Scheme & Syllabus of

UNDERGRADUATE DEGREE COURSE

B.Tech. VII & VIII Semester

Mechanical Engineering

Rajasthan Technical University, Kota

Effective from session: 2020 – 2021

Teaching & Examination Scheme
B.Tech.: Mechanical Engineering
4th Year – VII Semester

SN	Category	Course		Contact hrs/week			Marks				Cr
		Code	Title	L	T	P	Exm Hrs	IA	ETE	Total	
THEORY											
1	PEC	7ME5-11	I. C. Engines	3	0	0	3	30	70	**100**	**3**
2		7ME5-12	Operations Research								
3		7ME5-13	Turbomachines								
4	OE		Open Elective-I	3	0	0	3	30	70	**100**	**3**
			Sub Total	**6**	**0**	**0**		**60**	**140**	**200**	**6**
PRACTICAL & SESSIONAL											
5	PCC	7ME4-21	FEA Lab	0	0	3	3	60	40	**100**	**1.5**
6		7ME4-22	Thermal Engineering Lab II	0	0	3	3	60	40	**100**	**1.5**
7		7ME4-23	Quality Control Lab	0	0	2	2	60	40	**100**	**1**
8	PSIT	7ME7-30	Industrial Training *	1	0	0	1	60	40	**100**	**2.5**
9		7ME7-40	Seminar *	2	0	0	2	60	40	**100**	**2**
10	SODECA	7ME8-00	Social Outreach, Discipline & Extra Curricular Activities	0	0	0			100	**100**	**0.5**
			Sub- Total	**3**	**0**	**8**		**300**	**300**	**600**	**9**
			TOTAL OF VII SEMEESTER	**9**	**0**	**8**		**360**	**440**	**800**	**15**

*for the purpose of counting teaching load

L: *Lecture,* ***T:*** *Tutorial,* ***P:*** *Practical,* ***Cr:*** *Credits*

ETE: *End Term Exam,* ***IA:*** *Internal Assessment*

Office of Dean Academic Affairs
Rajasthan Technical University, Kota

Teaching & Examination Scheme
B.Tech.: Mechanical Engineering
4th Year – VIII Semester

SN	Category	Course		Contact hrs/week			Marks				Cr
		Code	Title	L	T	P	Exm Hrs	IA	ETE	Total	
THEORY											
1	PEC	8ME5-11	Hybrid and Electric Vehicles	3	0	0	3	30	70	**100**	**3**
2		8ME5-12	Supply and Operations Management								
3		8ME5-13	Additive Manufacturing								
4	OE		Open Elective - II	3	0	0	3	30	70	**100**	**3**
			Sub Total	**6**	**0**	**0**		**60**	**140**	**200**	**6**
PRACTICAL & SESSIONAL											
5	PCC	8ME4-21	Industrial Engineering Lab	0	0	2	2	60	40	**100**	**1**
6		8ME4-22	Metrology Lab	0	0	2	2	60	40	**100**	**1**
7	PSIT	8ME7-50	Project *#	3	0	0	3	60	40	**100**	**7**
8	SODECA	8ME8-00	Social Outreach, Discipline & Extra Curricular Activities	0	0	0			100	**100**	**0.5**
			Sub- Total	**3**	**0**	**4**		**180**	**220**	**400**	**9.5**
			TOTAL OF VIII SEMEESTER	**9**	**0**	**4**		**240**	**360**	**600**	**15.5**

*for the purpose of counting teaching load

#Evaluation by one internal and one external examiner (External examiner will preferably be from Industry)

