MADANAPALLE INSTITUTE OF TECHNOLOGY & SCIENCE
MADANAPALLE

(UGC-AUTONOMOUS)

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MASTER OF TECHNOLOGY

ADVANCED MANUFACTURING SYSTEMS

COURSE STRUCTURE
And
DETAILED SYLLABUS (R20)

For the students admitted to

Master of Technology in Advanced Manufacturing Systems from the academic year 2020-21 Batches onwards

M. Tech Regular Two-Year P. G. Degree Course

CURRICULUM STRUCTURE

I Year I Semester

Sl. No.	Course Code	Course Title	Hours Per Week				Credits
			L	T	P	Total Contact Hours	
1	20AMSP101	Advanced Machining Processes	3	0	0	3	3
2	20AMSP102	Automation in Manufacturing	3	0	0	3	3
	DISCIPLINE ELECTIVE – I		3	0	0	3	3
3	20AMSP401	Advanced Materials Characterization					
	20AMSP402	Advanced Tool Engineering Design					
	20AMSP403	Micro and Nano Manufacturing Technology					
	20AMSP404	Advanced Casting and Welding Technology					
	DISCIPLINE ELECTIVE – II		3	0	0	3	3
4	20AMSP405	Theory of Metal Forming					
	20AMSP406	Industrial Surface Engineering					
	20AMSP407	Quality and Reliability Engineering					
	20AMSP408	Supply Chain Management					
5	20ICP101	Research Methodology and IPR	2	0	0	2	2
6	20AMSP201	Advanced Machining Laboratory	0	0	4	4	2
7	20AMSP202	Modelling and Simulation Laboratory	0	0	4	4	2
	AUDIT COURSE – I		2	0	0	2	0
8	20AUP901	Disaster Management					
	20AUP902	Sanskrit for Technical Knowledge					
	20AUP903	Constitution of India					
	20AUP904	Pedagogy Studies					
Total			**16**	**0**	**8**	**24**	**18**

I Year II Semester

Sl. No.	Course Code	Course Title	Hours Per Week				Credits
			L	T	P	Total Contact Hours	
1	20AMSP103	Robotics in Manufacturing	3	0	0	3	3
2	20AMSP104	Advanced Production and Operations Management.	3	0	0	3	3
	DISCIPLINE ELECTIVE – III		3	0	0	3	3
3	20AMSP409	Advanced Materials Processing					
	20AMSP410	Advanced Operations Research					
	20AMSP411	Rapid Prototyping and Tooling					
	20AMSP412	Design and Analysis of Experiments					
	DISCIPLINE ELECTIVE – IV		3	0	0	3	3
4	20AMSP413	FEA in Manufacturing					
	20AMSP414	Design and Manufacturing of MEMS and MICRO Systems					
	20AMSP415	Flexible Manufacturing Systems					
	20AMSP416	Precision Engineering					
5	20AMSP203	Computer Aided Engineering Laboratory	0	0	4	4	2
6	20AMSP204	Production Tooling Laboratory	0	0	4	4	2
7	20AMP701	Mini Project	0	0	4	4	2
	AUDIT COURSE – II		2	0	0	2	0
8	20AUP905	English for Research Paper Writing					
	20AUP906	Value Education					
	20AUP907	Stress Management by Yoga					
	20AUP908	Personality Development through Life Enlightenment Skills					
Total			**14**	**0**	**12**	**26**	**18**

Curriculum Structure for II Year

II Year I Semester

Sl. No.	Course Code	Course Title	Hours Per Week				Credits
			L	T	P	Total Contact Hours	
	DISCIPLINE ELECTIVE – V		3	0	0	3	3
1	20AMSP417	Additive Manufacturing Technology					
	20AMSP418	Manufacturing Informatics					
	20AMSP419	Artificial Intelligence in Manufacturing					
	20AMSP420	Product Design and Development					
	OPEN ELECTIVE		3	0	0	3	3
2	20OEP307	Sensors for Intelligent Manufacturing and Condition Monitoring					
	20OEP308	Total Quality Management					
	20OEP309	Industrial Safety and Maintenance Engineering					
	20OEP310	Machine Learning					
3	20AMSP702	Dissertation Phase I	0	0	20	20	10
		Total	**6**	**0**	**20**	**26**	**16**

II Year II Semester

Sl. No.	Course Code	Course Title	Hours Per Week				Credits
			L	T	P	Total Contact Hours	
1	20AMSP703	Dissertation Phase I	0	0	32	32	16
		Total	**0**	**0**	**32**	**32**	**16**

I YEAR I SEMESTER SYLLABUS

M. Tech. I Year I Semester

20AMSP101 ADVANCED MACHINING PROCESSES

L	T	P	C
3	0	0	3

Course Prerequisite: Theory of Metal Cutting & Tool Design, Material Technology

Course Description:
There is a need for machine tools and processes which can accurately and easily machine the most difficult-to-machine materials and components with intricate and accurate shapes. In order to meet these challenges, a number of newer material removal processes have now been developed to the level of commercial utilization. These newer methods are also called advanced machining in the sense that conventional tools are not employed for metal cutting. Instead, energy in its direct form is used to remove the material from the components. This course aims at bringing the students up-to-date with the latest technological developments and research trends in the field of advanced machining processes.

Course Objectives:
1. To impart knowledge on the principles of material removal mechanism of advanced machining processes such as mechanical, electro-chemical and thermal.
2. To provide in depth knowledge in selection of advanced machining process to fabricate intricate and complex shapes in difficult to machine material.
3. To provide awareness of advanced finishing processes to achieve submicron/nan surface finish.
4. To evaluate and select suitable manufacturing process for machining advanced materials for wide variety of applications.
5. To differentiate between conventional processes and non-conventional processes and develop niche applications based on these processes.

UNIT I: INTRODUCTION
History of machining process, Material Removal Processes: Traditional machining, Non-Traditional Machining, Advanced machining process: evolution, need, classifications, Overview of advanced machining processes and hybrid machining processes. **(5)**

UNIT II: MECHANICAL PROCESSES
USM, AJM, WJM, AWJM, AFM, Magneto Rheological Abrasive Finishing (MRAF) processes - Process principle and mechanism of material removal, Process Parameters, Process Capabilities, Applications, Operational characteristics, Limitations. **(10)**

UNIT III: ELECTRO-THERMAL PROCESSES
EDM, WEDM, LBM, EBM, IBM, PAM - Process principle and mechanism of material removal, Process parameters and characteristics, Surface finish and accuracy, Process Capabilities, Applications, Limitations.
(10)

UNIT IV: CHEMICAL & ELECTRO-CHEMICAL PROCESSES
Chemical Machining (CHM), Photo-Chemical Machining (PCM), and Bio-Chemical Machining (BCM) processes Electrochemical Machining (ECM), Micro-ECM - Process principle and mechanism of material removal, Process Parameters, Process Capabilities, Applications, Operational characteristics, Limitations, environmental impacts. **(10)**

UNIT V: HYBRID MACHINING PROCESSES

Electrochemical Discharge Grinding, Electrochemical Honing, Electro Chemical Deburring, Ultrasonic-Assisted ECM & EDM, Laser Assisted ECM, Electro Stream Drilling, Shaped Tube Electro Machining, Electro-erosion Dissolution Machining, Abrasive Electro Discharge Machining, Brush Erosion-Dissolution Mechanical Machining. **(10)**

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Classify the various advanced machining processes based on energy principles.
2. Utilize the mechanical energy to machining the hard material.
3. Understand material removal mechanism by using electro-thermal energy and its applications.
4. Select the chemical and electro chemical processes for micro-machining to fabricate micro-devices.
5. Identify and select the suitable hybrid machining processes for new materials.

Text Books:

1.Jain V. K., "Advanced Machining Processes", Allied Publishers, New Delhi, 2008.

2.Hassan El-Hofy, "Advanced Machining Processes: Non-traditional and Hybrid Machining Processes", McGraw-Hill Co., New York.

Reference Books:

1. Pandey, P. C. and Shan, H. S., "Modern Machining Processes", Tata McGraw Hill Co, New Delhi.
2. Mishra P. K, "Non-conventional Machining", Narosa Publishing House

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

M. Tech. I Year I Semester

20AMSP102 AUTOMATION IN MANUFACTURING

L	T	P	C
3	0	0	3

Course Prerequisite: FMS

Course Description:
This course reviews the introduction to automation, Material Handling, Overview of Material Handling Equipment, Storage Systems, Automated Production Lines and Line balancing method to reduce lead time.

Course Objectives:

1. The principles of automation, importance of automated flow lines and its types.
2. Study the elements in automation, types of automation and levels of automation.
3. Outline of the system configurations used in automated production
4. Recognize and articulate the foundational assumption of the transfer mechanism, types of transfer mechanism that may be used for work part transfer.
5. Automated assembly systems, and their associated system configurations, list the hardware components used for parts delivery at workstations Outline typical automated assembly.

UNIT I: INTRODUCTION TO AUTOMATION
Automation in Production Systems-Automated Manufacturing Systems, Computerized Manufacturing Support Systems, Reasons for Automation, Automation Principles and Strategies. Basic elements of an automated Systems, Advanced Automation Functions, Levels of automation, Production concepts and Mathematical Models, Costs of manufacturing operations. **(9)**

UNIT II: INTRODUCTION TO MATERIAL HANDLING SYSTEMS
Overview of Material Handling Equipment, Considerations in Material Handling System Design, 10 Principles of Material Handling, Material Transport Systems, Automated Guided Vehicle Systems, Monorails and other Rail Guided Vehicles, Conveyor Systems, Analysis of Material Transport Systems. **(9)**

UNIT III: STORAGE SYSTEMS
Storage System Performance, Storage Location Strategies, Conventional Storage Methods and Equipment, Automated Storage Systems, Engineering Analysis of Storage Systems. **(9)**

UNIT IV: AUTOMATED PRODUCTION LINES
Analysis of Transfer Lines with no Internal Storage, Analysis of Transfer lines with Storage Buffers. Manual Assembly Lines - Fundamentals of Manual Assembly Lines, Alternative Assembly Systems, Design for Assembly, Analysis of Single Model Assembly Lines. **(9)**

UNIT V: LINE BALANCING ALGORITHMS
Automated Assembly Systems -: Fundamentals of Automated Assembly Systems, Design for Automated Assembly, and Quantitative Analysis of Assembly. Electrochemical Discharge Grinding, Electrochemical Honing, Electro Chemical Deburring, Ultrasonic-Assisted ECM & EDM, Laser Assisted ECM, Electro Stream Drilling, Shaped Tube Electro Machining, Electro-erosion Dissolution Machining, Abrasive Electro Discharge Machining, Brush Erosion-Dissolution Mechanical Machining. **(9)**

Course Outcomes:

1.Explain types of automation, components of automation, strategies and levels of automation and advanced automation functions.

2.Understand automated transfer and storage system, recognize the equipment's used in auto- mated transfer and storage system Classify the various advanced machining processes based on energy principles.

3.Summarize the various automated storage systems and automatic data capture.

4. Apply the transfer lines with and without storage buffers in manual assembly line.

5. Apply line balancing algorithms to various manual assembly lines problems Select the chemical and electro chemical processes for micro-machining to fabricate micro-devices.

Text Books:

1.Mikel P. Groover, Automation, Production systems and computer integrated manufacturing, Pearson Education, 3rd Edition, 2007.

2.Chris Mc Mohan, Jimmie Browne, CAD CAM: Principles, Practice and Manufacturing Management, Pearson edu. (LPE).

Reference Books:

1.Buckinghsm W, Automation, Haper & Row Publishers, New York, 2005

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

M. Tech. I Year I Semester **Discipline Elective I**

20AMSP401 ADVANCED MATERIALS CHARACTERIZATION

L	T	P	C
3	0	0	3

Course Prerequisite: Materials Science Engineering

Course Description:

This course focuses on the principal methods required to characterize broad range of materials such as metal, alloys, semiconductors, insulators, polymers, ceramics, nanostructures etc. for their applications based on mechanical, electrical, optical, thermal properties of materials. Characterization of materials is essential to the systematic development of new materials and understanding how they behave in practical applications.

Course Objectives:

1. Study the various materials characterization techniques.
2. Get knowledge of instrumentation & working principle of the characterization tools.
3. Learn to analyze the properties of materials by using appropriate tool.
4. Identify the importance of characterization techniques.
5. Use the various instruments for the projects.

UNIT I: INTRODUCTION AND STRUCTURE ANALYSIS TOOLS

Introduction to materials and Techniques, X-ray diffraction: phase identification, indexing and lattice parameter determination, Analytical line profile fitting using various models, Neutron diffraction, Reflection High Energy Electron Diffraction, and Low Energy Electron Diffraction. **(8)**

UNIT II: MICROSCOPY TECHNIQUES

Optical microscopy, transmission electron microscopy (TEM), energy dispersive X-ray micro-analysis (EDS), scanning electron microscopy (SEM), Rutherford backscattering spectrometry (RBS), atomic force microscopy (AFM) and scanning probe microscopy (SPM). **(12)**

UNIT III: THERMAL ANALYSIS AND ELECTRICAL CHARACTERIZATION TECHNIQUES

Differential thermal analysis (DTA), Differential Scanning Calorimetry (DSC), Thermo- gravimetric analysis (TGA); Electrical resistivity, Hall effects, Magnetoresistance. **(8)**

UNIT IV: OPTICAL CHARACTERIZATION TECHNIQUES

UV-VIS-NIR spectroscopy, Fourier transform infrared spectroscopy, Raman spectroscopy, X-ray photoelectron spectroscopy. **(8)**

UNIT V: NONDESTRUCTIVE AND MECHANICAL TESTING

Liquid penetrant testing and ultrasonic testing, Micro indentation testing, Nano-indentation Testing, Indenter types, Load displacement curves, Analysis of nano-indentation test data-Hard- ness and Elastic Modulus, Factors affecting Nano indentation test data, Nano indentation of thin films and small volume of materials. **(9)**

Course Outcomes:

1. Identify phase composition of materials by XRD.
2. Measure grain size of the material by microscopic techniques. Evaluate the surface morphology by using SEM and AFM.
3. Determine the thermal stability by using DTA, DSC and TGA
4. Discuss the electronic state and chemical state of elements by using XPS.
5. Describe the working principle of important material characterization tools. Analyze the results of nano-indentation test. Select appropriate characterization technique to analysis a specific property.

Text Books:

1. S Zhang, L. Li and Ashok Kumar, Materials Characterization Techniques, CRC Press 2008.
2.P. E. J. Flewitt and R K Wild, Physical methods for Materials Characterization, IOP Publishing 2003.

Reference Books:

1.Douglas B. Murphy, Fundamentals of light microscopy and electronic imaging, 2001, Wiley-Liss, Inc. USA.

2.B.D. Cullity and S.R. Stock, Elements of X-ray diffraction 2001, Prentice Hall, Inc. USA.

3.D.B. Williams and C. Barry Carter, Transmission electron microscopy 4 volumes, Springer, 1996, USA.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

M. Tech. I Year I Semester **Discipline Elective I**

20AMSP402 ADVANCED TOOL ENGINEERING DESIGN

L	T	P	C
3	0	0	3

Course Prerequisite: Manufacturing Process

Course Description:
The advanced tool engineering tools are required to produce components for volume production by using sophisticate tools. The quality and efficiency of the components production depends upon the tools used with ease. The productivity and quality of the parts production depends on tools and equipment used.

Course Objectives:
1. Provides an overview of tool materials, tool geometry, different cutters used.
2. Understand and apply various cutting tools for different machining process and understand the international coding.
3. Provide knowledge on various locators, clamps fastening methods.
4. Understand and use various drill jigs and fixtures for variety of components.
5. Study and apply knowledge to produce sheet metal components using various types of Press tools.

