



Name :

Roll No. :

Invigilator's Signature :

**CS/M.TECH (ME)/SEM-1/ME-1101/2009-10
2009**

NUMERICAL CONTROL OF MACHINE TOOLS

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

Answer any *five* questions.

5 × 5 = 25

1. Explain the closed loop control system of a CNC machine tool by a block diagram, mentioning the role of each component. Why is a velocity loop incorporated in the system ?
2. Highlight the advantages of Adaptive control and DNC systems in relation to CNC.
3. What is meant by control resolution of a CNC ? For a closed control system using a shaft encoder as feedback device, prove that control resolution $CR = \frac{P}{n_s \times r_g \times r_{ge}}$, where p is the pitch of the lead screw, r_g is the gear ratio between motor and lead screw, r_{ge} is the gear ratio between lead screw and the encoder shaft and n_s is the encoder number of slots.

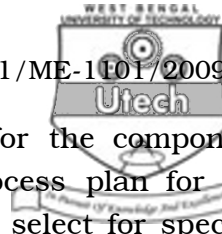


4. Explain the concept of part surface, guide surface and check surface by a sketch in relation to APT programming.
5. Why is gray code suitable for encoder ? What is the purpose of using recirculating ball screw in a CNC machine tool ?
6. The CNC machines are commensurable with the batch manufacturing system. Justify the statement.
7. Write the syntax of a thread cutting cycle following any controller, clearly mentioning the implication of each word.

GROUP – B

Answer any *three* questions. $3 \times 15 = 45$

8. a) Prove that the number of pulses required (N_p) to travel the table by a distance l can be expressed as
$$N_p = \frac{n_s \times l \times r_g}{p}$$
where p is the pitch of the lead screw, r_g is the gear ratio between motor and lead screw, and n_s is the number of steps of the stepper motor. Hence prove that pulse frequency (f_p) for a feed rate of f is $f_p = \frac{f \times n_s \times r_g}{60p}$.
- b) Why are carbide inserts provided with zero clearance angle ? Highlight the criteria of a cutting tool for its use in a CNC machine tool. 10 + 5
9. a) Explain the steps of Computer Aided Part Programming (APT) by a block diagram, clearly mentioning the role of each module.
- b) Explain the different modes of check surfaces associated with APT programming. 10 + 5



10. Write a complete manual part program for the component shown in the figure. Also prepare a process plan for the same, mentioning the type of tool that you select for specific operation. The raw material size is

85 mm diameter \times 125 mm long.

dia

11. a) What is meant by wind-up error in relation to CNC machine tools ? The load on the positioning table of an NC machine tool requires that the servomotor delivers 200 N.m of torque. If the motor is directly connected to a 0.5 m long lead screw, and the lead screw pitch is 10 mm/revolution, compute (i) the wind-up and (ii) the lost motion. The lead screw diameter is 25 mm and $G = 7.6 \times 10^{10}$ Pa.
- b) The initial cost of one CNC machine tool and a conventional lathe are found to be Rs. 10 lakhs and Rs. 4 lakhs respectively. The variable costs are estimated to be Rs. 50 and Rs. 120 respectively. The component produced can be sold in the market at Rs. 150. The company wishes to produce 14000 components in the year. Justify which of the above machines is suitable for this quantity production and what would be the associated profits ? 9 + 6

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12. Write a complete APT program for the component shown in figure. Neglect clamping aspects. Assume one cut is necessary to cover entire plate thickness.

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