MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2013 Certified)

WINTER – 19 EXAMINATION

Subject Name: Advanced manufacturing process **Model Answer** Subject Code: **22563**

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No.	Sub Q. N.	Answer	Marking Scheme
1		**Attempt any FIVE of the following**	10
	a)	**Enlist any four process parameters in EDM** Ans: Process parameters in EDM are: 1. Peak current 2. Peak Voltage 3. Spark gap 4. Pulse duration 5. Dielectric pressure 6. Material removal rate (MRR) 7. Polarity	1 process parameter = 1/2 marks
	b)	**State the equation of cutting speed for milling operation** Ans: The equation for cutting speed for milling calculation is $Cutting\ Speed = \frac{\pi\, dn}{100}\ m/min$ Where d= diameter of cutter(m) ,N= Cutter speed (RPM)	Correct equation with meaning= 2 marks
	c)	**List the various gear finishing methods** Ans: Gear finishing methods: 1. Gear shaving 2. Gear grinding 3.Gear Honing 4. Gear lapping 5. Gear burnishing	2 methods= 1 mark
	d)	**Name the basic components of CNC machine** Ans: Basic components of CNC machine are 1) Input device 2. Control unit 3. Drives for spindle/table slides 4. Machine tool 5. Feedback system	4 basic components =2 marks

Q. No.	Sub Q. N.	Answer	Marking Scheme
	e)	**Write only classification of CNC machines.** Ans: Classification of CNC machines 1. As per feedback system : a) Open loop Type b) Closed loop type 2. As per motion control : a) Point to point path motion b) Continuous path motion 3. As per application: a) CNC milling b) CNC Turning c) CNC drilling	Classification on any one basis = 2 marks
	f)	**Write meaning of following G and M codes** Ans: 1. G02 : Circular interpolation clockwise 2. M30: Program end , reset to start	1 meaning= 1 mark
	g)	**State any two examples of fixed automation** Ans: Examples of fixed automation are a. Transfer lines used in automotive industry b. Automatic assembly machines or systems installed for assembly without need of human being c. Industrial robots installed or fixed for performing repetitive operations	Two examples=2 mark
Q.2		**Attempt any THREE of the following**	12
	a)	**Explain the purpose of electrolyte in ECM.** Ans: Purpose of electrolyte in ECM process 1. It is conductive medium without which ECM process cannot be performed. 2. It carries the current between the tool and the work piece. 3. It removes the particles of ECM process from the cutting region It helps to remove heat produced by the current flow in the operation	4 points= 4 marks

b) Ans

Compare between Vertical and horizontal milling machine

Parameter	Vertical milling	Horizontal milling
1. Position of arbor	It is mounted vertically	It is mounted horizontally
2. Spindle and worktable	Spindle is vertical and perpendicular to the work table	Spindle is horizontal and parallel to the work table
3.Cutter movement	It can be moved up and down.	It can be moved up and down.
4.spindle tilting	It can be tilted for angular milling operations	It cannot be tilted
5.Opertions	Angular milling, slot milling, T- slot milling, flat milling, etc	Plain milling, gear cutting, form milling, gang milling, etc

4 points= 4 marks

C)

Describe Automatic tool changer (ATC) of CNC machine

Ans:

Concept of Automatic tool changer (ATC):

1. Tool changing in CNC machines is carried out automatically by using Automatic tool changer according to the sequence of operations given in the part program
2. Tool magazine is provided with various tools mounted sequentially and identified by specific tool number which helps for tool changing using ATC

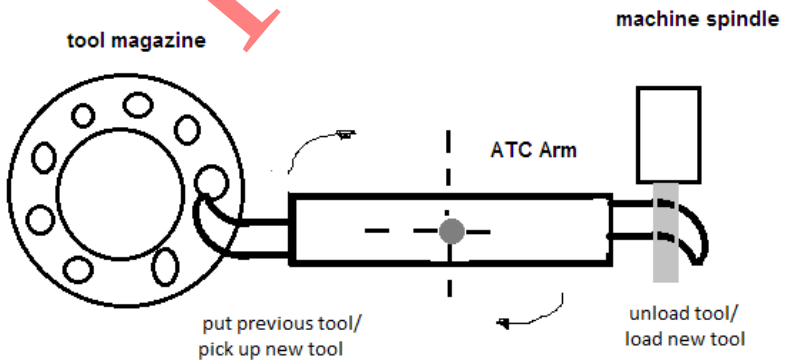


Fig. Automatic tool changer

concept -2 Marks

Function : 2 marks

Function of automatic tool changer:

