ROLL NO. | | | | | | | | | | |

Internal Assessment Test III

Sub:	Mechatronics					Sub Code:	18ME744	Branch:	ME
Date:	27/1/2022	Duration:	90 min's	Max Marks:	50	Sem / Sec:	A - B		OBE

	Answer any Five Questions	MARKS	CO	RBT
1	Explain processes that occur in signal conditioning & different types of filtering with sketches.	10	C04	L2
2	Explain Data loggers and SCADA with sketches.	10	CO2	L1
3	Explain brush type DC motor & briefly explain brush type with field coil motors.	10	CO2	L1
4	Explain variable reluctance & hybrid stepper motors with sketch.	10	CO2	L2
5	Explain Timers, counters, latching, Internal relays,master jump control in PLC	10	CO4	L2
6	Write a PLC program with data table for extending and retracting of a pneumatic piston with latch..	10	CO4	L3

CI CCI HOD

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SCHEME: Internal Assessment Test III

Sub:	Mechatronics					Sub Code:	18ME744	Branch:	ME	
Date:	20/12/2021	Duration:	90 min's	Max Marks:	50	Sem / Sec:	A - B		OBE	
	Answer any Five Questions							MARKS	CO	RBT
1	Explain different types of friction guideways with sketches. **Sketch: 4 marks** **Explanation: 6 marks**							10	C04	L2
2	Adaptive controllers for machine tools with their functions and a sketch. **Define: 3** **Diagram: 7**							10	CO5	L1
3	Explain with a sketch recirculating ball screws and its threadforms. **Sketch: 4 marks** **Explanation: 6 marks**							10	CO5	L1
4	Explain the mechatronic design process with a sketch and give 4 differences between conventional and mechatronic design. **Sketch: 2 marks** **Difference: 4** **Explanation: 4 marks**							10	CO5	L2
5	Explain the steps in drawing a PLC ladder diagram and explain the components. **Each point: 1 marks each**							10	CO4	L1,
6	Explain construction and working of LVDT & potentiometer with sketch. **Sketch: 4 marks** **Explanation: 6 marks**							10	CO1	L2

SOLUTION : Internal Assessment Test I

Sub:	Mechatronics					Sub Code:	18ME744	Branch:	ME
Date:	20/12/2021	Duration:	90 min's	Max Marks:	50	Sem / Sec:	A - B		OBE

1. Different types of friction guideways are;

   o Vee Guideways o Flat and Dovetail Guideways o Cylindrical Guideways

   The vee or inverted vee is widely used on machine tools, especially on lathe beds. One of the advantages of vee or inverted vee is that the parallel alignment of the guideway with the spindle axis is not affected by wear. There is a closing action as the upper member settles on the lower member, and this automatically maintains the alignment. Jibs are, therefore, not required with the vee guideway to take up the clearance caused by wear. On some machines, the angles of the vee are different so as to reduce the possibility of uneven wearing of vee sides. The majority of lathes have a combination of vee and flat guideways to prevent the carriage from lifting of the guideway.

   Flat or dovetail forms are commonly used in CNC machine tools. The flat guideways have better load – bearing capabilities than the other guideways. Jibs are used to ensure accurate fitting of the slide to both the flat and dovetail guideways. The jibs are tapered and can be adjusted to reduce excessive clearance caused by wear. The metal to metal contact on the vee, flat and dovetail types of guideway is normally cast iron to cast iron. The cast iron may be heat treated to increase its hardness and the surfaces ground to obtain the required accuracy.

   In cylindrical guideways, the bore in the carriage housing provides support all around the guideway. For relatively short traverse and light loads, cylindrical guideways are very efficient. A limitation on the use of these guideways for long traverse is that if the guide bar is supported only at each end, it may sag or bend in the centre of the span under a load.

