1701MF101	ADVANCED OPTIMIZATION TECHNIQUES	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

To introduce the various advanced optimization techniques and their advancements.

UNIT I INTRODUCTION **7 Hours**

Optimization – Historical Development – Engineering applications of optimization – Statement of an Optimization problem – classification of optimization problems.Classical optimization Techniques – Linear Programming, Non-linear Programming, Integer Programming and Dynamic Programming.

UNIT II FUZZY SYSTEMS **9 Hours**

Basic definition and terminology, set-theoretic operations, Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions, Fuzzy Rules & Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making; Neuro-fuzzy modeling- Adaptive Neuro-Fuzzy Inference Systems, Coactive Neuro-Fuzzy Modeling, Classification and Regression Trees, Data Clustering Algorithms, Rulebase Structure Identification and Neuro-Fuzzy Control , Applications of neuro-fuzzy modeling

UNIT III ARTIFICIAL NEURAL NETWORKS **10 Hours**

Introduction – Fundamental concept – Evolution of Neural Networks – Basic Models of Artificial Neural Networks – Important Terminologies of ANNs – McCulloch-Pitts Neuron – Linear Separability – Hebb Network. SupervisedLearning Network: Perceptron Networks – Adaline – Multiple Adaptive Linear Neurons – Back-Propagation Network – Radial BasisFunction Network.Applications of ANN.

UNIT IV GENETIC ALGORITHM **10 Hours**

Introduction to Genetic Algorithms (GA), Representation, Operators in GA, Fitness function, population, building block hypothesis and schema theorem.; Genetic algorithms operators- methods of selection, crossover and mutation, simple GA(SGA), other types of GA, generation gap, steady state GA, Applications of GA

UNIT V SWARM INTELLIGENCE **9 Hours**

Swarm intelligence, Various animal behaviors, Ant Colony optimization, swarm intelligence in bees, flocks of birds, shoals of fish, ant-based routing, Particle Swarm optimization

TOTAL: 45 HOURS

REFERENCES:

1. S.S. Rao, "Engineering Optimization: Theory and Practice", New Age International P)Ltd.,New Delhi, 2000.
2. S. Rajasekaran and G.A.V.Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms, PHI, 2003.
3. Timothy J.Ross, Fuzzy Logic with Engineering Applications, McGraw-Hill, 1997.
4. J.S.R.Jang, C.T.Sun and E.Mizutani, Neuro-Fuzzy and Soft Computing, PHI, 2004, Pearson Education.
5. S.N. Sivanandan and S.N. Deepa, Principles of Soft Computing, Wiley India, 2007. ISBN: 10: 81-265-1075-7

1702MF102	POLYMERS AND COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To study matrix material, reinforcements of polymer matrix composites, MMC and ceramic matrix composites.
2. To develop knowledge on processing, interfacial properties and application ofcomposites.

UNIT I PROCESSING OF POLYMERS **9 Hours**

Chemistry and Classification of Polymers – Properties of Thermo plastics - Properties of Thermosetting Plastics - Extrusion – Injection Moulding – Blow Moulding – Compression and Transfer Moulding – Casting - Thermo Forming. General Machining properties of Plastics – Machining Parameters and their effect – Joining of Plastics – Thermal bonding – Applications.

UNIT II FIBERS AND MATRIX MATERIALS **9 Hours**

Fibers – Fabrication, Structure, properties and applications – Glass fiber, Boron fiber, carbon fiber, organic fiber, ceramic and metallic fibers - whiskers–Fabrication of Matrix materials – polymers, metals and ceramics and their properties – interfaces – Wettability – Types of bonding at theinterface– Tests for measuring interfacial strength - Physical and chemical properties.

UNIT III PROCESSING OF POLYMER MATRIX COMPOSITES **9 Hours**

Thermoset matrix composites: hand layup, spray, filament winding, Pultrusion, resin transfer moulding, autoclave moulding - bag moulding, compression moulding with Bulk Moulding Compound and sheet Moulding Compound – thermoplastic matrix composites – film stacking, diaphragm forming, thermoplastic tape laying, injection moulding – interfaces in PMCs - structure, properties and application of PMCs –recycling ofPMCs.

UNIT IV PROCESSING OF METAL MATRIX COMPOSITES **9 Hours**

Metallic matrices: aluminium, titanium, magnesium, copper alloys – processing of MMCs: liquid state, Solid state, in situ fabrication techniques – diffusion bonding – powder metallurgy techniques- interfaces in MMCs – mechanical properties – machining of MMCs – Applications.

UNIT V PROCESSING OF CERAMIC MATRIX COMPOSITES AND CARBON-CARBON COMPOSITES **9 Hours**

Processing of CMCs: cold pressing, sintering, reaction bonding, liquid infiltration, lanxide process – in situ chemical reaction techniques: chemical vapour deposition, chemical vapour impregnation,sol-gel– interfaces in CMCs – mechanical properties and applications of CMCs – Carbon-carbon Composites –applications.

TOTAL: 45 HOURS

REFERENCES:

1. Krishnan K Chawla, Composite Materials: Science and Engineering, International Edition, Springer, 2012,ISBN:978-0-387-74364-6.
2. Mallick P.K., Fiber Reinforced Composites: Materials, Manufacturing and Design, CRC press, New Delhi, 2010,ISBN:0849342058.
3. Jamal Y. Sheikh-Ahmad, Machining of Polymer Composites, Springer, USA, 2009. ISBN: 978-0- 387-35539-9.
4. Mallick, P.K. and Newman.S., Composite Materials Technology, Hanser Publishers,2003.
5. Harold Belofsky, Plastics, Product Design and Process Engineering, Hanser Publishers,2002.
6. Seamour, E.B. Modern Plastics Technology, Prentice Hall,2002
7. Said Jahanmir, Ramulu M. and PhilpKoshy, Machining of Ceramics and Composites, Marcel Dekker Inc., New York, 1999, ISBN:0-8247-0178-x.
8. ASM Handbook – Composites, Vol-21, 2001, ISBN: 978-0-87170-703-1.

1702MF103	MATERIALS TESTING AND MECHANICAL CHARACTERIZATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The students are expected to be knowledgeable in microstructure evaluation, crystal structure analysis, electron microscopy, Chemical Thermal Analysis, static and dynamic mechanical testing methods.

UNIT I MICRO AND CRYSTAL STRUCTURE ANALYSIS **9 Hours**

Principles of Optical Microscopy – Specimen Preparation Techniques – Polishing and Etching – Polarization Techniques – Quantitative Metallography – Estimation of grain size – ASTM grain size numbers – Microstructure of Engineering Materials - Elements of Crystallography – X- ray Diffraction – Bragg's law – Techniques of X-ray Crystallography – Debye – Scherer camera – Geiger Diffractometer – analysis of Diffraction patterns – Inter planer spacing – Identification of Crystal Structure, Elements of Electron Diffraction.

