MADANAPALLE INSTITUTE OF TECHNOLOGY & SCIENCE

MADANAPALLE

(UGC-AUTONOMOUS)

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MASTER OF TECHNOLOGY

ADVANCED MANUFACTURING SYSTEMS

(R18)

For the students admitted to

Master of Technology in **Advanced Manufacturing Systems**

For the academic year 2018-19 Batches onwards

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

CURRICULUM STRUCTURE

I Year I Semester

Sl. No.	Course Code	Name of the Course	Credits
1	18AMSP101	Advanced Machining Processes	3
2	18AMSP102	Automation in Manufacturing	3
	Discipline Elective – I		
3	18AMSP401	Theory of Metal Cutting and Tool Design	3
	18AMSP402	Materials Characterization Techniques	
	18AMSP403	Advanced Casting and Metal Joining	
	Discipline Elective – II		
4	18AMSP404	Simulation and Modelling of Manufacturing Systems	3
	18AMSP405	Product Design and Development	
	18AMSP406	Materials Technology	
5	18AMSP201	Advanced Machining Laboratory	2
6	18AMSP202	Modelling and Simulations Laboratory	2
7	18RMP101	Research Methodology and IPR	2
	Audit Course – I		
8	18AUP901	Disaster Management	0
	18AUP902	Sanskrit for Technical Knowledge	
	18AUP903	Constitution of India	
	18AUP904	Pedagogy Studies	
		Total Credits	**18**

CURRICULUM STRUCTURE

I Year II Semester

Sl. No.	Course Code	Name of the Course	Credits
1	18AMSP103	Surface Engineering	3
2	18AMSP104	Advanced Production and Operation Management	3
	Discipline Elective – III		
3	18AMSP407	Optimization Techniques and its Applications	3
	18AMSP408	Precision Engineering	
	18AMSP409	Rapid Prototyping and Tooling	
	Discipline Elective – IV		
4	18AMSP410	FEA in Manufacturing	3
	18AMSP411	Design and Manufacturing of MEMS and MICRO Systems	
	I8AMSP412	Flexible Manufacturing Systems	
5	18AMSP203	Computer Aided Engineering Laboratory	2
6	18AMSP204	Production Tooling Laboratory	2
7	18AMSP701	Mini Project	2
	Audit Course – II		
8	18AUP905	English for Research Paper Writing	0
	18AUP906	Value Education	
	18AUP907	Stress Management by Yoga	
	18AUP908	Personality Development through Life Enlightment Skills	
		Total Credits	**18**

CURRICULUM STRUCTURE

II Year I Semester

Sl. No.	Course Code	Name of the Course	Credits
	Discipline Elective – V		
1	18AMSP413	Design for Manufacturing and Assembly	3
	18AMSP414	Industrial Robotics	
	18AMSP415	Total Quality Management	
	18AMSP416	Powder Metallurgy	
	18AMSP417	Advances in Metals Joining	
	Open Elective		
2	18OEP301	Business Analytics	3
	18OEP302	Industrial Safety	
	18OEP303	Operations Research	
	18OEP304	Cost Management of Engineering Projects	
	18OEP305	Composite Materials	
	18OEP306	Waste to Energy	
3	18AMSP702	Dissertation Phase I	10
		Total Credits	**16**

CURRICULUM STRUCTURE

II Year II Semester

Sl. No.	Course Code	Name of the Course	Credits
1	18AMSP703	Dissertation Phase II	16
		Total Credits	**16**

I YEAR I SEMESTER

I Year I Semester

18AMSP101 ADVANCED MACHIINING PROCESSES

L	T	P	C
3	0	0	3

Course Prerequisites:

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 workpieces 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 workpiece. 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:

The student will study:

1. To study the various kinds of advanced machine tools and its process capability.
2. To Study of machining technique and study machining mechanism.
3. Study of newer material removal process and productivity analysis.
4. Study of various energy usages in material processing and technological developments.
5. Application of the hybrid energy processing and research initiatives.

UNIT-I: INTRODUCTION

Advanced machining process, need, history of machining process, classifications, hybrid machining, high speed machining, nearly dry machining, hard turning, wear and failure of tools. **(9)**

UNIT-II: MECHANICAL PROCESSING OF MATERIALS

Ultrasonic Machining: Definitions, characteristics, machining system, material removal process, design of acoustic horns, factors affecting material removal rate, dimensional accuracy and surface quality, applications. **(9)**

Water Jet Machining: Introduction, machining system, process parameters, and applications. Abrasive Jet Machining: Introduction, machining system, material removal rate, applications. Abrasive Water Jet Machining: Process Characteristics, machining system, process capabilities, and applications.

UNIT-III: ELECTRO-THERMAL PROCESSES

Electro-discharge Machining: Mechanism of material removal, machining system, EDM-spark circuits, material removal rates, surface integrity, Heat-affected zone, applications, process control, EDM automation, environmental impact, Electrical Discharge Milling, Wire EDM.

Laser Beam Machining: Material removal mechanism, types of Lasers, LBM equipment, process characteristics, applications. Electron Beam Machining: Basic equipment and metal removal mechanism, process characteristics, applications.

Plasma Beam Machining: Machining systems, material removal rate, accuracy and surface quality and applications. Ion Beam Machining: Introduction, material removal rate, accuracy and surface effects and applications. **(9)**

UNIT-IV: CHEMICAL & ELECTRO-CHEMICAL PROCESSES

Chemical Milling: Introduction, tooling for CHM, process parameters, material removal rate, accuracy and surface finish, applications. Photochemical Milling: Introduction, process description and applications.

Electrochemical Machining: Principles of electrolysis, theory of ECM, ECM equipment, basic working principles, process characteristics, process control, applications, micro-ECM, environmental impacts. **(9)**

UNIT-V: HYBRID MACHINING PROCESSES

Hybrid Electrochemical Processes: Electrochemical Grinding, Electrochemical Honing, Electrochemical Superfinishing, Electrochemical Buffing, Ultrasonic-Assisted ECM, Laser-Assisted ECM.

Hybrid Thermal Processes: Electro-erosion Dissolution Machining, Electro-discharge Grinding, Abrasive Electro- Discharge Machining, EDM with Ultrasonic Assistance, Electrochemical Discharge Grinding, Brush Erosion-Dissolution Mechanical Machining, Super finishing processes and challenges. **(9)**

Course Outcomes:

At the end of the course students will be able:

1. Learning the various advanced machining processes and will be able to select their respective parameters.
2. Know the mechanical energy conversion into machining of material and other applications
3. Students will learn bulk material removal, fine finishing processes, micro-machining and fabrication of micro-devices.
4. Classify the chemical and electro chemical processes in various manufacturing applications.
5. Originate the materials processing using hybrid machining and high speed machining processes.

Textbooks:

1. Jain V. K., “Advanced Machining Processes”, Allied Publishers, New Delhi.
2. Hassan El-Hofy, “Advanced Machining Processes: Nontraditional and Hybrid Machining Processes”, McGraw-Hill Co., New York.

References:

1. Mishra P. K, “Non-conventional Machining”, Narosa Publishing House.
2. Benedict, Gary F., “Non-Traditional Manufacturing Processes”, Marcel Dekker Inc., New York.
3. J. Paulo Davim “Machining: fundamentals and recent advances “Springer.
4. Pandey, P. C. and Shan, H. S., “Modern Machining Processes”, Tata McGraw Hill Co, New Delhi.
5. Hong Hocheng, and Hung-Yin Tsai, “Advanced Analysis of Nontraditional Machining,” Springer
6. Pert P. Erdel “High speed machining” SME, Michigan.

Mode of Evaluation:

Assignments, Mid Examinations, End Examination.

I Year I Semester

18AMSP102 AUTOMATION IN MANUFACTURING

L	T	P	C
3	0	0	3

Course prerequisites:

FMS

Course Description:

This course reviews the latest trending technologies in many fields especially in industries like manufacturing, control systems, mining, etc. The current era fully rolled out with many new automation technologies. In such case more automation companies and industries were newly introduced within market which obviously shows the market growth of Automation. Due to unpredictable technology development, the industries are trying to reduce man power where they trying to increase automation function in various sectors. Now automation is used in each and every company where machines are involved and some or other process is involved. Many fields like robotics, mechatronics, control systems, electronics, wireless, laser technology, automotive motors are depended only on this Automation functions. Also, this course describes costs down techniques, quality improvements, reduces waste and optimizes energy use.

Course Objectives:

The students will study:

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

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. Manufacturing operations, Production Concepts and Mathematical Models. Costs of Manufacturing Operations. **(9)**

UNIT-II

Introduction to Material Handling, Overview of Material Handling Equipment, Considerations in Material Handling System Design, The 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. Automatic data capture-overview of Automatic identification methods, bar code technology, other ADC technologies. **(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 problem, largest candidate rule, Kilbridge and Wester method, and Ranked Positional Weights Method, Mixed Model Assembly Lines, Considerations in assembly line design. Automated Assembly Systems, Fundamentals of Automated Assembly Systems, Design for Automated Assembly, and Quantitative Analysis of Assembly Systems - Parts Delivery System at Work Stations, Multi- Station Assembly Machines, Single Station Assembly Machines, Partial Automation. **(9)**

Course Outcomes:

After successful completion of this course students will be able to:

1. Know what is automation, types of automation, components of automation, strategies and levels of automation
2. The types of flow lines, quantitative analysis of flow lines, how the assembly is carried out on automated flow line without interruption and how to balance the line and flexible assembly lines
3. Understand automated transfer and storage system, recognize the equipment's used in automated transfer and storage system
4. Know regarding of Robotics, mechatronics, control systems, electronics, wireless, laser technology, automotive motors

Text books:

1. Automation, Production systems and computer integrated manufacturing, Mikel P. Groover, Pearson Education.

Reference books:

1. CAD CAM: Principles, Practice and Manufacturing Management, Chris Mc Mohan, Jimmie Browne, Pearson edu. (LPE)
2. Automation, Buckinghsm W, Haper & Row Publishers, New York, 1961

Mode of Evaluation:

Assignments, Mid Examinations, End Examination.