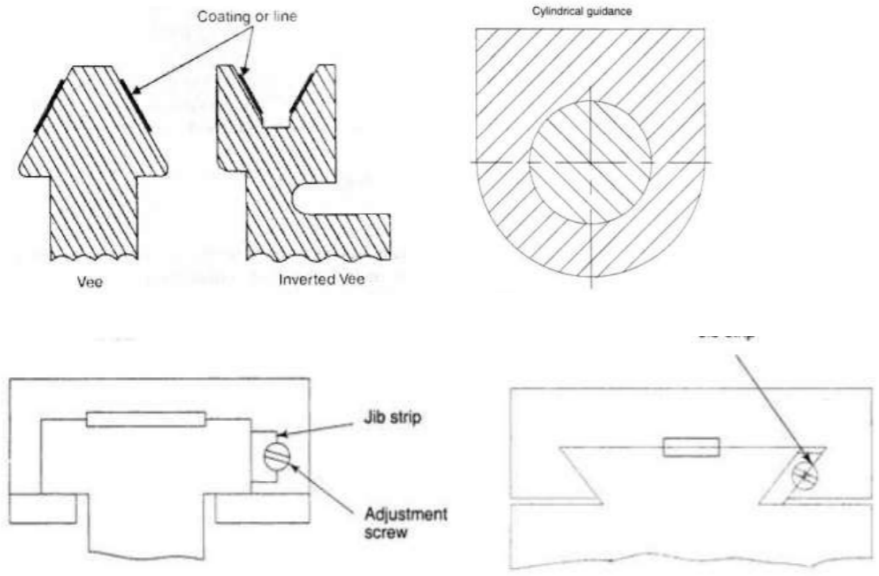
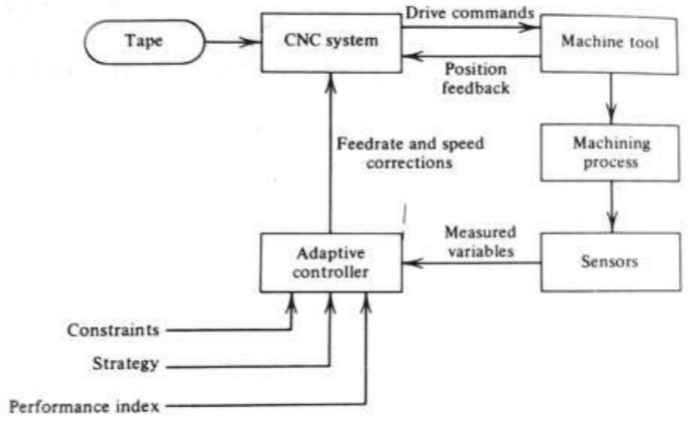


Fig 4.4 Flat and Dovetail Guideway

2. 

For a machining operation the term AC denotes control systems that measures certain output variables and uses to control speed or feed. Some of the process variables that have been used in AC machining systems include spindle deflection or force, torque, cutting temperature and horse power. The adaptive control is basically a feedback system that treats the CNC as an internal unit and in which the machining variables automatically adapt themselves to the actual conditions of the machining process. IP (Performance Index) - is usually an economic function such as max production rate or minimum machining cost. Adaptive control is not suitable for every machining situation. In general, the following characteristics can be used to identify situations where adaptive control can be beneficially applied. o The in-process time consumes a significant portion of the machining cycle time. o There are significant sources of variability in the job for which AC can compensate. o The cost of operating the machine tool is high. o The typical jobs involve steels, titanium and high strength alloys.

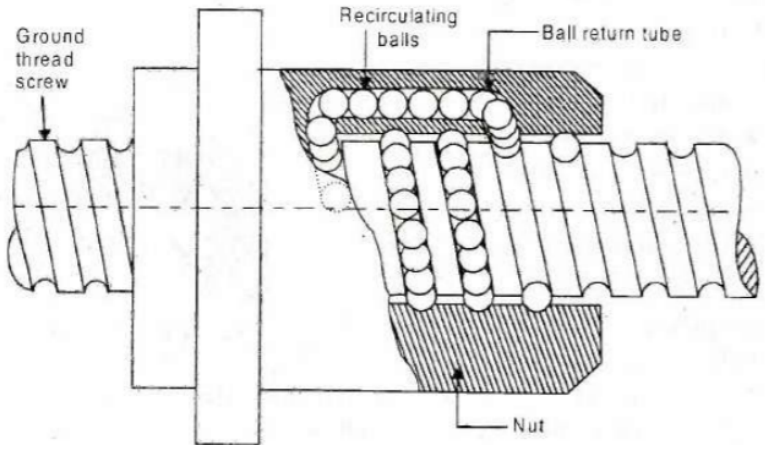
FUNCTIONS OF ADAPTIVE CONTROL

The three functions of adaptive control are:

o Identification function o Decision function o Modification function

The main idea of AC is the improvement of the cutting process by automatic on line determination of speed and/or cutting. The AC is basically a feedback system in which cutting speed and feed automatically adapt themselves to the actual condition of the process and are varied accordingly to the changes in the work conditions as work progresses. Identification Function: This involves determining the current performance of the process or system. The identification function is concerned with determining the current value of this performance measure by making use of the feedback data from the process. Decision Function: Once the system performance is determined, the next function is to decide how the control mechanism should be adjusted to improve process performance. The decision procedure is carried out by means of a pre-programmed logic provided by the designer Modification Function The third AC function is to implement the decision. While the decision function is a logic function, modification is concerned with a physical or mechanical change in the system.

