

Branch Name:	Mechanical Engineering
Program Code:	ET402
Course Title:	Computer Aided Manufacturing (CAM)
Course Code:	2ET4020504
Pre-requisite Course:	-----

Course Objectives:

1. Identify different axes, machine zero, home position, controls and features of CNC machines.
2. Select, mount and set cutting tools and tool holders on CNC.
3. Prepare part program using ISO format for given simple components with and without use of MACRO, CANNED CYCLE and SUBROUTINE using ISO format.
4. Interface software application for auto part programming.

TEACHING AND EVALUATION SCHEME:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)			
Lecture	Tutorial	Practical	Credit	Theory		Practical	
				University Assessment	Continuous Assessment	University Assessment	Continuous assessment
3	-	2	4	60	40	20	30

COURSE DETAILS

Sr. No.	Topic	Total Hours	Weightage (%)
01	Fundamentals of CAM. 1.1 CAM - concept and definition. 1.2 NC, CNC and DNC - concept, features and differences. 1.3 Advantages and limitations of CNC. 1.4 Selection criteria for CNC machines.	6	15
02	Constructional features of CNC machines. 2.1 CNC machines: Types, classification, working and constructional features. 2.2 Spindle drives and axes drives on CNC Machines. 2.3 Machine structure- Requirements and reasons. 2.4 Elements of CNC machines - Types, sketch, working and importance of: i. Slide ways. ii. Re-circulating ball screw. iii. Feedback devices (transducers, encoders). iv. Automatic tool changer (ATC). v. Automatic pallet changer (APC). 2.5 CNC axes and motion nomenclature. 2.6 CNC tooling: i. Tool presetting-concept and importance. ii. Qualified tools-definition need and advantages. 2.7 Tool holders- types and applications.	8	20
03	CNC Turning & Machining Centers 3.1 CNC turning centers: i. Types. ii. Features.	8	20

	iii. Axes nomenclature. iv. Specification. v. Work holding devices -types, working and applications. vi. Tool holding and changing devices - types, working and applications. 3.2 CNC machining centres: i. Types. ii. Features. iii. Axes nomenclature. iv. iv. Specification. v. Work holding devices-types, working and applications. vi. Tool holding and changing device types, working and applications		
04	CNC part programming. 4.1 Definition and importance of various positions like machine zero, home position, work piece zero and program zero. 4.2 CNC part programming: programming format and structure of part program. 4.3 ISO G and M codes for turning and milling- meaning and applications of important codes. 4.4 Simple part programming for turning using ISO format having straight turning, taper turning (linear interpolation) and convex / concave turning (circular interpolation). 4.5 Simple part programming for milling using ISO format. 4.6 Importance, types, applications and format for: i. Canned cycles., ii. Macro. iii. Do loops.vi. Subroutine. 4.7 CNC turning and milling part programming using canned cycles, do loops and Subroutine. 4.8 Need and importance of various compensations: i. Tool length compensation. ii. Pitch error compensation. iii. Tool radius compensation. iv. Tool offset. 4.9 Simple part programming using various compensations.	14	35
05	Recent trends in CAM. 5.1 Interfacing standards for CAD/CAM - Types and applications 5.2 Adaptive control- definition, meaning, block diagram, sources of variability and applications. 5.3 Flexible Manufacturing System (FMS) - concept, evaluation, main elements and their functions, layout and its importance, applications. 5.4 Computer Integrated Manufacturing (CIM) - Concept, definition, and areas covered benefits. 5.5 Robotics- definition, terminology, classification and types, elements and applications. 5.6 Rapid prototyping - Concept and application	6	10

SUGGESTED LIST OF EXERCISES/PRACTICALS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills (outcomes in psychomotor and affective domain) so that students are able to acquire the competencies/program outcomes. Following is the list of practical exercises for guidance.