L: *Lecture,* ***T:*** *Tutorial,* ***P:*** *Practical,* ***Cr:*** *Credits*

ETE: *End Term Exam,* ***IA:*** *Internal Assessment*

Office of Dean Academic Affairs
Rajasthan Technical University, Kota

List of Open Electives for Mechanical Engineering				
Subject Code	**Title**		**Subject Code**	**Title**
Open Elective - I			**Open Elective - II**	
7AG6-60.1	Human Engineering and Safety		8AG6-60.1	Energy Management
7AG6-60.2	Environmental Engineering and Disaster Management		8AG6-60.2	Waste and By-product Utilization
7AN6-60.1	Aircraft Avionic System		8AN6-60.1	Finite Element Methods
7AN6-60.2	Non-Destructive Testing		8AN6-60.2	Factor of Human Interactions
7CH6-60.1	Optimization Techniques		8CH6-60.1	Refinery Engineering Design
7CH6-60.2	Sustainable Engineering		8CH6-60.2	Fertilizer Technology
7CR6-60.1	Introduction to Ceramic Science & Technology		8CR6-60.1	Electrical and Electronic Ceramics
7CR6-60.2	Plant, Equipment and Furnace Design		8CR6-60.2	Biomaterials
7CE6-60.1	Environmental Impact Analysis		8CE6-60.1	Composite Materials
7CE6-60.2	Disaster Management		8CE6-60.2	Fire and Safety Engineering
7CS6-60.1	Quality Management/ISO 9000		8CS6-60.1	Big Data Analytics
7CS6-60.2	Cyber Security		8CS6-60.2	IPR, Copyright and Cyber Law of India
7EE6-60.1	Electrical Machines and Drives		8EE6-60.1	Energy Audit and Demand side Management
7EE6-60.2	Power Generation Sources.		8EE6-60.2	Soft Computing
7EC6-60.1	Principle of Electronic communication		8EC6-60.1	Industrial and Biomedical applications of RF Energy
7EC6-60.2	Micro and Smart System Technology		8EC6-60.2	Robotics and control
7MI6-60.1	Rock Engineering		8MI6-60.1	Experimental Stress Analysis
7MI6-60.2	Mineral Processing		8MI6-60.2	Maintenance Management
7PE6-60.1	Pipeline Engineering		8PE6-60.1	Unconventional Hydrocarbon Resources
7PE6-60.2	Water Pollution control Engineering		8PE6-60.2	Energy Management & Policy
7TT6-60.1	Technical Textiles		8TT6-60.1	Material and Human Resource Management
7TT6-60.2	Garment Manufacturing Technology		8TT6-60.2	Disaster Management

Office of Dean Academic Affairs
Rajasthan Technical University, Kota

7ME5-11: I. C. Engines

Credit: 3 **Max. Marks: 100(IA:30, ETE:70)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**History of IC engines:** Nomenclature, Classification & Comparison, SI & CI, 4stroke- 2 stroke, First Law analysis, Energy Balance. Fuel-air cycles, Actual cycles.	4
3	**Testing & Performance:** Performance parameters, Measurement of operating parameters e.g. speed, fuel & air consumption, Powers, IHP, BHP, FHP, Efficiencies Thermal, Mechanical, Volumetric, Emission Measurement, Indian & International standards of Testing, Emission.	4
4	**Fuel & Combustion:** Combustion in CI & SI engines, Ignition Limits, Stages of combustion, Combustion parameters. Delay period and Ignition Lag, Turbulence and Swirl, Effects of engine variables on combustion parameters, abnormal combustion in CI & SI engines, Detonation & knocking, Theories of detonation, Control of abnormal combustion, Combustion chamber design principles, Types of combustion chamber.	4
5	**Alternative Fuels:** Methanol, Ethanol, Comparison with gasoline, Manufacturing, Engine performance with pure Methanol, Ethanol & blends, Alcohols with diesel engine, Vegetable oils, Bio gas.	2
6	**Engine Systems & Components:** Fuel System (SI Engine), Carburetion & Injection, process & parameters, properties of A/F mixture, Requirements of A/F ratios as per different operating conditions, Carburettors, types, Aircraft carburettor, comparison of carburetion & injection, F/A ratio calculations.	4
7	**CI engine:** Mixture requirements & constraints, Method of injection, Injection systems, CRDI etc. system components, pumps injectors.	3
8	**Ignition system:** Conventional & Modern ignition systems Magneto v/s Battery, CB point v/s Electronic ignition, Fuel Ignition Energy requirements. Spark advance, centrifugal, vacuum Firing order, spark plugs.	3
9	**Engine Friction & Lubrication:** Determination of friction, Lubrication principles, Types of lubrication, Places of lubrication Bearings and piston rings etc., Functions of Lubrication, Properties, Rating and Classification of lubricating oil, Additives, Lubrication systems. Engine Cooling: Requirements of cooling, Areas of heat flow, High temperature regions of combustion chamber. Heat Balance, Cooling Systems, Air, Water Cooling, Cooling system components.	5

