NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL ENGINEERING

COMPUTER AIDED MANUFACTURING - TIE 5011

SECOND SEMESTER EXAMINATION - APRIL 2000

Time Allowed: 3 Hours
Answer 5 Questions
Attempt at least TWO (2) Questions in each section

SECTION A

Qu 1 a) Briefly outline what you understand by the term numerical controlled machines and their advantages over conventional machines. [5]

b) Write a concise part program to machine the component shown in Fig Qu1. Given T0101 have F = 0.4mm/min and spindle speed S = 160 rev/min. Given that the Feedrate F=0.15 mm/min and the spindle speed S = 180 rev/min using a tool T0303 for finishing pass. Assuming that the blank is 101 mm x D60. [15]

Qu 2 a) Briefly explain the terms with the help of examples where possible

i. contouring machine motion [2]
ii. modal and non-modal commands [2]
iii. absolute and incremental positioning commands [2]

b) Write a concise part program to machine the component shown in Fig Qu2. Given that the milling tool T4 which is of diameter 8 mm operates with a feedrate F = 80 mm/min and the spindle speed S=1392 rev/min which the drilling tool T5 which is of diameter 8

mm operates with a feedrate F = 120 mm/min and spindle speed S = 1193 rev/min. Given also that the maximum depth of cu for the milling tool T4 is 3 mm. [14]

Qu. 3 a i) Explain briefly what is a post processor related to CNC machines and give example where possible from local industries. [3]

ii) Give details of two advantages of APT over manual part programming. [2]

b) A full program in APT is needed for machining of a part given in Fig Qu3. The dimensions of the stock material are 100 x 70 x 10mm. Given a milling tool T2 with diameter D = 20 mm, feedrate F = 80 mm/min and spindle speed S = 477 rev/min. [15]

SECTION B

Qu. 4 a) What do you understand by the following as related to industrial robots:

i. spatial resolution [2]
ii. accuracy [2]
iii. repeatability [2]

b) Give the list the physical configurations of industrial robots. [4]

c) Given a single machine robot cell operating on an 8-hr shift with the system availability being 95%. The CNC machine takes 25s to process a part on average. The other robot operation times are:

Description of task	Time
Robot picks up a part form the conveyor	4.0s
Robot moves the part to the machine	1.4s
Robot loads the part onto the machine	1.0s
Robot unloads the part from the machine	0.6s
Robot moves to the conveyor	1.6s
Robot puts the part on outgoing conveyor	0.4s
Robot moves from output conveyor to the input conveyor	3.0s

Find :

i. the cycle time [2]
ii. production rate [2]
iii. the percent utilisation of the machine and the robot [6]

Qu. 5 a) What is Process planning and what are the steps followed in coming up with a process plan? [4]

b) Briefly explain one of the approaches to computer aided process planning. [4]

c) How does CAPP facilitate the integration of CAD and CAM. [4]
d) Briefly enumerate four objectives in CAPP systems. [4]
e) Briefly outline the criteria for a selection procedure of a CAPP system. [4]

Qu 6 a) Briefly explain what is CAD with the aid of illustrations. [4]

b) Outline the possible input devices of the CADCAM system stating the factors you would use to select one of them and how the devices rank between one another. [6]

c) A point P (100, 100, 200) is to be translated by 50 units in X-direction, 60 units in they-direction and 40 units in the Z-direction. It was then given a rotation of 10 degrees about the x-axis, 15 degree about the y-axis and 15 degrees about the Z-axis. Find the transformation matrix and co-ordinates of the final position of the point. [6]

d) Describe briefly the following methods of solid modelling
i) pure primitive instancing [2]
ii) octree decomposition [2]

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Fig Qu1

(Sorry the diagrams were given as hard copies)

Fig Qu2

(Sorry the diagrams were given as hard copies)

Fig Qu3