DISCIPLINE ELECTIVE I

Discipline Elective - I

18AMSP401 THEORY OF METAL CUTTING AND TOOL DESIGN

L	T	P	C
3	0	0	3

Course prerequisites:

Production Technology

Course Description:

The main objectives of this course are to present advanced information about metal cutting theory to students and to enlarge the students' knowledge in metal cutting theory. The course includes *b*asic concepts and definitions, tool geometry, tool materials, chip formation, mechanics of metal cutting, cutting forces; measurements and analysis, heat generation and dissipation; analysis and measurements, tool wear and failure, tool life, chatter in machining, cutting fluids, surface roughness, machining process planning, machining economy and machinability.

Course Objectives:

The student will study:

1. To provide the basic concepts in mechanics of metal cutting, chip formation, various tool materials and tool life.
2. To train the students in the metal cutting domain so as to equip them with adequate knowledge about the various processes.
3. To apply knowledge of basic mathematics to calculate the machining parameters for different machining processes.
4. To develop fundamental knowledge on tool materials, cutting fluids and tool wear mechanisms.
5. To provide an insight about the super finishing operations of lapping and honing.
6. To lay groundwork for further studies in manufacturing stream.

UNIT-I: Mechanics of metal cutting

Overview of metal cutting, cutting tool, chip formation, chip thickness ratio, radius of chip curvature, cutting conditions, types of chips, chip breakers, orthogonal and oblique cutting processes, forces and energy calculations (merchant's analysis), power consumed, effect of cutting variables on forces, force measurement using dynamometers, numerical problems. **(9)**

UNIT-II: Geometry of cutting tools

Single point cutting tool: various systems of specifications, cutting tool geometry and their importance, design of single point cutting tool and inserts, Multi point cutting tool: drill geometry, cutting conditions in drilling, geometry of milling cutters, cutting conditions in milling, broaches, saw blades, machining time, design of twist drill, milling cutter, numerical problems. **(9)**

UNIT-III: Grinding and abrasive processes

Mechanics of grinding, effect of grinding conditions on wheel wear and grinding ratio, cutting conditions, temperature, power, specifications of grinding wheel, application considerations in

grinding, grinding operations, machining time, numerical problems. Abrasive Processes: honing, lapping, superfinishing, polishing and buffing. **(9)**

UNIT-IV: Tool life, tool materials and cutting fluids

Types of tool wear and its mechanisms, cutting tool temperature, taylor tool life criteria and machinability index, types of tool materials, characteristics of tool materials, effect of tool material on tool geometry, numerical problems in tool life, cutting fluid functions, chemical formulation of cutting fluids, types of cutting fluids, application of cutting fluids, application methods, cutting fluid filtration. **(9)**

UNIT-V: Economics, jigs and fixtures

Economic considerations in machining, tolerances, surface finish in machining, geometric factors, work material factors, optimizing cutting speed, maximizing production rate, minimizing cost per unit, numerical problems, basic principles of location and clamping, locating methods and devices, types of jigs, fixtures- vice fixtures, milling, boring, lathe, grinding fixtures. **(9)**

Course outcomes:

At the end of course, the students will be able to:

1. Demonstrate various metal removal processes.
2. Select appropriate machining processes and cutting conditions for machining different materials.
3. Understand the importance of cutting fluids and tool materials.
4. Design a single and multi-point cutting tool geometry.
5. Learn machining economics and find the optimum cutting conditions for machining.
6. Understand different machine tool jigs and fixtures.

Text books:

1. Mikell P Groover. Fundamentals of Modern manufacturing: materials, processes and systems, 4thed. John wiley& sons, inc, 2010.
2. A. K. Hajra Choudhury, S. K. Hajra Choudhury, Nirjhar Roy. Elements of Workshop Technology: Machine Tools (Vol - 2), Media Promoters and Publishers Pvt. Ltd.

Reference books:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition) Pearson India, 2014.
2. B.L.Juneja, G. S. Sekhom and Nitin Seth, Fundamentals of Metal cutting and Machine tools, New Age International publishers.

Mode of Evaluation:

Assignments, Mid Examinations, End Examination.

Discipline Elective - I

18AMSP402 MATERIALS CHARACTERIZATION TECHNIQUES

L	T	P	C
3	0	0	3

Course Prerequisites:

Materials Science Engineering, Engineering Physics and Chemistry.

Course Description:

Characterization of materials is essential to the systematic development of new materials and understanding how they behave in practical applications. 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.

Course Objectives:

Students will

1. Study the various materials characterization techniques.
2. Get knowledge about the instrumentation and working principle of the characterization tools
3. Learn to analysis the properties of materials by using appropriate tool
4. Identify the importance of characterization techniques.

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. **(7)**

UNIT-IV: OPTICAL CHARACTERIZATION TECHNIQUES

UV-VIS-NIR spectroscopy, Fourier transform infrared spectroscopy, Raman spectroscopy, X-ray photoelectron spectroscopy. **(9)**

UNIT-V: NONDESTRUCTIVE AND MECHANICAL TESTING

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

Course Outcomes:

At the end of the course students will be able to:

1. Identify phase composition of materials by XRD.
2. Measure grain size of the material by microscopic techniques.
3. Evaluate the surface morphology by using SEM and AFM.
4. Determine the thermal stability by using DTA, DSC and TGA.
5. Discuss the electronic state and chemical state of elements present in material by using XPS.
6. Describe the working principle of important material characterization tools
7. Analysis the results of nanoindentation test.
8. 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).
3. References:
4. Douglas B. Murphy, Fundamentals of light microscopy and electronic imaging, 2001, Wiley-Liss, Inc. USA
5. B.D. Cullity and S.R. Stock, Elements of X-ray diffraction 2001, Prentice Hall, Inc. USA
6. D.B. Williams and C. Barry Carter, Transmission electron microscopy 4 volumes, Springer, 1996, USA

Mode of Evaluation:

Assignments, Mid Examinations, End Examination.

Discipline Elective - I

18AMSP403 ADVANCED CASTING AND METAL JOINING

L	T	P	C
3	0	0	3

Course Prerequisites:

Knowledge on casting process and welding

Course Description:

Advanced casting and metal joining is a merging technique to produce bulk components through casting process and welding is form producing components by joining different type of materials using different welding techniques. This will give students exhaustive knowledge on design of pattern, pattern making, various and special casting process. Metal joining or welding process is emerging technique which will help to produce variety of metal joined by advanced metal joining.

Course Objectives:

The students will be able to:

1. Understand the principle, procedure and applications of casting or Foundry and Welding processes.
2. Design of patterns, runner and risers for special metal casting process
3. Different metal joining techniques involved including special welding process.
4. Understand Quality check involved for casted and welded products Non-Destructive testing methods

UNIT-I: CASTING PROCESS

Introduction to Casting processes: Classification, Metal mould casting processes, advanced casting processes, investment casting, Rheocasting, mould and core making materials and their characteristics. Technology of Selected casting Processes: Clay bonded, synthetic resin bonded, inorganic material bonded mould and core making, sand additives, mould coating, continuous casting process, centrifugal casting process. **(9)**

UNIT-II: SPECIAL CASTING PROCESS AND FURNACES

Introduction to special casting, Pressure die casting – Centrifugal – continuous – investment – shell moulding – squeeze – electro slag casting – CO_2 moulding – Plaster Mould castings – Antioch process – Slush casting- Counter gravity low pressure casting electro-magnetic casting, Design Considerations, different types melting furnaces. **(9)**

UNIT-III: METAL JOINING

Physics of welding arc, characteristics of arc, modes of metal transfer, welding fluxes, electrode coating, classification of electrode, characteristics of welding power source, pulsed and inverter type power source, power source for resistance welding, weldability, weldability tests, weldability of cast iron, Plain carbon steels, welding heat treat components, Determination of preheating temperature, Stainless steel, use of Scheffler' s diagram, **(9)**

UNIY-IV: SPECIAL METAL JOINING

Solid Sate Welding, Heat flow in welding, significance, theory of heat flow, cooling rate determination, selection of welding parameters based on heat flow analysis, residual stress and its measurement, types and control of distortion, Heated Affected Zone, Thermally Affected Zone, Melt zone, Special welding process – TIG, MIG, Friction Stir and Friction Stir Welding, Laser welding, Laser beam welding. **(9)**

UNIT-V: MECHANICAL PROPERTIES TESTING OF CASTED AND WELDED PRODUCTS.

Introduction - Causes and remedies for casting defects – welding defects – Destructive testing – NDT methods– Dye penetrant – magnetic particle – X-ray/Radiography -ultrasonic testing- Case studies in testing of welded joints & castings. **(9)**

Course outcomes:

Upon successful completion of this course, the student will be able to:

1. Apply knowledge on design of patterns, core making, and select technique for san casting.
2. Make of special casting process and furnaces based on metals to be melted and casted.
3. Identify various welding process for ferrous and non-ferrous metals.
4. Experiment with special metal joining process and verify the heat affected zone.
5. Examine the casted and welded products for quality, defect and testing of mechanical properties.

Text Books:

1. P.L.Jain, Principle of Foundry Technology – Tata McGraw Hill – 2003.
2. R.S.Parmer Welding Engineering & Technology – Khanna Publishers – 2002.
3. Principle of metal casting, Heime, Looper and Rosenthal – Tata McGraw Hill – 2001.
4. Welding Technology, Little, Tata McGraw Hill – 2000.

References:

1. Modern Welding Technology – B.Curry – Prentice Hall – 2002.
2. Welding Principle & applications – Larry Jeff in Delmar – 1997.
3. Foundry Engineering – Taylor HF Fleming, M.C. & Wiley Eastern Ltd., 1993

Mode of Evaluation:

Assignments, Mid Examinations, End Examination.

