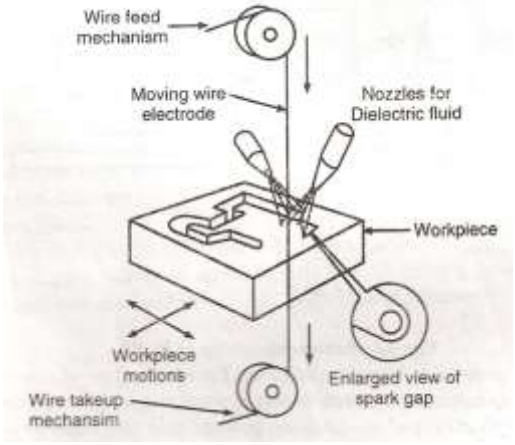
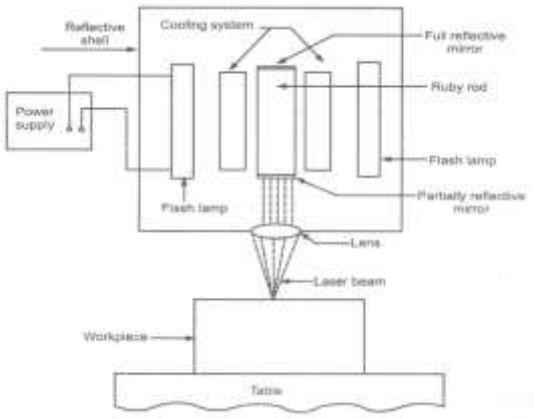
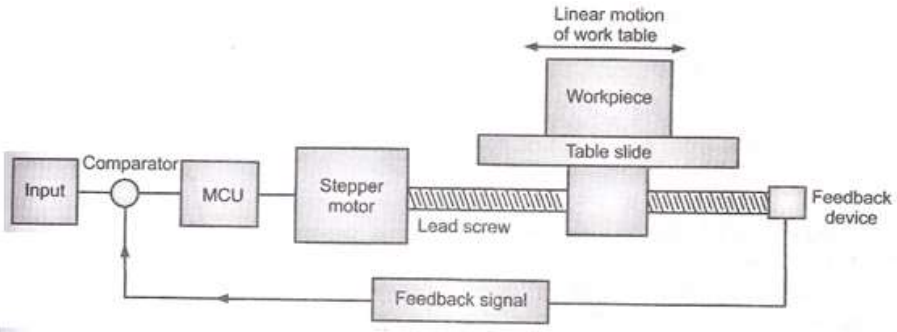
Important Instructions to examiners:

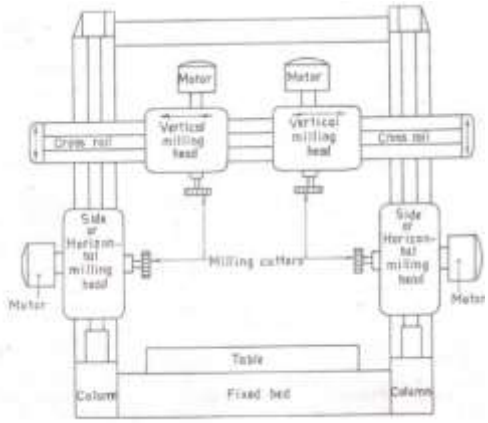
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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	Bit No.	Description/ Answer	Marks
Q1	a.	**Attempt any Three of the Following**	12
	i)	**i) State the need and importance of non – traditional machining process.** **(Two point each)** Need of non – traditional machining process. (1) The need to shape new metal alloys and non-metals that are difficult to machine by conventional processes; (2) The requirement of unusual and complex workpart geometries. (3) The need to avoid surface damage which is often associated with conventional machining Importance of Nontraditional Machining process. 1. Material removal may occur with chip formation or even no chip formation may take place. 2. In NTM, there may not be a physical tool present. 3. In NTM, the tool need not be harder than the work piece material. 4. Mostly NTM processes do not necessarily use mechanical energy to provide material removal. **5.** They use different energy domains to provide machining.	**Any 2 2 marks** **Any 2 2 marks**
	ii	**ii) Explain the working of wire-cut EDM process with neat sketch.**	**Fig 02 Marks** **02**

