PANDIT DEENDAYAL PETROLEUM UNIVERSITY
SCHOOL OF TECHNOLOGY
COURSE STRUCTURE FOR B.TECH. MECHANICAL ENGINEERING

SEMESTER VIII			B.TECH. MECHANICAL ENGINEERING											
Sr. No	Course Code	Course Name	Teaching Scheme					Exam Scheme						
								Theory			Practical		Total	
			L	T	P	C	Hrs/wk	MS	ES	IA	LW	LE/Viva	Marks	
1	ME 405P	**Major project**	--	--	12	6	12	--	--	--	100	50	150	
2	ME 406T	**Robotics Engineering**	2	1	--	5	3	30	60	10	--	--	100	
3	ME 407T	**Thermal Engineering**	2	0	--	4	2	30	60	10	--	--	100	
	ME 407P		--	--	2	1	2	--	--	--	25	25	50	
4	ME 408T	**Computer Aided Manufacturing**	4	0	--	8	4	30	60	10	--	--	100	
	ME 408P		--	--	2	1	2	--	--	--	25	25	50	
5	ME 4XXT	**Department Elective-III**	3	0	--	6	3	30	60	10	--	--	100	
6	ME 410T	**Project Management**	3	0	--	6	3	30	60	10	--	--	100	
		Total	**14**	**1**	**16**	**37**	**31**						750	

Department Elective – III (ME425: Applications of FEM in Mechanical Engineering, ME 426: Rapid Product Development, ME427: Automobile Engineering, ME 428: Micro- & Nano-Manufacturing, ME429: Design for Manufacturing, ME430: Ergonomics, ME431/IE403: Planning of Facilities and Materials Handling Systems, ME:432/IE308: Procurement and Material management.

MS = Mid Semester, ES = End Semester;
IA = Internal assessment (like quiz, assignments etc) LW = Laboratory work; LE = Laboratory Exam

ME 405P MAJOR PROJECT										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	12	6	12	--	--	--	100	50	150
Duration: During VIII semester										

ME 406T ROBOTICS ENGINEERING										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	1	0	5	3	30	60	10	--	--	100

UNIT I **09**

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

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

UNIT II **12**

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

UNIT III **09**

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

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

UNIT IV **09**

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

Robotics programming :

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

Robot applications and Economic analysis of robotics

Approximate Total : 39 Hrs

Texts and References

Fundamentals of Robotics Analysis and control : Robert J. Schiling

Industrial robotics : Groover, weiss nagel and odrey, Mc Graw Hill

Robotics engineering : klafter, Chmielwski and nagirn,Prentice hill.

Robotics for engineering : Yorem Korem, Mc Graw Hill.

Robotics:control,sensing vision and intelligence: K.S. Fu, R.C.Gonzalez, C.S.g Lee, McGraw Hill

ME407T THERMAL ENGINEERING										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	--	4	2	30	60	10	--	--	100

UNIT I **08**

Gas Turbines: Simple open and close cycle gas turbine, efficiency and specific output of simple cycle, effects of – regeneration, re-heating and inter-cooling on efficiency and work output, effect of operating variables on thermal efficiency, air rate, work ratio; water injection, Advantages and disadvantages of gas turbine, gas turbine components, performance and application of gas turbine.

UNIT II **07**

Gas Dynamics and Jet Propulsion: Fundamentals of gas dynamics, energy equation, stagnation properties, isentropic flow through nozzle and diffusers, Introduction to shock waves, introduction to jet propulsion, advantages and disadvantages of jet propulsion – turbojet engine with and without after burner, turboprop, ram jet, pulse jet, rocket engines – operation, solid and liquid propellants.