UNIT II ELECTRON MICROSCOPY **9 Hours**

Interaction of Electron Beam with Materials – Transmission Electron Microscopy – Specimen Preparation – Imaging Techniques – BF & DF – SAD – Electron Probe Microanalysis – Scanning Electron Microscopy – Construction & working of SEM – various Imaging Techniques – Applications- Atomic Force Microscopy- Construction & working of AFM - Applications .

UNIT III CHEMICAL ANDTHERMAL ANALYSIS **9 Hours**

Basic Principles, Practice and Applications of X-Ray Spectrometry, Wave Dispersive X-Ray Spectrometry, Auger Spectroscopy, Secondary Ion Mass Spectroscopy, Fourier Transform Infra Red Spectroscopy (FTIR)- Proton Induced X-Ray Emission Spectroscopy, Differential Thermal Analysis, Differential Scanning Calorimetry (DSC) And Thermo Gravitymetric Analysis (TGA)

UNIT IV MECHANICAL TESTING –STATIC TESTS **9 Hours**

Hardness – Brinell, Vickers, Rockwell and Micro Hardness Test – Tensile Test – Stress – Strain plot – Proof Stress – Torsion Test - Ductility Measurement – Impact Test – Charpy&Izod – DWTT - Fracture Toughness Test, Codes and standards for testing metallic and composite materials.

UNIT V MECHANICAL TESTING –DYNAMIC TESTS **9 Hours**

Fatigue – Low & High Cycle Fatigues – Rotating Beam & Plate Bending HCF tests – S-N curve – LCF tests – Crack Growth studies – Creep Tests – LM parameters – AE Tests-modal analysis - Applications of Dynamic Tests.

TOTAL: 45 HOURS

REFERENCES:

1. Culity B.D., Stock S.R& Stock S., Elements of X ray Diffraction, (3rd Edition). Prentice Hall,2001.

2. Dieter G.E., Mechanical Metallurgy, (3rd Edition), ISBN: 0070168938, McGraw Hill,1988.

3. Davis, H.E., Hauck G. &Troxell G.E., The Testing of engineering Materials, (4th Edition), McGraw Hill, College Divn.,1982.

4. Suryanarayana A. V. K., Testing of metallic materials, (2nd Edition), BS publications,2007.

5. Newby J., Metals Hand Book- Metallography & Micro Structures, (9th Edition), ASM International,1989.

6. ASM Hand book-Materials characterization, Vol – 10,2004.

1702MF104 INDUSTRIAL AUTOMATION AND MECHATRONICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

Knowledge in Industrial Automation and Mechatronics systems and impart the source of concepts and techniques, which have recently been applied in practical situation. It gives the frame work of knowledge that allows engineers and technicians to develop an interdisciplinary understanding and integrated approach to engineering

UNIT I INDUSTRIAL AUTOMATION **9 Hours**

Role of automation in industries, Benefits of automation –Introduction to fluid power, Advantages of fluid power, Application of fluid power system -Types of fluid power systems -Introduction to automation tools: Low cost automation, PLC, DCS, SCADA -Automation strategy evolution.

UNIT II INTRODUCTION TO MECHATRONICS **9 Hours**

Introduction to Mechatronics-systems – Mechatronics approach to modern engineering and design – Need of Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics – Mechatronics elements.

UNIT III SENSORS AND TRANSDUCERS **9 Hours**

Introduction – Performance Terminology – Potentiometers – Strain gauges – LVDT – Eddy current sensor – Hall effect sensor – Capacitance sensors – Digital transducers – Temperature sensors – Optical sensors – Piezo electric sensor-ultrasonic sensors – Proximity sensors – Signal processing techniques.

UNIT IV ACTUATORS **9 Hours**

Switching Devices, Classification of actuators – Electrical actuators – Solid state relays, solenoids, D.C. motors, Servo motors, Stepper motors – Interfacing with microcontroller through H-bridge Circuits – Piezoelectric actuators.

UNIT V MECHATRONIC SYSTEMS **9 Hours**

Design process-stages of design process – Traditional and Mechatronics design concepts – Case studies – Engine management system, Automatic camera, Automatic wishing machine, Pick and place robots.

TOTAL: 45 HOURS

REFERENCES:

1.R.K.Rajput.A Text Book of Mechatronics, Chand &Co,2007

2.W.Bolton,-Mechatronics|Pearson Education Limited,2004

3.M.A. Mazidi& J.G. Mazidi, 8051 Micrcontroller and embedded systems,2002

4.Devadasshetty, Richard A. Kolk, -Mechatronics System Design|, PWS Publishing Company, 2001.

1702MF105	ROBOT DESIGN & PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To teach the students about the kinematic arrangement of robots and its applications in the area of manufacturing sectors
2. To expose the students to build a robot for any type of application

UNIT I INTRODUCTION **9 Hours**

Definition, Need Application, Types of robots – Classifications – Configuration, work volume, control loops, controls and intelligence, specifications of robot, degrees of freedoms, end effectors – types, selection applications.

UNIT II ROBOT KINEMATICS **9 Hours**

Introduction – Matrix representation Homogeneous transformation, forward and inverse – Kinematic equations, Denvit – Hartenbers representations – Inverse Kinematic relations. Fundamental problems with D-H representation, differential motion and velocity of frames – Jacobian, Differential Charges between frames:

UNIT III ROBOT DYNAMICS AND TRAJECTORY PLANNING **9 Hours**

Lagrangeon mechanics, dynamic equations for sing, double and multiple DOF robots – static force analysis of robots, Trajectory planning – joint space, Cartesian space description and trajectory planning – third order, fifth order - Polynomial trajectory planning

UNIT IV ROBOT PROGRAMMING & AI TECHNIQUES **9 Hours**

Types of Programming – Teach Pendant programming – Basic concepts in A1 techniques – Concept of knowledge representations – Expert system and its components.

UNIT V ROBOT SENSORS AND ACTUATORS **9 Hours**

Design of Robots – characteristics of actuating systems, comparison, microprocessors control of electric motors, magnetostrictive actuators, shape memory type metals, sensors, position, velocity, force, temperature, pressure sensors – Contact and non contact sensors, infrared sensors, RCC, vision sensors.

TOTAL: 45 HOURS

REFERENCES:

1. Saeed.B.Niku, ¸Introduction to Robotics, Analysis, system, Applications', Pearson educations, 2002
2. Groover.M.P. Industrial Robotics, McGraw – Hill International edition,1996.
3. Wesley E Snyder R, ¸Industrial Robots, Computer Interfacing and Control', Prentice Hall International Edition,1988.
4. Gordon Mair,¸Industrial Robotics', Prentice Hall (U.K.)1988

1703MF003 MICRO ELECTRO MECHANICAL SYSTEMSAND NANO TECHNOLOGY **L TPC 3 0 03**

AIM:

- To inspire the students to expect to the trends in manufacturing of micro components and measuring systems to nanoscale.