UNIT I: BASIS OF TOOL ENGINEERING
Introduction- Design of cutting tools: tool materials – tool geometry – single point cutting tools– tipped tools – Milling cutters – Drills – form tools – Broaches – gear cutting tools – Grinding wheels. Cutting force analysis in turning & milling – Design of tool holders for single point tools – Boring bars – Selection of tools for machining applications. Concept and principles in tool engineering, Tool types – features and applications. **(9)**

UNIT II: CUTTING TOOL MATERIALS
Introduction -Cutting tool materials-composition properties and applications. ISO specification for cutting tools. Single point and multi point cutting tools and their applications. Types of cutting tools – Carbide, Ceramics, Cubic Boron Nitride (CBN), PCBN, Coated Cutting tools, Tool holders ISO designation for tool holders**.** **(9)**

UNIT III: LOCATING AND CLAMPING DEVICES
Introduction-Design of fixtures: Degree of freedom, 3-2-1 method of location, Standard work holding devices – principles of location and clamping – Types of clams-adjustable clamps, Two point clamps, Adjustable clamps, Spider clamps, Latch type of clamps, Equalizer clamps, Latch clamps, Quick-acting clamps etc. Clamping materials used. **(9)**

UNIT IV: JIGS AND FIXTURES
Introduction - Design of Drill jigs: Drill bushings –Types of drill bushes –Plain bush, Head bush, headless bush, Step bush, threaded bush, bush materials. Types of jigs: Template jig, Plate, Open jig, Channel jig, Leaf jig, Box jog, Angle plate jig, Turn over jigs, Jigs for multi spindle operations. Materials used for jigs – Design of drill jigs for machining simple components, Milling fixtures- Use of Tenons and setting blocks, –Simple fixture, Face milling fixture, Slot milling fixture, Form milling fixture, Indexing milling fixture, Line or string milling fixture. Turning fixture, Grinding fixtures, Assembly fixture and Welding fixture. **(9)**

UNIT V: PRESS TOOL DESIGN

Introduction-Press tools– Die cutting principle – Centre of pressure – Scrap strip lay out, – Press tonnage calculations – Progressive & Compound dies – die design for simple components. Drawing dies – blank development – Estimation of drawing force – Blank holders & blank holding pressure – Design & sketching of drawing dies for simple components – Bending dies & Combination dies, Compound dies, Types of presses used –: Power presses -Mechanical, Hydraulic press and their constructions. **(9)**

Course Outcomes:

1. Apply knowledge and interpret the use of various production tools to produce parts.
2. Apply the knowledge in producing components by using various cutting tools.
3. Prepare the presentations and participate the GD.
4. Apply knowledge in using different clamps for to hold the components.
5. Apply knowledge to produce components by using various jigs and fixtures for volume production.

Text Books:

1. Nagpal G.R, "Tool Engineering and Design", Khanna Publisher, 2012.
2. Tiklam Lal Chaudhary, "Metal Cutting and Machine Tool Engineering", Khanna Publishers, 2012.

Reference Books:

1. Jigs and Fixtures by Kempster, USA publications.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

M. Tech. I Year I Semester **Discipline Elective I**

20AMSP403 MICRO AND NANO MANUFACTURING TECHNOLOGY

L	T	P	C
3	0	0	3

Course Prerequisite: All types of machining process

Course Description:

This course will provide the technological advancements for the manufacturing of microproducts especially with both mechanical micromachining and non-traditional methods like Electro Discharge Machining (EDM), Electro Chemical Machining (ECM), and Ultrasonic Machining (USM).The essentials like process variants, design considerations for manufacturing technology provided for the participants will ease their manufacturing practices of microproducts. While Advances in Micro/Nano finishing techniques and joining processes are included in this course will enable the participants to get familiar with the current trends and advances manufacturing engineering.

Course Objectives:

1. To give awareness of different techniques used in micro and nano-manufacturing.
2. To give in-depth idea of the conventional techniques used in micro manufacturing.
3. To introduce Non-conventional micro-nano-manufacturing and finishing approaches.
4. To introduce Micro and Nanofabrication Techniques and other processing routes in Micro and nano manufacturing.
5. To know different techniques used in Micro Joining and Micro/Nano fabrications.

UNIT I: INTRODUCTION TO MICRO AND NANO MANUFACTURING

Introduction to Precision engineering, Micro electromechanical systems – merits and applications, Micro phenomenon in Electro photography –applications. Introduction to Bulk micromachining, Surface micromachining-steps, Micro instrumentation – applications, Micro Mechatronics, Nanofinishing – finishing operations. Laser technology in micro manufacturing- Introduction to Micro-energy and chemical system (MECS), Space Micro-propulsion, e-Beam Nanolithography – important techniques, Nano level Biosensors – applications. **(9)**

UNIT II: MICRO AND NANO CONVENTIONAL PROCESSES

Introduction to mechanical micromachining, Micro drilling, Micro turning, Diamond Microturning - Micro milling and Micro grinding– process, tools and applications. Micro extrusion- process and applications. Micro bending with Laser, Nano- Plastic forming and Roller Imprinting. **(9)**

UNIT III: MICRO AND NANO NON CONVENTIONAL MANUFACTURING PROCESSES

Introduction to Non-conventional micro-nano manufacturing. Abrasive Jet Micro Machining, Micro EDM, Micro WEDM, Micro EBM – Process principle, description and applications. Micro Electrochemical arc machining (micro-ECAM), Micro Ultrasonic machining, Fabrication of Micro/Nano structures by Laser beam machining and focused ion beams - Principle and applications. **(9)**

UNIT IV: MICRO AND NANO FINISHING TECHNIQUES

Introduction to Micro and Nano Finishing Processes, Magnetorheological Finishing (MRF) processes, Magnetorheological abrasive flow finishing processes (MRAFF)– process principle and applications, Force analysis of MRAFF process, Working principle and polishing performance of MR Jet Machine, Elastic Emission Machining (EEM) – machine description, Applications, Ion Beam Machining (IBM) – principle, mechanism of material removal, applications, Chemical Mechanical Polishing (CMP) – Schematic diagram, principle and applications. **(9)**

UNIT V: MICRO AND NANO FABRICATON AND JOINING PROCESS

Introduction to Micro Fabrication: basics, flowchart, basic chip making processes, Introduction to Nanofabrication, Nanofabrication using soft lithography – principle, applications – Examples (Field Effect Transistor, Elastic Stamp) Manipulative techniques – process principle, applications. Laser Micro welding – description and applications, Defects, Electron Beam Micro-welding – description and applications. **(9)**

Course Outcomes:

1.Identify different techniques used in micro and nano manufacturing.
2.Examine in-depth idea of the conventional techniques used in micro manufacturing.
3.Explain about non-conventional micro-nano manufacturing approaches.
4.Interpret the role of micro and nano finishing processes in manufacturing field.
5.Understand micro and nanofabrication techniques and joining process.

Text Books:

1. Mark. J. Jackson, Micro and Nano-manufacturing, Springer, 2006.Mark.
2. J. Jackson, Micro-fabrication and Nano-manufacturing - Pulsed water drop micromachining CRC Press 2006**.**

Reference Books:

1. Nitaigour, Premchand Mahalik, Micro-manufacturing and Nanotechnology, 2006.
2. V.K.Jain, Micro-manufacturing Processes, CRC Press, 2012.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

M. Tech. I Year I Semester **Discipline Elective I**

20AMSP404 ADVANCED CASTING AND WELDING TECHNOLOGY

L	T	P	C
3	0	0	3

Course Prerequisite: Casting and welding process

Course Description:
To study different advanced casting and welding process for future industry requirement with detailed study in heat flow concepts and designing of cast components. To acquire knowledge in CAD of casting and automation of welding process.

Course Objectives:
1.To study the different advanced welding process.
2.To study the heat flow concepts.
3.To study the special casting process
4.To know the designing of riser.
5.To acquire knowledge in CAD of casting and automation of welding process.

UNIT I: SPECIAL CASTING PROCESS
Investment casting, shell molding, squeeze casting, vacuum casting, counter-gravity flow - pressure casting, directional and mono-crystal solidification, squeeze casting, semisolid metal casting, rheocasting. **(5)**

UNIT II: SOLIDIFICATION PROCESS AND DESIGN OF RISER
Solidification, Gating and Risering, Nucleation and grain growth, solidification of pure metals, short and long freezing range alloys. Gating and risering design calculations, Fluidity and its measurement. **(6)**

UNIT III: ADVANCED WELDING PROCESS
Laser Beam Welding: Types of lasers, equipment, power calculation, applications, dual laser beam welding, use of fibre optics in LBW.
Friction Stir Welding: Details of process and process parameters, specific applications.
Electron Beam Welding: The interaction of electron beam with matter, mode of heat generation, mode of energy losses, details of the equipment, product design for EBW, case studies.Ultrasonic Welding: Propagation of ultrasonic waves in matter, mode of joint formation, joint types and design of product for ultrasonic welding, details of equipment and case studies, cutting and gauging, flame cutting, plasma arc welding, laser assisted cutting**.** **(15)**

UNIT IV: HEAT FLOW IN WELDING
Heat flow in welding, Significance, theory of heat flow, cooling rate determination, selection of welding parameters based on heat flow analysis, residual stresses and distortion. Joint design, analysis of fracture and fatigue of welded joints. Automated welding systems. **(9)**

UNIT V: CAE OF WELDING AND CASTING
Design of weldment, application of finite element method in welding – determination of distortion in weldments, modelling of temperature distribution - case studies.Design for casting, application of finite element method in casting - determination of hot spots, location of turbulence and other defects, modelling of flow in molds, modelling of heat transfer in castings – case studies. **(10)**

Course Outcomes:
1. Apply the knowledge on advanced casting techniques.
2. Choose the good solidification process and design of riser.
3. Make use of the knowledge in special casting techniques.
4. To analyze the heat flow, residual stress and joints in welding.
5. To apply computer aided engineering to welding and casting process.

Text Books:
1. Richard L Little, “Welding and Welding Technology”, Tata McGraw Hill, 2004.
2. John Campbell, “Casting Practice”, Elsevier Science Publishing Co., 2004.

Reference Books:

1. Howard B Cary, “Modern Welding Technology”, Prentice Hall, 2002S.
2. Ravi B, “Metal Casting: Computer Aided Design and Analysis”, Prentice Hall, 2005.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

M. Tech. I Year I Semester **Discipline Elective II**

20AMSP405 THEORY OF METAL FORMING

L	T	P	C
3	0	0	3

Course Prerequisite: Sheet metal forming

Course Description:
To impart knowledge on plasticity, surface treatment, forming of various types of metal forming.

Course Objectives:
1. To get knowledge in plastic deformation and its theory.
2.To study the basic concepts of metal forming techniques and to develop force calculation in metal forming process.
3. To study the various sheet metal forming process.
4. Understand the powder metallurgy and special forming process
5.Acquire knowledge in surface treatment of various metals and applications of metal forming.

UNIT I: THEORY OF PLASTICITY
Theory of plastic deformation – Yield criteria – Tresca and Von-mises – Distortion energy – Stress strain relation – Mohr's circle representation of a state of stress – cylindrical and spherical co-ordinate system – upper and lower bound solution methods – Overview of FEM applications in Metal Forming analysis. **(9)**

UNIT II: THEORY AND PRACTICE OF BULK DEFORMATION PROCESS
Analysis of plastic deformation in Forging, Rolling, Extrusion, rod/wire drawing and tube drawing – Effect of friction – calculation of forces, work done – Process parameters, equipment used – Defects – applications – Recent advances in Forging, Rolling, Extrusion and Drawing processes – Design consideration in forming. **(9)**

UNIT III: SHEET METAL FORMING
Formability studies – Conventional processes – High energy rate forming techniques – Superplastic forming techniques – Hydro forming – Stretch forming – Water hammer forming – Principles and process parameters – Advantages – Limitations – Applications. **(7)**

UNIT IV: POWDER METALLURGY AND SPECIAL FORMING PROCESSES
Overview of P/M technique – Advantages – applications – Powder preform forging – powder rolling – Tooling, process parameters and applications. Orbital forging – Isothermal forging – Hot and cold isostatic pressing – High speed extrusion – Rubber pad forming – Fine blanking – LASER beam forming. **(7)**

UNIT V: SURFACE TREATMENT AND METAL FORMING APPLICATIONS
Experiment techniques of evaluation of friction in metal forming selection – influence of temperature and gliding velocity – Friction heat generation – Friction between metallic layers – Lubrication carrier layer – Surface treatment for drawing, sheet metal forming, Extrusion, hot and cold forging. Processing of thin Al tapes – Cladding of Al alloys – Duplex and triplex steel rolling – Thermo mechanical regimes of Ti and Al alloys during deformation – Formability of welded blank sheet – Laser structured steel sheet - Formability of laminated sheet. **(13)**

Course Outcomes:

1.To impart the knowledge in plastic deformation and its theory.
2. To understand the basic concepts of metal forming techniques and to develop and develop Force calculation in metal forming process.
3. To reveal the knowledge in various sheet metal forming process.
4. To understand the powder metallurgy and special forming process.
5. To apply surface treatment of various metals and applications of metal forming.

Text Books:

1. Surender kumar, Technology of Metal Forming Processes, Prentice Hall India Publishers,2010.
2**.** Nagpal G.R., Metal Forming Processes- Khanna publishers, 2005.

Reference Books:

1. Altan T., Metal forming – Fundamentals and applications – American Society of Metals, Metals park, 2003S.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

M. Tech. I Year I Semester **Discipline Elective II**

20AMSP406 INDUSTRIAL SURFACE ENGINEERING

L	T	P	C
3	0	0	3

Course Prerequisite: Materials Science and Engineering

Course Description:
Surface Engineering is a multidisciplinary course intended to tailor the properties of the surfaces of engineering components so that their function and serviceability can be improved. The ASM Handbook defines surface engineering as treatment of the surface and near surface regions of a material to allow the surface to perform functions that are distinct from those functions demanded from the bulk of the material. The course mainly discusses about the need of surface engineering and various coating technologies available and characterization techniques. The last unit of the course discusses the application part.

Course Objectives:
1.To understand the relation between structure and surface & bulk properties of metallic materials.
2.To know the various types of surface modifications and coating technologies.
3.To learn the characterization and testing techniques.
4.To identify the importance of surface engineering and its applications.
5.To understand the different coatings.

UNIT I: FUNDAMENTALS OF SURFACE ENGINEERING
Introduction-Tribology and its classification-surface degradation-wear and corrosion-types of wear-roles of friction and lubrication-overview of different forms of corrosion. **(9)**

UNIT II: UNCONETIONAL SURFACE ENGINEERING
Conventional surface Engineering-Types of surface modification-Physical modifications- Chemical and electrochemical polishing-significance-specific examples-chemical conversion coatings-phosphating-chromating-chemical coloring-anodizing of aluminum alloys-thermo- chemical processes-industrial practices. **(9)**

UNIT III: SURFACE COATINGS
Definitions and concepts-physical vapor deposition (PVD)-evaporation-sputtering-ion plating-plasma nitriding-process capabilities-chemical vapor deposition (CVD)-metal organic CVD- plasma assisted CVD-Thermal spraying techniques-specific industrial applications**.** **(9)**

UNIT IV: CHARACTERIZATION OF COATINGS AND SURFACES
Need of advanced methods for surface and coating testing's-Measurement of coating thickness-porosity and adhesion of surface coatings-measurement of residual stress and stability-surface microscopy and topography-tests for assessment of wear and corrosion behavior and mechanical properties of the coatings. **(9)**

UNIT V: FUNCTIONAL COATINGS AND APPLICATIONS
Nanostructured coatings and their Application-Modified Nanomaterials: In-use for consumer Products-Main problems in synthesis of modified Nanomaterials-Surface engineering for polymers and composites-hard, super hard and ultra-hard thin film coatings**.** **(9)**

Course Outcomes:

1. To know need for surface engineering and basics of surface engineering.
2. To understand various traditional surface engineering processes
3.To understand various modern surface engineering, process and respective application for the modern needs
4. To become aware of various characterization techniques available for analyzing the modified surfaces.
5. To recognize the importance surface modifications in various fields. Understand the guidelines for wiring of household and commercial buildings.

