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End Semester Exam
Sub: Computer Aided Manufacturing (ME 018)
B.E. Final Year, Mechanical, Date: 13/12/2006

Instructions:
Attempt Question 1 and any 5 from the rest
All questions carry equal marks
Use graph paper for question no 6(a)
Answer for a particular question should be at one place
Assume suitable data wherever necessary

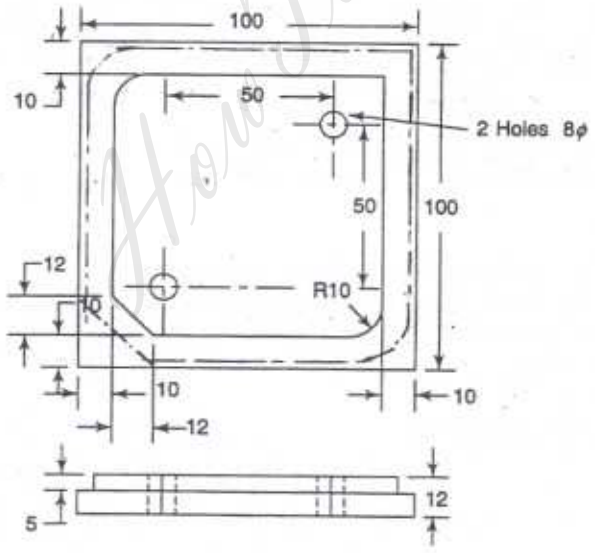
Time: 3 Hours
Instructor: T. Chakraborty

1. (i) Under what circumstances are closed loop NCs used? Give example.
(ii) Justify the use of '*Ruby*' as probe tip in CMM.
(iii) What situation warrants the use of '*paint strips*', in vehicle guidance technology in AGVs?
(iv) *SCARA* robot doesn't come with a separate wrist assembly- Give reason.
(v) What do you mean by 'APT Major' and 'APT Minor' words? Give example.
(vi) Why retrieval type CAPP is also known as '*variant type*' CAPP? [6×1]

2. (a) .Write a short note on 'CODE' system used in part classification and coding. [3]
(b) Give an example each for '*fixed*', '*flexible*' and '*programmable*' automation [1.5]

(b) With a neat sketch show the various modes of approximation of a curved path done by a NC system. [1.5]

3. (a) A component has to be machined as shown below. The upper profile needs to be machined using an end mill cutter of diameter **Φ16**mm. Two holes on the finished surface needs to be drilled with a **Φ8**mm drill. The path to be taken by the tool to generate the profile is shown as centerline. Write the complete part program without using radius compensation and drilling canned cycles. Clearly show the axes and the set point. [4+1]



(b) Categorize the following APT statements: OUTTOL, MACHIN, LOADTL, FINI [1]

4. (a) Illustrate with a neat sketch the tool change procedure with a double gripper tool change arm in an ATC. [2]
(b) FMS milling and drilling technology is more mature than FMS turning - Discuss [1.5]
(c) Mention the most suitable robot configuration for the following:
(i)Placing a component in a CNC machine tool, (ii) picking a part from a moving conveyor, (iii) placing an object in an oven for heat treatment, (iv) welding a steel almirah, (v) inserting a peg into a hole. [2.5]

5. (a) State with reason whether the following are permissible symbols or not in APT geometry statement:
(i)PA2CD9F (ii) 135246 (iii) CIRCLE (iv) P1.5 [1]
(b) A stepper motor with 200 step angles is coupled to lead screw through a gear reduction of 5: 1(5 rotations of motor for each rotation of lead screw). The lead screw has 2.4 threads/cm. the worktable driven by the lead screw must move a distance = 25 cm at a feed rate of 75cm/min. determine (a) number of pulses required to move the table (b) the required motor speed and (c) the pulse rate to achieve the desired table speed. [3]
(c) With the aid of a neat sketch, describe briefly the '*pitch*', '*yaw*' and '*roll*' motion of a robot wrist. [2]

6. (a) The following APT statements gives complete geometry of a part

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PARTNO SAMPLE PART MILLING OPERATION
MACHIN/MILLING, 01
UNITS/MM
REMARK Part geometry
P1= POINT/ 40, (160+40 - 10)
P2= POINT/ 40, 40
L1=LINE/ P1, P2
L5=LINE/ XAXIS
L4=LINE/PARLEL, L5, YLARGE, 40
L2=LINE/PARLEL, L4, YLARGE, 160
L3=LINE/ (POINT/ (40+120), (40+160)), ATANGL, 135
C2=CIRCLE/ YLARGE, L4, XSMALL, L3, RADIUS, 20
A= SQRT (40*40 - 30*30)
C1=CIRCLE / (40+A), 160, 40
FINI
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Using a graph paper draw the entire part with proper dimensions to the scale. [4.5]

(b) Differentiate between an AS/RS and a carousel in terms of storage structure, motion and storage retrieval operation. [1.5]

7. (a) The length of one aisle in an AS/RS is 100m and its height is 20m. Horizontal travel speed is 2 m/sec. the vertical speed is so specified that the storage structure is 'square in time' (i.e. $L/V_y = H/V_z$). The pick up and deposit time is 15 sec. Determine the expected transactions per hour for the aisle if the ratio of single to dual command cycles is 2 : 1. The system operates continuously during the hour. [3]

(b) Explain the term '*fixed zero*' and '*floating zero*' in context of NC. [2]
(c) With an example, differentiate between 'GOTO' and 'GODLTA' command in APT. [1]

8. (a) Three point locations on the surface of a drilled hole have been measured by a CMM in the X-Y axes. The three coordinates are (34.41, 21.07), (55.19, 30.50) and (50.10, 13.18) mm. The given coordinates have been corrected for probe radius. Determine (a) coordinates of the hole center (b) hole diameter as they would be computed by the CMM software. [4.5]

(b) Differentiate between an FMS and an FMC. [1.5]

NB: The evaluated answer scripts will be available for viewing at the course instructor's office (S.M Lab) on 15th December 2006, between 9:30 AM – 12:00 PM