AJAY KUMAR GARG ENGINEERING COLLEGE, GHAZIABAD

Department of Mechanical Engineering.

Model Solution ST-2

Course: B. Tech
Session: 2017-18
Subject: Computer Aided Manufacturing.
Max Marks: 50

Semester: VII
Section: ME, 1, 2, 3
Sub. code: NME-031
Time: 2 HOURS.

SECTION-A

Q.1 Attempt all the parts.

a. Name important elements of NC machine tools.

Ans. NC machine may have following elements.

1. Software
2. Machine control unit
3. Driving Devices.
4. Manual control unit
5. Machine tool.

b. Discuss feedback devices and counting Devices.

Ans. → Feed back devices are class of devices required for close loop operation. They provide a signal back to the drive or motion controller to monitor an operation or process and verify that proper operation occur.

→ Counting Devices counts the input due to events at irregular or regular interval.

c. Enlist any 10 G codes.

Ans → G00 (Rapid positioning), G01 (Linear interpolation), G02 (Clock wise circular interpolation), G03, G04 (Dwell), G05 (High precision control), G07 (imaginary axes), G09 (Exact Stop), G10 (Program data input), G17 (XY plane), G18 (ZX plane).

d. Discuss Encoders and Transducers used in manufacturing industries.

Ans. → Encoder is a sensing device that provides feed back. Encoder converts motion into electrical signals that can be read by some type of control device in a motion control system, such as a counter or PLC.

→ A device that converts variation in physical quantity, such as pressure or brightness into an electrical signal or vice versa.

e. Give limitations of NC machine tools compared to using alternative method.

Ans. Limitation of NC machines -

(I) Machine cost.
(II) Programming Training.
(III) Higher maintenance cost.
(IV) Higher skilled workers.

Benefits of NC machines:-

(I) Runs automatically.
(II) Greater flexibility.
(III) Less machine idle time.
(IV) complex Geometries.
(V) Increased productivity.

Section B.

Q.2. Attempt all parts.

a. Explain the function of MCU in NC machine tools.

Ans. Machine control unit is a heart of a CNC system. It is used to perform the following function

(I) To read the coded instructions.
(II) To decode the coded instructions.
(III) To implement interpolation (Linear, circular etc)
(IV) To feed the axis motion commands to amplifier circuits for driving axis motion.
(V) To receive feedback signals of position and speed for each drive axis.
(VI) To implement auxilary control function such as coolant or spindle on/off tool change.

(b) What is the difference between a closed loop control system and an open-loop control system.

Ans. Dissimalirities of control systems (open loop & closed loop) are:-

(I) Effect of output:-
→ An open loop control system acts completely on the basis of input and output has no effect on the control action.
→ A closed loop control system considers the current output and alters it to the desired condition. The control action in these systems is based on the output.

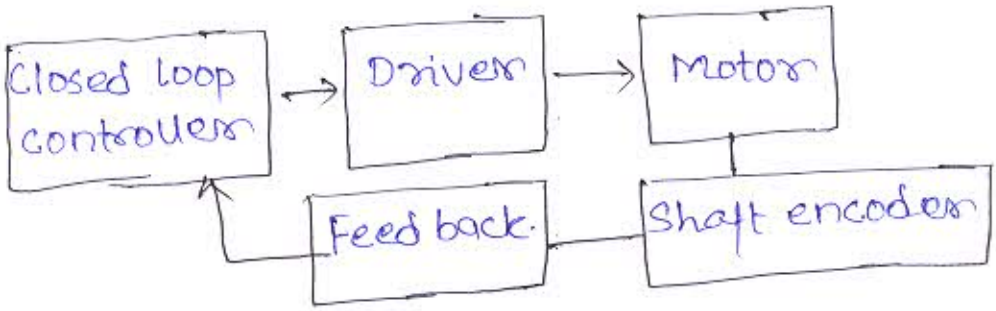
(II) Reaction to internal & External disturbances:-
→ An open loop control system works on fixed operation condition & there is no disturbance.
→ A closed loop control system doesnot encounter and react on external disturbances or internal variations.

3. Stability:-
   → open loop control systems are mostly stable
   → In closed loop control systems stability is a major issue

4. Effect on Gain:-
   → There is no effect on gain.
   → There is no-linear change in system gain.

5.

open loop control system.



closed loop control system.

C. Briefly Describe three phases of analog to digital conversion process with neat block diagram.

Ans. The procedure for converting an analog signal form into digital form consists of following steps-

1. (i) Sensors and Transducers:- It generates analog signal.