Text Books:

1.Bharat Bhusan, Introduction to Tribology, John Wiley & Sons, USA.
2.William, Hand book of thin film deposition process techniques, edited by Krishnan

Reference Books:

1.Materials Degradation and its control by surface engineering, Imperial College Press, (2006).

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

M. Tech. I Year I Semester **Discipline Elective II**

20AMSP407 QUALITY AND RELIABILITY ENGINEERING

L	T	P	C
3	0	0	3

Course Prerequisite: Industrial engineering and management, statistical concepts and probability.

Course Description:
This course focuses on teaching how to increase product reliability. The course covers such topics as model product failure times, analyzing data to determine reliability characteristics, and other general data driven decisions to insure a reliable product. This course delivers tools that helps to recognize and use the proper probability distribution to model product times to failure. The course taught how to analyses life data to determine reliability characteristics and to achieve reliability improvement of a product. It also discusses about reliability testing for determining and demonstrating a reliability value, and design procedures that are necessary to ensure a reliable product.

Course Objectives:
1. Demonstrate the approaches and techniques to assess and improve process and/or product quality and reliability.
2. Introduce the principles and techniques of Statistical Quality Control and their practical uses in product and/or process design and monitoring.
3. Illustrate the basic concepts and techniques of modern reliability engineering tools.
4. To study the acceptance of the components produced in volume.
5. To study the reliability in producing components.

UNIT I: FUNDAMENTALS OF PROBABILITY AND STATISTICS
Definitions of quality, Quality of design, Quality of conformance, and Quality of performance, Dimensions of quality, Quality characteristics, Quality control, Statistical quality control and cost of quality. Events, Sample space, Probability rules, Dependent and Independent events, Statistical tools in quality control, Concept of variation, Graphical tools for data representation and analysis, Discrete and continuous probability distributions and their applications in quality control. **(9)**

UNIT II: CONTROL CHARTS FOR VARAIABLES
Variation, Causes of variation, Objectives of control charts, Choice of variable, Subgroup size and subgrouping, frequency of sampling, control limits. Process capability analysis, Relationship of a process in control to specification limits, Variable charts - X bar chart, R chart, σ chart, revision of control limits and RPI, Introduction to cusum chart and moving range charts**.** **(9)**

UNIT III: - CONTROL CHARTS FOR ATTRIBUTES AND FAILURE DATA ANALYSIS
Control charts for fraction nonconforming (p chart, np chart) and nonconformities (c chart and u chart) with variable and constant sample size, Choice between variables and attributes control charts, revision of control.
Introduction, Failure Data, Quantitative measures, MTTF, MTBF, Bathtub Curve, Mean Life, Life Testing, Introduction to Failure Mode and Effect Analysis. **(9)**

UNIT IV: ACCEPTANCE SAMPLING
Fundamentals of acceptance sampling, Sampling methods, OC Curves and their characteristics, AQL, IQL, LTPD, AOQ/AOQL. Types of acceptance sampling-Single, Double, Multiple, and Sequential sampling plans, Average Total Inspection, comparison amongst sampling plans. **(9)**

UNIT V: SYSTEM RELIABILITY

Definition, Series, parallel and mixed configuration, Block diagram concept, r-out-of-n structure solving problems using mathematical models. Difficulty in achieving reliability, Methods for improving reliability during design, Different techniques available to improve reliability, Reliability-Cost trade off, Prediction and Analysis**.** **(9)**

Course Outcomes:

1. Identify different areas of Quality and Reliability Engineering.
2. Identify process control and acceptance sampling procedure and their application.
3. Determine the concepts and methods of Quality and Reliability Engineering.
4. Discover the applications of Quality and Reliability Engineering.
5. Illustrate the applications of system reliability.

Text Books:

1. Besterfield, “Inspection Quality Control and Reliability”.
2. S. Srinath, “Reliability Engineering” Affiliated East west press, 1991.

Reference Books:

1. B. L. Hanson and P. M. Ghare, “Quality Control & Application”, Prentice Hall of India.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

M. Tech. I Year I Semester **Discipline Elective II**

20AMSP408 SUPPLY CHAIN MANAGEMENT

L	T	P	C
3	0	0	3

Course Prerequisite: Management principles

Course Description:
Supply Chain Management (SCM) has emerged as the most exciting and most rewarding career in management. In the present business environment, an understanding of supply chain is a must to succeed in other functional customer relationship management, physical distribution and logistics management, procurement, service-operations management, information management, global business management, strategic management, etc. The course is designed to equip the students with basic concepts, tool and technologies for design, analysis and performance metrics of SCM and to provide.

Course Objectives:
1. Understand the basic concepts and primary differences between logistics and supply chain management.
2. Identify the individual processes of supply chain management and their interrelationships.
3. Analyse the management components of supply chain management.
4. Learn the tools and techniques useful in implementing supply chain management.
5. Know the professional opportunities in supply chain management.

UNIT I: STRATEGIC FRAMEWORK TO ANALYZE SUPPLY CHAINS
Understanding the Supply Chain Management, Decision phases in a supply chain, Process views of a supply chain: push/pull and cycle views, Supply Chain Performance: Achieving Strategic Fit and Scope, Supply Chain Drivers and Metrics. **(9)**

UNIT II: SUPPLY CHAIN NETWORK DESIGN
Factors influencing Distribution Network Design, Design options for a Distribution network, online sales, Factors influencing Network Design decisions, Framework for Network Design Decisions, Models for Facility Location and Capacity Allocation. Risk management in global supply chains. **(9)**

UNIT III: DEMAND FORECASTING IN SUPPLY CHAIN
Role of forecasting in a supply chain, Components of a forecast and forecasting methods, Models for forecasting: Time series, Causal methods, Accuracy of forecasts. Risk management in forecasting**.** **(9)**

UNIT IV: AGGREGATE PLANNING AND INVENTORIES IN SUPPLY CHAIN
Aggregate planning: Role of Aggregate planning in SC, Aggregate Planning Strategies, Inventory: Types of inventory, Cycle inventory: Estimating cycle inventory related costs in practice, Economies of scale to exploit Fixed Costs and Quantity Discounts, Managing uncertainty in a SC, Determining the appropriate level of Safety Inventory**.** **(9)**

UNIT V: TRANSPORTATION AND COORDINATION IN SUPPLY CHAIN Transportation: Modes of Transportation and their performance characteristics, Design Options for a Transportation Network, Trade-Offs in Transportation Design, Tailored Transportation, Coordination in Supply Chain: Lack of Supply Chain Coordination and the Bullwhip Effect, Obstacles to Coordination in a Supply Chain, Managerial levers to achieve coordination. **(9)**

Course Outcomes:

1. Classify the supply chain macro processes in a firm and Recognize the decision phases and drivers of supply chain performance.
2. Develop a framework for making network design decisions in supply chain
3. Analyse demand forecasts to estimate forecast error.
4. Identify the decisions that are best solved by aggregate planning and inventory models.
5. Understand the different modes of transportation and importance of coordination in a supply chain performance.

Text Books:

1. D K Agrawal, Textbook of Logistics and Supply Chain Management, MacMillan 2015.
2. Sunil Chopra and Peter Meindl, Supply Chain Management - Strategy, Planning and Operation, 6th Edition, Pearson Education Asia, 2016.

Reference Books:

1. V.V. Sople, "Supply Chain Management, text and cases", Pearson Education South Asia, 2012.
2. Janat Shah, "Supply Chain Management, text and cases", Pearson Education South Asia, 2016S.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

M. Tech. I Year I Semester

20ICP101 RESEARCH METHODOLOGY AND IPR

L	T	P	C
2	0	0	2

Course Prerequisite: None

Course Description:
This course provides the fundamental aspects of data collection, analysis, and interpretation of research problem. it also provides the effective way of paper writing, intellectual property rights and process of patenting.

Course Objectives:
1.To obtain solution for research problem, data collection and analysis.
2. To know effective paper writing
3. know the patenting process
4.To know the new developments in IPR
5.To understand the electrical wiring systems for residential, commercial and industrial consumers.

UNIT I: INTRODUCTION
Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations, Effective literature studies approaches, analysis Plagiarism., research ethics. **(6)**

UNIT II: EEFFECTIVE PAPER WRITING
Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee. **(6)**

UNIT III: NATURE OF INTELLECTUAL PROPERTY
Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT**.** **(6)**

UNIT IV: PATENT RIGHTS
H Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical indications. **(6)**

UNIT V: NEW DEVELOPMENTS IN IPR
Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs. **(6)**

Course Outcomes:
1. Analyze research related information.
2. Follow research ethics.
3. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
4. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.

5. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Text Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students".
2.Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction".

Reference Books:

1.Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
2.Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

M. Tech. I Year I Semester

20AMSP201 ADVANCED MACHINING LABORATORY

L	T	P	C
0	0	4	2

Course Prerequisite: All machining process

Course Objectives:

1.To train the students to write CNC Programing to simulate tool path simulation for different components.

LIST OF EXPERIMENTS:

1. Study of different control systems and NC codes
2. Program for Turning and Facing Operation
3. Program for circular interpolation, Taper turning Operation
4. Program for thread cutting operation
5. Program using Do-loop and sub-routine
6. Program for profile milling operation, circular interpolation
7. Program for circular, rectangular pocket milling
8. Program for drilling cycle
9. Program for tool compensation and Program offset
10. NC code generation using CAD software packages

Course Outcomes:

The students can able to perform programming on CNC machine and simulate tool path movement and able to apply the programming to machine industrial components.

Mode of Evaluation: Continuous Internal Evaluation and End Semester Examination.

M. Tech. I Year I Semester

20AMSP202 MODELLING AND SIMULATION LABORATORY

L	T	P	C
0	0	4	2

Course Prerequisite: Manufacturing shop floor activities.

Course Objectives:
To train the students to model the various manufacturing activities and simulate for the objectives of productivity and cost effectiveness.

LIST OF EXPERIMENTS:

1. Study of elements, entities, activities and basic models of a simulation package modelling and simulation.
2.Throughput analysis of an individual production facility using simulation.
3.Modelling of a typical manufacturing facility and study its performances.
4.Breakdown analysis of a production facility with one machine.
5.Breakdown analysis of a production system having multiple machines.
6.Modelling and Simulation of layouts.
7.Study of transport system in a shop floor.
8.Buffer size design.
9.Identification of bottleneck machine on a given shop floor.
10.Study of conjunction, collision and dead locks through simulation.

Software facilities:
1. QUEST, 2. PROMODEL, 3. FLEXSIM, 4. AUTOMOD, 5. WITNESS, 6. GPSS and 7. SIMULA

Course Outcomes:
1. Develop the manufacturing process model and simulate for individual process objective.
2. Demonstrate the manufacturing model for simulation shop floor activities.
3. Develop the simulation program for simulate maintenance activity.

Mode of Evaluation: Continuous Internal Evaluation and End Semester Examination.

M. Tech. I Year I Semester **Audit Course I**

20AUP901 DISASTER MANAGEMENT

L	T	P	C
2	0	0	0

Course Prerequisite: Nil

Course Description:
This course deals with disaster management in case of natural calamities, Tsunami, flood etc.

Course Objectives:
1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches,
5. Planning and programming in different countries, particularly their home country or the countries they work.

UNIT I: DISASTER CLASSIFICATION
Disaster: definition, factors and significance; difference between hazard and Disaster; natural disaster: earthquakes, volcanisms, cyclones, tsunamis, floods, droughts and famines, landslides and avalanches; man-made disasters: nuclear reactor meltdown, industrial accidents, oil slicks Study of seismic zones; areas prone to floods and droughts, landslides and Avalanches; man- made disasters: nuclear reactor meltdown, industrial accidents, oil slick areas and spills, outbreaks of disease and epidemics, war and conflicts. **(6)**

UNIT II: REPERCUSSIONS OF DISASTERS
Economic damage, loss of human and animal life, destruction of ecosystem.
Disaster Prone Areas in India - Study of seismic zones; areas prone to floods and droughts, landslides and Avalanches; areas prone to cyclonic and coastal hazards with special reference to tsunami. **(6)**

UNIT III: DISASTER PREPAREDNESS AND MANAGEMENT
Preparedness: monitoring of phenomena triggering a disaster or hazard; Evaluation of risk, application of remote sensing, data from meteorological and Other agencies, media reports: governmental and community preparedness. **(6)**

UNIT IV: RISK ASSESSMENT
Disaster risk: concept and elements, disaster risk reduction, global and national disaster risk situation. Techniques of risk assessment, global co-operation in risk assessment and warning. **(6)**

UNIT V: DISASTER MITIGATION
Meaning, concept and strategies of disaster mitigation, emerging trends in Mitigation. Structural mitigation and non-structural mitigation, programs of Disaster mitigation in India**.** **(6)**

Course Outcomes:

1. Students will be able to understand disaster and its types in general.
2. They will understand the post disaster damage in terms of both like and commodity.
3. They will have clear picture of disaster prone zones,
4. They will be able to understand the pre and post disaster preparedness needed to mitigate the disaster impact in large scale.
5. Student will also understand to quantify the risk in terms of monetary for both commodity and life.

Text Books:

1.Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation. S. L. Uppal and G. C. Garg, "Electrical Wiring, Estimating & Costing", Khanna publishers, 2008.
2. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies New Royal Book Company.

Reference Books:

1. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

Mode of Evaluation: Assignment, Mid Term Tests.

M. Tech. I Year I Semester **Audit Course I**

20AUP902 SANSKRIT FOR TECHNICAL KNOWLEDGE

L	T	P	C
2	0	0	0

Course Prerequisite: Nil

Course Description:
The students will study about value of this language and its ancient history.

Course Objectives:
1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3 Learning of Sanskrit to develop the logic in mathematics, science & other subjects
4 Enhancing the memory power
5.The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

UNIT I: INTRODUCITION
Alphabets- Vowels- Consonants - Māheśvara sutras - Combined alphabets- Verbs- Basic words. **(6)**

UNIT II: STUDY OF GRAMMER
Singular/Dual/Plural – Nominative case – Accusative case - Instrumental case - Dative case - Ablative case- Genitive case - Locative case **(6)**

UNIT III:
Nouns and adjectives – Indeclinables - Present tense - Past tense - Future tense- Order and request– Prefixes - Number word - Combinations and **cases.** **(6)**

UNIT IV:
Sanskrit literature-Harsacaritasangrah-Kumarasambhava-sabdamanjari. **(6)**

UNIT V:
Technical concept of Architecture-Manasar text –logic- nyaya sutras –pramana-mathematics- sulva sutras-baudhyana theorem. **(6)**

Course Outcomes:
1. Understanding basic alphabets and vowels
2. Understanding the cases in Sanskrit language
3. Understanding of Nouns and tense
4. Understanding of some literature
5. Analyzing the observation through pramana, application of architecture and mathematics

Text Books:
1. Abhyaspustakam, Dr.Vishwas, Samskrita-Bharti Publication, New Delhi.
2.Teach Yourself Sanskrit, Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi.

Mode of Evaluation: Assignment, Mid Term Tests.

