M.Tech. Degree

PROGRAMME

In

Production & Industrial Engineering

CURRICULUM

(w.e.f. Session 2019-2020)

DEPARTMENT OF MECHANICAL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY
KURUKSHETRA-136119

VISION OF THE INSTITUTE

- To be a role model in technical education and research, responsive to global challenges.

MISSION OF THE INSTITUTE

- To impart technical education that develops innovative professionals and entrepreneurs.
- To undertake research that generates cutting-edge technologies and futuristic knowledge, focusing on the socio-economic needs.

VISION OF THE DEPARTMENT

To make contribution in the development of nation and evolution of technology by creating highly ethical professionals in Mechanical Engineering who are technically competent and are aware of their social responsibilities.

MISSION OF THE DEPARTMENT

- M1: To produce highly qualified, socially responsible, ethical and motivated students having sound theoretical and practical knowledge of Mechanical Engineering as well as communicative skills who can serve the nation as well as at global level
- M2: To inspire students to be a part of research and development activities.
- M3: To carry out research in order to serve the needs of industries, government and society.
- M4: To encourage students to participate in conferences, workshops, seminars and research activities.
- M5: To develop partnership with government agencies and industries.

VISION OF THE PROGRAMME

- To be a role model in Mechanical Engineering and Research responsive to global challenges.

MISSION OF THE PROGRAMME

M1- To impart quality Mechanical Engineering education that develops innovative professionals to undertake research/investigations/developmental works independently.

M2- To develop professionals with mastery in Mechanical Engineering field to generate cutting-edge technologies & futuristic knowledge, focusing on the socio-economic needs.

M3- To prepare professionals with emphasis on leadership, team work, adaption to changing needs and ethical conduct.

PROGRAMME: - PRODUCTION & INDUSTRIAL ENGINEERING

Programme Education Objectives (PEOs)

1. To impart education in Production & Industrial Engineering to have all-round development of students in order to serve the global society.
2. To develop the critical thinking and problem solving ability amongst the students through application of various aspects/fundamentals of Production & Industrial Engineering to understand/ analyze/ solve the critical situations in the area amicably.
3. To develop independent research attitude through projects/dissertations and its administrative & financial management as well as its dissemination to the PG students.
4. To create awareness amongst the students for collaborative and multidisciplinary activities through usage of modern/emerging tools, technologies and research publications.
5. To encourage students to be ethically and socially responsible and articulate themselves to be a lifelong learner.

Programme Outcomes (POs)

PO1: An ability to independently carry out research /investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report/document.

PO3: Students should be able to demonstrate a degree of mastery over the area of Production & Industrial Engg. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

PO4: An ability to develop and apply software and hardware tools / techniques for the analysis of problems related to design, manufacturing and optimization.

PO5: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

MASTER OF TECHNOLOGY SCHEME IN MECHANICAL ENGINEERING (PRODUCTION AND INDUSTRIAL ENGINEERING)

SEMESTER – I

S.No.	Course Code	Tutorial	Lecture	Tutorial	Practical	Credits
1	MME2C01	Advanced Machining Processes	3	-	-	3
2	MME2C03	Operations Management	3	-	-	3
3	MME2C05	Computer Aided Manufacturing	3	-	-	3
4	MME2C07	Experimental Design	3	-	-	3
5	MME2E__	Elective I	3	-	-	3
6	MME2E__	Elective II	3	-	-	3
7	MME2S01	Seminar			2	1
8	MME2L01	Advanced Manufacturing Processes Lab	-	-	3	1
		Total	**18**		**5**	**20**
		Total Contact Hours	**23**			

SEMESTER – II

S.No.	Course Code	Course Title	Lecture	Tutorial	Practical	Credits
1	MME2C02	Soft Computing	3	-	-	3
2	MME2C04	Supply Chain Management & Logistics	3	-	-	3
3	MME2E__	Elective-III	3	-	-	3
4	MME2E__	Elective IV	3	-	-	3
5	MME2E__	Elective V	3	-	-	3
6	MME2O__	Open Elective (Non Departmental)	3	-	-	3
7	MME2P02	Project	-	-	2	1
8	MME2L02	Soft Computing Lab	-	-	3	1
		Total	**18**		**5**	**20**
		Total Contact Hours	**23**			

SUMMER VACATION

Course Code	Course Title	P/T	Credits
MME2PW02	Short Term Courses on Personality Development / Soft Skills Preparatory Work for Dissertation / Project		0

SEMESTER - III

Course Code	Course Title	P/T	Credits
MME2D01 / MME2P01 / MME2I01	Dissertation /Project/Internship Part-I		14

SEMESTER - IV

Course Code	Course Title	P/T	Credits
MME2D02 / MME2P04 / MME2I02	Dissertation /Project/Internship Part-II		14

TOTAL CREDITS: 68

*Name of programme will be M. Tech (Industrial & Production Engineering) for the students admitted in academic session 2019-20

LIST OF ELECTIVES (PRODUCTION AND INDUSTRIAL ENGINEERING)

S.No.	Course Code	Course Title	Credits
1	MME2E31/MME2E32	Welding Science & Technology	3
2	MME2E33/MME2E34	Quality and Reliability Management	3
3	MME2E35/MME2E36	Production Planning and Control	3
4	MME2E37/MME2E38	Terotechnology	3
5	MME2E39/MME2E40	Advances in Polymer Matrix Composites	3
6	MME2E41/MME2E42	Advanced Matlab Programming	3
7	MME2E43/MME2E44	Machine Learning	3
8	MME2E45/MME2E46	Modeling & Simulation	3
9	MME2E47/MME2E48	Hybrid Machining Processes	3
10	MME2E49/MME2E50	Machine Vision & Artificial Intelligence	3
11	MME2E51/MME2E52	Strategic Entrepreneurship	3
12	MME2E53/MME2E54	Total Quality Management	3
13	MME2E55/MME2E56	Surface Engineering	3
14	MME2E57/MME2E58	Additive Manufacturing	3
15	MME1E37/MME1E38	Advanced Tribology	3
16	MME3E39/MME3E40	Renewable Energy & Energy Management	3
17	MME3E45/MME3E46	Solar Energy	3

LIST OF OPEN ELECTIVES FOR OTHER DEPARTMENTS

S.No.	Course Code	Course Title	Credits
1	MME2C01	Advanced Machining Processes	3
2	MME2C02	Soft Computing	3
3	MME2C03	Operations Management	3
4	MME2C04	Supply Chain Management & Logistics	3
5	MME2C05	Computer Aided Manufacturing	3
6	MME2C07	Experimental Design	3
7	MME2E51/MME2E52	Strategic Entrepreneurship	3
8	MME2E53/MME2E54	Total Quality Management	3

MME2C01
ADVANCED MACHINING PROCESSES

L	T	P/D	Cr.
3	0	-	3

Course Learning Objectives

1) To establish the need for non-conventional machining and their applications in current manufacturing scenario
2) To get acquainted with basics of the non-conventional machining process including the equipment, mechanism of material removal and process capabilities
3) To identify the distinguished applications of these manufacturing methods in different sectors of Industry
4) To understand the latest developments in the non-conventional machining processes

Course Contents

1. Introduction:

Need for advanced machining processes; An Overview of Modern machining processes including Process capabilities, shape/material applications, physical parameters and process economy considerations **(6 hours)**

2. Mechanical processes:

Abrasive Jet Machining; Ultrasonic Machining; Abrasive Flow Finishing; Magnetic Abrasive Finishing; Abrasive Water Jet Machining **(12 hours)**

3. Thermoelectric advanced machining processes:

EDM; Wire EDM; Laser beam Machining; Plasma Arc Machining; Electron Beam Machining, Ion beam Machining **(10 hours)**

4. Electrochemical and Chemical Processes:

ECM; ECG; Electro stream Drilling; Electrochemical Deburring; Chemical Machining **(6 hours)**

5. Hybrid Machining Processes:

Rotary Ultrasonic Machining, Electro-Chemical discharge Machining (ECDM), hybrid EDM-USM **(6 hours)**

Course Outcomes:

1) Chalk out the ideas for improvement of machining efficiency or performance of these machining techniques
2) Develop the models for describing the process behavior or prediction of machining performance
3) Analyze the latest developments in the area of non-traditional machining

Reference Books:

1) Advanced Machining Processes by V.K. Jain, Allied Publishers Pvt Ltd, New Delhi
2) Modern Machining Processes by P.C. Pandey and H.S. Shan, Tata McGraw- Hill
3) Non-Traditional Machining Processes by Jagdeesha T., I.K. International Publishing
4) Non-Traditional Machining Processes (Research Advances) by J. Paulo Davim, Springer.

MME2C03
OPERATIONS MANAGEMENT

L	T	P/D	Cr.
3	0	-	3

Course Learning Objectives

1. The prime objective of this course is to improve students understanding of the concepts, principles, problems, and practices of operations management.
2. To understand how Enterprise Resource Planning. JIT and MRP systems are used in managing operations.
3. To increase the knowledge, and broaden the perspective of the world in which the incumbents will contribute their talents and leadership in business operations.
4. To understand the managerial responsibility for Operations, even when production functions are outsourced, or performed in regions far off from corporate headquarters.

