Teaching Scheme and Syllabus

For

Bachelor of Technology

In Mechanical Engineering

Minors in Mechanical Engineering

Department of Mechanical Engineering

Sardar Vallabhbhai National Institute of Technology

Minor in Mechanical Engineering

Sr. No.	Semester	Subject	Code	Schema	Credit	Notional hours of Learning (Approx.)
1.	IV	Theory of Machine and Machine Design	MEM21	3-1-0	4	70
2.	V	Thermal & Fluid Engineering	MEM32	3-1-0	4	70
3.	VI	Manufacturing Processes	MEM33	3-1-0	4	70
4.	VII	Industrial Engineering and Management	MEM44	3-1-0	4	70

B.Tech. II (DoME) Semester – 4 THEORY OF MACHINE AND MACHINE DESIGN (MINORS) MEM21	Scheme	L	T	P	Credit
		4	0	0	04

1. Course Outcomes (COs): At the end of the course, students will be able to	
CO1	Understanding of various concepts related to machines and mechanisms.
CO2	Analyse the kinematic requirements of various mechanism.
CO3	Evaluate gears and gear trains for specific applications.
CO4	Design the various types of joints and fasteners.
CO5	Design the shafts and its components.
CO6	Design procedures to gears and bearings.

2.	Syllabus	
	INTRODUCTION	**(15 Hours)**
	Introduction to Machines and Mechanisms: Introduction, Mechanism and machine, Rigid and Resistant body, Link, Kinematic pair, Types of motion, Degrees of Freedom (Mobility), Classification of Kinematic pairs, Kinematic Chain, Linkage, Kinematic Inversion, Inversions of Slider-Crank Chain, Double Slider-Crank Chain. Cams: Introduction, Types of Cams, Types of Followers, Cam Terminology, Displacement Diagrams, Motions of the Follower, Drawing of Cam Profile	
	GEARS AND FRICTION	**(15 Hours)**
	Gears: Different Types of Motion Transmitting Elements, Advantages and Disadvantages, Types of Gears and Gear trains, Gear Terminology and classification. Friction: Introduction to Friction, Significance of Friction, its Merits and Demerits, Application of Friction to Screw Jack, Brakes and Clutches etc.	
	DESIGN JOINTS AND DESIGN POWER TRANSMISSION ELEMENTS	**(30 Hours)**

	Introduction: Types of Load, Design Process, Material Selection, Factor of Safety, Failure and Their Causes, Introduction to Corrosion (Design Aspect). Design of Joints: Introduction, Different types of Joints and Their Applications, Design of Bolts and Rivets joints, Design of Screw Joint, Design of Welded Joints (Efficiency & Strength). Design of Power Transmission Elements: Introduction, Stresses Induced in the Shaft Under Different Conditions, Selection of Keys, Power Transmitting Capacity of Flat & V Belt, Selection of Bearings, Power Rating of Spur and Helical Gears.
	(Total Contact Time: = 60 Hours)

3.	**Books Recommended**
1	A. Ghosh and A. K. Mallik, Theory of Mechanisms and Machines, Affiliated East-West Press, 2008.
2	S. Singh, Theory of Machines, 2nd Edition, Pearson Education India, 2013.
3	S. S. Rattan, Theory of Machines, Tata McGraw Hill Education Private Limited, 2007.
4	R. G. Budynas and K. Nisbett, Shigley's Mechanical Engineering Design, 11th Edition, McGraw Hill, 2020.
5	V. B. Bhandari, Design of Machine Elements, 4th Edition, Tata McGraw Hill, 2016.

B.Tech. III (DoME) Semester – 5 THERMAL & FLUID ENGINEERING (MINORS) MEM32	Scheme	L	T	P	Credit
		3	1	0	04

1. Course Outcomes (COs): At the end of the course, students will be able to	
CO1	Relate the thermodynamic laws to engineering systems and processes.
CO2	Apply the second law of thermodynamics.
CO3	Apply concepts of fluid mechanics.
CO4	Apply appropriate mode of heat transfer while analyzing engineering problems.
CO5	Compare the different types of power cycles.
CO6	Evaluate the different types of refrigeration systems.