			Marks
		 The basic mechanism of metal removal in WEDM is identical to that in die sinking type EDM. Instead of moving electrode, the electrode in this process is a moving wire of CU or brass. A vertically oriented wire is fed into the work piece continuously travelling from a supply spool to take a spool, so that it is continuously renewed , since it will get worn out during the process.	
	iii	**iii) State the meaning of G03 , G40, M03, M06** Codes in part programming – Meaning G03 – Circular interpolation Anticlockwise G40 – Cutter diameter compensation Cancel M03 – Spindle start Clockwise M06 – Tool Change	**Each 1 Marks**
	iv	**iv) Write down the classification of boring machine.** 1.Horizontal Boring Machine - Table type - Floor Type - Planer Type 2. Vertical Boring Machine - Stander vertical Boring Machine -Vertical Turret lathe 3. Jig Boring Machine 4. Precision boring machine.	**4 Marks**
1	**b.**	**Attempt any ONE of the following**	**6**

		i) Describe the working of LBM with neat sketch. State any two advantages of LBM.	**02 marks**
			
		Laser(amplification of light by stimulated emission of radiation) beam machining set up consists of a stiumulating light source and a laser rod. The light radiated from the flash lamp is focused on to the laser rod from where it is reflected and accelerated in the path. This light is emitted in the form of divergent beam. A lens is incorporated in the path of this beam of light which converges and focuses the light beam on to the workpiece to be machined. This concentration of laser beam on the work piece melts the work material & vapourises it.	**02 marks**
		Advantages 1. Good Surface finish with accurate profile can be obtained. 2. Extremely hard and brittle material can be easily machine. 3. Conducting as well as non - conducting material can be machined. **4.** Any complicated shape can be produced.	**02 marks**
		ii) State the importance of dry run in CNC machine, Enlist the safty procedures to be followed while using CNC machine.	
		importance of dry run in CNC	**02 marks**
		It is the trial run without actual running of CNC machine for checking correct shape of the component. It shows correctness of the steps given in the program. It give idea about the tool impact collision with the chuck and other machine parts due to incorrect program.	
		Safty procedures to be followed while using CNC machine.	
		1. Operators Should Have Proper Training	
		Computer Numerical Control (CNC) machining involves a technical process of controlling the motion of parts and tools through a computer software that uses numeric data. Whether a CNC shop has mills or lathes, the operators must be adequately trained to inspect, maintain, and use the machine, brand, and controller type. Being skilled in the programming of CAD and CAM programs is also essential for experienced users.	**4 marks**
		2. The Area Around the Machine Must Be Free of Obstacles	

		Before a machining or tooling process is initiated, the machinist must inspect the machine to remove any obstacles that may fly off and hit someone. The user must check the path of the router to ensure that there are no screws that can stay embedded in the project. The floor should be clear of sawdust and scraps to prevent any possible accidents. **3. Conducting a Dry Run Is Important** Before beginning the actual CNC machining process, the operator must conduct a trial run to ensure that all moving parts are set and configured correctly. Most machines have a lock feature that allows users to scan the program for mistakes. During this process, the spindle will run, the control will execute the program, and the turret will index. However, only the axes (X, Y and Z) will stay still. **4. Operators Must Dress Accordingly** Users should never wear gloves while operating the machine. Jewelry should be avoided as some can conduct electrical charges as well as getting caught in machinery. Wearing loose clothing is also prohibited since the operator risks getting pulled into the machinery, and this can be quite fatal. In any workplace, safety comes first. Operators must understand all the safety features on the machine such as curtain guards, contact mats, guard fencing, soundproof casing, and emergency stop button operation to ensure a safe CNC machining operation.	
Q2		**Attempt any FOUR of the following:**	**16**
	a)	**a) State any four essential requirements of dielectric fluid used in EDM** - Low viscosity - High flash point - Controlled level of toxicity - Freedom from acid & alkaline products - High electric strength	**04 marks**
	b)	**b) Explain Closed loop control system with neat sketch.**  The name indicates that the closed loop control system has a loop that is closed as shown in fig. A	**01 marks** **03 marks**