Course Contents

1. Basics of Production Management:

Types of production, life cycle approach to production system, Productivity and Productivity measures, types of productivity index, productivity improvement, MRP. **(7 hrs)**

2. JIT:

JIT, requirements and problems in implementing JIT, Benefits of JIT, Introduction to JIT purchasing and JIT quality management, Lean manufacturing, Agile manufacturing (**6 hrs)**

3. Supply chain management:

Supply chain management, its importance, objectives and applications. Tenabled supply chain supply chain drives concepts of stockless, VRM and CRM. **(6 hrs)**

4. Business Process Reengineering:

Re-engineering-characteristics, organizational support, responsibility of re-engineering, re-engineering opportunities, choosing the process to re-engineer, success factors and advantages. **(6 hrs)**

5. ERP:

Evolution of ERP, Characteristics, approaches, methodology for implementation, Success factors. **(6 hrs)**

6. Waste Management:

Introduction, classification of waste, systematic approach to waste reduction, waste disposal. **(5 hrs)**

7. Some Case Studies in TQM

Minimum four Case Studies to be explained. **(4 hrs)**

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

1. Identify the elements of operations management and various transformation processes to enhance productivity and competitiveness.

2. Analyze and evaluate various facility alternatives and their capacity decisions, develop a balanced line of scheduling & production / sequencing techniques in operation environments.

3. Develop learning for Business Process Reengineering.

4. Appreciate and improve suitable materials handling principles and practices in the operations.

5. Understand and analyze operations and supply chain management issues in a firm

Reference Books:

1. Mohanty, R. P. and Deshmukh, S. G. "Advanced Operations Management" Pearson Education.
2. Krishnaswamy, K. N.,"Case in Production/ Operations management" Prentice Hall of India.
3. Muhlemann, A., Oakland, J., Lockyer, K., Sudhir, B. and Katyayani, J., "Production and Operations Management", Pearson Education South Asia.
4. Adam, E.E and Ebert, J.R.J," Production and Operations Management" Prentice Hall of India.

MME2C05
COMPUTER AIDED MANUFACTURING

L	T	P/D	Cr
3	0	-	3

Course Learning Objectives

1) To understand the basic concepts of Computer –Aided Manufacturing and its scope
2) To understand the basic concepts of Group Technology and Cellular Manufacturing, clustering algorithm as well as methods to carry out arrangement of machines with in a cell
3) To understand Computer aided process planning and its types and associated aspects
4) To understand Flexible manufacturing systems and related aspects
5) To understand CNC manual part programming and prepare part programs

Course Contents

1. Introduction to Manufacturing

Basic definitions, design activities for manufacturing systems, Planning and control activates for manufacturing system, Manufacturing control, Types of production –low, Medium and high quantity production, Recent Developments (**6 hrs**)

2. Group Technology and Cellular Manufacturing

Part families, parts classifications and coding, Production flow Analysis, cellular Manufacturing- composite part concept, machine cell design, applications of group technology, Grouping parts and machines by Rank order clustering technique, Arranging machines in a G.T. cell. (**10 hrs**)

3. Process Planning

Introduction, Manual process planning, Computer aided process planning – variant, generative, Decision logic- decision tables, decision trees, Introduction to Artificial intelligence. (**6 hrs**)

4. Flexible Manufacturing

Introduction, FMS components, Flexibility in Manufacturing – machine, Product, Routing, Operation, types of FMS, FMS layouts, FMS planning and control issues, deadlock in FMS, FMS benefits and applications. (**8 hrs**)

5. CNC Basics and Part Programming

Introduction, Principle of CNC, Classification of CNC – point to point and continuous path, positioning system- fixed zero and floating zero, Dimensioning- absolute and incremental, Coordinate system, Basic requirements of CNC machine control, CNC words, Manual part programming, (G&M codes only) canned cycles, tool length and radius compensation. (**10 hrs**)

Course Outcomes:

1) Understand Scope of Computer aided manufacturing
2) Apply knowledge of Group Technology and Cellular Manufacturing for formation of cells as well as arrangement of machines within a cell
3) Understand CAPP and its general architecture as well as types and related concepts
4) Understand FMS, manufacturing flexibility, production planning and control in FMS and related issues such as deadlock
5) Prepare manual part programs of simple components

Reference Books:

1. Automation, Productions systems and Computer-Integrated Manufacturing by M.P. Groover, Prentice – Hall
2. Computer Aided Manufacturing by Chang, Wang & WySK
3. Numerical Control and Computer – Aided Manufacturing by Kundra, Rao and Tiwari, Tata Mc Graw Hill.
4. International Journal of Production Research
5. International Journal of Flexible Manufacturing system.

MME2C07
EXPERIMENTAL DESIGNS

L	T	P/D	Cr
3	0	-	3

Course Learning Objectives

1) To introduce the concept of experimentation
2) To expose students to different types of experimental designs like Latin Square Design and Graeco Latin Square Design
3) To understand the nature of full factorial designs with two levels
4) To understand the concept of fractional factorial designs with two levels
5) To understand Taguchi's DOE Approach and Response Surface Methodology

Course Contents

1. Introduction
Introduction, Objectives for experimental designs, Basic design concepts, Steps for the design of experiments, Types of experimental designs, Analysis of Means, Experimental designs and six sigma **(6 hrs)**

2. Completely Randomized Design
Model for a completely randomized design with a single factor, ANOM for a completely randomized design, Randomized Block Design, Incomplete Block Designs, Latin Square Design, Graeco-Latin Square Design **(8 hrs)**

3. Full Factorial Designs With Two Levels
Nature of Factorial Designs, Deleterious Effects of Interactions, Effect Estimates, The 2^3 Design, Built –In- Replication, Role of expected mean squares in experimental design **(6 hrs)**

4. Fractional Factorial Designs with two Levels
2^{k-1} Designs, Effect Estimates and Regression Coefficients, 2^{k-2} Designs, Design Efficiency, John's ¾ Designs **(6 hrs)**

5. Robust Designs
DOE and Taguchi Approach, Experimental Design using orthogonal arrays; Experimental Designs With Two-Level Factors Only; Experimental Designs With Three and Four Level Factors; ANOVA; Analysis using Signal- to Noise Ratios; Some case studies; QT4 Software; Response Surface Methodology; Response surface experimentation; Process improvement with Steepest Ascent; Analysis of Second-order response Surfaces; Central Composite Design; Box-Behnken Design; Analyzing the fitted surface; Design-Expert Software **(10 hrs)**

Course Outcomes:

1) Become conversant with different types of experimental designs
2) Select a suitable design for undertaking experimental investigation in any field of engineering
3) Learn effectively Taguchi's parameter design approach for solving all kinds of Industrial problems
4) Learn effectively Response Surface Methodology for modeling and optimizing responses

Reference Books:

1. Modern Experimental Design by Thomas P Ryan. John Wiley
2. Response Surface Methodology by Myers R H and Montgomery Dc. John Wiley
3. Design of Experiments using the Taguchi Approach by Ranjit K Roy. John Wiley
4. Design and analysis of Experiment by Montgomery D.C. Wiley India
5. Taguchi Methods: A Hands-on Approach by Glen Stuart Peace Addison-Wesley

MME2L01
ADVANCED MANUFACTURING PROCESSES LAB

L	T	P/D	Cr.
0	0	3	1

Course Learning Objectives

1. To learn the basic concepts of advanced manufacturing like CIM, Non-traditional machining methods, Robot assisted welding operations etc.
2. To learn about programming of advanced machining equipment such as CNC WEDM
3. To learn about the capabilities and applications of different advanced machining processes

List of Experiments

1. Study of the various components (ASRS, Robot system, CNC turning center) of the CIM station available at the AMS Lab
2. To assemble two components (using ASRS and Robot system) and perform the inspection of the assembly (using View Flux automated inspection system)
3. To perform different operations on CNC turning center and measure the force and vibration during machining
4. Study of the spark EDM machining set up
5. To perform profile cutting operation at CNC Wire-Cut EDM machine
6. To perform milling operation at CNC vertical milling machine and measure the forces and vibration during machining.
7. To perform drilling operation on rotary ultrasonic machining set up.
8. Study and experiments on robotic pulse MIG welding cell.
9. Study and experiments on robotic pulse TIG welding cell.

Course Outcomes:

1. To perform the different operations on CIM station including the programming for CNC turning center and robot system etc.
2. To perform the experiments on different advanced machining equipments
3. To measure the force and vibration during milling/turning operations

MME2C02
SOFT COMPUTING

L	T	P/D	Cr
3	-	-	3

Course Learning Objectives

1) To understand basics of Artificial Neural Network , Genetic Algorithm, Particle Swarm optimization and fuzzy logic
2) To learn soft computing techniques so as to build computationally intelligent systems that possess human like abilities to reason, learn and handle the uncertainty and vagueness often inherent in real world problems.
3) To solve complex practical problems for which conventional mathematical and analytical methods are inefficient.
4) To implement the soft computing solutions using appropriate tools.

