



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - VI Semester: B.Tech. : Production and Industrial Engineering

6PI3-01: PRINCIPLES & PRACTICES OF MANAGEMENT

Credit: 2
2L+0T+0P

Max. Marks: 100 (IA:30, ETE:70)
End Term Exam: 3 Hours

| Unit | CONTENTS | Contact Hours |
|--------------|---|---------------|
| I | Management: Definition including conceptual analysis, functions. Evolution of management thought, scientific management, contributions of Taylor, Gilbert, Gantt, Elton Mayo, Henry Fayol and others. | 5 |
| | Management process & systems approach to Management, functions of managers. Levels of management, Administration & Mnmgt. Decision making. | 3 |
| II | Forms of ownership: Proprietorship, partnership, joint stock company, private and public limited companies, Joint Stock Companies: Co-operative Society, choice of business forms and state undertakings. Multinational corporations. | 4 |
| | Management Planning: Managerial planning, Type of plans, steps in planning; mission, objectives, strategies, policies, procedures, rules and programs. Managing by objectives, strategic planning process, SWOT analysis. | 4 |
| III | Organizing: Meaning of organizing and organization, formal and informal organization, span of management, process of organizing. Organizational structure: Line organization, functional organization, matrix organization, strategic business units. Line/ Staff concepts, empowerment, and decentralization, delegation of authority. | 5 |
| | Effective organizing and organizational culture. Staffing: overview, factors affecting staffing, systems approach, job design, selection, Performance appraisal, rewards. Career strategy, managerial training. Managing change. | 4 |
| IV | Human factors in managing Motivation : Theory X, Theory Y, Maslow's hierarchy of needs, Hertzberg's hygiene theory, porter and Lawler model, equity theory, Reinforcement theory, McClelland's theory behavioural model. | 5 |
| | Motivational techniques, job enrichment. Leadership: traits, approaches situational, contingency, path goal approach, transactional and transformational leadership. | 3 |
| V | Group decision making: Reasons for using Committees and groups, successful operation of committees and groups, working in teams. Communication: purpose, process of communication, communication flow in the organization, barriers to communication, Improvement of communication; role of electronic media in communication. | 4 |
| | Controlling: Basic control process, feed forward and feedback control, performance measures and control, requirement of effective control, use of Information Technology for control. | 3 |
| TOTAL | | 40 |



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - VI Semester: B.Tech. : Production and Industrial Engineering

6PI4-02 : TOOL ENGINEERING

Credit: 3
3L+0T+0P

Max. Marks: 100 (IA:30, ETE:70)
End Term Exam: 2 Hours

| UNIT | CONTENTS | CONTACT HOURS |
|------|---|---------------|
| I | Introduction, properties of tool material, types of tool material, Basic requirement of tool material and general consideration in tool design. | 8 |
| II | Design of material-cutting tool: Single point tools, basic principles of multiple point tools, Linear-Travel tools (Broach), Axial Feed Rotary Tools (Drill), Milling Cutters. | 7 |
| III | Introduction to press, Press accessories, Die design fundamentals, Strip layout, Blanking and piercing Dies, Combination Dies (compound & progressive die). | 8 |
| IV | Design of Bending Dies, Design of Drawing and Deep drawing dies. | 8 |
| V | Introduction to Jig & Fixtures, usefulness, Principles of Jig & Fixtures design, Principle of location, Locating and Clamping devices. Basic construction principle, Drilling jigs, Brief introduction about Milling fixtures, Grinding fixtures, Broaching and Lathe fixtures. | 9 |
| | TOTAL | 40 |



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - VI Semester: B.Tech. : Production and Industrial Engineering