M. Tech. I Year I Semester **Audit Course I**

20AUP903 CONSTITUTION OF INDIA

L	T	P	C
2	0	0	0

Course Prerequisite: Nil

Course Description:
This course deals with basics of electrical wiring systems for residential, commercial and industrial consumers, and its representation with standard symbols and drawings, various components of industrial electrical systems and its sizing and control aspects of industrial electrical system using PLC and SCADA.

Course Objectives:
1.Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.
4. To get knowledge about the Indian Federal System and Center – State Relations
5. To Understand the Election Commission functions and administration system2. Identify critical evidence gaps to guide the development.

UNIT I: INTRODUCTION
Historical Background – Drafting Committee (Composition & Working) – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies for citizens. **(6)**

UNIT II: - STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT
Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review. **(6)**

UNIT III: STRUCTURE AND FUNCTION OF STATE GOVERNMENT
State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature –Judicial System in States – High Courts and other Subordinate Courts. **(6)**

UNIT IV: CONSTITUTION FUNCTIONS
Indian Federal System – Center – State Relations – President's Rule – Constitutional ,Amendments –Constitutional Functionaries - Assessment of working of the Parliamentary System in India. **(6)**

UNIT V: RESEARCH GAPS AND FUTURE DIRECTIONS
Central Election Commission - Role and functioning – Chief Election Commissioner and Election Commissioners – State Election Commission – Institute and Bodies for the welfare of SC/ST/OBC and Women. **(6)**

Course Outcomes:

1. Know about Human rights protection by Indian Constitution.
2.Understand the functions of the Indian government
3. Understand and abide the rules of the Indian constitution.
4. Role of Constitution in Socio-economic development and welfare activities of the Country.1.

Text Books:

1. Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare.
2. R.C.Agarwal, (1997) "Indian Political System", S.Chand and Company, New Delhi 31 (2):245-261.S. L. Uppal and G. C. Garg, "Electrical Wiring, Estimating & Costing", Khanna publishers, 2008.

Reference Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication. .

Mode of Evaluation: Assignment, Mid Term Tests.

M.TECH. I Year I Semester **Audit Course - I**

20AUP904 PEDAGOGY STUDIES

L	T	P	C
2	0	0	0

Course Objectives: Nil

Course Description:

1. Review existing evidence on the review topic to inform program design and policy making undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

UNIT I : INTRODUCTION AND METHODOLOGY

Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching. **(6)**

UNIT II - THEMATIC OVERVIEW

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education. **(6)**

UNIT III -EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES

Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy. Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies. **(6)**

UNIT IV - PROFESSIONAL DEVELOPMENT:

Alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes. **(6)**

UNITV - RESEARCH GAPS AND FUTURE DIRECTIONS:

Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment Dissemination and research impact. **(6)**

Course Outcomes:

1. What pedagogical practices are being used by teachers in formal and informal classroom in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.

Text Books:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.

Mode of examination: Assignment, Mid Term Tests.

I YEAR II SEMESTER SYLLABUS

M. Tech. I Year II Semester

20AMSP103 ROBOTICS IN MANUFACTURING

L	T	P	C
3	0	0	3

Course Prerequisite: Manufacturing process and automation

Course Description:
This course provides an overview of robot components, mechanisms and drive controls. Topics include industrial automation and robot motion planning; mechanism design for manipulators and mobile robots, control design, actuators, and sensors; task modelling, human-machine interface, and embedded software.

Course Objectives:
1. Understand the components and their working principles of a robotic system.
2. Learn industrial automation processes and its importance.
3. Learn robot programming and industrial application of robots.
4.To learn about the sensors used in the robots.
5.To understand Application of Robots In Industrial applications.

UNIT I: - BASICS OF ROBOT
Basic components of Robotic system, Terminology- Accuracy, Repeatability, Resolution, Degree of freedom. Mechanisms and transmission, End effectors, Grippers-different methods of gripping, Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, Cam type gripper, Magnetic grippers, Vacuum grippers, Air operated grippers; Specifications of robot. Drive system-hydraulic, pneumatic and electric systems. **(9)**

UNIT II: INDUSTRIAL AUTOMATION
Definition, automation principles and strategies, scope of automation, socio-economic consideration, low cost automation, basic elements of advanced functions, Information processing in manufacturing industry, Production concepts and automation strategies. Fixed Automation: Automated Flow lines, Methods of Work Part Transport, Transfer Mechanism - Continuous transfer, intermittent transfer, Indexing mechanism, Operator-Paced Free Transfer Machine, Buffer Storage, Control Functions, Automation for Machining Operations, Design and Fabrication Considerations. **(9)**

UNIT III: ROBOT CONTROL AND PROGRAMMING
Robot control-Point to point control, Continuous path control, Intelligent robot, Control system for robot joint, Control actions, Feedback devices, Encoder, Resolver, LVDT, Motion Interpolations, Adaptive control. Programming Applications for Industrial robot - programming in – VAL II, RAIL and their features, Typical Programming Examples such as Palletizing, Loading a Machine etc. **(9)**

UNIT IV: ROBOT SENSORS AND ACTUATORS
Design of Robots – characteristics of actuating systems, comparison, microprocessors control of electric motors, magneto strictive actuators, shape memory type metals, sensors, position, velocity, force, temperature, pressure sensors – Contact and non-contact sensors, infrared sensors, RCC, vision sensors. Segmentation and region characterization object recognition by image matching and based on features. **(9)**

UNIT V: APPLICATIONS OF ROBOTS

Robot application in Manufacturing- Material Transfer- Material handling, loading and unloading, Processing - spot and continuous arc welding and spray painting, Assembly and Inspection. **(9)**

Course Outcomes:

1. Understand the components and drive mechanism of robot system.
2. Understand the various automation possibilities in manufacturing processes.
3. Perform specific task by preparing the robot program.
4. Identify and select the suitable sensors and actuators to design the robot system.
5. Specify and select a Robot for manufacturing applications. Upon successful completion of the course, students will be able to

Text Books:

1. Mikell P Groover, Mitchel Weiss and Roger N Nagel, "Industrial Robotics", McGraw Hill, 2017.
2.Mikell P Groover, "Automation, Production Systems and Computer-Integrated Manufacturing", Prentice Hall, 2015.

Reference Books:

1.John Craig, "Introduction to Robotics, Mechanics and Control", Pearson Education, 2008.
2.Richaerd D Klafter, Thomas Achmielewski and MickaelNegin, "Robotic Engineering - An Integrated Approach", Prentice Hall India, New Delhi, 2001.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

M. Tech. I Year II Semester

20AMSP104 ADVANCED PRODUCTION AND OPERATIONS MANAGEMENT

L	T	P	C
3	0	0	3

Course Prerequisite: Knowledge on Production Engineering

Course Description:

Production/operations management involves the integration of numerous activities and processes to produce products and services in a highly competitive global environment. Many companies have experienced a decline in market share as a result of their inability to compete on the basis of product design, cost or quality. Most now agree that world class performance in operations. The key performance measures of operations (productivity, quality and response time) as well as important concepts for improving the performance of operations along these dimensions. A fair understanding of the role Production/Operations Management plays in business processes.

Course Objectives:

1.Introduce concepts and techniques related to the design, planning, control and improvement of businesses in both manufacturing and service sectors.
2.Understand and apply the tools of management learned in the course to practical situations.
3. Produce the desired product this has marketability at the most affordable price by properly planning the manpower, material and processes.
4.Achieve the objective of delivering the right goods of right quantity as well as quality, at right place and at right time one needs to understand and apply the concepts of Production and operations management.
5.To acquaint the students with decision making in Planning, scheduling and Control of Production and operations management functions in both manufacturing and services.

UNIT I: OVERVIEW OF PRODUCTION AND OPERATIONS MANAGEMENT

Introduction-Definition-Importance- Historical Development of POM, Brief History & Classification of Decision Areas in OM, Product Development: Role of product development- Product development process -Tools for efficient product development (brief treatment). Process Design and Value Analysis Determination of process characteristics- Types of processes and operations systems- Continuous – Intermittent-Technology issues in process design- Flexible Manufacturing Systems- Auto- mated Material Handling Systems. **(9)**

UNIT II: VALUE ANALYSIS & PLANT LOCATION

Definition- Objectives; Types of Values-Phases- Tools; FAST diagram-Steps-Advantages-Matrix method-Steps, Plant Location and Plant layout: Factors affecting locations, decisions- Location planning methods- Location factor rating -Centre of Gravity method-Load distance method, Plant Layout, Basic Types of Layouts and their merits & demerits. Optimization in process layouts. Design of product layout-Line balance-Terminology-RPW method. **(9)**

UNIT III: MATERIAL PLANNING

Definition- Objectives-Basic strategies for aggregate production planning- Aggregate production planning Method-Transportation model- Master Production Scheduling- MRP-I & MRP- II Systems. Material Requirement Planning: Terminology-Logic-Lot sizing Methods Advantages and Limitations, MRP for multilevel multiproduct environments. **(9)**

UNIT IV: WORK STUDY & QUALITY MANAGEMENT

Work study: method study –definition-objectives-steps-Charts used- Work measurement- Time study- Definition-steps- Determination of standard time- Performance rating- Allowances. Work sampling- steps- comparison with time study. Quality Management: Economics of quality Assurance- Control charts for variables and for attributes – Acceptance sampling plans Total Quality Management-ISO 9000 series Standards-Six sigma. **(9)**

UNIT V: SCHEDULING & PROJECT MANAGEMENT

Need-basis for scheduling- Scheduling rules- Flow shop and Job shop scheduling. Line of Balance and dispatching rules in scheduling, Project management: PERT- Critical path determination- Probability of completing project in a given time- CPM- Types of floats- Critical path determination- Crashing of simple networks- Optimum project schedule. **(9)**

Course Outcomes:

1. Apply the knowledge gained to reduce the material handling system.
2. Solve to reduce the movement of components through various plant layout.
3. Solve using the aggregate planning method and reduce transportation costs.
4 Choose the method to determine time required and planning the MRPII.
5. Design shop scheduling process to complete the project using PERT and CPM.

Text Books:

1. Pannerselvam,R "Production and Operations Management", PHI.
2.William J.Stevenson, "Operations Management" Eighth Edition, Irwin/McGraw-Hill, 2005

Reference Books:

1.SN Chary, Theory and Problems in Production and Operations Management: TMH.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

M. Tech. I Year II Semester **Discipline Elective III**

20AMSP409 ADVANCED MATERIALS PROCESSING

L	T	P	C
3	0	0	3

Course Prerequisite: Zeal to learn the subject

Course Description:
Intention is to develop an understanding of the principles, capabilities, limitations and applications of commonly used advanced materials processing technologies; and in-depth knowledge of non-traditional materials processing, metal forming, micro-machining, laser processing and smart materials.

Course Objectives:
1. A comparative study of working principle and applications of various non-conventional machining processes.
2. A comparative study of working principle and applications of various finishing processes and metal forming processes
3. A comparative study of working principle and applications of various Micro-Machining processes, and study effects of process parameters of them.
4. Study of process parameters of Laser processing and smart materials.

UNIT I: ADVANCES IN NON-CONVENTIONAL MACHINING PROCESSES
Outline of advanced materials processing techniques: Non-Conventional Materials Removal Processes; Finishing Processes; Forming; Advanced Surface Engineering Processes; Joining Technologies, A brief review of non-conventional machining processes, Analysis of mechanical, thermal and electrochemical type non-traditional machining processes, and Tool design for selected non-traditional machining processes. **(9)**

UNIT II: ADVANCED FINE FINISHING & METAL FORMING PROCESS
Advanced Fine Finishing Process: Abrasive Flow Machining; Magnetic Abrasive Finishing; Magneto Rheological Abrasive Finishing: Process principle, process equipment, Applications Conventional processes-High Energy Rate Forming techniques-Explosive forming, electro hydraulic forming, magnetic pulse forming, super plastic forming, rubber forming, flow forming - Principles and process parameters, Advantages -Limitations and Applications. Overview of powder metal forming technique, Advantages, applications-Powder perform forging- Hot and cold Isostatic pressing-powder rolling-Tooling and process parameters **(12)**

UNIT III: MICRO-MACHINING
Micro-Machining: Introduction to micromachining technologies, Micro electro discharge Machining: Principles of micro-EDM, micro-EDM by Die-sinking and WEDG, micro-WEDM, micro-WEDG, micro-ECM, Principles of micro turning, micro-drilling and micro-milling, micro grinding, hybrid micromachining method, on-line measurement by machine vision and integrated probe, Measuring Techniques in micro-machining, surface integrity and other related measurements. **(9)**

UNIT IV: FABRICATION OF MICRO-DEVICES

Fabrication of Micro-Devices Semiconductors – films and film depurification – Oxidation - diffusion – ion implantation – etching – metallization – bonding – surface and bulk machining – LIGA Process – Solid free form fabrication. **(6)**

UNIT V: LASER MATERIALS PROCESSING & SMART MATERIALS

Laser Materials Processing, Fundamentals of lasers, materials interaction theories, Laser processing for various industries such as metals, non-metals, photovoltaic, biomedical applications, Smart Materials: Shape memory alloys, hydrogen storage alloys, Functionally gradient material (FGM), super alloys. **(9)**

Course Outcomes:

1.Understand various non-conventional machining processes and will be able to select their respective parameters.
2. Evaluate the process parameters in Metal forming processes.
3. Analyze the effect of micro machining processes using different methods.
4. Develop Micro-devices by performing different operations.
5. Understand the various materials processing using laser and smart materials.

Text Books:

1.M P Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Wiley India.
2.Serope Kalpakjian, Steven R Schmid, "Manufacturing Processes for Engineering Materials, Pearson Education.

Reference Books:

1.Pandey, P.C., and Shan, "Modern Machining Processes" Tata McGraw-Hill Education.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

M. Tech. I Year II Semester **Discipline Elective III**

20AMSP410 ADVANCED OPERATIONS RESEARCH

L	T	P	C
3	0	0	3

Course Prerequisite: Nil

Course Description:
The objective of this course is to develop an ability in the students to understand and analyze managerial problems in industry so that they are able to use resources (capitals, materials, staffing, and machines) more effectively, formulate mathematical models for quantitative analysis of managerial problems in industry and develop skills in the use computer tools in solving real problems in industry.

Course Objectives:

1.To provide the students with significance of Operations research and the use of linear programming for optimal decision making
2.To understand transportation and assignment for making optimize allocation related decisions.
3.To comprehend the methods used for solving game theory and making decision under competitive environment.
4.To familiarize students with various types of simulation& Replacement methods used for better business decisions.
5.To provide the students with project management & queuing theory methods used for optimizing managing projects and queuing system.

UNIT I: LINEAR PROGRAMMING
Introduction to Operations Research, Linear Programming Problem- Formulation and Graphical Solution of LPP, Simplex Algorithm, Artificial Variable Technique- Big M-method. Linear Programming Problem-Data using with Excel Solver. **(7)**

UNIT II: TRANSPORTATION AND ASSIGNMENT PROBLEMS
Transportation problem-mathematical model, IBFS by north-west corner rule, least cost entry method and Vogel's Approximation method, Optimal solution by MODI's method, maximization in TP, Trans-Shipment problem. Assignment problem, mathematical model, Hungarian's algorithm for solving Assignment problem, Travelling salesman problem. **(11)**

UNIT III: GAME THEORY & DECISION THEORY
Introduction to theory of games, Two-person zero-sum games, pure strategies-games with saddle point, mixed strategies- games without saddle point rules of dominance, solution method games without saddle point by algebraic method, arithmetic method and matrix method. Decision theory: Introduction, Process, Types of Decision-Making environments-certainty, risk, uncertainty, Decision tree analysis. **(9)**

UNIT IV: I REPLACEMENT MODELS & SIMULATION
Introduction to Simulation, types of simulation, Stochastic Simulation and Random Numbers-Monte – Carlo Simulation. Introduction to replacement models, replacement of items whose efficiency deteriorates with time, replacement of items that completely fail- individual replacement policy and group replacement policy. **(9)**

UNIT V: PROJECT MANAGEMENT AND QUEUING MODELS

Network analysis- Network representation, Critical Path Method (CPM) and Project Evolutionary and Review Technique (PERT). Introduction to Queuing theory. single server queuing models like FCSFS, SPT, LPT and EDD**.** **(12)**

Course Outcomes:

1. Demonstrate high of knowledge to apply on linear programming methods in industries.
2. The students use the knowledge to find optimum solution for transportation products and assignment to machines.
3. The understand and use the game and decision theories on day to day problem.
4. The students can implement replacement of parts for machineries.
5. The students can able to use the PERT and CPM techniques in implementing the projects. Upon successful completion of the course, students will be able to

Text Books:

1. Taha, H.A., "Operations Research - An Introduction", Sixth Edition, Prentice Hall of India Private Limited, N. Delhi, 1997.
2. Panneerselvam. R, "Operations Research", Prentice – Hall of India, New Delhi,2010.