1. It will improve the production rate and tool carrying capacity of the machine.
2. It will help to save time required for changing tools as per number of operations to be performed on the work piece.
3. It will automatically unload the tool from the spindle of machine and load the new cutting tool from tool magazine using tool changing arm.
4. The arm of ATC can be rotated through 180 degree to unload the tool from

spindle and put this tool in the tool magazine.
5. In the next rotation it will hold the tool from tool magazine and load it in the machine spindle.

d) **Justify the need of tool length compensation of CNC machine**

Ans:

1. Tool used in CNC machines may have difference in their lengths and during programming it will be difficult to specify coordinates as per tool length of individual tools, hence tool length compensation is required.
2. During programming when tools are changed , any variation in tool length will throw the origin out of zero, to prevent this tool length compensation is required

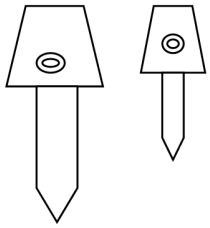


Fig. tools of different lengths

3. It is the procedure to mention the difference in length of tool assumed during programming and actual tool used for machining for error free programming of CNC.
4. The standard tool length is used as a reference during programming and length of various tools was measured in advance to specify difference in length of standard tool and actual tool in the form of tool length compensation.
5. It will help easy programming without making changes in the program even if tool is changed.

4 points : 4 marks

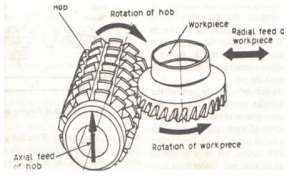
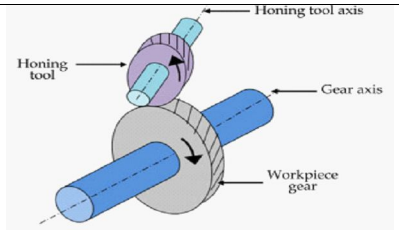
3 **Attempt any THREE of the following** 12

a) **Differentiate between gear hobbing and gear honing**

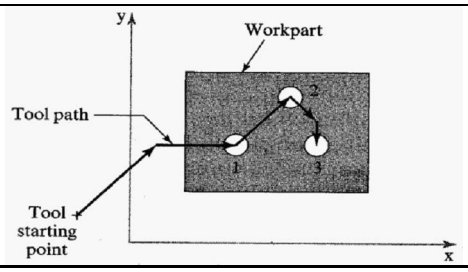
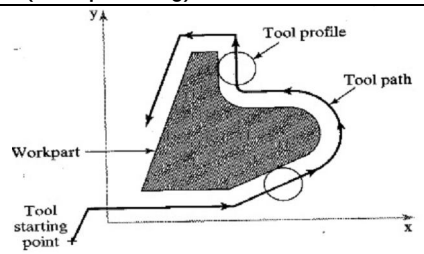
Ans

S. N.	Gear Hobbing	Gear Honing
1	It is gear manufacturing method	It is gear finishing method.
2	Cutting tool known as hob is used	Honing stones are used as cutter.
3	The direction of feed of the hob can be achieved in three ways.	The honing tool traverses back and forth in parallel path to the work gear axis.
4	Hob and workpiece gear are indexed independently.	The honing tool drives the work gear.
5	Material removal rate is high.	Material removal rate is low.
6	It is carried out before hardening of gear.	It is carried out after hardening of gear.
7	It is used for manufacturing of gear teeth.	It is used for superfinishing of gear teeth.
8	Higher depth of cut.	Lower depth of cut.
9	Poor surface finish.	Good surface finish.
10	Poor dimensional accuracy.	High dimensional accuracy.
11	Poor Tolerance	Close tolerance,

