

# Biju Patnaik University of Technology, Orissa Rourkela

## M.Tech. Syllabus (Industrial Engineering & Management / Industrial Engineering)

### Course Structure

#### First Semester

<u>Subject name</u>	<u>L-T-P</u>	<u>Credit</u>
1. Decision Modeling - I	3-1-0	4
2. Production Planning and Inventory Control	3-1-0	4
3. Work System Design	3-1-0	4
4. Elective I	3-1-0	3
5. Elective II	3-1-0	3
6. Computational Laboratory	0-0-3	2
7. Industrial Engg. Laboratory	0-0-3	2
8. Pre-thesis Work & Seminar-I		2

#### Second Semester

<u>Subject name</u>	<u>L-T-P</u>	<u>Credit</u>
1. Quality Engg. & Management	3-1-0	4
2. Supply Chain Management	3-1-0	4
3. Elective III	3-0-0	3
4. Elective IV	3-0-0	3
5. Elective V	3-0-0	3
6. MIS Laboratory	0-0-6	4
7. Pre-thesis Work & Seminar-II	0-0-3	2
8. Comprehensive Viva Voce - I		2

#### Third Semester

1. Thesis part-I	14
2. Research Methodology*	3

#### Fourth Semester

1. Thesis part-II	20
2. Seminar	2
3. Comprehensive Viva Voce - II	2

\* The subject 'Research Methodology' will be taught during 1<sup>st</sup> month of 3<sup>rd</sup> semester, which will help the students to do thesis work.

## Electives

### Elective-I

1. Human Resource Management
2. Marketing Management
3. Financial Management & Accounting

### Elective-II

1. Project Management
2. Strategic Management
3. Facility Planning

### Elective-III

1. Decision Modeling - II
2. Systems Modelling and Analysis
3. Soft Computing

### Elective-IV

1. Total Productive Maintenance
2. Total Quality Management
3. Productivity Management

### Elective-V

1. Software Engineering
2. Enterprise Resource Planning
3. Data Mining and Data Warehousing

## Semester-I

### **DECISION MODELLING - I**

Use of quantitative techniques in decision making, Elements of linear algebra, Linear programming and Simplex method, Artificial variable, Duality in LP, Sensitivity analysis

Network flows: Shortest path, minimum spanning tree, maximum flow and minimum cost flow problems; Transportation problem, Degeneracy, Assignment problem, Transshipment Model

Integer Programming: 0-1 and mixed integer programming problem formulation, Branch and Bound method, Cutting-plane method

Game theory: Two person Zero-sum game, Saddle point, Mixed strategies, Use of dominance, Subgames method, Linear programming method

#### **Books:**

1. *Operation Research: An Introduction*, Taha H A, PHI
2. *Operation Research*, Phillips, Rabindran and Solberg, "John Wiley & Sons
3. *Introduction to Operation Research*, Hiller F S and Lieberman G J

# PRODUCTION PLANNING AND INVENTORY CONTROL

Generalised model of a production system, Different kinds of production systems, mass, batch job and cellular production

Layout: Optimisation in Product and Process layout; FMS; Manufacturing Strategies

Demand forecasting: Moving Average and Exponential Smoothing methods, Multiple regression method, Error in forecasting

Decisions in the life cycle of a production system, Evaluation of investments in new product and services, risk analysis using decision trees, product mix decisions

Aggregate planning, Operation planning and control, Scheduling, Comparison of dispatch rules, Johnson rule

Inventory control: EOQ and EBQ, EOQ Sensitivity, Backordering, Determination of safety stock, P and Q System, Joint cycle for multiple products

Materials Requirements Planning (MRP): Independent and dependent items, Master production schedule, MRP Inputs and outputs, Bill of Material, MRP Computation, EOQ-MRP comparison, MRP Types, Capacity planning and control, JIT in production planning and planning

## **Books:**

1. *Manufacturing Planning and Control*, Vollman, Berry, Whybark & Jacobs, TMH
2. *Production Planning and Inventory Control*, Narasimhan S L, Mcleavey D W, Billington P J, PHI

# WORK SYSTEM DESIGN

Work Study Fundamentals: Productivity and Work Study, Definitions, Scope, and History of Work Study, Analysis of Work Content.