Course Contents

UNIT-1

Introduction to soft computing, Hard Computing versus Soft Computing, Introduction to artificial neural network, Biological Neural network, Comparison between Artificial and Biological Neural Network , Model of an Artificial Neuron, Characteristics of Neural Network , Basic building blocks of Artificial Neural Network: Network Architecture, Learning methods, Activation function **(5 hrs)**

UNIT-II

McCulloch Pitts Neuron Model, Simple perceptron model, Limitations of Perceptron Single layer feed forward network, Learning process in single layer feed forward network, Multi layer feed forward neural network, Back propagation learning, Stopping criteria, Problems with backpropagation **(8 hrs)**

UNIT-III

Introduction to Genetic Algorithm, Advantages and Disadvantages, GA's Basic Terms, Implementation of GA, Fitness function, genetic operators, Representation/Encoding Schemes, Selection of parents, cross over methods and rate, mutation operator and rate, Convergence of genetic algorithm, Optimizing numerical functions using GA, difference and similarities between GA and other traditional methods **(9 hrs)**

UNIT-IV

Basic Particle Swarm Optimization, Global Best PSO, Local Best PSO, gbest versus lbest PSO, Velocity Components, Algorithm Aspects: (particle initialization, stopping conditions and defining the terms iteration and function evaluation) Social Network Structures, Basic PSO Parameters, Basic variations: velocity clamping, Inertia weights. **(6 hrs)**

UNIT-V

Fuzzy versus crisp, Crisp set Theory , operation on crisp sets, properties of crisp sets ,crisp relation, Fuzzy sets: Membership function, basic fuzzy set operations, properties of fuzzy sets ,fuzzy relations, Crisp logic, Predicate Logic, Fuzzy logic, Fuzzy quantifiers, Fuzzy inference, Fuzzy rule based system, De-fuzzification methods **(12 hrs)**

Course Outcomes:

1) Student will be able to understand concept of soft computing and fundamental theory and concepts of neural networks
2) Student will be able to apply neural networks to prediction and pattern classification problems
3) Student will be able to apply Genetic Algorithm to solve optimization problems
4) Student will be able to apply Particle swarm optimization to solve optimization problems
5) Students will be able to apply fuzzy logic to solve engineering problems having uncertainty

Reference Books:

1. Saroj Kauhik and Sunita Tiwari, Soft computing fundamentals, Techniques and Applications , McGraw Hill Education Private Limited
2. S. Rajasekaran & G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, PHI.
3. David.E. Goldberg, Genetic Algorithms in Search, Optimization and machine learning, Addison Wesley.
4. S. N. Sivanandam & S. N. Deepa, Principles of Soft Computing, Wiley – India.
5. Saroj Kaushik, Artificial Intelligence, Cengage Learning.
6. M. Mitchell, An Introduction to Genetic Algorithms, Prentice-Hall.
7. S. N. Sivanandam , Sumuthi & S. N. Deepa, Introduction to Neural Networks using MATLAB
8. S. N. Sivanandam , Sumuthi & S. N. Deepa, Introduction to fuzzy logic using MATLAB
9. Timothy ,J.Ross Fuzzy Logic with Engineering Applications,Wiley.

MME2C04
SUPPLY CHAIN MANAGEMENT AND LOGISTICS

L	T	P/D	Cr.
3	0	-	3

Course Objectives:

To develop:

Ability to address SCM problems in a holistic approach by taking into account general management concepts, human resources, environmental concerns, quality, technological and economic aspects

Ability to analyze structure and discuss situations to identify problems in the field of SCM and evaluate their complexity and apply suitable methodologies and strategies to design a solution for an SCM problem using ICT.

Ability to evaluate different alternatives and select the solution to be implemented to elaborate solid arguments to convince and motivate decision makers, select the proper SCM partners and then plan and coordinate the project to implement the solution for creation of new value in the supply chain for customers, society and the environment.

Course Contents

1. **Understanding the Supply Chain, Performance, Drivers and Obstacles**
   Objectives of supply chain, Stages of supply chain, Supply chain process cycles, Push/pull view of supply chain processes, Importance of supply chain flows, Examples of supply chain, Strategic decisions in supply chain management. Supply Chain Performance**,** Supply chain strategies, Achieving strategic fit, Product life cycle, Supply Chain drivers and Obstacles, Four drivers of supply chain – inventory, transportation, facilities, and information, Obstacles to achieve strategic fit. **(10 hours)**

2. **Planning Demand and Supply in a Supply Chain**,
   Role of forecasting in a supply chain, Forecasting methods in a supply chain, Basic approach to demand forecasting, Time series forecasting methods, Aggregate planning resources. Managing economies of scale in a supply chain**,** Role of cycle inventory in a supply chain. **(4 hours)**

3. **Transportation and Coordination in a Supply Chain**
   Facilities affecting transportation decisions, Transport selection, Modes of transportation and their performance characteristics, Trade-offs in transportation decision, Tailored transportation, Routing and scheduling in transportation, Making transportation decisions

in practice, Models for transportation and distribution, Third party logistics (3PL). Coordination in a Supply chain**,** Lack of supply chain coordination and the Bullwhip effect, Effect of lack of coordination on performance, Obstacles to coordination, Achieving coordination in practice**.** **(6 hours)**

4. **Source Management and IT in Supply Chain**
   Inventory management in supply chain, Information technology in supply chain, Typicality solution, Reverse supply chain, Reverse supply chain Vs. Forward supply chain. **(5 hours)**

5. **Advanced topics in SCM**
   Green, Lean, Sustainable, Global and Agile supply chain Management, Quality in Supply Chain. IoT **(6 hours)**

6. **Some Case Studies in SCM**
   Minimum four Case Studies to be explained. **(4 hours)**

Course Outcomes:

1. Understand the nomenclature of supply chains and the different ways through which supply chains can become effective & efficient in the market
2. Analyze the importance of the term "value creation" and to propose actions in the field of management of logistics costs towards the creation of value
3. Understand and recognize the forces shaping international logistics in a global market
4. Define the principles of scheduling and planning in supply chain management.
5. Identify the principles of customer and supplier relationship management in supply chains
6. Understand the role of aggregate planning, inventory, IT and coordination in a supply chain.

Reference Books:

1. Christopher Martin, "Logistics and Supply Chain Management", Pearson Education Asia.
2. Chopra Sunil and Meindl Peter, "Supply Chain Management – Strategy, planning and operation's", Pearson Education, Asia.
3. Kapoor K K, KansalPurva, "Marketing logistics: A Supply Chain Approach", Pearson Education Asia.
4. Mohanty, R.P and Deshmukh, S.G., "Supply Chain Management", Pearson Education Asia.
5. Fawcett, S. E., Ellram, L. M and Ogden, J. A., "Supply Chain Management" Pearson Education Asia.

MME2L02
SOFT COMPUTING LAB

L	T	P/D	Cr.
0	0	3	1

Course Learning Objectives

1) How to use Artificial Neural Network, Genetic algorithm, Fuzzy logic Toolbox™ in MATLAB
2) Learn development of algorithms to solve real life applications using ANN, Genetic Algorithm, Fuzzy logic, Particle Swarm optimization.

List of Experiments

1. Write a program for solving linearly separable problems (OR, AND) using Perceptron Model.
2. To use MATLAB ANN toolbox to solve XOR using back propagation algorithm
3. Write a program to solve non-linearly separable problem XOR using back propagation algorithm
4. Let function $f(x) = \frac{(2x^2-x)}{8}$ be defined on the interval [0,30] Write a program to determine the maximum of the function in given interval using Genetic Algorithm
5. Use of Genetic toolbox to minimize function

$$f(\mathbf{x}) = -\frac{1+\cos\left(12\sqrt{x_1^2+x_2^2}\right)}{0.5(x_1^2+x_2^2)+2}$$

$x_i \in [-5.12, 5.12]$, for all i = 1, 2.

6. Use of Genetic toolbox to minimize an objective function subject to nonlinear inequality constraints and bounds using the Genetic Algorithm.
7. Solve Greg Viot's fuzzy cruise controller using MATLAB Fuzzy logic toolbox.
8. Solve Air Conditioner Controller using MATLAB Fuzzy logic toolbox
9. Fuzzy logic control of washing machine using MATLAB Fuzzy logic toolbox
10. Let function $f(x) = \frac{(2x^2-x)}{8}$ be defined on the interval [0,30] Write a program to determine the maximum of the function in given interval using Particle Swarm Optimization

Course Outcomes:

1. To develop the logic given in problem statement using algorithms in NN and basics of toolbox
2. To develop the logic given in problem statement using operations in fuzzy logic and basics of toolbox
3. Develop real life applications using NN and Fuzzy Logic
4. Able to solve optimization problem using Genetic algorithm and Particle swarm optimization.

MME2E31/MME2E32
WELDING SCIENCE & TECHNOLOGY

L	T	P/D	Cr.
3	0	-	3

Course Learning Objectives

1) To understand the physics of welding arc, its theories, metal transfer modes and various forces acting on metal droplet
2) To understand various welding power sources, characteristics desired and their selection
3) To understand various welding processes
4) To understand coated welding electrodes, their composition and selection
5) To understand weldability of metals such as steel, Cast iron Aluminum
6) To understand various non destructive methods of testing weldments
7) To understand weld joint design

Course Contents

1. **Introduction**
   Evolution of welding, Classification, Importance and applications, Heat Sources and Shielding Methods **(4 hrs)**

2. **Physics of Welding Arc**
   Welding Arc, Voltage Distribution along arc, theories of cathode and anode mechanism, arc characteristics, arc efficiency, heat generation at cathode and anode, effect of shielding gas on arc, isotherms of arc, modes of metal transfer, forces acting on metal droplet, arc blow **(9 hrs)**

3. **Welding Power Sources**
   Types, static and dynamic characteristics, selection **(3 hrs)**

4. **Arc Welding Processes**
   Manual metal arc welding, Gas tungsten Arc welding, metal inert gas welding, pulsed MIG welding, submerged arc welding, electroslag welding, electrogas welding, resistance welding, friction welding, laser beam welding, electron beam welding **(8 hrs)**

5. **Welding Electrodes**
   Types, electrode coating ingredients and their functions, types of heavy coated electrodes, specification and selection of electrodes **(3 hrs)**

6. **Weldability of Metals**
   Effect of alloying elements, weldability of steel, cast iron, Aluminum **(5 hrs)**

7. **Weld Joint Design**
   Types of welds and joints, joint design, description of welds: terminology, definitions and weld symbols, edge preparation, sizing of welds in structure, Design for static loading, weld calculations for lap, butt and fillet welds, design for fatigue loading **(4 hrs)**

8. **Non Destructive Testing of Weldments**
   Visual inspection, Dye-penetrant inspection, Magnetic particle inspection, Ultrasonic inspection, Radiographic inspection **(4 hrs)**

Course Outcomes:

1) Understand the welding arc and parameters affecting it
2) Understand various welding processes
3) Select welding power source as per requirement
4) Understand coated welding electrodes and its composition
5) Understand weldability of metals
6) Understand various non-destructive testing of weldments
7) Carry out weld design calculations in lap, butt and fillet welds

Reference Books:

1. Principles of Welding (processes, Physics, Chemistry and Metallurgy) by Robert W. Messler, Wiley
2. Metallurgy of Welding by Lancaster
3. Welding Metallurgy by S. Kuo, Wiley
4. Modern Welding Technology by Carry Howard B.
5. Welding Processes and Technology by R. S. Parmar
6. Welding Handbooks by AWS
7. Welding Technology and Design by V.M. Radha krishnan, New Age.
8. Physics of Welding by J.F. Lancaster, Pergamon
9. Welding Process Technology- Houldcroft, P.T., Cambridge University Press
10. Modern Arc Welding Technology by S.V. Nadkarni, Oxford IBH.

