



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3154103

Semester – V

Subject Name: CNC Machine and Metrology

Type of course: Professional Core Course

Prerequisite: NA.

Rationale: CNC Machine and Metrology is fundamental course for Robotics and Automation engineers to understand CNC machine. This course is essential for CNC turning, CNC milling and Linear and Angular Measurements.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
4	0	2	5	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Introduction To CNC Machine Tools:- Evolution of CNC Technology, principles, features, advantages, applications, CNC and DNC concept, classification of CNC Machines turning centre, machining centre, grinding machine, EDM, types of control systems, CNC controllers, characteristics, interpolators Computer Aided Inspection, CNC Machine building, structural details, configuration and design, guide ways, Friction and other types of guide ways.	10
2	Drives And Work Holding Devices: Spindle drives – DC shunt motor, 3 phase AC induction motor, feed drives –stepper motor, servo principle, DC and AC servomotors, Axis measuring system synchro, synchro resolver, gratings, moiré fringe gratings, encoders, laser interferometer, work holding devices for rotating and fixed work parts, economics of CNC, maintenance of CNC machines.	9
3	CNC Programming: Coordinate system, structure of a part program, G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, programming for machining centre and turning centre for well known controllers such as Fanuc, Heidenhain, Sinumerik etc., generation of CNC codes from CAM packages	13



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4	Linear And Angular Measurements: Linear Measuring Instruments – Evolution – Types Classification Limit gauges gauge design terminology procedure concepts of interchange ability and selective assembly – Angular measuring instruments Types Bevel protractor clinometers angle gauges, spirit levels sine bar Angle alignment telescope Autocollimator Applications.	10
5	Advances In Metrology: Basic concept of lasers Advantages of lasers, laser Interferometers types DC and AC Lasers interferometer Applications Straightness Alignment. Basic concept of CMM Types of CMM, Constructional features Probes, Accessories Software, Applications Basic concepts of Machine Vision System Element Applications.	10

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
26%	26%	20%	20%	8%	-

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. Mechatronics”, HMT, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005.
2. Warren S.Seamers, “Computer Numeric Control”, Fourth Edition, Thomson Delmar, 2002.
3. Jain R.K. “Engineering Metrology”, Khanna Publishers, 2005.
4. Gupta. I.C., “Engineering Metrology”, Dhanpatrai Publications, 2005.
5. Charles Reginald Shotbolt, “Metrology for Engineers”, 5th edition, Cengage Learning EMEA,1990.

Course Outcomes: After learning the course the students should be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Ability to know about the basic in CNC machineries.	20%
CO-2	Evolution and principle of CNC machine tools and different measurement technologies	17%
CO-3	Able to write simple programs for CNC machinery	23%
CO-4	To impart knowledge about linear and angular measurements in metrology.	20%
CO-5	Ability to know about the advancement in metrology.	20%



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List of Experiments:

1. Study of the CNC machine.
2. Programming and simulation of a lathe using any CAM package.
3. Programming and simulation of a machining centre using any CAM package
4. Programming and operation of a CNC Lathe.
5. Programming and operation of a CNC machining centre.
6. Measurement of Taper Angle using Sine Bar.
7. Optical profile projector – study of profile of gear tooth, screw threads.
8. Tool maker's microscope – to study cutting tool geometry, screw threads.
9. Tool wear and surface finish measurement.
10. Dimensional measurement of machined components using, bore gauge, air gauge and height master.

Major Equipment:

1. CNC Lathe
2. CNC Milling
3. Optical profile projector
4. Tool makers microscope
5. Measuring gauges for hole depth and height
6. Sine bar

List of Open Source Software/learning website:

- Fanuc controller software, Heidenhain.
- <https://nptel.ac.in/courses/112105211/>