

B.E. 7th Semester (M.E.) Examination, 2012

Subject: NC/CNC Machine Tools (Elective-I, ME 705/10)

Duration: 3 hours

F.M. 70

First Half

Answer any three questions

All the questions carry equal marks

1. Design the CLU of a NC lathe with 10mm. L.S. pitch, maximum feed-rate 1500mm/min and 0.01 mm. BLU and load torque 200 N-m (max). The feed-drive used is a DC servomotor having the following specifications: Nominal Torque = 1000 N-m, Nominal speed = 1400 rpm, Torque Constant=5 N-m/A, Motor constant = 1 rad/s-V, Time constant = 40 ms, Armature resistance=2Ω, Speed variation allowed= 10 rpm at full load.
2. (a) What is path error? Show that the path error (ϵ) in case of linear interpolation is given by

$$\epsilon = \frac{f_x f_y}{fK} \left(\frac{\Delta K}{K} \right),$$

where f_x and f_y are frequencies of operation in x and y direction, respectively, f is the feed rate, $K = \sqrt{K_x K_y}$ and $\Delta K = |K_x - K_y|$ with K_x and K_y are the open-loop gains in x and y axis, respectively.

- (b) Calculate the steady state path error generated in the linear interpolation of a line with 45° slope and path velocity 4 mm/s. The average open-loop gain is 25 s⁻¹ and the difference between the loop's gain is 2 %. What is the maximum permitted velocity if the error should be smaller than 1 BLU (=0.01 mm) ?
3. (a) What is meant by interpolation efficiency? How interpolation efficiency is enhanced in a software DDA interpolator ?
(b) How feedrate is controlled in software DDA interpolator?
(c) Give the flow chart of software DDA linear interpolator.
4. (a) Show and discuss the architecture of a sampled data CNC system.
(b) How a sampled data system is different from reference pulse system?
(c) Write the reference word interpolator algorithm with Tustin approximation and error estimation routine.
5. (a) Give the flow chart of Direct Search Interpolation (DSI) algorithm.
(b) Show the steps of calculation (table as well as graphical) of DSI for clockwise circular interpolation in the first quadrant.

SECOND HALF

(Answer any THREE questions, all questions carry equal marks)

- 6 a) Write the functional difference between an incremental encoder and absolute encoder.
b) Draw side-by-side two 3-track absolute encoder, one in binary code and another in gray code. Discuss the advantage of gray code disc compared to a binary code disc.
c) Describe how direction of rotation is detected with incremental encoders.
- 7 a) The work-table of a CNC machine, is controlled by a servo-system with the following parameters: gain of the electric amplifier= 10 volt output/volt; gain of the motor=5 revolution per second/volt; gain of the leadscrew= 1 mm / revolution. Total movement of the table=600 mm and volt reading corresponding to the length of the table varies from 0 to 30 volts. If the error signal is received every after 0.1 sec, what is the error signal (in volts) and the speed of the table after 0.4 second?
b) Describe briefly any one type of braking system for instantaneous stopping of a DC servomotor used in CNC machines.
- 8 a) A stepper motor with 1.8° step-angle is fitted with the axis drive of a CNC machine. Calculate the pulse rate to be send to the motor if a feed required is 10 mm/min. Assume that pitch of the lead-screw=0.5 mm.
b) How exactly clockwise and anticlockwise movements are detected in stepper motor?
c) Write the main features required for a CNC machine DC servo-motor.
- 9 a) Write the main function of JOG and AUTO mode of a CNC machine. Why they are given as a toggle switch?
b) Write the canned cycle program to machine the product as shown in Fig. A on a CNC Lathe.

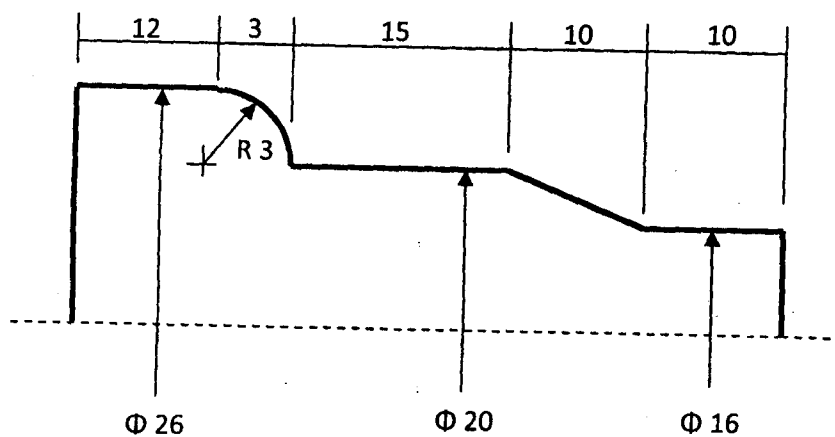


Fig.-A : Half-section view of a CNC Lathe product
(dimensions are in mm)

- 10 Write short notes on
- a) Macro-programming (or sub-programming): with an example and code.
b) Cutter radius compensation : with example & code.