Elective Subjects
B. Tech. Mechanical Engineering Program
w.e.f. Admission Batch: 2017

Department Elective-I
B. Tech. Third Year (Mechanical Engineering), Semester-V

Course Code: 19MI302T					**Course Name: Elective-I:** Production and Operations Management			
Teaching Scheme					**Examination Scheme**			
L	**T**	**P**	**C**	**Hrs/Week**	**Theory**			**Total**
3	0	--	3	3	**Continuous evaluation**	**Mid Semester**	**End Semester**	100
					25	25	50	

Prerequisites:

Knowledge of basic manufacturing processes such as casting, metal forming, machining and welding are required (subject: Manufacturing Processes I and Manufacturing Processes II).

Learning objectives:

1. To demonstrate significance on management of production operations.
2. To comprehend the importance of forecasting and to study various techniques of forecasting (Time series, causal and qualitative techniques).
3. To apply fundaments of inventory management and develop understanding on the concept of optimum ordering quantity.
4. To develop skills of material requirement planning and project management.
5. To evaluate various waiting line models, analysis of various queues and measuring queue performance.

UNIT I **(10 L, 0 T)**

Operations Management: Introduction, Operations Management and Strategy, Tools for Implementation of Operations, Industry Best Practices.

Demand management and forecasting: Introduction, The Strategic Importance of Forecasting, Benefits, Cost implications and Decision making using forecasting, Classification of Forecasting Process, Methods of Forecasting, components of demand Forecasting and Product Life Cycle, Selection of the Forecasting Method, Qualitative Methods of Forecasting: Market research, historical analogy, Delphi method and other methods, Quantitative Methods, web-based forecasting: collaborative planning, forecasting and replenishments. Associative Models of Forecasting, Accuracy of Forecasting, case studies in fore casting.

Inventory management: definition of inventory, purposes of inventory, independent vs dependent demand, inventory costs, fixed order quantity models and fixed time period models, ABC inventory planning, inventory accuracy and cycle, the basic EOQ model, EOQ with gradual replenishment, price break models, reorder point, safety stock, the Newsboy problem, inventory control and supply chain management, case studies in inventory control.

UNIT II

(10 L, 0 T)

Material Requirements Planning (MRP): Components and structure of MRP (demand for products, bill of materials, inventory records, MRP computer program). MRP logic, lot sizing in MRP systems (LFL, EOQ, POQ, LTC, LUC, etc.), case studies on MRP, introduction to ERP.

Operations Scheduling: Introduction, Purpose of Operations Scheduling, Factors Considered while Scheduling, Scheduling Activity under Production Planning and Control, Scheduling Strategies, Scheduling Guidelines, Approaches to Scheduling, Scheduling Methodology [Quantitative], Scheduling in Services, Sequencing methods (SPT, EDD, Moore's method, Johnson's method, etc.), case studies in operation scheduling.

Project management: Project control charts, Gantt charts, Critical Path Method, Activity on arrow /Activity on node networks, concept of slack, the critical path, probabilistic time estimates, and project crashing. Case studies in project management.

UNIT III

(09 L, 0 T)

Service Processes: the queuing system, customer arrival, distribution of arrivals, Waiting line models, various types of queues M/M/1. M/D/1, M/G/1, M/M/S and their corresponding derivations to measure various quantities such as length of queue, length of system, average waiting time in queue and in system, probability of waiting in line, measures of queue performance, management of waiting lines, computer simulation of waiting lines. Case studies in waiting line models.

Facility planning: Introduction, objectives of the layout, types of layouts, the facility location problem, factors influencing facility location, facility location models, process layouts, layout methods, computerized algorithms for facility layout, product layouts, fixed position layouts, cellular layouts, layout of service facilities, case studies in facility planning.

UNIT IV **(10 L, 0 T)**

Quality Management: Introduction, quality specification, quality cost, quality management systems, concepts of total quality management (TQM), quality tools, process capability, concept of six sigma, quality tools, statistical quality control, control charts (X and R charts, p-chart, np-chart, c chart), acceptance sampling, AQL, LTPD, OC curves. Six-sigma quality, six-sigma methodology, process control procedures, case studies in quality management.