Reference Books:

1.G.Srinivasan , "Operations Research Principles and Applications" ,PHI 2008.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

M. Tech. I Year II Semester **Discipline Elective III**

20AMSP411 RAPID PROTOTYPING AND TOOLING

L	T	P	C
3	0	0	3

Course Prerequisite: Material science, Production technology

Course Description:
Producing a model or a part for prototype is important in developing a product, this course covers the tips and technique in delivering a good rapid prototype. Rapid prototyping is a group of techniques used to quickly fabricate a scale model of a physical part or assembly using three- dimensional computer aided design (CAD) data. Construction of the part or assembly is usually done using 3D printing or "additive layer manufacturing" technology. Rapid Prototyping has also been referred to as solid free-form manufacturing, computer automated manufacturing, and layered manufacturing.

Course Objectives:
1. To understand the basic principles of rapid prototyping technologies to product development.
2. To know fabrication techniques, materials and applications of rapid prototyping.
3. To provide enhanced experiences in modern rapid prototyping of mechanical components and subsystems essential in the construction of mechanical systems.
4. To develop a three-dimensional computer model of a mechanical system and fabricate an actual device via rapid prototyping.
5. To understand solid modelling concepts and techniques in rapid prototyping.

UNIT I: INTRODUCTION TO RAPID PROTOTYPING
Need, development of rapid prototyping (RP) systems, RP process chain, impact of rapid prototyping and tooling on product development, history of RP systems and their classification, benefits, applications, digital prototyping, virtual prototyping. **(9)**

UNIT II: LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS
Stereo lithography apparatus, fused deposition modelling, laminated object manufacturing, three-dimensional printing, rapid freeze prototyping, paper lamination technology, slicing solid manufacturing, melted extrusion modelling and multi-functional RPM systems: working principles, details of processes, products, materials, advantages, limitations and applications and number of lamps, earthing of commercial installation, selection and sizing of components. **(9)**

UNIT III: POWDER BASED RAPID PROTOTYPING SYSTEMS
Selective laser sintering, direct metal laser sintering, laser engineered net shaping, selective laser melting, electron beam melting, lasform technology, theriform technology: processes, materials, products, advantages, applications and limitations. **(9)**

UNIT IV: REVERSE ENGINEERING AND CAD MODELING
Introduction to reverse engineering and its integration with rapid prototyping. Cad modelling: basic concept, digitization techniques, model reconstruction, data processing for rapid proto- typing: CAD model preparation, data requirements, geometric modelling techniques: wire frame, surface and solid modelling, data formats, data interfacing, part orientation and support generation, support structure design, model slicing and contour data organization, direct and adaptive slicing, tool path generation. **(9)**

UNIT V: RAPID TOOLING AND APPLICATIONS OF RAPID PROTOTYPING

Rapid tooling: classification, soft tooling, production tooling, bridge tooling, direct and indirect fabrication processes, applications. Applications of RP: Aerospace, defense, automobile, bio-medical and general engineering industries**.** **(9)**

Course Outcomes:

1. Apply & explain the rapid prototyping and rapid tooling technologies in the product development process.
2. Perform prototyping and rapid tooling operations in the production of new products.
3. Select the appropriate process for producing parts and small batch production.
4. Analyze and implement the different algorithms associated with STL file errors.
5. Analyze the layer thickness in different layering techniques and carry out design manipulations for the generation of support structure.

Text Books:

1. C.K. Chua, K.F. Leong, and C.S. Lim, Rapid prototyping: Principles and applications, Third Edition, World Scientific Publishers, 2010.
2.A. Gebhardt, Rapid prototyping, Hanser Gardener Publications, 2003.

Reference Books:

1. L.W. Liou and F.W. Liou, Rapid Prototyping and Engineering applications: A tool box for prototype development, CRC Press, 2007.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

M. Tech. I Year II Semester **Discipline Elective III**

20AMSP412 DESIGN AND ANALYSIS OF EXPERIMENTS

L	T	P	C
3	0	0	3

Course Prerequisite: Mathematical knowledge

Course Description:

Design and analysis of experiments takes into account variation of information under conditions that are hypothesized to reflect the variation. The tools and techniques mentioned in this course will enable a student to understand the relationship between factors affecting a process and the output of that process.

Course Objectives:

1.Basic idea of paired comparison problems.
2. Worked out problems related to regression and co-relation analysis.
3. Introductory concepts of factorial designs.
4. Various Regression Models.
5. Miscellaneous analysis. To understand the electrical wiring systems for residential, commercial and industrial consumers.

UNIT I: INTRODUCTION

Basic Statistical Concepts Hypothesis Testing Choice of Sample Size, The Paired Comparison Problem Advantages of the Paired Comparison Design, Advantages of the Paired Comparison Design. **(9)**

UNIT II: REGRESSION AND CORRELATION ANALYSIS

Regression and correlation analysis: Linear Regression models – Simple Linear Regression, method of least squares, estimation of regression coefficients, analysis of variance of LR, determination of correlation coefficients. Multiple regression, Curvilinear Regression – Quadratic, Logarithmic and Exponential models. Tutorial exercises from Journal papers. **(9)**

UNIT III: INTRODUCTION TO FACTORIAL DESIGNS

The Battery Design Experiment, A Two-Factor Experiment with a Single Replicate. The Soft Drink Bottling Problem, The Battery Design Experiment with a Covariate, A 32 Factorial Experiment with Two Replicates, A Factorial Design with Blocking. **(9)**

UNIT IV: INTRODUCTION TO FACTORIAL DESIGNS

Multiple Linear Regression Model, Regression Analysis of a 23 Factorial Design, A 23 Factorial Design with a Missing Observation, Inaccurate Levels in Design Factors, Tests on Individual Regression Coefficients, Confidence Intervals on Individual Regression Coefficients. **(9)**

UNIT V: OTHER DESIGN AND ANALYSIS TOPICS

Box-Cox Transformation, The Generalized Linear Model and Logistic Regression, Poisson Regression The Worsted Yarn Experiment, Unbalanced Data in a Factorial Design, Analysis of Covariance, Factorial Experiments with Covariates. **(12)**

Course Outcomes:

1. Understand the introductory concepts of Design and analysis.
2. Apply the concepts of regression an d correlation analysis.
3. Demonstrate the introductory concepts of factorial designs.
4. Understand the various regression models.
5. Outline the miscellaneous design and analysis of models.

Text Books:

1.Gary W. Oehlert, "A First Course in Design and Analysis of Experiments", 2012S.
2. Douglas C. Montgomery, "Design and Analysis of Experiments", Wiley, 2017

Reference Books:

1. Klaus Hinkelmann and Oscar Kempthorne, "Design and Analysis of Experiments, Volume 2: Advanced Experimental Design", Wiley, 2005.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

M. Tech. I Year II Semester **Discipline Elective IV**

20AMSP413 FEA IN MANUFACTURING

L	T	P	C
3	0	0	3

Course Prerequisite: Computational Engineering, Engineering Mathematics

Course Description:

The course introduces you to theoretical basics and practical application of the finite element analysis as well as to related numerical modelling techniques. It is designed to enable you to solve practical problems related to solid mechanics, machines, structures heat-transfer and acoustics. FEA is a design/research tool that is extensively used in industry and research institutions. Students will also gain hands-on experience in using finite element analysis software ANSYS to solve realistic engineering problems. This course provides a necessary tool for the analysis and solution of practical structures and processes.

Course Objectives:

1. To equip the students with the Finite Element Analysis fundamentals.
2. To enable the students to formulate the problems (manufacturing, design etc.) into FEA.
3. To introduce basic aspects of finite element technology, Two Dimensional Finite Element Formulations for Solid Mechanics Problems.
4. To introduce the heat transfer effects.
5. To introduce the FEM process. To understand the electrical wiring systems for residential, commercial and industrial consumers.

UNIT I: INTRODUCTION TO FEM

Basic concepts, application of FEM, general description, advantages of FEM, comparison of FEM with other methods: finite difference method, vibrational method, Galerkin Method, basic element shapes, interpolation function. Basic equations of elasticity, strain displacement relations.1-D structural problems: axial bar element–stiffness matrix, load vector, quadratic shape function. **(9)**

UNIT II: ANALYSIS OF BEAMS

Analysis of beams– Introduction to beams shape functions, stiffness matrix, load vector Problems, 2-D problems–CST, force terms, stiffness matrix and load vector, boundary conditions. **(9)**

UNIT III: TWO DIMENSIONAL FINITE ELEMENT FORMULATIONS FOR SOLID MECHANICS PROBLEMS

Triangular Membrane (TRIA 3, TRIA 6, TRIA 10) Element, Four-Noded Quadrilateral Membrane (QUAD 4, QUAD 8) Element Formulations for in-plane loading with sample problems. Triangular and Quadrilateral Axi-symmetric basic and higher order Elements formulation for axi-symmetric loading only with sample problems Three Dimensional Finite Element Formulations for Solid Mechanics Problems: Finite Element Formulation of Tetrahedral Element (TET 4, TET 10), Hexahedral Element (HEXA 8, HEXA 20), for different loading conditions. Serendipity and Lagrange family Elements. **(9)**

UNIT IV: HEAT TRANSFER

Steady state heat transfer, 1D heat conduction governing equations. Functional approach for heat conduction. Galerkin's approach for heat conduction. 1D heat transfer in thin fins. Trusses- Stiffness matrix of Truss element. Numerical problems. **(9)**

UNIT V: APPLICATIONS OF FEM

Applications of FEM in Analysis of Manufacturing process: Applications of FEM in various metal forming Process-Extrusion, deep drawing, closed die forming etc. Applications of FEM in solidification of castings -Applications of FEM in welding Process. **(9)**

Course Outcomes:

1. Understand the basic concept and numerical methods involved in Finite Element theory.
2. Calculate stress stain relations for the two dimensional problems using finite element methods and understanding the one dimensional beams problems.
3. Analyze the 2-D and axisymmetric problems using FEM.
4. Explain the 1D, heat transfer problems and trusses.
5. Understanding and applying the FEA in manufacturing process.

Text Books:

1.Tirupathi K. Chandrupatla and Ashok D. Belagundu, Introduction to finite elements in engineering.
2.S.S.Rao, An Introduction to Finite Element Methods, Pegamon, New York 2007.

Reference Books:

1.S Kobayashi.S, Soo-ik-ohandAltam. Metal forming and the finite elements methods, Oxford University, 1985.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

M. Tech. I Year II Semester **Discipline Elective IV**

20AMSP414 DESIGN AND MANUFACTURING OF MEMS AND MICROSYSTEMS

L	T	P	C
3	0	0	3

Course Prerequisite: Nil

Course Description:
This course covers the Design and fabrication of MEMS and Microsystems, such as micro-actuators and micro sensors, as well as their principles of operation. The course will introduce the state-of-the-art micromachining techniques including surface micromachining, bulk micromachining, and relevant methods.

Course Objectives:
1.Gain a fundamental understanding of standard micro fabrication techniques and their issues
2.Know the major classes, components, and applications of MEMS devices/systems and to demonstrate
3.Understanding of the fundamental principles behind the operation of these devices/systems
4.nderstand the unique requirements, environments, and applications of MEMS
5.pply knowledge of micro fabrication techniques and applications to the design and manufacturing of an MEMS device or a microsystem.

UNIT I: MEMS, MICRO SYSTEMS AND MINIATURIZATION
Introduction, history of MEMS development, intrinsic characteristics of MEMS. Devices: Sensors and Actuators. Overview of microfabrication, microelectronics fabrication process, silicon based MEMS processes, new materials and fabrication processes. Points of consideration for processing. The trimmer force scaling vector – scaling in electrostatic forces, electromagnetic forces, scaling in electricity and fluid dynamics, scaling in heat conducting and heat convection. **(9)**

UNIT II: SENSORS AND ACTUATORS
Classification of sensors. Signal conversion. Ideal characteristics of sensors. Mechanical sensors. Introduction to electrostatic sensors and actuators. Parallel plate capacitors – equilibrium position of electrostatic actuator under bias – pull in effect of parallel plate actuators. Applications: accelerometer, pressure sensor and flow sensor. Thermal sensors and thermal actuators – applications: Inertia sensors and IR sensors. Magnetic actuators. Principles of micro magnetic actuators. MEMS magnetic actuators. Principles of piezoelectric sensing and actuation. Acoustic sensors and tactile sensors. **(9)**

UNIT III: MATERIALS FOR MEMS
Substrates and Wafers, Active substrate materials, Silicon as a substrate material, Silicon compounds, Silicon Piezoresistors, Gallium Arsenide, Quartz, Piezoelectric Crystals and Polymers, Packaging Materials. **(9)**

UNIT IV: DESIGN OF MICROSYSTEMS
Initial design considerations, Fabrication process design, Mechanical Design, Mechanical design using FEM, Design of a Silicon Die for a Micro pressure sensor, Design of microfluidic network systems with a case study on electrophoresis systems design, Computer-aided design in MEMS and microsystems. **(9)**

UNIT V: MANUFACTURING OF MICROSYSTEMS AND PACKAGING

Photolithography, Ion implantation, Diffusion and oxidation, Chemical and Physical vapor deposition, Etching, Bulk micro manufacturing, Surface Micromachining, The LIGA Process. Essential packaging technologies – die preparation – surface bonding, wire bonding and sealing. Three dimensional packaging. Assembly of Microsystems – selection of packaging materials. **(9)**

Course Outcomes:

1. Apply scaling laws that are used extensively in the conceptual design of micro devices and systems.
2. Selection of suitable sensors and actuators for design of MEMS device.
3. Design and selection of materials for micro components and devices.
4. Design the microsystem and device for given application.
5. Understand the working principles and apply in the micro-fabrication processes. Upon successful completion of the course, students will be able to

Text Books:

1.Tai-Ran Hsu, "MEMS and Microsystems Design and Manufacture", Tata Mcgraw Hill Publishing Co Ltd, New Delhi, 2002.

2.Chang Liu, Foundations of MEMS, Pearson International Edition, 2006. S. L. Uppal and G. C. Garg, "Electrical Wiring, Estimating & Costing", Khanna publishers, 2008.

Reference Books:

1. Mark Madou, Fundamentals of microfabrication, CRC Press, New York, 1997.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

M. Tech. I Year II Semester **Discipline Elective IV**

20AMSP415 FLEXIBLE MANUFACTURING SYSTEMS

L	T	P	C
3	0	0	3

Course Prerequisite: Knowledge on manufacturing process

Course Description:
This course reviews the understanding of FMS, Overview of Material Handling Equipment, Storage Systems, Designing and analyzing the FMS using simulation and different analytical techniques, Tool management in FMS & to handle the production management problems in planning, loading, scheduling, routing and breakdown in a typical FMS, group technology and cellular manufacturing.