Method Study: Process Analysis, Process and Activity Charts, Operation Analysis, Basic procedure, Micro Motion Study, Principles of Motion Economy.

Work Measurement: Purposes and uses, Basic procedure, Techniques – Work Sampling, Stop-Watch Time Study, Rating and Allowances, Setting Standard Times for Jobs, Standard Data, Predetermined Time Standards.

Ergonomics: Fundamental Concepts, Issues in Worksystem Design, Measuring Work by Physiological means, Work Posture, Fatigue Measurement and Evaluation, Environmental Factors and Work Systems, Industrial Product Design.

Job Evaluation: Basic concepts, Objective and Subjective methods, Compensation Schemes, Relationship of Work Study to Incentive Schemes, Wage Incentive Plans.

## **Books:**

1. *Motion and Time Study*, Barnes R M
2. *Motion and Time Study*, Mundel M, PHI
3. *Introduction to Work Study*, ILO

# COMPUTATIONAL LABORATORY

Programming in C / C++

Programming in Java

## **INDUSTRIAL ENGG. LABORATORY**

Experiment on Work Study, Ergonomics, Computer Simulation, Practice on Optimization and Statistical Packages

### **Second Semester**

#### **QUALITY ENGINEERING AND MANAGEMENT**

Attributes of quality, Evolution of philosophy of Quality Management, Economics of quality and measurement of cost of quality, Data presentation techniques for quality analysis,

Statistical process control, Use of control charts and process engineering techniques for implementing quality plan, Machine and process capability analysis, statistical tolerance analysis, Acceptance sampling: Single, double and multiple sampling plans, Acceptance sampling for variables

Reliability analysis and predictions, Bath-Tub Curve, Exponential and Weibull distribution in modelling reliability, System reliability

Experimental designs and factorial experiments: Concepts of randomization, Blocking and Confounding

Single factor randomized design, ANOVA,  $2^k$  factorial experiments

Taguchi philosophy; Loss function; Signal to noise ratio, Orthogonal arrays for parameter and tolerance design.

Fundamentals of TQM: Customer orientation, Continuous improvement, Total participation; Some important philosophies and their impact on quality (Deming, Juran, Crosby), QC Tools, Components of Total Quality System (TQS), Quality audit, Introduction to ISO 9000 and 14000 standards.

#### **Books:**

1. *Fundamental of Quality Control and Improvement*, Mitra A, PHI
2. *Quality Planning and Analysis*, Juran J M and Gryna F M, Tata McGraw Hill

# SUPPLY CHAIN MANAGEMENT

Introduction and overview of supply chain management; Supply chain performance: Strategic fit and scope; Supply chain drivers and obstacle

Designing distribution network, Network design in uncertain environment

Demand forecasting in supply chain, Bullwhip effect in logistics, Aggregate planning in supply chain

Inventory Planning in supply chain, Economy of scale: cycle inventory

Managing uncertainty in supply chain: Safe inventory, Determination of optimal level of product availability

Transportation and servicing, Pricing and revenue management in supply chain

Supply chain information system, E-business and supply chain

## **Books**

1. *Supply Chain Management: Strategy, Planning, and Operation*, Chopra Sunil and Meindl Peter, PHI
2. *Designing and Managing the Supply Chain Concepts, Strategies and Case Studies*, David Semchi-Levi, Philip Kaminsky & Edith Semchi-Levi, TMH

# MIS LABORATORY

Process Modeling, Project Management Software, Database Design, Website Design, Learning through projects on some aspects of management information system, Decision Support System, or Executive Information system with the help of a real life case study.

