

5.3 CNC MACHINES AND AUTOMATION

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RATIONALE

Diploma holders are required to supervise and handle specialized machines and equipments like CNC machines. For this purpose, knowledge and skills about NC machines, part programming in NC machines and tooling for CNC machines are required to be imparted for enabling them to perform above functions. This subject aims at development of knowledge and skills about CNC machines, tools, equipment and use of high tech machines for increased productivity and quality.

COURSE OUTCOMES

After undergoing the training, the students will be able to:

- CO1 Explain the construction and tooling of CNC machine.
- CO2 Prepare simple part programme.
- CO3 Demonstrate and Operate a CNC lathe and milling machine.
- CO4 Assess the part program, edit and execute in CNC turning and machining centre
- CO5 Diagnose common problems in CNC machines.
- CO6 Explain the trends in the field of automation.
- CO7 Use Advanced programming structures.
- CO8 Develop the part program and tool path generation using simulation software for Lathe and Milling machines

DETAILED CONTENTS

UNIT-I

Introduction

Introduction to NC, Basic Components of NC, binary coding, MCU, input devices, advantages / disadvantages of NC machines over conventional machines, CNC & DNC, their types, their relative advantages, disadvantages, Adaptive control systems, selection of parts to be machined on CNC machines, Problems with conventional NC, PLC Control and its purpose, types and applications.

Classification Of NC Systems

According to Feedback, motion, positioning.

UNIT-II

Part Programming

Part programming and basic procedure of part programming, Rules for Axis identification, NC words, Blocks, part programming formats, simple programming for rational components (Point to point, Straight line, curved surface), tool off sets, cutter radius compensation and wear compensation. Comparative study of Fanuc Controller and Sinumerik codes.

Advanced Structures in Part Programming

Advantages of using advanced structures, part programming using canned cycles, subroutines and do loops, mirror image.

UNIT III

Construction and Tooling

Need of Special mechanical design features for CNC, specification Chart of CNC machines, types of slideways, balls, rollers, motor- servo/stepper , recirculating ball screw and nut assembly, swarf removal, safety and guarding devices,

Various cutting tools for CNC machines, overview of tool holder, different pallet systems and automatic tool changer-ATC system, tool change cycle, types of tool magazines, specialized work done in CNC tool room.

UNIT IV

System devices

Control System, Transducers and Sensors, characteristics of sensors, Tachometer, LVDT, opto-interrupters, potentiometers for linear and angular position, encoder, Actuators, axis drives.

Problems in CNC Machines

Common problems in mechanical, electrical, pneumatic, electronic and PC components of NC machines, diagnostic study of common problems and remedies, use of on-line fault finding diagnosis tools in CNC machines, methods of using discussion forums.

UNIT V

Automation System

Automation, suitability of production system to automation, types, automatic assembly, manufacture of printed circuit boards(PCB), manufacture of integrated Circuits, Overview of FMS, AGV-types, ASRS, Group technology, CAD/CAM and CIM, Automated Identification system,

Automated inspection: Off-line, On-line, Contact, Non-contact; Coordinate Measuring machines; Machine vision, concept of AI and its applications in manufacturing, Robotics, nomenclature of joints, motion.

PRACTICAL EXERCISES

1. Comparative Study of the constructional details of CNC lathe and CNC milling Machine.
2. Comparative Study of international standard codes:
-G-Codes and M-Codes; for major operations.
3. Study the constructional details of following components of CNC machine installed in lab for:
- Automatic tool changer and tool setter
- Multiple pallets
- Swarf removal
- Safety devices
4. Develop a part programme for following lathe operations and make the job on CNC lathe and CNC turning center.(for finish pass only) – (At least two) Calculating coordinate points for a cylindrical job by considering sign convention for lathe (Material: Aluminium/Acrylic/Plastic rod)
- Plain turning and facing operations
- Taper turning operations
- Operation along contour using circular interpolation.
5. Develop a part programme for the following milling operations and make the job on CNC milling (for finish pass only)- At least two (Material: Aluminium/Acrylic/Plastic rod)
- Plain milling
- Slot milling
- Contouring
- Pocket milling
6. Calculate coordinate points for a zig zag job by considering sign convention for milling
7. Using canned cycle - Create a part program for drilling, tapping, counter sinking and produce component in the Machine

8. Demonstration through industrial visit for awareness of actual working of FMS in production.
9. Use of software for any one of turning or milling operations on CNC turning center. Program writing – Turning simulator for generation of tool path.
10. Demo of 3-D Printing.

RECOMMENDED BOOKS

1. CNC Machine and Automation by JS Narang, Dhanpat Rai & Co, New Delhi.
2. CNC Machines – Programming and Applications by M Adithan and BS Pabla; New Age International (P) Ltd., Delhi.
3. Computer Aided Manufacturing by Rao, Kundra and Tiwari; Tata McGraw Hill, New Delhi.
4. CNC Machine by Bharaj; Satya Puble-books Publications, New Delhi.
5. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

RECOMMENDED WEBSITES

1. <http://swayam.gov.in>

INSTRUCTIONAL STRATEGY

This is hands on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills among the students. This subject contains five units of equal weightage. Efforts should be made to develop programming skills amongst the students. During practice work, it should be ensured that students get opportunity to individually perform practical tasks.