10	**Supercharging:** Objectives, Thermodynamic cycle & performance of super charged SI & CI engines, Methods of super charging, Limitations, Two stroke engines: Comparison of 4s & 2s engines construction & valve lining scavenging. Process parameters, systems, supercharging of 2 stroke engines.	**5**
11	**Dual & Multi fuel engines:** Principle, fuels, Combustion, performance Advantages, Modification in fuel system.	**3**
12	**Special Engines:** Working principles of Rotary, Stratified charge, Free piston, Variable compression ratio engines.	**2**
	Total	**40**

TEXT BOOK	
1	Mathur and Sharma, Internal Combustion Engines, Dhanpat Rai & Sons
REFERENCE BOOKS	
SN	**Name of Authors /Books /Publisher**
1	Gupta H.N., Fundamentals of Internal Combustion Engines, Prentice Hall of India
2	F. EdwardObert, Internal Combustion Engines, Harper and Raw Publisher
3	John B. Heyword, Internal Combustion Engines Fundamentals, McGraw Hill
4	Lichty, Internal Combustion Engines, McGraw Hill.
5	Gill, Smith, Ziurs, Fundamentals of Internal Combustion Engines, Oxford & IBH Publishing
6	Rogowsky, IC Engines, International Book Co.
7	Ganeshan V., Internal Combustion Engines, Tata McGraw Hill.
8	R. Yadav, I.C. Engines, Central Publishing House, Allahabad

7ME5-12: OPERATIONS RESEARCH

Credit:3 **Max. Marks: 100(IA:30, ETE:70)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Overview of Operations Research**	1
3	**Linear Programming**: Applications and model formulation, Graphical method, Simplex method, duality and Sensitivity analysis.	4
4	Transportation Model and Assignment Model including travelling salesman problem.	4
5	**Integer Linear Programming:** Enumeration and cutting Plane solution concept, Gomory's all integer cutting plane method, Branch and Bound Algorithms, applications of zero-one integer programming.	5
6	**Replacement Models:** Capital equipment replacement with time, group replacement of items subjected to total failure.	3
7	**Queuing Theory**: Analysis of the following queues with Poisson pattern of arrival and exponentially distributed service times, Single channel queue with infinite customer population, Multichannel queue with infinite customer population,	3
8	**Competitive Situations and Solutions**: Game theory, two person zero sum game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy, approximate solution, and simplified analysis for other competitive situations. Application of linear programming	4
9	Theory of Decision making: Decision making under certainty, risk and uncertainty. Decision trees.	3
10	**Deterministic Inventory control models:** functional role of inventory, inventory costs, model building, Single item inventory control model without shortages, with shortage and quantity discount. Inventory control model with uncertain demand, service level, safety stock, P and Q systems, two bin system. Single period model. Selective Inventory control techniques.	4
11	**Probabilistic Inventory control models:** Instantaneous demand without setup cost and with setup cost, Continuous demand without setup cost	4
12	**Simulation**: Need of simulation, advantages and disadvantages of simulation method of simulation. Generation of Random numbers, Generation of Normal Random numbers. Use of random numbers for system simulation. , Monte Carlo simulation, simulation language ARENA, Application of simulation for solving queuing Inventory Maintenance, Scheduling and other industrial problems	4
	Total	40

TEXT BOOK	
1	Operations Research, Ravindran, Phillips and Solberg, Wiley India.
2	Operations Research, Gupta and Heera, S. Chand Publications.
REFERENCE BOOKS	
SN	**Name of Authors /Books /Publisher**
1	Introduction to Operations Research, Hillier F.S. and Lieberman G.J., CBS Publishers.
2	Operations Research, Taha H.A., Pearson Education
3	Linear Programming and Network Flows, Bazaraa, Jarvis and Sherali, Wiley India.
4	Principles of Operations Research, Wagner H.M., Prentice Hall of India.

