GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Subject Code: ME02000851

Subject Name: CNC Technology and Rapid Product Development

w. e. f. Academic Year:	2024-25
Semester:	2
Category of the Course:	PCC

Prerequisite:	Nil
Rationale:	The course on CNC technology and RPD is aimed to CNC programming and controls of CNC drives and covers RPD methods.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Apply operational controls of CNC drives	
2	Do part programming for turning and milling centers	
3	Select Rapid product development process	
4	Analyse the product develop by various methods of RPD methods	

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	30	20	150

Course Content:

Content	Hours
Introduction to CNC Technology: Principles of Numerical control, Classification of CNC machines, Features of CNC Systems, Direct Numerical Control and Distributed Numerical Control (DNC), Specification of CNC system, Constructional details of CNC machines (guideways - friction and antifriction, recirculating ball screws, planetary roller screw, recirculating roller screw, types of indexing with numerical problems, automatic tool changers (ATC), automatic pallet changers (APC)), Axis designation,	7

CNC Drives and Control: Drives (stepper motor, servo principle, DC & AC servomotors with numerical Problems), Feedback devices (Types of encoders, absolute and incremental optical encoders), Interpolator systems, Control loop circuit elements in point to point (PTP) and contouring system, Interpolation schemes for linear and circular interpolations.	5
Part Programming for CNC: Basic Programming terms, Programming format, Preparatory (G-Codes) and Miscellaneous (m-Codes) functions, Machine zero, work zero and tool zero, Work offsets, Tool length offset and setup methods, cutter radius offset, CNC milling cutter holder, Part programming for turning and milling – linear and circular interpolation, subprogram, canned cycles for turning and milling, mirrors commands, machining large hole pattern, polar coordinates, round and rectangular pocket machining and cycles. Introduction to APT (Automatically Programmed Tools), geometry and motion statements, programming for geometry, Drill cycles and hole pattern.	15
Introduction to Rapid Manufacturing: Product Developing Cycle, Definition of Rapid Product Development, Virtual prototypical and rapid manufacturing technologies, Physical Prototyping & rapid manufacturing technologies, Principal of Rapid Prototyping (RP), Various RP technologies, Selection of a suitable RP process for a given application, Status of outstanding issues in RP- accuracy, speed, materials (strength, homogeneity and isotropy), Emerging Trends.	5
Rapid Manufacturing Processes: Definition of Rapid Manufacturing, Roadmap to Rapid Manufacturing, Comparison of Various Processes for Rapid Manufacturing of Metallic Objects, Rapid Manufacturing of Polymeric Objects, Rapid Casting, other RM Processes like Hybrid Layered Manufacturing, Material Translation, Segmented Object Manufacturing.	10
Rapid Tooling: Introduction to Rapid Tooling, Indirect Rapid Tooling Processes, Direct Rapid Tooling Processes, Emerging Trends in Rapid Tooling.	3
TOTAL	**45**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	**10**	**25**	**25**	**20**	**10**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:References:

1. Mikell P. Grover, Automation, Production System and Computer Integrated Manufacturing, Prentice Hall of India Pvt. Ltd.
2. Mechatronics, HMT, McGraw Hill Education
3. P. N. Rao "CAD/CAM principles and operations", Tata McGraw Hill
4. Yoram Koren, Computer Control of Manufacturing systems, McGraw Hill
5. Reference Manuals of FANUC, Siemens, Mazak, etc.
6. Manuals of CAD/CAM Software Package on CAM Module and CNC Machines.
7. Chua Chee Kai and Leong Kah Fai, Rapid Prototyping Principles and Applications in Manufacturing, John Wiley & Sons
8. K.P.Karunakaran, Rapid Product Development & Manufacturing, IIT, Bombay, 1st edition
9. Peter D. Hilton and Paul F. Jacobs (Editors.), Rapid Tooling Technologies and Industrial Applications, Marcel Dekker. 4th edition
10. Gibson D W Rosen, Brent Stucker., Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer
11. Noorani R, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons
12. Kamrani A K, Nasr E A, Rapid Prototyping: Theory and practice, Springer
13. Kenneth G. Cooper, Rapid Prototyping Technology: Selection and Application, CRC Press

(b) Open-source software and website:

Suggested Course Practical List:

1. CNC machining by turning and milling center & product development through RPD processes.

As per the course content and course outcome.

List of Laboratory/Learning Resources Required: CNC & RPD tools and software.

Suggested Activities for Students: Any activity based on above syllabus content

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