## **E1.1 HUMAN RESOURCE MANAGEMENT**

**Managing the Human Resource:** the role and function of HR including strategic linkages; HRM policy and procedures; organization of the HR department; models of HR delivery; the role of line managers in managing HR.

**Human Resource Planning (HRP):** HR Planning Process; modeling HRP including mathematical models; external and internal strategic integration; HR information system.

**Recruitment and Selection (R&S):** the theoretical basis of R&S; external and internal influences; methods of recruiting; alternatives to recruitment; cost-benefit analysis of recruiting; selection process; cost-benefit analysis for the selection decision; strategic R&S; legal and ethical perspectives.

**Human Resource Development (HRD):** different approaches to HRD; strategically focused HRD; managerial responsibilities and approaches for developing managers; HRD contribution to change management; techniques for organizational development; the need for training ;creation of a HRD plan; training management.

**Management Development:** HRM and management development; management development and organizational strategy; organizational approaches to management development; implementing management development programmes; issues in management development.

**Performance Management (PM):** performance evaluation techniques; performance appraisal; problems in performance evaluations; performance-based rewards; legal and ethical perspectives; PM as a driver and facilitator of change; cross-cultural implications for PM.

**Managing the Employment Relationship:** nature of the employment relationship; statutory frameworks; employment contract; key concepts such as conflict, cooperation, involvement and commitment; employee involvement and communication; types of employee involvement; processes used to regulate the employment relationship.

**Terminating the Employment Relationship:** managing dismissal and redundancy; statutory aspects; organizational downsizing and change implications; ethical and sustainability considerations

**Remuneration and Reward:** remuneration strategies; pay determination; designing a payment system; salaries and wages; payment by time systems; incentives; bonus schemes; performance related pay; employee benefits, contingency theory.

**Books:**

1. Gary Dessler, *Human Resources Management*, Pearson Education, New Delhi.
2. Udai Pareek, T.V Rao, *Designing Managing Human Resources Systems*, Oxford IBH, New Delhi
3. Arun Monappa, *Human Resource Management*, TMH, New Delhi, 2004
4. John M. Ivancevich, *Human Resource Management*, 9/e, Tata McGraw- Hill, 2003.

## E1.2 MARKETING MANAGEMENT

Overview of marketing: Importance and scope of marketing, Marketing management and planning and environments of marketing strategy. Markets and segmentation, Consumer buying behaviour & Organizational buying behaviour

Research for marketing decisions: Problem formulation, Obtaining and organizing data, analyzing associative data, and selected activities in marketing research.

Product and pricing strategies: product and service concepts, Product development strategy, Pricing concepts and practices.

Placement and promotion strategy: Marketing channels, Distributing goods. Advertising sales promotion and publicity, Personal selling and sales management

Industrial marketing: Managing industrial sales, Industrial marketing communication, and industrial distribution strategy and control.

### **Books:**

1. *Marketing Management, Kotler Philip, PHI*
2. *Fundamentals of Marketing, Stanton William J, TMH*
3. *Marketing Management, Saxena Rajan, TMH*

## E1.3 FINANCIAL MANAGEMENT AND ACCOUNTING

**Introduction:** Nature and scope, Finance functions, financial objectives, roles and responsibilities of the finance manager, introduction to Indian financial system, Sources of finance: Equity capital, debenture, preference capital and term loans, Cost of capital,

**Principles of Valuation:** Opportunity Cost of Capital; Money-Time relationships and applications; Present Value; Discount Rates; Comparables

**Project and Firm Valuation:** Evaluating Projects; Net Present Value; Measuring Cash flows, Internal Rate of Return; Firm Valuation; Growth and Free Cash flows; Valuation Models, Accounting vs. Economic Returns

**Risk and Return:** Introduction to Risk and Return; Historical Evidence; Measuring the Risk of a Portfolio; Statistics Review; Portfolio Theory; Risk in a Portfolio Context, Trade-off between Risk and Return; Measuring the Risk of a Stock; Discount Rates in Practice.