7ME5-13: TURBOMACHINES

Credit: 3 **Max. Marks: 100(IA:30, ETE:70)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**Basic Concepts of Turbo Machines:** Definition & classification of Turbo machine, Basic laws and governing equations: continuity equation, steady flow energy equation(1st law of thermodynamics),2nd law of thermodynamics applied to turbo machines, Newton's 2nd law of motion applied to turbomachines - Euler's pump equation and Euler's turbine equation	4
3	Dimensional analysis applied to hydraulic machines, power coefficient, flow coefficient, head coefficient, non-dimensional specific speed, Range of specific speeds for various turbo machines, Dimensional analysis applied to compressible flow machines, pressure ratio as a Function of temperature ratio, mass flow rate parameter and speed parameter	3
4	**Centrifugal Compressors and Fans:** Components and description, velocity iagrams, slip factor, energy transfer, power input factor, stage pressure rise and loading coefficient, pressure coefficient, degree of reaction, Centrifugal compressor characteristic, surging, rotating Stall and Choking	8
5	**Axial Flow Compressors and Fans:** Basic constructional features, Advantages of axial flow compressors, working principle, velocity triangle, elementary theory, stage work, work done factor, stage loading, degree of reaction; vortex theory, simple design calculations, introduction to blade design, cascade test, compressibility effects, operating characteristics	8
6	**Reciprocating Compressors:** Basic constructional features, working principle, work done calculation, single and double acting compressors	4
7	**Centrifugal Pumps:** Main parts, work done and velocity triangles, slip and slip factor, pump losses and efficiencies, minimum starting speed, net positive suction head, performance curve.	4
8	**Axial Flow Pumps:** Description, velocity triangles, work done on the fluid, energy transfer, axial pump characteristics, cavitation.	4
9.	**Reciprocating Pumps:** Classification, component and working, single acting and double acting, discharge, work done and power required, coefficient of discharge, indicator diagram, slip, effect of friction and acceleration, theory of air vessels.	4
	Total	40

Office of Dean Academic Affairs
Rajasthan Technical University, Kota

TEXT BOOK	
1	Gas turbines, V. Ganesan, Tata McGraw-Hill
2	Hydraulic Machines, Subramanya, K., Tata McGraw Hill
REFERENCE BOOKS	
SN	**Name of Authors /Books /Publisher**
1	Principle of Turbo Machinery, Turton R.K., Springer Publication
2	Fundamentals of Turbo Machinery, William W., John Wiley and Sons.
3	Turbo Machinery Basic Theory and Application, Logan E.J.
4	Principles of Turbo Machinery, Shepherd Dennis G., Mac Millan Pub, N.York.
5	TurboMachines, A ValanArasu, Vikas Publishing House Pvt. Ltd.
7	Gas turbine theory, Cohen and Saravanamutto, Pearson Educational Pub.
8	Hydraulic Machines: Turbines and Pumps, Nazarov N.T., Springer New York.
9	Gas Turbine Theory, Cohen and Roger, Pearson Education.
10	Hydraulic Machinery, Jagdish Lal, Metropolitan Books.