OBJECTIVES:

- To expose the students to the evolution of micro electromechanical systems, to the various fabrication techniques and to make students to be aware of microactuators.
- Also to impart knowledge to the students about nano materials and various nano measurements techniques.

UNITI OVER VIEW OF MEMSANDMICROSYSTEMS **6**

Definition – historical development – properties, design and fabrication, micro-system, microelectronics, working principle ,applications and advantages of micro system. Substrates and wafers, silicon as substrate material, mechanical properties of Si, Silicon Compounds - silicon piezo resistors, Galium arsenide, quartz, polymers for MEMS, conductive polymers.

UNITII FABRICATION PROCESSES AND MICROSYSTEM PACKAGING **10**

Photolithography, photo resist applications, light sources, ion implantation, diffusion–Oxidation - thermal oxidation, silicon dioxide, chemical vapour deposition, sputtering - deposition by epitaxy – etching – bulk and surface machining – LIGA process – LASER, Electron beam ,Ion beam processes
– Mask less lithography. Micro system packaging –packaging design– levels of micro system packaging -die level, device level and system level – interfaces in packaging – packaging technologies- Assembly of Microsystems

UNITIII MICRODEVICES **8**

Sensors – classification – signal conversion ideal characterization of sensors micro actuators, mechanical sensors – measurands - displacement sensors, pressure sensor, flow sensors, Accelerometer , chemical and bio sensor - sensitivity, reliability and response of micro-sensor - micro actuators – applications.

UNITIV SCIENCE ANDSYNTHESIS OFNANOMATERIALS **10**

Classification of nano structures – Effects of nano scale dimensions on various properties – structural, thermal, chemical, magnetic, optical and electronic properties fluid dynamics –Effect of nano scale dimensions on mechanical properties - vibration, bending, fracture
Nanoparticles, Sol-Gel Synthesis, Inert Gas Condensation, High energy Ball Milling, Plasma Synthesis, Electro deposition and other techniques. Synthesis of Carbon nanotubes – Solid carbon source based production techniques – Gaseous carbon source based production techniques – Diamond like carbon coating. Top down and bottom up processes.

UNITV CHARACTERIZATION OFNANOMATERIALS **11**

Nano-processing systems – Nano measuring systems – characterization – analytical imaging techniques – microscopy techniques, electron microscopy scanning electron microscopy, confocal LASER scanning microscopy - transmission electron microscopy, transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy, diffraction techniques – spectroscopy techniques – Raman spectroscopy, 3D surface analysis – Mechanical, Magnetic and thermal properties – Nano positioning systems.

TOTAL: 45 PERIODS

1704MF106	CAD / CAM LAB	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

1. To teach the students about the drafting of 3D components and analyzing the same using various CAD packages and programming of CNC machines
2. To train them to use the various sensors

LIST OF EXPERIMENTS:

CAM LABORATORY

1. Exercise on CNC Lathe: Plain Turning
2. Exercise on CNC Milling Machine: Profile Milling
3. Study of Sensors

CAD LABORATORY

2D modeling and 3D modeling of components such as

1. Bearing
2. Couplings
3. Gears
4. Sheet Metal Components
5. Jigs, Fixtures and Die Assemblies.

TOTAL: 45 HOURS

1704MF107	INDUSTRIAL AUTOMATION AND MECHATRONICS LAB	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

To train the students to have a hands on training of the basic concepts of various industrial automation and Mechatronics systems

LIST OF EXPERIMENTS:

1. Simulation of single and double acting cylindercircuits
2. Simulation of Hydrauliccircuits
3. Simulation of electro pneumaticcircuits
4. Simulation of electro hydrauliccircuits
5. Simulation of PLCcircuits
6. Software simulation of fluid power circuits using a software package.
7. Simulation of various Mechatronics systems using hardware components

TOTAL: 60 HOURS

1704MF108	COMMUNICATION SKILLS LAB I (Common to all M.E Progarmmes)	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

1. To acquire skills for using English in workplace effectively.
2. To communicate for essential business needs.
3. To prepare students for taking BEC Vantage level examination which is an International Benchmark for English language proficiency of Cambridge English Language Assessment

LIST OF EXPERIMENTS:

1. **GRAMMAR AND VOCABULARY**
   Forming asking complex questions – expressing purpose and function –modal verbs – impersonal passive voice– Reported speech – cause and effect – relative pronouns – expressions followed by – *ing* forms– acronyms – marketing terms / vocabulary – financial terms – collocations – discourse markers
2. **LISTENING**
   Purposes of listening – features of listening texts – potential barriers to listening – specific listening skills – strategies to use when listening– distinguishing relevant from irrelevant information – gap filling exercise – multiple-choice options – note completion – matching and multiple choice questions – listening for specific information, gist, topic, context and function.
3. **SPEAKING**
   Word and sentence stress – clear individual sounds – turn taking – initiating and responding - intonation patterns – pronunciation – mother tongue intrusion– conversation practice – turn-taking and sustaining the interaction by initiating and responding appropriately- Public Speech – Lectures.
4. **READING**
   Purposes of reading – potential barriers to reading – paraphrasing – identifying facts and ideas – skimming and scanning for information – matching statements with texts– spotting reference words – understanding text structure – understanding the ideas in a text – distinguishing between the correct answer and the distracter – understanding cohesion in a text – deciphering contextual meaning of words and phrases – cloze – proof reading - transcoding.
5. **WRITING**
   Paragraphing a text – using appropriate connectives – editing practice –Longer Documents: writing a proposal & Reports, Agenda – Minutes – Circular

TOTAL: 30 HOURS

ADDITIONAL EXPERIMENTS:

1. Body Language: Kinesics, Proxemics, Para linguistic, Nuances of Speech Delivery
2. Personality Development: Building self esteem
3. Team work

COURSE OUTCOMES:

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

CO1: To enable students to get International recognition for work and study.

CO2: To use English confidently in the International business environments.

CO3: To be able to take part in business discussion, read company literature, write formal and informal business correspondences and listen and understand business conversations

REFERENCES:

1. Guy Brook-Hart, "BEC VANTAGE: BUSINESS BENCHMARK Upper-Intermediate – Student's Book", 1st Edition, Cambridge University Press, New Delhi, 2006.
2. Cambridge Examinations Publishing, "Cambridge BEC VANTAGE – Self-study Edition", Cambridge University Press, UK, 2005.
3. Swets, Paul. W. 1983. The Art of Talking So That People Will Listen: Getting
4. The Process of Writing: Planning and Research, Writing, Drafting and Revising

1701MF201	ADVANCED MACHINING TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To impart knowledge in the area of advanced machining processes.