Any For Points = 01 Mark Each

12	Higher load on cutter(Hob)	Lower load on Cutter (Honing Tool)
13	Higher feed rate.	Lower feed rate.
14		

b) Ans **Compare "Point to Point" and continuous path CNC machine**

S. N.	Point to Point	Continuous Path
1	The primary function of point to point path control system, is to move a cutting tool form one point location to another predefined point on the worktable	Contouring system generates a continuously controlled tool path by the capability of computing the points of the path
2	It is the cheapest tool control system	It is the most expensive.
3	It is generally used for hole operations such as drilling, boring, reaming, tapping and punching.	Contouring system had the ability to perform linear and circular or parabolic interpolation.
4	It is the lowest level of motion control between the tool and workpiece.	It is the highest level of control between the tool and workpiece.
5	Point-to-point (PTP) is also sometimes called a positioning system.	Continuous Path is also called Contouring path system.
6	It is simple and easy.	Contouring is the most complex
7	Only two axis movement can complete PTP operation.	Simultaneous movement of more than one axis movement can take place to complete the operation.
8	It is not capable to perform Contouring operations.	It is capable of performing both PTP and straight-cut operations.
9	No cutting is performed between holes, there is no need for controlling the relative motion of the tool and workpiece between hole locations	Contouring system generates a continuously controlled tool path by the capability of computing the points of the path (interpolating).
10		

Any Four = 01 Mark Each.

c) Ans **Explain the meaning of following block format of CNC.**
N020 G03 X12 Y14 Z-0.5 I0 J12 EOB

N0020 – Block Number.
G03 – Circular interpolation (Counter- Clockwise).
X12 – X coordinate of the arc end point = 12.
Y14 – Y coordinate of the arc end point = 14.
Z-0.5 – Depth of Cut in Z - Direction= 0.5.
I0 – Distance along X – axis from the arc start point to the arc center point = 0.
J12 – Distance along Y – axis from the arc start point to the arc center point = 12.

Correct Ans. = ½ Mark Each

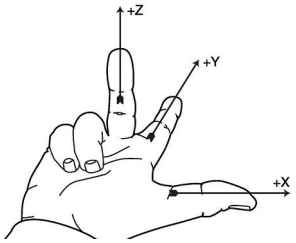
		EOB – End of Block.	
	d) Ans	**Describe fixed and programmable automation0** **Fixed Automation (Hard automation):** Fixed automation refers to the use of special purpose equipment to automate a fixed sequence of processing or assembly operations. Each of the operation in the sequence is usually simple, involving perhaps a plain linear or rotational motion or an uncomplicated combination of two. It is relatively difficult to accommodate changes in the product design. **Advantages:** 1. Low unit cost 2. Automated material handling 3. High production rate. **Disadvantages:** 1. High initial Investment 2. Relatively inflexible in accommodating product changes. **Examples:** Transfer Lines, Assembly lines etc. **Programmable Automation:** In programmable automation, the production equipment is designed with the capability to change the sequence of operations to accommodate different product configurations. The operation sequence is controlled by a program, which is a set of instructions coded. So that they can be read and interpreted by the system. New programs can be prepared and entered into the equipment to produce new products. **Example:** Numerical controlled machine tools, industrial robots and programmable logic controller **Advantages:** 1. Flexible to deal with design variations. 2. Suitable for batch production. **Disadvantages:** 1. High investment in general purpos equipment 2. Lower production rate than fixe automation.	**02 Marks** **02 Marks**
4		**Attempt any THREE of the following:**	**12**
	a) Ans	**Classify the different methods of gear manufacturing.** **Classification of Gear Manufacturing Methods:** **A) Cutter Method** 1) By formed disc cutter in milling machine 2) By formed end mill 3) By formed single point cutting tool 4) By formed cutter in a shear speed gear shaper 5) By formed cutter in a broaching machine **B) Template method in gear cutting machine** **C) Generating method** 1) By rack tooth cutter in gear cutting machine 2) By a pinion cutter in gear cutting machine 3) By a hob cutter 4) By Bevel gear genarator **D) Casting** 1) Sandcasting 2) Die casting 3) Investment casting **E) Stamping** **F) Powder metallurgy**	**Correct Answer = 04 Marks**

G) Plastic molding
H) Extruding

b) Ans

Apply right hand rule for axes identification of CNC vertical milling with neat diagram

Right Hand Rule for Axes Identification of CNC Vertical Milling :



The main axis of movement and the direction of movement along this axis is identified as follows:

Z- Axis: The Z- axis motion is always the axis of the main spindle of the machine. It does not matter whether the spindle carries the work piece or the cutting tool. On vertical machines the Z-axis is vertical. Positive Z movement is in the direction is towards the tip of middle finger.