MME2E33/MME2E34
QUALITY & RELIABILITY MANAGEMENT

L	T	P/D	Cr.
3	0	-	3

Course Learning Objectives

1) To understand the basic concepts of Quality Engineering and apply them to address the practical Quality problems of Industrial World.
2) To understand the basic concepts of Quality Circle: its objectives, structure and techniques.
3) To impart the knowledge to the students about various Design of Sampling Plans and Control Charts.
4) To impart the knowledge to the students about T.Q.M., Q.F.D., ISO-9000, Six Sigma and their applications in Manufacturing and Service Sectors.
5) To understand the basic fundamentals of Reliability Engineering and apply them to know about the practical aspects of Industrial World.

Course Contents

1. Introduction

Concept of Quality, Need, Factor influencing quality, Types of Quality, Quality Control, Cost of Quality Control, Quality Assurance, Benefits, Modern concept, Inspection and Quality Control, Quality Characteristics, Quality Circles **(6 hrs)**

2. Statistical Concepts and Control Charts

Review of fundamental statistical concepts, Frequency distribution, Central tendency, measures of dispersion, Probability distributions, statistical Quality Control, Theory of Control charts, Control charts for variables and attributes ($\overline{X}$, R, p, np and C chart), their advantages and disadvantages, Applications. **(8 hrs)**

3. Acceptance Sampling

Introduction, Advantages and Disadvantages, Operating Characteristics curve, Producer's and consumer's risk, Quality indices for Acceptance Sampling plans, Types of Sampling Plans-Single, Double, Multiple and Sequential Sampling plans, Sampling plan for variables, Continuous Sampling plans, Skip lot Sampling plans, Chain Sampling plan. **(8 hrs)**

4. **Total Quality Management**
   Introduction, Concept of Total quality, Quality Function Deployment tools for continuous quality improvement, The ISO 9000 family of standards, Six Sigma and other extensions of TQM. **(8 hrs)**

5. **Reliability**
   Introduction, Factor effecting Reliability, Failure and its types, Failure curve, Majors of reliability, MTBF, MTTF, Relationship b/w reliability failure rate and MTBF and its characteristics, System reliability (components in series and parallel) System reliability with stand by components, Reliability Improvement Technique-Redundancy, Derating, Operating characteristics curve, Reliability and life testing plans, Types of test, Maintainability, Availability. **(10 hrs)**

Course Outcomes:

1) Students will be able to understand the fundamentals of Quality
2) Students will be able to understand basic statistical concepts, decision preparatory of the control charts and applications.
3) Students will be able to analyse the Process Capability Behaviour
4) Students will be able to understand the concepts of Acceptance Sampling, Sampling Plans and their applications
5) Students will be able to know about the practical aspects of T.Q.M., Q.F.D., ISO-9000, Six Sigma and other extensions of T.Q.M.
6) Students will be able to understand the Reliability and its relationship with Availability and Maintainability

Reference Books:

1. Statistical Quality control by C. Gupta.
2. Modern Methods for Quality Control and Improvement by Harrism M. Wadsworth.
3. Statistical Quality control by E.L. Grant.
4. Fundamental of Quality Control and Improvement by Amitava Mitra.
5. Total Quality Management by Besterfield
6. Statistical Quality Control by Douglas C. Montgomery
7. Total Quality Management by P.N. Mukherjee
8. Reliability Mathematics by B.L. Amstadter
9. Reliability Engineering by E. Balagurusamy

MME2E35/MME2E36
PRODUCTION PLANNING & CONTROL

L	T	P/D	Cr.
3	0	-	3

Course Learning Objectives

1) To understand the basic concepts of Production Planning and Control, Preplanning Planning, Production Planning and Control Functions.
2) To understand the basic concepts of Product Development and Design.
3) To impart the knowledge of Inventory Control, V.E.D. analysis, S-D-E analysis, F-S-N analysis H-M-L analysis and ABC analysis, Safety stocks and service levels.
4) To impart the knowledge of Evaluation of Material Processes and Value Analysis Tests.

Course Contents

1. Introduction

Basic concepts of Production Planning and Control, Preplanning Planning, Production Planning and Control Functions: Estimating, Scheduling, Routing, Sequencing, Loading, Dispatching, Expediting, Inspection and Evaluation. **(4 hrs)**

2. Product Development and Design

Effect of competition on design, Long-range Planning, Company policy, product analysis, marketing aspects, the product characteristics, functional aspect, operational aspect, durability and dependability, Aesthetic aspect; Economic analysis, Profit and competitiveness, The three S's:- Standardization, Simplification and Specialization. Break Even Analysis. **(9 hrs)**

3. Inventory Control

Definition, classification, objectives of inventory control, functions, economic order quantity various inventory models. Numericals on inventory control. Inventory carrying costs, factors affecting inventory costs. V.E.D. analysis, S-D-E analysis, F-S-N analysis H-M-L analysis and ABC analysis. Safety stocks, their objectives safety stocks and service levels. **(9 hrs)**

4. **Evaluation of Material and Processes**
   Introduction, Value Analysis, consideration of new techniques and materials, Value Analysis Tests, material utilization of a product or assembly. Numerical problems on material utilization of a product. Value Engineering job plan and various phases of job plan in systematic value engineering approach. **(10 hrs)**

Course Outcomes:

1) Understand the basic concepts of Production Planning and Control and significance of Production Planning and Control function.
2) Understand the major concepts of Production Development and Design and their applications.
3) Develop an understanding of various inventory Control Concepts, Inventory models, Inventory Cost and ABC Analysis.
4) Understand the evaluation of materials and processes and concept of Value Analysis.

Reference Books:

1. Production Planning and Control: Samuel Eilon
2. Production Planning and Control: K.C. Aggarwal & K.C. Jain
3. Industrial Engg. & Operation Management by S.K. Sharma & Savita Sharma.
4. Production Planning and Control: King J.R.
5. Production Planning and Control: Sharma, Hari Rraghu Rama.
6. Production Planning and Control: Narasimhan Seetha-rama L.
7. Production Planning and Control: S.K. Mukhopadhyay
8. The Fundamentals of Production Planning and Control: Stephen N. Chapman

MME2E37/MME2E38
TEROTECHNOLOGY

L	T	P/D	Cr
3	-	-	3.0

Course Learning Objectives

1) To enhance the basic understanding of concepts of Terotechnology.
2) To understand the basic concepts of Maintenance policies and planning.
3) To explore the basic fundamentals of Repair-Discard decisions, cost-analysis and optimum module size.
4) To learn the basic concepts of Spare Parts Management.
5) To experience the latest developments in the field of Terotechnology.

Course Contents

Introduction:
Introduction, Importance of Terotechnology, definitions and concepts used in Terotechnology, objectives, advantages and applicationsof Terotechnology. **(8 hrs)**

Maintenance Policies and Planning:
Maintenance strategies, planned maintenance procedure, scientific maintenance, safety aspects in maintenance, simulation of various maintenance systems, development of planned maintenance schedule, budgeting and cost control. **(8 hrs)**

Repair-Discard Decisions:
Introduction, factors affecting repair-discard decisions, cost-analysis and optimum module size. **(6 hrs)**

Spare Parts Management:
Material and store control, consideration of spare provisioning on operational availability. **(6 hrs)**

Latest Developments in Terotechnology:
Introduction, Computer Aided Maintenance, Computerized Maintenance Models, Computerized Maintenance Planning, Computerized Maintenance Management Systems, Reliability Centered Maintenance, Total Productive Maintenance. **(8 hrs)**

Course Outcomes:

1. Enhance the knowledge of Terotechnology.
2. Understand the major concepts of Maintenance Policies and Planning.
3. Make out theRepair-Discard decisions, Cost-analysis and Optimum module size.
4. Understand the importance of Spare Parts Management.
5. Experience thelatest developments in the field of Terotechnology.

Reference Books:

1. Maintenance Planning and Control by Enthory Kelly, EWP-NWP, N. Delhi
2. Reliability Engineering by A.W. Von, Prentice Hall, N.D.
3. Principles of Planned Maintenance by Clifton R.H., McGraw Hill.
4. Queues, Inventories and Maintenance by P.M. Morse, Prentice Hall, NY.
5. Frank Gradon, Maintenance Engineering: Organisation and Management Applied Science Publishers Ltd., Landon.
6. Keith, R. Mobley et al., Maintenance Engineering Handbook, McGraw-Hill.
7. White, E.N., Maintenance Planning Control and Documentation, Gower Press, Teakfield Ltd., England.
8. N.K. Shivananda, World Class Terotechnology, McGraw Hill Education, New Delhi.