UNIT I METAL CUTTING **8 Hours**

Metal Cutting Technology: Introduction to metal cutting - tool nomenclature and cutting forces - thermal aspects of machining - tool materials - tool life and tool wear - traditional and nontraditional machining – high speed machining.

UNIT II MECHANICAL ENERGY PROCESSES **10 Hours**

Mechanical Processes: Ultrasonic Machining - Water Jet Machining - Abrasive Jet Machining - Abrasive Water Jet Machining - Ice Jet Machining - Magnetic Abrasive Finishing

UNIT III CHEMICAL ENERGY PROCESSES **9 Hours**

Chemical and Electrochemical Processes: Chemical Milling - Photochemical Milling – Electropolishing - Electrochemical Machining - Electrochemical Drilling - Shaped Tube Electrolytic Machining.

UNIT IV THERMAL ENERGY PROCESSES **9 Hours**

Thermal Processes: Electric Discharge Machining - Laser Beam Machining - Electron Beam Machining - Plasma Beam Machining - Ion Beam Machining

UNIT V HYBRID PROCESSES **9Hours**

Hybrid Processes: Electrochemical Grinding, Honing, Superfinishing and Buffing – Ultrasonic and Laser Assisted ECM – Electroerosion Dissolution Machining - Abrasive Electrodischarge Machining - EDM with Ultrasonic Assistance

TOTAL: 45 HOURS

COURSE OUTCOMES:

On the Successful completion of the course, Students will be able to

CO1: Select suitable machining process for suitable materials
CO2: Select optimum parameters for the respective machining process
CO3: Summarizes the merits and demerits of the non-traditional manufacturing process

REFERENCES:

1. Bhattacharya "Metal Cutting Theory and Practice", New Central Book Agency (p) Ltd., Calcutta1984.
2. Boothroy .D.G. and Knight. W.A "Fundamentals of Machining and Machine tools", Marcel Dekker, New York, 1989.
3. Hassan Abdel – Gawad El-Hofy "Advanced Machining Processes", McGraw, New York, 2005.
4. Wellar, E.J. "Non-Traditional Machining Processes", Society of Manufacturing Engineers Publications, 2nd Edition, Michigan, 1984.
5. Metals Handbook. Vol. 16, Machining. Materials Park; OH: ASM International, 1995.
6. Kalpakjian, S "Manufacturing Process for Engineering Materials", MA:Addison-Wesley, 1997.
7. Brown, J "Advanced Machining Technology Handbook", New York: McGraw-Hill, 1998.
8. McGeough, J "Advanced Methods of Machining", London. New York: Chapman and Hall, London, 1988.
9. Rumyantsev, E and Davydov, A "Electrochemical Machining of Metals", Moscow:Mir Publishers, 1984.

1702MF202	FLEXIBLE TOOLING AND AUTOMATED INSPECTION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To impart knowledge in the area of Tooling in Manufacturing and Inspection.

UNIT I INTRODUCTION **9 Hours**

Introduction to Principles of Tooling in Manufacturing-Economics of Tooling- Pre -Design Product and Process Analysis -Automated Tooling for Machining-Tool Changers-Tool Presets

UNIT II FLEXIBLETOOLING **9 Hours**

Flexible Tooling –Tooling for Forming- Evolution of Dies, Forging, Bending and Drawing and Extrusion Processes- Tooling for Casting processes –Mechanization –Flexible tooling in Non Traditional Manufacturing

UNIT III MICRO-MANUFACTURING **9 Hours**

Tooling for Micro Manufacturing-Tooling for Physical and Mechanical joining Processes-Tooling for CMM-Tool handling Robots.

UNIT IV VISUAL REALISM **9 Hours**

Principles of Gauging - New concepts for gaging, inspection, checking, machine vision, and robotic testing. Smart Inspection Systems - Techniques and Applications of Intelligent Vision -Stages of automated visual inspection (AVI) and "smart" inspection systems- examples

UNIT V ARTIFICIAL INTELLIGENCE **9 Hours**

Application of conventional and artificial intelligence techniques in AVI. AVI process, from illumination, image enhancement, segmentation and feature extraction, through to classification, and includes case studies of implemented AVI systems-Robots in Automated Inspection Tutorial: Design of Tooling Layout for Automats, Die Design, Modular Fixture Design Practice: Exercises in CMM and Robots for Inspection

TOTAL: 45 HOURS

COURSE OUTCOMES:

On the Successful completion of the course, Students will be able to

CO1: State of Art in Tooling in Manufacturing and Inspection
CO2: Design and Develop tooling for Flexible Manufacturing
CO3: Design and Develop Automated Inspection Systems

REFERENCES:

1. Mikell P Groover Fundamentals of Modern Manufacturing: Materials, Processes, and Systems John Wiley and Sons 2012.
2. Stephen Murphy In-Process Measurement and Control: 32 (Series Manufacturing Engineering and Materials Processing) CRC Press 1990.
3. Boothroyd, G. (2005). Assembly automation and product design (Vol. 536). Boca Raton, FL: Taylor & Francis.
4. Stanley L. Robinson, Richard Kendall Miller Automated Inspection and Quality Assurance 1989 CRC Press
5. Duc T. Pham and R J Alcock Smart Inspection Systems: Techniques and Applications of Intelligent Vision Academic Press.
6. Black, J. Temple. The Design of the Factory with a Future. McGraw-Hill Companies, 1991.

1702MF203	THEORY OF METAL FORMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To study the basic concepts of metal forming techniques and to develop force calculation in metal forming process.
2. To study the thermo mechanical regimes and its requirements of metal forming.

UNIT I THEORY OF PLASTICITY 9 Hours

Theory of plastic deformation – Yield criteria – Tresca and Von-mises – Distortion energy – Stress- strain relation – Mohr,,s circle representation of a state of stress – cylindrical and spherical co-ordinate system – upper and lower bound solution methods – Overview of FEM applications in Metal Forming analysis.

UNIT II THEORY AND PRACTICE OF BULK FORMING PROCESSES 8 Hours

Analysis of plastic deformation in Forging, Rolling, Extrusion, rod/wire drawing and tube drawing – Effect of friction – calculation of forces, work done – Process parameters, equipment used – Defects – applications – Recent advances in Forging, Rolling, Extrusion and Drawing processes – Design consideration in forming.