**Accounting:** Cost accounting and its objectives, allocation of overhead cost; Cost and Performance based Systems; Concept of Activity Based Costing (ABC) Systems; System of Book Keeping; Books of Accounts; Journalizing; Trial Balance.

### **Books:**

1. *Prasanna Chandra, Financial Management: Theory and Practice, TMH, New Delhi.*
2. *Eugene F Brigham & Michael C Ehrhardt, Financial Management: Theory and Practice, Thomson, Bangalore.*
3. *I M Pandey, Financial Management, Vikas, New Delhi.*
4. *Brealey, R., and S. Myers. Principles of Corporate Finance. Irwin/McGraw Hill.*
5. *Robin Cooper & Robert S Kaplan, The Design of Cost Management Systems, Prentice Hall*

## **E2.1 PROJECT MANAGEMENT**

Project Feasibility Analysis: Technical feasibility, commercial and financial viability, Environment Analysis.

Project Engineering: Project Management Techniques : PERT, CPM, Project Scheduling Crashing, PERT / COST, LOB.

Projects Financing alternatives, Sources of finance, their advantages, Choice of Financing mix, Capital budgeting.

Costing: Fixed and variable cost. Break even analysis, Overhead allocation Techniques.

Project Organisation, management and control: Project organisation and control staffing, monitoring: cost, time and control and progress monitoring techniques.

Product and service pricing: Availability and quality based pricing for services.

Capacity planning and expansion, capacity decision considering and models.

### **Books:**

1. Prasanna Chandra: Project Engineering and Management, Prentice Hall
2. Levy and Weist: Management guide to PERT / CPM, Prentice Hall

## **E2.2 STRATEGIC MANAGEMENT**

Concepts in Strategic Management, Strategic Vision, Mission, Goals, Objectives, Policies and Core competency

Environmental Scanning: Industry and Competitive Analysis - Methods. Evaluating company resources and competitive capabilities - SWOT Analysis - Strategy and Competitive advantage

Strategic Analysis and Choice: Tools and techniques- Porter's Five Force Model, BCG Matrix, GE Model, Market Life Cycle Model - Capability Maturity Model (CMM) and Organisational Learning, Impact Matrix and the Experience Curve, Generic Strategies.

Strategy Formulation: Framework for analysing competition, Porter's Value Chain analysis, Competitive Advantage of a Firm, Exit and Entry Barriers; Types of Strategies: Offensive strategy, Defensive strategy, vertical integration, horizontal strategy; Tailoring strategy to fit specific industry and company situations.

Strategy Implementation: Strategy, Structure, Leadership and Culture; Operationalizing and institutionalizing strategy - Strategies for competing in Global markets and Internet economy, Organisational values, Resource allocation and Planning systems for implementation.

Turnaround Strategy, Management of Strategic Change, Strategies for Mergers, Acquisitions, Takeovers and Joint ventures

Diversification Strategy: Reasons for diversification, Types of diversification strategies,



Strategies and competitive advantage in diversified companies and its evaluation.

Strategy Evaluation and control - Establishing strategic controls - Measuring performance - using qualitative and quantitative benchmarking methods

**Books**

1. *Strategic Management, Concepts and Cases. Thompson & Strickland, Tata McGraw-Hill, 12/e, New Delhi, 2003.*
2. *Crafting the Strategy: Concepts and Cases in Strategic Management, Ranjan Das, TMH, New Delhi, 2003.*
3. *Business Models: A Strategic Management Approach, Allan Afuah, TMH, 2004*
4. *Concepts in Strategic Management and Business Policy, Wheelen & Hunger, Pearson Education, New Delhi.*

## **E2.3 FACILITY PLANNING**

Introduction: Nature, Significance and Scope of Facility layout and design

Facility Location: Location analysis, Single-facility and Multi-facility location problems, Location allocation problems

Facility Layout: Significance, Objectives, Steps in layout planning, Quantitative techniques

