Bengal Engineering and Science University, Shibpur
B. E. (Mechanical) Part IV 7th Semester Final Examination, 2012
Subject: Computer Integrated Manufacturing Systems (ME-705/3, Elective-I)

Time: 3 Hours   **Full Marks: 70**

<u>Answer SIX questions taking any THREE from each half</u>
<u>All questions carry equal marks, two marks in each half is reserved for overall quality.</u>

FIRST HALF

1   (a) Write the basic rules for ladder diagram of a PLC.

    (b) Three momentary pushbuttons (Normally Open) on a milling machine console are connected to a programmable controller. Switch functions are as follows:
- When switch A is pressed by the operator, it indicates start of a batch.
- Switch B, when pressed(by the operator), indicates completions of a single part
- The end of a batch run is indicated by switch C (pressed by the operator)

Draw a ladder diagram to allow the controller to:
- Reset counting at the start of a batch and count the parts during a batch run
- Stop the machine when switch C is pressed (operator ends the batch) or 10 parts are produced in a batch (i.e., not more than 10 parts in a batch are allowed).

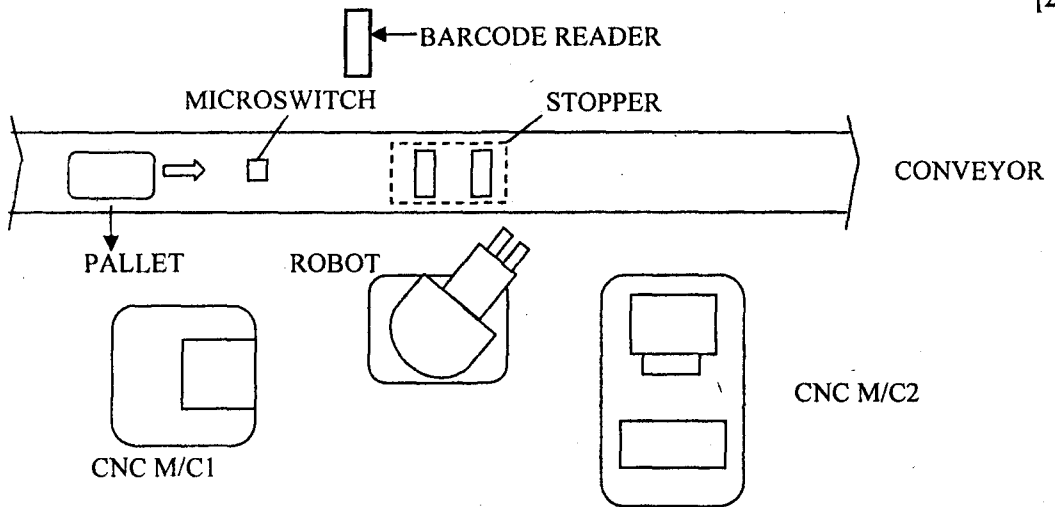   [2+9]

Fig. A: The Flexible Manufacturing System

2   a) Fig.A shows a part of a FMS where parts are automatically loaded on two CNC Machine with the help of a Robot. Parts are carried on pallets, which contains different barcode for different machine.

Write a ladder diagram to make the following sequence of operations (explain each step):
- a part is carried by the conveyor and as it touches the micro-switch the barcode reader is ON.
- If the barcode reader detects the pallet for CNC machine1 (output signal 201) and for CNC machine2 (output signal is 202) and the robot is NOT busy then activate the stopper.

- If the CNC Machine1 is not busy and the barcode signal is 201 then the robot will pick the part from stopper and load it on the CNC Machine1.(robot program1)
- If the CNC Machine2 is not busy and the barcode signal is 202 then the robot will pick the part from stopper and load it on the CNC Machine2.(robot program2)
- Here unloading is done manually.

b) With a neat sketch write the different components of a PLC.

[8+3]

3   (a) What are the proximity sensors for robots?
(b) An articulated robot has the following dimensions :
Base thickness = 120 mm, Waist thickness=   250 mm, length of lower arm = 300 mm, length of upper arm = 220 mm . X,Y, Z translation between the base and global origin is 150, 180, 0 respectively. Angle of rotation of waist joint, shoulder joint and elbow joint are 60^0, 45^0 and 0^0 respectively. Write the steps with required matrices to find the global coordinate of an arbitrary point (50,60,70) w.r.t. the center of the wrist. Draw approximate sketches of the coordinate system of the links and joints. (solution not required).

[2+9]

4   a) Prove that initial and final segment of the control polygon of a Bezier curve are tangent to the curve.
b) Explain, in detail how a parametric surface is modeled for CAD.
c) Write the main advantage of parametric representation of curves or surfaces in CAD.

[3+6+2]

5.   a) Write the Bezier curve equation with 6 control points.
b) Write a complete CAD program to plot a Bezier curve with 6 control points. Also plot the control polygon

[3+8]

6. (a) Name the different types of automation used in industries.

   (b) Enumerate the characteristics of fixed automation and programmable automation.

   (c) Discuss the advantages of fixed automation.

7. (a) Draw the schematic diagram of a closed loop control system for the table movement of a CNC milling machine.

   (b) Describe the working principle of the feedback sensor used in the above system.

   (c) Consider a CNC worktable driven by a closed loop control system consisting of a servomotor, leadscrew, and optical encoder. The leadscrew has a pitch of 5mm and is coupled to the motor shaft with a screw to motor gear ratio of 1:4. The encoder generates 150 pulses per revolution of the leadscrew. If the number of pulses and the pulse rate received by the control system are 2250 and 200Hz respectively, calculate (i) table speed, (ii) motor speed in RPM, and (iii) distance traveled by the table.

8. (a) Why the Automatically Guided Vehicle System (AGVS) is being increasingly used by the modern industries?

   (b) Discuss the different types of AGVS and their applications.

   (c) An engineering industry is contemplating to integrate the AGVS and automated storage and retrieval systems (AS/RS) with their flexible manufacturing system. The delivery rate is 67 pieces per hour. The company has decided in favour of installing a wire guided path system and the unit load AGVS. The following data has been collected as shown in the table.

Vehicle speed	61 m/min
Average loaded travel distance per delivery	183 m
Average empty travel distance per delivery	122 m
Pick-up time	15 s
Drop-off time	15 s
Traffic factor	0.75

   Calculate the number of vehicles required.

9. (a) Define Flexible Manufacturing System (FMS). What are the basic components of FMS?

   (b) State and explain the three levels of manufacturing flexibility.

   (c) Enumerate the different types of FMS layout and draw the schematic diagram of any two of them.

10. (a) What do you understand by Group Technology ?

    (b) State the different design and manufacturing attributes for part classification and coding system.

    (c) Discuss the benefits and problems of implementing Group Technology.