UNIT III SHEET METAL FORMING 8 Hours

Formability studies – Conventional processes – H E R F techniques – Superplastic forming techniques – Hydro forming – Stretch forming – Water hammer forming – Principles and process parameters – Advantage, Limitations and application

UNIT IV POWDER METALLURGY AND SPECIAL FORMING PROCESSES 9 Hours

Overview of P/M technique – Advantages – applications – Powder preform forging – powder rolling – Tooling, process parameters and applications. - Orbital forging – Isothermal forging – Hot and cold isostatic pressing – High speed extrusion – Rubber pad forming – Fine blanking – LASER beam forming

UNIT V SURFACE TREATMENT AND METAL FORMING APPLICATIONS 9 Hours

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

TOTAL: 45 HOURS

COURSE OUTCOMES:

On the Successful completion of the course, Students will be able to

CO1: Fem applications in metal forming.
CO2: Plastic deformations and recent advances in design.
CO3: Powder metallurgy and metal forming applications.

REFERENCES:

1. Helmi A Youssef, Hassan A. El-Hofy, Manufacturing Technology: Materials, Processes and Equipment, CRC publication press,2012.
2. SAE Transactions, Journal of Materials and Manufacturing Section 5,1993-2007
3. Surenderkumar, Technology of Metal Forming Processes, Prentice Hall IndiaPublishers,2010
4. Marciniak,Z .DuncanJ.L .HuS.J.,MechanicsofSheetMetalForming,,Butterworth-Heinemann An Imprint of Elesevier,2006.
5. Nagpal G.R., Metal Forming Processes- Khanna publishers,2005
6. Altan T., Metal forming – Fundamentals and applications – American Society of Metals, Metals park, 2003
7. ASM Hand book, Forming and Forging, Ninth edition, Vol – 14,2003
8. Shiro Kobayashi, Soo-IK-oh-Altan, T,Metal forming and Finite Element Method, Oxford University Press, 2001.
9. Proc.OfNational Seminaron—Advances in Metal FormingIMIT,March2000
10. Dieter G.E., Mechanical Metallurgy (Revised Edition II) McGraw Hill Co.,1988
11. Altan.T, Soo-IK-oh, Gegel, HL – Metal forming, fundamentals and Applications, American Society of Metals, Metals Park, Ohio,1995.

1702MF204	ADVANCES IN CASTING AND WELDING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To study the metallurgical concepts and applications of casting and welding process.
2. To acquire knowledge in CAD of casting and automation of welding process.

UNIT I CASTING DESIGN **8 Hours**

Heat transfer between metal and mould — Design considerations in casting – Designing for directional solidification and minimum stresses - principles and design of gating andrisering

UNIT II CASTING METALLURGY **8 Hours**

Solidification of pure metal and alloys – shrinkage in cast metals – progressive and directional solidification — Degasification of the melt-casting defects – Castability of steel , Cast Iron, Al alloys , Babbit alloy and Cu alloy.

UNIT III RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT **8 Hours**

Shell moulding, precision investment casting, CO_2 moulding, centrifugal casting, Die casting, Continuous casting, Counter gravity low pressure casting, Squeeze casting and semisolid processes. Layout of mechanized foundry – sand reclamation – material handling in foundry pollution control in foundry — Computer aided design of casting.

UNIT IV WELDING METALLURGY AND DESIGN **10 Hours**

Heat affected Zone and its characteristics – Weldability of steels, cast iron, stainless steel, aluminum, Mg , Cu , Zirconium and titanium alloys – Carbon Equivalent of Plain and alloy steels Hydrogen embrittlement – Lamellar tearing – Residual stress – Distortion and its control . Heat transfer and solidification - Analysis of stresses in welded structures – pre and post welding heat treatments – weld joint design – welding defects – Testing of weldment.

UNIT V RECENT TRENDS IN WELDING **11 Hours**

Friction welding, friction stir welding – explosive welding – diffusion bonding – high frequency induction welding – ultrasonic welding – electron beam welding – Laser beam welding –Plasma welding – Electroslag welding- narrow gap, hybrid twin wire active TIG – Tandem MIG- modern brazing and soldering techniques – induction, dip resistance, diffusion processes – Hot gas, wave and vapour phase soldering. Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under waterwelding.

TOTAL: 45 HOURS

COURSE OUTCOMES:

On the Successful completion of the course, Students will be able to

CO1: Designing for directional solidification and minimum stresses.
CO2: Solidification and cast ability of steel.
CO3: Recent trends in welding.
CO4: Analysis of stress in welded structures.
CO5: Recent trends in casting technology.

REFERENCES:

1. ASM Handbook, Vol 15, Casting, 2004.
2. ASM Handbook vol.6, welding Brazing & Soldering, 2003.
3. Jain P.L., Principles of Foundry Technology,TataMcGrawHill Publishers, 2003.
4. Parmer R.S., Welding Engineering and Technology, KhannaPublishers, 2002.
5. Srinivasan N.K., Welding Technology, Khanna Tech Publishers,2002
6. Heineloper& Rosenthal, Principles of Metal Casting, Tata McGraw Hill, 2000.
7. Carrry B., Modern Welding Technology, Prentice Hall Pvt Ltd., 2002.
8. Cornu.J. Advanced welding systems – Volumes I, II and III, JAICO Publishers, 1994.
9. Iotrowski, "Robotic welding-A guide to selection and application", Society of mechanical Engineers, 1987.
10. Schwariz, M.M., "Source book on innovative welding processes", American Society for Metals (OHIO), 1981.
11. Lancaster. J. F., "Metallurgy of welding", George Alien & Unwin Publishers, 1980.

1702MF205	PRECISION MACHINING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To impart knowledge on various micro/nano finishing techniques for the production of required components.

UNIT I INTRODUCTION **9 Hours**

Micro- manufacturing- types- micromachining- classification- mechanical advanced micro- machining processes.

UNIT II MEMS **9 Hours**

Advanced nano finishing processes-Micro Electro Mechanical Systems (MEMS) - Nano Electro Mechanical Systems (NEMS).

UNIT III MICRO MACHING - 1 **9 Hours**

Lithography-diamond turning- micro drilling - micro milling - Electrical Discharge Micro-Machining (EDMM) - Electro Chemical Micro-Machining (ECMM).

UNIT IV MICRO MACHING - 2 **9 Hours**

Wire Electrical Discharge Micro-Machining (EDMM)- Laser Micro-Machining (LMM) – Types of Lasers Nano finishing- magnetorheological finishing process-micro/nano finishing with flexible flow of abrasives-Electrolytic In-process Dressing (ELID) Grinding.

UNIT V ELECTRONMICROSCOPY **9 Hours**

Profilometers - optical microscopy - confocal laser scanning microscopy- Scanning Electron Microscope (SEM)-Atomic Force Microscope (AFM).

TOTAL: 45 HOURS

COURSE OUTCOMES:

On the Successful completion of the course, Students will be able to

CO1: Recognize the various micro machining techniques.
CO2: Apply various micro/nano finishing techniques for the production of required components
CO3: State the metrological principles and techniques for the evaluation of precision machined components.