7ME4-21: FEA LAB

Credit: 1.5 **Max. Marks: 100(IA:60, ETE:40)**
0L+0T+3P

SN	List of Experiments
1	Laboratory work for the solution of solid mechanics problems, heat transfer problems, and free vibration problems
A: by using FE packages such as NASTRAN/ANSYS/SIMULIA/ABAQUS	
2	Introduction of GUI of the software in the above mentioned areas' realistic problems.
3	Analysis of beams and frames (bending and torsion problems)
4	Plane stress and plane strain analysis problems
5	Problems leading to analysis of axisymmetric solids
6	Problems leading to analysis of three dimensional solids (a) Heat transfer problems (b) Modal analysis problem
B: by writing own code for finite element analysis using MATLAB for:	
7	Plane stress and plane strain analysis problems
8	Modal Analysis problem

7ME4-22: Thermal Engineering Lab-II

Credit: 1.5 **Max. Marks: 100(IA:60, ETE:40)**

0L+0T+3P

SN	List of Experiments
1	To perform constant speed load test on a single cylinder diesel engine and to plot performance curves: indicated thermal efficiency, brake thermal efficiency, mechanical efficiency Vs. Brake power and heat balance sheet.
2	To estimate the Indicated Power, Friction Power and Mechanical Efficiency ofa multi-cylinder Petrol Engine. (Morse Test)
3	Analysis of engine exhaust gases using Orsat apparatus /Engine gas analyzer.
4	Determination of coefficient of performance of Refrigeration cycle and tonnage capacity of refrigeration unit.
5	To determine the COP and tonnage capacity of a Mechanical heat pump.
6	To study various controls used in Refrigeration and Air conditioning system.
7	Study of commercial Refrigeration equipments like cooling towers, hermetically sealed compressors, automotive swash plate compressor etc.
8	To study automotive air conditioning system.
9	Determination of dryness fraction of steam.
10	Study and Performance of Simple Steam Turbine
11	Performance characteristics of Hydraulic turbines.
12	Study and Performance of Gas Turbine Plant.
13	Performance characteristics of variable and rated speed centrifugal pump.

7ME4-23: Quality Control Lab

Credit: 1 **Max. Marks: 100(IA:60, ETE:40)**
0L+0T+2P

SN	List of Experiments
1	Case study on X bar chart and R chart of an industrial process output and process capability analysis of the process. The charts are to be drawn and calculations of process capability analysis to be reported.
2	p Chart: (a) To verify the Binomial Distribution of the number of defective balls by treating the balls with a red colour to be defective. (b) To plot a p -chart by taking a sample of n=20 and establish control limits
3	Case study on C-chart of a product and establish control limits.
4	Operating Characteristics Curve: (a) To plot the operating characteristics curve for single sampling attribute plan for n = 20; c = 1, 2, 3. Designate the red ball as defective. (b) To compare the actual O.C. curve with theoretical O.C. curve using approximation for the nature of distribution
5	Distribution Verification: (a) To verify Normal Distribution using the experimental setup. (b) To find the distribution of numbered cardboard chips by random drawing one at a time with replacement. Make 25 subgroups in size 5 and 10 find the type of distribution of sample average in each case. Comment on your observations
6	To carry out verification of Poisson distribution using experimental set up.
7	Central Limit Theorem: (a) To show that a sample means for a normal universe follow a normal distribution (b) To show that the sample means for a non normal universe also follow a normal Distribution.
8	Solve quality control problems using SPC software like STATGRAPHICS/MINITAB/SIGMA XL /SYSTAT/EXCEL etc.
	Important Note: It is mandatory for every student to undertake a Case Study. The case study shall be of real problem involving quality issues preferably from local industry whose quality issues shall be solved using seven magnificent tools of SQC and other techniques of quality control. Case study shall be a group activity. A group shall consist of maximum five students. Final evaluation shall include 30% weight age to case study.