Course Objectives:
1.Designing and analyzing the FMS using simulation and different analytical techniques.
2. Tool management in FMS & to handle the production management problems in planning, loading, scheduling, routing and breakdown in a typical FMS.
3.The need for flexibility in manufacturing industries.
4.To learn the representation of systems with standard symbols and drawings.
5.To learn the different types of automated material handling systems its design and calculations for different applications both AS/RS. Concepts of group technology and cellular manufacturing.

UNIT I: UNDERSTANDING OF FMS
Evolution of Manufacturing Systems, Definition, objective and Need, Components, Merits, Demerits and Applications Flexibility in Pull and Push type, Types & configurations concepts – Types of flexibility & performance measures. Function of FMS host computer, FMS host and area controller function distribution.
Development and Implementation of FMS: Planning phase, Integration, System configuration, FMS layouts, FMS Project development steps. **(9)**

UNIT II: MATERIAL HANDLING SYSTEM
An introduction, Conveyor, Robots, Automated Guided Vehicle (AGV), Automated Storage Retrieval System (ASRS) Management technology: Tool Management, tool magazine, Tool preset, identification, Tool monitoring and fault detection, routing, Analysis of material handling equipment, Design of Conveyor & AGV systems, Benefits of Automated material handling systems. **(9)**

UNIT III: MODELLING AND ANALYSIS OF FMS
Need for FMS modeling, Analytical model and Simulation model of FMS, Scope applicability and limitations. GROUP TECHNOLOGY AND CELLULAR MANUFACTURING: Introduction, Part families, parts classification and coding, production flow analysis, Machine cell design, Benefits of Group Technology. **(9)**

UNIT IV: SCHEDULING & LOADING OF FMS
Introduction, scheduling of operations on a single machine, 2 machine flow shop scheduling, 2 machine job shop scheduling, 3 machine flow shop scheduling, scheduling ‘n’ operations on ‘n’ machines, Scheduling rules, loading problems, Tool management of FMS, material Handling system schedule. **(9)**

UNIT V: FMS RATIONAL

Economic and technological justification for FMS, JIT: Operation and evaluation, Personnel and Infrastructural aspects, Typical case, Future prospects. **(9)**

Course Outcomes:

1. Explain the Components of FMS, development and implementation of FMS.
2. Design the material handling system and storage systems used in FMS environments.
3. Analyze FMS using simulation and analytical techniques and understand the concepts of group technology and cellular manufacturing.
4. Analyze the production management problems in planning, loading, scheduling, routing and breakdown in a typical FMS.
5. Understand the concepts of FMS, JIT and Typical cases.

Text Books:

1.William W Luggen, "Flexible Manufacturing Cells and System" Prentice Hall of Inc New Jersey,1991.
2.Reza A Maleki "Flexible Manufacturing system" Prentice Hall of Inc New Jersey, 1991.

Reference Books:

1.Considine D M, and Considine G D, Chopman, Standard Handbook of Industrial Automation - Hall, London, 1986.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

M. Tech. I Year II Semester **Discipline Elective IV**

20AMSP416 PRECISION ENGINEERING

L	T	P	C
3	0	0	3

Course Prerequisite: Theory of Metal Cutting & Tool Design, Material Technology

Course Description:
Precision engineering is the study and practice of high accuracy in engineering, metrology, and manufacturing. The course takes an integrated approach to all subjects related to research, design, manufacture, performance validation, and application of high precision machines, instruments, and components, including fundamental and applied research and development in manufacturing processes, fabrication technology, and advanced measurement science.

Course Objectives:
1. The basic requirements of machine tools, fundamentals of precision machining and the recent developments in precision machining processes.
2. To prepare the student for selection of appropriate process considering the advantages, limitations, cost economy, etc.
3. To develop the skills for optimization of process parameters in precision engineering.
4. To understand the Photo resist process, Lithography and coatings.
5. To understand the material removal process through grinding etc.

UNIT I: INTRODUCTION
Definition, difference in precision and accuracy, need for high precision, Classes of achievable machining accuracy – normal, precision, high precision and ultra-precision machining; Concept of accuracy – part accuracy, errors of form, errors in flat surface and errors in relative location of surfaces, machining accuracies and the processes. Applications of Precision Manufacturing: Semiconductor device manufacturing- process steps, Micro electro mechanical devices – applications, Future of precision manufacturing. **(9)**

UNIT II: GEOMETRICAL DIMENSIONING AND TOLERANCING
Geometrical tolerances, tolerance zones – form, location and orientation of tolerance zones, Datum and precedence – primary, secondary and tertiary, Positional tolerances – zones, form; Combination of dimensional coordinate tolerance and positional tolerance, Defining substitute elements (best fit elements) from measured coordinates; Maximum Material Requirements and Minimum (Least) Material Requirements, their applications; Accumulation of tolerances (tolerance stacking and number of lamps, earthing of commercial installation, selection and sizing of components. **(9)**

UNIT III: MACHINE TOOLS AND ACCURACY
General concept of accuracy of machine tool, spindle rotation accuracy, displacement accuracy, the philosophy of precision machine design, sources of error on a machine tool, factors affecting work piece accuracy from the point of view of machine design, accuracy of CNC machines – errors due to input interpolation and servo system; Thermal errors- Sources and transmission of thermal errors in precision machining, error avoidance and compensation, environment control of precision machinery- machine enclosures, room and factory enclosures. **(9)**

UNIT IV: MICRO-MACHINING MICRO-FABRICATION

Micro Machining – Photo resist process – Lithography – LIGA Process – Optical, processing of materials – micro forming, diamond turning – micro positioning devices – etching –Physical Vapor Deposition (PVD) – Chemical Vapor Deposition (CVD). **(9)**

UNIT V: PRECISION MACHINING PROCESSES

Classification of material removal processes in terms of the energy source used and the tool-work piece reaction, influence of machining parameters, work material and tool geometry, Diamond turning and milling – machines, tool design and alignment, Fixed abrasive processes - Basic mechanics of grinding, finish grinding, precision cylindrical, internal and surface grinding bondless diamond grinding wheels, jig grinding, electrolytic in-process dressing, Ultra-precision grinding, nano-grinding; Loose abrasive processes – polishing, modes of material removal. **(9)**

Course Outcomes:

1. Examine the basic concepts of precision engineering and its applications.
2. Assign the geometrical dimensioning and tolerances to the components in precision engineering.
3. Explain the role of machine tools accuracies / errors and its control in precision engineering.
4. Assess the role of processing in precision engineering, errors in precision engineering, micro finishing, methods for improving surface finish and accuracy.
5. Discuss the precision machining processes their capabilities and applications.

Text Books:

1. Murty, R. L. (2009), - Precision Engineering in Manufacturing, -New Age International Publishers - ISBN: 81-224-0750-1.
2. G. Henzold, (2006), 2/e, - Geometric Dimensioning and Tolerancing for Design, Manufacturing and Inspection, (Butterworth Heinemann – Elsevier Ltd.), ISBN: 0-7506-6738-9.

Reference Books:

1. Dornfeld, David and Lee, Dae-Eun, (2008), - Precision Manufacturing, Springer Science Business Media, LLC, ISBN: 978-0-387-32467-8.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

M. Tech. I Year II Semester

20AMSP203 COMPUTER AIDED ENGINEERING LABORATORY

L	T	P	C
0	0	4	2

Course Prerequisite: Basic Knowledge on Industrial Engineering, Design of Experiments.

Course Objectives:
To train the students to model the various manufacturing activities and simulate for the objectives of productivity and cost effectiveness.

LIST OF EXPERIMENTS:

1. Study of elements, entities, activities and basic models of a simulation package modelling and simulation.
2. Throughput analysis of an individual production facility using simulation.
3. Modelling of a typical manufacturing facility and study its performances.
4. Breakdown analysis of a production facility with one machine.
5. Breakdown analysis of a production system having multiple machines.
6. Modelling and Simulation of layouts.
7. Study of transport system in a shop floor.
8. Buffer size design.
9. Identification of bottleneck machine on a given shop floor.
10. Study of conjunction, collision and dead locks through simulation.

Software facilities:
1. QUEST, 2. PROMODEL, 3. FLEXSIM, 4. AUTOMOD, 5. WITNESS, 6. GPSS and 7. SIMULA

Course Outcomes:

1. Develop the manufacturing process model and simulate for individual process objective.
2. Demonstrate the manufacturing model for simulation shop floor activities.
3. Develop the simulation program for simulate maintenance activity.

Mode of Evaluation: Continuous Internal Evaluation and End Semester Examination.

M. Tech. I Year II Semester

20AMSP204 PRODUCTION TOOLING LABORATORY

L	T	P	C
0	0	4	2

Course Prerequisite: Basic knowledge on tools, fixtures and sheet metal components**.**

Course Objectives:

The course provides wide knowledge on component production through jigs for guiding the cutting tool to make hole and fixtures to locate the components while machining in various machines tools. The course will help to design press tools for sheet metal components like simple die, compound, progressive and combination dies. The course enhances the knowledge on different type mechanical presses, hydraulic press and press brakes.

Course Objectives:

1. The metal cutting process, single point, multi point tools in various for components Production.
2. The fundamentals and functioning of locating, work holding and clamping devices.
3. Design of different drill bushes, construction methods, bushes used in jigs, various jigs used.
4. The design concepts, types of fixtures, various fixtures used in different machine tools.
5. Metal used, strip layout, shearing of strips, punch and dies, design considerations, force calculation, various parts used in dies, simple dies, progressive dies,

LIST OF EXPERIMENTS:

1. Study the components drawings.
2. Prepare the detail for drawing for drill jigs like –plate jig, box jig, and turn over jigs.
3. Decide different locations, clamps, drill bushes.
4. Design and prepare the drawings for components – fixture for turning, milling, welding, assembly fixture.
5. Design, prepare drawings and manufacture for simple dies for blanking, piercing, bending and forming**.**

Course Outcomes:

1. Develop the manufacturing process model and simulate for individual process objective.
2. Demonstrate the manufacturing model for simulation shop floor activities.
3. Develop the simulation program for simulate maintenance activity.

Mode of Evaluation: Continuous Internal Evaluation and End Semester Examination.

M. Tech. I Year II Semester **Audit Course II**

20AUP905 ENGLISH FOR RESEARCH PAPER WRITING

L	T	P	C
2	0	0	2

Course Prerequisite:

Course Description:
This course will be useful for learning English knowledge.

Course Objectives:
1.Conceptualize various components of academic writing.
2.. Enhance and use academic vocabulary.
3. Plan and write quality research papers in their respective field.
4. Ensure the good quality of paper at very first-time submission.

UNIT I: SCIENTIFIC WRITING
What is scientific writing – Language in scientific writing – Use and miss-use of English – Elements of scientific writing - Paraphrasing and Plagiarism - Hedging and Criticizing – How to identify research problem. **(6)**

UNIT II: WRITING TITLE AND ABSTRACT
Strategies for writing effective title – Planning and preparing your abstract - Things to consider while writing abstract – Useful phrases for writing abstract. **(6)**

UNIT III: ORGANIZING REVIEW OF THE LITERATURE; METHODS OF DATA COLLECTION AND DATA ANALYSIS
What is review of the literature - Techniques of reading and citing various studies relevant to the study – Things to consider while organizing review of the literature – useful phrases while writing review of the literature. Introduction to various methods of data collection – Preparing tools and describing them - How to interpret and analyze data. **(6)**

UNIT IV: WRITING FINDINGS, DISCUSSION AND CONCLUSION
Useful vocabulary while writing findings, discussion, and conclusion – elaboration of the findings - Preparing and describing charts and graphs – how to organize. **(6)**

UNIT V: PREPARING REFERENCES, APPENDIXES AND PROOFREADING THE PAPER
Various styles of referencing and bibliography (APA, MLA, Oxford, Harvard, Chicago), – Organizing and preparing Appendixes – Various strategies of proofreading. **(6)**

Course Outcomes:
1. Become aware of various components of academic writing
2. Improve and use academic vocabulary while writing a research papers
3. Plan and write quality research papers in their respective field

Text Books:
1.Adrian Wallwork, (2011). English for Writing Research Papers. Springer New York
2.Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)

Reference Books:

1.Kate L. Turabian, “A Manual for Writers of Research Papers, Theses, and Dissertations, Seventh Edition: Chicago Style for Students and Researchers [7th ed.] Chicago, Guides to Writing, Editing, and Publishing, 2007.

Mode of Evaluation: Assignments, Mid Term Tests

M. Tech. I Year II Semester **Audit Course II**

20AUP906 VALUE EDUCATION

Course Prerequisite: Nil

L	T	P	C
2	0	0	2

Course Description:
The students will be able to study:
1. Understand value of education
2. Understand value of self- development
3. Imbibe personality development
4. Imbibe spiritual development and to about the importance of character
5. Incorporate good emotional intelligence with self -Control.

Course Objectives:
6. To understand the electrical wiring systems for residential, commercial and industrial consumers.
7. To learn the representation of systems with standard symbols and drawings.
8. To understand the various components of industrial electrical systems.
9. To analyse and select the proper size of several electrical system components.
10. To study the control aspects of industrial electrical system using PLC and SCADA

UNIT I:
Values and self-development -Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements. **(6)**

UNIT II:
Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity .Patriotism. Love for nature, Discipline. **(6)**

UNIT III:
Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labor. Universal brotherhood and religious tolerance. True friendship Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature. **(6)**

UNIT IV:
Character –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. **(6)**

UNIT V:
Competence- Emotional Intelligence- Mind your Mind, Self-control-. Honesty, Studying Effectively. **(6)**

Course Outcomes:
1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the moral personality
4. Development of spiritual personality
5. Development of emotional personality for efficiency in

Text Books:
1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford

Mode of Evaluation: Assignments, Mid Term Tests.

M. Tech. I Year II Semester **Audit Course II**

20AUP907 STRESS MANAGEMENT BY YOGA

Course Prerequisite:

L	T	P	C
2	0	0	2

Course Description:
Learn to know Yoga for mental health**.**

Course Objectives:
1. To know the human psyche: Yogic and modern concepts.
2. To have the importance for mental health.
3. To know the relationship between mind and body.
4. To understand the concept of stress according to modern science and yoga.
5. To achieve overall health of mind through yoga.

UNIT I: SCIENTIFIC FOUNDATIONS OF STRESS
Concept of stress – Sources of stress - Types of Stress – Personality factors and Stress – Stress and the college student. **(6)**

UNIT II: CONSEQUENCES OF STRESS ON HUMAN MIND
Human Psyche: Yogic and Modern concepts, behavior and consciousness – Frustration – Conflicts – Psychosomatic, Disorders. **(6)**

UNIT III: MENTAL HYGIENE AND YOGA
Mental health: A Yogic Perspective – Mental hygiene and role of Yoga in mental hygiene – Yogic principles for the management of stress (Prayer and meditation for mental health) **(6)**

UNIT IV: ASHTANGA YOGA INTRODUCTION
Introduction to Ashtanga Yoga – Concepts and techniques of stress management in Ashtanga yoga of Patanjali Yoga sutra (i.e. Benefits of Meditation for stress management). **(6)**

UNIT V: YOGIC MANAGEMENT OF STRESS
Specific practices for stress management: Yogasana, breath awareness, shvasana, yoganidra, pranayama and meditation. **(6)**

Course Outcomes:
1. Understand the role of yoga in stress management
2. Understanding the role of yoga in life management
3. Understanding the role of yoga in mental hygiene
4. To Develop strong mental health
5. To Develop healthy mind and there by improve efficiency.