Lean manufacturing: Lean logic, lean implementation requirements, lean layout and design flow, lean applications for line flow, lean services, case studies in lean manufacturing, Just-in-time (JIT), characteristics of JIT, implementation of JIT, the Toyota Production System: elimination of waste and respect for people, push vs. pull systems, use of Kanban, case studies on pull vs push systems.

Self-study: The self- study contents will be declared at the commencement of semester.

Lecture: 39 Hrs
Tutorial: 00 Hrs
Approximate Total : 39 Hrs

Text/Reference Book(s):

1. Chase, R. B., Ravi Shankar, Jacobs, F. R. and Aquilano, N. J., Operations and Supply Management, Tata McGraw Hill.
2. Buffa, E. S. and Sarin, R., Modern, Production and Operations Management, John Wiley.
3. Russell, R. S. and Taylor, B. W., Operations Management along the Supply Chain, Wiley India.
4. Heizer J., Render, B. and Rajashekhar, J., Operations Management, Pearson Education.
5. Jacobs, F. R., Chase, R. B., & Aquilano, N. J. (2004). Operations management for competitive advantage. Boston: Mc-Graw Hill.
6. Martand Telsang, Industrial engineering and production management.
7. R. Panneerselvam, Production and operations management, PHI learning.
8. N. G. Nair, Production and operations management, Tata McGraw hill publishing company.

Course Code: 19MI307T					**Course Name: Elective-I:** Rapid Product Development			
Teaching Scheme					**Examination Scheme**			
L	**T**	**P**	**C**	**Hrs/Week**	**Theory**			**Total**
3	0	--	3	3	**Continuous evaluation**	**Mid Semester**	**End Semester**	100
					25	25	50	

Prerequisite: NIL

UNIT I **10L**

Introduction: CAD-CAM and its integration, Development of CAD CAM, The importance of being Rapid, The nature of RP/T, The state of RP/T industry, Rapid Prototyping Defined, Time compression Technologies, Product development and its relationship with rapid prototyping.

Process chain for Rapid Prototyping: Data Preparation (Pre-processing), Part Building, Post Processing. CAD Model Preparation, Reverse Engineering and CAD model, Digitizing Techniques: Mechanical Contact Digitizing, Optical Non-contact Measurement, CT Scanning Method, Data Processing for Surface Reconstruction.

Data interface for Rapid Prototyping: STL interface Specification, STL data generation, STL data Manipulation, Advantages and limitations of STL file format, Open files, Repair of STL files, Alternative RP interfaces.

UNIT II **10L**

Part orientation and support generation: Factors affecting part orientation, various models for part orientation determination, the function of part supports, support structure design, Automatic support structure generation.

Model Slicing and Contour Data organization: Model slicing and skin contour determination, Identification of external and internal contours, Contour data organization, Direct and adaptive slicing: Identification of peak features, Adaptive layer thickness determination, Skin contour computation. Tool path generation.

UNIT III **09L**

Part Building: Recoating, parameters affecting part building time, part quality.

Post Processing: Part removal, finishing, curing.

Other issues: Shrinkage, Swelling, Curl and distortion, Surface Deviation and accuracy, Build Style Decisions,

UNIT IV **10L**

Rapid Prototyping machines: Classification, Description of RP Machines: SLA, SLS, FDM, 3D Printing, LOM, SDM, Contour Crafting, 3D Welding, etc., CNC-machines and hybrid systems.

Rapid Tooling and Manufacturing: Classification of RT Routes, RP of Patterns, Indirect RT: Indirect method for Soft and Bridge Tooling, Indirect method for Production Tooling, Direct RT: Direct RT method for Soft and Bridge Tooling, Direct method for Production Tooling, Other RT Approaches. Rapid Manufacturing: Methods, limitations.

Application of RP: Heterogeneous objects, Assemblies, MEMES and other small objects, Medicine, Miscellaneous areas including art.