X-Axis: The X-axis is always horizontal and parallel to the work holding surface. If the Z-axis is vertical in vertical milling machine, positive X-axis movement is identified as being to the tip of thumb.

Y-Axis: The Y-axis is always at right angle to both the X-axis and Z-axis. Positive Y-axis movement is identified as being to the tip of Fore finger.

A- Axis: Direction of curled finger about X – axis is rotary motion along X-axis is consider as positive.

B- Axis: Direction of curled finger about Y – axis is rotary motion along Y-axis is consider as positive.

C- Axis: Direction of curled finger about Z– axis is rotary motion along Z-axis is consider as positive.

Sketch 01 Mark

&

Explanation = 03 Marks

c) Ans

Calculate the cutting parameters and prepare process sheet for the component shown in Fig. No. 1 with neat diagram. All the dimensions are in mm.
Given: Raw material - Aluminium, Stock Size – Dia.14 X 42 length, Feed (*f*) = 0.2 mm/rev., Cutting Speed (V) = 90 m/min., Consider work zero (W) as per Fig. No. 1.

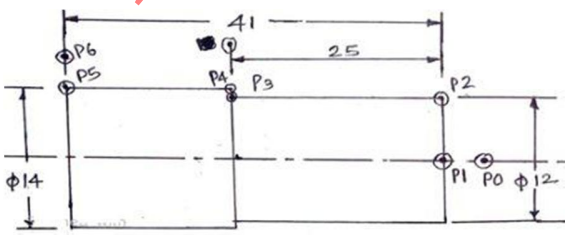


Figure No. 1

Given Data:
V = 90 m/min., *f* = 0.2 mm/rev., D = 14 mm, Depth of cut, d_c = 1 mm, Length of Cut, *l*= 25 mm
Cutting Parameters:
Spindle Speed: V = πDN/1000
N = 2043 rpm.
Feed: *f* = 0.2 mm/rev.
Depth of Cut: d_c = 1 mm

01 Mark for Calculation and 03 Marks for Process Sheet

		Part Name:- *Question No. 4 (c)*			**Name of Operator:-**		
		Part Material:- *Aluminium*			**Name of Machine :-** *Centre Lathe*		
		Part No.:- *Figure No. 1*			**Part Size:-** *Dia. 14 X 42 Length.*		
		Operation No.	**Description**	**Machine Tool**	**Tools / Fixture**	**Spindle Speed in rpm.**	**Feed in mm/rev.**	**Depth of Cut in mm**
		1	Clamp the blank in chuck	Cetre Lathe	3 jaw chuck,			
		2	Facing Operation	Cetre Lathe	Single point cutting tool. (Facing Tool)	2043	0.2	1
		3	Turning	Cetre Lathe	Single point cutting tool. (Turning tool)	2043	0.2	1
		4	Unloading Job		Chuck Key			

d) Ans

Develop full G and M code manual part program of CNC lathe for the component shown in Fig. No. 1 using word address format (WAF).

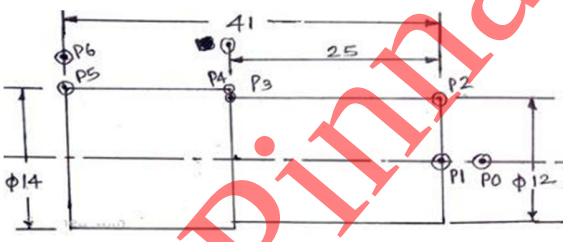


Figure No. 1

Point	X	Z
P0	0.0	2.0
P1	0.0	0.0
P2	12.0	0.0
P3	12.0	-25.0
P4	14.0	-25.0
P5	14.0	-41.0
P6	20.0	-41.0