6PI4-03: OPERATIONS RESEARCH

Credit: 3
3L+0T+0P

Max. Marks: 100 (IA:30, ETE:70)
End Term Exam: 2 Hours

| UNIT | CONTENTS | Contact hours |
|------|---|---------------|
| I | Overview of Operations Research. Linear Programming: Applications and model formulation, Graphical method, Simplex method, duality and Sensitivity analysis. | 4 |
| | Transportation Model and Assignment Model including travelling salesman problem. | 4 |
| II | Integer Linear Programming: Enumeration and cutting Plane solution concept, Gomory's all integer cutting plane method, Branch and Bound Algorithms, applications of zero-one integer programming. | 5 |
| | Replacement Models: Capital equipment replacement with time, group replacement of items subjected to total failure. | 3 |
| III | Queuing Theory: Analysis of the following queues with Poisson pattern of arrival and exponentially distributed service times, Single channel queue with infinite customer population, Multichannel queue with infinite customer population | 3 |
| | Competitive Situations and Solutions: Game theory, two person zero sum game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy, approximate solution, and simplified analysis for other competitive situations. Application of linear programming | 4 |
| IV | Theory of Decision making: Decision making under certainty, risk and uncertainty. Decision trees. | 5 |
| | Deterministic Inventory control models: functional role of inventory, inventory costs, model building, Single item inventory control model without shortages, with shortage and quantity discount. Inventory control model with uncertain demand, service level, safety stock, P and Q systems, two bin system. Single period model. Selective Inventory control techniques. | 4 |
| V | Probabilistic Inventory control models: Instantaneous demand without setup cost and with setup cost, Continuous demand without setup cost | 4 |
| | Simulation: Need of simulation, advantages and disadvantages of simulation method of simulation. Generation of Random numbers, Generation of Normal Random numbers. Use of random numbers for system simulation. Monte Carlo simulation, simulation language ARENA. Application of simulation for solving queuing Inventory Maintenance, Scheduling and other industrial problems | 4 |
| | TOTAL | 40 |



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - VI Semester: B.Tech. : Production and Industrial Engineering

6PI4-04: COMPUTER INTEGRATED MANUFACTURING SYSTEM

Credit: 3
3L+0T+0P

Max. Marks: 100 (IA:30, ETE:70)
End Term Exam: 2 Hours

| UNIT | CONTENTS | CONTACT HOURS |
|------|---|---------------|
| I | Introduction: Objective, scope and outcome of the course, Introduction to CIM: Overview of Production Systems, the product cycle, Automation in Production Systems, computer's role in manufacturing, sources and types of data used in manufacturing. The Beginning of CAM: Historical Background. | 3 |
| II | Numerical Control (NC): Basic components of an NC system, coordinate system and motions control systems. Computer Numerical Control (CNC): features of CNC, machine control unit, CNC software. Direct Numerical Control and Distributed Numerical Control. Applications, advantages and disadvantages of NC. Adaptive control of machining system. | 6 |
| III | NC Part programming: Manual and computer assisted part programming, Part programming with APT. NC part programming using CAD/CAM software. NC cutter path verification. | 8 |
| IV | Computer Aided Process Planning: Traditional Process Planning, Retrieval process planning system, Generative Process Planning, Machinability data systems, computer generated time standards. Group Technology: Introduction, part families, part classification and coding, coding system and machining cells. | 7 |
| V | Computer Aided Production Management Systems, MRP, MRP-II Computer Aided Quality Control; Computer in quality control, contact inspection methods, Non-contact inspection methods, optical and non-optical computer aided testing. | 8 |
| | Computerized material handling for automated inspection and assembly. Computer Integrated Manufacturing Systems: Introduction, types special manufacturing systems, flexible manufacturing systems (FMS). Collaborative Engineering; concurrent engineering, Agile and lean manufacturing. | 8 |
| | TOTAL | 40 |



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - VI Semester: B.Tech. : Production and Industrial Engineering