Material Handling: Definition, Principles of Material Handling, Material Handling System Design, Equipment Selection

Storage and Warehousing: Functions, Objectives and Principles; Facility Services;

Design of Assembly and Production Lines

**Books:**

1. *Facilities layout and location-An analytical approach, R L Francis, J A White and Mc Ginnis, PHI*
2. *Facilities Planning, J A Tomkins and J A White, John Wiley & sons*
3. *Manufacturing Systems Engineering, K.Hitomi, Viva Books Pvt Ltd, India*
4. *Plant Layout and Material Handling, J M Apple, McGraw Hill*

## **E3.1 DECISION MODELLING - II**

Non-Linear Programming: Unconstrained univariate optimization problems: Bisection method & Newton's method; Unconstrained multivariate optimization: Gradient search method; Constrained optimization: Kuhn Tucker conditions, Quadratic and Separable Programming methods

Dynamic Programming: Principle of Optimality, Concepts of state and stage, Solution of Discrete Problems through Backward Dynamic Programming, Multi-stage Dynamic programming problems

Queuing Theory: Markov Process - Description of state, Transition probability matrix, Birth and Death process, Markovian and Semi-Markovian Single-channel and Multiple-channel queues, Queuing Networks

Discrete-event Simulation: Time-flow mechanisms, Random number and Random variate generation, Simulation of queuing, inventory and industrial problems

**Books:**

1. *Operation Research: An Introduction*, Taha H A, PHI
2. *Operation Research*, Phillips, Rabindran and Solberg, John Wiley & Sons
3. *Introduction to Operation Research*, Hiller F S and Lieberman G J

## **E3.2 SYSTEM MODELLING AND ANALYSIS**

Definitions and Classification of Systems, Concept of Wholeness, Organisation, Hierarchy, Methodology and use of systems approach.

Systems Thinking, Learning Organizations, System Archetypes and their use

System dynamics: Causal loop and flow diagramming, Modeling non-linearity, simulation policy analysis and design.

Consensus Methodologies: Measurement of Consensus, Arrow's Conditions, Group Decision Processes, Interpretive structural Modeling, analytic Hierarchy process.

Statistical investigations into causal relationships, Principal component analysis, Factor analysis, Discriminate analysis, Cluster analysis.

**Books:**

1. *Introduction to System Dynamics and Modelling*, Mohapatra, Mandal and Bora, University Press
2. *Systems Thinking*, P Cheekland, John Wiley & sons
3. *Multi-variate Data Analysis*, Hair, Anderson, Tatham and Black, Pearson Education.

## E3.3 SOFT COMPUTING

Introduction to Soft Computing: Soft computing constituents and conventional Artificial Intelligence, Neuro-Fuzzy and Soft Computing characteristics.

Neural Networks (NN): Model of an Artificial Neuron, Neural Network Architecture, Comparison between Artificial NN and Biological NN, Application of ANN, Learning Methods.

Fuzzy Logic: Introduction, Crisp sets, Fuzzy sets, Crisp relations, Fuzzy relations, Operations on Crisp and Fuzzy sets.

Fuzzy Systems: Introduction, Crisp logic, Predicate logic, Fuzzy logic, Fuzzy Rule based system, Defuzzification Methods.

Genetic Algorithm (GA): Fundamental of Genetic Algorithms, Encoding, Fitness Functions and Reproduction.

Genetic Modelling: Crossover, Inversion and Deletion, Mutation Operators, Bitwise operators used in GA, Convergence of Genetic Algorithm, Applications.

### **Text Book:**

1. *Neural Networks, Fuzzy Logic, and Genetic Algorithms*, S.Rajasekaran, G.A. Vijaylakshmi Pai, PHI.

### **Reference Books:**

2. *Neuro-fuzzy and soft Computing*, J S R Jng, C T Sun and E. Mizutani, Pearson Education.
3. *An Introduction to Neural Networks*, S.N.Sivanandam, M.Paulraj, Vikas Publishing House.