2.	Syllabus	
	INTRODUCTION TO THERMODYNAMICS	**(10 Hours)**
	Classical & statistical thermodynamics, Thermodynamic: system, properties, states, processes, cycle & equilibrium, Zeroth law of thermodynamics, Concept of Work & Heat, Pure Substance, Phase Diagrams, Mollier diagram, Ideal Gas Equation, Concept of Enthalpy, First law of thermodynamics for cycle & process, Statements of second law of thermodynamics, Carnot cycle and Concept of Entropy.	
	FLUID MECHANICS & MACHINES	**(12 Hours)**
	Classification of fluid, Fluid properties, Fluid statics, Fluid kinematics, Fluid dynamics, Boundary layer phenomenon, Hydraulic turbines and pumps	
	HEAT TRANSFER	**(08 Hours)**
	Modes of heat transfer: conduction, convection and radiation; Heat exchanger: basic types of heat exchangers, fouling factors, LMTD, Effectiveness – NTU methods of design	
	POWER CYCLES	**(07 Hours)**
	Air standard cycles: Otto, Diesel and Dual Cycles, Fuel air cycles and Actual Cycles, Ideal	

	Rankine cycle, Improvement in Rankine cycle	
	REFRIGERATION & AIR CONDITIONING	**(8 Hours)**
	Reversed Carnot cycle, Aircraft refrigeration cycle, Simple vapor compression cycle, Analysis of vapor compression cycle, Simple vapor absorption refrigeration cycle, Psychrometric properties, Preparation of psychrometric charts, Psychrometric processes, Summer and winter air conditioning system	
	(Total Contact Time: = 45 Hours)	

3.	**Books Recommended**
1	Y.A. Cengel and M.A. Boles, Thermodynamics, Tata McGraw Hill, 2017
2	White F. M., “Fluids Mechanics”, McGraw-Hill Inc., 7th Ed., New York, 2010
3	Y. A. Cengel, A. J.Ghajar, Heat and Mass Transfer, McGraw Hill, 2017.
4	R. K. Rajput, Thermal Engineering, Laxmi Publications, 2017
5	C. P. Arora, Refrigeration and Air conditioning, Tata McGraw Hill, 2017.

B.Tech. III (DoME) Semester – 6 MANUFACTURING PROCESSES (MINORS) MEM33	Scheme	L	T	P	Credit
		3	1	0	04

1. Course Outcomes (COs): At the end of the course, students will be able to	
CO1	Classify and explain manufacturing processes.
CO2	Describe the working principles of various metal casting processes.
CO3	Explain the principles of material removal, bulk deformation of metals, and sheet metal operations.
CO4	Compare various joining processes and explain their defects & prevention.
CO5	Select relevant the manufacturing processes for a given workpieces to create desired feature.
CO6	Describe need of the heat treatment and surface modification processes.

2.	Syllabus	
	INTRODUCTION	**(08 Hours)**
	Introduction to manufacturing, Fundamental approaches of manufacturing, Classification of manufacturing processes, Specific advantages and limitation, Materials in manufacturing, Selection of manufacturing processes, Application of manufacturing processes, Effect of manufacturing processes on properties of metals. Introduction of computer-integrated manufacturing systems, micro & nano-manufacturing, automation.	
	METAL CASTING	**(09 Hours)**
	Introduction of Metal Casting & Suitability, Steps of casting processes, Pattern allowances, Sand Moulding, Core & Core Prints, Gating System, Cleaning of casting, Casting defects & their prevention, Shell moulding, Investment and permanent mould casting.	
	METAL FORMING	**(08 Hours)**
	Hot and cold working, Deformation processes and sheet metal operations.	

	MATERIAL REMOVAL	**(14 Hours)**
	Introduction to Machining, Mechanism of the metal cutting, Chip Formation, Types of chips; Cutting tool technology: tool geometry, failure and tool life, tool materials; Introduction of different conventional and nonconventional machining processes and equipments.	
	JOINING OF METALS	**(06 Hours)**
	Fundamentals of joining of metals, Joining processes; Weldability and welding defects.	
		(Total Contact Time: = 45 Hours)

3.	**Books Recommended**
1	S. K. Hajra Choudhury, Element of Workshop Technology; Vol. 2, 14th Edition, Media Promoters and publishers Pvt., 2010.
2	S. Kalpakjian and S. R. Illinois, Manufacturing Engineering and Technology; 6th Edition, Pearson Prentice Hall, New Jersey, 2010.
3	M.P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems; 3rd Edition, Wiley India Pvt. Ltd., New Delhi, 2012.
4	P. N. Rao, Manufacturing Technology-I, 4th Edition, Mc Graw Hill Education, 2013.
5	P. N. Rao, Manufacturing Technology-II, 4th Edition, Mc Graw Hill Education, 2013.
6	Ernest Paul DeGarmo, J. Temple Black, Ronald A. Kohser, Materials and Processes in Manufacturing, 8th Edition, Prentice Hall India, 2007.
7	V. K. Jain, Advanced machining processes; Allied publishers, 2009.