Text Books:
1.Certification of yoga professionals, Official guide book for Level 1 and Level 2" Excel books private limited, Noida.

Mode of Evaluation: Assignments, Mid Term Tests.

M. Tech. I Year II Semester **Audit Course II**

20AUP908 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

L	T	P	C
2	0	0	2

Course Prerequisite: Nil

Course Description:
This course intends and aims to enhance the confidence of the students by exposing them to various situations and contexts they face in their career. It is imperative for students to start preparing for the ever growing competition in the Job market. This course focuses on the practical aspects of soft skills relevant to the requirements of the prospective employers in view of globalization.

Course Objectives:
1. To expose the students to those soft skills which are crucial to an employee's ability to work smarter.
2. To enhance Art of Communication, Team Skills, GD handling skills and preparing resume.

UNIT I: VERBAL COMMUNICATIONS
Active listening - Non Verbal Communication - Body Language. **(6)**

UNIT II: RESIDENTIAL AND COMMERCIAL ELECTRICAL SYSTEMS
Importance of Team work - Leadership skills, self-realization (Identifying strengths and weaknesses). **(6)**

UNIT III: TIME MANAGEMENT
GD skills – Roles in a GD – Do's & Don'ts – Mock GD. **(6)**

UNIT IV: RESUME PREPARATION
Tips in writing resume - Interview Handling Skills Interview skills – Do's & Don't's – Goal setting. **(6)**

UNIT V:
Grooming etiquette, Professional Electronic Communication-Telephone etiquette, Email etiquette. **(6)**

Course Outcomes:
1. After completion of this course the students shall be able to communicate effectively and enhance their interpersonal relationship and building skills with renewed self-confidence.
2. Work together in teams and accomplish objectives in a cordial atmosphere.
3. Face Group Discussion with confidence.
4. Prepare resume and face interviews.
5. Understand and develop the necessary etiquette to present oneself in a professional setting.

Text Books:

1. Dr K Alex. Soft skills, S Chand Publications, New Delhi.
2. K. B. Raina, "Electrical Design, Estimating & Costing", New age International, 2007.

Reference Books:

1. Ludlow And Panthon, Essentials Of Effective Communication, Prentice Hall Of
2. India, 1993.

Mode of Evaluation: Assignments, Mid Term Tests.

M. Tech. II Year I Semester **Discipline Elective V**

20AMSP417 ADDITIVE MANUFACTURING TECHNOLOGY

L	T	P	C
3	0	0	3

Course Prerequisite: Zeal to learn the subject

Course Description:

Additive Manufacturing (AM) is a process of joining materials to make objects from 3D model data, usual layer up on layer, as opposed to subtractive manufacturing methodologies, such as traditional machining. The basic principle of AM is that a model, initially generated using a three- dimensional Computer Aided Design (3D CAD) system, can be fabricated directly, AM technologies have significantly evolved over the last decade, Because of their potential to extensively transform the nature of manufacturing processes.

Course Objectives:

The students will be able to study:

1. Learn what Advanced/Additive manufacturing (AM) is and understand why it has become one of the most important technology trends in decades for product development and innovation.
2. Demonstrate comprehensive knowledge of the broad range of AM processes, devices, capabilities and materials that are available and understand the various software tools, processes and techniques that enable advanced/additive manufacturing and personal fabrication.
3. Learn how to create physical objects that satisfy product development/prototyping requirements, using advanced/additive manufacturing devices and processes.
4. Articulate the various tradeoffs that must be made in selecting advanced/additive manufacturing processes, devices and materials to suit particular product requirements.

UNIT I - INTRODUCTION TO ADDITIVE MANUFACTURING:

Introduction to AM, AM evolution, Distinction between AM & CNC machining, Steps in AM, Classification of AM processes, Advantages of AM and Types of materials for AM**,** Vat Photo polymerization AM Processes: Stereolithography (SL), Materials, Process Modelling, SL resin curing process, SL scan patterns, Micro-stereolithography, Mask Projection Processes, Two- Photon vat photo polymerization, Process Benefits and Drawbacks, Applications of Vat Photo polymerization, Material Jetting and Binder Jetting AM Processes. **(9)**

UNIT II - ADDITIVE MANUFACTURING PROCESSES:

Extrusion-Based AM Processes: Fused Deposition Modelling (FDM), Principles, Materials, Process Modelling, Plotting and path control, Bio-Extrusion, Contour Crafting, Process Benefits and Drawbacks, Applications of Extrusion-Based Processes. Sheet Lamination AM Processes: Bonding Mechanisms, Materials, Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC applications. Powder Bed Fusion AM Processes: Selective laser Sintering (SLS), Materials, Powder fusion mechanism and powder handling, Process Modelling, SLS Metal and ceramic part creation, Electron Beam melting (EBM), Process Benefits and Drawbacks, Applications of Powder Bed Fusion Processes. **(12)**

UNIT III - DIRECTED ENERGY DEPOSITION AM PROCESSES:

Process Description, Material Delivery, Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Electron Beam Based Metal Deposition, Processing-structure-properties, relationships, Benefits and drawbacks, Applications of Directed Energy Deposition Processes. **(9)**

UNIT IV - MATERIALS SCIENCE & POST PROCESSING OF AM PARTS:

Materials science for AM - Multifunctional and graded materials in AM, Role of solidification rate, Evolution of non-equilibrium structure, microstructural studies, Structure property relationship, Post Processing of AM Parts: Support Material Removal, Surface Texture Improvement, Accuracy Improvement, Aesthetic Improvement, Preparation for use as a Pattern, Property Enhancements using Non-thermal and Thermal Techniques. **(9)**

UNIT V - PROCESS SELECTION, PLANNING, CONTROL FOR AM:

Guidelines for Process Selection: Introduction, Selection Methods for a Part, Challenges of Selection, Additive manufacturing process plan: strategies and post processing. Monitoring and control of defects, transformation. **(6)**

Course Outcomes:

After completion of the program, sstudents are able to:

CO 1. Understand the working principle and process parameters of AM processes. CO 2. Demonstrate comprehensive knowledge of AM processes in various fields. CO 3. Select the suitable material and process for fabricating a product.

CO 4. Apply the knowledge of Material science in Additive Manufacturing components. CO 5. Design and develop a product using AM Process.

Text Books:

1. Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing", 2nd Edition, Springer, 2015.
2. Patri K. Venuvinod and Weiyin Ma, "Rapid Prototyping: Laser-based and Other Technologies", Springer, 2004.
3. Chua Chee Kai, Leong Kah Fai, "3D Printing and Additive Manufacturing: Principles & Applications", 4th Edition, World Scientific, 2015.
4. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer 2001.
5. Rafiq Noorani, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons, 2006.
6. Andreas Gebhardt, Understanding additive manufacturing: rapid prototyping, rapid tooling, rapid manufacturing, Hanser Publishers, 2011.

Mode of Evaluation: Assignments, Midterm Examinations, End Examination.

M. Tech. II Year I Semester **Discipline Elective V**

20AMSP418 MANUFACTURING INFORMATICS

L	T	P	C
3	0	0	3

Course Prerequisite:

Course Description:

Manufacturing informatics is a hybrid of manufacturing science and information technology to make our industries smarter. In this age of digitalization, this subject is necessary to equip our manufacturing engineers and researchers to gain a thorough idea of smart manufacturing techniques using cutting edge technology.

Course Objectives:

The students will be able to study:

01. Automation tools and applications
02. A glimpse of digital manufacturing and its application areas
03. Various analytical tools used in manufacturing industries
04. Smart maintenance of equipment in manufacturing industries
05. Role of artificial intelligence in manufacturing

UNIT I - AUTOMATION:

Types of automation, automated production line- machining and press working, Programmable Logic Controllers- components and uses, Human machine interface (HMI), Control of vibration using PLC, NONC in switch, Ethernet-VPN solutions, Vision systems, Remote System Monitoring, Automatic report generation. **(9)**

UNIT II - DIGITAL MANUFACTURING:

Introduction and basic concepts of digital manufacturing (DM), Smart factory- The use of smart machines, sensors and tooling, Cloud-based manufacturing, Digital Inventory management, Software and tools used in DM, Advantages, Applications and Future of digital manufacturing. **(9)**

UNIT III - ANALYTICAL TOOLS IN MANUFACTURING:

Analytical tools and techniques for collecting, storing, and analyzing manufacturing data, SPC for process control, SQC for quality control, standard statistical analysis techniques- Pareto analysis, Root cause analysis (RCA), Fish bone diagrams, 6-Sigma study techniques, Design of experiments, and multi-variant analysis. **(9)**

UNIT IV - SMART EQUIPMENT MAINTENANCE:

The Industrial Internet of Things (IIoT), Software used in manufacturing industries- Computerized maintenance management system (CMMS), predictive maintenance, machine monitoring solutions used in industries. **(9)**

UNIT V - ARTIFICIAL INTELLIGENCE IN MANUFACTURING:

Part inspection, visual inspections, AI CAD Tools, smart cognitive gadgets and apps used for ensuring workers' safety-AI-SAFE, Machine learning, AI in automobile, aerospace, mining and food industries. **(9)**

Course Outcomes:

After completion of the program, the students are able to:

CO 1. Get a good understanding on automated industries of modern day and how the conventional factories are automated.
CO 2. Equip themselves with the various aspects of digital manufacturing.
CO 3. Understand the use of various analytical tools used in manufacturing informatics. CO 4. Maintain maintenance of equipment using cutting edge software and tools.
CO 5. Apply the techniques of AI in industries.

Text Books:

1. Zhou Z, Xie S, Chen D, "Fundamentals of Digital Manufacturing Science", Springer, 2012.
2. Manesis S, Nikolakopoulos G, "Introduction to Industrial Automation", Taylor and Francis, 2012

Mode of Evaluation: Assignments, Midterm Examinations, End Examination.

M. Tech. II Year I Semester **Discipline Elective V**

20AMSP419 ARTIFICIAL INTELLIGENCE IN MANUFACTURING

L	T	P	C
3	0	0	3

Course Prerequisite: Nil

Course Description:

The aim of the course is to build an understanding of Artificial Intelligence approaches, the need to use Artificial Intelligence, specific tools and techniques, their application in Manufacturing Engineering. AI will perform manufacturing, quality control, shorten design time, reduce materials waste, improve production reuse and perform predictive maintenance.

Course Objectives:

The students will be able to study:

1. To give awareness of different search algorithms for problem solving.
2. To give in-depth idea of Artificial Intelligence used in scheduling systems for predictive maintenance.
3. To introduce adaptive neuro-fuzzy control system in milling operations.
4. To introduce tool condition monitoring in neutral network.
5. To know intelligent real-time expert system in process control.

UNIT I - PHILOSOPHICAL FOUNDATIONS OF ARTIFICIAL INTELLIGENCE:
Introduction -Intelligent Agent- Solving Problems by Searching- Heuristic Algorithms- Tabu Search and Simulated Annealing- Genetic Algorithms- Neural Networks- Particle Swarm and Ant Colony Optimization- fuzzy logic. **(9)**

UNIT II - AI-BASED SCHEDULING SYSTEMS FOR PREDICTIVE MAINTENANCE:
Constraint Representation - Constructive Approach - Iterative Repair - Predictive and Reactive Scheduling - Distributed Scheduling Systems - Cooperative Problem Solving Systems -Knowledge Elicitation for Scheduling Systems - OR Algorithms in Systems - Generalized Scheduling Systems - Learning in Scheduling Systems - Simulation-Based Scheduling Support. **(9)**

UNIT III - NEURO-FUZZY CONTROL METHODS FOR MILLING OPERATIONS:

Introduction -Adaptive Control System for Milling Operations- Adaptive Neuro-Fuzzy Control of Milling Operations- Milling Controlled Process - Neuro-Fuzzy Logic Controller -Learning Algorithm for the Neuro-Fuzzy Logic Controller -Computer Simulation and Experimental Verification - Experimental Results and Discussion. **(9)**

UNIT IV - TOOL CONDITION MONITORING IN NEUTRAL NETWORK:

Tool Wear Mechanism -Forms of Tool Wear - Flank Wear - Crater Wear -Groove Wear- Sensors and Signal Processing- Neural Network Architectures- Multi-layer Perceptron (MLP) - Kohonen Networks -ART2 Networks -Tool Condition Identification Using Neural Networks MLP for Force Sensor with Simple Pre- Processing -ART2 Neural Network with Acousting Emission Sensing - Transient Tool Condition Identification -Tool Wear Monitoring. **(9)**

UNIT V - INTELLIGENT REAL-TIME EXPERT SYSTEM IN PROCESS CONTROL:

Introduction -An Expert Systems Approach -Real-time Control and Petri Nets -Overview of Fuzzy Logic- Fuzzy Expert Systems -Fuzzy Control - Overview of Petri Nets Fuzzy Petri Nets - Hybrid Petri Nets- The Continuous Fuzzy Petri Net Concept - Definition of a Continuous Fuzzy Petri Net Execution of a Continuous Fuzzy Petri Net -CFPN Places - CFPN Transitions -Examples A Simple Control Example - Dealing with Large CFPN Networks. **(9)**

Course Outcomes:

After completing the program, students are able to:

1. Relate various search algorithms for problem solving.
2. Adapt shop floor maintenance operations using Artificial Intelligence.
3. Apply adaptive neuro-fuzzy control system in milling operations.
4. Evaluate tool life by neural networks architectures.
5. Develop a novel approach to carry out system modeling, operational analysis, process monitoring, and control.

Text Books:

1. E Rich, K Knight, “Artificial Intelligence”, 3/e, Tata McGraw Hil, 2009.
2. Cornelius T. Leondes, “Artificial Intelligence and Robotics in Manufacturing”, CRC Press, 2001.

Reference Books:

1. D. Poole and A. Mackworth. Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010.
2. Dan W Patterson, Introduction to Artificial Intelligence,Pearson,2009.
3. Deepak Khemeni,A First course in Artificial Intelligence,Tata McGraw Hill,2013.

Mode of Evaluation: Assignments, Midterm Examinations, End Examination.

M. Tech. II Year I Semester **Discipline Elective V**

20AMSP420 DESIGN FOR MANUFACTURE AND ASSEMBLY

L	T	P	C
3	0	0	3

Course Prerequisite: Casting, Machining, Metal joining, Forging, Sheet metal components, Plastics.

Course Objective:

The students will be able to study:

1. Introduce design principles, properties of materials, fits and tolerances and datum features.
2. Understand the influence of materials on form design and able to select possible material and feasible design.
3. Introduce design features to facilitate machining and design for machinability, economy, accessibility and assembly.
4. Know about redesign of castings, modifying the uneconomical design, group technology and applications of DFMA.
5. Understand the Environmental objectives and issues and to design considering them.