UNIT III &IV **11**

Steam Nozzles: Types of nozzles, velocity and heat drop, condition for maximum discharge, Effect of Friction and nozzle efficiency, Physical concept of critical pressure, General relationship between area, velocity and pressure, super saturated flow, Effect of variation of back pressure.
Steam Turbine: Principle of operation, Types of steam turbines, classification of steam turbines; Velocity diagrams and compounding of turbines.
Impulse Turbine: Velocity diagrams, forces on blade and work done on the turbine blades, diagram efficiency, stage efficiency, Axial thrust, multi staging, most economical ratio of blade angles, Reheat factor, Internal Efficiency, Effects of finite stages.
Impulse-Reaction Turbine: Velocity diagrams, forces on blade and work done by blade; degree of reaction, Impulse reaction turbine with similar blade section and half degree reaction, height of impulse-reaction blading, Effects of varying heat drop, blade sections and losses in turbine.

APPROXIMATE TOTAL 26 Hours

Texts and References

1. Gas Turbines, Cohen & Rogers, Pearson Prentice Hall
2. Fundamentals of Gas Dynamics By Robert D. Zucker and Oscar Biblarz, John Wiley & Sons,
3. Fundamentals of Gas Dynamics by Robert P. Benedict, John Wiley & Sons, Inc.
4. Steam & Gas turbines, R. Yadav, Central publishing House, Allahabad.

ME407P THERMAL ENGINEERING										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
--	--	2	1	2	--	--	--	25	25	50

List of Experiments:

1. To study the working of Gas turbine and methods of improving the performance of gas turbine.
2. To study the working of Jet Propulsion Engine.
3. Experiment on hydrodynamic boundary layer development on airfoil in wind tunnel test rig.
4. Experiment on pressure distribution over the airfoil in wind tunnel test rig.
5. Experiment on measurement of drag and lift force on airfoil model in wind tunnel test rig.
6. Experiment on performance of parallel and counter flow heat exchanger.
7. A case study on the design of industrial exchanger.
8. A case study on gas turbine power plant.

ME 408T COMPUTER AIDED MANUFACTURING										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
4	0	-	8	4	30	60	10	--	--	100

UNIT I **07**

Introduction: Introduction to CAM, Concepts & scope of CAM, Nature & type of manufacturing system, Evolution, Benefits of CAM,

Constructional details, of CNC machines:

Basis and need of CNC machines: NC, CNC and DNC systems. Machine structures, slide ways, motion transmission elements, swarf (Chip) removal and safety considerations, Automatic tool changers and multiple pallet systems, Sensors and feedback devices in CNC machines, Constructional" details of CNC turning center, Classification of CNC control systems, Applications of CNC machines in manufacturing, advantages of CNC machine.

UNIT II **14**

CNC part programming: Axis identification and coordinate systems, structure of CNC part program, Programming formats, NC programming codes.

Programming for 2 axis control systems: Manual part programming for a turning center, programming using tool nose radius compensation, do loop, sub routines and fixed cycles. Programming for CNC wire-cut machines.

Programming for 3 axis control system: Manual part programming for CNC machining center programming using tool radius compensation tool offsets, do loop, subroutines and fixed cycles.

COMPUTER AIDED CNC PART PROGRAMMING: Using APT language CAD/CAM Aided CNC part programming.

Tooling for CNC machines: Tooling requirements of CNC machine, preset and qualified tools, work and tool holding devices in CNC machines

UNIT III **09**

FMS:

Introduction & Component of FMS, Needs of FMS, general FMS consideration, Objectives, Types of FMS, advantages of FMS, Automated material movement & AS/RS AGVS , RGV Manufacturing Cells, Cellular & Flexible manufacturing, JIT & GT applied to FMS, FMC & FMS, Tool Management, Tool supply system, Tool Monitoring System, Work piece Handling, Flexible Fixturing, Flexible Assembly Systems, Flexibility. FMS scheduling, sequencing, FMS lay out and essentials

UNIT IV **09**

Group Technology and Cellular Manufacturing:

Introduction, part families, part classification and coding, machining cells, benefits of group Technology, production flow analysis, Cellular Manufacturing

Computer Aided Production management:

Introduction, PPC fundamentals, Problems with traditional PPC, use of computer in PPC such as CAPP, MRPI, MRPII, CAGC etc.

