

Subject Code: 1ET4020504	Subject Title: Computer Aided Manufacturing(CAM)
Pre-Requisite	--

RATIONALE

Manual operations have limitations in terms of power, precision and repetitions so the use of Computerized Numerical Control (CNC) machines is increasing day by day. CNC machines are the main component in Computer Aided Manufacturing Systems. In this course an attempt has been made to focus exclusively on constructional features of CNC machines, their programming and tooling, so that students may learn to use the CNC machines efficiently for manufacturing desired products. CAM is normally not only limited to machine tools but in real life its use has widened in almost all areas of manufacturing, processes and support activities.

COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competencies.

- Select required operating parameters, appropriate tools, tool holders, accessories and consumables for manufacturing a given job on CNC.
- Manufacture simple jobs using CNC part programming.

COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

- Identify different axes, machine zero, home position, controls and features of CNC machines.
- Select, mount and set cutting tools and tool holders on CNC.
- Prepare part programmes using ISO format for given simple components with and without use of MACRO, CANNED CYCLE and SUBROUTINE using ISO format.
- 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 (%)
1	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
2	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. iii. Tool holders- types and applications.	8	20
3	CNC Turning & Machining Centers. 3.1 CNC turning centres: i. Types. ii. Features. 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. Specification. v. Work holding devices-types, working and applications. vi. Tool holding and changing device types, working and applications.	8	20

4	CNC partprogramming. 4.1 Definition and importance of various positions like machine zero, home position, work piece zero and programme zero. 4.2 CNC part programming: programming format and structure of part programme. 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. iv. 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
5	Recent trends inCAM. 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/programme 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 programme 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 programmes using available simulation softwares. 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 include 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 programme 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 programmes using available simulation softwares. 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	Prentice Hall 2014.
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 McGraw Hill 2014.
6	CAD/CAM: computer aided design and manufacturing.	Groover Mikell P, Zimmered W Emory	Prentice Hall 2011.

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 MASTERCAM, 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>