MME2E45/MME2E46
MODELING AND SIMULATION

Course Learning Objectives:

1. To understand the basics of modeling and simulation
2. To understand the various statistical models used in modeling and simulation
3. To understand stochastic simulation and its applications to queuing models and inventory models
4. To understand the modeling and simulation of manufacturing and material handling systems
5. To carry out modeling of simulation of manufacturing and material handling systems

Course Contents

1. Introduction to Modeling: Concept of system, continuous and discrete systems; Types of models and simulation; Discrete event simulation: Time advance mechanisms, components and organization of simulation model, steps in simulation study, advantages and disadvantages of simulation (**6hrs)**

2. Statistical Models in Simulation: Discrete, continuous, Poisson and empirical distributions, output data analysis for a single system, comparing alternative system configurations, statistical procedures for comparing real world observations with simulation output data, generation of arriving processes, verification and validation of simulation models. (**12hrs)**

3. Stochastic Simulation: Random number generation: Properties of random numbers, techniques of generating random numbers, generation of random variates, Monte Carlo simulation and its applications in queuing models and inventory models. (**10hrs)**

4. Simulation of Manufacturing and Material Handling Systems:
Models of manufacturing systems, models of material handling systems, goals and performance measures; Issues in manufacturing and material handling simulation: Modeling downtime failures, trace driven models. (**8hrs)**

5. Case Studies on Simulation Packages: Simulation of queuing system (bank/job shop), simulation of manufacturing and material handling systems. (**6hrs)**

Course Outcomes:

1. Understand the basics of modeling and simulation
2. Understand the various statistical models used in modeling and simulation
3. Understand stochastic simulation and its applications to queuing models and inventory models
4. Understand the modeling and simulation of manufacturing and material handling systems
5. Carry out modeling of simulation of manufacturing and material handling systems

Reference Books:

1. Banks, J., Nelson, B.L., Carson, J. S., and Nicol, D., "Discrete EventSystem Simulation", Pearson Education.
2. Law, A.M., and Kelton, W.D., "Simulation Modeling and Analysis",McGraw-Hill.
3. Schwarzenbach, J., and Gill, K.F., "System Modeling and Control",Butterworth-Heinemann.
4. Carrie, A., "Simulation of Manufacturing Systems", John Wiley &Sons.
5. Viswanadham, N., and Narahari, Y., "Performance Modeling ofAutomated Manufacturing System", Prentice-Hall of India.
6. Theory of Modeling & Simulation, B.P. Zeigler, Taqgon Kim and Herbert Praehofer, Academic Press.
7. Handbook of Simulation: Principles, Methodology, Advances, Applications & Practice, Jerry Banks.
8. Discrete Systems Simulation, Khoshnevis.
9. Simulation Made Easy, Charles Harrell and KerimTumay, Engineering and Management Press.
10. Simulation with Arena, W. David Kelton, Randall P. Sadowski, and Deborah A. Sadowski, McGraw-Hill.
11. Pro Model Software - Student Version, Published by the Day Grp.

MME2E39/MME2E40
ADVANCES IN POLYMER MATRIX COMPOSITES

L	T	P/D	Cr.
3	-	-	3.0

Course Learning Objectives:

1. To get familiar with the basic ideas of composites especially polymer composites
2. To get acquainted with various processing and joining techniques of PMCs
3. To recognize the distinguished applications of PMCs in different segments of industries
4. To understand the recent developments occurring in this field

Course Content

Overview of Composites
Composites, classification, MMC, PMC, CMC, advantages, disadvantages, applications. Polymer matrix composites: classification, matrix materials, reinforcement materials.

(2 hrs)

Processing of Polymer Composites
Primary and secondary processing techniques: autoclave, hand lay-up, spray lay-up, filament winding, pultrusion, compression moulding, injection moulding, machining, forming, etc.

(12 hrs)

Joining of Polymer Composites
Thermal, mechanical and electromagnetic joining of PMCs: mechanical fastening, friction welding, friction stir welding, chemical bonding, adhesive bonding, hot plate welding, ultrasonic welding, microwave joining, etc., process principle, influencing parameters, advantages, disadvantages and applications.

(14 hrs)

Applications and Recent Advancement in PMCs
Application of PMCs: Automotive, aerospace, marine, chemical industry, electrical & electronics industry, biomedical, etc., conducting polymer, polymeric nanocomposites, biodegradable PMCs, green PMCs, etc.

(08 hrs)

Course Outcomes:

- Understand the concept of polymer composites, its matrix and reinforcement
- Decide and recommend appropriate processing and joining techniquesfor accomplishing different industrial needs
- Analyze the recent advancements occuring in this field

Reference books:

- ASM Handbook Volume 21: Composites, ASM International.
- Composite Materials Handbook, M Schwartz,McGraw Hill Inc.
- Manufacturing Techniques for Polymer Matrix Composites (PMCs), Advani and Hsiao, Woodhead Publishing.
- Processing of Polymer Matrix Composites: Processing and Applications, Mallick, CRC Press.
- Joining of Polymer-Metal Hybrid Structures: Principles and Applications, Filho and Blaga, Wiley.
- Processing of Green Composites, Rakesh and Singh, Springer.

MME3E39/MME3E40
RENEWABLE ENERGY & ENERGY MANAGEMENT

L	T	P/D	Cr.
3	0	-	3

Course Learning Objectives

1. To understand the basic concepts of Renewable Energy and apply them to address the practical applications.
2. To understand the basic concepts and applications of sources of renewable energy.
3. To impart the knowledge to the students about various contemporary methods to utilize different sources of renewable energy.
4. To impart the knowledge to the students about energy conservation management.

Course Contents

1. **Solar Energy**
   The sun as a perennial source of energy, direct solar energy utilization; solar thermal applications – water heating systems, space heating and cooling of buildings, solar cooking, solar ponds, solar green houses, solar thermal electric systems; solar photovoltaic power generation; solar production of hydrogen. **(6 hrs)**

2. **Energy from Oceans**
   Wave energy generation – energy from waves; wave energy conversion devices; advantages and disadvantages of wave energy; Tidal energy – basic principles; tidal power generation systems; estimation of energy and power; advantages and limitations of tidal power generation; ocean thermal energy conversion (OTEC); methods of ocean thermal electric power generation. **(6 hrs)**

3. **Wind energy**
   Basic principles of wind energy conversion; design of windmills; wind data and energy estimation; site selection considerations. **(4 hrs)**

4. **Hydro power**
   Classification of small hydro power (SHP) stations; description of basic civil works design considerations; turbines and generators for SHP; advantages and limitations. **(5 hrs)**

5. **Biomass and bio-fuels**
   Energy plantation; biogas generation; types of biogas plants; applications of biogas; energy from wastes. **(5 hrs)**

6. **Geothermal energy**
   Origin and nature of geothermal energy; classification of geothermal resources; schematic of geothermal power plants; operational and environments problems. **(5 hrs)**

7. **Energy conservation management**
   The relevance of energy management profession; general principles of energy management and energy management planning; application of Pareto's model for energy management; obtaining management support; establishing energy data base; conducting energy audit; identifying, evaluating and implementing feasible energy conservation opportunities; energy audit report; monitoring, evaluating and following up energy saving measures/projects. **(10 hrs)**

Course Outcomes:

1. The students will be able to understand importance of Renewable Energy Sources.
2. The students will be able to utilize different sources of renewable energy in engineering applications.
3. The students will be able to work on different methods to utilize renewable sources.
4. The students will be able to understand and make energy audit report.

Reference Books:

1. 'Renewable energy resources'. John W Twidell and Anthony D Weir.
2. 'Renewable energy – power for sustainable future'. Edited by Godfrey Boyle. Oxford University Press in association with the Open University.
3. 'Renewable energy sources and their environmental impact'. S.A.Abbasi and Naseema Abbasi. Prentice-Hall of India.
4. 'Non-conventional sources of energy'. G.D. Rai. Khanna Publishers.
5. 'Solar energy utilization'. G.D. Rai. Khanna Publishers.
6. 'Renewable and novel energy sources'. S.L.Sah. M.I. Publications.
7. 'Energy Technology'. S.Rao and B.B. Parulekar. Khanna Publishers.

MME3E45/MME3E46
SOLAR ENERGY

L	T	P/D	Cr.
3	0	-	3

Course Learning Objectives

1. To understand the basic concepts of Renewable Energy, specifically solar energy and apply them to address the practical applications.
2. To understand the basic concepts and applications of solar energy.
3. To impart the knowledge to the students about various contemporary methods to utilize solar energy.
4. To impart the knowledge to the students about solar thermal power generation.