Approximate Total : 39 Hrs

Texts and References

1. Computer Aided Manufacturing by Tien Chien Chang, Pearson Education

2. Automation, Production Systems and Computer Integrated Manufacturing by by Groover, Pearson Education
3. CNC Programming - Principles and Applications, Mike Mattson, Cengage Publication.
4. CNC programming – Dr. S.K.Sinha – Golgotia publications.
5. Flexible Manufacturing Cells and System -William. W. Luggen Prentice Hall, England Cliffs, New jersy
6. P.Radhakrishnan, " Computer Numerical Control ", New Central Book Agency.
7. Computer integrated manufacturing -S. Kant Vajpayee – Prentice Hall of India.
8. Computer Aided Manufacturing- Rao, Tewari, Kundra, McGraw Hill.
9. CAD/CAM, Principles and Applications –P N Rao, McGraw Hill.
10. CAD/CAM, Introduction, -Ibrahim Zeid, Tata McGraw Hill.
11. CAD/CAM, Groovers and Zimmers, Pearson

ME 408P COMPUTER AIDED MANUFACTURING

Teaching Scheme					Examination Scheme					
					Theory			Practical		
L	T	P	C	Hrs/Week	MS	ES	IA	LW	LE/Viva	Total Marks
--	--	2	1	2	--	--	--	25	25	50

List of Experiments:

1. Demonstration of CNC Milling machine with user interface and calculating the Co - ordinates of given geometry in absolute end increment mode for cutter path.
2. **Validate** the CNC programming for a given geometry using Mirror and Subroutine.
3. **Validate** the CNC programming for a given geometry using Polar Co -ordinate for drilling cycles.
4. **Validate** the CNC programming for a given geometry using Tool Radius Compensation and Repeat loop for Peck drilling cycles.
5. Introduction and programming of all canned cycle of milling machine.
6. Perform the Various turning operation on CNC turning/lathe.
7. Perform the Various machining operation on CNC milling/machining centre.
8. Perform the various drilling operation on CNC milling/machining centre.
9. Demonstration of As /Rs and AVG operation.
10. **Tool path generation with CAM software like Master CAM, Siemens nx**

ME 410T PROJECT MANAGENMENT										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	--	6	3	30	60	10	--	--	100

UNIT I **09**

Introduction to Project Management: Justifying Project Management, Projects – Definitions, The Project Management Triangle – Scope, Time and Cost, What is Project Management, Projects & Operations, The Project Life Cycl e, Project Stakeholders, Project Management Process Groups, Project Management Knowledge Areas

Specification of a Project: The Project Charter, The Project Scope Document, Work Breakdown Structures, Project Contracts – Scope, Delivery, Costs and Risks.

UNIT II **09**

Project Planning and Scheduling: Project Network Representations, Activity Parameter Estimation – Time, Cost and Resources, Project Time Schedule, Gantt Charts, CPM and PERT, Activity and Project Crashing, Resources Scheduling.

UNIT III **12**

Project Execution Management: Quality Specifications, Quality Control Tools, Resources Procurement and Allocation, Systems and Processes, Communications and Documentation, Managing Teams, Resources Demobilization, Project Simulation and Risk Assessment, Use of IT tools.

UNIT IV **09**

Project Monitoring and Control: Project Work Measurement, Performance Measurement, Earned Value Management, Estimate Revision.

Project Closure and Review: Performance Evaluation – Scope, Time and Cost, Performance of Teams, Lessons Learnt, Project Closure Report.

Integrated Examples/Cases

APPROXIMATE TOTAL **39 Hours**

Texts and References

1. *PMBOK*® Guide, 4th Edition
2. Mantel Jr., Samuel J., Jack R. Meredith, Scott M. Shafer, Margaret M. Sutton with M. R. Gopalan (2006) *Project Management Core Text Book*, First Indian Edition, Wiley, New Delhi.
3. Meredith, Jack R., and Samuel J. Mantel, Jr. (2010) *Project Management: A Managerial Approach*, 7/e, Wiley, New Delhi.
4. Maylor, Harvey (2003) *Project Management*, 3/e, Pearson, New Delhi.
5. Pinto, Jeffrey K. (2009) *Project Management: Achieving Competitive Advantage and MS Project*, 1/e, Pearson, New Delhi.
6. Gray, Clifford and Erik Larson (2005) *Project Management: The Managerial Process*, 3/e, Tata McGraw-Hill, New Delhi.
7. Nicholas, John M. (2008) *Project Management for Business, Engineering and Technology: Principles and Practice*, 3/e, Elsevier, New Delhi.