3.



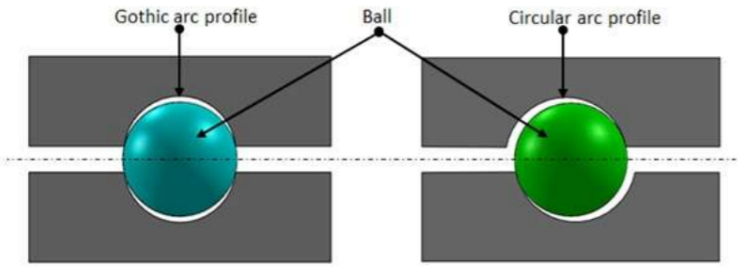


Fig 4.16 Thread Forms Used in Recirculating Ball Screws

In ball screws, the sliding friction encountered in conventional screws and nuts is replaced by rolling friction in a manner analogous to the replacement of simple journal bearings by ball bearings. Two types of thread forms are used on these screws. They are gothic arc and circular arc

The efficiency of the recirculating ball screw is of the order of 90% and is obtained by the balls providing rolling motion between the screw and the nut. The mounting arrangement of ball screw depends on its required speed, length and size.

Recirculating arrangements:

The balls rotate between the screw and the nut, and at some point are returned to the start of the thread in the nut. Two types of arrangements are there; Recirculation through an external tube – the balls at the end of the thread will be picked up by a return tube which recirculates the balls to the beginning of the load zone by providing continuous rolling motion Recirculation through an insert channel – the balls are returned to the start through a channel inside the nut.

Advantages:

o Low frictional resistance

o Low drive power requirement

o Little temperature rise

o Less wear and longer life

o No stick – slip effect

o High traverse speed

o High efficiency

4. The design of mechatronic systems can be divided into a number of stages.

1. The Need: The design process starts with the needs of a customer. By adequate market research and knowledge, the potential needs of a customer can be clearly identified. In some cases, companies may create a market need but failures are more in this area. Hence, market research technology is necessary.

2. Analysis of the Problem: This is the first stage and also the critical stage in the design process. After knowing the customer's needs, analysis should be done to know the true nature of the problem. Shady, to define a problem accurately, analysis should be done carefully otherwise. The design leads to waste of time and may not fulfill the need.

3. Preparation of a Specification: The second stage of the mechatronic process involves the preparation of a specification. The specification must be given to understand everyone the requirements and functions to be met. The specification might have the statements about mass dimensions, types, accuracy, input/output requirements, interfaces, power requirements, operating environment, relevant standards and codes of practice, space requirements and constraints payload, velocities and speed of motion, accelerations, resolution, control functions, life etc.

4. Conceptualization: In this stage, possible solutions should be generated for each of the functions required. Such as shape, size, material cost etc. It should be possible to think of at least six solutions for realizing each function. For obtaining a solution, similar problems that are solved linearly days are compared or newly generated techniques may be used

5. Optimization: This stage involves a selection of the best solution for the problem. Optimization is defined as a technique in which a best solution is selected among a group of solutions to solve a problem. The various possible solutions are evaluated and the most suitable solution is selected.

6. Detail Design: Once optimizing a solution is completed, the detailed design of that solution is developed. This may require a production of prototype etc. Mechanical layout is to be made whether physically all components can be accommodated. Also whether components are accessible for replacement/ maintenance is to be checked.

7. Production of working Drawings: The selected design or solution is then translated into working drawings, circuit diagrams, etc. So that the item can be made. Drawings also include the manufacturing tolerances for each component.

Traditional approach	Mechatronics approach
Bulky system	Compact
It is a complex process involving interactions between many skills and disciplines.	It is the basic of integration of various emerging technology with mechanical engineering
The control is accomplished by manually.	A microprocessor is used a controller by programming it.
Complex mechanisms	Simplified mechanism may transferred to the software through programs.
Non-adjustable movement cycles	Programmed movements
Constant speed drives	Variable speed drives
Mechanical Synchronization	Electronic Synchronization
Rigid heavy structures	Lighter Structures.
Accuracy determined by tolerance of mechanism	Accuracy achieved by feedback
Flexibility is less	Flexibility is more.
Less accurate	More accurate.
It consists of more components and moving parts.	It involves less components and moving parts
Less cost	High cost.