8ME5-11: Hybrid and Electric Vehicles

Credit: 3 **Max. Marks: 100(IA:30, ETE:70)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Introduction to Hybrid Electric Vehicles:** History of hybrid and electric vehicles, environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.	5
3	**Conventional Vehicles:** Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.	4
4	**Hybrid Electric Drive-trains:** Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.	6
5	**Electric Drive-trains:** Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electricdrive-train topologies, fuel efficiency analysis.	6
6	**Electric Propulsion unit:** Introduction to electric components used inhybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives	6
7	**Energy Storage:** Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Hybridization of different energy storage devices.	6
8	**Sizing the drive system:** Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology	6
	Total	40

Office of Dean Academic Affairs
Rajasthan Technical University, Kota

TEXT BOOK	
1	Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press
REFERENCE BOOKS	
SN	**Name of Authors /Books /Publisher**
1	James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley
2	Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press

8ME5-12: SUPPLY AND OPERATIONS MANAGEMENT

Credit: 3 **Max. Marks: 100(IA:30, ETE:70)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	Introduction to operations management (OM), the scope of OM; Historical evolution of OM; Trends in business; the management process. Operations Strategy, Competitiveness and Productivity	4
3	Demand Forecasting: components of forecasting demand, Approaches to forecasting: forecasts based on judgment and opinion, Time series data. Associative forecasting techniques, Accuracy and control of forecasts, Selection of forecasting technique.	4
4	Product and Service design, Process selection, Process types, Product and process matrix, Process analysis.	5
5	Capacity Planning: Defining and measuring capacity, determinants of effective capacity, capacity strategy, steps in capacity planning process, determining capacity requirements, Capacity alternatives, Evaluation of alternatives; Cost-Volume analysis.	5
6	Facility Location: Need for location decisions, factors affecting location, qualitative and quantitative techniques of location. Facilities layout: Product, Process, Fixed position, combination and cellular layouts; line balancing. Material Handling	5
7	Planning levels: long range, Intermediate range and Short range planning, Aggregate planning: Objective, Strategies, and techniques of aggregate planning. Master scheduling; Bill of materials, MRP; inputs processing and outputs, and overview of MRPII , use of MRP to assist in planning capacity requirements, Introduction to ERP	4
8	Techniques of production control in job shop production, batch production and mass production systems. sequencing: priority rules, sequencing jobs through two work centers, scheduling services	4
9	Introduction to Just-in-time (JIT) and Lean Operations: JIT production, JIT scheduling, synchronous production, Lean operations system	4
10	Supply Chain Management (SCM): Need of SCM, Bullwhip effect, Elements of SCM, Logistics steps in creating effective supply chain, Purchasing and supplied management.	4
	Total	40

TEXT BOOK	
1	Stevenson, Operations Management, Tata McGraw Hill.
REFERENCE BOOKS	
SN	**Name of Authors /Books /Publisher**
1	Roberta S. Russell, Bernard W. Taylor, Operations Management, John Wiley
2	Joseph S. Martinich, Production And Operations Management, John Wiley
3	S.N. Chary, Production and Operations Management, Tata McGraw Hill
4	Norman Gaither, Greg Frazier, Operations Management, Thomson Learning

8ME5-13: ADDITIVE MANUFACTURING

Credit: 3 **Max. Marks: 100(IA:30, ETE:70)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1.	**Introduction:** Objective, scope and outcome of the course.	1
2.	Overview of Rapid Product Development (RPD): Need for the compression in product development, history of RP systems, Definition of RPD; Components of RPD. Rapid Prototyping (RP); Principle of RP; Technologies and their classifications.	2
3.	**Stereo Lithography Systems**: Principle, Process parameter, Process details, Data preparation, data files and machine details, Application	2
4.	**Selective Laser Sintering& Fusion Deposition Modelling:** Selective Laser Sintering: Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications. Fusion Deposition Modelling: Principle, Process parameter, Path generation, Applications.	4
5.	**Solid Ground Curing**: Principle of operation, Machine details, Applications. Laminated Object Manufacturing: Principle of operation, LOM materials. Process details, application.	4
6.	Selection of RP process; Issues in RP; Emerging trends.	2
7.	**Rapid Tooling (RT):** Introduction to RT, Indirect RT process-Silicon rubber molding, Epoxy tooling, Spray metal tooling and Investment Casting, Cast kirksite, 3Q keltool, etc.	3
8.	**Direct RT processes**: Laminated Tooling, Powder Metallurgy based technologies, Welding based technologies, Direct pattern making (Quick Cast, Full Mold Casting),	3
9.	Emerging Trends in RT, Reverse Engineering: Geometric data acquistion, 3D reconstruction, Applications and Case Studies, Engineering applications, Medical applications.	3
10.	Processing Polyhedral Data: Polyhedral B-Rep modeling, STL format, Defects and repair of STL files,	2
11.	Introduction to software for RP : Brief overview of Solid view, magics etc.	2
	TOTAL	40