Lecture: 39 Hrs
Tutorial: 00 Hrs
Approximate Total : 39 Hrs

Texts and References

1. Bjorke, Layer Manufacturing, Tapir Publisher. 1992.
2. Jacobs, PF (Ed), Rapid Prototyping and Manufacturing, Society of Manuf. Engrs.
3. Burns, M., Automated Fabrication: Improving Productivity in Manufacturing,
4. Jacobs, P.F. (Ed.), Stereolithography and Other RP&M Technologies: From Rapid Prototyping to Rapid Tooling, Society of Manuf. Engrs. NY,
5. Chua C. k. and L. K. Fai, Rapid Prototyping: Principles and Applications in Manufacturing.
6. Gibson, I. (Ed.), Software Solutions for Rapid Prototyping, Professional Engineering Publications, London., 2002.

Course Code: ME424					**Course Name: Elective-I:** Turbo Machinery			
Teaching Scheme					**Examination Scheme**			
L	**T**	**P**	**C**	**Hrs/Week**	**Theory**			**Total**
3	0	--	3	3	**Continuous evaluation**	**Mid Semester**	**End Semester**	100
					25	25	50	

Prerequisite: Fluid Mechanics and Machine

UNIT I **9L**

Introduction: Turbomachines; parts of a Turbomachines; Comparison with positive displacement machine; Classification: Application of First and Second Laws to Turbomachines, Efficiencies. Dimensionless parameters and their physical significance; Effect of Reynolds number; Specific speed; Illustrative examples on dimensional analysis and model studies.

Principles of turbo machinery: Transfer of energy to fluids, Performance characteristics, fan laws, selection of centrifugal, axial, mixed flow, Axial flow machines.

UNIT II **10L**

Flow through Cascades: Two-dimensional Flow, Cascade of Blades, Cascade Tunnel, Axial Turbine Cascades, Axial Compressor Cascades. Analysis of cascade forces; Energy losses: Lift and Drag; Circulation and lift; efficiency of compressor cascade; performance of two dimensional cascades. The cascade wind tunnel. Compressor cascade performance; Turbine cascade performance; compressor cascade correlations. Fluid deviation; off design performance; Much number effects. Turbine cascade co-relation (Ainley); Optimum space chord ratio of turbine blades (Zweifel).

UNIT II **10L**

Analysis of axial flow Machines: Axial flow fans and compressors: Rotor design airfoil theory, vortex theory, cascade effects, degree of reaction, blade twist, stage design, surge, choking and stall, stator and casing, mixed flow impellers. Design considerations for supersonic flow

UNIT II **10L**

Design and applications of blowers and Fans: Special design and applications of blower: induced and forced draft fans for air-conditioning plants, cooling towers, ventilation systems, booster systems.

Testing and control of Blowers and Fans: Performance testing, noise control, Speed control, throttling control at discharge and inlet.

Lecture: 39 Hrs
Tutorial: 00 Hrs
Approximate Total : 39 Hrs

Texts and References

1. Turbines, Compressors and Fans, S.M. Yahya, Tata McGraw Hill, 2007.
2. Fluid Mechanics, Thermodynamics of turbomachinery, Dixon, Pergamon Press, 1984.
3. Handbook of Turbomachinery, Edited by Earl Logan Jr, Ramendra Roy; Second Edition , Marcel Dekker, Inc, New York.
4. Principles of Turbo machines, D.G. Stephard, Macmillan Co., 1984.
5. Turbomachinery Design and Theory, Rama S.R.Gorla, Aijaz Khan, Marcel Dekker, Inc, New York

Department Elective-II
B. Tech. Third Year (Mechanical Engineering), Semester-VI

Course Code: ME419					**Course Name: Elective-I:** Quality Engineering			
Teaching Scheme					**Examination Scheme**			
L	**T**	**P**	**C**	**Hrs/Week**	**Theory**			**Total**
3	0	--	3	3	**Continuous evaluation**	**Mid Semester**	**End Semester**	100
					25	25	50	

Prerequisite: Nil

Course Outcomes (COs):

CO1: To establish an understanding of the fundamental concepts related to Quality, Team management, attributes of a Leader.
CO2: To introduce Juran Trilogy, Kaizen principles, Six Sigma, MBNQA.
CO3: To conduct and adapt the principles of Benchmarking, Spider chart and comparison with competitors products.
CO4: To introduce ISO certifications, establish the concepts of House of Quality.
CO5: To discover the liability laws and defences, draw and analyze affinity diagrams, interrelations digraph, tree and matrix diagrams.
CO6: To introduce Quality control charts, prepare and analyze the techniques of Statistical Process Control

UNIT I **10L**

Definition, History, Framework and Benefits of TQM, Characteristic and roles of a successful quality leader, Voice of customer and retention of customer, Employee involvement, teamwork, performance appraisal and rewards.

