Course code	Course Name	L-T-P-Credits	Year of Introduction
ME306	ADVANCED MANUFACTURING TECHNOLOGY	3-0-0-3	2016

Pre requisite: ME 220 Manufacturing Technology, ME303 Machine Tools and Digital Manufacturing

Course Objectives

1. To introduce machining principles and processes in the manufacturing of precision components and products that use conventional and nonconventional technologies.
2. To give basic understanding of the machining capabilities, limitations, and productivity of advanced manufacturing processes.
3. To describe how PLC's operate and how they control automated equipment and systems
4. To demonstrate tool path simulations with CNC powered equipment
5. To introduce CNC programming

Syllabus:-

Powder Metallurgy- Programmable Logic Controllers- CNC- non-traditional and micro machining process - high velocity forming of metals-material additional process.

Expected outcome:

The students will be able to

i. Become conversant with the non- traditional machining process and to appreciate the effect of process parameters on the surface integrity aspects during the non- traditional machining process.
ii. Appreciate the use of an EDM as a non traditional method of machining complex and hard materials.
iii. Prescribe a laser materials processing technique suitable for a given product with material, size, precision, and surface quality requirements.
iv. Program and operate a CNC mill and lathe.
v. Select the tool material and machining process parameters.

Text books/References

1. ASTME, High velocity forming of metals, PHI, 1968.
2. Davies K and Austin E.R, Developments in high speed metal forming, the machinery publishing Co, 1970.
3. Ibrahim Zeid, R Sivasubrahmanian CAD/CAM: Theory & Practice, McGraw Hill Education, 2009
4. Jain V.K., Introduction to Micromachining, Narosa publishers,2014
5. M.P. Groover, E.M. Zimmers, Jr. CAD/CAM; Computer Aided Design and Manufacturing, Prentice Hall of India, 1987
6. Petruzella Frank.D., Programmable logic controllers,McGraw Hill,2016
7. Yoram Koren, Computer control of manufacturing systems, TMH,2006

Course Plan			
Module	**Contents**	**Hours**	**End Sem. Exam. Marks**
I	Introduction: Need and comparison between traditional, non-traditional and micro & nano machining process.	1	**15%**
	Powder Metallurgy: Need of P/M - Powder Production methods:- Atomization, electrolysıs, Reduction of oxides, Carbonyls (Process parameters, characteristics of powder produced in each method).	1	
	Powder characteristics: properties of fine powder, size, size distribution, shape, compressibility, purity etc.	1	
	Mixing – Compaction:- techniques, pressure distribution, HIP & CIP.	1	
	Mechanism of sintering, driving force for pore shirking, solid and liquid phase sintering - Impregnation and Infiltration Advantages, disadvantages and specific applications of P/M.	1	
	Programmable Logic Controllers (PLC): need – relays - logic ladder program –timers, simple problems only.	1	
	Point to point, straight cut and contouring positioning - incremental and absolute systems – open loop and closed loop systems - control loops in contouring systems: principle of operation.	1	
II	DDA integrator:-Principle of operation, exponential deceleration –liner, circular and complete interpolator.	1	**15%**
	NC part programming: part programming fundamentals - manual programming –	1	
	NC coordinate systems and axes — sequence number, preparatory functions, dimension words, speed word, feed world, tool world, miscellaneous functions –	1	
	Computer aided part programming:– CNC languages – APT language structure: geometry commands, motion	1	
	commands, postprocessor commands, compilation control commands	1	
	Programming exercises: simple problems on turning and drilling etc - machining centers- 5 axis machining **(*At least one programming exercise must be included in the end semester University examination).***	2	
	FIRST INTERNAL EXAMINATION		

III	Electric Discharge Machining (EDM):- Mechanism of metal removal, dielectric fluid, spark generation, recast layer and attributes of process characteristics on MRR, accuracy, HAZ etc, Wire EDM, applications and accessories.	3	**15%**
	Ultrasonic Machining (USM):-mechanics of cutting, effects of parameters on amplitude, frequency of vibration, grain diameter, slurry, tool material attributes and hardness of work material, applications.	2	
	Electro chemical machining (ECM):- Mechanism of metal removal attributes of process characteristics on MRR, accuracy, surface roughness etc, application and limitations.	1	
IV	Laser Beam Machining (LBM), Electron Beam Machining (EBM), Plasma arc Machining (PAM), Ion beam Machining(IBM) - Mechanism of metal removal, attributes of process characteristics on MRR, accuracy etc and structure of HAZ compared with conventional process; application, comparative study of advantages and limitations of each process.	3	**15%**
	Abrasive Jet Machining (AJM), Abrasive Water Jet Machining **(AWJM)** - Working principle, Mechanism of metal removal, Influence of process parameters, Applications, Advantages & disadvantages.	3	
	SECOND INTERNAL EXAMINATION		
V	High velocity forming of metals:-effects of high speeds on the stress strain relationship steel, aluminum, Copper – comparison of conventional and high velocity forming methods- deformation velocity, material behavior, stain distribution.	3	**20%**
	Stress waves and deformation in solids – types of elastic body waves- relation at free boundaries- relative particle velocity.	2	
	Sheet metal forming: - explosive forming:-process variable, properties of explosively formed parts, etc.	2	
	Electro hydraulic forming: - theory, process variables, etc, comparison with explosive forming.	1	
V1	Micromachining: Diamond turn mechanism, material removal mechanism, applications.	1	**20%**
	Advanced finishing processes: - Abrasive Flow Machining, Magnetic Abrasive Finishing.	2	
	Magnetorheological Abrasive Flow Finishing, Magnetic Float Polishing, Elastic Emission Machining.	3	
	Material addition process:- stereo-lithography, selective laser sintering, 3D Printing, fused deposition modeling, laminated object manufacturing, , laser engineered net-shaping, laser welding, LIGA process.	2	

Question Paper Pattern

Maximum marks: 100 **Time: 3 hrs**

The question paper should consist of three parts

Part A
There should be 2 questions each from module I and II
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B
There should be 2 questions each from module III and IV
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C
There should be 3 questions each from module V and VI
Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: Each question can have a maximum of four sub questions, if needed.