ME 426T Rapid Product Development										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	-	6	3	30	60	10	--	--	100

UNIT I **10**

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

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

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

UNIT II **10**

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

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

UNIT III **09**

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

Post Processing: Part removal, finishing, curing.

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

UNIT IV **10**

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

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

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

Approximate Total : 39 Hrs

Texts and References

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

ME 425T APPLICATIONS OF FEM IN MECHANICAL ENGINEERING										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	6	3	30	60	10	--	--	100

UNIT I **09**

Introduction to the Stiffness Method: Stiffness matrix for spring element, direct stiffness method,boundary conditions, Stiffness matrix for bar element, global stiffness matrix, solution of a plane truss, solution of bar and trusses using FEA software.

UNIT II **12**

Development of beam Equations: beam stiffness matrix, global matrix, end conditions, distributed loading,

Frame and Grid Equations: 2-D arbitrarily oriented element, grid equations, beam element arbitrarily oriented in space

Solution of beam, frame and grids using FEA software.

UNIT III **09**

Two dimensional and three dimensional finite elements: stiffness matrix, global stiffness matrix, plane stress and plane strain, applications of 2D and 3D elements

Solution of 2D and 3D mechanical problems using FEA software

UNIT IV **09**

Applications of Finite element analysis to modal problems, Dynamic problems, thermal problems and fluid problems.

Approximate Total : 39 Hrs

Texts and References

Daryl L. Logan, A First Course in the Finite Element Method, Thomson

R D Cook, D S Malcus, M E Plesha, Concepts and applications of Finite Element Methods

Chandrupatla and Belegundu, Introduction to Finite Elements in Engineering

S.S. Rao, The finite element methods in Engineering, Pergamon, New York.

P. Seshu, A Textbook of Finite Element Analysis

J.N Reddy, An Introduction to finite element analysis, Mc graw hill

W Young, Finite element methods using MATLAB, CRC press

ME 427T AUTOMOBILE ENGINEERING										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	--	6	3	50	100	10	--	--	100

UNIT I **06**

Introduction to Automobile and its Performance

Automobile parts, assembly of vehicle, power required for acceleration, stability of a vehicle on a slope, dynamics of a vehicle running on banked track, stability of a vehicle taking a turn.

Chassis, Frame & Body:

Types, comparison, Comparison of front and rear mounting of engine, aerodynamic considerations in body profiling, Ergonomical considerations, defects in frames and body.

UNIT II **14**

Transmission system:

Clutch

constructional features and working of different types of clutch (like single plate/multi plate/cone/semi-centrifugal/ fully centrifugal/wet etc.) used in automobiles, calculation of surface area and number of driving and driven plates, nature of wear and tear each components, effect of misalignment and mis- adjustment of components, fluid coupling, trouble shooting in clutch systems.

Gear Box

Functions of gearbox, need of gear box, gears & gear ratios, principle of gearing, types of gear boxes, manual gearboxes, sliding mesh/ constant mesh

Automatic Transmission:

Basic devices used in automatic transmission, principle of epicyclic gearing, torque converter, free wheel clutch, over speed drive and its working, semi/fully automatic transmission, continuously variable transmission(CVT).

Propeller Shaft:

Propeller shafts and their types, fluid drive and fluid flywheel, universal joints, hotchkiss drive, torque tube drive, whirling of propeller shaft.

Differential:

Principle of the differential, locking differential, limited slip differential

Final Drive and Rear Axle:

Final drives and its types, hypoid type final drive, rear axle, rear axle drives, rear axle shaft supporting, rear axle casing, axle breather, oil retention

UNIT III **12**

Axel, Suspension system and Steering system

Front Axle: Types, construction, components and their functions

Suspension System Principle, type of suspension system, conventional and independent front and rear axle, spring, rubber and air suspensions, automatic/hydro suspension system, shock absorbers.

