SCHEME & SYLLABUS
OF

VII & VIII Semesters B.E.

INDUSTRIAL ENGINEERING & MANAGEMENT

2023-24

Vision of the Department

To be a distinguished centre for the dissemination of knowledge and promoting research and consultancy in the field of Industrial Engineering and Management and for catering to the needs of the society.

Mission of the Department

1. To practice the philosophy of learning-teaching-learning and adopt the latest tools and techniques for the effective dissemination of knowledge in the field of Industrial Engineering and Management.
2. To collaborate with academic institutions, industry and research organizations to establish Centers of Excellence (COE) in emerging areas and promote research and consultancy.
3. To impart training for the overall development of students and inculcate commitment for social responsibility.

Program Educational Objectives (PEOs)

1. Graduates will excel in their chosen careers and successfully pursue higher education in Industrial Engineering and Management and related fields.
2. Graduates will manage the functioning of organization and enhance its competitiveness using contemporary tools in a socially acceptable way.
3. Graduates will demonstrate professionalism, ethical conduct, and societal responsibility and adapt to current trends by engaging in lifelong learning.

Programme Specific Outcomes (PSOs)

PSO1: Apply broad-based basic engineering and analytical tools for system design, analysis, performance evaluation and decision-making.

PSO2: Apply management concepts and principles for decision making in the area of operations, marketing, finance and human resource and analyse their impact.

PSO3: Apply the knowledge of materials, machining and manufacturing; analyse and evaluate the choices made.

PSO4: Apply the knowledge of industrial engineering for work system design and analyse, evaluate and create cost effective and safer systems and procedures.

Program Outcomes (POs)

Graduates in Industrial Engineering & Management will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institute affiliated to Visvesvaraya Technological University, Belagavi, Approved by AICTE, New Delhi)

SCHEME OF TEACHING AND EXAMINATION VII Semester

Sl. No.	Course	Course Code	Course Title	Teaching Department	Teaching hrs/week			Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	PC	7RIM01	Operations Management	IEM	4	1	--	3	50	50	100	**4.5**
2	PC	7RIM02	Logistics & Supply Chain Management	IEM	4	--	--	3	50	50	100	**4.0**
3	PE	7RIME3x	Professional Elective - 3	IEM	3	--	--	3	50	50	100	**3.0**
4	OE	OE	Open Elective - 3	IEM	3	--	--	3	50	50	100	**3.0**
5	PCL	7RIML01	Supply Chain Management Laboratory	IEM	--	--	3	3	50	50	100	**1.5**
6	Project	7RIMP01	Major Project - Phase I	IEM	--	--	4	--	--	100	100	**2.0**
7	INT	7RIMINT	Internship /Industrial Training	IEM				--	--	100	100	**2.0**
8	Seminar	7RIMTS	Technical Seminar	IEM	--	--	-	--	--	100	100	**1.0**
Total					**14**	**01**	**07**	**15**	**250**	**550**	**800**	**21.0**

Professional Elective -3	
7RIME31	Non-Traditional Machining
7RIME32	Lean Manufacturing System
7RIME33	Facilities Planning & Design
7RIME34	Design for Manufacturability

Student has to complete Internship for minimum 4 weeks in intervening vacation of either 4th to 5th Semester or 6th to 7th Semester.
Examination of Internship will be conducted at the end of 7th Semester.
Technical Seminar has to be carried out under the Supervision and Guidance of Major Project Work Guide.
No SEE for Project Work Phase – I, Internship & Technical Seminar

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SCHEME OF TEACHING AND EXAMINATION VIII Semester

Sl. No.	Course	Course Code	Course Title	Teaching Department	Teaching hrs/week			Examination				Credits
					Theory lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	PE	8RIME4X	Professional Electives - 4	IEM	3	--	--	3	50	50	100	**3.0**
2	PE	8RIMP5X	Professional Electives - 5	IEM	3	--	--	3	50	50	100	**3.0**
3	PE	8RIME6x	Professional Electives - 6	IEM	3	--	--	3	50	50	100	**3.0**
4	Project	8RIMP01	Major Project - Phase II	IEM	--	--	16	3	50	50	100	**9.0**
5	AP	8APIM	AICTE Activity Points	IEM	400 HOURS FOR ENTIRE PROGRAM			--	--	100	100	**0.0**
				Total	**09**	**--**	**16**	**12**	**200**	**300**	**500**	**18.0**

Professional Elective 4		Professional Elective 5		Professional Elective 6	
8RIME41	Total Quality Management	8RIME51	Management Information System & E-Commerce	8RIME61	Product Development for Six-Sigma
8RIME42	Flexible Manufacturing Systems			8RIME62	Business Process Reengineering
8RIME43	Productivity Engineering & Management	8RIME52	Reliability Engineering	8RIME63	Design of Experiments
8RIME44	Human Factors in Engineering	8RIME53	Maintenance & Safety Engineering	8RIME64	Product Design and Manufacturing
		8RIME54	Industrial Hydraulics and Pneumatics		

Operations Management (7RIM01)

Contact Hours/ Week	:	4+1 (L+T)	Credits:	4.5
Total Lecture Hours	:	52	CIE Marks:	50
Total Tutorial Hours	:	13	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Operations Planning Concepts: Introduction to Operations Management, Operations Functions in Organizations, The Environment of Operations, Historical development, Framework for managing operations, The trend: Information and Non-manufacturing systems, Factors affecting productivity, International Dimensions of Productivity, Production systems decisions- a look ahead.

Operations Decision Making: Introduction, Management as a science, Characteristics of decisions, Framework for decision making, Decision methodology. (Problems on decision trees)

09+02-Hours

Unit-II

System Design and Capacity: Introduction, Manufacturing and service systems, Design and systems capacity, Capacity planning.

Forecasting Demand: Forecasting objectives and uses, forecasting variables, Opinion and Judgmental methods, Time series methods, Moving Average methods, Exponential smoothing, Trend adjusted Exponential Smoothing, Regression and correlation methods, Application and control of forecasts-Mean Absolute Deviation, Bias, and Tracking Signal.

11+3-Hours

Unit-III

Aggregate Planning and Master Scheduling: Introduction- planning and scheduling, Objectives of aggregate planning, Three Pure Strategies, Aggregate planning methods, Master scheduling objectives, Master scheduling methods.

Material and Capacity Requirements Planning: Overview: MRP and CRP, MRP: Underlying concepts, System parameters, MRP logic, System refinements, Capacity management, CRP activities.

12+4-Hours

Unit-IV

Scheduling and Controlling Production Activities: Introduction, PAC objectives and Data requirements, Loading –Finite and Infinite Capacity, Scheduling methodology, Priority sequencing, Capacity control.

Single Machine Scheduling/ Sequencing: Concept, measures of performance, SPT rule, Weighted SPT rule, EDD rule.

Flow –Shop Scheduling: Introduction, Johnson's rule for 'n' jobs on 2 and 3 machines, CDS heuristic.

Job-Shop Scheduling: Types of schedules, Heuristic procedure, scheduling 2 jobs on 'm' machines.

11+2-Hours

Unit-V

Lean Systems: Seven Wastes in Lean, Characteristics of Just-in-Time operations, Pull method of materials flow, consistently high quality, small lot sizes, Uniform workstation loads, Standardized

components and work methods, close supplier Ties, Flexible workforce, Line flows, Automated production, preventive maintenance, continuous improvement, The Kanban system, General operating rules, Determining the number of containers, Other Kanban Signals, JIT II, Lean Systems in Services, Strategic Implications of Lean systems, Competitive Priorities, Flows, Operational Benefits Implementation Issues, Organizational Consideration, Process considerations, Inventory and scheduling, Lean system across the organization. (Numerical on Calculation of Number of Kanbans, Takt Time).

9-Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Discuss how operations management has evolved, the trends in OM and factors affecting productivity and operations decision making
CO2	:	Apply various Forecasting techniques to estimate demand and assess System capacity.
CO3	:	Develop Aggregate planning; Master Production Schedule and Material Requirements Plan.
CO4	:	Perform Sequencing and Scheduling for given conditions.
CO5	:	Discuss the principles of lean operating systems.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2												3		
CO2	3	3	3	3										3		
CO3	3	3	3	3										3		
CO4	3	3	3											3		
CO5	3	3												3		

Text Books:

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Joseph G Monks	Operations Management, McGraw-Hill International Editions, 1988, ISBN-13: 978-0070427273
2.	Pannerselvam. R.	Production and Operations Management, 3rd Edition, PHI, 2012, ISBN-13: 978-8120345553 (Unit-IV)
3.	Lee J Karjewski and Larry P Ritzman,	Operations Management– Strategy and Analysis, 6th Edition, Pearson Education Asia, 2009, ISBN-13: 978-0131872943 (Unit-V).

Reference Book:

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Buffa	Modern Production/Operations Management, Wiely Eastern Ltd, 8th Edition, 2003
2.	Chary, S.N.	Production and Operations Management, Tata-McGraw Hill, 5th Edition, 2012.
3.	Chase Jacobs Aquilano	Operations Management for Competitive Advantages, 10th Edition, 2012, TMH.
4.	B Mahadevan	Operations Management: Theory & practice, Pearson Publication, 3rd Edition, 2018

Logistics & Supply Chain Management (7RIM02)

Contact Hours/ Week	:	4 (L)	Credits:	4.0
Total Lecture Hours	:	52	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Introduction to supply chain management & building a strategic SCM framework : Definition and development of supply chain, global optimization, managing uncertainty & risk, the evolution of supply chain management, key issues and decision phases in supply chain management, process view of supply chain management, competitive & supply chain strategies, achieving strategic fit, drivers of supply chain performance & a framework for structuring drivers.

Case studies: Dell, LL Bean and Wal-Mart Supply chains

11- Hours

Unit-II

Inventory Management: Role of cycle inventory in supply chain, economies of scale to exploit fixed cost, aggregating multiple products in single order- lots are ordered independently and jointly, quantity discounting –single and double price breaks.

Managing uncertainty in supply chain: Role of safety stock in supply chain, determining appropriate level of safety inventory, impact of supply uncertainty on safety inventory, impact of aggregation on safety inventory, impact of replenishment policy on safety inventory.

Selective inventory control Techniques: ABC, FSN, VED Classification.

Problems on: EOQ, cycle inventory, safety stock calculations, ABC classification

11- Hours

Unit-III

Strategic alliances, procurement & outsourcing strategies: Introduction, a framework for strategic alliances, third party logistics, retailer- supplier partnerships, outsourcing benefits & risks.

Sourcing and Pricing Products: Role of Sourcing, Sources of supply and Supplier selection Vendor Rating supplier – scoring & assessment- supplier performance evaluation, selection & contracts. Design collaboration, procurement process

Revenue Management: Role of revenue management in the supply chain, revenue management for: multiple customer segments, perishable assets, seasonal demand, bulk & spot contracts

Problems on: Vendor rating

10- Hours

Unit-IV

Transportation in supply chain: Role of transportation, factors affecting transportation decisions. Modes of transportation and their performance characteristics, design options for transportation network, trade-off in transportation design, tailored transportation.

Network Design in Supply Chain: Role of facility decisions in supply chain, factors influencing network design decisions, frame work for supply chain design decisions, models and mathematical formulations for facility location and capacity allocation.

10- Hours

Unit-V
Role of IT in supply chain: Bullwhip effect, obstacles to coordination. Managerial levers to achieve co-ordination, Role of IT in supply chain, introduction to B2B, B2C, EDI, ERP, Customer Relationship Management. **Measuring supply chain performance**: Supply Chain Key Performance Indicators (KPIs). **Supply chain sustainability**: Green supply chain management-reverse logistics & Recycling. **New Treads in a supply chain**: Basic concepts & benefits of new cutting-edge technologies -Lean and Six sigma supply chain management, Block chain in supply chain, IOT in supply chain, AI in SCM. **Case study:** Wall mart supply chain
10- Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Illustrate the impact of supply chain activities and decisions on firm's performance.
CO2	:	Analyse inventory planning decisions, under demand and lead time variability and optimize total cost of inventory.
CO3	:	Describe the types and key successful factors of business partnerships to improve supply chain performance & develop optimized transportation plan for complex business operations.
CO4	:	Apply revenue management strategies to improve supply chain profitability and formulate mathematical models for optimizing network design decisions.
CO5	:	Integrate information technology systems, lean and green supply chain concepts to support supply chain management decisions.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3													3		
CO2	3	3												3		
CO3	3	3												3		
CO4	3	3												3		
CO5	3				2		2							3		

Text Books:

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Chopra.S.& Meindl P	Supply Chain Management: Strategy, Planning & Operation, Pearson Education, 6th Edition, 2016, ISBN: 0131730428.
2.	David Simchi-Levi, Philip Kaminasky, Edith Simchi-Levi	Designing & Managing the Supply Chain, Tata McGraw-Hill Publishing Company Ltd., 3rd Edition, 2008, ISBN: 9780070666986.

Reference Book:

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Jeremy F. Shapiro	Modeling the Supply Chain, Cengage Learning India Pvt. Ltd., 2nd Edition, 2006, ISBN:0495126098

Non-Traditional Machining (7RIME31)

Contact Hours/ Week	:	3 (L)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I
Introduction: Need for non-traditional machining methods-Classification of modern machining processes – considerations in process selection, applications and recent development.
8- Hours
Unit-II
Mechanical Processes: Ultra Sonic Machining (USM) - Working principles, equipment used, process parameters, Material Removal Rate (MRR), applications. Abrasive Jet Machining (AJM) - Working Principles, equipment used, process parameter, MRR, applications. Water Jet Machining- Working principles, equipment used, process parameters, MRR, applications.
8- Hours
Unit-III
Electro – Chemical Processes: Fundamentals of Electro Chemical Machining (ECM), Electro Chemical Grinding, Electro Chemical Honing and deburring process, Metal Removal Rate in ECM, Tool design, Surface finish and accuracy, economic aspects of ECM – Simple problems for estimation of metal removal rate. Fundamentals of chemical machining, advantages and applications.
8- Hours
Unit-IV
Thermal Processes–I: General Principle and applications of Electric Discharge Machining (EDM), Electric Discharge Grinding and electric discharge wire cutting processes – Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, methods, surface finish and machining accuracy, characteristics of spark eroded surface and machine tool selection. Wire EDM, principle, applications.
8- Hours
Unit-V
Thermal Processes–II: Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes –General Principle and application of laser beam machining – thermal features, cutting speed and accuracy of cut. Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries. Chemical machining-principle maskants –etchants- applications. Magnetic abrasive finishing, Abrasive flow finishing.
7- Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Explain the role and importance of non-traditional machining in recent manufacturing process
CO2	:	Describe the working principles, parameters affecting the process and the application of USM, AJM, and WJM.
CO3	:	Explain the working principles of electro chemical machining and calculate MRR of the process
CO4	:	Explain the working principles of Electric Discharge machining
CO5	:	Explain the working principles of EDM, PAM and Chemical machining process

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3														3	
CO2	3	3													3	
CO3	3	3	3												3	
CO4	3														3	
CO5	3														3	

Text Book:

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Vijay.K. Jain	Advanced Machining Processes, Allied Publishers Pvt. Ltd., New Delhi, 1st Edition, 2010, ISBN: 8177642944.

Reference Books:

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	M. Adithan	Unconventional Machining Processes, Atlantic Publishers Edition, 2018, ISBN-13: 978-8126910458.
2.	Benedict. G.F	Nontraditional Manufacturing Processes, CRC Press (Marcel Dekker Inc)., New York, 1st Edition, 1987, ISBN-13 : 978-0824773526.
3.	Pandey P.C. and Shan H.S	Modern Machining Processes, Tata McGraw-Hill, New Delhi, 1981, ISBN-13: 978-0070965539
4.	J. A. Mcgeough	Advanced Methods Of Machining, Springer, 2011, ISBN: 8184898452
5.	Hassan El-hofy, El-hofy Hassan	Advanced Machining Processes: Nontraditional And Hybrid Machining Processes, Mcgraw- Hill Professional Publishing, 1st Edition, 2005, ISBN: 0071453342.

Lean Manufacturing System (7RIME32)

Contact Hours/ Week	:	3 (Lecture)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I
Introduction: SEVEN forms of waste and their description; Historical evolution of lean manufacturing; Global competition, Customer requirements, Requirements of other stake holders, Meaning of Lean Manufacturing System (LMS), Meaning of Value and waste, Need for LMS, Symptoms of underperforming organizations, Meeting the customer requirement, Elements of LMS.
8- Hours
Unit-II
Primary tools used in LMS: Meaning and Purpose of 5S Work place organization, 5S process – Sort, set in order, Shine, Standardize, Sustain, implementing 5S, Meaning and purpose of TPM, Pillars of TPM, Conditions for TPM success, TPM implementation process, Overall Equipment Effectiveness (OEE) and problems on computation of OEE.
8- Hours
Unit-III
Primary tools used in LMS Contd.: Process Mapping and Value Stream Mapping (VSM) – Need for process maps, advantages, types and its construction, steps in preparing VSM; Concept of work Cell and its design, Line balancing algorithms and problems.
8- Hours
Unit-IV
Secondary tools used in LMS: Cause and effect diagram, Pareto chart, Radar chart, Poke Yoke, Kanban, Automation, SMED, Standardized fixture, DFMA, JIT, Visual workplace, problems on Pareto analysis and computation of number of kanbans.
8- Hours
Unit-V
LMS Rules: Stability, Management, Standardized work, Pull system, Continuous improvement. Lean Implementation: Training, selecting the projects, preparing project charter, project implementation, Project review. Implementing LMS for higher productivity: Operator, process, machinery and equipment, workplace organization, Inventory, LMS Design Process
7- Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Describe the concepts of Lean Manufacturing to solve complex organizational problems
CO2	:	Identify and apply primary tools used in Lean Manufacturing to solve complex organizational problems and draw substantial conclusions.
CO3	:	Construct current state VSM and create future VSM by applying Lean concepts and principles.
CO4	:	Identify and apply secondary tools used in Lean Manufacturing to solve organizational problems and draw substantial conclusions
CO5	:	Describe the procedure involved in implementation of lean Manufacturing System for higher productivity.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3													3		3
CO2	3	3												3		3
CO3	3	3	3		2									3		3
CO4	3	3												3		3
CO5	3	3												3		3

Text Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	N. Goplakrishnan	Simplifed Lean Manufacture, PHI, 2010, ISBN-13: 978-8120339439
2.	Pascal Dennis	Lean Production Simplified, Productivity Press, 2nd Edition, 2007, ISBN-13: 978-1563273568

Reference Book

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Jeffrey Liker	The Toyota Way, Tata McGraw-Hill, Reissue, 2004, ISBN-13: 978-0071392310

Facilities Planning & Design (7RIME33)

Contact Hours/ Week	:	3 (Lecture)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Introduction to Facility Planning and Design: Definition, Importance of facility planning and design, Applications of facility planning, Characteristics of facility planning, objectives of facility planning, facility planning process.

Emerging trends in facilities Management: Outsourcing facilities management, Integrated value and related services, Workplace strategy, Internet of Things (IoT) evolution, Advent of robots, Augmented reality.

Facilities Design: 7 Management and planning tools - affinity diagram, interrelationship diagram, tree diagram, matrix diagram, contingency diagram, activity network diagram and prioritization matrix.

8- Hours

Unit-II

Plant Location and layouts: Facility location, Factors influencing plant location, Evaluating location alternatives- Locational break-even analysis, Center of gravity method and Transportation model, (Numerical problems).

Facilities layout: Types of Layouts their merits and demerits, Principles of plant layout.

8- Hours

Unit-III

Material Handling: Objectives and principles of Material handling, Unit load concept, classification of material handling equipment basic systems, Characteristics of material handling equipment, Layout procedures: Immer, Naddler, Muther and Apple James, Reed approaches to plant layout, Systematic Layout Planning (SLP)

8- Hours

Unit-IV

Space determination and area allocation: Factors for consideration in space planning, planning the space requirement for receiving, storage, production and shipping activity,

Area allocation: Establishing total space requirement, factors for consideration in area allocation, factors to be considered in planning for expansion. Six ways to expand a layout, Flexibility, Methods of obtaining the flexibility. Area allocation procedure, Introduction to Plot plan, Travel chart, blocks plan. Concept of single piece flow, uniform flow and MINOMI concept in TPS.

8- Hours

Unit-V

Construction of layout and Computerized Layout Planning: Construction of the Layout - Methods of constructing the layout, evaluation of layout, efficiency indices, presenting layout to management, implementing layout.

Computerized Layout Planning -Measurement scales, preference measurement, CRAFT, COFAD, PLANET, CORELAP, and ALDEP	
	7- Hours

Course Outcomes: Upon completion of this course the student will be able to:		
CO1	:	Explain facility planning process and its objectives and describe seven management and planning tools in designing a layout.
CO2	:	Describe factors influencing facility layout and use appropriate method for selection of right location.
CO3	:	Describe objectives, principles and approaches for designing effective material handling system.
CO4	:	Describe the procedure applied with space determination/area location and compute the area for a given condition.
CO5	:	Develop the skills to evaluate plant layouts using computerized layout planning procedures.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3															3
CO2	3	2														3
CO3	3			2												3
CO4	3			2												3
CO5	3															3

Text Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	James A. Tompkins, John A. White	Facilities Planning, John. Wiley & Sons, Inc., New York, 4th Edition, 2010, ISBN-13: 978-0470444047
2.	Francis, R. L. and J. A. White	Facility Layout and Location: An Analytical Approach, Pearson, 2nd Edition, 1991, ISBN-13: 978-0132992312
3.	James M Apple	Plant Layout and Material handling, John Wiley and Sons, 3rd Re-Edition, 1991, ISBN-13: 978-0894645457

Reference Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Sunderesh S. Heragu	Facilities Design, Brooks/Cole, 11th Edition, 1997, ISBN-13: 978-0534951832
2.	James M Moore	Plant Layout Design, McMillon Co., 1962, ISBN-13: 978-0023831805

Design for Manufacturability (7RIME34)

Contact Hours/ Week	:	3 (Lecture)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I
Selection of materials for processes: Introduction, Advantages of applying DFMA, General requirements of early materials and process selection, Selection of Manufacturing processes, Process capabilities, shape attributes, material selection by Membership function modification and dimensionless ranking, computer based primary process/material selection.
7- Hours
Unit-II
Design Features: Engineering Design features Dimensioning, General Tolerance, Assembly limits, achieving larger machining tolerances, Screw threads, Ground surfaces, holes. Problems. Datum features – Functional datum, machining sequence, manufacturing datum, changing the datum. Examples.
8- Hours
Unit-III
Component Design: Casting Considerations – Pattern, Mould, parting line, cast holes, machined holes, identifying parting line, special sand cores, designing to obviate sand cores. Examples, Design for Injection Molding – Injection molding materials, Molding cycle, Systems, machine size, cycle time, cost estimation, Insert molding, Design guidelines.
8- Hours
Unit-IV
Design for Die casting and Powder metal processing: Die casting alloys, cycle, machines, dies, finishing, Assembly techniques, Design principles, Powder metallurgy processing, stages, compaction characteristics, Tooling, Sintering, Design guidelines.
8- Hours
Unit-V
GD&T: Symbols, three datum concepts of dimensioning, Straightness, concentricity, Run-out, Location Tolerance, Assembly of parts having concentric cylinders, Control of feature location by true position, Body of revolution, Roundness, Profile dimensioning, Tapers, Shaft of two diameters. Examples.
8- Hours

Course Outcomes:
Upon completion of this course the student will be able to:

CO1	:	Outline the appropriate design for economical production and select the materials
CO2	:	Evaluate the assembly limits, general tolerances and process parameters
CO3	:	Apply the concept of DFM for molding and machining
CO4	:	Evaluate the design considerations for casting and powder metallurgy process
CO5	:	Apply the concepts of Geometrical dimensioning, selection of materials and tolerance for engineering products

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3													3	
CO2	3	3													3	
CO3	3	3	3												3	
CO4	3	3	3												3	
CO5	3	3													3	

Text Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Geoffrey Boothroyd, Peter Dewhurst, Winston Knight	Product Design for Manufacture and Assembly, CRC Press Inc. 3rd Edition, 2010, ISBN-13: 978-1420089271
2.	Harry Peck	Designing for Manufacturing, Pitman Publications, 1973, ISBN-13: 978-0273000075

Reference Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Merhyle F Spotts, Englewood Cliffs	Dimensioning and Tolerance for Quantity Production, Prentice Hall, 5th Edition, 1983, ISBN-13: 978-0132146845

Supply Chain Laboratory (7RIML01)

Contact Hours/Week	:	0 (L)	Credits:	1.5
Total Lecture Hours	:	0	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	3 Hours		

Part-A (Solving Problems using Excel)
1. Evaluate Customer Service Level (CSL) and Product Fill Rate for a continuous review policy under which Q units are ordered when the quantity on hand drops to the Re-Order Point (ROP).
2. Evaluate safety inventory, given desired cycle service level or fill rate
3. Develop a Gravity Location Model to find locations that minimize the cost of transporting raw materials from suppliers and finished goods to the markets
4. Develop a Demand Allocation Model to allocate the demand from different markets to the various plants that minimize the total cost of facilities, transportation and inventory
5. Develop a Capacitated Plant Location Model to locate factories and then allocate demand to the open factories to minimize the total cost of facilities, transportation, and inventory
6. Develop a Capacitated Plant Location Model to identify the plants that are to be kept open, their capacity, and the allocation of regional demand to these plants to minimize the cost of meeting global demand

Part-B (Solving Problems using Arena software)
1. Creating Make Master, Group Master, Category Master and Item Master for various Engineering Designs.
2. Generating Bill of Materials for Various Engineering Designs
3. Creating supplier Master
4. Creating customer Master
5. Using Purchase Management System create A. Purchase Enquiry B. Purchase Quotation C. Purchase Order D. Gate Pass E. Material Inward Note F. Bill
6. Using Purchase Management System create A. Sales Enquiry B. Sales Quotation C. Sales Order D. Dispatch Instruction E. Packing Slip F. Invoice against Packing Slip G. Dispatch Instruction Report Generating various reports for confirmed orders

Open ended Exercises

1. Develop a 'Capacitated Plant Location Model with single sourcing' to locate factories and then allocate demand to the open factories satisfying the constraint of single sourcing, to minimize the total cost of facilities, transportation, and inventory.
2. Create an Aggregate Plan, to determine the production level, inventory level, and capacity level (internal and outsourced) for each period that maximizes the firm's profit over the planning horizon given the demand forecast for each period in the planning horizon

Suggested Softwares

Microsoft Excel for Part A and Sixth Sense ERP for Part B

Scheme of Examination

1. Part A: 20 Marks
2. Part B: 20 Marks
3. Viva Voce: 10 Marks
4. Total: 50 Marks

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Determine appropriate level of safety inventory under demand uncertainty
CO2	:	Design the Supply Chain network using gravity models or network optimization models
CO3	:	Creating Masters for items and generating Bill of Materials for Various Engineering Designs.
CO4	:	Creating Purchase order, work order and dispatch Instructions for different Items

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3											3		
CO2	3	3	3											3		
CO3	3	3	3											3		
CO4	3	3	3											3		

Total Quality Management (8RIME41)

Contact Hours/ Week	:	3 (L)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Overview of Total Quality Management – History of TQM, Axioms of TQM, Contribution of quality Gurus – Deming's approach, Juran's quality trilogy, Crosby and quality treatment, Imai's Kaizen, Ishikawa's company Wide quality control and Fegenbaum's theory of TQC.

7- Hours

Unit-II

Evolution of Quality Concepts and Methods – Quality concepts, Development of four fitness's, evolution of methodology, evolution of company integration, quality of conformance versus quality of design from deviations to weaknesses to opportunities. Future fitness's, Four revolutions in management thinking and four levels of practice – customer focus, continuous improvement, total participation and societal networking. Focus on customers; change in work concept marketing and customers.

8- Hours

Unit-III

Continuous Improvement – Improvement as problem solving process; management by process, WV model of continuous improvement, process control and process improvement, process versus creativity. Reactive improvement; identifying the problem, standard steps and tools, seven steps case study, Seven Quality Control tools, management diagnosis of seven steps reactive improvement. General guidelines for managers diagnosing a Quality Improvement (QI) story, discussion on case study for diagnosis of the seven steps. Proactive improvement; introduction to proactive improvement, standard steps for proactive improvement, semantics, example- customer visitation, applying proactive improvement to develop new products –three stages and nine steps.

8- Hours

Unit-IV

Total Participation - Teamwork skill, dual function of work, teams and teamwork, principles for activating teamwork, creativity in team processes, initiation strategies, CEO involvement example strategies for TQM introduction. Infrastructure for mobilization, Goal setting (Vision/Mission), organization setting, training and E-education, promotional activities, diffusion of success stories, awards and incentives monitoring and diagnosis, phase-in, orientation phase, alignment phase, evolution of the parallel organization. Hoshin management; definition, phases in hosing management-strategic planning (Proactive), Hoshin deployment, controlling with metrics (Control), check and act (reactive). Hoshin management versus management by objectives, Hoshin

management and conventional business planning and alternative Hoshin deployment system, Hoshin management as "systems engineering" for alignment.
8- Hours
Unit-V
Societal Networking – Networking and societal diffusion – regional and nationwide networking infrastructure for networking, openness with real cases, change agents, center for quality management case study, dynamics of a societal learning system. TQM as learning system, keeping pace with the need for skill, a TQM model for skill development, summary of skill development
8- Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Explain the core concepts of TQM and contributions of various quality gurus to TQM.
CO2	:	Explain the concept of four fitness of quality and apply the concept of four revolutions in management thinking for effective quality management.
CO3	:	Apply the various tools and techniques of continuous improvement in solving quality related problems.
CO4	:	Apply the strategies for total participation of employees in solving quality related problems and hoshin deployment and skill development.
CO5	:	Apply networking concept for skill development, learning and change management.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3													3		
CO2	3	2												3		
CO3	3	2	2		2									3		
CO4	3	2			2									3		
CO5	3													3		

Text Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Shoji Shiba, Alan Graham and David Walden	A new American TQM-four practical revolutions in management, Productivity press, Portlan (USA), 1st Edition, 1993, ISBN-13: 978-1563270321
2.	N Logothetis	Management for Total Quality, Prentice Hall of India, New Delhi, 1992, ISBN-13: 978-0135535127

Reference Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Roger C Swanson	The Quality Improvement Hand Book, CRC press, 1st Edition, 1992, ISBN-13: 978-1884015595

Flexible Manufacturing Systems (8RIME42)

Contact Hours/ Week	:	3 (L)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Introduction: Flexible and rigid manufacturing, Concept of Flexible Manufacturing, Cell and Flexible Manufacturing system, Functions of a manufacturing cell, Types and components of FMS, Tests of flexibility, Group Technology and FMS, Optimization of FMS, Tasks in selection of FMS.

Control structure of FMS: Architecture of typical FMS, Automated work piece flow in FMS, Hierarchical control system architecture of FMS –Factory level, Cell level and Equipment level; Factory networks, Distributed Numerical Control (DNC), unmanned operation, FMS Diagnostics.

8- Hours

Unit-II

Production Scheduling and database concepts in FMS: Shop Floor Control system, phases in SFC, Variable route part programming system in FMS, dynamic scheduling in FMS, procedure, FMS application and flexibility –single product, single batch, n – batch scheduling problem – knowledge-based scheduling system. Performance analysis of FMS –measures, Deadlocks in automated manufacturing systems-handling deadlocks. Database Management Systems in FMS: Conceptual DBMS, types of data structures and their applications in FMS, Integrated DBMS in FMS and its implementation.

8- Hours

Unit-III

Group Technology (GT) & Cellular Layout: Introduction, objectives, definition, need, scope, part families -concept, & benefits. Production layout-types, features and applications.GT Layout - concept, need, benefits, comparison with conventional layout with examples. Parts classification and coding: GT-codification systems-types, method of coding and examples. Part features-concept, types and examples, Part family-concept, method to form and approach to form cell using part families. Types and comparison of cell: manual and automatic cell, assembly cell, Steps of cell design and cell layout.

7- Hours

Unit-IV

Tooling and fixturing in FMS: Tool holders for CNC machines, modular tooling, tool monitoring; preset, offset and wear compensation values, robotized tool assembly, tool database, tool management system, tool flow control in FMS. Fixturing in FMS: palletizing of parts, pallet pool, and flexible fixturing –principles and methodologies, standard fixtures, modular fixturing system –T-slot based and dowel pin based and their components; Computer aided fixture design –approaches, use of GT in fixture design –fixture design process, fixturing structure and fixturing information tree,

fixture database.

8- Hours

Unit-V

Designing FMS: Simulation–Need, techniques, inputs, procedure, performance Analysis. Flexible Assembly Systems: Basic concepts, classification, planning and scheduling in FAS, loading and scheduling in F.A. cells. Reconfigurable Manufacturing Systems: Definition, goals, elements, rationale, characteristics, principles, RMS and FMS.

Applications of FMS and Factory of The Future: FMS application in machining, sheet metal fabrication, prismatic component production –aerospace application – FMS development towards factories of the future – artificial intelligence and expert systems in FMS – design philosophy and characteristics for future.

Case studies: Typical FMS problems from research papers.

8- Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Describe the principles of flexible manufacturing system, control structures of FMS.
CO2	:	Discuss the concepts of production scheduling and DBMS integrated to FMS.
CO3	:	Discuss importance Group Technology (GT) & Cellular Layout in industries.
CO4	:	Apply the knowledge of tooling and fixturing in FMS
CO5	:	Explore the designing concepts and flexible assembly concepts used in FMS.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3														3	
CO2	3														3	
CO3	3	2	2												3	
CO4	3	2													3	
CO5	3	2													3	

Text Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	William W. Luggen	Flexible Manufacturing Cells and Systems, Pearson College Div, 1991, ISBN-13: 978-0133217384
2.	Mikell P. Groover	Automation, Production Systems and Computer-Integrated Manufacturing, PHI Learning (pearsons), 3rd Edition, 2013, ISBN-13: 978-1292025926
3	Jha, N.K.	Handbook of flexible manufacturing system, Academic Press Inc., 1991, ISBN-13: 978-0123853103

Reference Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	J. Talavage, R. Hannam, Joseph Talavage	Flexible Manufacturing Systems in Practice: Design: Analysis and Simulation, CRC Press, 1st Edition, 1987, ISBN-13: 978-0824777180.
2.	Shivanand	Flexible Manufacturing System, New Age International, Pvt. Ltd., 1st Edition, 2006, ISBN-13: 978-9386070227.
3.	Viswanadham, N., Narahari. Y	Performance Modeling of Automated Manufacturing Systems, PHI (Pearsons) Learning, 2015, ISBN: 978-81-203-0870-1.
4.	Radhakrishnan P. and Subramanyan S	CAD/CAM/CIM, New Age International Ltd., 3rd Edition, 2008, ISBN: 978-81-224-2711-0
5.	Burbridge J L	G.T. in the Engineering Industry, Wiley- Blackwel Publication, 1980, ISBN-10: 0852984022

Productivity Engineering & Management (8RIME43)

Contact Hours/ Week	:	3 (L)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I
Definitions and basic concepts of productivity, the importance and role of productivity cycle, Productivity management, Elements of productivity management. Phases of productivity management, The Productivity cycle, Mendel's cycle-of-management process, Productivity index.
8- Hours
Unit-II
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.
7- Hours
Unit-III
Productivity evaluation, Productivity evaluation in companies & organizations, Total productivity change, and evaluation of total productivity between successive time periods & within a given time period.
7- Hours
Unit-IV
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.

7- Hours

Unit-V

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

10- Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Apply the concepts of productivity in an organization
CO2	:	Measure productivity in an organization
CO3	:	Evaluate productivity of organization
CO4	:	Apply basic IE knowledge about productivity and plan for short term and long-term methods of productivity for organization
CO5	:	Apply Productivity Improvement in an organization

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3															3
CO2	3															3
CO3	3															3
CO4	3															3
CO5	3															3

Text Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Joseph Prokopenko	Productivity Management: A Practical Hand Book, Intl Labour Organisation, ISBN-13: 978-9221059011
2.	David .J Sumanth	Productivity Engineering and Management, McGraw- Hill Higher Education, 1984, ISBN-13: 978-0070624269

Reference Book:

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Prem Vat, G.D. Sardana, B.S. Sahay	Productivity Management: A Systems Approach, Narosa Publishing House, 1998, ISBN-13: 978-8173191473

Human Factors in Engineering (8RIME44)

Contact Hours/ Week	:	3 (L)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Introduction: Introduction to Human Factors Engineering, the scope of human factors, the study of human factors as a science, Historical evolution of ergonomics, ergonomics and human factors engineering, Goals of human factors engineering. Introduction to research methods, an overview of research methods, experimental research methods Experimental design.

8- Hours

Unit-II

Visual Sensory Systems: The stimulus; light the receptor system; the eye ball and optic nerve, visual receptive system, contrast sensitivity, reading, colour sensation, night vision, Bottom-up vs top-down processing, depth perception, Visual search, detection, discrimination

6- Hours

Unit-III

Cognition: Information processing models, selective attention, Reception, Human Factor Guidelines in perception, Working Memory, Human factors Implications of working memory Limits, Long term memory, Organisation of information in ling term memory, episodic memory, Situation Awareness (SA), problem solving and troubleshooting, Metacognition and effort, Attention and Time sharing, mental effort and resource demand, task management and interruptions, addressing time sharing overload.

Decision Making: Decision making models; normative and descriptive decision-making models, Heuristics and biasness, Dependency of decision making on the decision context. Factors affecting decision making performance, improving human decision making. Displays & Controls: classifications of displays, thirteen principles of display design, alternates.

10- Hours

Unit-IV

Engineering Anthropometry and Work place Design: Human Variability and Statistics, anthropometric data, Structural and Functional data, Use of anthropometric data in design, General; Principles for workplace design; clearance requirement of the largest users, reach requirements of the smallest users, special requirements of maintenance people, adjustability requirements, visibility and normal line of slight, component arrangement, Design of standing and seated work areas, work surface; height, depth & inclination. Work posture risk assessment using OWAS.

8- Hours

Unit-V
Work Physiology: Muscle structure and metabolism, Circulatory and respiratory system, the respiratory system, Lung capacity, Lung capacity measurement using Spirometry. Measurement of workloads. Physical work capacity and whole-body fatigue, causes and Control of whole-body fatigue. Bio Energies. Stress and workloads. RSPM assessment.
7- Hours

Course Outcomes:
Upon completion of this course the student will be able to:

CO1	:	Apply the basic knowledge of effect of factors like visual, auditory and cognitive on performance to design suitable work systems.
CO2	:	Analyse the factors affecting decision making and improve the same.
CO3	:	Analyse and calculate the level of risk in a job causing stress, fatigue and musculoskeletal disorders among the employees of an organisation and will design a suitable system to reduce the same.
CO4	:	Assess level of occupational environmental factors like heat stress, noise, vibration and RSPM in a company.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3															3
CO2	3	3														3
CO3	3	3	2													3
CO4	3															3
CO5	3															3

Text Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Mark S. Sanders and Ernest J McCormick	Human Factors in Engineering and Design, McGraw-Hill and Co., Singapore, 7th Edition, 1992, ISBN 0-07-112826-3.
2.	Christopher D. Wickens, John D. Lee, Yili Liu, Sallie Gordon-Becker	Introduction to Human Factors Engineering, Pearson Publication, 2nd Edition, 2003, ISBN: 978-0131837362
3.	John B West	Respiratory Physiology Wolter Kulwer Lippincott Williams & Wilkins, 9th Edition, 2011, ISBN: 9781609136406

Reference Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Oborne David	Ergonomics At Work, John Wiley And Sons, London, 1980

Management Information Systems &E-Commerce (8RIME51)

Contact Hours/ Week	:	3 (L)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Foundation Concepts: Information Systems, Introduction, The Real World of Information Systems, The IS Function, An IS Framework for Business Professionals, The Fundamental Roles of IS in Business, Trends in Information Systems, The Role of e-Business in Business, Types of Information Systems, Managerial Challenges of Information Technology, Developing IS Solutions Challenges of Ethics and IT.

System Concepts: A Foundation, Components or an Information System, System Activities, Storage of Data Resources, Control of System Performance, Output of Information Products, Fundamentals of Strategic Competitive Forces and Strategies, The Competitive Advantage of Information Technology.

8- Hours

Unit-II

Computer Systems: End User and Enterprise Computing, Types of Computer Systems, Computer Peripherals, Input, Output, and Storage Technologies. Computer Software: Introduction to Software, Types of Software, Data Resource Management, Managing Data Resources, Data Resource Management, Types of Databases, Telecommunications and Networks: Internet Applications, Business Use of the Internet, The Role of Intranets and Extranets, Telecommunication Networks, Telecommunication Alternatives, A Telecommunication Network Model, Types of Telecommunication Networks, Telecommunications Media, Tele communications processors, Internet work Processors, Telecommunications Software, Network Management.

8- Hours

Unit-III

Electronic Business Systems: Introduction, Cross-Functional Enterprise Applications, Enterprise Application Architecture, Enterprise Application Integration, Transaction Processing Systems, The Transaction Processing Cycle, Enterprise Collaboration Systems, Tools for Enterprise Collaboration, Functional Business Systems : Introduction, IT in Business, Sales Force Automation, Manufacturing Systems, Computer-Integrated Manufacturing, Human Resource Systems, HRM and the Internet, Customer Relationship Management, Enterprise Resource Planning, Electronic Data Interchange, Electronic Commerce, Fundamentals Introduction to e-Commerce, The Scope of e-Commerce, Essential e-Commerce Processes, Electronic Funds Transfer.

8- Hours

Unit-IV

Developing Business IT Strategies: Planning Fundamentals, Planning for Competitive

Advantage, SWOT Analysis, Business Models and Planning, Business/IT Planning, Implementation Challenges. Developing Business, IT Solutions, Feasibility Studies, IS Development, The Systems Approach, System thinking, The Systems Development Cycle, The Prototyping Process, Developing Business Systems, Implementing Business Systems, Management Challenges: Security and Ethical Challenges : Security, Ethical, and Societal, Challenges of IT, IT Security, Ethics, and Society, Ethical Responsibility of Business Professionals, Cyber Crime, Health Issues, Other Challenges, Internetworked Security Defenses

8- Hours

Unit-V

Emerging areas in Decision Support Systems: Management Information Systems, Online Analytical Processing, Optimization Analysis, What-lf Analysis, Sensitivity Analysis, Goal-Seeking Analysis, Using Decision Support Systems, Executive Information Systems.

Artificial Intelligence, Business, AI & Expert Systems, Components of an Expert System, Expert System Applications, Benefits of Expert Systems, Limitations of Expert Systems, Developing Expert Systems, Neural Networks, Fuzzy Logic Systems, Intelligent Agents, Genetic Algorithms, Virtual Reality, VR Applications, Fuzzy Logic in Business.

7- Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Explain the systems concepts of MIS.
CO2	:	Describe the role of Information system in business and explain information systems and components.
CO3	:	Explain the different types of IT infrastructure needed for MIS.
CO4	:	Explain Cross Functional enterprise application, application Architecture, application integration and enterprise collaboration.
CO5	:	Develop IT strategies and discuss the ethical and security issues in IT.
CO6	:	Apply the emerging decision support systems to business.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3													3		
CO2	3													3		
CO3	3													3		
CO4	3	2		2										3		
CO5	3	2												3		
CO6	3			3										3		

Text Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	James. A O'Brien -	Management Information systems- managing information technology in the internet worked enterprise by Tata McGraw Hill publishing company limited, 6th Edition, 2006, ISBN-13: 978-0072823110

Reference Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Laaudon & Laudon	Management Information Systems- Pearson, 17th Edition, 2021, ISBN-13:978-0137442263
2.	S. Sadogopan	Management Information systems- Prentice Hall India, 2nd Edition, 2014, ISBN 81-203-1180-9

Reliability Engineering (8RIME52)

Contact Hours/ Week	:	3 (L)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Introduction - Concepts, terms, and definitions of reliability and related performance measure, Terminology in reliability, Failure rate, MTBF, Life test, importance of reliability, definition, meaning of adequate performance, reliability-engineering Programme and its scope, Typical applications., Reliability Management: Reliability goals & policies, economics of reliability, reliability data Collection , Component Life - Failure distribution function, reliability function and hazard rate function, interrelationships, MTTF, MTBF, bath tub curve (Mortality curve), conditional reliability function, constant and time dependent failure models.

8- Hours

Unit-II

Practical Failure Patterns - Failure behavior of mechanical, electrical, electronic parts, common failure distribution, Combinatorial Reliability (Reliability of Systems) - Reliability analysis of systems: (Success-Failure models only) Analysis of Series, parallel, series parallel and parallel series configurations. R out of n configurations, redundancy improvement factor and standby systems

9- Hours

Unit-III

Techniques for Complex Systems Reliability Evaluation: Inspection methods, event space methods, path tracing methods, decomposition methods, cut set methods, tie set methods. Design For Reliability - System effectiveness measures and life cycle cost analysis, reliability allocation,

methods for reliability in design, failure analysis, systems safety and fault tree analysis, multistate model. Failure mode effect and criticality analysis.

8- Hours

Unit-IV

Markov Models For System Reliability - Reliability analysis of state dependent systems, Markov analysis, stand by system analysis, Load sharing systems, Maintainability and Availability: Analysis of Down time, Repair Time distributions, maintainability, Maintenance increment, Design for maintainability. Availability analysis, Different forms of availability, system availability analysis, mission availability, Availability of stand-by system.

7- Hours

Unit-V

Analysis Failure Data - Types of life testing, data collection, Empirical methods, Estimation of Static life, types of life testing: Development of confidence intervals, acceptance test procedures for life estimation using exponential, Weibull and Gamma distribution models. Sequential life tests and acceptance criteria. Application and case studies: Case example involving redundancy, burning tests, preventive maintenance analysis. Repairable system analysis, Software reliability.

7- Hours

Course Outcomes:
Upon completion of this course the student will be able to:

CO1	:	Explain and evaluate reliability performance measure
CO2	:	Perform reliability analysis of system
CO3	:	Apply reliability techniques for complex systems
CO4	:	Analyze and develop Markov model for system reliability
CO5	:	Perform acceptance test procedures for life estimation using Exponential, Weibull and Gamma distribution models

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3												3			
CO2	3	2											3			
CO3	3	2											3			
CO4	3	2											3			
CO5	3	2											3			

Text Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Charles E Ebeling	An Introduction to Reliability and Maintainability Engineering, Tata McGraw Hill, 2005, ISBN-13: 978-1577663867.
2.	Balagurusamy E	Reliability Engineering, McGraw Hill, 1st Edition, 2010, ISBN-13: 978-0070483392

Reference Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Srinath. L. S	Reliability Engineering, East West Press Pvt, 4th Edition, 2005, ISBN-13: 978-8176710480.
2.	K. K. Aggarwal	Reliability Engineering, Springer Nature (Sie), 2014, ISBN-13: 978-8181285577.
3.	Patrick P. O'Connor, Andre Kleyner	Practical Reliability Engineering, Wiley India Pvt Ltd, 5th Edition, 2012, ISBN-13: 978-0470979815
4.	Nicholas Summerville	Basic Reliability: An Introduction to Reliability Engineering, Author house Publishing, 1st Edition, 2004, ISBN-13: 978-1418424183.
5.	E. Lewis, Elmer E. Lewis, Andrew Lewis	Introduction to Reliability Engineering, John Wiley & Sons, 2nd Edition, 1995, ISBN-13: 978-0471018339.

Maintenance and Safety Engineering (8RIME53)

Contact Hours/ Week	:	3 (L)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Introduction to Maintenance System – Definition, scope, objective, functions and importance of maintenance system, type of maintenance system. Break down maintenance, preventive maintenance, predictive maintenance, planned maintenance, total productive maintenance, corrective maintenance, condition monitoring. Problems on selection of methods like preventive or breakdown maintenance. MTBF, MTTR, MWT.

Economics in Maintenance: Repair, replacement, repair complexity, finding out most optimal preventive maintenance frequency. Numerical treatment.

8- Hours

Unit-II

Maintenance of Machinery – Causes of machine failure, performance evaluation, complete overhauling of machines tools. Maintenance planning and scheduling, repair order control manpower requirement. Maintenance job analysis, spare parts control. Maintenance planning – planning of maintenance junctures, manpower allocation, long range planning, short range planning techniques and procedures. Estimation of maintenance work. Maintenance control

8- Hours

Unit-III

Computers in Maintenance: Features of computerized maintenance system, benefits of computerization, office automation.

Maintenance Information System: Classification of information system, operations information systems, management information systems, executive information systems. Features of good computerized work order system, applications of computers in maintenance work.

8- Hours

Unit-IV

Industrial Safety – Economic importance of accidents, types of safety organizations, analysis of accident record, accident investigations, analysis of accident safety standards for mechanical equipment. Electrical equipment and systems. Chemical hazards, material handling, exhaust system, welding. Plant housekeeping-building, aisles, passages, floors, tool cribs, washrooms, canteens. Fire handling equipments.

8- Hours

Unit-V

Occupational Safety: Concept of OSH, significance of OSH, assessment of OSH. Industrial pollution, dust control–mechanical dust collectors, wet type dust collector, electrostatic precipitator. Noise pollution control, noise measurement and noise control techniques. Safety standards: ISO 45000 series, objectives, features of ISO 45000 series.

7- Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Describe the different types of maintenance systems and their relevance
CO2	:	Describe maintenance planning and scheduling and the tools and procedures used in process; analyze the reasons for the machine failure
CO3	:	Illustrate the role of computers in maintenance and describe maintenance information systems
CO4	:	Debate the need for industrial safety system and categorize the various industry hazards and demonstrate how to prevent
CO5	:	Discuss the role of occupation safety standards and their recommendations for noise and pollution control

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3													3		
CO2	3													3		
CO3	3													3		
CO4	3													3		
CO5	3													3		

Text Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	R.C. Mishra and K.Pathak	Maintenance Engineering and Management, Prentice Hall of India Pvt, Ltd., 2004, ISBN-13: 978-8120317468
2.	K. Venkataraman	Maintenance Engineering and Management, Prentice Hall of India Pvt, Ltd., 1st Edition, 2007, ISBN-13: 978-8120331303

Reference Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Ramesh Gulati	Maintenance and Safety Engineering, Industrial Press Inc.,U.S., 3rd Edition, 2020, ISBN-13: 978-0831136475
2.	H. P. Garg	Industrial Maintenance, S. Chand & Company Ltd., New Delhi, 3rd Edition, 2003- ISBN – 8121901685

Industrial Hydraulics and Pneumatics (8RIME54)

Contact Hours/ Week	:	3 (L)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Introduction to Hydraulic Power and Pumps: Introduction to Hydraulic Power: Definition of hydraulic system, advantages, limitations, applications, Pascal's law, structure of hydraulic control system, problems on Pascal's law. The source of Hydraulic Power: Pumps Classification of pumps, pumping theory of positive displacement pumps, construction and working of Gear pumps, Vane pumps, Piston pumps, fixed and variable displacement pumps, Pump performance characteristics, pump Selection factors, problems on pumps

8- Hours

Unit-II

Hydraulic Actuators and Motors: Classification cylinder and hydraulic motors, Linear Hydraulic Actuators [cylinders], single and double acting cylinder, Mechanics of Hydraulic Cylinder Loading, mounting arrangements, cushioning, special types of cylinders, problems on cylinders, construction and working of rotary actuators such as gear, vane, piston motors, Hydraulic Motor Theoretical Torque, Power and Flow Rate, Hydraulic Motor Performance, problems, symbolic representation of hydraulic actuators (cylinders and motors).

8- Hours

Unit-III

Control Components in Hydraulic Systems: Classification of control valves, Directional Control Valves- Symbolic representation, constructional features of poppet, sliding spool, rotary type valves solenoid and pilot operated DCV, shuttle valve, check valves, Pressure control valves - types, direct operated types and pilot operated types. Flow Control Valves -compensated and non-compensated

FCV, needle valve, temperature compensated, pressure compensated, pressure and temperature compensated FCV, symbolic representation

8- Hours

Unit-IV

Hydraulic Circuit Design and Analysis: Control of Single and Double -Acting Hydraulic Cylinder, Regenerative circuit, Pump Unloading Circuit, Double Pump Hydraulic System, Counter balance Valve Application, Hydraulic Cylinder Sequencing Circuits, Automatic cylinder reciprocating system, Locked Cylinder using Pilot check Valve, Cylinder synchronizing circuit using different methods, factors affecting synchronization, Hydraulic circuit for force multiplication, Speed Control of Hydraulic Cylinder, Speed Control of Hydraulic Motors, Safety circuit, Accumulators, types, construction and applications with circuits.

8- Hours

Unit-V

Introduction to Pneumatic control, Actuators and control valves: Pneumatic Control Valves: DCV such as poppet, spool, suspended seat type slide valve, pressure control valves, flow control valves, types and construction, use of memory valve, Quick exhaust valve, time delay valve, shuttle valve, twin pressure valve, symbols.

Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, speed control of cylinders - supply air throttling and Exhaust air throttling and Exhaust air throttling.

7- Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Explain the Fluid power and operation of different types of pumps.
CO2	:	Explain the features and functions of Hydraulic motors, actuators
CO3	:	Explains and design the flow Control Components and valve in Hydraulic Systems
CO4	:	Design the simple Hydraulic circuits and systems for industrial application
CO5	:	Explain working and identify of different pneumatic circuits and systems

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3														3	
CO2	3														3	
CO3	3														3	
CO4	3	3	2												3	
CO5	3	2	2												3	

Text Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Anthony Esposito	Fluid Power with Applications, 7th Edition, Pearson Education 2008. ISBN: 978-0135136904
2.	Majumdar S.R	Oil Hydraulics Systems- Principles and Maintenance, Tata McGraw-Hill, 2002.ISBN: 978-0071406697

Reference Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Stephen Michael Elonka, Orville Howard Johnson	Standard Industrial Hydraulics 1967, ISBN-13: 978-0-07-019280-5
2.	Anthony Lal	Oil hydraulics in the service of industry, Allied publishers, 1982.
3.	Dudelyt, A. Pease and John T. Pippenger	Basic Fluid Power, Prentice Hall, 2nd Edition, 1987, ISBN-13: 9780130615084.
4.	Majumdar S.R	Pneumatic systems – Principles and maintenance, Tata McGraw Hill, 1st Edition, 2017, ISBN-13: 978-0074602317
5.	Michael J, Prinches and Ashby J. G	Power Hydraulics, Longman Higher Education, 1988, ISBN-13: 978-0136874430.
6.	Shanmugasundaram.K	Hydraulic and Pneumatic controls, Chand and Co, 2006, ISBN-13: 978-8121926355.

Product Development for Six-Sigma (8RIME61)

Contact Hours/ Week	:	3 (L)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Design for quality: Taguchi's Approach to Quality, On-line and Off-line Quality Control, Quality Loss Function, System Design, Parameter Design, Design for Environment, Human factor design, Design for casting and forging, Causes of Variation.

7- Hours

Unit-II

Quality Function Deployment: Introduction, QFD team, benefits, voice of customer, organization of information, house of quality, QFD process Design of Experiments: Basic methods- Two factorial experiments-Extended method reduced tests and fractional experiments, orthogonality, base design method, higher dimensional fractional factorial design

8- Hours

Unit-III

Failure Mode Effect Analysis: Refining geometry and layout, Failure tree analysis, Defects and failure modes, Techniques of failure analysis, Field inspection of failure, Macroscopic and

Microscopic examination, Additional tests, Analysis of data and report of failure
8- Hours
Unit-IV
Statistical Consideration in Product Design and Development: Frequency distributions and Histograms- Run charts –stem and leaf plots- Pareto Diagrams-Cause and Effect Diagrams-Box plots- Probability distribution- Statistical Process control–Scatter diagrams – Multivariable charts.
8- Hours
Unit-V
Six Sigma: Overview, Basics and history of the approach for six sigma, Methodology and focus, the application of Six Sigma in production and in service industries, Relationship of Six Sigma and Lean Management, linking Six Sigma project goals with organizational strategy.
8- Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Identify the importance of various principles of quality in product or service
CO2	:	Use statistical tools in product development
CO3	:	Apply basic risk analysis and experiment design techniques into practical cases
CO4	:	Demonstrate knowledge about Six sigma, Design of Experiments

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3												3			
CO2	3												3			
CO3	3	2											3			
CO4	3												3			

Text Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Kevin Otto & Kristin Wood	Total Quality Management, Product Design Techniques in Reverse Engineering and New Product Development, Pearson Education (LPE), 2001. ISBN10:0130212717.
2.	Karl T. Ulrich, Steven D. Eppinger	Product Design and Development, TATA McGraw-Hill 3rd Edition, 2003. ISBN: 13:978-0073404776.
3.	James R. Evens, William M Lindsay	The Management and control of Quality, 6th Edition- South-western Publishers ISBN: 0314062157
4.	George E Dieter	Engineering Design, McGraw Hill International Edition, 3rd Edition, 2015, ISBN-13:978-1259064852

Business Process Re-Engineering (8RIME62)

Contact Hours/ Week	:	3 (L)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Introduction - Concepts, terms, and definitions of reliability and related performance measure, Terminology in reliability, Failure rate, MTBF, Life test, importance of reliability, definition, meaning of adequate performance, reliability-engineering Programme and its scope, Typical applications., Reliability Management: Reliability goals & policies, economics of reliability, reliability data Collection , Component Life - Failure distribution function, reliability function and hazard rate function, interrelationships, MTTF, MTBF, bath tub curve (Mortality curve), conditional reliability function, constant and time dependent failure models.

8- Hours

Unit-II

Practical Failure Patterns - Failure behavior of mechanical, electrical, electronic parts, common failure distribution, Combinatorial Reliability (Reliability of Systems) - Reliability analysis of systems: (Success-Failure models only) Analysis of Series, parallel, series parallel and parallel series configurations. R out of n configurations, redundancy improvement factor and standby systems

8- Hours

Unit-III

Techniques for Complex Systems Reliability Evaluation: Inspection methods, event space methods, path tracing methods, decomposition methods, cut set methods, tie set methods. Design For Reliability - System effectiveness measures and life cycle cost analysis, reliability allocation, methods for reliability in design, failure analysis, systems safety and fault tree analysis, multistate model. Failure mode effect and criticality analysis.

8- Hours

Unit-IV

Markov Models For System Reliability - Reliability analysis of state dependent systems, Markov analysis, stand by system analysis, Load sharing systems, Maintainability and Availability: Analysis of Down time, Repair Time distributions, maintainability, Maintenance increment, Design for maintainability. Availability analysis, Different forms of availability, system availability analysis, mission availability, Availability of stand-by system.