6PI4-05: SUPPLY AND OPERATIONS MANAGEMENT

Credit: 3
3L+0T+0P

Max. Marks: 100 (IA:30, ETE:70)
End Term Exam: 3 Hours

| UNIT | CONTENTS | Contact Hours |
|------|--|---------------|
| I | Introduction to operations management (OM), the scope of OM; Historical evolution of OM; Trends in business; the management process. Operations Strategy, Competitiveness and Productivity | 4 |
| | Demand Forecasting: components of forecasting demand, Approaches to forecasting: forecasts based on judgment and opinion, Time series data. Associative forecasting techniques, Accuracy and control of forecasts, Selection of forecasting technique. | 4 |
| II | Product and Service design, Process selection, Process types, Product and process matrix, Process analysis. | 4 |
| | Capacity Planning: Defining and measuring capacity, determinants of effective capacity, capacity strategy, steps in capacity planning process, determining capacity requirements, Capacity alternatives, Evaluation of alternatives; Cost- Volume analysis. | 4 |
| III | Facility Location: Need for location decisions, factors affecting location, qualitative and quantitative techniques of location. Facilities layout: Product, Process, Fixed position, combination and cellular layouts; line balancing. Material Handling | 4 |
| | Planning levels: long range, Intermediate range and Short range planning, Aggregate planning: Objective, Strategies, and techniques of aggregate planning. Master scheduling; Bill of materials, MRP; inputs processing and outputs, and overview of MRPII , use of MRP to assist in planning capacity requirements, Introduction to ERP | 4 |
| IV | Techniques of production control in job shop production, batch production and mass production systems. sequencing: priority rules, sequencing jobs through two work centers, scheduling services | 4 |
| | Introduction to Just-in-time (JIT) and Lean Operations: JIT production, JIT scheduling, synchronous production, Lean operations system | 4 |
| V | Supply Chain Management (SCM): Need of SCM, Bullwhip effect, Elements of SCM, Logistics steps in creating effective supply chain, Purchasing and supplied management. | 3 |
| | Project Management: Nature of projects, project life cycle, Work breakdown structure, PERT and CPM, Time-Cost trade-offs: Crashing. Resource allocation, leveling | 5 |
| | TOTAL | 40 |



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - VI Semester: B.Tech. : Production and Industrial Engineering

6PI5-11: INDUSTRY 4.0

Credit: 3
3L+0T+0P

Max. Marks: 100 (IA:30, ETE:70)
End Term Exam: 3 Hours

| UNIT | CONTENTS | CONTACT HOURS |
|------|---|---------------|
| I | Introduction to Industry Revolutions, Details of Industry 4.0, Globalization and Emerging Issues, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories | 5 |
| | Sensors, Machine Vision and Connected Systems Analyzing Data and Modeling to Make Sense of Data, Industrial Sensing & Actuation, Industrial Internet Systems, Introduction to Industrial Internet of Things- IIoT. | 3 |
| II | Data Analysis, the role of Big Data and Analytics, Control of Manufacturing Systems and Processes. | 4 |
| | Artificial intelligence (AI) and big data analytics in manufacturing. AI fundamentals, components, and applications. differences between AI, machine learning (ML), deep learning (DL), and big data analytics, with practical applications in manufacturing. impacts on manufacturing processes, and future trends. AI and big data analytics for enhanced manufacturing efficiency and innovation | 4 |
| III | Digital Twin concept, digital twins-creation, management, and real-world applications. | 4 |
| | Applications of Collaborative Robots, industrial robot types, autonomous systems, and robotic process automation (RPA). Applications of Automated Guided Vehicles (AGVs) in Industries, | 4 |
| IV | Augmented Reality (AR) and Virtual Reality (VR) in Manufacturing Environment, their differences, extended reality (XR) and mixed reality (MR). Key impacts on the manufacturing industry and future trends. AR in training, VR in product design, prototyping, and applications for remote assistance and maintenance. | 5 |
| | | 3 |
| V | Additive manufacturing, Various technologies, processes, and applications. Additive manufacturing techniques, industry standards, and future developments. Real-world applications and potential across different sectors. | 5 |
| | Application Domains: Factories and Assembly Line, Food Industry, Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security Facility Management. | 3 |
| | TOTAL | 40 |