Course Contents

1. **Solar Radiation**
   Characteristics, Earth-sun relations, Estimation on horizontal and tilted surfaces, Radiation characteristics of opaque and transparent material. **(5 hrs)**

2. **Flat Plate Collectors**
   Description, theory, Heat capacity effects, Time constant, Measurement of thermal performance, Air heaters. **(6 hrs)**

3. **Evacuated Tubular Collectors**
   One axis, Two axis, Solar tracking, Cylindrical, Spherical and Parabolic and Paraboloid concentrators. Composite collectors, Central receiver collectors. **(6 hrs)**

4. **Heat Storage**
   Sensible and latent heat storage, Chemical energy system, performance calculations. **(5 hrs)**

5. **Flow Systems**
   Natural and forced flow systems, Water heating systems for domestic, industrial and space heating requirements, Solar distillation. **(5 hrs)**

6. **Solar Heating and Cooling**
   Direct, indirect and isolated heating concepts, Cooling concepts, Load calculation methods, Performance evaluation methods. **(4 hrs)**

7. **Solar Thermal Power Generation**
   Introduction, Paraboloidal concentrating systems, Cylinderical concentrating systems, Central receiver system. **(5 hrs)**

8. **Solar Refrigeration and Air Conditioning Systems**
   Introduction, Solar refrigeration and air conditioning systems, Solar desiccant cooling. **(4 hrs)**

Course Outcomes:

1. The students will be able to understand importance of Solar Energy amongst Renewable Energy Sources.
2. The students will be able to utilize different sources of renewable energy in engineering applications.
3. The students will be able to work on different contemporary methods to utilize solar energy, especially solar thermal power generation.

Reference Books:

1. Solar Thermal Engineering Process by Duffie and Beckman.
2. Advanced Solar Energy Technology by H.P. Garg.
3. Solar Energy by S.P. Sukhatme.
4. Solar Energy by J.S. Hsieh.
5. Solar Thermal Engineering by P.J. Lunde.

MME2E51/MME2E52
STRATEGIC ENTREPRENEURSHIP

L	T	P/D	Cr.
3	0	-	3

Course Learning Objectives

1) To make students aware on significance and various facets of entrepreneurship.
2) To create awareness on role of SSIs and EDPs in economic development of the country.
3) To make students understand basics of marketing and financial management.
4) To create awareness on basics of business incubation and create awareness on incubation facilities in the country.

Course Contents

1. **Entrepreneurs and Entrepreneurship**
   Concept, Role and Significance of Entrepreneurship; Entrepreneurial Myths; Entrepreneurs - Types and Characteristics; Need for Entrepreneurs; Special Entrepreneurial Aspects - Social Entrepreneurship, Women Entrepreneurship, International Entrepreneurship, Rural Entrepreneurship, Corporate Entrepreneurship, Technical Entrepreneurship; Entrepreneurship. **(8 hrs)**

2. **Small Scale Industries And Entrepreneurship Development**
   Concept, Types and Role of Small Scale Industries; Problems of Small Scale Industries; Industrial Sickness and Remedies; Entrepreneurship Development; Entrepreneurship Development Programmes (EDPs) - Objectives and Contentss; Government and Non-Government Agencies involved in Entrepreneurship Development. **(10 hrs)**

3. **Marketing Management and Financial Management**
   Market Analysis; Industrial Potential Survey; Demand Forecasting; Marketing Aspects for Entrepreneurs - Pricing, Branding, Packaging, After Sales Service, Advertising, Sales Promotion etc.; Sources of Finance for Entrepreneurs; Factors affecting Selection of Sources of Finance; Role of Banks and Financial Institutions in Entrepreneurship Development. **(12 hrs)**

4. **Business Incubation**
   Introduction; Origin and Development of Business Incubators in India and Other Countries; Types of Business Incubator Models; Business Supports; Thrust Areas for Business Incubation in India; Role of Business Incubators for Entrepreneurs, Institutes, Government and Society; Sustainability Issues for Business Incubators in India. **(10 hrs)**

Course Outcomes:

1) Understanding the dynamic role of entrepreneurship and small businesses
2) Role of SSIs in economic development and government support for entrepreneurship development.
3) Market research and financial planning for small business.
4) Strategic business supports being provided by Business Incubators.

Reference Books:

1. Small Business Management An Entrepreneur's Guidebook (McGraw-Hill)
2. Project Management - Strategic Design and Implementation by David Cleland (McGraw-Hill).
3. Marketing Management by Kotler (Prentice Hall of India)
4. Sustainable Strategic Management by Steed and Steed (Prentice Hall of India)
5. Engineering Economics Principles by Henry Steiner (McGraw-Hill).

MME2E53/MME2E54
TOTAL QUALITY MANAGEMENT

L	T	P/D	Cr.
3	0	-	3

Course Objectives:

- The objectives of this course is to introduce the main principles of business and social excellence, to generate knowledge and skills of students to use models and quality management methodology for the implementation of total quality management in any sphere of business and public sector and to describe it in its broader perspective.
- To provide a forum for discussion on quality, and to provide an exposure and discussion on quality issues to analyze some existing methods and techniques of quality management within an organization and to advise on how to overcome various quality issues.
- To give exposure to students on a basic competence with the tools and techniques used by real-life quality assurance department in maintaining quality w.r.t Implication of Quality on Business and challenges in Quality Improvement Programs.

Course Contents

1. **Concept of Quality**
   Products and services, quality of products and services, definition of quality, dimensions of quality and their measure **(4 hrs)**

2. **Quality Management Practices**
   Various approaches to control and management of quality,: inspection oriented, statistical process control oriented, assurance oriented and TQM oriented approaches. **(8 hrs)**

3. **Cost of Quality**
   Productivity and quality relationship, concept of cost of quality, cost of conformance, prevention, appraisal and failure cost, internal and external failures, quality cost estimation in engineering and service industries. **(4 hrs)**

4. **Organizing for Quality**
   Company wide organization for quality management, prevention, control and improvement, continuous improvement process. **(4 hrs)**

5. **Human Aspects in Management of Quality**
   Commitment, motivation, and involvement for quality,top management, management and worker participation, zero defects, quality circle, small group activity. **(4 hrs)**

6. **Quality Systems**
   Introduction, ISO 9000 Series of standards, Other quality systems, ISo 14000 series standards, concepts of ISO 14001, requirements of ISO 14001, EMS benefits.
   (6 hrs)

7. **Some Case Studies TQM**
   Minimum four Case Studies to be explained. **(4 hrs)**

Course Outcomes:

1. Develop an understanding of quality management philosophies, framework and realize the importance of significance of quality leading to identification of requirements for quality improvement programs

2. Know the principles of total quality management and peculiarities of their implementation.

3. Analyze the TQM tools and techniques to improve the product and process quality.

4. Use quality management methods for analyzing and solving problems of organization by applying modern tools to improve quality of the product.

5. Know business excellence models and be able assess organization's performance making reference to their criteria.

Reference Books:

1. Besterfield, D.H, Michna, C.B, Besterfield, G. H and Sacre, M.B, "Total Quality Management" Pearson Education Asia.
2. Mukherjee, P. N., "Total Quality Management" Prentice Hall of India.
3. Rajaram, S., "Total Quality Management" Biztantra.
4. Ramasamy, S. "Total Quality Management" Mc Graw Hill Education.

MME2E55/MME2E56
SURFACE ENGINEERING

L	T	P/D	Cr.
3	0	-	3

Course Learning Objectives

To impart an in-depth knowledge of surface degradation phenomena and various surface modification technologies used for the performance enhancement of mechanical components.

Course Contents

1. **Introduction:**
   Surface; Structural and Topographical States of Surface**,** Concept of Surface Engineering and its significance, different types of surface treatments, their benefits and limitations. **(4 hrs)**

2. **Degradation of Surface:**
   Causes of Surface Degradation, Different Modes of Wear; Adhesive, Abrasive, Erosion, Surface Fatigue, Fretting, Wear Testing, Different Forms of Corrosion, Tribo-Corrosion, Corrosion Testing Methods, Lubrication; Modes of Lubrication, Advantages and Limitations. **(10 hrs)**

3. **Conventional Surface Modification Methods:**
   Surface Hardening Methods; Flame Hardening, Induction Hardening, High-Energy Beam Hardening, Diffusion Coatings; Carburizing, Nitriding, Carbonitriding, Boronizing, Hot Dip Coatings, Galvanized Coating, Zinc-Aluminium Coating, Weld Over-Lay methods; SMAW, FCAW, ESW, Electro-Deposition, Electro-less Coating. **(10 hrs)**

4. **Advanced Surface Modification Techniques:**
   Thermal Spraying; Flame Spray, Wire-Arc Spray, Detonation Spray, HVOF, Warm Spray, Suspension Plasma Spray, Cold Spray, Chemical Vapour Deposition (CVD), Physical Vapour Deposition (PVD), DC-Magnetron Sputtering, RF-Sputtering, Friction Surfacing; Friction Coating, Friction Stir Processing, Laser Cladding, Microwave glazing, Microwave Cladding. **(10 hrs)**

5. **Characterization of Engineered Surface:**
   Measurement of Hardness, Porosity, Roughness, Fracture toughness, Elemental Analysis by Energy Dispersive Spectroscopy, Phase Identification by X-Ray Diffraction Analysis, Microstructural and Topographical Analysis by SEM, TEM, AFM & STM. **(10 hrs)**

Course Outcomes:

1. To be informed about the characteristics of a surface and various surface degradation phenomenon.
2. To be aware of different surface protection methods against wear and corrosion.
3. To have an understanding of wear/corrosion testing and characterization methods.
4. To develop new engineered surfaces for specific applications.

Reference Books:

1. **Burakowski, T., and Wierzchon, T.** Surface engineering of metal: principles, equipment, technologies, CRC Press LLC, Florida.
2. **Holmberg, K., and Matthews, A.**, *Coatings Tribology: properties, mechanisms, techniques and applications in surface engineering*, Tribology and interface engineering series, Ed. 2nd, Elsevier, Oxford.
3. **Mellor, B.G.,** *Surface coatings for protection against wear*, Woodhead Publishing Limited, Cambridge.
4. **Pawlowski, L.** *The science and engineering of thermal spray coatings*, John Wiley & Sons Ltd, England.
5. **Stachowiak, G.W., and Batchelor, A.W.,** Engineering Tribology, Tribology series 24, Elsevier, Amsterdam.
6. ***ZumGahr, K.-H,*** Microstructure and wear of materials, Tribology series, Elsevier, Amsterdam.