TEXT BOOK	
1.	Rapid Prototyping: Principles and Applications, Volume 1 by Chee Kai Chua, Kah Fai Leong, Chu Sing Lim, World Scientific.
REFERENCE BOOKS	
1.	Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing by Brent Stucker, David W. Rosen, and Ian Gibson, Springer
2.	Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Gibson, Ian, Rosen, David, Stucker, Brent, Pearson.
3.	Rapid Prototyping: Principles and Applications in Manufacturing Noorani R, John Wiley & Sons.
4.	Rapid Prototyping and Engineering applications: A tool box for prototype development, Liou W. L., Liou F. W., CRC Press.
5.	Rapid Prototyping: Theory and practice, Kamrani A. K., Nasr E.A., Springer.

8ME4-21: INDUSTRIAL ENGINEERING LAB

Credit: 1 **Max. Marks: 100(IA:60, ETE:40)**

0L+0T+2P

SN	List of Experiments
1	Determination of time standard for a given job using stopwatch time-study.
2	Preparation of flow process chart, operation process chart and man-machine charts for an existing setup and development of an improved process.
3	Study of existing layout of a workstation with respect to controls and displays and suggesting improved design from ergonomic viewpoint.
4	To perform ABC analysis for the given set of inventory data.
5	To develop Bill of Materials/Product structure tree and calculate planned order release (POR) using MRP format
6	To solve the operations research problems on Linear programming/Transportation/Assignment etc. using OR software's like TORA/LINGO/LINDO/SAS/EXCEL SOLVER etc.
7	Simulation of inventory system/Queuing system/production system using Monte-Carlo method.
8	To perform case study on sales forecasting.
9	To perform case study on project management using PERT/CPM.
10	To perform a case study on plant location and layout planning.
11	To perform a case study on capacity planning.

Important Note:

It is mandatory for every student to undertake a Mini project. The mini project shall involve a detailed project report of establishing a factory in which plant location, plant layout, capacity planning, selection of processes, ergonomically designing of equipments and other facilities are to be installed. Mini project shall be a group activity. A group shall consist of maximum five students. Final evaluation shall include 30% weight age to mini project.

8ME4-22: METROLOGY LAB

Credit: 1 **Max. Marks: 100(IA:60, ETE:40)**
0L+0T+2P

SN	List of Experiments
1	Study of various measuring tools like dial gauge, micrometer, vernier caliper and telescopic gauges.
2	Measurement of angle and width of a V-groove by using bevel protector..
3	To measure a gap by using slip gauges
4	Measurement of angle by using sine bar.
5	Study and use of surface roughness instrument (Taylor Hobson make) Inspection of various elements of screw thread by Tool makers microscope and optical projector.
6	Measurement of gear tooth thickness by using gear tooth vernier caliper.
7	To check accuracy of gear profile with the help of profile projector.
8	To determine the effective diameter of external thread by using three-wire method.
9	To measure flatness and surface defects in the given test piece with the help of monochromatic check light and optical flat.
10	To plot the composite errors of a given set of gears using composite gear tester.
11	Measurement of coating thickness on electroplated part and paint coating on steel and non-ferrous material using coating thickness gauge.
12	Study and use of hardness tester for rubber and plastics.
13	To check the accuracy of a ground, machined and lapped surface - (a) Flat surface (b) Cylindrical surface.
14	To compare & access the method of small-bore measurement with the aid of spheres.