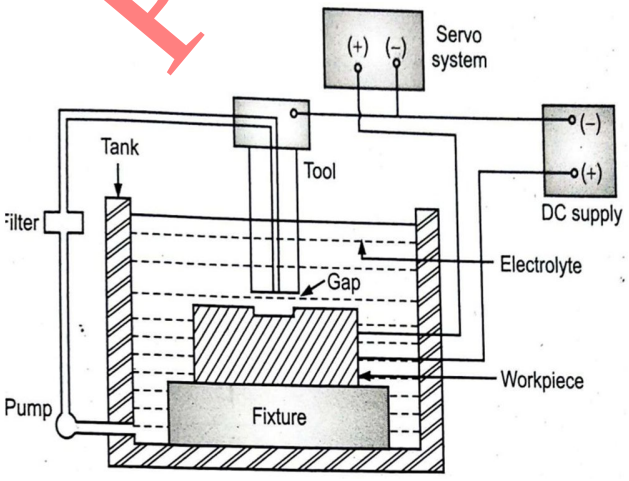
O1234;
N001 G28 U0.0 W0.0;
N002 G90 G21 G95;
N003 M03 S2043 M08;
N004 G00 X0.0 Z2.0;
N005 G01 X0.0 Z0.0 F0.2;
N006 G01 X12.0 Z0.0;
N007 G01 X12.0 Z -25.0;
N008 G01 X14.0 Z -25.0;
N009 G01 X14.0 Z -41.0;
N010 G01 X20.0 Z -41.0;
N011 G28 U0.0 W0.0;
N012 M05;
N013 M09;
N014 M30;

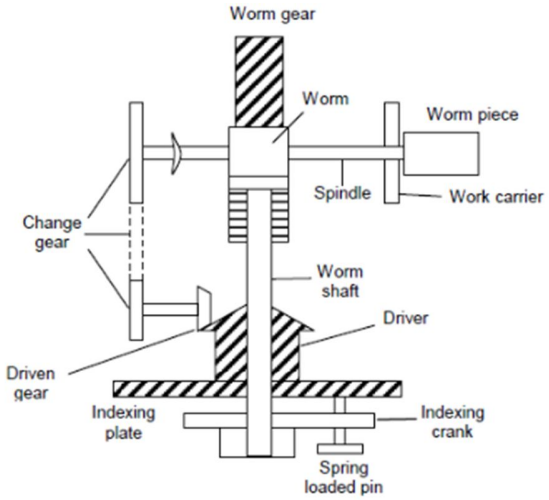
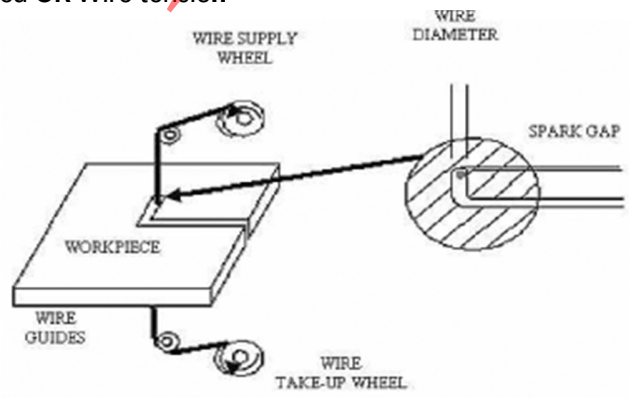
Correct Answer = 04 Marks

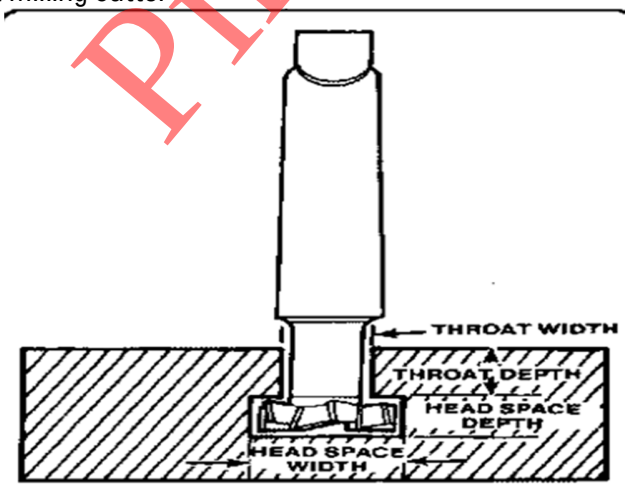
e) Ans

Justify the need of Group Technology in today's manufacturing situation

Group technology is an approach to organizing manufacture which can be applied in any industry (machining, welding, foundry, press work, forging, plastic molding, etc.) where small-