   (ii) Signal conditioning:- The continuous analog signal from transducer may require conditioning to render it into more suitable form.

common signal conditioning includes -

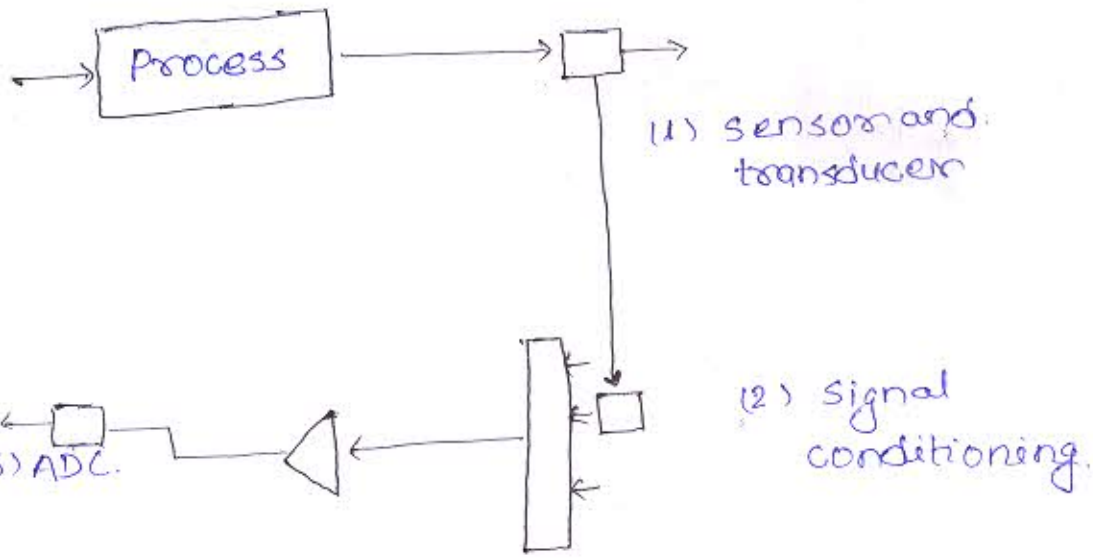
(i) Filtering to remove random noise.

(ii) conversion from one signal form to other.

(iii) Multiplexer:- Multiplexer is a switching device connected in series with each point input channel from the process. it is used to time-share the analog-to-digital converter among input channels.

4. Amplifiers:- Amplifiers are used to scale the incoming signal up or down to be compatible with range of analog to digital converter.

3. Analog to digital converter:- Function of ADC is to convert the incoming analog signal into its digital counterpart.



(4) Amplifiers (3) Multiplexer

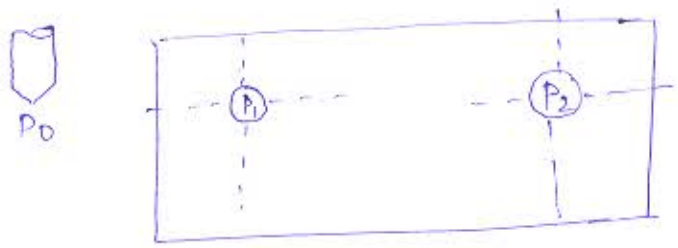
Steps in Analog-to-digital conversion.

Q. Discuss various types of NC motion control systems with the help of suitable diagram.

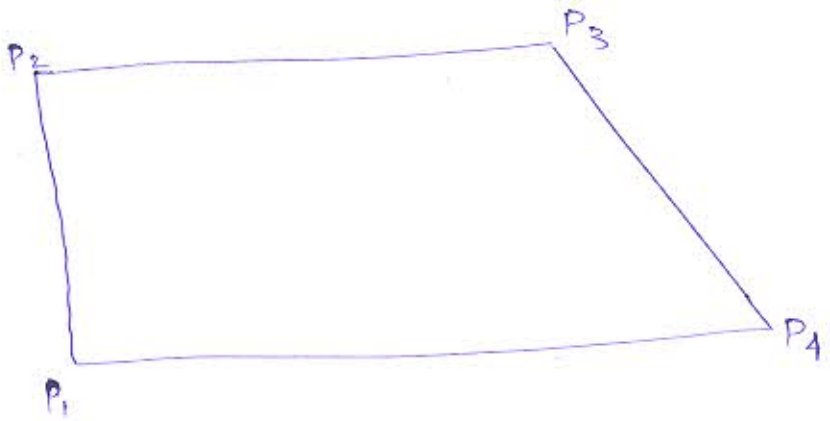
Ans. The cutting tool and work-piece are located at certain position in NC machines. During machining, they are moved from their positions with relation to each other. The system involved in moving cutting tool and the work is known as motion control system.