8- Hours

Unit-V

Analysis Failure Data - Types of life testing, data collection, Empirical methods, Estimation of Static life, types of life testing: Development of confidence intervals, acceptance test procedures for life estimation using exponential, Weibull and Gamma distribution models. Sequential life tests and

acceptance criteria. Application and case studies: Case example involving redundancy, burning tests, preventive maintenance analysis. Repairable system analysis, Software reliability.
7- Hours

Course Outcomes:
Upon completion of this course the student will be able to:

CO1	:	Describe the business process Re- engineering concepts, principles and also its significance.
CO2	:	Discuss the various BPR methodologies used in Business processes.
CO3	:	Analyze the factors influencing successful implementation of BPR.
CO4	:	Compare and contrast BPR with the other process improvement techniques like TQM and Kaizen.
CO5	:	Explain the enablers of BPR and role of IT in BPR applied to both manufacturing and service industries.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3													3		
CO2	3			2										3		
CO3	3	2												3		
CO4	3	3												3		
CO5	3				2									3		

Text Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	R Radhakrishnan & S. Balasubramanian,	Business Process Reengineering: Text and cases, Easter Economy Edition, PHI Learning, 1st Edition, 2008, ISBN: 8120335678.
2.	Michael Hammer, James Champy	Reengineering the corporation: a manifesto for business revolution, Nicholas Brealey Publishing, 3rd Edition, 2001, ISBN: 1857880978.
3.	B.R.Dev	Business Process Reengineering & Change management, Dreamtech Press, 1st Edition, 2004, ISBN: 8177225367.

Reference Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	G. Hansen	Automating Business Process Re-Engineering, Prentice-Hall, 2nd Edition, 1997.
2.	G. Darnton and M. Darnton	Business Process Analysis, Thomson Learning, Boston, MA, 1997. ISBN: 1861520395.

Design of Experiments (8RIME63)

Contact Hours/ Week	:	3 (L)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Introduction: Modern quality control. Quality in engineering design. History of quality engineering: Japan versus U.S. track records. Overview of contents. Taguchi Approach to Quality: Definition of quality. Loss function. Off-line and on-line quality control. Taguchi's quality philosophy. Basic Designs – Completely Randomized Design, Randomized Block Design, Latin Square Designs.

8- Hours

Unit-II

Factorial Experimentation: Two Levels - Full Factorial Designs: Experimentation as a learning process. Traditional scientific experiments. Three-factor design, Replicating experiments, Factor interactions. Normal plots of estimated effects, Mechanical plating experiment. Two-factor design. Four-factor design. Fractional Factorial Designs: Blocking two-level designs. Other useful two-level designs.

8- Hours

Unit-III

Constructing Orthogonal Arrays: Counting degrees or freedom, selecting a standard orthogonal array, dummy level technique, and compound factor method. Linear graphs and interaction assignment, modification of linear graphs, column merging method, branching design. Strategy for constructing an orthogonal array. Comparison with the classical statistical experiment design.

8- Hours

Unit-IV

Steps In Robust Design: case study discussion. Noise factors and testing conditions. Quality characteristics and objective functions. Control factors and their levels. Matrix experiment and data analysis plan. Conducting the matrix experiment, data analysis, verification experiment and future plan.

8- Hours

Unit-V

Signal-To-Noise Ratio - Evaluation of sensitivity to noise. S/N ratios for static problems, SIN ratios for dynamic problems. Analysis of ordered categorical data. Minimizing variability and optimizing averages. Taguchi Inner and Outer Arrays -noise factors, experimental designs for control and noise factors. Illustrative example. Experimental designs for factors at three and four levels.

7- Hours

Course Outcomes: Upon completion of this course the student will be able to:		
CO1	:	Apply the Taguchi approach in quality engineering problems
CO2	:	Apply the principles of randomization, replication, and blocking to successfully analyze problems and as well perform the analysis of variance (ANOVA) in factorial experiments
CO3	:	Construct and analyze orthogonal arrays in their fields of study and work
CO4	:	Apply the robust design principles in characterization of new process and product
CO5	:	Determine the S/N ratio and interpret the results in optimization of the process

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2											3			
CO2	3	2											3			
CO3	3	2											3			
CO4	3	2											3			
CO5	3	2											3			

Text Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Madhav S. Phadke	Quality Engineering Using Robust Design, 1st Edition, Udveli Books, 2021, ISBN-13: 978-8195657247
2.	Douglas C. Montgomery	Design and Analysis of Experiments, Wiley India Pvt Ltd., 7th Edition, 2010, ISBN-13: 978-8126528370

Reference Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Chapman, Robert H. Lochner	Designing For Quality: An Introduction to The Best of Taguchi And Western Methods of Statistical Experimental Design, Springer, 1990, ISBN-13: 978-0412400209.
2.	Philip J. Ross	Taguchi Techniques for Quality Engineering: Loss Function, Orthogonal Experiments, Parameter and Tolerance Design, McGraw-hill Professional, 1st Edition, 1988, ISBN-13: 978-0070538665.

Product Design and Manufacturing (8RIME64)

Contact Hours/ Week	:	3 (L)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Introduction: Characteristics of Successful Product Development, Design and Development of Products, Duration and Cost of Product Development, Challenges of Product Development

Development Process and Organization: A Generic Development Process, Concept Development: The Front-End Process, Adopting the Generic Product Development Process, AMF Development Process, Product Development Organizations, AMF Organization.

8- Hours

Unit-II

Product Planning: The Product Planning Process, Identify Opportunities, Evaluate and Prioritize Projects, Allocate Resources and Plan Timing, Complete Pre Project-Planning, Reflect all The Results and The Process.

Identifying Customer Needs: Gather Raw Data from Customers, Interpret Raw Data in Terms of Customer Needs, Organize the Needs into a Hierarchy, Establish the Relative Importance of Needs and Reflect on the Results and Process.

Product Specification: Specifications, Establishing the Specifications, Establishing Target Specifications, Setting the Final Specifications. Case study on QFD.

8- Hours

Unit-III

Concept Generation: The Activity of Concept Generation: Clarify the Problem, Search Externally, Search Internally, Explore Systematically and Reflect on the Results and Process.

Concept Selection: Overview of Methodology, Concept Screening and Concept Scoring

Concept Testing: Define the Purpose of Concept Test, choose a Survey Population, choose a Survey Format, Communicate the Concept, Measure Customer Response, Interpret the Result, Reflect on the Results and the Process. Case study on FMEA.

8- Hours

Unit-IV

Product Architecture: Product Architecture, Implications of the Architecture, Establishing the Architecture, Variety and Supply Chain Considerations, Platform Planning, Related System Level Design Issues.

Industrial Design: Assessing the Need for Industrial Design, The Impact of Industrial Design, Industrial Design Process, Managing the Industrial Design Process, Assesses the Quality of Industrial Design

7- Hours

Unit-V
Design for Environment: Life cycles, Environmental impact: Herman Miller's journey toward Design for Environment, Design for Environment process **Design for Manufacture:** Definition, Estimation of Manufacturing Cost, Reducing the Cost of Components, Assembly, Supporting Production, Impact of DFM decisions on Other Factors. **Prototyping:** Prototyping Basics, Principles of Prototyping, Technologies, Planning for Prototypes. **Robust Design:** DOE, Robust design process.
8- Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Explain the concepts and various phases of product development.
CO2	:	Identify the customer needs and articulate the product specifications.
CO3	:	Demonstrate creative thinking skills for idea generation, translate conceptual ideas into clear sketches and choose the best concept among the various alternatives available for developing a product.
CO4	:	Generate the product architecture and explain the need of industrial design in product development.
CO5	:	Design product for manufacturing feasibility with respect to assembly, production, quality, safety and explain the concepts of prototyping.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1													3
CO2	3															3
CO3	3	2	2	2					2							3
CO4	3		2	2												3
CO5	3		1												2	3

Text Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Karl.T.Ulrich, Steven D Eppinger	Product Design and Development, McGraw Hill Education, 9th Edition, 2016
2.	Douglas C. Montgomery	Design and Analysis of Experiments, Wiley India Pvt Ltd., 7th Edition, 2010, ISBN: 8126528370.

Reference Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	A C Chitale and R C Gupta	Product Design and Manufacturing - PH1, - 3rd Edition, 2003.
2.	Geoffery Boothroyd	Product Design for Manufacture and Assembly, Peter Dewhurst and Winston Knight – 2002.