## E4.1 TOTAL PRODUCTIVE MAINTENANCE

Maintained systems and various definitions associated with them, Type of Maintenance. Maintainability analysis, Maintainability design considerations, Availability and MTTF computations, Renewal Theory Approach, Life Cycle Costs

Optimum Inventory Assessment. Optimal inspection, overhaul, replacement or repair strategies

Causes and types of failures, Reliability expressions for constant, increasing and decreasing hazard rates. Data Analysis, Probability plots for various distributions (exponential, Weibull, Normal and Gamma)

Maintainability test, demonstration and warranties, Case Studies

Maintenance strategies, Managing change, Selection of maintenance tactics, Planning and scheduling resources, Measurement and benchmarking of performance, MIS for maintenance, Re-engineering maintenance process

### **Book**

1. *Total Productive Maintenance, Borris & Steve, McGraw Hill*

## E4.2 TOTAL QUALITY MANAGEMENT

Fundamentals of TQM; Some important philosophies and their impact on quality (Deming, Juran, Crosby), Features of Malcom Balridge quality award; Identification and measurement of quality costs; Issues related to products, processes, organization, leadership and commitment for total quality achievement; Tools and techniques used in TQM, seven tools, new seven, essential features of QCC, ZD, Kaizen, and JIT programmes; Fundamental concepts about Quality Function Deployment (QFD); Components of Total Quality System (TQS) in organizations, Quality Auditing : Introduction to ISO 9000 and 14000 standards, Case studies.

### **Books**

1. *Managing Total Quality, Rampersad, Hubert and Narasimhan, TMH*
2. *Quality Planning and Analysis, Juran J M and Gryna F M, TMH*

## E4.3 PRODUCTIVITY MANAGEMENT

Definitions and basic concepts of productivity, The importance and role of productivity cycle, Productivity management, Phases of productivity management, The Productivity cycle, Mundel's cycle-of-management process. Productivity index

Productivity measurement: Productivity measurement hierarchy, Productivity measurement at national and industrial levels, Productivity measurement in companies & organizations, The system of productivity measurement: partial productivity, total factor productivity, total productivity, measures

Productivity evaluation, Productivity evaluation in companies & organizations, Total productivity change, and evaluation of total productivity between successive time periods & within a given time period

Productivity planning in companies and organizations, Short term and long term methods of productivity planning, Productivity planning executives and their responsibilities, Total Productivity–profit model

Productivity improvement in companies & organizations, Productivity improvement techniques (technology based, material based, employee based, product based and task based productivity improvement), Improving productivity in software development, Creation and organization of the department of productivity management in a firm. Productivity improvement programmes and their implementation, Organisational structure for productivity improvement programmes

White-collar productivity measurements and evaluation techniques, evaluation of knowledge worker productivity

### **Books:**

1. *Productivity Engineering and Management*, D.J Sumanth, TMH, New Delhi.
2. *Productivity Management: A Systems Approach*, Prem Vrat, G.D Sardana & B.S Sahay, Narosa Publishing House, New Delhi, 2006
3. *Productivity Management: A Practical Hand Book*, Joseph Prokopenko, ILO Geneva.

## **E5.1 SOFTWARE ENGINEERING**

**Introduction:** Evolution of Software Engineering, Software Life Cycle Models, Requirement Analysis and Specification

**Conventional methods for software engineering:** System Engineering, Analysis concepts and principles, Structured Analysis and Design; Analysis Modelling (DFD, ER Diagram, Data Dictionary, STD); Design Concepts and principles, Architectural design- Structured Chart, Component level Design.

**Object Oriented Software Engineering:** Object Oriented Concepts and principles, UML for Object Oriented Analysis and Object Oriented Design.

**Testing and Maintenance:** User Interface Design, Software Testing Techniques, Software testing Strategies, technical metrics for software, Software Implementation and Integration, Software Maintenance.

**Managing software projects:** Project management concepts, Software Project Planning, Risk Analysis and Management; Project scheduling and tracking, Software project metrics, Software Quality Assurance, Software Configuration management.

### **Books**

- 1) Roger S. Pressman, "Software Engineering A Practitioners Approach", Mc-Graw Hill Publication.
- 2) Ian Sommerville, "Software Engineering", Pearson Education Asia.
- 3) Stephen R. Schach, "Object Oriented and Classical Software Engineering", Tata-McGraw-Hill, 2002.

## E5.2 ENTERPRISE RESOURCE PLANNING (ERP)

**Introduction to ERP:** Overview of ERP - Introduction and Evaluation of ERP, Reasons for the growth of the ERP-Market, Advantages and Disadvantages of ERP, Overview of Enterprise - Integrated Management Systems, Business Modeling, Integrated Data Model.

**ERP-and Related Technologies:** Business Process Re-engineering (BPR) - Best Practices in ERP, Re-engineering Options - Clean State Re-engineering, Technology Enabled Re-engineering, Business Intelligence Systems-Data Mining, Data Warehousing, On-Line Analytical Processing (OLAP), Supply Chain Management.

**Benefits of ERP:** 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 Design Making Capabilities (Case Studies)

**ERP System Options and Selection Methods:** Optimal Means of Developing an ERP, Measurement of Project Impact, IT Selection and Project Approval, ERP proposal Evaluation, Project Evaluation Techniques, Testing.

**ERP Implementation and Maintenance:** Implementation Strategy Options, Features of Successful ERP Implementation, and Strategies to Attain Success, User Training , ERP Maintenance.

**ERP - The Business Modules:** Introduction: - Finance, Manufacturing (Production), Human Resource, Plant Maintenance, Materials Management, Quality Management, Sales and Distribution.

**The ERP Market:** Introduction to ERP Market - SAP AG, PeopleSoft, Baan Company, Oracle Corporation, JD Edwards World Solutions Company, QAD, System Software Associates, Inc. (SSA) - *Case Studies*.

**Future Directions in ERP:** Introduction - New Markets, New Technologies, Faster Implementation Methodologies, New Business Segments, Trends in Security.

### **Books**

1. Alexis Leon, *Enterprise Resource Planning, 10/E, TMH, 2004.*
2. *ERP: A Managerial Perspective, Sadagopan, S., Tata Mcgraw-Hill*

## E5.3 DATA WAREHOUSING AND DATA MINING

### **Data Warehouse:**

Introduction, Data Warehouse vs Database, Features of Data Warehouse, Data Warehousing Architecture

Multidimensional data model, Facts & dimensions, Types of facts and types of dimensions, OLAP Operations, Warehouse Schema, OLAP Engine, Data Warehouse Implementation, DW Case Studies: Retail Sales, Inventory, Procurement, CRM, Banking, Insurance, etc

### **Data Mining:**

Introduction, Association Rules, Methods to mine association rules: *a priori*, Partitioning, DIC, FP Tree

Clustering & Classification: Introduction, Mining Techniques for Clustering: PAM, CLARA, CLARANS, Neural Network

Mining Techniques for Classification: Decision Tree Construction, Neural Network and other Classifiers

Data Mining in soft computing paradigm, Page Mining and Web Mining, Cases on Data Mining

### **Text Books:**

1. *Data Mining: Concepts and Techniques*, J. Hahn and Micheline Kamber, Morgan Kaufmann
2. *Data Warehousing and Data Mining*, McLaren & McLaren, Tata McGraw-Hill, New Delhi

### **References Books**

3. *Data Warehouse Toolkit*, R.Kimball, J.Wiley
4. *Data Mining: Modeling Data for Marketing, Risk and CRM*, O.P.Rud, Wiley
5. *Marakas: Modern Data Warehousing, Mining, and Visualization Core Concepts* Pearson Education
6. *Data Mining: Introductory and Advance Topics*, Dunham, Pearson Education.

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