MME1E37/MME1E38
ADVANCED TRIOBOLOGY

L	T	P/D	Cr.
3	0	-	3

Course Learning Objectives

1) To understand the concept of tribology, factors affecting tribological process and the surface measurement techniques.
2) To gain knowledge about the friction process, its types and the friction measurig techniques.
3) To impart the knowledge of wear, its types, wear measurement and the controlling processes, lubrication process and its types.
4) To understand micro and nano tribology and the various types of tools used in nano tribological process.

Course Contents

1. Introduction

Introduction to tribology and its historical background. Industrial importance. Factors influencing tribological phenomena. **(2 hrs)**

2. Engineering Surfaces-Properties and Measurement

Engineering surfaces - surface characterization, computation of surface parameters. Surface measurement techniques. Apparent and real area of contact. Contact of engineering surfaces. **(5 hrs)**

3. Surface Contact

Hertzian and Non-hertzian contact. Contact pressure and deformation in non-conformal contacts. **(6 hrs)**

4. Friction

Genesis of friction, friction in contacting rough surfaces, sliding and rolling friction, Various laws and theory of friction. Stick slip friction behaviour, frictional heating and temperature rise. Friction measurement techniques. **(6 hrs)**

5. Wear

Wear and wear types. Mechanisms of wear -Adhesive, abrasive, corrosive, erosion, fatigue, fretting, etc., wear of metals and non-metals. Wear models – asperity contact, constant and variable wear rate, geometrical influence in wear models, wear damage. Wear in various mechanical components, wear controlling techniques. **(7 hrs)**

6. Lubrication

Introduction to lubrication. Lubrication regimes. Lubricants and their properties. Solid Lubricants. **(6 hrs)**

7. Nanotribology

Introduction to micro and nano tribology. Measurement tools used in nanotribology: SFA, STM, AFM microscale and nanoscale wear Nanofabrication/nanomachining Nanohydrodynamics Nanolubrication Tribological issues in MEMS. **(8 hrs)**

Course Outcomes:

1) Explain the concept of tribology, factors affecting tribological process and the surface measurement techniques.
2) Understand the friction process, its types and the friction measurig techniques.
3) Explain wear process, its types, wear measurement and the controlling processes, lubrication process and its types.
4) Understand micro and nano tribology and the various types of tools used in nano tribological process.

Reference Books :

1. "Engineering Tribology" by Prasanta Sahoo, PHI.
2. "Engineering Tribology" by Stachowiak & Batchelor, Elsevier.
3. "Nanotribology and Nanomechanics: An Introduction" by Bharat Bhushan, Springer.
4. "Nanotribology" by Hsu & Ying, Springer.

MME2E57/MME2E58
ADDITIVE MANUFACTURING

L	T	P/D	Cr.
3	0	-	4

Course Learning Objectives

1.To understand the basic fundamentals and generic process chain of additive manufacturing
2. To understand the difference between various AM processes and their selection criteria
3. To understand the materials selection for additive manufacturing
4. To understand the accuracy issues and design challenges of additive manufacturing
5. To understand the post processing of a product fabricated through additive manufacturing
6. To understand the role of rapid prototyping and rapid tooling in industries

Course Contents

1. Introduction

Introduction to AM, Difference between additive and subtractive manufacturing, AM evolution, Distinction between AM &CNC machining, Generic AM Process chain: The Eight Steps in Additive Manufacturing, Production planning and control of AM, Advantages and limitations of AM, Reverse engineering, Role of additive manufacturing product design and development, Application of AM for Aerospace, defense, automobile, Bio-medical and general engineering industries **(6 hrs)**

2. AM Technologies

Classification of AM Processes**,** Vat photo-polymerization processes, Powder bed fusion processes, Extrusion based processes, Material jetting based processes, Binder jetting processes, Sheet lamination processes, Directed energy deposition processes, Direct write technologies, Micro and Nan additive processes, recent development in AM Methods Guidelines for AM method selection, challenges of selection, Selection of AM technologies using decision methods **(8 hrs)**

3. Materials Science for AM

Discussion on different materials used, Use of multiple materials, multifunctional and graded materials in AM, Role of solidification rate, Evolution of non-equilibrium structure, structure property relationship, new materials development, Grain structure and microstructure, Monitoring and control of defects, transformation **(5 hrs)**

4. Accuracy Issues in AM

Properties of metallic and nonmetallic additive manufactured surfaces, Stress induced in additive manufacturing (AM) processes. Surface roughness problem in rapid prototyping, Part deposition orientation and issues like accuracy, surface finish, build time, support structure, cost etc **(6 hrs)**

5. Design for AM

DFMA concepts and objectives, Exploring design freedoms, Design tools for AM, CAD model preparation, Part Orientation and support generation, Model Slicing, Tool path Generation, Softwares for AM Technology: MIMICS, MAGICS **(6 hrs)**

6. Post processing of AM parts

Removal of Supports, Hollowing out parts, Inclusion of Undercuts and Other Manufacturing Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Identification of markings/ numbers etc. surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non-thermal and thermal techniques **(4 hrs)**

7. Rapid Prototyping and Rapid Tooling Processes

Fundamentals of Rapid Prototyping, physics of processes, principles and process mechanism of SLA, SGC, LOM, FDM and SLS processes, their advantages, limitations, and applications **(4 hrs)**

Course outcomes:

1. Classify and compare the various additive manufacturing processes
2. Select suitable materials and additive manufacturing process for a particular application
3. Suggest feasible solution for design and processing issues of additive manufacturing
4. Design CAD models of products having simple geometry
5. Explain the basic concepts of rapid tooling processes.

Reference Books:

1. Chua Chee Kai, Leong Kah Fai, "Rapid Prototyping: Principles & Applications", World Scientific.
2. Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer.
3. Ali K. Kamrani, EmandAbouel Nasr, "Rapid Prototyping: Theory & Practice", Springer.
4. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer.
5. Hilton P.D. and Jacobs P.F., "Rapid Tooling: Technologies and Industrial Applications", CRC press.
6. Andreas Gebhardt, Understanding additive manufacturing: rapid prototyping, rapid tooling, rapid manufacturing, Hanser Publishers.
7. J.D. Majumdar and I. Manna, Laser-assisted fabrication of materials, Springer Series in Material Science.
8. L. Lu, J. Fuh and Y. S. Wong, Laser-induced materials and processes for rapid

prototyping, Kluwer Academic Press.

9. Zhiqiang Fan and Frank Liou, Numerical modeling of the additive manufacturing (AM) processes of titanium alloy, lnTech.
10. Hopkinson, N., Hague, R.J.M. and Dickens, P.M., Rapid Manufacturing and Industrial Revolution for the Digital Age, John Wiley and Sons Ltd, Chichester.
11. Noorani, R., Rapid Prototyping: Principles and Applications, John Wiley & Sons, Inc., New Jersey,
12. Gibson, I., Software Solutions for Rapid Prototyping, Professional Engineering Publication Ltd.
13. Patri, K. V., and Weiyin, Ma, Rapid Prototyping – Laser based and Other Technologies, Kluwer Academic Publishers, U.S.A.
14. Mortenson, M.E., Geometric Modelling, John Wiley and Sons, Inc.
15. Saxena, A., Sahay, B., Computer Aided Engineering Design, Anamaya Publishers, New Delhi.
16. Zeid, I., Mastering CAD/CAM, Tata McCraw Hill.

MME2E47/MME2E48
HYBRID MACHINING PROCESSES

L	T	P/D	Cr.
3	-	-	3.0

Course Learning Objectives:

1. To establish the credential of employing hybrid machining processes in present day scenario
2. To get familiar with the fundamental concepts of hybrid machining processes including machine setup, mechanism of material removal and process capabilities
3. To recognize the unique features and notable applications of these techniques in different segments of industries
4. To understand the recent developments occurring in this field

Course Contents

Overview of Hybrid Machining Processes (HMP)
Evolution of machining processes: conventional, advanced and hybrid machining processes, necessity of hybrid machining processes, classification and applications **(2 hrs)**

Electrochemical Hybrid Machining Processes
Experimental setup, process principle, process parameters, advantages, limitations and applications of electrochemical hybrid machining processes: electrochemical grinding, electrochemical honing, electrochemical buffing, electrochemical super finishing. **(10 hrs)**

Thermal Hybrid Machining Processes
Experimental setup, process principle, process parameters, advantages, limitations and applications of electric discharge grinding, electric discharge abrasive or diamond grinding, electrochemical discharge machining, electrochemical discharge grinding. **(10 hrs)**

Assisted Hybrid Machining Processes
Experimental setup, process principle, process parameters, advantages, limitations and applications of **Vibration assisted HMPs**: ultrasonic assisted lapping, ultrasonic assisted ECM, ultrasonic assisted ECH, ultrasonic assisted EDM, ultrasonic assisted AFM; **Laser assisted HMPs**: laser assisted ECM, laser assisted EDM; **Magnetic field assisted HMPs**: magnetic field assisted ECM, magnetic field assisted EDM, magnetic field assisted abrasive flow machining.
(14 hrs)

Course Outcomes:

- Understand the fundamental concept of various hybrid machining processes
- Decide and recommend appropriate technique for accomplishing different manufacturing needs
- Develop the concepts for enhancing the process performance characteristics
- Formulate the models for describing the process behaviour or prediction of process performances

Reference books:

- Manufacturing Science, Ghosh & Mallik, Affiliated East-West Press Pvt. Ltd.
- Advanced Machining Processes, V K Jain, Allied Publishers Pvt. Ltd
- Advanced Machining Processes: Non-traditional and Hybrid Machining Processes, Hassan El-Hofy, McGraw-Hill Education
- Advanced Machining Technology, James Brown, McGraw-Hill Inc.
- Handbook of Manufacturing Engineering and Technology, Andrew Y. C. Nee (Editor), Springer

MME2E49/MME2E50
MACHINE VISION & ARTIFIAL INTELLIGENCE

L	T	P/D	Cr.
3	0	-	3

Course Learning Objectives

1) To gain an understanding of the fundamental issues and techniques for extracting information from digital images.
2) To have knowledge of well established methods for processing, segmentation, feature extraction and recognition of objects.
3) To provide the student with programming experience from implementing computer vision and object recognition applications

Course Contents

1. Introduction

Machine vision, difference between computer vision and machine vision, relationship of machine vision to other fields , Applications of machine vision, typical machine vision tasks, components of digital image processing system, Digital images , types of images, Elements of machine vision system, Basic relationship between pixels (neighbors of a pixel, connectivity, ,path, foreground, background, connected component, boundary, interior) Labeling of connected components, Distance measure **(7 hrs)**

2. Image Processing

Digitization, Noise, levels of operations, look up table, Image enhancement techniques by point processing (Negative of image, Contrast stretching, Histogram Equalization, Histogram specification), Image enhancement based on the neighborhood of pixels (spatial domain and frequency domain) spatial domain techniques (Low pass filters and high pass filters, High boost filter), Image enhancement in frequency domain (Low pass and High pass filters) **(8 hrs)**

3. Image Analysis

Segmentation of images (Region based, Edge detection),Region based- thresholding, Types of thresholds, Iterative threshold selection, Adaptive thresholding, Region growing by pixel aggregation, Split and merge algorithm, Edge detection- point detection, line detection, edge detection (Roberts, Prewitt, Sobel, Laplacian operations) **(7 hrs)**

4. **Description**
   Shape representation, Topological shape descriptors, Contour-based Shape Representation Techniques- Simple Shape Descriptors , Signatures, Fourier descriptors, Boundary moments, Polygon approximation , Chain code, Region based shape representation techniques- simple shape descriptors, Moment based features, Convex Hull, Skeleton of a region, Medial axis transform **(9 hrs)**

5. **Pattern Recognition**
   Pattern recognition methods- Structural methods, syntactic methods, Template matching, Artificial neural network- biological neural model, neuron model, advantages and disadvantages, characteristics of artificial neural network, usefulness and capabilities perceptron-single layer, multi layer, Back propagation Neural Network **(9hrs)**

Course Outcomes:

1) Student will be able to understand the application of computer vision in industrial tasks
2) Students will have the knowledge of various methods of enhancing Images
3) Students will be able to segment the images using spatial domain and frequency domain methods
4) Student will be able to find features invariant to translation, rotation, scale
5) Student will be able to recoganise /classify the objects using Artificial Neural Network

Reference Books:

1. Digital image processing by Rfael C. Gonzalez and Richard E. Woods.
2. Fundamentals of Digital image processing by Anil K. Jain
3. Digital image processing-Concepts, Algorithms and Scientific Applications by Bernd Jahne.
4. Machine vision by Ramesh Jain, Rangachar Kasturi, Brian G. Schunck.
5. Introduction to Neural Networks using MATLAB, S. N. Sivanandam , Sumuthi & S. N. Deepa

MME2E41/MME2E42
ADVANCED MATLAB PROGRAMMING

L	T	P/D	Cr.
3	-	-	3.0

Course Learning Objectives

1. Become familiar with the main features of the MATLAB integrated design environment and its user interfaces .
2. Understand the MATLAB Desktop, Command window and the Graph Window .
3. Able to do simple and complex calculation using MATLAB.
4. Able to understand how to automate commands with scripts ,
5. To Increase automation by encapsulating modular tasks as user-defined functions.
6. Understand the tools that are essential in solving engineering problems

Course Contents

UNIT-I

Introduction to MATLAB, MATLAB Windows, Variables, Keywords, Special variables, Managing the workspace, Complex Numbers, Number display formats, Mathematical functions, MATLAB search path, Script M-File use, Use of Special functions-disp, input, pause, waitforbuttonpress, Comments, Block comments, punctuation and aborting execution, Simple arrays, Array addressing, Array construction, array orientation,, scalar-array mathematics, array-array mathematics, standard arrays, array manipulation, array sorting, subarray searching, array manipulation functions, array size, multidimensional arrays, Numeric Data types- integer data types, floating point data types, structure creation, structure manipulation, retrieving structure content, structure functions, Relational operators, logical operators, operator precedence, relational and logical functions **(10 Hours)**

UNIT-II

Control flow-for loops, While loops, if-Else-End, Switch-Case, Try-Catch block, M-FILE function construction rules, input and output arguments, nested functions,Function handles and anonymous functions **(12 Hours)**

UNIT - III

Two dimensional graphics- The plot function, Line style, Markers, Colors, plot grids, axes box and labels, Customizing plot axes, Multiple plots, Multiple figures, Subplots, Interactive plotting tools, Specialized 2D plots, Three- Dimensional graphics- Line plots, Scalar functions of two variables, Mesh plots, Surface plots, Contour plots, How to do Debugging in MATLAB, Native data files, directory management **(7 Hours)**

UNIT IV

Basic stastical analysis,Basic data analysis, Data Analysis and statistical functions, on dimensional interpolation, two dimensional interpolation,zero finding, Minimization in one dimension, minimization in higher dimension **(9 Hours)**

Course Outcomes:

1) Student will be able to generate matrix and manipulate matrix
2) Student will be able to use cell and structures
3) Student will be able to use control flow statements
4) Student will be able to write script file
5) Students will be able to use functions
6) Students will be able to plot 2-D and 3-D graphs
7) Students will be able to perform statistical analysis, interpolation and optimization

Reference Books:

1. Mastering MATLAB 7 BY Duane Hanselman, Bruce Lttle field
2. MATLAB Programming for Engineersby Stephen J. Chapman
3. Introduction to MATLAB for Engineers by William J. Palm III
4. A Guide to MATLAB: For Beginners and Experienced Users by Brian R. Hunt

MME2E43/MME2E44
MACHINE LEARNING

L	T	P/D	Cr.
3	-	-	3.0

- To familiarize the students with several powerful search techniques for automatically solving complex problems.
- To introduce students to the basic concepts and techniques of Machine Learning.
- To enable the students to design and implement machine learning solutions to classification, regression, and clustering problem

Course Contents

UNIT-1

Overview of Machine learning, Linear algebra(Scalar, vector, tensor, basic operations ,norms, linear combinations span linear independence, machine operations special matrix , matrix decomposition, Introduction to Probability Theory Discrete and Continuous Random Variables, Conditional, Joint, Marginal Probabilities Sum Rule and Product Rule Bayes'Theorm, Independence Conditional Independence Chain Rule of Probability, Expectation, variance covariance, some relations for expectation and covariance, Machine Representation of Numbers, overflow ,underflow, Condition Number, Derivatives, Gradient Hessian, Jacobian, Taylor, Matrix calculus **(8 Hours)**

UNIT-II

Unconstrained optimization, constrained optimization, Introduction to Numerical optimization Gradient descent-1, Gradient descent-2 Proof of steepest descent Numerical gradient calculation stopping criteria, The learning paradigam ,A linear regression,Linear regression least squares Gradient descent, coding linear regression,generalized function for linear regression,Goodness of fit Bias Variance Trade off, Gradient Descent Algorithms **(8 Hours)**

UNIT-III

Introduction to Deep learning, Logistic Regression, Binary Entropy cost function, OR Gate Via Classification, NOR,AND,NAND Gates,XOR Gate, Differentiating the sigmoid,Gradient of logistic regression,code for logistic regression, Multinomial classification-Introduction,Multinomial classification-one hot vector, Multinomial classification-Softmax,Schematic of Multinomial logistic regression, Biological Neuron, Structure of artificial

Neuron,Feedforward Neural Network, Introduction to Back propagation **(7 Hours)**

UNIT-IV

Introduction to convolution Neural Networks, Types of convolution, CNN Architecture(LeNet and Alex Net,VGGnet, GoogleNet, ResNet, DenseNet), Train Network for Image classification, Semantic segmentation, Hyperparameter optimization, Transfer learning Activation functions, Learning rate decay, weight initialization, data normalization, batch norm, Introduction to RNNs,sequence classification, Training RNN-Loss and BPTT, Vanishing Gradients and TBPTT, RNN Architecture,LSTM, Deep RNN, Bi-RNN **(7 Hours)**

UNIT-V

kNN,Binary decision trees, binary regression trees,bagging, Random forest, boosting, gradient boosting, unsupervised learning and Kmeans, Agglomerative clustering, Probability Distributions-Gaussian, Bernoulli, Covariance Matrix of Gaussian distribution, Central limit theorem, Naïve Bayes, Maximum likelihood estimation, Principal Component Analysis, Support vector Machine, MLE,MAP,Bayesian Regression **(9 Hours)**

Course outcomes:

1. Have a good understanding of the fundamental issues and challenges of machine learning
2. Have an understanding of the strengths and weaknesses of many popular machine learning approaches.
3. Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.
4. Be able to design and implement various machine learning algorithms in a range of real-world applications.
5. Ability to recognize and implement various ways of selecting suitable model parameters for different machine learning