DISCIPLINE ELECTIVE II

Discipline Elective - II

18AMSP404 SIMULATION AND MODELLING OF MANUFACTURING SYSTEMS

L	T	P	C
3	0	0	3

Course prerequisites:
None

Course Objectives:
The students will study:

1. To provide knowledge simulation and simulation steps.
2. To provide knowledge on parameter estimation and hypothesis.
3. To provide knowledge on building simulation model how to validation and verification is done.
4. To provide knowledge on Generation of random variants and variables.
5. To provide knowledge on some Simulation languages.
6. To provide knowledge on some Applications of Simulation.

UNIT-I
System – ways to analyze the system – Model - types of models – Simulation – Definition – Types of simulation models – steps involved in simulation – Advantages and Disadvantages. **(9)**

UNIT-II
Parameter estimation – estimator – properties – estimate – point estimate – confidence interval estimates – independent – dependent – hypothesis – types of hypothesis- steps – types 1 & 2 errors – Framing – Strong law of large numbers. **(9)**

UNIT-III
Building of Simulation model – validation – verification – credibility – their timing – principles of valid simulation Modelling – Techniques for verification – statistical procedures for developing credible model. Modelling of stochastic input elements – importance – various procedures – theoretical distribution – continuous – discrete – their suitability in modelling. **(9)**

UNIT-IV
Generation of random variants – factors for selection – methods – inverse transform – composition – convolution – acceptance – rejection – generation of random variables – exponential – uniform – Weibull – normal Bernoulli – Binomial – uniform – Poisson. Simulation languages – comparison of simulation languages with general purpose languages – Simulation languages vs. Simulators – software features – statistical capabilities – G P S S – SIMAN- SIMSCRIPT –Simulation of M/M/1 queue – comparison of simulation languages. QUEST, WITNESS, PROMODEL and AUTOMOD. **(9)**

UNIT-V

Output data analysis – Types of Simulation with respect to output data analysis – warm up period- Welch algorithm – Approaches for Steady – State Analysis – replication – Batch means methods – comparisons. Applications of Simulation – flow shop system – job shop system – M/M/1 queues with infinite and finite capacities – Simple fixed period inventory system – Newboy paper problem. **(9)**

Course Outcomes:

After completion of the course, students will able to:

1. Apply knowledge on various types of simulation and simulation languages steps in simulation and applications of simulation.
2. Apply gain knowledge on parameter estimation and hypothesis.
3. Identify simulation model, apply to validate and verify model.
4. Apply random variants and variables.

Text books:

1. Simulation Modelling and Analysis, Law, A.M.& Kelton, McGraw Hill, 2nd Edition, New York, 1991.
2. Discrete Event System Simulation, Banks J. & Carson J.S., PH, Englewood Cliffs, NJ, 1984.
3. Simulation of Manufacturing Systems, Carrie A., Wiley, NY, 1990.

Reference books:

1. A Course in Simulation, Ross, S.M., McMillan, NY, 1990.
2. Simulation Modelling and SIMNET, Taha H.A., PH, Englewood Cliffs NJ, 1987
3. Performance modeling and analysis of manufacturing systems, Viswanatham & Narahari, PHI.

Mode of Evaluation:

Assignments, Mid Examinations, End Examination.

Discipline Elective - II

18AMSP405 PRODUCT DESIGN AND DEVELOPMENT

L	T	P	C
3	0	0	3

Course Prerequisites:

Basic knowledge in product design

Course description:

This course will provide students to learn how to design the product for fulfilling the expectations of customer in present and future aspects. Development of new concept and design with robust features of product to attracts the customer. Suitability of product architecture and its design for manufacturability will be learnt by the students. Rapid prototyping and modelling analysis is studied for enhancement of competitiveness in the product market.

Course objective:

The students will study:

1. Competence with a set of tools and methods for product design and development.
2. Confidence in your own abilities to create a new product.
3. Awareness of the role of multiple functions in creating a new product (e.g. marketing, finance, industrial design, engineering, production).
4. Ability to coordinate multiple, interdisciplinary tasks in order to achieve a competitive product.

UNIT-I

Introduction: Need for IPPD – strategic importance of product development – integration of customer, designer, material supplier and process planner, Competitor and costumer – behaviour analysis. Understanding customer – promoting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specification. **(9)**

UNIT-II

Concept generation and concept selection: Activity of concept generation – Structured approaches – Five step Method: clarify – Search-Externally and internally – explore systematically – reflect on the solutions and processes – Concept selection – Integral part of PDD process-methodology – benefits. ROBUST DESIGN-introduction, various steps in robust design. **(9)**

UNIT-III

Industrial design: Assessing the need for industrial design, impact – design process Integrate design process – assessing the quality of industrial design. Investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design. **(9)**

UNIT-IV

Product architecture: Implications – Product change – variety – component standardization – product performance – manufacturability. Design for manufacturing: Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs –cost of supporting production. Minimizing System complexity. **(9)**

UNIT-V

Prototyping: Prototype basics – Principles of prototyping – planning for prototypes – Economic analysis. Understanding and representing tasks – baseline project planning – accelerating the project execution. Competitive Aspects of Product Design, Product Quality, Reliability, Concurrent engineering aspects, Substitution of materials, SQC and SPC. **(9)**

Course Outcomes:

After the completion of course, students will able to:

1. Understand the product design and development process
2. Know the process of product design from ideas and concepts.
3. To develop product design proposals
4. Able to realize the outcome and quality of the product design and development.
5. Apply techniques to produce components using prototype.

Text books:

1. Kari T. Ulrich and Steven D. Eppinger, Product Design and Development, McGraw Hill International Edns. 1999.
2. Stephen Rosenthal, Effective Product Design and Development, Business One Orwin, Homewood, 1992, ISBN, 1-55623-603-4.

Reference books:

1. Biren Prasad, Concurrent Engineering Fundamentals: Integrated product development, Prentice Hall PTR, 1996.
2. Staurt Pugh, Tool Design – Integrated Methods for Successful Product Engineering, Addison Wesley Publishing, Newyork, NY, 1991, ISBN 0-202-41639-5.

Mode of Evaluation:

Assignments, Mid Examinations, End Examination.

Discipline Elective - II

18AMSP406 MATERIALS TECHNOLOGY

L	T	P	C
3	0	0	3

Course Prerequisites:
Material Science Engineering.

Course Description:
Materials have always been the keystone of society, and they are playing an increasingly paramount role in our high-tech age. This course presents a broad approach to understanding the relationship between the structure and properties of materials. This course will provide key information about fundamental characteristics of a variety of materials including metals, ceramics, polymers, and composites.

Course Objectives:
Students will study and understand:

1. Understand the relationship between structure and properties of materials.
2. Obtain basic knowledge on alloying theory and strengthening mechanisms
3. Study the modern metallic and non-metallic materials
4. Identify the importance of structural composite.

UNIT-I: CLASSIFICATION OF MATERIALS AND THEIR PROPERTIES

Bonds in Solids-Crystallographic planes and directions- Elasticity in metals and polymers, mechanism of plastic deformation- role of dislocations, yield stress, shear strength of perfect and real crystals - effect of temperature, strain and strain rate on plastic behavior- super plasticity- deformation of non-crystalline material. **(9)**

UNIT-II: PHASE DIAGRAM AND STRENGTHENING MECHANISMS

Types of solid solutions and Compounds-Hume-Rothery rules for formation of substitutional solid solutions-properties of solid solutions. Essential principles of solidification. Determination and uses of phase diagrams. Phase rule and its application to phase diagrams. Lever rule. Poly-phase mixture-work hardening-solid solution strengthening-grain boundary strengthening-precipitation strengthening mechanism- particle, fiber and dispersion strengthening**.** **(10)**

UNIT-III: MODERN METALLIC MATERIALS

Iron-Iron Carbide Diagram, TTT Diagram, Dual phase steels, high strength low alloy (HSLA) Steel, transformation induced plasticity (TRIP) Steel, maraging steel, intermetalics, Ni and Ti aluminides. Smart materials Classification, shape memory alloys, metallic glass, quasi crystal and nano crystalline materials. **(9)**

UNIT-IV: NON-METALLIC MATERIALS

Polymeric materials Classification, properties and applications, production techniques for fibers, foams, adhesives and coatings, structure, properties and applications of engineering polymers. Advanced structural ceramics: Ceramic materials Classification, properties and applications, WC, TiC, TaC, Al_2O_3, SiC, Si_3N_4, CBN and diamond-properties, processing and applications. **(9)**

UNIT-V: ADVANCED STRUCTURAL COMPOSITES

Introduction, types of composite materials, properties, processing and application. Motivation of selection, cost basis and service requirements, selection for mechanical properties, strength, toughness, fatigue and creep. **(8)**

Course Outcomes:

At the end of the course students will be able to:

1. Predict properties of materials based on knowledge of their structure, atomic composition and chemical bonding.
2. Make use of phase diagram to quantitatively describe the compositions, phases and microstructures of alloys
3. Describe strengthening mechanism involved in engineering materials
4. Assess the importance of structural composites and their applications.
5. Relate the structure and properties of modern metallic and non-metallic materials.

Text Books:

1. Thomas H.Courtney , Mechanical behavior of materials, 2nd Edition, McGraw-Hill, 2000
2. George E.Dieter , Mechanical Metallurgy, 3rd Edition, McGraw Hill, 1998
3. Sidney H. Avner, Introduction to Physical Metallurgy, US, 2nd Edition, 2007 Tata McGraw Hill, Noida, 1985.

References:

1. William D. Callister, Materials Science and Engineering, 8th Edition, 2010.
2. V.D. Kodgire, Material Science and Metallurgy, 12th Edition, Everest Publishing House 2002.

Mode of Evaluation:

Assignments, Mid Examinations, End Examination.

I Year I Semester

18AMSP201 ADVANCED MACHINING LABORATORY

L	T	P	C
0	0	4	2

Course Objectives:

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:

Upon completion of this course:

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:

Practical Exam.

I Year I Semester

18AMSP202 MODELLING AND SIMULATION LAB

L	T	P	C
0	0	4	2

Course Prerequisites:

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.

Lab Facilities Adequate number of Computer Systems in Networked Environment.