REFERENCES:

1. M.J. Madou, "Fundamentals of Micro Fabrication", CRC Press, 2002
2. V.K.Jain, "Introduction to Micromachining", Narosa Publishing House, 2010
3. Mark J. Jackson, "Micro Fabrication and Nano machining", Taylor and Francis, 2006
4. SeropeKalpakjian, "Manufacturing Engg. and Technology", Pearson Education, 2005
5. Yi Qin, "Micro-Manufacturing Engineering and Technology", Elsevier Publication,2010

1703MF002 **FLEXIBLE MANUFACTURING SYSTEMS**

COURSE OUTCOMES:

L T P C
3 0 0 3

1. Define the flexibilities in FMS
2. Apply the components of FMS and their integration
3. Analyze the issues related to planning for successful implementation of FMS

UNIT I INTRODUCTION **09**

FMS Introduction and Description - Objectives and Benefits of FMS - Basic Components of FMS and their integration in the data processing systems - Types of FMS - FMS Layouts – Types of Flexibility - FMS design criteria - Group Technology – Cellular manufacturing - Differences between FMC and FMS

UNIT II FMS WORKSTATIONS **09**

FMS workstations - Machining station – CNC/DNC Features – Machine Tool applications - Machining Centers – Automated Features and Capabilities - Wash Stations - Coordinate Measuring Machines – Contact and noncontact inspection principles - Functions of CMM Computer/software

UNIT III INDUSTRIAL ROBOTS **09**

Material Handling Systems - Introduction to material handling – material transport systems – AGV's - conveyors – storage systems - AS/RS – Automatic data capture - Industrial Robots - Basic Configurations – Sensors in Robotics - robot cell design and control - Applications of Industrial Robots – Robot programming

UNIT IV FMS SOFTWARE **09**

FMS Software Structure, Functions and Description - General Structure and Requirements - Activities and Functions to be Performed by FMS Software - Requirements of FMS Software - Types of FMS Software Modules - Computer Simulation - Functions of an FMS Host Computer – Distributed systems in FMS – Part program preparation

UNIT V CASE STUDIES 09

System Hardware and General Functionality - Programmable Logic Controllers - Cell Controllers - Communication Networks - FMS Installation and Implementation - Case Studies - Just-in-Time production – CIM Technology

TOTAL: 45 PERIODS

1704MF206	METAL FORMING LAB	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To train the students to have an hands on having the basic concepts of metal forming processes and to determine some metal forming parameters for a given shape.

LIST OF EXPERIMENTS:

1. Determination of strain hardening exponent.
2. Determination of strain rate sensitivity index.
3. Determination of tension test.
4. Determination of efficiency in water hammer forming.
5. Determination of interface friction factor.
6. Study of rolling process.
7. Determination of torque and force measurement in rolling mill.

TOTAL: 45 HOURS

1704MF208	COMMUNICATION SKILLS LAB II (Common to all M.E Progammes)	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

1. To prepare students for taking BEC Vantage level examination conducted by the Cambridge English Language Assessment (CELA).
2. To communicate appropriately in business contexts.
3. To acquire skills for using English in business environment.

LIST OF EXPERIMENTS:

UNIT I SPEAKING

Non-verbal communication – agreeing / disagreeing, reaching decisions, giving and supporting opinions – making mini presentations – extending on conservations – collaborative task – tongue twisters.

UNIT II WRITING

Business letters – fax – Shorter Documents: e-mail - memo – message - note – report writing – formal / informal styles.

TOTAL: 30 HOURS

COURSE OUTCOMES:

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

CO1: Enable students to acquire business terms for communication.
CO2: Use English confidently in the business contexts.
CO3: Take part in business discussion and write formal and informal business correspondences.

REFERENCES:

1. Guy Brook-Hart, BEC VANTAGE: BUSINESS BENCHMARK Upper-Intermediate – Student's Book, 1st Edition, Cambridge University Press, New Delhi, 2006.
2. Cambridge Examinations Publishing, Cambridge BEC VANTAGE – Self-study Edition, Cambridge University Press, UK, 2005.

MF7001 FLUID POWER AUTOMATION

AIM:

To impart knowledge in the area of hydraulics, pneumatic and fluid power components and its functions.

OBJECTIVES:

- To make the students to learn the basic concepts of hydraulics and pneumatics and their controlling elements in the area of manufacturing process.
- To train the students in designing the hydraulics and pneumatic circuits using various design procedures.

UNIT I INTRODUCTION 5

Need for Automation, Hydraulic & Pneumatic Comparison – ISO symbols for fluid power elements, Hydraulic, pneumatics – Selection criteria.

UNIT II FLUID POWER GENERATING/UTILIZING ELEMENTS 8

Hydraulic pumps and motor gears, vane, piston pumps-motors-selection and specification-Drive characteristics – Linear actuator – Types, mounting details, cushioning – power packs – construction. Reservoir capacity, heat dissipation, accumulators – standard circuit symbols, circuit (flow) analysis.
symbols, circuit (flow) analysis

UNIT III CONTROL AND REGULATION ELEMENTS 8

Direction flow and pressure control valves-Methods of actuation, types, sizing of ports-pressure and temperature compensation, overlapped and underlapped spool valves-operating characteristics- electro hydraulic servo valves-Different types-characteristics and performance

UNIT IV CIRCUIT DESIGN 10

Typical industrial hydraulic circuits-Design methodology – Ladder diagram-cascade, method-truth table-Karnaugh map method-sequencing circuits-combinational and logic circuit.

UNIT V ELECTRO PNEUMATICS & ELECTRONIC CONTROL OF HYDRAULIC AND PNEUMATIC CIRCUITS 7

Electrical control of pneumatic and hydraulic circuits-use of relays, timers, counters, Ladder diagram. Programmable logic control of Hydraulics Pneumatics circuits, PLC ladder diagram for various circuits, motion controllers, use of field busses in circuits. Electronic drive circuits for various Motors.

TOTAL: 45 PERIODS

REFERENCES:

1. W.Bolton, Mechatronics, Electronic control systems in Mechanical and Electrical Engineering Pearson Education, 2003.
2. Peter Rohner, Fluid Power Logic Circuit Design, Mcmelan Prem, 1994.
3. Antony Esposito, Fluid Power Systems and control Prentice-Hall, 1988
4. E.C.Fitch and J.B.Suryaatmadyn. Introduction to fluid logic, McGraw Hill, 1978
5. Peter Rohner, Fluid Power logic circuit design. The Macmillan Press Ltd.,London, 1979
6. Herbert R. Merritt, Hydraulic control systems, John Wiley & Sons, Newyork, 1967

Dudbey. A. Peace, Basic Fluid Power, Prentice Hall Inc, 1967.

