

**Type of course:** Core

**Prerequisite:** Manufacturing Process

**Rationale:** The manufacturing field has witnessed the development of major automation alternatives recently. CNC machines play a big role in manufacturing field. An attempt has been made to focus on CNC machine tools, related programming and their advanced features.

**Teaching and Examination Scheme:**

Teaching Scheme ( Hours)			Credits	Evaluation Scheme					Total Marks
Theory	Tutorial	Practical		Theory Marks			Practical Marks		
				ESE (E)	IA	CSE	Viva (V)	Term Work (TW)	
3	---	2	4	50	30	20	25	25	150

Sr. No.	Content	Total Hrs
1	<b>CNC Machine Tools</b> <b>Introduction:</b> Concept of CNC and development of its technology, advantages, applications, classification of CNC Machine, axis designations, interpolators- linear, circular and helical Interpolators.	4
	<b>Hardware:</b> CNC Machine building, structural details, CNC block diagram, 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), timing gear belt design, types of control, CNC networking topologies and their protocols, concept of DNC	5
2	<b>System drives and control system:</b> <b>Spindle drives</b> - DC shunt motor, 3 phase AC induction motor & their comparison <b>Feed drives</b> - stepper motor, servo principle, DC & AC servomotors with numerical problems. <b>Control system-</b> Types of encoders, absolute and incremental optical encoders, synchro, synchro-resolver, gratings, moire fringe gratings, inductosyn, laser interferometer.	5
3	<b>Manual Part Programming for CNC:</b> Various controllers for CNC, Structure of a part program, G & M Codes, Types of programming, different compensations, Manual part	12



	programming using FANUC controllers: Canned cycles for lathe: G70, G71, G72, G73, G75, G76, G81; Canned cycles for Milling: G81, G82, G83, G73, G84, G74, Mirroring, Sub programming, Macros.	
<b>4</b>	<b>Feature Based Manufacturing:</b> Deficiencies of Geometric Models, Definition of Features, Types and Attributes of Features, Properties of Features and composite features; Taxonomies, Validation and Mapping of Features; Feature Creation, Automatic Feature recognition, Design by Features, Comparison of Feature Creation Techniques and Their Unification; Feature Based Part Creation, Feature Identification, Design by Feature, Tolerance Specification; Manufacturing Features, Level abstraction and Specification, Dimensionality, Completeness of Feature Model, Feature Relationships, Temporal Ordering, Product Families, Interactive Feature Identification, Design to Manufacturing Feature Mapping, Manufacturing Feature Recognition; Group Technology Coding, Feature based Planning: Process, Assembly, Inspection, Feature based Evaluation.	<b>12</b>
<b>5</b>	<b>Automated Part Programming:</b> Computer Assisted Part Programming, Automatic NC program generation from CAD models, Parametric Programming.	<b>4</b>

**Suggested Specification table with Marks (Theory):**

<b>Distribution of Theory Marks</b>					
R Level	U Level	A Level	N Level	E Level	C Level
<b>10</b>	<b>20</b>	<b>20</b>	<b>20</b>	<b>20</b>	<b>10</b>

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**Reference Books:**

1. Parametric and feature based CAD/CAM, Shah J.J., Mäntylä M., 1995, John Wiley Sons Inc.
2. Mechatronics, HMT, McGraw Hill Education
3. James V. Valentino and Joseph Goldenberg, Introduction to Computer Numerical Control, 5<sup>e</sup>, Prentice Hall, Englewood Cliff, New Jersey, 2012.
4. Yoram Koren, Computer control of Manufacturing Systems, McGraw Hill, 2006
5. T.K. Kundra, P.N.Rao, N.K. Tewari, Numerical Control and Computer Aided Manufacturing, Tata McGraw Hill Publishing Company Ltd.
6. David Gibbs and Thomas Crandall, CNC Machining and Programming: An Introduction, Industrial Press Inc., 2003

**Course Outcomes:**

Sr. No.	CO statement	Marks % weightage
CO-1	Understand Computer Aided Manufacturing technology, through programming, setup, and operations of various Computer Numerical Control (CNC) machine	52

	tools	
CO-2	Prepare programmes of various CNC machine tools.	24
CO-3	To use feature based modelling for design for manufacture and manufacturing as well.	24

**List of Experiments:**

1. CNC machines hardware and their axis designations.
2. Manual part programming for CNC lathe without canned cycles
3. Manual part programming for CNC lathe for multipass turning and facing
4. Manual part programming for CNC lathe for undercutting, multi-pass threading and grooving
5. Manual part programming for profile milling with cutter radius compensation
6. Manual part programming for pocket milling with repeat count
7. Manual part programming for mirroring using sub program
8. Manual part program using macros.
9. Automatic part programming using high end CAD/CAM softwares

**Equipment / Computational facility:**

1. CNC Turning Centre
2. CNC Milling Centre
3. Manual Part programming software.
4. Computational facility.

**List of Open Source Software/learning website:** <https://nptel.ac.in/>