Software Packages:

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:

Practical Exam.

I Year I Semester

18RMP101 RESEARCH METHODOLOGY AND IPR

L	T	P	C
2	0	0	2

Course Prerequisites: 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. To know the patenting process
4. To know the new developments in IPR

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: EFFECTIVE 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
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:

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

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"

References:

1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Asimov, "Introduction to Design", Prentice Hall, 1962.

Mode of Evaluation: Assignments, Internal Mid Examinations, External End Examination.

AUDIT COURSE – I

Audit Course - I

18AUP901 DISASTER MANAGEMENT

L	T	P	C
2	0	0	0

Course Objectives:

Upon the completion of subject student will be able to-

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 in

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 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
After the completion of the subject following outcomes can be achieved-

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.
6. Student will also learn the structural and non-structural measures for risk mitigation

Reference Books
1. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation

Text Books
1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.
3. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi

Audit Course - I

18AUP902 SANSKRIT FOR TECHNICAL KNOWLEDGE

L	T	P	C
2	0	0	0

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

Alphabets- Vowels- Consonants - Māheśvara sutras - Combined alphabets- Verbs- Basic words (6)

Unit-II

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 Outcome:

Students will be able to

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/Reference Books:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi

2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication

3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Audit Course - I

18AUP903 CONSTITUTION OF INDIA

L	T	P	C
2	0	0	0

Course Objectives:

Students will be able to:

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 system

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: ELECTION COMMISSION

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:

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

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.

Textbooks:

1. Durga Das Basu, “Introduction to the Constitution of India “, Prentice Hall of India, New Delhi.
2. R.C.Agarwal, (1997) “Indian Political System”, S.Chand and Company, New Delhi.

References:

1. The Constitution of India, 1950 (Bare Act), Government Publication
2. Dr. S.N. Busi, Dr. B.R. Ambedkar framing of Indian Constitution, 1st Edition, 2015
3. M.P. Jain, Indian Constitution Law, 7thEdn., Lexis Nexis, 204
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015

Audit Course - I

18AUP904 PEDAGOGY STUDIES

L	T	P	C
2	0	0	0

Course Objectives:

Students will be able to:

1. Review existing evidence on the review topic to inform programme 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)**

UNIT-V

- Research gaps and future directions
- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact. **(6)**

Course Outcomes

Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms 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

Suggested reading

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.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, ‘learning to read’ campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

I YEAR II SEMESTER

I Year II Semester

18AMSP103 SURFACE ENGNEERING

L	T	P	C
3	0	0	3

Course Prerequisites:
Coating technology

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 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.

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. **(6)**

UNIT-II: Conventional Surface Engineering
Conventional surface Engineering-Types of surface modifications-Physical modifications-Chemical and electrochemical polishing-significance-specific examples-chemical conversion coatings-phosphating-chromating-chemical colouring-anodizing of aluminium 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 **(10)**

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 **(10)**

UNIT-V: Functional coatings and applications
Nanostructured coatings and their applications-Modified Nanomaterials: In-use for consumer products-Main problems in synthesis of modified nanomaterials-Surface engineering for polymers and composites-hard, superhard and ultrahard thin film coatings **(10)**

Course Outcomes:

At the end of the course students will be able:

1. To know need for surface engineering.
2. To understand surface properties and their modifications.
3. To become aware of various characterization techniques available for analyzing the modified surfaces.
4. To recognize the importance surface modifications in various fields.

Text Books:

1. Handbook of thin film deposition processes and techniques Edited by Krishna Seshan, William Andrew Publishing Norwich, New York, U.S.A.
2. The Materials Science of Thin Films by M. Ohring, Academic Press Inc, 2005
3. Introduction to Tribology by Bharat Bhusan, John Wiley & Sons, USA.

References:

1. K.G. Budinski, Surface Engineering for Wear Resistances, Prentice Hall, Englewood Cliffs, 1988.
2. Ohio D K Dwivedi, Surface Engineering: Enhancing life of tribological component, Springer (2017) New Delhi
3. Materials Degradation and its control by surface engineering, Imperial College Press, (2006).
4. London Tadeusz Burakowski, Tadeusz Wierzchon, Surface engineering in metals, CRC Press (1999) London
5. ASM Handbook, Surface Engineering, ASM, (1995).

Mode of Evaluation:

Assignments, Mid Examinations, End Examination.

I Year II Semester

18AMSP104 ADVANCED PRODUCTION AND OPERATION MANAGEMENT

L	T	P	C
3	0	0	3

Course Prerequisites:
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, i.e., in product design, manufacturing, engineering and distribution, is essential for competitive success and long term survival. This course considers the operations from a managerial perspective. 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. Emphasis is given both to familiarization of various production processes and service systems, and to quantitative analysis of problems arising in the management of operations

Course Objectives:
The students will be able to:
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.

UNIT-I: OVERVIEW OF PRODUCTION AND OPERATIONS MANAGEMENT
Introduction-Definition-Importance- Historical Development of POM-POM scenario today 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- Definition- Objectives-Types of layouts-Design of product layout-Line balance-Terminology-RPW method. **(9)**

UNIT-III: AGGREGATE PLANNING & MATERIAL REQUIREMENT 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 multi product 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. Upon successful completion of this course, the student will be able to:
2. Understand the role Production/Operations Management plays in business processes Able to understand the principles of production and operations Management
3. Adopt the operations process, be able to analyze and solve problems pertaining to operations.
4. Generate some of the mathematical models of production management.
5. Appraise how other functional areas of business are integrated with Operations Management.

Text Books:
1. Production and Operations Management: R.Panneerselvam
2. Operations Management by William J.Stevenson. Eighth Edition, Irwin/McGraw-Hill, 2005
3. Operations Management for Competitive Advantages- Chase Aquinano - TMH, 2009.
4. Operations Management: Theory and Practice: B.Mahadevan Pearson.
5. Industrial Engineering and Management: Dr.Ravi Shankar- Golgotha.

References:
1. Modern Production and Operations Management: Buffa, Wiley
2. Theory and Problems in Production and Operations Management: SN Chary TMH.
3. Operations Management 8e Process and Value Chains: Lee Krajewski ET. All Pearson
4. Operations Management, Amol Gore, Roberto Pawzzolo, Lengage, 2012.

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

DISCIPLINE ELECTIVE III

Discipline Elective - III

18AMSP407 OPTIMIZATION TECHNIQUES AND ITS APPLICATIONS

L	T	P	C
3	0	0	3

Course Prerequisites:
None

Course Description:
Engineers and analysts are often faced with the challenge of making trade -offs between different factors in order to achieve desirable outcomes. Optimization is the process of choosing these trade-offs in best way. Optimization problems, having reached a degree of maturity over the past several years, are encountered in physical sciences, engineering, economics, industry, planning, and many other areas of human activity.

This course deals with details of various aspects associated with optimization. These include description of optimization techniques, namely, linear programming methods, classic optimization, queuing systems, multi optimization algorithms and evolutionary algorithms.

Course Objective:
1. To understand the formulation of a structural optimization problem, including defining appropriate design variables, constraints, and objective functions of linear programming.
2. To solve the single and multi-variables problems using classic optimization techniques.
3. To apply various approximation methods to construct a sequence of approximate structural design problems appropriate for static strength, natural frequencies, buckling, and dynamic response.
4. To apply appropriate algorithms for discrete design variables and multi objective optimization.

UNIT-I
Linear programming: Two-phase simplex method, Big-M method, duality, interpretation, applications. assignment problem: hungarian's algorithm, degeneracy, applications, unbalanced problems, traveling salesman problem. **(9)**

UNIT-II
Classical optimization techniques: Single variable optimization with and without constraints, multi – variable optimization without constraints, multi – variable optimization with constraints – method of lagrange multipliers, kuhn-tucker conditions. **(9)**

UNIT-III
Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between genetic algorithm (GA) & GP, random population generation, solving differential equation using GP. **(9)**

UNIT-IV
Multi-Objective GA: Pareto's analysis, Non-dominated front, multi-objective GA, Non-dominated sorted GA, convergence criterion, applications of multi-objective problems. **(9)**

UNIT-V

Applications of optimization in design and manufacturing systems: some typical applications like optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, optimization of springs and gears. General optimization model for a machining process, general procedure in optimizing machining operations sequence and optimization of arc welding parameters. **(9)**

Course Outcomes:

After completion of course, the student will able to the

1. To understand a given problem, formulate and model it suitably, select an appropriate optimization technique, solve, find and implement the optimal solution.
2. Strengthen the analytical skills using various linear programing techniques.
3. Develop the population generation and differential equations using genetic programming.
4. To apply the optimization techniques for various engineering applications.
5. Create the optimal path for four bar mechanism and cantilever beam.

Text books:

1. Optimal design – Jasbir Arora, McGraw Hill (International) Publishers
2. Optimization for Engineering Design – Kalyanmoy Deb, PHI Publishers
3. Engineering Optimization – S.S. Rao, New Age Publishers

Reference books:

1. Genetic algorithms in Search, Optimization, and Machine learning – D.E. Goldberg,
2. Addison Wesley Publishers.
3. Multi objective Genetic algorithms - Kalyanmoy Deb, PHI Publishers.

Mode of Evaluation:

Assignments, Mid Examinations, End Examination.

Discipline Elective - III

18AMSP408 PRECISION ENGINEERING

L	T	P	C
3	0	0	3

Course prerequisites:
Metrology and Measurement, Design of Machine Elements

Course description:
Precision engineering is the science of a-priori identification of cause-effect relationships in machine tools that consist of more than one component, and the design of the machine tools to reduce sources of error to a satisfactory level. In industry, mitigating the sources of error in a dynamic or quasi-static machine is critical to ensuring that the machine executes a process that yields an acceptable product. In academic research, precision engineering is important not only for manufacturing but also to a wider range of engineering applications. For example, a fundamental understanding and implementation of precision engineering principles is key to the development of optical systems like laser-based interferometers and alignment systems.