Sr. No.	Practical Exercises	Approx. Hours. required
1	Demonstrate constructional features of CNC a. Demonstrate CNC machines and its operations. b. Identify major parts of CNC and draw sketch. c. Write specification of CNC taken for demonstration. d. Sketch important tool holders. e. Tabulate sensors / feedback devices with type, specification and purposes used on CNC taken for demonstration. f. Sketch display console. Also sketch symbols used on display console with meaning of each. g. State interfacing standards used.	06
2	CNC turning part programming Teacher will assign part drawings. Minimum five drawings having following details are to be assigned. This include parts- (i) Simple turning with steps, (ii) Turning with tapers, (iii) Turning with circular (concave / convex shape) interpolation, (iv) Turning using canned cycle - with threading or drilling or other and (v) Turning with use of subroutine or macro or do-loop. Students would: a. Sketch each part with dimensions. b. Prepare CNC part program using G and M codes with ISO format. c. Show various zeros and tool path on part sketch with color codes and dimensions. d. Simulate the prepared part program using available simulation software. e. Prepare the parts on CNC.	10
3	CNC machining Centre part programming Teacher will assign part drawings. Minimum three drawings having following details are to be assigned. This includes parts- (i) Simple contour milling (ii) Contour milling with (convex / concave) circular interpolation and (iii) contour milling with drilling / tapping. Students would: a. Sketch each part with dimensions. b. Prepare CNC part program using G and M codes with ISO format. c. Show various zeros and tool path on part sketch with color	08

	codes and dimensions. d. Simulate the prepared part program using available simulation software. e. Prepare the parts on CNC.	
4	Demonstration of CAD/CAM integration a. Demonstrate CAD/ CAM integration. b. List interfacing standards.	02
5	Industrial visit Visit nearby industry having CNC machines. List and state important features of them with detail specifications and name of manufacturers.	02
Total Hours		28

SUGGESTED LEARNING RESOURCES

A. List of Books:

Sr. No.	Title of Book	Author	Publication
1	CNC Machines.	Pabla B.S., Adithan M.	New Age Int. New Delhi, 2014(reprint).
2	Computer Numerical Control-Turning and Machining centers.	Quesada Robert	PrenticeHall2014.
3	CAD/CAM.	Sareen Kuldeep	S. Chand 2012.
4	Introduction to NC/CNC Machines.	Vishal S.	S.K. Kataria & Sons. 2012.
5	Computer Aided Manufacturing.	Rao P N, Tiwari NK, Kundra T	Tata Mc Graw Hill 2014.
6	CAD/CAM: computer aided design and manufacturing.	Groover Mike llP, Zimmered W Emory	PrenticeHall2011.

B) List of Major Equipment/ Instrument with Broad Specifications:

Sr. No.	Resource with brief specification.
1	CNC Turning Centre (Tutor or Productive)-Minimum diameter 25 mm, Length 120 mm with ATC. (Approximate)
2	CNC Machining Centre (Tutor or Productive)- X axis travel - 225 mm, Y axis travel - 150 mm, Z axis travel - 115 mm, With ATC. (Approximate)
3	Simulation software likes: CNC Simulator Pro, Swansoft CNC, etc.
4	Latest version of CAD/CAM integration software like MASTER CAM, NXCAM. etc.

C. List of Software/Learning Websites.

- <http://www.nptel.ac.in>
- <http://www.youtube.com/watch?v=M3eX2PKM1RI>
- <http://www.swansoftcncsimulator.com>
- <http://www.youtube.com/watch?v=hJFLcvtiNQI>
- <http://www.youtube.com/watch?v=BIM1AyxfYkw>.
- <http://www.mtabindia.com>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Illustrate Computer Aided Manufacturing with NC, CNC technology for Industry	1 Remembering 2 Understanding
CLO2	Identify different axes, machine zero, home position, controls and features of CNC machines.	2 Understanding
CLO3	Select, mount and set cutting tools and tool holders on CNC.	2 Understanding 3 Applying
CLO4	Prepare part program using ISO format for given simple components with and without use of MACRO, CANNED CYCLE and SUBROUTINE using ISO format.	4Analyzing 6 Creating
CLO5	Interface software application for auto part programming.	3 Applying

Course Learning Outcomes	Program Outcomes (Po's)												Program specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO1	M								L					M	
CLO2	M				L								M		
CLO3	L		L		M							L		L	L
CLO4	H	M			M				M		M	M			
CLO5	H	H	M		H	M				H	M	H	H	H	M

H: High, M: Medium, L: Low