Steering System Steering layout, types of steering gears, steering linkages, steering mechanism, definitions and significance of camber, caster, king pin inclination, toe in and toe out on turn, measurement and adjustment of various steering system layouts, steering ratio, under steering and over steering, power assisted steering, steering geometry, checking wheel alignment and steering geometry, computerized wheel alignment equipment, steering trouble shooting

Brakes: Principle, braking distance, braking efficiency ,weight transfer, wheel skidding, principle and working of various types of brakes (like drum/disc/mechanical/girling mechanical/hydraulic etc.), power assisted brakes, hand brake, anti-lock brake systems (ABS), diagnosis of faults , adjustment and maintenance of brakes.

Battery, Lighting System , Accessories and Safety System :

Battery:

Construction, working, methods of rating, faults, charging methods, test, generator and cranking motor with drive purpose, construction, faults and diagnosis, voltage and current regulator, purpose, typical circuit, layout, working principle, voltage setting.

Lighting system:

Wiring system, head lights, aiming of head lights, indicating lights.

Accessories like direction indicators, hazard flashes, horn, speedometer, tachometer, wind screen wiper, wind screen washer, central locking system, power windows, and vehicle tracking system.

Safety provisions like air bags/ safety belts.

UNIT IV **08**

Automobile garage for maintenance and repair:

Scope of a garage, types of garages, equipments /tools for garages / service station, services carried out in garages and service station. necessity and types of servicing, engine decoking overhauling of engine, battery services, introduction to use of engine scanner / engine analyzer /chassis dynamometer / vehicle test lane etc., repairing of automobile component / system, laboratory & road testing of an automobile.

Regulation and Standardization of Vehicles:

Motor vehicle act, registration of motor vehicles, driving license, control of traffic, insurance against third party, claims for compensation, traffic signs, central motor vehicle rules, vehicle safety standards and regulations, classification and definition of vehicles, enforcement of emission norms, duties of surveyor.

Modern Vehicles:

Construction and operational features of four wheelers available in Indian market, introduction to electric vehicles & hybrid vehicles.

Approximate Total : 40 Hrs

Texts and References

1. Automobile Engineering Vol- I & II by Dr. Kirpal Singh, Standard Pub.& Dist.
2. Automobile Engineering Vol- I & II by Dr. K.M.Gupta,Umesh Pub.
3. Automobile Engineering by R.B.Gupta , Satya Prakashan
4. Automobile Technology by Dr. N.K.Giri, Khanna Pub.
5. Automotive Mechanics by W.Crouse , Tata Mc Graw Hill
6. Automobile Engineering by G.B.S.Narang, Khanna Pub

ME 428T Micro and Nano-manufacturing										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	--	6	3	30	60	10	--	--	100

UNIT I **10**

Background Review:

Introduction to manufacturing process and its impact. Materials and properties; classification of materials; how material properties affect a manufacturing process parameters and vice versa.

Traditional Manufacturing:

Mechanics of metal cutting; application to turning, drilling, grinding, and milling; cutting tool and tool life. Principle of welding and typical welding processes using gas and electrode. Solidification processes. Analysis of bulk material forming; application to forging, extruding, and drawing.

UNIT II **10**

Non-traditional Manufacturing :

Survey of common processes; powder metallurgy, electrical discharge machining, chemical milling, laser and plasma-assisted machining; abrasive jet machining.

Micro-manufacturing: Introduction to different mili-machining, micromachining, Nano-machining processes, Micro and Nano- finishing processes, Micro-forming, Micro-joining techniques, nanotechnology processes, the related process mechanism, process parameters of these processes and their applications to production of miniaturized components.

UNIT III **07**

Micro-machines: Introduction, Mesoscopic domain, Biological systems, cells as machines, Role of proteins, Physics of micro- mechanism, Future prospects.Handling for Micro Manufacturing, Robotics in Micro Manufacturing and Micro Robotics

UNIT IV **12**

Introduction Nano Technology: Historical perspective of micro and Nano manufacturing technology, Advantages and applications of nanotechnology. Materials overview, atomic structure, bonding, polymers, electrical characteristics, periodic table, crystal structures and defects, physical chemistry of solid surfaces, Introduction to Si-based materials, Ge-based materials.