Course objectives:
This course is focus to

1. Impart knowledge about basics of precision machining and different Manufacturing technique in precision engineering
2. Recall the basics of accuracy and alignment with various tests
3. Analyze the influences of effects of errors in precision machining
4. Enrich and recall their knowledge in various surface finish operations
5. Discover the errors in machining process

UNIT-I
Tolerance and fits: ISO and ISI designation, calculation of clearance and interference fits, probability of clearance and interference fits in transitional fits, examples of applications of various fits, concept of selective assembly, calculation of fits in selective assembly. **(9)**

UNIT-II
Concept of part and machine **tool accuracy:** Accuracy specification of parts and assemblies, accuracy of machine tools, alignment testing of machine tools. **(9)**

UNIT-III
Theory of dimensional chains: Definitions, concept of dimensional chain or tolerance stack, Examples of right and wrong dimensioning. Basic theory of dimensional chains. Calculation of tolerances in dimensional chains. **(9)**

UNIT-IV

Errors during machining: Errors due to compliance of Machine-Fixture-Tool-Work piece (MFTW) System, influence of compliance on progressive decrease of error in a series of machining operations, theory of location, location errors, errors due to geometric Inaccuracy of machine tool, errors due to tool wear, errors due to thermal effects, errors due to clamping. Statistical method of accuracy analysis. **(9)**

UNIT-V

Surface roughness: Definition and measurement, surface roughness indicators, (CLA, RMS, etc,.) and their comparison, influence of machining conditions, methods of obtaining high quality surfaces, Lapping, Honing, Super finishing and Burnishing processes. **(9)**

Calculation of machining allowance: In process dimensioning of work pieces with examples

Course Outcomes:

At the end of this course students can

1. Apply fits and tolerances for parts and assemblies according to ISO standards
2. Plan selective assembly concept for quality and economic production.
3. Assign tolerances using principles of dimensional chains for individual features of a part or assembly.
4. Evaluate the part and machine tool accuracies
5. Estimate the machining allowance for various machining process

Text books:

1. R.L.Murty,"Precision Engineering in Manufacturing", New Age International Publishers, 1996.
2. V.Kovan,"FundamentalsofProcessEngineering",ForeignLanguagesPublishingHouse, Moscow, 1975
3. Eary and Johnson, "Process Engineering for Manufacture"
4. J.L.Gadjala, "Dimensional control in Precision Manufacturing", McGraw Hill Publishers.

Reference books:

1. V.C.Venktesh, Precision Engineering, Tata McGraw Hill, New Delhi2007
2. Kalpakjian S., Manufacturing Engineering and Technology. 3rd Ed. Addision-Wesley Publishing Co., New York,2001.
3. Nakzavawa H, Principles of Precision Engineering, Oxford University Press,1994.

Mode of Evaluation:

Assignments, Mid Examinations, End Examination.

Discipline Elective - III

18AMSP409 RAPID PROTOTYPING AND TOOLING

L	T	P	C
3	0	0	3

Course prerequisites:
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:
The students will study:

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 1: Introduction
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 2: 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 **(9)**

UNIT 3: 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 4: Reverse engineering and cad modelling

Introduction to reverse engineering and its integration with rapid prototyping. Cad modelling: basic concept, digitization techniques, model reconstruction, data processing for rapid prototyping: 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 5: 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, biomedical and general engineering industries **(9)**

Course Outcomes:

At the end of course, the students will be able to

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. Calculate the layer thickness in different layering techniques and carry out design manipulations for the generation of support structure.
6. Identify, characterize and select the ideal materials for a given Rapid Prototyping system.

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.
2. A.K. Kamrani and E.A. Nasr, Rapid Prototyping: Theory and practice, Springer, 2006.
3. P.D. Hilton and P.F. Jacobs, Rapid Tooling: Technologies and Industrial Applications, CRC press, 2000.

Mode of Evaluation:

Assignments, Mid Examinations, End Examination.

DISCIPLINE ELECTIVE IV

Discipline Elective - IV

18AMSP410 FEA IN MANUFACTURING (16AMS401)

L	T	P	C
3	0	0	3

Course prerequisites:
Computational Engineering, Engineering Mathematics

Course description:
The course introduces you to theoretical basics and practical application of the finite element method 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 Objective:
To enable the knowledge in selection of various analysis methods

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, including domain discretization, polynomial interpolation, application of boundary conditions, assembly of global arrays, and solution of the resulting algebraic systems.

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, temperature effects, quadratic shape function, and analysis of trusses – plane truss and space truss elements. **(9)**

UNIT-II:
Analysis of beams– introduction to beams s h a p e functions, stiffness matrix, load vector Problems,

2-D problems–CST, force terms, stiffness matrix and load vector, boundary conditions. **(9)**

UNIT-III
Iso-parametric element, quadric element, shape functions, Numerical Integration Jacobian matrix, stiffness matrix.

Axis Symmetric formulations, Finite Element Modeling- Triangular element, Problem modeling and Boundary conditions **(9)**

UNIT-IV:

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)**

UNIT-V:

Computer Implementations: Pre-processing, mesh generation, elements connecting, Boundary conditions, input of material and process characteristics – solution and post processing- overview and application packages. **(9)**

Course Outcomes:

Upon completing this course, the students will be able to:

1. Identify mathematical model for solution of common engineering problems.
2. Formulate simple problems into finite elements.
3. Solve structural, thermal, fluid flow problems.
4. Use professional-level finite element software to solve engineering problems in Solid mechanics, fluid mechanics and heat transfer.
5. Derive element matrix equation by different methods by applying basic laws in mechanics and integration by parts.
6. Apply the FEA methods in manufacturing process like welding, casting, and deep drawing.

Text books:

1. Finite Element Methods, Alavala, PHI.
2. Introduction to finite elements in engineering, Tirupathi K. Chandrupatla and Ashok D. Belagundu.

Reference books:

1. An Introduction to Finite Element Methods, S.S.Rao, Pegamon, New York.
2. The Finite element method in Engineering Science, O.C.Aienkowitz, Mc.GrawHill.
3. Concepts and applications of finite element analysis, RobertCook.
4. Finite Element Methods in Engineering analysis, K.J.Bathe
5. Metal forming and the finite elements methods-Kobayashi.S, Soo-ik-ohandAltam.T Oxford university press, 1989

Mode of Evaluation:

Assignments, Mid Examinations, End Examination.

Discipline Elective - IV

18AMSP411 DESIGN AND MANUFACTURING OF MEMS AND MICRO SYSTEMS

L	T	P	C
3	0	0	3

Course prerequisites:

Knowledge in Micro systems design and Manufacturing process

Course description:

The objective of this course is to make students to gain basic knowledge on overview of MEMS (Micro electro Mechanical System) and various fabrication techniques. This enables them to design, analysis, fabrication and testing the MEMS based components. And to introduce the students' various opportunities in the emerging field of MEMS.

Course objective:

1. To learn about electromechanical micro devices and systems.
2. To study the basic design principles for MEMS and Microsystems.
3. To learn the basic principles of micro fabrication techniques for micro devices and systems.
4. To know the basic principles involved in micro systems packaging.
5. To learn the basic principle of Nano technology and Nano scale engineering analysis.

UNIT-I: Overview and working principles of MEMS and Microsystems:

MEMS and Microsystems, Evolution of Micro fabrication, Microsystems and Microelectronics, Microsystems and miniaturization, Applications of MEMs in Industries, Micro sensors, Micro actuation, MEMS with Micro actuators, Micro accelerometers, Micro fluidics. Engineering Science for Micro systems Design and Fabrication: Atomic structure of Matter, Ions and Ionization, Doping of Semiconductors, The Diffusion Process, Plasma Physics, Electro chemistry. **(9)**

UNIT-II: Engineering Mechanics for Microsystems Design:

Static Bending of Thin plates, Mechanical Vibration, Thermo mechanics, over view of Finite Element Stress Analysis. Thermo Fluid Engineering and Micro Systems Design: Over view of Basics of Fluid Mechanics in Macro and Meso scales, Basic equations in Continuum Fluid Dynamics, Laminar Fluid Flow in Circular Conduits. **(9)**

UNIT-III: Mechanical Design of MEMS:

Over view of Heat conduction in Solids, Heat Conduction in Multi layered thin films and in solids in sub micro meter scale, Design Considerations, Process Design Mechanical Design, Mechanical design using FEM, Design of a Silicon Die for a Micro pressure sensor. **(9)**

UNIT-IV: Materials for MEMS and Micro systems and their fabrication:

Substrates and Wafers, Active substrate materials, Silicon as a substrate material, Silicon compounds, Silicon Piezo resistors, Gallium Arsenide, Quartz, Piezo electric Crystals and Polymers. **(9)**

UNIT-V: MEMS Manufacturing Techniques:

Photolithography, Ion implantation, Diffusion and oxidation, Chemical and Physical vapor deposition, etching, Bulk micro manufacturing, Surface Micro machining, The LIGA Process. **(9)**

Course outcomes:

1. Understand the operational theory of common MEMS sensors and MEMS actuators.
2. Identify situations where MEMS sensors and actuators would be ideal for application to various products.
3. Apply the scaling laws to determine if MEMS devices would perform better than existing non-microscale devices.
4. Analyze the engineering science and physics of MEMS devices at the micro-scale including: electrostatics, thermodynamics, piezoresistive, piezoelectric, magnetism, microfluidics, and optics.
5. Understand the fabrication methods used to build/construct MEMS. • Develop new ideas and applications for MEMS devices

Text books:

1. MEMS and Microsystems. Design and Manufacturing, Tia-Ran Hsu, TMH 2002.
2. Foundation of MEMS, Chang Liu, Pearson Education, 2012.

Reference books:

1. An Introduction to Micro electro mechanical Systems Engineering. Maluf, M., Artech House, Boston 2000.
2. "Micro robots and Micro-mechanical Systems", Trimmer, W.S.N., Sensors & Actuators, Vol19, 1989
3. Applied Partial Differential Equations, Trim. D.W., PWS-Kent Publishing, Boston, 1990.