UNIT II **10L**

Juran Trilogy, PDSA, Kaizen, Six-sigma, Selection, certification and rating of suppliers, Quality costs, Malcolm Baldrige National Quality Award, benchmarking, Spider chart and comparison with competitors products.

UNIT III **10L**

ISO 9000+ certifications, quality audits, ISO14000+ certifications, Voice of customer, house of quality, Rationale and methods, Methodology and documentation

UNIT IV **10L**

Liability laws and defense, Affinity diagram, interrelations digraph, tree and matrix diagrams, Charts and techniques for statistical process control.

Lecture: 40 Hrs
Tutorial: 00 Hrs
Approximate Total : 40 Hrs

Texts and References:

1. Besterfield, Dale H., Total Quality Management, Pearson Education, 3rd Revised Edition, 2011.
2. Sharma D.D., Total Quality Management, Principles, Implementation & Cases, Sultan Chand & Sons, New Delhi, 2000
3. James R. Evans, Total Quality Management, Organization, and Strategy, Thomson, 4th Ed., 2007.
4. Besterfield, D.H., Quality Control, Pearson, 7th Ed., 2004.

Course Code: 19MEXXXT					Course Name: Elective-I: Elements of Mechatronics System Design			
Teaching Scheme					Examination Scheme			
L	T	P	C	Hrs/Week	Theory			Total
3	0	--	3	3	Continuous evaluation	Mid Semester	End Semester	100
					25	25	50	

Prerequisite: Nil

Course Outcomes:

CO1: The student can get a basic understanding of Mechatronics, and its applications
CO2: The student can get the knowledge of various sensors, proper selection of sensors based on the need.
CO3: The student can get knowledge of various control boards available for interfacing with mechanical systems.
CO4: The student can get knowledge of how to interface and interconnect various electronics and hardware to design the mechatronics system.
CO5: The student can control a mechanical system with the designed embedded system.

UNIT I

INTRODUCTION (12 L)

Introduction to Mechatronics – Systems – Concepts of Mechatronics approach – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics.

Sensors and Transducers: Static and dynamic Characteristics of Sensor,
Position sensors: Potentiometers, encoders, LVDT, resolvers, Hall-effect sensor, Velocity sensors, acceleration sensors, force sensors, touch sensors – Capacitance Sensors – Strain gauges – Eddy current sensor –– Temperature sensors – Light sensors.

UNIT II 8085 MICROPROCESSOR AND 8051 MICROCONTROLLER (10 L)

Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes –Instruction set, Timing diagram of 8085 – Concepts of 8051 microcontroller – Block diagram. Arduino boards, Teensy board.

UNIT III PROGRAMMABLE PERIPHERAL INTERFACE (08 L)

Introduction – Architecture of 8255, Keyboard interfacing, LED display –interfacing, ADC and DAC interface and Temperature Control – Stepper Motor Control – Traffic Control interface.

UNIT IV PROGRAMMABLE LOGIC CONTROLLER (07 L)

Introduction – Basic structure – Input and output processing – Programming – Mnemonics – Timers, counters and internal relays – Data handling – Selection of PLC.

UNIT V ACTUATORS AND MECHATRONIC SYSTEM DESIGN (08 L)

Types of Stepper and Servo motors – Construction – Working Principle – Advantages and Disadvantages. Design process-stages of design process – Traditional and Mechatronics design concepts – Case studies of Mechatronics systems – Pick and place Robot – Engine Management system – Automatic car park barrier

Lecture: 45 Hrs
Tutorial: 00 Hrs

Approximate Total : 45 Hrs

Text books:

1. Bolton, “Mechatronics”, Printice Hall, 2008
2. Ramesh S Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, 5th Edition, Prentice Hall, 2008.