Rails – There are two rails in a ladder diagram which are drawn as vertical lines running down the far most ends of the page. If they were in a relay logic circuit they

would represent the active and zero volt connections of the power supply where the power flow goes from the left hand side to the right hand side.

Rungs – The rungs are drawn as horizontal lines and connect the rails to the logic expressions. If they were in a relay logic circuit they would represent the wires that connect the power supply to the switching and relay components. Each rung is numbered in ascending sequential order.

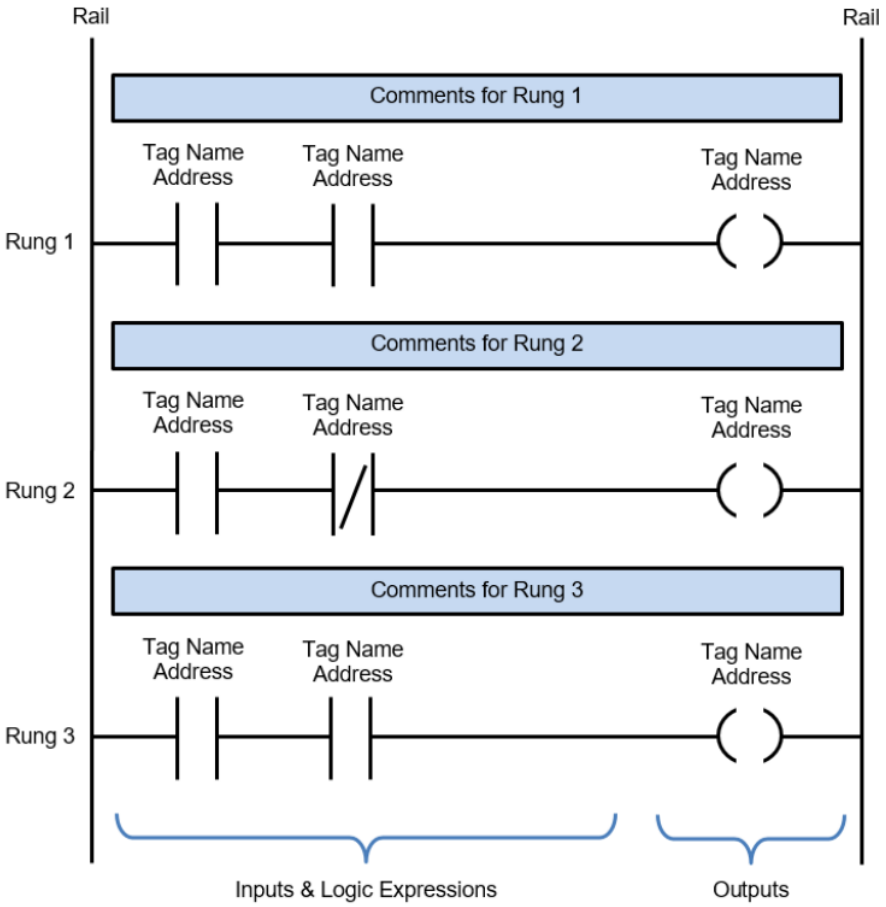
Inputs – The inputs are external control actions such as a push button being pressed or a limit switch being triggered. The inputs are actually hardwired to the PLC terminals and represented in the ladder diagram by a normally open (NO) or normally closed (NC) contact symbol.

Outputs – The outputs are external devices that being are turned on and off such as an electric motor or a solenoid valve. The outputs are also hardwired to the PLC terminals and are represented in the ladder diagram by a relay coil symbol.

Logic Expressions – The logic expressions are used in combination with the inputs and outputs to formulate the desired control operations.

Address Notation & Tag Names – The address notation describes the input, output and logic expression memory addressing structure of the PLC. The tag names are the descriptions allocated to the addresses.

Comments – Last but by not least, the comments are an extremely important part of a ladder diagram. Comments are displayed at the start of each rung and are used to describe the logical expressions and control operations that the rung, or groups of rungs, are executing. Understanding ladder diagrams is made a lot easier by using comments.


Rail
Rail
Comments for Rung 1
Tag Name
Address
Tag Name
Address
Tag Name
Address
Rung 1
Comments for Rung 2
Tag Name
Address
Tag Name
Address
Tag Name
Address
Rung 2
Comments for Rung 3
Tag Name
Address
Tag Name
Address
Tag Name
Address
Rung 3
Inputs & Logic Expressions
Outputs