Mode of Evaluation:

Assignments, Mid Examinations, End Examination.

Discipline Elective - IV

I8AMSP412 FLEXIBLE MANUFACTURING SYSTEMS

L	T	P	C
3	0	0	3

Course Prerequisites:
None

Course Objectives:
To make the student understand

1. The need for flexibility in manufacturing industries
2. To learn the development and implementation of an FMS
3. To learn the different types of automated material handling systems its design and calculations for different applications both AS/RS
4. Concepts of group technology and cellular manufacturing.

UNIT-I
Definition of an FMS – Types & configurations concepts – Types of flexibility & performance measures. Function of FMS host computer, FMS host and area controller function distribution.

Development and implementation of an FMS: Planning phase, Integration, System configuration, FMS layouts, FMS Project development steps. **(10)**

UNIT-II
Automated Material Handling Systems: Functions, Types, Analysis of material handling equipments, Design of Conveyor & AGV systems. Benefits of Automated material handling systems.

Automated Storages Systems: Storage system performance, AS/RS, Carousel storage system, WIP storage system, Interfacing handling storage with manufacturing. **(10)**

UNIT-III
Modelling and Analysis of FMS: Need for FMS modeling, Analytical, Heuristics, queuing simulation and Petrinet modeling techniques-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. **(10)**

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. **(8)**

UNIT-V

FMS Relational: Economic and technological justification for FMS, JIT: Operation and evaluation, Personnel and Infrastructural aspects, Typical case, Future prospects. **(7)**

Course Outcomes:

At the end of the course students will be able:

1. The students will get a clear idea of importance of an FMS system in present manufacturing world.
2. The student will learn the different types of FMS layouts, material handling and retrieval systems
3. They will be able to solve the sequencing problems for different cases and tool management

Text Books:

1. **Flexible manufacturing -** Parrish D J, Butter Worth – Heinemann, Ltd Oxford, 1993.
2. Production Systems and Computer Integrated Manufacturing - GROOVER M P, Automation, Prentice Hall India (P) Ltd, 1989.
3. **Intelligent Manufacturing Systems** - Kusiak A, Prentice Hall, Englewood Clitts, NJ, 1990.
4. Flexible Manufacturing Cells & Systems - William W. Luggen –Prentice hall, NJ.

References:

1. Standard Handbook of Industrial Automation - CONSIDINE D M, and CONSIDINE G D, Chopman and Hall, London, 1986.
2. Performance Modeling of Automated Manufacturing Systems - Viswanatham N & Narahari Y, Prentice Hall of India (P) Ltd, 1992.
3. The design and Operation of FMS - Ranky P G, IFS Pub. UK, 1988.

Mode of Evaluation:

Assignments, Mid Examinations, End Examination.

I Year II Semester

18AMSP203 COMPUTER AIDED ENGINEERING (CAE) LABORATORY

L	T	P	C
0	0	4	2

Course Prerequisites:

Basic Knowledge on Industrial Engineering, Design of Experiments.

Course Description:

In thermo mechanical members and structures, finite-element analysis (FEA) is typically invoked to compute displacement and temperature fields from known applied loads and heat fluxes. FEA has emerged in recent years as an essential resource for mechanical and structural designers. Its acceptance has benefited from rapid progress in related computer hardware and software, especially computer-aided design (CAD) systems. A number of highly developed, user-friendly finite-element packages are available commercially, those can be employed for solving the engineering problems.

Course Objectives:

The students will be able to:

1. To model and analyze the mechanical engineering problems using FEA.
2. To analysis the fluid flow, heat flow problems through Computational Fluid Dynamics (CFD) commercial software.

List of Experiments:

FEA: Geometric modelling, Mesh generation (Pre-processing) and Solver settings (Post processing) of basic FEA problems.

1. Analysis of Bars of Constant Cross-section Area, Trusses Analysis
2. Simply Supported Beam with Uniformly varying load, uniformly distributed load, moment and overhung, Stress analysis of a rectangular plate with a circular hole.
3. Thermal analysis, Steady State, Transient analysis.
4. Dynamic analysis - Modal Analysis of Cantilever beam for natural frequency determination.
5. Buckling analysis

CFD: Geometric modelling, Mesh generation (Pre-processing) and Solver settings (Post processing) of basic CFD problems.

1. Laminar flow through a circular pipe.
2. Compressible and incompressible flow through a channel.
3. Flow over cylinder.
4. Radiation and Natural Convection.
5. Nozzle Analysis.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Analyze the problem through modelling, meshing, applying boundary conditions and solving.
2. Apply FE method in various engineering applications.
3. Solving the dynamics, thermal, linear static analysis through numerical method.
4. Implement Computational Fluid Dynamic method to solve the fluid flow and thermal related problems using commercial software.

References:

1. ANSYS Fluent Manual 2017. http://dl.racfd.com/ANSYS-Fluent-Tutorial-Guide_r170.pdf
2. ANSYS CFX manual 2017. https://www.sharcnet.ca/Software/Ansys/16.2.3/en-us/help/cfx_tutr/cfx_tutr.html.
3. Nitin S Gokhale, Sanjay S Deshpande, “Practical Finite element analysis”
4. John D. Anderson, “Computational Fluid Dynamics: The Basics with Applications”

Mode of evaluation:

Practical Examinations.

I Year II Semester

18AMSP204 PRODUCTION TOOLING LABORATORY

L	T	P	C
0	0	4	2

Course Prerequisites:

Basic knowledge on tools, fixtures and sheet metal components.

Course Description:

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:

The students will study and understand:

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,

Lists of experiments:

1. Study the components drawings. **(9)**
2. Prepare the detail for drawing for drill jigs like –plate jig, box jig, and turn over jigs. **(9)**
3. Decide different locations, clamps, drill bushes. **(9)**
4. Design and prepare the drawings for components – fixture for turning, milling, welding, assembly fixture. **(9)**
5. Design, prepare drawings and manufacture for simple dies for blanking, piercing, bending and forming. **(9)**

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Apply the knowledge to develop various work holding devices.
2. Choose various jigs and fixtures to produce components.
3. Design strip layout for various sheet metal components.
4. Design press tools for blanking, piercing die, compound die, combination die.
5. Estimate the forces required for blanking, piercing, bending and drawing.

Text Books:

01.Donaldson C., Lecain G.H. and Goold V.C. (2007), Tool Design, 3rd edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi.

References:

1. Joshi P. H., (2004) Jigs and Fixtures, 2nd Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi.
2. Edward G. Hoffman (2004) Jigs and Fixtures Design, Thomson - Delmar Learning Series, Singapore. 03. Jeff Lantrip, David A. Smith and John G. Nee, (2003) Fundamentals of Tool Design, 5th Edition, Society of Manufacturing Engineers.01. Gupta. I.C., "Engineering Metrology", Dhanpat Rai and Sons, 2000.

Mode of Evaluation:

Assignments and practical.

AUDIT COURSE – II

Audit Course - II

18AUP905 ENGLISH FOR RESEARCH PAPER WRITING

L	T	P	C
2	0	0	0

Course Objectives:

At the end of the course the learners will be able to:

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: An Introduction

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 your discussion section – Discussing the findings of your study with the literature available. **(6)**

Unit V– Preparing References, Appendixes and proofreading the paper

Various styles of referencing and bibliography (APA, MLA, Oxford, Harvard, Chicago), – Organising and preparing Appendixes – Various strategies of proofreading. **(6)**

Course Outcomes:

At the end of the course the learners will be able to:

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

Suggested Studies:

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)
3. Day, R. (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
4. Highman, N. (1998), Handbook
5. Research Papers, Springer New York Dordrecht
6. Kate L. Turabian, (2007). A Manual for Writers of Research Papers, Theses, and Disserta tions, Seventh Edition: Chicago Style for Students and Researchers [7th ed.] Chicago Guides to Writing, Editing, and Publishing

Audit Course - II

18AUP906 VALUE EDUCATION

Course Prerequisite: None

L	T	P	C
2	0	0	0

Course Objectives:

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

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 labour.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:

Students will be able to

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 work

Text/Reference Books:

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Audit Course - II

18AUP907 STRESS MANAGEMENT BY YOGA

L	T	P	C
2	0	0	0

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

UNIT-II: Consequences of stress on human mind

Human Psyche: Yogic and Modern concepts, behavior and consciousness – Frustation – Conflicts – Psychosomatic Disorders

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)

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)

UNIT-V: Yogic management of stress

Specific practices for stress management: Yogasana, breath awareness, shvasana, yoganidra, pranayama and meditation

Course Outcomes:

Students will be able to:

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/Reference Books:

1. 'Certification of yoga professionals, Official guide book for Level 1 and Level 2" Excel books private limited, Noida
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Audit Course - II

18AUP908 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

L	T	P	C
2	0	0	0

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:

3. To expose the students to those soft skills which are crucial to an employee's ability to work smarter.
4. To enhance Art of Communication, Team Skills, GD handling skills and preparing resume & Interview Skills

UNIT I: VERBAL COMMUNICATION –

Active listening - Non Verbal Communication - Body Language. **(6)**

UNIT II: DEVELOPING EMOTIONAL INTELLIGENCE –

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'ts - 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. "Soft Skills". Dr K Alex. S Chand Publications, New Delhi

References Books:

1. The Seven Habits Of Highly Effective People By Stephen R. Covey, Covey Leadership
   Center, 2005.
2. Negotiate To Close By Gary Karnass, Simon And Schuster, 1987.
3. The Greatest Miracle In The World – Ogmandino, Random House Publishing Group, 2009.
4. Working With Emotional Intelligence - Daniel Goleman, A&C Black, 2009.
5. Developing Communication Skills By Krishna Mohan And Meera Banerji;
   Macmillan In- dia Ltd., Delhi, 2000.
6. Essentials Of Effective Communication, Ludlow And Panthon; Prentice Hall Of India,
   1993.
7. Effective Presentation Skills (A Fifty-Minute Series Book) By Steve Mandel, Crisp
   Publi- cations, 1996.
8. "Strategic Interviewing" By Richard Camp, Mary E. VielhaberAnd Jack L. Simonetti –
   Published By Wiley India Pvt. Ltd, 2007.
9. "Effective Group Discussion: Theory And Practice" By Gloria J. Galanes, Katherine Ad-
   ams, John K. Brilhart, Tata Mcgraw-Hill, 2010.