(i) Point-to-point motion control system:- It is a system in which cutting tool and work are located at particular point in relation to work. Machining is performed only after cutting tool and the work are located at defined positions and there will not be any change in positioning during machining. When machining at particular position is over, the cutting tool or work or both are moved to be relocated to different points for subsequent machining. The NC machines with point to point systems are simple in construction.

(ii) Continuous path motion control system:- In this system, both the cutting tool and work change their positions during machining. The movement of the cutting tool and work is simultaneously in all axes and in all planes each at different speed. This system is also called as contouring system and is mainly used in milling machine.



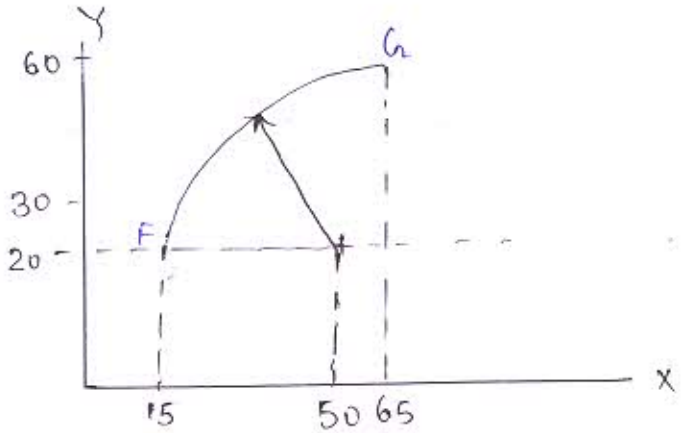
A Job Requiring point to point control.



A Typical component Requiring profiling work.

e. Explain with the help of diagram / Table, the principle of working of a circular interpolator.

Ans.



Circular interpolation: G02/G03.

When an arc is to be traversed in a plane, the function G02 or G03 is used. if the direction of motion is clockwise or anticlockwise respectively. Refferring to fig. when the motion from F to G in XY Plane the program block would be as per ISO.

N010 G02 X65000 Y60000 I35000J-10000F250

But if motion is from G to F then it would be

N010 G03 F X15000 Y30000 I-15000J-40000 F250

Here (X,Y) are the co-ordinates of the destination and (I,J) the distances along Reference axes of the centre of the arc from the starting point of Arc.

Section - C.

Q.3. Attempt all the parts.

a. Write a manual part program for Turning & drilling Operation to make a shaft with dimension shown in figure below from the shaft of diameter 30 mm.

Ans. Turning Programe..

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M47;
G28 U0 W0 ;
T0101 ; (Turning operation)
G0 G97 M03 S1500 X25 Z2.0 ;
M07;
G01 Z-15 F10;
G0 X27 Z-13.0;
Z 2.0;
X 20;
G01 Z-10.0;
G0 X22 Z-8.0;
Z 2.0;
X 13.0;
Z 0.0;
G01 X15. Z-1.0;
Z -10.0;
G02 X25.0, Z-15 R5;
G01 X26.0.
G03 X30; Z-17.0 R2;
G0 X 35.0 Z-15.0,
G28 U0 W0;
M05
T02 02 ; (Drilling operation,
M07;
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G0 G97 M04 S800 X0 Z2.0;

G01 Z-15.0 F0.05;

G0 Z2.0;

G28 U0 W0;

M05;

M09;

M46;

M30;

b) (1) What is adaptive control under what condition adaptive control is recommended? Discuss ACC & ACO types of adaptive control with help of suitable examples.

Ans. Adaptive control implies that the CNC system is responsive to adapt itself to operate at those machining parameters which results into higher productivity.

ACC:- Suppose in a real time situation where, cutting speeds, depth of cuts, go on automatically and constantly adjusting themselves so as to:

(i) use the available spindle power to maximum.

(ii) Limit the deflection of cutter.

(iii) Limit the cutting tool temprature.

(iv) Limit the vibration amplitude of the cutter.

The above mentioned control situation can be named as adaptive control with constraints or ACC.

ACO (Adaptive control optimization):- It determines operating parameters to optimize some production performance criteria or index in the light of constraints Usually this criteria is the ratio of MRR to TWR.

$$\text{Performance index (PI)} = \frac{MRR}{TWR}$$

(ii) Explain following terms related to NC control systems.
Resolution, Accuracy & Repeatability.

Ans:- control Resolution:- It refers to the control systems ability to ~~avoid~~ divide the total range of axes movement into closely spaced points that can be distinguished by the MCU.

Accuracy:- It designates how close a measured value is to the true quantity of what is being measured.

Repeatability:- It describes how well a system or device can reproduce an outcome in unchanged condition.

Configuration of an adaptive control System: