DEPARTMENT OF INDUSTRIAL AND PRODUCTION ENGINEERING

SHRI G S INSTITUTE OF TECHNOLOGY AND SCIENCE INDORE

SYLLABUS: M. TECH (INDUSTRIAL ENGINEERING MANAGEMENT)

SEMESTER A

IP 81016: INDUSTRIAL DESIGN & PROCESSES

PERIOD PERWEEK			CREDITS			MAXIMUM MARKS				
L	P	Tu	T	P	Tu	THEORY		PRACTICAL		TOTAL MARKS
03	00	00	03	-	-	CW	END SEM	SW	END SEM	100
						30	70	-	-	

Note: Each lecture is of one hour duration.

COURSE OBJECTIVE	The course aims at imparting the knowledge of design process, consideration of various lifecycle stages of a product at design stage. It expose the student to creative process and aesthetic aspect of product design. Later it gives the idea about various types of models used by the designers. It also gives a brief introduction about manufacturing process and rapid prototyping techniques. Lastly it expose the student to manufacturing systems philosophy and concept of value.
COURSE OUTCOMES	On successful completion of the course, the student should be able-
CO 1	Illustrate and apply the knowledge of morphology and design for X guidelines.
CO 2	Explain and apply creative design techniques.
CO 3	Illustrate of the various types of Models.
CO 4	Extend design with manufacturing processes.
CO 5	Identify operations management aspects related with product design.

Course Outcomes	PO1	PO2	PO3
CO1	1	0	1
CO2	1	1	0
CO3	1	0	1
CO4	0	0	0
CO5	1	1	1

COURSE ASSESSMENT : Students will be assessed as following:	
Theory paper	End Semester Exam: 70 Marks
	Continuous assessment: 30 Marks (Two mid-term tests:15 Marks, Assignment:5 Marks,Quiz: 5 Marks, and Regularity: 5 Marks)
COURSE CONTENTS	
UNIT 1	**Idea Generation**: Design by Evolution and Innovation. Design process and morphology of design. Needs analysis, Design for production, Distribution, Consumption and Retirement. Environmental Factors and Resources.

UNIT 2	**Design Methods:** Creative design process, Brain storming, Synectics, Compatibility Matrix approach to design. Physical Reliability. Design Tree. Utility Analysis Economic Analysis. Role of Proportions. Visual Balance.
UNIT 3	**Type of Model:** Scale Models, Prototype and Mockups. Methods of Optimum Design. Reliability based design.
UNIT 4	**Study of Primary and Secondary Production Processes:** Designing of physical configurations for production purpose. Casting, Joining, powder metallurgy.
UNIT 5	**Production System** as input output model. Productivity, manning for optimum production, Group Technology, Standardization, coding and classification of parts types, Quality Assurance. Failure model and effects analysis. Value Engineering: Introduction, Cost Vs Price, Type of Values, Functions and costs. Job plan, scientific approach to VA / organizing VE Program.
Textbooks:	
Dieter G.E., Engineering Design A Material Processing Approach, McGraw Hill. 1986	
Roy A. Lindberg, Production Process, Prentice Hall	
Jones J.C. Design Method-Seeds of Human Future. Prentice Hall	
Reference Books:	
Chitale A.K. and Gupta R.C, Product Design & Manufacturing. PHI.	
Ullamn H. Engineering Design. McGraw Hill.	

DEPARTMENT OF INDUSTRIAL AND PRODUCTION ENGINEERING

SHRI G S INSTITUTE OF TECHNOLOGY AND SCIENCE INDORE

SYLLABUS: M. TECH (INDUSTRIAL ENGINEERING MANAGEMENT)

SEMESTER A

IP-81017: QUANTITATIVE TECHNIQUES FOR MANAGEMENT

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
L	P	Tu	T	P	Tu	THEORY		PRACTICAL		TOTAL MARKS
						CW	END SEM	SW	END SEM	
03	00	00	03	-	-	30	70	-	-	100
Note: Each lecture is of one hour duration.										

COURSE OBJECTIVE	The course presents basic theory of linear and different quantitative problems to analyzing different situations arises in engineering and management, it gives understanding of getting solution to these problems and some experience in solving them. Also helps to formulate and solve mathematical models in researches.
COURSE OUTCOMES	On successful completion of the course, the student should be able-
CO 1	To analyze any real life system with limited constraints and depict it in a model form and convert the problem into a mathematical model using linear programming problem.
CO 2	To apply the knowledge of linear programming to solve real life problems of industry.
CO 3	To apply and simulate concepts of queuing models and find the optimal solutions using models for different situations.
CO 4	To apply and model concepts of game theory.
CO 5	To apply the concept of non-linear programming and solve the mathematical model manually as well as using software's such as solver, TORA etc. MS Excel Solver, Lingo and lindo etc.

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3
CO1	1	0	1
CO2	1	0	1
CO3	1	0	1
CO4	1	0	1
CO5	1	1	1

COURSE ASSESSMENT : Students will be assessed as following:

Theory paper	End Semester Exam: 70 Marks
	Continuous assessment: 30 Marks (Two mid-term tests:15 Marks, Assignment:5 Marks, Quiz: 5 Marks, and Regularity: 5 Marks)

COURSE CONTENTS

UNIT 1	**Introduction:** History and Development of O.R & Linear Programming. Present Trend. (i) Assignment models (ii) Transportation: Optimality Test, Degeneracy unbalanced Problems, Transshipment.

UNIT 2	**Linear Programming:** Formulation, Graphical Method, Simplex Method, and Big - M Method, Two-phase Method, Degeneracy, and Unrestricted variables. Revised Simplex, Duality, Sensitivity analysis. Introduction to Integer programming. Branch and Bound Method.
UNIT 3	**Waiting model:** Introduction, Classification, States in queue, Probability distribution of arrival and service times Birth and Death Process, Single Server Model (M/M/1), Multiple Server Model (M/M/S), Single Server Model with finite capacity.
UNIT 4	**Game Theory:** Rectangular, Two persons, Zero Sum Games, Maximum and Minimax Principles. Saddle Point. Dominance. Graphical and Algebraic Methods of solution, transforming into Linear Programming Problem. Bidding Problems. Dynamic Programming: Characteristic of Dynamics Optimization Model, Applications of Dynamic Programming, Continuous state DP. Multiple state variables
UNIT 5	**Simulation:** Building a Simulation Model. Monte-Carlo Simulation and Applications. Random No. And mapping to probability distributions. Simulation Software. Nonlinear Programming: Introduction application. Decision under uncertainty. Tree diagram, probability trees. Decision tree. Markovian Chain. Computer Application in O.R. and Case Study.
Textbooks:	
Philip, Ravindran, Operation Research, John Wiley.	
Heera and Gupta, Operation Research, s. Chand.	
Sharma S.D. Operation Research	
Reference Books:	
Vohra N.D., Operation Research, TMH	
Taha H. Operation Research, PHI	

DEPARTMENT OF INDUSTRIAL AND PRODUCTION ENGINEERING

SHRI G S INSTITUTE OF TECHNOLOGY AND SCIENCE INDORE

SYLLABUS: M. TECH (INDUSTRIAL ENGINEERING MANAGEMENT)

SEMESTER A

IP 81018: PRINCIPLES AND PRACTICES OF MANAGEMENT

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
L	P	Tu	T	P	Tu	THEORY		PRACTICAL		TOTAL MARKS
						CW	END SEM	SW	END SEM	
03	00	00	03	-	-	30	70	-	-	100

Note: Each lecture is of one hour duration.

COURSE OBJECTIVE	Objective of this course is to enable the students gain understanding of the functions and responsibilities of the manager, provide them tools and techniques to be used in the performance of managerial job, and enable them to analyze and understand the environment of the organization. It also provides an opportunity to the students to inculcate and develop soft skills on communication, decision-making, motivation, and leadership through in-depth knowledge of theory and research on individual and group processes.
COURSE OUTCOMES	On successful completion of the course, the student should be able-
CO 1	To create an understanding on basic principles, concepts & functions, ethical issues of management
CO 2	To interpret the fundamentals of planning techniques.
CO 3	To outline the fundamentals of organizational principles, designs, and structures.
CO 4	To explain the key competencies and skills required for personnel management, motivation, and leadership.
CO 5	To explain and assess the importance of effective control system in a changing environment.

Course Outcomes	PO1	PO2	PO3
CO1	0	1	0
CO2	1	1	0
CO3	1	1	1
CO4	1	1	1
CO5	1	1	1

COURSE ASSESSMENT : Students will be assessed as following:	
Theory paper	End Semester Exam: 70 Marks
	Continuous assessment: 30 Marks (Two mid-term tests:15 Marks, Assignment:5 Marks,Quiz: 5 Marks, and Regularity: 5 Marks)
COURSE CONTENTS	
UNIT 1	**Introduction:** Definition, Roles and Functions of a Manager, Schools of Management Thought, Comparison of American, Japanese and Indian Philosophies of Management.

UNIT 2	**Planning:** Nature and Purpose of Planning, Components of Planning - Objectives of business, Forecasting, Decision-Making, Policy Formulation and Strategies. Management by Objectives.
UNIT 3	**Organization:** Nature and Purpose of Organizing, Departmentation, Organization Structures, Span of Control, Delegation of Authority.
UNIT 4	**Staffing:** Functions of Personnel Management, Manpower Planning, Selection and Recruitment, Methods & Types of Training, Motivation and Leadership Theories, Performance Appraisal.
UNIT 5	**Control:** Meaning, Process and Evaluations, Developing and compensating employees, Feedback & Feed forward System, Control Methods, Effective Communication. **Case Studies.**
Textbooks:	
Chhabra T.N., Principles and Practice of Management.	
Koontz -O'Donnell, Essentials of Management.	
Murton- Gulab, Management Today.	
Prasad L.M., Principles and Practice of Management	
Reference Books:	
Stoner- Philips, Management.	
Terry G.R., Principles of Management.	

DEPARTMENT OF INDUSTRIAL AND PRODUCTION ENGINEERING

SHRI G S INSTITUTE OF TECHNOLOGY AND SCIENCE INDORE

SYLLABUS: M. TECH (INDUSTRIAL ENGINEERING MANAGEMENT)
SEMESTER A

IP 81019: STATISTICAL QUALITY CONTROL AND TQM

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
L	P	Tu	T	P	Tu	THEORY		PRACTICAL		TOTAL MARKS
						CW	END SEM	SW	END SEM	
03	00	00	03	-	-	30	70	-	-	100

Note: each period is of one hour duration.

COURSE OBJECTIVE	The objective of the course is to introduce basic concepts and statistical methods employed for assurance of quality in products, processes and systems in an industrial environment (manufacturing and service organizations), such as Management and Control of Quality and Quality System, Statistical Process Control, Process Capability Analysis, Acceptance Sampling, Process Capability Analysis, Reliability.
COURSE OUTCOMES	On successful completion of the course, the student should be able-
CO 1	To develop conceptual understanding of Quality, Quality cost and value.
CO 2	To analyze and develop control charts for Statistical Quality Control. To apply the Knowledge of quality control and its tools for process capability.
CO 3	To choose, analyze and develop sampling plans for acceptance sampling.
CO 4	To perceive concept of TQM and philosophy of quality leaders.
CO 5	To recognize and identify failure pattern of product and Reliability & Maintenance concepts.

Course Outcomes	PO1	PO2	PO3
CO1	1	1	1
CO2	1	1	1
CO3	1	1	1
CO4	1	1	1
CO5	1	1	1

COURSE ASSESSMENT : Students will be assessed as following:	
Theory paper	End Semester Exam: 70 Marks
	Continuous assessment: 30 Marks (Two mid-term tests:15 Marks, Assignment:5 Marks, Quiz: 5 Marks, and Regularity: 5 Marks)

COURSE CONTENTS	
UNIT 1	**Quality Control:** Definitions, Place of quality control in industries, Quality control organization. Difference between inspection and quality control. Applications of quality control in industries. Economics of Quality systems. Quality Assurance.
UNIT 2	**Statistical process control:** Sample size and frequency of sampling and control, Design and application of control charts for variable and attribute. Process capability studies.
UNIT 3	**Acceptance Sampling:** Single sampling plans. Double sampling and sequential sampling plans. Rectifying inspection for lots. Sampling plans for continuous production. Selection of sampling plans for different situations. Economics of acceptance sampling.
UNIT 4	**T.Q.M.:** Evolution of total quality management. Historical perspective. Elements of

	TQM: elimination of waste and problem exposure. Total quality control systems. Demings wheel, Deming 14 points-pros and cons in industrial engineering context, Philip Crosby philosophy, Juran Philosophy, Ishikawa Diagram. Quality function development, quality circles & ISO 9000. Application of TQM to service type organizations. Various Quality Awards. Costs benefit analysis. Life cycle costing.
UNIT 5	**Reliability:** Distributions encountered in controlling Reliability mean time to failure, Exponential failure density, MTTF, Weibull, Failure density, Measurement and Tests, Maintenance and Reliability, Life testing.
Text Books	
Kapur K.C. and Lamberson, Reliability in Engg. Design Wiley Estern.	
Dhillon, Reliability, Wiley Eastern	
Grant E.L. and Leave Worth, Statistical Quality Control, TMH.	
Juran and Gray, Quality Planning Control, TMH.	
Mood and Gray Bill, Statistics, John Wiley.	
Reference Books:	
Hansen B.L. and Ghare P.M. Q C and Application PHI.	
Jain K.C. and Chitale A.K., Quality Assurance and Total Quality Management, Khanna.	

DEPARTMENT OF INDUSTRIAL AND PRODUCTION ENGINEERING

SHRI G S INSTITUTE OF TECHNOLOGY AND SCIENCE INDORE

SYLLABUS: M. TECH (INDUSTRIAL ENGINEERING MANAGEMENT)
SEMESTER A

IP 81020: WORK STUDY AND PRODUCTIVITY MANAGEMENT

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
L	P	Tu	T	P	Tu	THEORY		PRACTICAL		TOTAL MARKS
						CW	END SEM	SW	END SEM	
03	00	00	03	-	-	30	70	-	-	100

COURSE OBJECTIVE	This course is aimed at enable students to understand the concept and significance of Work Study and Ergonomics including various techniques of work-study for improving the productivity of an organization. As well as to inculcate the skill for analyzing and improving existing methods of working on the shop floor of an organization.
COURSE OUTCOMES	On successful completion of the course, the student should be able-
CO 1	To apply the knowledge of evaluating productivity of an enterprise with different Productivity models and productivity improvement techniques.
CO 2	To illustrate the historical view of Work Study with its applications in industries and its role in productivity improvement along with engineering approach to analyze the methods for proposing the new improved methods.
CO 3	To explain and apply the principles of motion economy and work measurement techniques.
CO 4	To illustrate the knowledge of industrial applications using the human factors and work design for man machine system.
CO 5	The ability to design appropriate wage and incentive plan for the employees of an Organization and designing salary structure.

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3
CO1	1	1	1
CO2	2	2	2
CO3	2	2	2
CO4	2	2	2
CO5	2	2	2

COURSE ASSESSMENT : Students will be assessed as following:

Theory paper	End Semester Exam: 70 Marks
	Continuous assessment: 30 Marks (Two mid-term tests:15 Marks, Assignment:5 Marks,Quiz: 5 Marks, and Regularity: 5 Marks)

COURSE CONTENTS

UNIT 1	**Productivity Management**: Concept of Productivity, Factors affecting Productivity, Total productivity model. Short term and Long term Productivity Planning Models. Productivity improvement Techniques: Technology based, Material based, Employee based, Product and Time based P.I. Techniques.

UNIT 2	**(a) Work Study:** Definition, objectives and areas of application of work study in industries, Historical review. Interrelation between method study and work measurement; Human aspects of work-study. Role of work-study in productivity improvement. **(b) Method Study:** Definition and objectives; Engineering approach to methods analysis and improvement. Data collection and recording techniques; critical examination and development, creative thinking, tools of creativity. Installation and maintenance of the new improved methods.
UNIT 3	**(a) Motion Economy and Analysis:** Principles of motion economy, motion analysis; Micro motion and memo motion study; Therbligs and Simo charts, **(b) Work Measurement:** Definition and objectives; work measurement techniques, Stop watch time study, Principles and procedures. Systems of performance rating; calculation of basic time, allowances and standard time. Predetermined motion time and other standard systems, MOST, Work Sampling: principles and techniques, application of work sampling studies.
UNIT 4	**Introduction to Ergonomics:** Ergonomics as a multi-disciplinary field, components. Importance of ergonomics in equipment and work design. Concept of man-machine system; Types and characteristics of Man-machine systems. Rest Pause design based on physiological consideration, Anthropometry and Work place design.
UNIT 5	**Wage Incentives and Job Evaluation:** Various types of wage Incentive schemes and their impact on productivity. Comparison of different incentive plans, design of incentive plans, Group system of Wage payment. Supervisory incentive plans. Job Evaluation: Purpose, Various types of jobs evaluation system and their application of classification. Wage Cure. Designing salary structure and Grade. Merit Rating. Performance Appraisal. **Case Studies.**
Text Books	
Sumanth D.J., Productivity Management, TMH.	
I.L.O., Introduction of Work Study.	
Maynard H.B., Industrial Engineering Hand Book.	
Reference Books:	
Jhamb L.C., Workstudy and Ergonomics.	
Sumanth D.J., Productivity Managment. TMH.	

IP81451 - INDUSTRIAL DESIGN AND PROCESSES (IDP Lab.)

LIST OF EXPERIMENTS

1. To compare the surface to volume ratio of cube, cylinder & sphere.
2. To calculate & analyze the heights to width ratio of parallelepiped & heights to diameter ratio of cylinder for minimum paper consumption.
3. To determine OPTIZ code for V-Block & Rotational geared component given for study.
4. To design an ink writing instrument using morphological table.
5. To design a garden chair using morphological analysis.
6. Product analysis on the basis of product characteristics.
7. Cost reduction in case of value engineering & case study on the switch control assembly.

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IP-81007: QUANTITATIVE TECHNIQUES FOR MANAGEMENT
(IP-81452: QTM LAB)

LIST OF EXPERIMENTS

1. Solving linear programming problems using Lindo software.
2. Solving linear programming problems using Lindo software.
3. Solving transportation and assignment programming problems using Lingo software.
4. Solving transportation and assignment programming problems using Lindo software.
5. Solving Lpp problems using Tora software.
6. Solving transportation and assignment problems using Tora software.
7. Solving game, queuing and integer programming problems using Tora software.
8. Solving Lpp problems using Ms Excel software.
9. Solving transportation and assignment problems using ms excel software.

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DEPARTMENT OF INDUSTRIAL AND PRODUCTION ENGINEERING

SHRI G S INSTITUTE OF TECHNOLOGY AND SCIENCE INDORE

SYLLABUS: M. TECH (INDUSTRIAL ENGINEERING MANAGEMENT)

SEMESTER B

IP 81514: FINANCIAL MANAGEMENT

PERIOD PERWEEK			CREDITS			MAXIMUM MARKS				
L	P	Tu	T	P	Tu	THEORY		PRACTICAL		TOTAL MARKS
03	00	00	03	-	-	CW	END SEM	SW	END SEM	100
						30	70	-	-	
Note: Each lecture is of one hour duration.										

COURSE OBJECTIVE	This course is designed to enable the students to understand the financial issues of determining the monetary resources needed by a business, the mix of these resources, the sources and uses of funds, the benefits, risks and costs associated with different types of resources and financing.
COURSE OUTCOMES	On successful completion of the course, the student should be able-
CO 1	To demonstrate the applicability of the concepts of Financial Management to understand the managerial decisions in economic environment.
CO 2	To develop the analysis associated with balance sheets and tools of financial analysis in the corporate environment.
CO 3	To illustrate the basics of working capital management and financial leverages.
CO 4	To define and apply the fundamentals of financial decision making.
CO 5	To identify and apply the fundamentals of investment decisions.

Course Outcomes	PO1	PO2	PO3
CO1	0	0	0
CO2	0	1	0
CO3	1	1	1
CO4	1	1	1
CO5	1	1	1

COURSE ASSESSMENT : Students will be assessed as following:	
Theory paper	End Semester Exam: 70 Marks
	Continuous assessment: 30 Marks (Two mid-term tests:15 Marks, Assignment:5 Marks,Quiz: 5 Marks, and Regularity: 5 Marks)
COURSE CONTENTS	
UNIT 1	**Nature and Scope of Financial Management:** Role of financial management in business decision, goal of financial management. , The Firm and Its Environment: Forms of business ownership, economic and regulatory environment, Tax planning.
UNIT 2	**Financial Analysis:** Balance sheet and profit and loss statements, Tools of Financial Analysis, Funds flow analysis - sources and uses of funds,

	measurements of cash flow, Revenue costs.
UNIT 3	**Profit relationship,** break even analysis, ratio analysis, of operating and financial leverages. Working Capital Management, Credit Policy.
UNIT 4	**Financial Decision Making:** Sources of raising capital, Internal financing, Cost of capital. Balanced Capital Structure. Capital Structure Theories. Dividend Policy & its Theories.
UNIT 5	**Investment Management:** Capital Budgeting Techniques. PBP, ARR, Discounted PBP, PI, Time Value of Money, NPV v/s IRR. Risk Analysis, Case Studies.
Textbooks:	
Khan and Jain, Financial management.	
Pandey I M, Financial Management	
Reference Books:	
Kuchchal, Financial management.	

DEPARTMENT OF INDUSTRIAL AND PRODUCTION ENGINEERING

SHRI G S INSTITUTE OF TECHNOLOGY AND SCIENCE INDORE

SYLLABUS: M. TECH (INDUSTRIAL ENGINEERING MANAGEMENT)

SEMESTER B

IP 81516: MARKETING MANAGEMENT

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
L	P	Tu	T	P	Tu	THEORY		PRACTICAL		TOTAL MARKS
						CW	END SEM	SW	END SEM	
03	00	00	03	-	-	30	70	-	-	100
Note: Each lecture is of one hour duration.										

COURSE OBJECTIVE	The objective of this course is to introduce the students with various aspects of marketing as it plays as a major source of influence in every aspect of an Industrial Engineers decision making and working.
COURSE OUTCOMES	On successful completion of the course, the student should be able-
CO 1	Recognize and identify marketing philosophies.
CO 2	Interpret marketing research projects and consumer behavior.
CO 3	Grasp and identify product philosophy and product mix strategies.
CO 4	Comprehend the knowledge of promotion.
CO 5	Realize and identify distribution decision and distribution decision.

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3
CO1	0	0	0
CO2	2	2	2
CO3	1	1	1
CO4	0	0	0
CO5	1	1	1

COURSE ASSESSMENT : Students will be assessed as following:

Theory paper	End Semester Exam: 70 Marks
	Continuous assessment: 30 Marks (Two mid-term tests:15 Marks, Assignment:5 Marks, Quiz: 5 Marks, and Regularity: 5 Marks)

COURSE CONTENTS

UNIT 1	**Introduction:** Tasks and Philosophies of Marketing Management. The marketing system and environment. Systems approach to marketing. Marketing Organization: Organization of marketing department. Responsibilities and functions of Marketing managers, Interaction of Marketing with other functions. Sales Function: Recruitment, Selection, Training, Motivation and compensation of sales force, Controlling and evaluating.
UNIT 2	**Marketing research:** Scope and objective, Planning and formulating Marketing Research Projects, Methods of collecting data. Analysis and evaluation of data.

	Consumer behavior analysis, Vendor analysis.
UNIT 3	**Product Planning:** Product Policy decision, Life Cycle, Innovation, Product failure. Introducing new products, Product Mix strategies.
UNIT 4	**Sales Promotion** and evaluation of advertising program.
UNIT 5	**Distribution:** Importance of middlemen. Types of distribution channel, design decisions, Problem in Channel Determination and uses.
Textbooks:	
Philip Kotler, Marketing Management: Analysis, Planning Implementation and Control. PHI.	
Stanton " Marketing Management " Mc Graw Hill	
Philip Kotler " Principles of Marketing " PHI	
Rajagopal "Marketing Management: Text and Cases" Vikas Publishing House	
Gandhi " Marketing a managerial Introduction" TMH	
Reference Books:	
Still,Cundiff and Govoni " Sales Management – Decision , strategy and Cases" Prentice Hall	
Beri " Marketing Research" PHI	

DEPARTMENT OF INDUSTRIAL AND PRODUCTION ENGINEERING

SHRI G S INSTITUTE OF TECHNOLOGY AND SCIENCE INDORE

SYLLABUS: M. TECH (INDUSTRIAL ENGINEERING MANAGEMENT)

SEMESTER B

IP 81517: PRODUCTION AND OPERATIONS MANAGEMENT

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
L	P	Tu	T	P	Tu	THEORY		PRACTICAL		TOTAL MARKS
						CW	END SEM	SW	END SEM	
03	00	00	03	-	-	30	70	-	-	100

Note: Each lecture is of one hour duration.

COURSE OBJECTIVE	This Course provides the fundamental concepts and models of designing and problem solving in various aspects of production and operations management in manufacturing and service organizations.
COURSE OUTCOMES	On successful completion of the course, the student should be able-
CO 1	To develop the basic concepts in production & operations management including decision making, objectives, production systems, Ethical issues involved etc.
CO 2	To apply the knowledge of design of facilities planning, forecasting and production planning and control.
CO 3	To demonstrate and use the strategies in aggregate production planning framework, scheduling algorithms etc.
CO 4	To demonstrate and apply the concept of maintenance management.
CO 5	To interpret and apply the concept of materials management such as TPM, MRP, stores management, replacement models, and inventory control.

Course Outcomes	PO1	PO2	PO3
CO1	0	0	0
CO2	1	1	1
CO3	2	2	2
CO4	2	2	2
CO5	2	2	2

COURSE ASSESSMENT : Students will be assessed as following:

Theory paper	End Semester Exam: 70 Marks
	Continuous assessment: 30 Marks (Two mid-term tests:15 Marks, Assignment:5 Marks,Quiz: 5 Marks, and Regularity: 5 Marks)

COURSE CONTENTS

UNIT 1	**Production Management:** Introduction, Systems concept, Decisions, Organization, Objectives and Evolution of Operations Management, Operations Strategy, Type of Production Systems. Role of Production Manager.
UNIT 2	**Facilities Planning & PPC:** Plant location, Plant layout and Material Handling, Layout analysis, Procedures such as CORELAP, CRAFT etc. Organization & Functions of PPC CAPP, Make or Buy Decision, Forecasting Methods & its relationship with Product Life Cycle, Case Studies.

UNIT 3	**Aggregate Planning and Master Scheduling:** Strategies of Aggregate Planning, Graphic & and Charting methods, Application of LP, Master Scheduling, Job Shop Scheduling and Sequencing Algorithms Gantt Chart, Line Balancing, LOB, Case Studies.
UNIT 4	**Maintenance Management:** Types of maintenance strategies, Breakdown, Preventive and Predictive maintenance, Individual and Group Replacement Policies, Case Studies.
UNIT 5	**Materials Management**: Purchasing, stores and vendor selection, Inventory Models, Selective Inventory Control, MRP, MRP-II, Lot size Techniques, Just - In - Time system of manufacturing, Kaizen, Total Productive Maintenance (TPM) . BPR, SCM, ERP etc.& Case Studies.
Textbooks:	
Chitle A.K., Gupta R.C. Materials Management, PHI.	
Chase, Acquilino, Production & Operations Management, TMH.	
Eilon S. Production Planning and Control, McMillon Pub.	
Reference Books:	
Charry S.N., Production & Operations Management. TMH.	
Dobler & Lee, Purchasing & Materials Management, PHI.	

DEPARTMENT OF INDUSTRIAL AND PRODUCTION ENGINEERING

SHRI G S INSTITUTE OF TECHNOLOGY AND SCIENCE INDORE

SYLLABUS: M. TECH (INDUSTRIAL ENGINEERING MANAGEMENT)

SEMESTER B

IP 81518: SUPPLY CHAIN & LOGISTICS MANAGEMENT

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
L	P	Tu	T	P	Tu	THEORY		PRACTICAL		TOTAL MARKS
						CW	END SEM	SW	END SEM	
03	00	00	03	-	-	30	70	-	-	100

Note: each period is of one hour duration.

COURSE OBJECTIVE	This course focuses on the tools of Supply Chain Management including concepts and applications. It details the basic and advanced concepts for designing and improving supply chains through exposure to real-world supply chain problems faced by manufacturing organizations.
COURSE OUTCOMES	On successful completion of the course, the student should be able-
CO 1	To explain the basic fundamental concepts of supply chain, major business processes, drivers to SC performance, ethical issues, and major decisions.
CO 2	To interpret & apply the components and models of demand management in supply chain.
CO 3	To apply various mathematical models and simulation in supply chain planning and decision-making.
CO 4	To illustrate the significance of basic concepts of logistics management.
CO 5	To elaborate the significance of basic concepts of various strategies of transportation and network design issues.

Course Outcomes	PO1	PO2	PO3
CO1	2	2	2
CO2	2	2	2
CO3	2	2	2
CO4	2	2	2
CO5	2	2	2

COURSE ASSESSMENT : Students will be assessed as following:

Theory paper	End Semester Exam: 70 Marks
	Continuous assessment: 30 Marks (Two mid-term tests:15 Marks, Assignment:5 Marks, Quiz: 5 Marks, and Regularity: 5 Marks)

COURSE CONTENTS

UNIT 1	**Introduction to SCM**: Understanding supply chain, supply chain performance; supply chain drivers and obstacles, Building Blocks of a Supply Chain Network, Performance Measures, Decisions in the Supply Chain World, Models for Supply Chain Decision-Making.
UNIT 2	**Supply Chain Inventory Management Demand:** forecasting in supply chain; aggregate planning in supply chain; planning supply and demand; managing predictable variability, Economic Order Quantity Models, Reorder Point Models, Multi-echelon Inventory Systems**.** Inventory Optimization, JIT in SCM.

UNIT 3	**Mathematical Foundations of Supply Chain Solutions:** Use of Stochastic Models and Combinatorial Optimization in: Supply Chain Planning, Supply Chain Facilities Layout, Capacity Planning, Dynamic Routing and Scheduling Managing economies of supply chain; managing uncertainty in a supply chain; determining optimal levels of product availability.
UNIT 4	**Logistics Management**: Definition - Logistics role in the economy and in the firm, Concept - Components and requirements, Organization of Logistics functions, Integrating Logistics functions in overall organization structure, Measurement of performance of Logistics function and functionaries, Supply Management and Logistics - Integrated Logistics Planning - Evolution of World Class Management and implication for supply Management, Business Logistics - Concept - Customers Satisfaction - Customers Value Creation, Relationship Management - Cost and relationship, Lean logistics.
UNIT 5	**Transportation, Network Design and Information Technology:** Transportation Fundamentals Transportation Decisions, facility Decision; Network design in a supply chain; Information technology and its use in supply chain, Coordination and E-business in a supply chain; financial evaluation in a supply chain, Relation to ERP, E-procurement, E-Logistics, Internet Auctions, E-markets, Electronic business process optimization.

Text Books

Chopra, S. and P. Meindl, Supply Chain Management: Strategy Planning and Operation, (5th ed.),Prentice Hall, Upper Saddle River, NJ, USA 2010. (Textbook)

Christopher, M. Logistics and supply chain management: strategies for reducing cost and improving service (3rd ed.). London: FT Press, UK, 2005.

Kulkarni Sarika, Sharma Ashok, Supply Chain Management, Tata McGraw-Hill, 2004, New Delhi.

Shah Janat Supply Chain Management: Text and Cases, Pearson Education India, 2009

Levi D. S., Kaminsky P., and Levi E. S., Designing and Managing the Supply Chain: Concepts, Strategies, and Case Studies, Irwin McGraw-Hill, USA 2000.

Reference Books:

"Quantitative Models for Supply Chain Management", Sridhar Tayur, Ram Ganeshan, Michael Magazine (editors), Kluwer Academic Publishers, 1999

Bowersox D.J., ClossD.J. and Helferich O.K., Logistical Management, McGraw-Hill College, UK, 1996.

DEPARTMENT OF INDUSTRIAL AND PRODUCTION ENGINEERING

SHRI G S INSTITUTE OF TECHNOLOGY AND SCIENCE INDORE

SYLLABUS: M. TECH (INDUSTRIAL ENGINEERING MANAGEMENT)

SEMESTER B

IP-81718 ERGONOMICS & INDUSTRIAL SAFETY

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
L	P	Tu	T	P	Tu	THEORY		PRACTICAL		TOTAL MARKS
						CW	END SEM	SW	END SEM	
03	00	00	03	-	-	30	70	-	-	100

COURSE OBJECTIVE	This course is designed to provide basic understanding to the students about the concept and significance of Ergonomics & Industrial Safety, through imparting knowledge about visual, auditory and cognitive aspects of human factors. It also inculcates the skills for analyzing work place design, working postures and lifting tasks, human systems integration and improving overall decision-making and the performance of the system.
COURSE OUTCOMES	On successful completion of the course, the student should be able-
CO 1	To illustrate the knowledge of ergonomics and its applications for benefit of worker's performance, as well as employ work techniques to minimize stress and alleviate eye strain during working hours.
CO 2	To summarize stressors that cause occupational injuries and describe an expanded view of ergonomic this encompasses more than ergonomically related injuries.
CO 3	To perceive industrial culture, environment concern and industrial safety in workers.
CO 4	To illustrate the knowledge of ergonomics assessments and design solutions to practice use in workplace and distinguish proper workstation settings to minimize hazards.
CO 5	To develop team work for development and design of safe working environment.

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3
CO1	0	0	0
CO2	1	0	0
CO3	0	0	0
CO4	2	2	1
CO5	2	2	2

COURSE ASSESSMENT : Students will be assessed as following:

Theory paper	End Semester Exam: 70 Marks
	Continuous assessment: 30 Marks (Two mid-term tests:15 Marks, Assignment:5 Marks,Quiz: 5 Marks, and Regularity: 5 Marks)

COURSE CONTENTS

UNIT 1	**Introduction:** Definition, History of Development, Characteristics of Man Machine Systems, Relative capabilities of Human beings and Machines.
UNIT 2	**Information Input and Processing:**

	a) Introduction to information theory, Factors affecting information reception and processing. Coding and Selection of sensory inputs. b) Human Sensory Process: Vision, Hearing, Cutaneous, Kinesthetic, and orientation senses
UNIT 3	**Display:** a) Visual Display: Quantitative and qualitative types of visual display, Visual indicators and warning signals, pictorial and Graphic displays, Alphanumeric Characteristics, Symbolic Codes. b) Auditory and Textual Display: General Principles, Characteristics and Selection of Auditory and Textual display.
UNIT 4	**Human Motor Activities:** a) Biomechanisms of motion, Measurement of Physiological Functions, Energy Expenditure in Physical Activities. b) Human Control of Systems: Human input and output channels. Compatibility, Tracking Operations, Design of Control. c) Anthropometry: Anthropometrics Data and their uses, Work Space Dimensions. Design of seats and seating Arrangement, Location of components, Design of work place.
UNIT 5	**Environment and Safety:** Introduction to Environmental stresses and their impacts on human work. Industrial Safety: Analysis of cost of accidents, Hazards in various fields like Fire, Electrical shocks. Chemicals, Material Handling, Radiation Machine and Machine Tools and Methods of eliminating them, Personnel Protective equipments, Government legislation about occupational safety, organization for safety, plant safety.
Text Books and Reference Books:	
McCormick, Human Factors in Engineering and design.	
Singalton, Introduction to Ergonomics.	

DEPARTMENT OF INDUSTRIAL AND PRODUCTION ENGINEERING

SHRI G S INSTITUTE OF TECHNOLOGY AND SCIENCE INDORE

SYLLABUS: M. TECH (INDUSTRIAL ENGINEERING MANAGEMENT)
SEMESTER B

IP-81712-Human Resource Development

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
L	P	Tu	T	P	Tu	THEORY		PRACTICAL		TOTAL MARKS
						CW	END SEM	SW	END SEM	
03	00	00	03	-	-	30	70	-	-	100

COURSE OBJECTIVE	The objective of this course is to co-create a comprehensive view of Human Resource Development (HRD) through assessment of theories and practices of HRD.
COURSE OUTCOMES	On successful completion of the course, the student should be able-
CO 1	To explain an understanding and perspective of HRD as discipline appreciating learning.
CO 2	To learn the concepts in individual as well as group behavior.
CO 3	To illustrate the processes and issues related to human resource.
CO 4	To analyze the processes and issues related to training & development of manpower.
CO 5	To identify the significance of the organizational culture and strategies of managing organization change.

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3
CO1	1	1	0
CO2	1	1	1
CO3	1	1	1
CO4	1	0	1
CO5	1	0	1

COURSE ASSESSMENT : Students will be assessed as following:

Theory paper	End Semester Exam: 70 Marks
	Continuous assessment: 30 Marks (Two mid-term tests:15 Marks, Assignment:5 Marks,Quiz: 5 Marks, and Regularity: 5 Marks)

COURSE CONTENTS

UNIT 1	**Introduction:** Importance of HRD, Characteristic and need for HRD, Difference between traditional and HRD philosophy, HRD processes. HRD Methods or Mechanisms. Outcomes of HRD. Planning Organizing HRD system, Indian Scenario for HRD.
UNIT 2	**Individual Behavior:** Personality, Perception, Attitude Role conflict and stress. Goal Conflict, Frustration, Cognitive Dissonance. Group Behavior: Stages of Group development, Group Cohesiveness, Characteristics of effective group, informal group, Morale.
UNIT 3	**Acquisition of Human Resource:** Job Analysis Job Description, Job Specification, Analysis Technique, Manpower Planning, Objectives and

	process of Manpower Planning. Recruitment, Selection Placement, Induction. Performance and Potential Appraisal - Purpose, Factor, Criteria of Performance Appraisal (Indian Scenario).
UNIT 4	**Training & Development:** Principles of learning, Evaluation of various methods of Training and Development. Motivation, Job Satisfaction and Quality of work life, Job Enrichment and Role Enrichment Promotions. Career Planning, Quality Circles. Employee Compensation Employee Welfare and Social Security, Help Cooperation Competition and Conflict. Grievance and Discipline: Grievance, Causes, Settlement and model of grievance procedure. Employee discipline, Misconduct, Ideal disciplinary System.
UNIT 5	**Organizational Climate Culture (OC)** Theory X and Y. HRD Climate and organizational climate. Organization Development Organization Change: Strategy for introducing change, Organizational development, Nature and Objectives, Phases of OD program.
Text Books and Reference Books:	
Shaikh AM, Human Resource Management.	
Stephen Robbins, Human Resource Development	

DEPARTMENT OF INDUSTRIAL AND PRODUCTION ENGINEERING

SHRI G S INSTITUTE OF TECHNOLOGY AND SCIENCE INDORE

SYLLABUS: M. TECH (INDUSTRIAL ENGINEERING MANAGEMENT)
SEMESTER B

IP-81703 Materials Management

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
L	P	Tu	T	P	Tu	THEORY		PRACTICAL		TOTAL MARKS
						CW	END SEM	SW	END SEM	
03	00	00	03	-	-	30	70	-	-	100

COURSE OBJECTIVE	This course is designed to enable and train the students for working as materials managers by providing knowledge about effective and efficient purchase, different inventory policies and models, effective and efficient stores management, modern techniques like JIT and MRP.
COURSE OUTCOMES	On successful completion of the course, the student should be able-
CO 1	To illustrate the basic concepts of materials management in business organizations.
CO 2	To explain the fundamentals of purchase.
CO 3	To explain the fundamentals of stores management.
CO 4	To explain and apply the models in inventory management.
CO 5	To demonstrate the significance of value engineering.

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3
CO1	1	2	0
CO2	1	2	1
CO3	1	2	2
CO4	2	2	2
CO5	1	2	1

COURSE ASSESSMENT : Students will be assessed as following:

Theory paper	End Semester Exam: 70 Marks
	Continuous assessment: 30 Marks (Two mid-term tests:15 Marks, Assignment:5 Marks,Quiz: 5 Marks, and Regularity: 5 Marks)

COURSE CONTENTS

UNIT 1	**Introduction:** Field and scope of Material Management. General Analysis of Material Quality. Material Planning and Programming.
UNIT 2	**Purchase Management:** Problems of Purchasing, Organization of Purchasing Dept., Purchase methods and Procedure, Placing of order, Inspection and testing Purchasing for Mass Production, Purchase contract, Make or Buy Decision, Material Import.
UNIT 3	**Stores Management:** Stores Organization. Methods of storing, Record - keeping and checking. Issue Methods. Waste Control. Standardization, Simplification, Codification.

UNIT 4	**Inventory Management:** Various inventory models. Quantity Discounts, Shortages, Instantaneous Production with back orders. Fixed Time Models. Single Period Model of Profit maximization with time independent cost. Lead Time. Re-order Point. Buffer Stock. Models with price Breaks, Inventory Classification systems, Multi-period Models, Stochastic Inventory Models, Inventory Planning to meet resource constraints.
UNIT 5	**Value Engineering:** Introduction, Cost Vs Price. Value of performance. Value of services. Functions and costs. Job plan, Scientific Approach to Value Analysis. Organizing of Value Engineering program.
Text Books and Reference Books:	
A.K. Chitale, R.C. Gupta, Materials Management Text and cases	
Gopalkrishanan, Integrated Materials Management.	
Dobler & Lee, Purchasing and Materials Management.	
Jhamb L.C, Inventory Control.	

DEPARTMENT OF INDUSTRIAL AND PRODUCTION ENGINEERING

SHRI G S INSTITUTE OF TECHNOLOGY AND SCIENCE INDORE

SYLLABUS: M. TECH (INDUSTRIAL ENGINEERING MANAGEMENT)
SEMESTER B

IP81714- Project Management

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
L	P	Tu	T	P	Tu	THEORY		PRACTICAL		TOTAL MARKS
						CW	END SEM	SW	END SEM	
03	00	00	03	-	-	30	70	-	-	100

COURSE OBJECTIVE	This course is designed to enable the students learn the concepts, tools and skills of Project Management. It will also help to control and monitor projects using various tools for cost and time estimation and evaluating and countering risks involved.
COURSE OUTCOMES	On successful completion of the course, the student should be able-
CO 1	To illustrate the concepts of Project Management and role of project manager for Project planning, monitoring and analysis also to identify opportunities of new products.
CO 2	To the fundamentals of financial analysis, estimation of working capital and Project cash flows.
CO 3	To identify, analyze, and apply the project risk management plan.
CO 4	To analyze project appraisal criteria.
CO 5	To illustrate and analyze network techniques and to estimate optimal time, cost tradeoff by using optimization techniques like PERT, GERT & CPM.

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3
CO1	0	1	1
CO2	1	1	1
CO3	1	1	1
CO4	1	1	1
CO5	1	1	1

COURSE ASSESSMENT : Students will be assessed as following:

Theory paper	End Semester Exam: 70 Marks
	Continuous assessment: 30 Marks (Two mid-term tests:15 Marks, Assignment:5 Marks,Quiz: 5 Marks, and Regularity: 5 Marks)

COURSE CONTENTS

UNIT 1	**Project Management:** Definition, characteristics, and life cycle, difference with operations management, Steps in PM, project manager's jobs, Organization for PM. Market Potentiality Analysis: Identification of opportunities of new products.
UNIT 2	**Technical Analysis:** Materials and Inputs, Production Technology, Product mix, Plant capacity, Project planning and Analysis tools. Monitoring and Control: Features of control, Project control, Performance analysis and cost control curves, Line of balance, GERT, Computer Applications.

UNIT 3	**Financial Analysis:** Estimation of cost of project, means of finance, newer modes of financing. Estimation of working capital, estimation of cost of production working results and profitability, Project cash flows.
UNIT 4	**Project Appraisal Criteria:** Payback period, Net present value method, Cost benefit ratio, Internal Rate of return. Risk Analysis, Sensitivity analysis and its applications.
UNIT 5	**Project Management Through Network:** Work Break Down structure, Gantt chart etc. PERT Activity Average Time variance and project completion time by Normal Distribution. CPM: Critical path, floats and their Interpretation Event Occurrence times, Net slacks, Resource allocation, Crashing of Network, Time cost trade-off.
Text Books and Reference Books:	
Prasanna Chandra, Project Preparation, Appraisal and Implementation, Tata McGraw HillPublishing Co.1, New Delhi.	
Dennis Lock, Project Management, Galgotia Book Service, New Delhi.	
Chaudhary S., Project Management, TMH	
Pitman K. G., Critical Path Analysis, Lockyer.	
Moder & Phillips, Project Management, CBS Pub., Delhi.	

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SHRI G S INSTITUTE OF TECHNOLOGY AND SCIENCE INDORE

SYLLABUS: M. TECH (INDUSTRIAL ENGINEERING MANAGEMENT)

SEMESTER B

(Elective-I)

IP 81711: ENTERPRISE RESOURCE PLANNING AND MIS

PERIOD PER WEEK			CREDITS			MAXIMUM MARKS				
L	P	Tu	T	P	Tu	THEORY		PRACTICAL		TOTAL MARKS
						CW	END SEM	SW	END SEM	
03	00	00	03	-	-	30	70	-	-	100

COURSE OBJECTIVE	This course Introduces various aspects of MIS and ERP as applied to engineering problems in a systematic manner imparting the knowledge of fundamentals of data base, business applications.
COURSE OUTCOMES	On successful completion of the course, the student should be able-
CO 1	To illustrate fundamentals of MIS and be able to compare it with other approaches.
CO 2	To explain the fundamentals of planning, designing and implementing of MIS.
CO 3	To Identify and describe important features of Computer Based Information System for an organization in order to build and use information systems successfully.
CO 4	To perceive fundamentals of enterprise resource planning (ERP) systems concepts and the importance of integrated information systems in an organization.
CO 5	To illustrate the knowledge of the Business Process Re-Engineering, and its application in ERP Implementation.

CO-PO Mapping

Course Outcomes	PO1	PO2	PO3
CO1	0	0	0
CO2	1	1	1
CO3	1	1	1
CO4	1	1	1
CO5	2	1	1

COURSE ASSESSMENT : Students will be assessed as following:

Theory paper	End Semester Exam: 70 Marks
	Continuous assessment: 30 Marks (Two mid-term tests:15 Marks, Assignment:5 Marks,Quiz: 5 Marks, and Regularity: 5 Marks)

COURSE CONTENTS

UNIT 1	**a) Introduction:** Characteristics and Importance of information, Search, Storage and Retrieval of Information, Information Feedback system. **b) Management Information System (MIS):** Objectives & Cost Benefits of MIS, Management and System concept, Decision and MIS. Decision Environment Model. Functional Applications of MIS: Production Subsystem, Marketing Subsystem, Personnel Subsystem, Financial Subsystem.
UNIT 2	**Planning, Design and Implementation of MIS:** Planning Techniques, Project Proposal, Reporting and Controlling, Information needs and

	sources, Conceptual Design, Detailed Design. Selection of Final Design. Organization for implementation and Training of Operational Personnel. Data Collection, Evaluation, Control and Maintenance of Information Systems.
UNIT 3	**Computer Based Information System (CBIS):** Role of C.B.I.S. in Management, Hierarchy of C.B.I.S., M.I.S. and C.B.I.S. family. M.I.S. in total C.B.I.S. environment. Types of C.B.I.S. Transaction Processing System (TPS): Overview of T.P.S., Techniques of T.P.S. Processing Modes of TPS. Decision Support System (DSS): Definition, Characteristic Evolution & Applications of D.S.S., Difference between DSS and M.I.S. Office Automation System (OAS): Definition, Importance, Planning and Implementation of OAS, Computer based Office Communication System.
UNIT 4	**Evolutionary stages of Enterprise Resource Planning(ERP),** Need for ERP, Variety accommodation, Strategic and operational issues in ERP, Integrated and Business model of ERP, Zachmann enterprise architecture, MRP and MRP-II.
UNIT 5	**Introduction to Business Process Re-Engineering,** ERP Implementation: Role of consultants, vendors and users, Guidelines and Procedure for ERP implementation, strategic advantage through ERP, ERP Domain.
Text Books and Reference Books:	
Planning Men at Work. Enterprise Resource Planning, Concept and Practice, Chhabra, Ahuja & Jain, PHI	
Business Process Re-Engineering, Jayaraman, , TMH.	
ERP by Alexis Leon	
Management Information System, Kanter, PHI.	
Management Information System, Murdick & Ross, PHI.	
D. Base –III, Alan Simpson.	