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3rd Year - VI Semester: B.Tech. : Production and Industrial Engineering

6PI5-12: FACILITY PLANNING

Credit: 3
3L+0T+0P

Max. Marks: 100 (IA:30, ETE:70)
End Term Exam: 3 Hours

| UNIT | CONTENTS | CONTACT HOURS |
|------|---|---------------|
| I | Definition of facilities planning, significance and objectives of facilities planning. Process of facilities planning. Strategic facilities planning. | 5 |
| | Product selection, Review of various types of manufacturing processes and Process selection. | 3 |
| II | Facility Location: Need for location decisions, location factors, location analysis: Qualitative methods: subjective, equal weight, variable weight, factor point rating and composite measure method. | 4 |
| | Quantitative methods: location breakeven analysis, median model, gravity model, Brown and Gibson method, single facility location models, minmax location problem, Location allocation models, Bridgeman's Dimensional Analysis. | 4 |
| III | Facility Layout: Importance and function, objectives and advantages of good layout, types of plant layout problems. Basic layout types: Product, Process, Group and fixed position layout. Plant layout factors, Layout procedure, Systematic layout planning procedure, Flow and activity analysis, Process charts, flow diagram, Travel chart, activity relationship chart, and Relationship diagram. Evaluation and implementation of layout. Industrial buildings, influence of building on layout. | 4 |
| | Computer aided layout: CRAFT, CORELAP, COFAD, ALDEP, PLANET. | 4 |
| IV | Production and assembly line balancing - various operational research techniques for balancing of assembly line and fabrication line. | 5 |
| | Material Handling: Principles of material handling, materials handling system design. Systematic handling analysis, Unit loads. Computer Aided Material Handling. | 3 |
| V | Material Handling Equipment: Conveyors, monorail, hoists and Cranes; automated storage and retrieval systems (AS/RS) , Industrial trucks, Containers and supports, Auxiliary and other equipments | 5 |
| | Receiving and shipping, storage and warehousing; Equipment planning, layout planning. | 3 |
| | TOTAL | 40 |



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - VI Semester: B.Tech. : Production and Industrial Engineering

6PI5-13: ADDITIVE MANUFACTURING

Credit: 3
3L+0T+3P

Max. Marks: 100 (IA:60, ETE:40)

| UNIT | CONTENTS | CONTACT HOURS |
|------|--|---------------|
| I | Introduction: Overview of Additive Manufacturing (AM); AM history; Classification of AM; Merits/de-merits and applications of AM process; Outline on AM software's. Brief information on different materials used for AM. | 3 |
| II | CAD Data Processing for AM: - CAD model development; Overview on Data requirements, Data formats (STL, SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP), Data interfacing, Part orientation and support generation; Design of support structure for AM; Overview on slicing methods; Tool path generation for AM. | 9 |
| III | Liquid, Solid & Powder Based AM Technologies: Stereolithography; FDM; LOM; Multijet Modeling, SLS, Direct Metal Laser Sintering, 3-Dimensional Printing; Working Principles, products, materials, merits, drawbacks and applications –Case studies. | 8 |
| IV | Direct Energy Deposition AM Process: Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Electron Beam based metal deposition: working principles, products, benefits and drawbacks, applications. Overview on new & Hybrid AM technologies. | 8 |
| V | Post Processing of AM Parts: Overview on support material removal, Surface quality and aesthetic improvement. Applications of AM. Overview on construction of basic AM machines. | 3 |
| | Rapid Tooling: Rapid Tooling: Conventional Tooling Vs Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods. | 7 |
| | AM Applications: Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP. | 2 |
| | TOTAL | 40 |



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3rd Year - VI Semester: B.Tech. : Production and Industrial Engineering

6PI4-21: OPERATIONS RESEARCH LAB.