UNIT I - DESIGN PHILOSOPHY:

Introduction: Steps in Design process – General Design rules for Manufacturability – Basic principles of designing for economical production – Creativity in design. Materials: Selection of Materials for design – Developments in Material Technology – Criteria for material selection – Material selection interrelationship with process selection – process selection charts. **(9)**

UNIT II – MACHINING PROCESS:

Overview of various machining processes – general design rules for machining - Dimensional tolerance and surface roughness – Design for Machining ease – Redesigning of components for machining ease with suitable examples, General design recommendations for machined parts. **(9)**

UNIT III – METAL CASTING AND JOINING:

Meatal casting -Appraisal of various casting processes, Selection of casting process, Factors affecting casting design. General design considerations for casting – Use of Solidification Simulation in casting design – Product design rules for sand casting. Metal joining Appraisal of various welding processes, Factors in design of weldments – General design guidelines – pre and post treatment of welds – Effects of thermal stresses in weld joints – Design of brazed joints. **(9)**

UNIT IV – BULK DEFORMATION PROCESS:

Forging – Design factors for forging – Closed die forging design – Location of parting lines of dies – Drop forging die design – General design recommendations. Extrusion - Design guidelines for Extruded sections - Keeler Goodman Forming Limit Diagram – Sheet metal component production-blanking, piercing, bending, forming and fore calculations. **(9)**

UNIT V- PLASTICS AND ASSEMBLY:

Plastics Viscoelastic and Creep behavior in plastics – Design guidelines for Plastic com-components– Design considerations for Injection Molding.Design for assembly General design guidelines for Manual Assembly- Development of Systematic DFA Methodology- Assembly Efficiency- Classification System for Manual handling- Classification System for Manual Insertion and Fastening- Effect of part symmetry on handling time- Effect of part thickness and size on handling time- Effect of weight on handling time- Effect of symmetry, Further design guidelines. **(9)**

Course Outcome:

After completion of the program, students are able to:
CO 1. Select the design principle, suitable material, mechanism, fit and tolerance for designing a product/component.
CO 2. Select the appropriate material, proper working principle and a feasible design.
CO 3. Design (optimum) a component which requires less material removal, easy to machine, assemble, access and cost effective.
CO 4. Redesign the uneconomical casting design and know the applications of DFMA. CO 5. Incorporate the Environmental Objectives, issues and guidelines into the design.

Text Books:

1. 1. Engineering Design-Material and Processing Approach, George E. Deiter, Mc. Graw Hill Intl. 2nd Ed.2000.
2. Product design for Manufacture and Assembly, Geoffrey Boothroyd,Marcel Dekker Inc. NY, 1994.

Reference Books:

1. Product design and Manufacturing, A.K Chitale and R.C Gupta, Prentice, Hall of India, New Delhi, 2003.
2. Design and Manufacturing ,Surender Kumar &Goutham Sutradhar, Oxford & IBH Publishing Co. Pvt .Ltd., New Delhi, 1998.
3. Hand Book of Product Design, Geoffrey Boothroyd Marcel Dekken Inc. NY, 1990.
4. Product Design, Kevin Otto and Kristin Wood, Pearson Education.

Mode of Evaluation: Assignments, Midterm Examinations, End Examination.

M. Tech. II Year I Semester **Open Elective**

20OEP307 SENSORS FOR INTELLIGENT MANUFACTURING AND CONDITION MONITORING

L	T	P	C
3	0	0	3

Course Prerequisite: Nil Course Description:
This course has been prepared keeping the need of industry 4.0 in mind. It discusses the role played by different sensors in making our existing manufacturing systems intelligent and turning the traditional industries in to smart industries.

Course Objectives:
The students will study:
1. Various types of sensors used in manufacturing industries.
2. Sensors used in monitoring various manufacturing systems and its parameters
3. Sensors used in automation of manufacturing processes
4. Sensors used in different manufacturing processes
5. Sensors used to ensure safety of equipment, machines and workers.

UNIT I - SENSORS USED IN MANUFACTURING INDUSTRIES:
Introduction to sensors, Motion Control, Operation principles of different sensors – electrical, optical, acoustic, pneumatic, magnetic, electro-optical and vision sensors, Micro sensors, Nano sensors. **(9)**

UNIT II - SENSORS USED IN MONITORING:
Condition monitoring of manufacturing systems – principles – sensors for monitoring force, vibration and noise, selection of sensors and monitoring techniques, sensors used for asset monitoring. **(9)**

UNIT III - SENSORS IN MANUFACTURING AUTOMATION:
Introduction to automation, Role of sensors in manufacturing automation, Temperature Sensors, Pressure sensors, MEMS Sensors, Torque Sensors, Automatic identification techniques for shop floor control – optical and machine vision sensors – smart / intelligent sensors – integrated sensors. **(9)**

UNIT IV - SENSORS USED IN VARIOUS MANUFACTURING PROCESSES:
Sensors used in metal casting- Sensors with melt contact and without melt contact, Sensors used in atomization process, Sensors for hot and cold rolling, types of welding sensors, sensors used in arc welding and spot welding, Sensors for CNC machine tools, Robotic sensors used in various manufacturing processes. **(9)**

UNIT V- SENSORS IN INDUSTRIAL SAFETY:
Manufacturing of semi-conductor sensors and fibre optic sensors – principles, applications, sensors used in equipment security, Control, Monitoring and Safety Systems, sensors in workers safety. **(9)**

Course Outcomes:

After completion of the program, students are able to:

1. Understand the working of different types of sensors and will be able to differentiate between various types of sensors.
2. Apply the knowledge gained and adopt in industrial applications.
3. Understand the working principle and role played by various sensors in automating a manufacturing unit.
4. Apply the different sensors used in various manufacturing processes.
5. Know about the various types of sensors used in ensuring safety of machines and workers by preventing accidents and failures.

Text Books:

1. Paul P.L. Regtien, "Sensors for Mechatronics", Elsevier,1st Edition 2012.
2. Patrick F Dunn, " Fundamentals of Sensors for Engineering and Science, Taylor and Francis, 2012.
3. Tönshoff H.K. and Inasaki. I, "Sensors in Manufacturing, Volume 1, Wiley, 2001.

Reference Books:

1. H. D. Haferkamp, M. Niemeyer, J. Weber, R. Wertheim, "Sensors for Process Monitoring: Casting and Powder Metallurgy", Wiley, 2001.

Mode of Evaluation: Assignments, Midterm Examinations, End Examination.

M. Tech. II Year I Semester **Open Elective**

20OEP308 TOTAL QUALITY MANAGEMENT

L	T	P	C
3	0	0	3

Course Prerequisite: Quality Control

Course Description:

The purpose of this course to provide the knowledge of quality in a particular system. Total quality management (TQM) is a philosophy, methodology and system of tools aimed to create and maintain mechanism of organization's continuous improvement. It helps to reduce costs and to meet and exceed needs and expectations of customers and other stakeholders of an organization. TQM encompasses the concepts of business and social excellence to organization's competition and improvement.

Course Objectives:

1. To learn the basic concepts of quality and quality from organizational point of view.
2. To learn the concept of total quality management from western and Japanese approach.
3. Gives information on various tools and techniques, Statistical Fundamentals &concept on Six Sigma.
4. To learn the internal politics, quality culture, education and training of the organization. Concept of bench marking and analyzing the failure using Failure Mode Effective Analysis (FMEA).
5. To be aware of international/national Quality awards.

UNIT I – INTRODUCTION:
Introduction - Need for quality - Evolution of quality - Definition of quality- Dimensions of quality – Benefits of quality and Barriers – Quality control, Quality management and Quality Assurance - Basic concepts of TQM - Definition of TQM – TQM Framework - Contributions of Deming, Juran and Crosby on Quality Management. **(9)**

UNIT II - TQM PRINCIPLES:
TQM principles - Strategic quality planning, Quality statements - Customer focus – Customerorientation, Customer satisfaction, Customer complaints, Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – 5S, Kaizen, Just-In-Time and TPS. **(9)**

UNIT III - STATISTICAL PROCESS CONTROL:
The seven tools of quality, New seven Management tools, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Concept of Six Sigma. **(9)**

UNIT IV - TOOLS AND TECHNIQUES:

Quality circles, Quality Policy Deployment (QPD), Quality Function Deployment (QFD), Benchmarking, Taguchi Quality Loss Function, Total Productive Maintenance (TPM)- Concepts, improvement needs – Cost of Quality – Performance measures- FMEA. **(9)**

UNIT V - QUALITY SYSTEMS:

Need for ISO 9000 and Other Quality Systems, ISO 9001:2008 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, ISO 14001:2004. **(9)**

Course Outcomes:

After completion of the program, students are able to:

1. Understand quality concepts and philosophies of TQM.
2. Apply TQM principles and concepts of continuous improvement.
3. Apply and analyze the quality tools, management tools and statistical fundamentals to improve quality.
4. Understand the TQM tools as a means to improve quality.
5. Remember and understand the quality systems and procedures adopted.

Text Books:

1. Dale H. Besterfield, "Total Quality Management", 3rd edition 2011 Pearson Education
2. James R. Evans& William M. Lidsay, "The Management and Control of Quality", 9th Edition South-Western.

Reference Books:

1. Feigenbaum.A.V. ―Total Quality Management; 4 edition (August 1, ‖, McGraw-HillProfessional.
2. Oakland.J.S. ―Total Quality Management‖, 3rd Edition, 2003. Butterworth –Hcinemann Ltd Oxford.

Mode of Evaluation: Assignments, Midterm Examinations, End Examination.

M. Tech. II Year I Semester **Open Elective**

20OEP309 INDUSTRIAL SAFETY AND MAINTENANCE ENGINEERING

L	T	P	C
3	0	0	3

Course Prerequisite: None Course Description:
Industrial safety refers to the management of all operations and events within an industry in order to protect its employees and assets by minimizing hazards, risks, accidents, personnel safety and maintenance of equipment pays equal importance in manufacturing process. This function expects that equipment are expected to work with maximum utilization.

Course Objectives:

The students will study:

1. To understand industrial safety, prevents of accidents, procedure adopted to maintain industrial act.
2. To know the maintenance engineering and their responsibilities.
3. To understand the importance wear and corrosion and their prevention.
4. To understand the various maintenance techniques available and set them right.
5. To practice the condition monitoring system available and maintain them.

UNIT I - INDUSTRIAL SAFETY:
Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc., Safety color codes. Fire prevention and firefighting, equipment and methods. **(9)**

UNIT II - FUNDAMENTALS OF MAINTENANCE ENGINEERING:
Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment. **(9)**

UNIT III - WEAR AND CORROSION AND THEIR PREVENTION:
Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods. **(9)**

UNIT IV - PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING:
Basic Principles of maintenance planning – Objectives and principles of planned maintenance activity – Importance and benefits of sound Maintenance systems – Reliability and machine availability, Equipment Life cycle, Measures for Maintenance, periodic maintenance- concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance.Performance: Equipment breakdowns, Mean Time Between Failures, Mean Time to Repair, Factors of availability, Maintenance organization, Maintenance economics. **(9)**

UNIT V- DIFFERENT TYPES OF MAINTENANCE:

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance. **(9)**

Course Outcomes:

After completion of the program, students are able to:

1. Apply the knowledge in the plant the factory act and other compliance.
2. Plan for maintenance activity in the plant.
3. Improve on lubrication method to prevent wear and corrosion.
4. Plan the maintenance of all equipment to reduce break down.
5. Select the best maintenance method to reduce down time in the operation

Text Books:

1. Srivastava, S.K., "Industrial Maintenance and Management", S. Chand and Co, 2012
2. H. P. Garg, "Maintenance Engineering", S. Chand and Co, 2012.

Reference Books:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Mode of Evaluation: Assignments, Midterm Examinations, End Examination

M. Tech. II Year I Semester **Open Elective**

20OEP310 MACHINE LEARNING

L	T	P	C
3	0	0	3

Course Prerequisite: Nil

Course Description:

Machine learning uses interdisciplinary techniques such as statistics, linear algebra, optimization, and computer science to create automated systems that can sift through large volumes of data at high speed to make predictions or decisions without human intervention. Machine learning as a field is now incredibly pervasive, with applications spanning from business intelligence to homeland security, from analysing biochemical interactions to structural monitoring of aging bridges, and from emissions to astrophysics, etc. This class will familiarize students with a broad cross-section of models and algorithms for machine learning, and prepare students for research or industry application of machine learning techniques.

Course Objectives:

The students will study:

1. Decision learning process and finding hypothesis.
2. Experimental evaluation by computational theory.
3. Application of artificial network.
4. Learning through vector machines.
5. Clustering and Unsupervised Learning, Language Learning.

UNIT I: INTRODUCTION, INDUCTIVE CLASSIFICATION, DECISION TREE LEARNING

Definition of learning systems; Goals and applications of machine learning; Aspects of developing a learning system: training data; concept representation; function approximation; The concept learning task; Concept learning as search through a hypothesis space; General-to-specific ordering of hypotheses; Finding maximally specific hypotheses; Version spaces and the candidate elimination algorithm; Learning conjunctive concepts; The importance of inductive bias; Representing concepts as decision trees; Recursive induction of decision trees; Picking the best splitting attribute: entropy and information gain; Searching for simple trees and computational complexity; Occam's razor; Overfitting, noisy data, and pruning. **(9)**

UNIT II: ENSEMBLE LEARNING, EXPERIMENTAL EVALUATION OF LEARNING ALGORITHMS, COMPUTATIONAL LEARNING THEORY

Using committees of multiple hypotheses; Bagging, boosting, and DECORATE; Active learning with ensembles; Measuring the accuracy of learned hypotheses; Comparing learning algorithms: cross-validation, learning curves, and statistical hypothesis testing; Models of learnability: learning in the limit; probably approximately correct (PAC) learning; Sample complexity: quantifying the number of examples needed to PAC learn; Computational complexity of training. Sample complexity for finite hypothesis spaces; PAC results for learning conjunctions, kDNF, and kCNF; Sample complexity for infinite hypothesis spaces; Vapnik-Chervonenkis dimension. **(9)**

UNIT III-RULE LEARNING: PROPOSITIONAL AND FIRST-ORDER, ARTIFICIAL NEURAL NETWORKS:

Translating decision trees into rules; Heuristic rule induction using separate and conquer and information gain; First-order Horn-clause induction (Inductive Logic Programming) and Foil; Learning recursive rules; Inverse resolution, Golem, and Progol; Neurons and biological motivation; Linear threshold units; Perceptron: representational limitation and gradient descent training; Multilayer networks and backpropagation; Hidden layers and constructing intermediate, distributed representations; Overfitting, learning network structure, recurrent networks. **(9)**

UNIT IV - SUPPORT VECTOR MACHINES, BAYESIAN LEARNING, INSTANCE-BASED LEARNING:

Maximum margin linear separators; Quadractic programming solution to finding maximum margin separators; Kernels for learning non-linear functions; Probability theory and Bayes rule; Naive Bayes learning algorithm; Parameter smoothing; Generative vs. discriminative training; Logisitic regression; Bayes nets and Markov nets for representing dependencies; Constructing explicit generalizations versus comparing to past specific examples; k-Nearest-neighbor algorithm; Case-based learning. **(7)**

UNIT V- TEXT CLASSIFICATION, CLUSTERING AND UNSUPERVISED LEARNING, LANGUAGE LEARNING:

Bag of words representation; Vector space model and cosine similarity; Relevance feedback and Rocchio algorithm; Versions of nearest neighbor and Naive Bayes for text; Learning from unclassified data; Clustering: Hierarchical Aglomerative Clustering. k-means partitional clustering; Expectation maximization (EM) for soft clustering; Semi-supervised learning with EM using labeled and unlabled data; Classification problems in language: word-sense disambiguation, sequence labelling; Hidden Markov models (HMM's); Veterbi algorithm for determining most- probable state sequences; Forward-backward EM algorithm for training the parameters of HMM's; Use of HMM's for speech recognition; part-of-speech tagging and information extraction Conditional random fields (CRF's); Probabilistic context-free grammars (PCFG); Parsing and learning with PCFGs; Lexicalized PCFGs. **(11)**

Course Outcomes:

After completion of the program, students are able to:

1. Develop an appreciation for what is involved in learning models from data.
2. Understand a wide variety of learning algorithms.
3. Understand how to evaluate models generated from data.
4. Apply the algorithms to a real-world problem, optimize the models learned. CO 5. Report on the expected accuracy that can be achieved by applying the models.

Text Books:

1. Stephen Marsland, “Machine Learning: An Algorithmic Perspective”, Chapman & Hall/Crc Press, 2009.
2. Tom Mitchell, “Machine Learning”, McGraw Hill, 1997.

Mode of Evaluation: Assignment, Midterm Examinations, End Examination.