		batch variety production is used. The basic approach enables all aspects of manufacturing, from design, through estimating and planning, to production, to be rationalized. It forms the basis for the development of computer-aided procedures and flexible automation. Group technology is a manufacturing philosophy or principle whose basic concept is to identify and bring together related or similar parts and processes, to take advantage of the similarities which exist, during all stages of design and manufacture. **Advantages of Group Technology:** The following are the advantages of introducing GT in manufacturing: 1. Work in progress and finished stock levels are re-duced. 2. Simplified estimating, accounting and work man-agement. 3. Improved plant replacement decisions, and. 4. Improved job satisfaction, morale, and communica-tion. 5. Short throughput times because machines are closed together. 6. Better quality because the group complete parts and the machines are closed together under one foreman. 7. Lower material handling costs because machines are closed together under one foreman. 8. Better accountability because of machines complete parts. 9. The foreman can be made responsible for costs, quality, and completion by the due date. 10. Training for promotion since GT provides a line of succession because a group is a mini-department. 11. Automation GT is the first evolutionary step in automation. 12. Reduced set up time since similar parts brought together on the same. 13. Morale and job satisfaction since most workers prefer to work in groups. The output is improved due to improved resource utilization.	**Any Four Advantages = 01 Mark Each.**
5		**Attempt any <u>TWO</u> of the following**	**12**
	a) Ans	**Draw set up diagram of ECM processes showing all the elements. State the function of each element**  **Functions of each element:-** [1] Fixture :- To hold the work piece rigidly and securely [2] DC Supply :- To supply current to cathode and anode [3] Tank :- To store the electrolyte [4] Tool (Cathode) :- To remove the material by controlled dissolution of anode	2 Marks for diagram And 1 mark each for any 4 correct function of elements

		[5] Servo system :- To circulate the electrolyte	
	b) Ans	**Draw internal mechanism of universal dividing head and label the parts**  **Figure:- Internal Mechanism of Universal Dividing Head**	4 Marks for neat diagram And 2 Marks for labeling
	c) Ans	**Explain need of virtual CNC machine simulators** **Need of Virtual CNC Machine Simulator:-** [1] Manufacturing process can be defined and verified in early stage [2] allows designers to conduct machining process planning, generating tool path [3] easy to visualize the process and simulate operations [4] Automatically calculate machining time [5] The tool path generated can be converted into CNC codes [6] Editing in the program is easy sue to prior information [7] Errors can be found out easily [8] Provides analysis features	1 Mark each for any 6 correct points
6		**Attempt any TWO of the following**	12
	a) Ans	**Draw a set up diagram of wire cut EDM and label the parts, also suggest the approximate range of following process parameters with its measuring units** **(i)** Discharge current **OR** Pulse frequency **(ii)** Wire speed **OR** Wire tension  **Figure 1. Details of WEDM Cutting Gap.** **(i) Discharge current OR Pulse frequency** Discharge current is limited to 30 A Pulse frequency is about 1 MHz **(ii) Wire speed OR Wire tension** Wire speed is about 2.5 to 150 mm/s	3 Marks for neat diagram and 1 mark for labeling 1 mark for any 1 correct point 1 mark for any 1 correct point

		Wire tension is about 50 – 60 % of tensile strength of wire	
	b) Ans	**Apply compound indexing method to divide 51 divisions on circular blank** Index crank movement (T) = 40 /N Where , N = No of divisions required T = 40 / 51 Let's try circle17 and 18 holes Factors of divisions required **x** factors of difference of hole circles Factors of 40 **x** Factors of first circle **x** Factors of second circle = 3 x 17 x 1 10 x 4 x 17 x 3 x 6 = 1 / 240 As all the factors from numerator can be cancelled we can select the 17 and 18 hole circle plate 240 / 17 – 240 / 18 **OR** 240 / 18 – 240 / 17 14 x 2 / 17 – 13 x 6 / 18 **OR** 13 x 6 / 18 – 14 x 2 / 17 **The above equation can be written as = 2 / 17 + 12 / 18 OR -12 / 18 – 2 / 17** Similar signs show that both the movements will be in the same direction. By adopting the first result we get the required movement.	2 Marks for formula 4 Marks for correct stepwise answer
	c) Ans	**Use the different milling cutter to cut T Slot on rectangular block with neat diagram also mention the sequence of operations and types of milling cutter used** **[1] T Slot cutter** Different milling cutter used for the T slot Milling [1] End milling cutter / Plain milling cutter [2] Special type T Slot Milling Cutter  **Figure :- T Slot Milling Operation** **Sequence of Operation** [1]]Using plain / end milling cutter plain slots are produced [2] The T slot cutter is used to enlarge and face the bottom of the slots	2 Marks for neat diagram 2 Marks for Sequence of operation