Credit: 1.5
0L+0T+3P

Max. Marks: 100 (IA:60, ETE:40)

| SN | NAME OF EXPERIMENT |
|----|---|
| | Solve using software and verify with analytical methods |
| 1 | Linear programming problem |
| 2 | Assignment problem |
| 3 | Transportation problem |
| 4 | Integer programming problem |
| 5 | Queuing Problem |
| 6 | Inventory problem |
| 7 | Simulation Problem |
| 8 | Replacement Problem |
| 9 | Decision Tree |
| 10 | Game theory |



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6PI4-22: MACHINE TOOL DESIGN SESSIONAL

Credit: 1.5
0L+0T+3P

Max. Marks: 100 (IA:60, ETE:40)

| SN | SESSIONAL WORK |
|----|--|
| 1 | Functional requirements of machine tools. |
| 2 | Working and auxiliary motions in machine tools. |
| 3 | Design criterion for machine tool structure, Static & dynamic stiffness. |
| 4 | Function & important requirements of spindle unit. |
| 5 | Importance of machine tool compliance with respect to machine tool accuracy. |
| 6 | Application and sketching of Slider-crank mechanism, Cam mechanism, Rack & pinion mechanism, Nut & screw mechanism, Ratchet gear mechanism, Geneva mechanism, Reversing mechanism, Differential mechanism, Norton mechanism, Mender's mechanism. |
| 7 | Aim of speed & feed rate regulation, stepped regulation of speed. |
| 8 | G.P. series is used in stepped regulation of speed. |
| 9 | Design a four / six speed Gear Box. |
| 10 | Design of Lathe bed. (including Torque analysis of lathe bed, bending of lathe bed, designing for torsional rigidity, use of reinforcing stiffener in lathe bed) |
| 11 | Analysis of force under headstock, tail stock and saddle. |
| 12 | Design of Guide ways / Slide ways. |
| 13 | Estimation of power requirements and selection of motor for metal cutting machine tool spindles. |



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6PI4-23: METAL CUTTING LAB

Credit: 1.5
0L+0T+3P

Max. Marks: 100 (IA:60, ETE:40)

| SN | NAME OF EXPERIMENT |
|----|--|
| 1 | Find out Chip reduction co-efficient (reciprocal of chip thickness ratio) during single point turning. |
| 2 | Forces measurements during orthogonal turning. |
| 3 | Estimation of Power required during orthogonal turning. |
| 4 | Torque and Thrust measurement during drilling. |
| 5 | Forces measurement during plain milling operation. |
| 6 | Measurement of Chip tool Interface temperature during turning using thermocouple technique. |
| 7 | Exercise involving cylindrical grinding on surface grinding machine. |
| 8 | Study the variation of surface roughness with different speed and feed during plain milling operation on flat surface. |
| 9 | Study of capstan lathe and its tooling and prepare a tool layout & job as per given drawing. |
| 10 | Engrave a profile on given work piece using EDM machine. |
| 11 | Exercises for boring of cylindrical bores and machining of external surfaces coincident with internal bores on boring machine. |



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6PI4-24: CIMS Lab

Credit: 1.5
0L+0T+3P

Max. Marks: 100 (IA:60, ETE:40)

| SN | NAME OF EXPERIMENT (Any ten experiments) |
|----|---|
| 1 | To prepare part programming for plain turning operation. |
| 2 | To prepare part program for turning operations using turning cycle. |
| 3 | To prepare part program for threading operation. |
| 4 | To prepare part program for gear cutting using mill cycle. |
| 5 | To prepare part program for multiple drilling in X and Z axis using drilling cycle. |
| 6 | To prepare part program for grooving operation using cycle. |
| 7 | Part program for drilling and boring. |
| 8 | Part program for internal threading operation. |
| | Simulation experiments |
| 1 | Generate Pseudo Random No. using different Techniques |
| 2 | Develop an Analytical Model for a given physical system |
| 3 | Develop a Monte-Carlo Simulation Model for a given physical system |
| 4 | Develop an algorithm for a selected Simulated Study and write the program in a high Level language. |
| 5 | Modeling of manufacturing system using simulation software such as ARENA |