II YEAR I SEMESTER

Discipline Elective - V

18AMSP413 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:

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 mach inability, 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

Introduction: Design philosophy – 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: 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

FORGING – Design factors for forging – Closed die forging design – Location of parting lines of dies – Drop forging die design – General design recommendations

EXTRUSION, SHEET METAL WORK: Design guidelines for Extruded sections - Keeler Goodman

Forming Limit Diagram – Component Design for Blanking. **(9)**

UNIT V

PLASTICS: Viscoelastic and Creep behavior in plastics – Design guidelines for Plastic components – Design considerations for Injection Moulding.

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:

1. Select the design principle, suitable material, mechanism, fit and tolerance for designing a product/component.
2. Select the appropriate material, proper working principle and a feasible design.
3. Design (optimum) a component which requires less material removal, easy to machine, assemble, access and cost effective.
4. Redesign the uneconomical casting design and know the applications of DFMA.
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. 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, Mid Examinations, End Examination.

Discipline Elective - V

18AMSP414 INDUSTRIAL ROBOTICS

L	T	P	C
3	0	0	3

Course Prerequisite:
None

Course Description:
Robotics subject describes various components of the robots and their working principles. Also, studies on robot kinematics, dynamics, and path planning with the different programming method are involved. It also covers the different industrial and non industrial application of the robot.

Course Objectives:
1. The student should understand the some fundamental aspects of an overview of robotics and automation, including components of the industrial robotics, arms, architecture, end effectors, actuators and feedback components.
2. Emphasis is placed on understanding motion analysis described mathematically.
3. Emphasis is placed on the manipulator kinematics, D-H notation joint, forward and inverse kinematics is also considered in some detail.
4. The differential transformation and trajectory planning, different motions should be able to apply to the analysis of robotics.
5. The student should able to apply the knowledge to solve more complicated problems and study the effect of problem parameters and able to describe the construction and working of different types of robots.
6. The student should be prepared to continue the study and analyze the robotics to solve the complicated practical problems.

UNIT-I: Introduction:
Automation and Robotics, Robot anatomy, robot configuration, motions joint notation, work volume, control system and dynamic performance, precision of movement.

Robot Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison.

Sensors: Position sensors, velocity sensors, tactile, proximity and range sensors, uses of sensors in robotics and desirable features. **(9)**

UNIT-II: Motion Analysis and Control:
Manipulator kinematics, position representation forward transformation, homogeneous transformation, Differential Kinematics, Jacobian Formulation, problems and robot dynamics.

Trajectory Planning: Joint space scheme, Cartesian space scheme, Cubic Polynomial fit without and with via point. **(9)**

UNIT-III: End Effectors:
Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design.

Robot Dynamics: Lagrange – Euler and Newton Euler formulations, problems on two link planar manipulators **(9)**

UNIT-IV: Robot Programming:
Lead through programming, Robot programming as a path in space, Motion interpolation, WAIT, SINONAL AND DELAY commands, branching.

Robot Languages: Textual robot Languages, Generation, Robot language structures, Elements in function. **(9)**

UNIT-V: Robot Cell Design And Control:
Robot cell layouts-Robot centered cell, In-line robot cell, Considerations in work design, Work and control, Inter locks, Error detect ion, Work wheel controller.

Robot Application: Material transfer, Machine loading/unloading, Processing operation, Assembly and Inspection, Feature application. **(9)**

Course Outcomes:
The students after completing the course will be able to:

1. Demonstrate the automation and brief history of robot and applications.
2. Applying the kinematic and dynamic motions of robot knowledge to new situations.
3. Explain the type's robot end effectors and their design concepts.
4. Summarize the programming methods and various languages of robots.
5. Recommend the type of sensor required based on the application in the robot.
6. Solve problems concern about path planning for the robot.

Text Books:
1. Industrial robotics, Mikell P.Groover , McGraw Hill.
2. Introduction to Robotics Mechanics and Control, John J.Craig, Pearson

References:
1. Robotics, K.S.Fu, McGraw Hill.
2. Robot Analysis, Lung Wen Tsai, John Wiley & Sons.
3. Robotics and control, RK Mittal & IJ Nagrath, Tata McGrawHill.
4. Fundamentals of Robotics,RobertJ.schilling, PHI.
5. Robotics, Saha, TMG.
6. Robotic Engineering, Richard D.Klafter, Thomas A.Chmielewski, PHI.

Mode of Evaluation:
Assignment, Mid Examination, End Examination

Discipline Elective - V

18AMSP415 TOTAL QUALITY MANAGEMENT

L	T	P	C
3	0	0	3

Course Prerequisite:

Quality Control

Course Description

Total quality management (TQM) is a philosophy, methodology and system of tools aimed to create and maintain mechanism of organization's continuous improvement. It involves all departments and employees into improvement of processes and products. 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 that is sustainable approach to organization's competition, efficiency improvement, leadership and partnership.

Course Objectives:

The students will be able to:

1. Understand comprehensive knowledge about the principles, practices, tools and techniques of total quality management.
2. Provide adequate knowledge on leadership, customer satisfaction, addressing customer complaints, team work, employee involvement, related to customer and supplier partnership.
3. Gives information on various tools and techniques, concept on Six Sigma, bench marking, analysing the failure using Failure Mode Effective Analysis (FMEA).
4. Provide the importance of quality circle, Quality Function Deployment, Taguchi design of experiments and some case studies.

UNIT-I: INTRODUCTION

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

UNIT-II: TQM PRINCIPLES

TQM principles - Strategic quality planning, Quality statements - Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – Supplier partnership – Partnering, Supplier selection, Supplier Rating. **(9)**

UNIT-III: TOOLS AND TECHNIQUES I

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench-mark, Bench marking process – FMEA. **(9)**

UNIT-IV: TOOLS AND TECHNIQUES II

Quality circles – Quality Function Deployment (QFD) – Design of Experiments-Taguchi quality loss function – TPM – Concepts, improvement needs – Cost of Quality – Performance measures. **(9)**

UNIT-V: IMPELMENTATION OF TQM

Steps, KAIZEN, 5S, JIT, POKAYOKE, I - Introduction to Robust Design, Taguchi Principles and Design, Case studies. **(9)**

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Understand the various principles and practices of TQM to achieve quality.
2. Identify the various statistical approaches for Quality control.
3. Demonstrate the TQM tools for continuous process improvement.
4. Adopt the importance of ISO and Quality systems.
5. Make use of the concepts of TQM to solve case studies

Text Books:

1. Dale H. BesterField, et al., Total Quality Management, Pearson Education Asia, Third Edition, Indian Reprint (2006).

References:

1. James R. Evans and William M. Lindsay, The Management and Control of Quality, (6th Edition), South-Western (Thomson Learning), 2005.
2. Oakland, J.S. TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, Third Edition (2003).
3. Suganthi,L and Anand Samuel, Total Quality Management, Prentice Hall (India) Pvt. Ltd. (2006) Model.

Mode of Evaluation:

Assignment, Mid Examination, End Examination

Discipline Elective - V

18AMSP416 POWDER METALLURGY

L	T	P	C
3	0	0	3

Course Prerequisite: Fundamental knowledge of Materials science, metallurgy and basic sciences.

Course Description:

The Powder Metallurgy course is to prepare students for careers in metallurgy engineering where knowledge to provide them with an insight into the emerging technology of powder metallurgy as an alternative route to conventional metal processing. It is important to understand and appreciate the importance of powder metallurgy as an effective and profitable material processing route to produce a variety of products for engineering industries. The course provides detailed knowledge of powder production and processing as well as to choose the right method to suit application in hand.

Course Objectives:

1. To understand various techniques are used for powder production and the versatile nature of these techniques to produce a wide range of powders.
2. To know the Characterization of powder, subsequent compaction methods and sintering processes.
3. To learn the methods production of metals and alloys in the form of semi-dense finished parts or fully dense structural shapes t.
4. To hasten development of the necessary scientific and engineering base i.e., to establish the powder fabrication route as a technologically and economically viable means of materials production.

UNIT I: INTRODUCTION TO POWDER METALLURGY (P/M) AND PRODUCTION METHODS

Necessity and importance of P/M, Particulate materials processing, Advantages of P/M over conventional materials processing, Applications of P/M, Limitations of P/M, Physical methods, Chemical methods, Mechanical methods, Selection of powder production method. **(9)**

UNIT II: POWDER CHARACTERIZATION AND PROPERTIES.

Chemical composition analysis, Particle shape & size analysis, Microscopic method, Characterization by surface area and gas adsorption method, Green strength, Properties of sintered compact, Apparent & tap density, Porosity, Flow rate, Pyrophoricity, Toxicity. **(9)**

UNIT III: COMPACTION OF METAL POWDERS

Powder pressing, Powder shaping and compaction, Binders, Pressureless compaction technique, Pressure compaction technique, Die compaction: Types of presses, Tooling & Design, Behavior of powder during compaction, Cold isostatic compaction: Processes, Types of cold isostatic pressing, Advantages of cold isostatic pressing, Powder roll compaction: Steps in powder rolling, Advantages and disadvantages of powder rolling, Applications **(9)**

UNIT IV: HIGH TEMPERATURE AND MISCELLANEOUS COMPACTION METHODS

Uniaxial hot pressing, Hot extrusion, Spark sintering, Hot isostatic pressing, Injection molding, Continuous compaction, Explosive compaction, Forming of ceramic powders **(6)**

UNIT V: SINTERING AND POWDER METALLURGY APPLICATIONS

Types of sintering: Solid state sintering (SSS), Liquid state sintering, Activated sintering, Microwave sintering, Spark plasma sintering, Theory of Sintering: Thermodynamics of SSS, stages of SSS, Driving force of sintering, Sintering mechanism, Sintering zones: Entrance zone, High temperature zone, Cooling zone, Sintering Furnaces: Batch type furnace, Continuous sintering furnace, Vacuum furnace, Sintering Atmosphere: Need for sintering atmosphere, Function of sintering atmosphere, Hydrogen, Reformed hydrogen gases, Nitrogen, Dissociated ammonia, Inert gases, Vacuum.
Porous materials, Cermets, Carbides, Electrical appliances, Sintered Friction materials **(12)**

Course Outcomes:
At the end of the course students will be able:

1. To develop deep knowledge of various powder production methods and application-based selection criterion.
2. To understand various properties of powders and its characterization.
3. Student will be able understand various paraments and processes employed for compaction of powders.
4. Student will have knowledge of various compaction techniques used for processing particulates.
5. To understand importance, processes and applicability of various sintering methods along with modern applications of P/M.