REFERENCES:

1. Michael B.Histand and Davis G.Alciatore, “Introduction to Mechatronics and Measurement systems”, McGraw Hill International edition, 2007.
2. Bradley D.A, Dawson D, Buru N.C and Loader A.J, “Mechatronics”, Chapman and Hall, 1993.
3. Smaili.A and Mrad.F , “Mechatronics Integrated Technologies for Intelligent Machines”, Oxford University Press, 2007.
4. Devadas Shetty and Richard A. Kolk, “Mechatronics Systems Design”, PWS publishing company, 2007.
5. Krishna Kant, “Microprocessors & Microcontrollers”, Prentice Hall of India, 2007.
6. Clarence W, de Silva, "Mechatronics" CRC Press, First Indian Re-print, 2013

Course Code: 18ME310T					**Course Name:** Robotics			
Teaching Scheme					**Examination Scheme**			
L	**T**	**P**	**C**	**Hrs/Week**	**Theory**			**Total**
3	0	--	3	3	**Continuous evaluation**	**Mid Semester**	**End Semester**	100
					25	25	50	

Prerequisites: 1.Design and Kinematics of Machines 2. Dynamics of Machine

Course Outcomes (Cos):

On completion of the course, students will be able to

CO1: Outline the capabilities and constructional features of an Industrial Manipulator.

CO2: Develop Kinematic and Dynamic Model for an Industrial Manipulator for successful function and trajectory manipulation.

CO3: Explain the function of various subcomponents of a industrial manipulator for successful function.

CO4: Understand the importance of allied technologies for successful function of a manipulator.

CO5: Understand the suitability of Robots in industrial applications and newer technologies associated with them.

Code/ Table/ Charts if any: NIL

UNIT I **(10 L)**

Introduction: Classification of robots, basic robot components, robot anatomy, manipulator end effectors, controller, power unit, sensing devices, specification of robot systems, accuracy precision and repeatability, work envelop, gripper actuators and gripper design.

Co-ordinate Systems: local frame and global frame, representation, transformations, wrist analysis

UNIT II **(12 L)**

Kinematics and Dynamics: Parameters of robot link, formulation of D-H matrix, Analysis of different types of robots with different degrees of freedom, kinematic chains, inverse kinematics, Dynamic analysis

UNIT III **(09 L)**

Motion planning: Different trajectories and its analysis, motion planning, trajectory planning and control

Robotic sensing devices: Position, velocity and acceleration sensors, proximity and range sensors, touch and slip sensors, tactile sensors, force sensors and torque sensors.

UNIT IV **(09 L)**

Robotic vision system: imaging components, picture coding, object recognition, training and vision systems, review of existing vision systems.

Robotics programming: Methods of robot programming, types of programming, robotics programming languages, artificial intelligence.

Robot applications and Economic analysis of robotics

UNIT IV **(05 L)**

Industry 4.0: Technologies involved, Implementation and Potential

Non-Industrial Robots: Technologies involved with Domestic Robots, Humanoids, Nature Exploration Robot and other futuristic design.

Self-study: The self- study contents will be declared at the commencement of semester.

Lecture: 45 Hrs

Tutorial: 00 Hrs

Approximate Total : 45 Hrs

Texts and Reference Books:

1. Fundamentals of Robotics Analysis and control : Robert J. Schiling
2. Introduction to Robotics: Mechanics and Control, 3E: John J. Craig, Pearson
3. Robotics and Control: R K Mittal and I J Nagrath, Tata McGraw-Hill Education Private Limited
4. Industrial robotics : Groover, Weiss Nagel and Odrey, Mc Graw Hill
5. Robotics engineering: Klafter, Chmielwski and Nagirn, Prentice Hall.
6. Robotics for engineering: Yorem Korem, Mc Graw Hill.
7. Robotics: Control, Sensing Vision and Intelligence: K.S. Fu, R.C.Gonzalez, C.S.g Lee, McGraw Hill