Nano Fabrication Methods: Top-down andbottom-up approaches, lithography, deposition, CVD, PVD,etching, and material modification methods, processes andequipment

APPROXIMATE TOTAL 39 Hours

Texts and References

1. V. K. Jain (Ed.), Introduction to Micromachining, Narosa Publishing House, New Delhi, 2010.
2. J.A. McGeough, Micromachining of Engineering Materials, CRC Press; 1st edition, 2001.
3. Yi Qin, Micro manufacturing Engineering and Technology, Elsevier, 2010.
4. Norio Taniguchi, Nano Technology, Oxford University Press, New York, 2003.
5. Charles P Poole, Frank J Owens, Introduction to Nano technology, John Wiley and Sons, 2003.

6. I. Fujimasa, Micro machines: A New Era in Mechanical Engineering, Oxford Science Publications.
7. Guozhong Cao, Nanostructures and Nano materials: Synthesis, Properties &Applications, Imperial College Press, 2004.

ME 429T DESIGN For MANUFACTURING

Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	-	6	3	30	60	10	--	--	100

UNIT I **06**

INTRODUCTION: Introduction, Advantages of applying DFM, General design principles for manufacturability, Strength and mechanical factors, mechanisms selection, Evaluation method, Process capability, Feature tolerances, Geometric tolerances , Assembly limits -Datum features, Tolerance stacks.

FACTORS INFLUENCING FORM DESIGN: General requirements of early materials and process selection, Selection of Manufacturing processes, Process capabilities, Selection of materials, Primary process/ materials selection, Systematic selection of processes and materials.

UNIT II **15**

COMPONENT DESIGN - MACHINING CONSIDERATION: Design features to facilitate machining , Drills, Milling cutters, keyways, Doweling procedures, Counter sunk screws, Reduction of machined area , Simplification by separation, Simplification by amalgamation, Design for machinability, Design for economy, Design for capability, Design for accessibility, Design for assembly.

COMPONENT DESIGN - CASTING CONSIDERATION: Redesign of castings based on parting line considerations, minimizing core requirements, machined holes, Redesign of cast members to obviate cores. Identification of uneconomical design, Modifying the design, Group technology, Computer Applications for DFMA

UNIT III **08**

Design for Injection molding and Sheet metal working: Injection molding materials, Molding cycle, Systems, molds, machine size, cycle time, Cost estimation, Insert molding, Design guidelines, Introduction to sheet metalworking, Dedicated Dies and Press working, Press selections, Design Rules.

UNIT IV **10**

DESIGN FOR THE ENVIRONMENT: Introduction, Environmental objectives, Global issues, Regional and local issues, Basic DFE methods, Design guide lines, Applications, Lifecycle assessment: Basic method, AT&T's environmentally responsible product assessment , Weighted sum assessment method, Lifecycle assessment method, Techniques to reduce environmental impact , Design to minimize material usage, Design for disassembly: Design for recyclability, Design for remanufacture, Design for energy efficiency, Design to regulations and standards.

Approximate Total : 39 Hrs

Texts and References

1. Bralla, "Design for Manufacture handbook", McGraw Hill Ltd.
2. Boothroyd, G, Heartz and Nike, "Product Design for Manufacture", Marcel Dekker Newyork.
3. Dixon, John. R, and Corroda Poli, "Engineering Design and Design for Manufacture and Structural Approach", Field Stone Publisher, USA.
4. Fixel, J. "Design for the Environment", McGraw Hill Ltd
5. Kevien Otto and Kristin Wood, "Product Design", Pearson Publication.
6. Harry Peck, "Designing for Manufacturing' –, Pitman Publications.
7. Merhyle F Spotts, "Dimensioning and Tolerancing for Quantity Production", Prentice Hall, Inc. Englewood Cliffs, New Jersey.