MF7009 **NON-DESTRUCTIVE EVALUATION** **L T P C**
3 0 0 3

AIM:

To stress the importance of NDT in engineering.

OBJECTIVES:
To introduce all types of NDT and their applications in Engineering.

UNIT I NON-DESTRUCTIVE TESTING: AN INTRODUCTION, VISUAL INSPECTION & LIQUID PENETRANT TESTING **6**

Introduction to various non-destructive methods, Comparison of Destructive and Non destructive Tests, Visual Inspection, Optical aids used for visual inspection, Applications.
Physical principles, procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods-water washable, Post – Emulsification methods, Applications

UNIT II EDDY CURRENT TESTING & ACOUSTIC EMISSION **10**

Principles, Instrumentation for ECT, Absolute, differential probes, Techniques – High sensitivity techniques, Multi frequency, Phased array ECT, Applications.
Principle of AET, Instrumentation, Applications - testing of metal pressure vessels, Fatigue crack detection in aerospace structures.

UNIT III MAGNETIC PARTICLE TESTING & THERMOGRAPHY **10**

Principle of MPT, procedure used for testing a component, Equipment used for MPT, Magnetizing techniques, Applications.
Principle of Thermography, Infrared Radiometry, Active thermography measurements, Applications – Imaging entrapped water under an epoxy coating, Detection of carbon fiber contaminants.

UNIT IV ULTRASONIC TESTING **10**

Principle, Ultrasonic transducers, Ultrasonic Flaw detection Equipment, Modes of display A- scan, B- Scan, C- Scan, Applications, Inspection Methods - Normal Incident Pulse-Echo Inspection, Normal Incident Through-transmission Testing, Angle Beam Pulse-Echo testing, TOFD Technique, Applications of Normal Beam Inspection in detecting fatigue cracks, Inclusions,Slag,Porosity
.

UNIT V RADIOGRAPHY **9**

Principle of Radiography, x-ray and gamma ray sources- safety procedures and standards, Effect of radiation on Film, Radiographic imaging, Inspection Techniques – Single wall single image, Double wall Penetration, Multiwall Penetration technique, Real Time Radiography - Codes, standards, specification and procedures and case studies in Radiography test.
Case studies on defects in cast, rolled, extruded, welded and heat treated components - Comparison and selection of various NDT techniques

TOTAL: 45 PERIODS

REFERENCES:

1. Baldev Raj, Jeyakumar,T., Thavasimuthu,M., -Practical Non Destructive Testing| Narosa publishing house, New Delhi, 2002
2. Peter J. Shull -Non Destructive Evaluation: Theory, Techniques and Application| Marcel Dekker, Inc., New York, 2002
3. Krautkramer. J., -Ultra Sonic Testing of Materials|, 1st Edition, Springer – Verlag Publication, New York, 1996.
4. www.ndt.net

MF7004 **METAL CUTTING THEORY AND PRACTICE**

AIM:

- To impart the knowledge and train the students in the area of metal cutting theory and its importance.

OBJECTIVES:

- To make the students familiar with the various principles of metal cutting, cutting tool materials and its wear mechanisms during the machining operation.

UNIT I INTRODUCTION **9**

Need for rational approach to the problem of cutting materials-observation made in the cutting of metals-basic mechanism of chip formation-thin and thick zone modes-types of chips-chip breaker- orthogonal Vs oblique cutting-force velocity relationship for shear plane angle in orthogonal cutting- energy consideration in machining-review of Merchant, Lee and Shafter theories-critical comparison.

UNIT II SYSTEM OF TOOL NOMENCLATURE **9**

Nomenclature of single point cutting tool-System of tool nomenclature and conversion of rake angles- nomenclature of multi point tools like drills, milling-conventional Vs climb milling, mean cross sectional area of chip in milling-specific cutting pressure.

UNIT III THERMAL ASPECTS OF MACHINING **9**

Heat distribution in machining-effects of various parameters on temperature-methods of temperature measurement in machining-hot machining-cutting fluids.

UNIT IV TOOL MATERIALS, TOOL LIFE AND TOOL WEAR **9**

Essential requirements of tool materials-development in tool materials-ISO specification for inserts and tool holders-tool life-conventional and accelerated tool life tests-concept of mach inability index- economics of machining.

UNIT V WEAR MECHANISMS AND CHATTER IN MACHINING **9**

Processing and Machining – Measuring Techniques – Reasons for failure of cutting tools and forms of wear-mechanisms of wear-chatter in machining-factors effecting chatter in machining-types of chatter- mechanism of chatter.

TOTAL: 45 PERIODS

REFERENCES

1. Boothroid D.G. & Knight W.A., Fundamentals of machining and machine tools, Marcel Dekker, Newyork, 1989.
2. Shaw.M.C.Metal cutting principles, oxford Clare don press, 1984.
3. Bhattacharya.A., Metal Cutting Theory and practice, Central Book Publishers, India, 198

1703MF011	RAPID PROTOTYPING	L	T	P	C
		3	0	0	3

PREREQUISITE :

1. Manufacturing Technology – I
2. Manufacturing Technology – II

COURSE OBJECTIVES:

1. To make the students to understand the importance of time compression technologies
2. To make the students to understand the Selection of appropriate technology for the application
3. To make the students to have knowledge on Exposure to RP software packages

UNIT I INTRODUCTION **9 Hours**

Introduction- Need for the compression in product development, History of RP systems, Survey of applications, Growth of RP industry, Classification of RP systems.

UNIT II RP PROCESS-1 **9 Hours**

Principle, process parameters, process details and applications of various RP processes - Stereo lithography systems, Laser Sintering, Fused Deposition Modeling, Laminated Object.

UNIT III RP PROCESS-2 **9 Hours**

Manufacturing, Solid Ground Curing, Laser Engineered Net Shaping, 3D Printing, Laser Melting, Cladding.

UNIT IV RAPID TOOLING **9 Hours**

Rapid Tooling: Indirect rapid tooling Direct rapid tooling , soft tooling Vs hard tooling, Rapid Manufacturing Process Optimization- Factors influencing accuracy, data preparation errors, part building errors, errors in finishing, influence of part build orientation.

UNIT V RP SOFTWARES **9 Hours**

Software for RP: STL files, overview of solid view, magics, mimics, magics communicator, etc., internet based softwares, collaboration tools. RP Technology selection, Decision Making, Life Cycle Assessment of RP processes, Sustainability issues.

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

1. 3-D Printing
2. Sustainable Manufacturing
3. Advanced Rapid prototyping software

COURSE OUTCOMES:

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

CO1 Understand the importance of time compression technologies
CO2 Selection of appropriate technology for the application
CO3 Exposure to RP software packages
CO4 Understand the different rapid tooling process.
CO5 Analyze the rapid prototyping using relevant software.