Textbooks:

1. Anish Upadhyaya, G. S. Upadhyaya, "Powder Metallurgy: Science, Technology, and Materials", CRC Press, 1st edition, 2011.
2. P. C. Angelo, R. Subramanian, "Powder Metallurgy", PHI Learning Pvt Ltd., McGraw Hill Education, 1st Edition, 2009.

References:

1. G. S. Upadhyaya, "Powder Metallurgy Technology", Cambridge International Science Publishing, 1st edition, 1998.
2. Randall M. German, "Powder Metallurgy and Particulate Materials Processing", Metal Powder Industries Federation, 1st Edition, 1994.

Mode of Evaluation: Assignments, Internal Mid Examinations, External End Examination.

Discipline Elective - V

18AMSP417 ADVANCES IN METAL JOINING

L	T	P	C
3	0	0	3

Course Prerequisite: Fundamental knowledge of welding and metal joining processes

Course objectives:

01. To conceptualize the production of bulk components and products by metal joining process.
02. Apply the knowledge on fabrication of dissimilar metals through FSW process.
03. Study of various non-conventional metal joining process
04. Investigation of welding products by NDT and other inspection techniques

Unit I

Overview of metal joining processes- requirements of metal joining products –Types of metal joining processes –Heat sources – Joint design and process selection, for metal joining- edge preparation – flame characteristics – different types of flames- Shielding methods –manual arc welding –gas welding- functions of flux covering – Types of electrodes for different metals – submerged arc welding – gas metal arc welding-resistance welding –TIG and MIG welding – flash butt welding – HAZ - Advantages in welding – Shielded arc welding – Under water welding

Unit II

Introduction to Friction stir welding (FSW), Solid state welding – Friction stir processing – Metal flow phenomena – FSW spot welding – Tools in FSW process parameters – Induction pressure welding –various metals used in FSW- Resistane seam- Thermit welding – Ultasonic welding – Roll welding –explosive welding – diffusion welding, Defects in FSW and their eradications – NDE of FSW – FSW applications and economics of FSW process.

Unit III

Effect of pre and post welding – structural changes in welding – process induced in welds – their casues and remidies – effects of metallurgical parameters – concepts of weldability and assesment tests.

Other metal joining process – brazing – soldering – surfacing – adhesive joints – Joining of plastics, ceramics, and glasses – welding for light weight metals – Advanatges and limitations – Inspection of joints – case studies

Unit IV

Description of nonconventional welding process – construction of equipment – working principles and application of – Laser Beam Welding – Electron Beam Welding – Plasma Arc Welding – types of metals used – study of microstructure, HAZ and TMAZ

Unit V

Testing and inspection of welding – ASTM Standards – requirements of testing and inspection – Testing of welded products – welding defects and their inspection – various inspectio techniques – NDT – Inspection of welded parts – Visual inspection – dye penetrant-magnetic particle – flourescent test - Ultrasonic testing – Destructive testing (DT) – mechanical tests –mettallurgical tests - X ray, gamma ray tests etc.

Course outcomes:

At the end of the course students will be able:

1. Learning the various advanced metal joining processes and will be able to select suitable metal joining process based on the requirement.
2. Know the friction stir welding and their applications of dissimilar metals.
3. Students will learn joining process for non-metals energy based non-conventional metal joining processes and their applications in newer materials.
4. Classify the conventional and nonconventional welding processes
5. Inspect the quality of weld joints using destructive and non-destructive testing processes.

Text books:

01. M.D.Jackson- Welding methods and mettallurgy, Griffin
02. H.B.Carry and Helzer –Modern welding technology, prentice hall, 6th edition 2004.
03. Serope Kalpakjian and Steven R.Schmid, Manufacturing Engineerinf and technology, 7th eidtion, Pearson India Educations services, 2014.

Reference book:

01. R.S.Mishra, M.V.Mahoney, Y.Sato and Y.Havanski – Friction stir welding process, John Wiley and Sons -2013.
04. R.S.Parmer – Welding Engineering and Technology, Khanna publishes, 2010.

Mode of Evaluation: Assignments, Internal Mid Examinations, External End Examination.

OPEN ELECTIVE

Open Elective - V

18OEP301 BUSINESS ANALYTICS

L	T	P	C
3	0	0	3

Course Prerequisite:
None

Course Description:
Course delves into commonly encountered business situations requiring optimization of business resources and provides basic solutions methods using traditional and advanced methods.

Course objective:
1. Refresh basic statistics
2. Explain the importance of statistics in business analytics
3. Introduce predictive modeling for business decisions
4. Explain the tools for predictive modeling
5. Explain the use of simulation to make business decision
6. Explain the use of data mining techniques for making business decision

UNIT-I: Introduction to Business Analytics
Introduction to Business Analytics (BA). Evolution and Scope of Business Analytics. Data for Business Analytics.Analyzing uncertainty and model assumptions – What if analysis, Data tables, Scenario manager and Goal Seek. Regression modelling. **(9)**

Unit-II: Statistics for Business Analytics
Brief overview of descriptive statistics, graphical representation of data, and overview of hypothesis testing, Introduction to R statistical software **(9)**

Unit-III: Predictive Analytics Methods
Forecasting techniques – Statistical forecasting techniques. Decomposition model – Estimation of trend, seasonality and cyclical components. Smoothing models for forecasting – moving average, exponential smoothing methods, time series analysis. **(9)**

Unit-IV: Simulation, Risk Analysis and Data Mining
Simulation and Risk Analysis – Monte Carlo simulation Examples of simulation models, Introduction to Data Mining – Scope of Data Mining. Data exploration and reduction. Classification – Measuring classification performance. Classification techniques – K nearest neighbor, Discriminant Analysis, factor analysis, and Logistic regression. **(9)**

Unit-V: Decision Analysis
Decision making with uncertain information. Decision strategies for a minimize objective. Decision strategies for a maximize objective. Decision Tress. Building a decision tree. Decision trees and risk. Sensitivity analysis, Baye‘s Rule.

Case Study:
Compulsory and Relevant Cases have to be discussed in each unit. **(9)**

Assignment:
Two relevant assignments have to be given to the students

Course Outcomes
At the end of this course students will be able to

1. Understand the need and significance of business analytics for decision making
2. Use statistical tools to extract information from raw data
3. Use regression technique to build predictive models
4. Apply simulation technique to predict business scenarios
5. Use data mining techniques to make business decsisions

Text Books:
1. Essentials of Business Analytics, Jeffrey Camm, James Cochran, Michael Fry, Jeffrey Ohlmann, David Anderson

References:
1. Albright C. S., Winston Wayne L. and Zappe C. J (2009). Decision Making Using Microsoft Excel (India Edition). Cengage Learning.
2. Evans J. R (2013). Business Analytics Methods, Models and Decisions. Pearson, Upper Saddle River, New Jersey.

Mode of Evaluation:
Assignment, Mid Examination, End Examination

Open Elective - V

18OEP302 INDUSTRIAL SAFETY

L	T	P	C
3	0	0	3

UNIT-I

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

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equip- ment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes. **(9)**

UNIT-V

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)**

Reference:

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:

Assignment, Mid Examination, End Examination

Open Elective - V

18OEP303 OPERATIONS RESEARCH

L	T	P	C
3	0	0	3

UNIT-I

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models **(9)**

UNIT-II

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming **(9)**

UNIT-III

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT **(9)**

UNIT-IV

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming. **(9)**

UNIT-V

Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation **(9)**

Course Outcomes:

At the end of the course, the student should be able to

1. Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
2. Students should able to apply the concept of non-linear programming
3. Students should able to carry out sensitivity analysis
4. Student should able to model the real world problem and simulate it.

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Mode of Evaluation:

Assignment, Mid Examination, End Examination

Open Elective - V

18OEP304 COST MANAGEMENT OF ENGINEERING PROJECTS

L	T	P	C
3	0	0	3

UNIT–I:

Introduction and Overview of the Strategic Cost Management Process **(6)**

UNIT–II:

Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making. **(9)**

UNIT – III:

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process **(12)**

UNIT–IV:

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing. **(12)**

UNIT – V:

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory. **(6)**

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Mode of Evaluation:

Assignment, Mid Examination, End Examination

Open Elective - V

18OEP305 COMPOSITE MATERIALS

L	T	P	C
3	0	0	3

UNIT–I:

INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance. **(9)**

UNIT–II:

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions. **(9)**

UNIT – III:

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique,

Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix

Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications. **(9)**

UNIT–IV:

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications. **(9)**

UNIT – V:

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations. **(9)**

Text books:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Mode of Evaluation:

Assignment, Mid Examination, End Examination

Open Elective - V

18OEP306 WASTE TO ENERGY

L	T	P	C
3	0	0	3

UNIT-I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue,Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors **(9)**

UNIT-II

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods – Yields and application – Manufacture of pyrolytic oils and gases, yields and applications. **(9)**

UNIT-III

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers –

Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation. **(9)**

UNIT-IV

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed-bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors. **(9)**

UNIT-V

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and-status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion – Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India. **(9)**

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Mode of Evaluation:

Assignment, Mid Examination, End Examination