B.Tech. IV (DoME) Semester – 7 INDUSTRIAL ENGINEERING AND MANAGEMENT (MINORS) MEM44	Scheme	L	T	P	Credit
		3	1	0	04

1. Course Outcomes (COs): At the end of the course, students will be able to	
CO1	Demonstrate and apply selected industrial engineering techniques for enhancing productivity in an organization.
CO2	Apply the various forecasting and project management techniques.
CO3	Apply the concept of break-even analysis, inventory control and resource utilization using queuing theory.
CO4	Apply principles of work study and ergonomics for design of work systems.
CO5	Formulate mathematical models for optimal solution of industrial problems using linear programming approach.
CO6	Understand functions of a product/service and apply Value engineering and Reliability in real industrial problems.

2.	Syllabus	
	OVERVIEW OF INDUSTRIAL ENGINEERING	**(10 hours)**
	Types of production systems, concept of productivity, productivity measurement in manufacturing and service organizations, operations strategies, liability and process design. Facility location and layout: Factors affecting facility location; principle of plant layout design, types of plant layout; computer aided layout design techniques; assembly line balancing; materials handling principles, types of material handling systems, methods of process planning, steps in process selection, production equipment and tooling selection, group technology, and flexible manufacturing.	
	PRODUCTION PLANNING & CONTROL AND PROJECT MANAGEMENT	**(08 hours)**
	Forecasting techniques–causal and time series models, moving average, exponential smoothing, trend and seasonality; aggregate production planning; master production scheduling; materials requirement planning (MRP) and MRP-II; routing, scheduling and priority dispatching, concept of JIT manufacturing system. Project Management: Project network analysis, CPM, PERT and Project crashing.	
	ENGINEERING ECONOMY AND INVENTORY MANAGEMENT	**(08 hours)**
	Definition and meaning of management, Methods of depreciation; break-even analysis, techniques for evaluation of capital investments, financial statements, time-cost trade-off, resource levelling; Inventory functions, costs, classifications, deterministic inventory models,	

	perpetual and periodic inventory control systems, ABC analysis, and VED analysis. Queuing Theory: Basis of Queuing theory, elements of queuing theory, Operating characteristics of a queuing system, Classification of Queuing models.	
	WORK SYSTEM DESIGN AND PRODUCT DESIGN & DEVELOPMENT	**(07 hours)**
	Work System Design: Taylor's scientific management, Gilbreths's contributions; work study: method study, micro-motion study, principles of motion economy; work measurement–time study, work sampling, standard data, Predetermined motion time system (PMTS); ergonomics; job evaluation, merit rating, incentive schemes, and wage administration. Product Design and Development: Principles of product design, tolerance design; quality and cost considerations; product life cycle; standardization, simplification, diversification, value engineering and analysis, and concurrent engineering.	
	OPERATIONAL ANALYSIS	**(12 hours)**
	Operational Analysis: Formulation of LPP, Graphical solution of LPP, Simplex Method, Sensitivity Analysis, degeneracy and unbound solutions. Transportation and assignment models; Optimality test: the stepping stone method and MODI method, simulation.	
	(Total Contact Time: = 45 Hours)	

3.	**Books Recommended**
1	Martand T Telsang, Industrial Engineering and Production Management, 3rd Edition, S. Chand Publishing, 2018.
2	M. Mahajan, Industrial Engineering and Production Management, Dhanpat Rai & Co. (P) Limited, 2015.
3	Ravi Shankar, Industrial Engineering and Management, 2nd Edition, Galgotia Publications Pvt Ltd., 2000.
4	B.E. Adam and R.J. Ebert, Production and Operations Management, 5th Edition, Prentice-Hall, 1992.
5	A.V. Chitale and R. C. Gupta, Product Design and Manufacturing, 5th Edition, PHI, 2011.
6	J. K. Sharma, Operations Research Theory & Applications, 4th edition, Macmillan India Ltd, 2017.
7	J. L. Riggs, Production Systems Analysis and Control, 4th Edition, John Wiley & Sons, 1987.
8	P. K. Gupta and D. S. Hira, Operations Research, 11th Edition, S. Chand & Co., 2015.
9	A.M. Natarajan, P. Balasubramani, A. Tamilarasi, Operations Research, 2nd Edition, Pearson Education India, 2014.
10	Buffa, Modern Production/operations Management, Wiley Eastern, New York, 1999.
11	Muhlemann Alan, Oakland John and Lockyer Keith, Production and Operations Management, Macmillan India Publications Ltd., 2001.
12	Adam and Ebert, Production and Operation Management, 5th Edition, Pearson Education Asia, 2003.