REFERENCES:

1. Pham D T and Dimov S S, "Rapid Manufacturing", Verlag, 2001.
2. Paul F Jacobs, "Stereo lithography and other RP&M Technologies", SME,1996.
3. Terry Wohlers, "Wohlers Report 2001", Wohlers Associates, 2008.
4. Prasad H and Badrinarayanan, K S, "Rapid Prototyping and Tooling", SPI-Pageturners, Bangalore, India, 2013.

1703MF016	HEAT TREATMENT	L	T	P	C
		3	0	0	3

PREREQUISITE :

Engineering Materials and Metallurgy

COURSE OBJECTIVES:

1. To make the students to have knowledge on identify the effect of heat treatment in alloying elements
2. To make the students to have knowledge on apply surface modification techniques
3. To make the students to have knowledge on find the defects occurring in heat treated parts

UNIT I INTRODUCTION **9 Hours**

Iron - Carbon Equilibrium Diagram: Effect of alloying element on properties of steel and heat treatments. Types and application of heat treatments in manufacturing Industries.

UNIT II TTT PROCESS **9 Hours**

TTT & CCT diagram for steels-Various heating media used for heat treatment, furnaces, Temperature and atmosphere control- Selection of furnace for heat treatment.

UNIT III HEAT TREATMENT PROCESS **9 Hours**

Heat Treatment Processes: Annealing – Normalising, Hardenability studies, Jominy end quench test, Grossman's experiments - Tempering, Austempering and Martempering. Thermomechanical treatments.

UNIT IV SURFACE MODIFICATION TECHNIQUES **9 Hours**

Surface Modification Techniques: Induction hardening, flame hardening, electron beam hardening and Laser beam hardening. Carburising, nitriding, carbonitriding, CVD and PVD processes, Ion implantation.

UNIT V DESIGN FOR HEAT TREATMENT **9 Hours**

Heat Treatment of Non-Ferrous Metals and Specific Alloy steels: Heat treatment of gray irons, white irons (malleabilising) and S.G.irons. Austempering of S.G.Iron. Defects: Defects in heat treated parts, causes and remedy Design for heat treatment.

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

1. Heat treatment for metal matrix composite.
2. Heat treatment for high temperature application metal.
3. Design for smart material heat treatment.

COURSE OUTCOMES:

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

CO1 Identify the effect of heat treatment in alloying elements
CO2 Apply surface modification techniques
CO3 Find the defects occurring in heat treated parts
CO4 Understand the different surface modification techniques.
CO5 Design heat treatment for different metals.

REFERENCES:

1. Rajan and Sharma "Heat Treatment Principles and Techniques" – Prentice Hall of India (P) Ltd, New Delhi, 2004.
2. Prabhudev, K H., "Handbook of Heat Treatment of Steels", Tata - McGraw Hill Publishing Co., New Delhi, 2000.
3. VijendraSingh,"Heat Treatment of Metals", Standard Publishers Distributors, Delhi, First edition 1998.
4. American Society for Metals, "Metals Handbook Vol.4", ASM Metals Parks, Ohio, USA, 2001.
5. Karl-Erik Thelning, "Steel and its Heat Treatment", Butterworths London, second edition 1984.
6. Novikov I, "Theory of Heat Treatment of Metals", MIR Publishers, Moscow, 1978.

1703EV017	INDUSTRIAL WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

PREREQUISITE :

Knowledge on waste water and treatment

COURSE OBJECTIVES:

1. To impart knowledge on the concept and application of Industrial pollution prevention
2. To impart knowledge on the cleaner technologies
3. To educate about the industrial wastewater treatment and residue management.

UNIT I INTRODUCTION **8 Hours**

Industrial scenario in India– Industrial activity and Environment - Uses of Water by industry – Sources and types of industrial wastewater – Nature and Origin of Pollutants - Industrial wastewater and environmental impacts – Regulatory requirements for treatment of industrial wastewater – Industrial waste survey – Industrial wastewater monitoring and sampling -generation rates, characterization and variables –Toxicity of industrial effluents and Bioassay tests – Major issues on water quality management.

UNIT II INDUSTRIAL POLLUTION PREVENTION & WASTE MINIMISATION **8 Hours**

Prevention vis a vis Control of Industrial Pollution – Benefits and Barriers – Waste management Hierarchy - Source reduction techniques – Periodic Waste Minimisation Assessments – Evaluation of Pollution Prevention Options – Cost benefit analysis – Pay-back period – Implementing & Promoting Pollution Prevention Programs in Industries.

UNIT III INDUSTRIAL WASTEWATER TREATMENT **10 Hours**

Flow and Load Equalisation – Solids Separation – Removal of Fats, Oil & Grease- Neutralisation – Removal of Inorganic Constituents – Precipitation, Heavy metal removal , Nitrogen & Phosphorous removal, Ion exchange, Adsorption, Membrane Filtration, Eletrodialysis & Evaporation – Removal of Organic Constituents – Biological treatment Processes, Chemical Oxidation Processes, Advanced Oxidation processes – Treatability Studies.

UNIT IV WASTEWATER REUSE AND RESIDUAL MANAGEMENT **9 Hours**

Individual and Common Effluent Treatment Plants – Joint treatment of industrial and domestic wastewater - Zero effluent discharge systems - Quality requirements for Wastewater reuse – Industrial reuse , Present status and issues - Disposal on water and land – Residuals of industrial wastewater treatment – Quantification and characteristics of Sludge – Thickening, digestion, conditioning, dewatering and disposal of sludge – Management of RO rejects.

UNIT V CASE STUDIES **10 Hours**

Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Oil Refining – Pharmaceuticals – Sugar and Distilleries

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

1. Recent industrial waste management methodologies
2. Advanced treatment techniques

COURSE OUTCOMES:

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

CO1 Understand the wastewater monitoring and treatment requirements
CO2 Define the Principles of pollution prevention and mechanism of oxidation processes.
CO3 Suggest the suitable technologies for the treatment of wastewater.
CO4 Discuss about the wastewater characteristics
CO5 Design the treatment systems

REFERENCES:

1. Industrial wastewater management, treatment & disposal, Water Environment
2. Lawrance K.Wang, Yung . Tse Hung, Howard H.Lo and Constantine Yapijakis, " handlook of Industrial and Hazardous waste Treatment", Second Edition, 2004.
3. Metcalf & Eddy/ AECOM, water reuse Issues, Technologies and Applications, The Mc Graw- Hill companies, 2007.
4. Nelson Leonard Nemerow, "industrial waste Treatment", Elsevier, 2007.
5. W.Wesley Eckenfelder, "Industrial Water Pollution Control", Second Edition, Mc Graw Hill, 1989.
6. Paul L. Bishop, „Pollution Prevention: - Fundamentals and Practice", Mc-Graw Hill International, Boston, 2000.