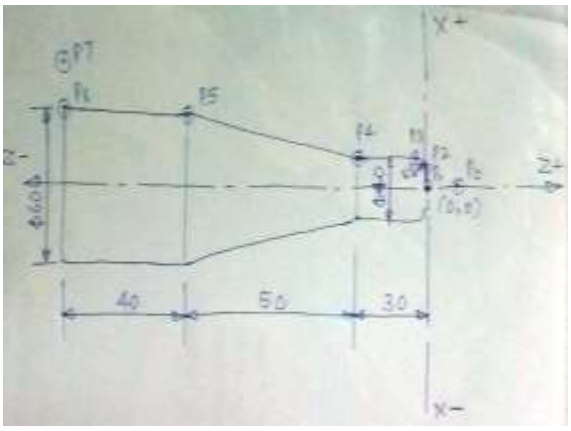
		feedback device is used for this purpose. This makes the design of closed loop a little complicated and expensive. But a very high degree of accuracy is achieved in the movement of slide. This system is similar to open loop control system. But it consists of two additional devices in the form of feedback transducer and a comparator as shown in Fig. The transducer feedbacks the actual slide displacement to the comparator. The comparator compares the actually achieved slide movement with command signal. If there is any error then it is feedback to the MCU. The MCU then sends the corrective commands to the drive unit and the cycle repeats until there is no error signal from the comparator.	
	c)	c) Explain the construction of planomiller with neat  1. Bed: A fixed bed is considered as the base of the machine. 2. Table : A table is mounted on the bed. The table has longitudinal movement only. 3. Column : Two vertical columns, one on each side of the bed are mounted on the bed. 4. Cross rail: A cross rail is fitted on the column. It may be lowered or raised to suit the height of the workpiece. 5. Milling Head: Two vertical milling head are fitted on the cross rail which can move towards each other. Two horizontal milling head are mounted on the column which can move vertical over it. 6. Milling cutter: Each milling head carries one cutter	**02 marks** **02 marks**
	d)	d) Write down the detailed classification of milling machine. 1. According to position / location of spindle a. Horizontal milling machine b. Vertical milling machine c. Special purpose milling machine. 2. According to design : a. Column and knee type milling machine	**04 marks**

		I. Hand milling machine II. Plain milling machine III. Universal milling machine IV. Vertical milling machine b. Fixed bed type milling machine I. Simplex milling machine II. Duplex milling machine III. Triplex milling machine c. Planer milling machine d. Special type of milling machine I. Rotary table milling machine II. Planetary milling machine III. Profiling milling machine IV. Duplicating milling machine V. Pantograph milling machine VI. Tracer contour miling machine	
	e)	**e) State the objectives and need of maintenance (2 point each)** **objectives** - To minimize the number of breakdown. - To keep plant in good working condition at the lowest possible cost. - To minimize the hindrance and interruption of work. - To carry out the work of all the machines smoothly. **need of maintenance** • Maintenance should be planned at regular intervals to prevent uncalled breakdown. • If proper attention is not given to the machine tool then it will fail. • The maintenance of machine tool is needed to keep them in working condition at all the times. • The maintenance of machine tool is important to minimize the hindrance and interruption of work.	**02 marks Any 2** **02 marks Any 2**
	f)	**f) Compare traditional and non-traditional machining processes. (Four point each)**	**[any 4 points 4 marks]**

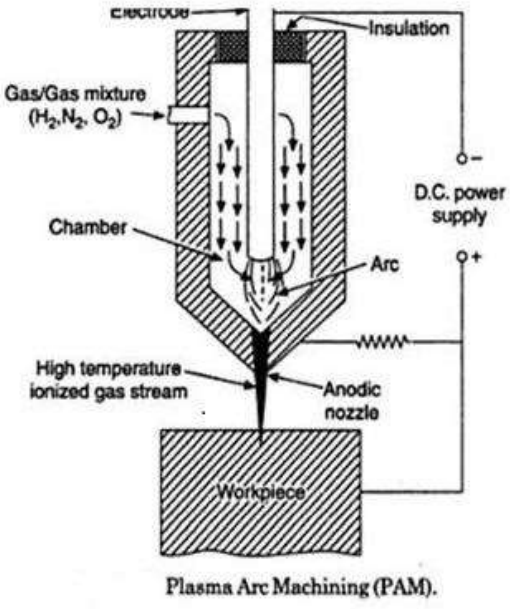
Traditional Machining Processes	**Non- Traditional Machining Processes**
1. Generally macroscopic chip formation by shear deformation. 2. There may be a physical tool present. 3. Cutting tool is harder than work piece 4. Material removal takes place due to application of cutting forces – energy domain can be classified as mechanical	1. Material removal may occur with chip formation or even no chip formation may take place. 2. There may not be a physical tool present. 3. Cutting tool not harder than work piece 4. Mostly NTM processes do not necessarily use mechanical energy to provide material removal. They use different energy domains to provide machining. For example, in USM, AJM,

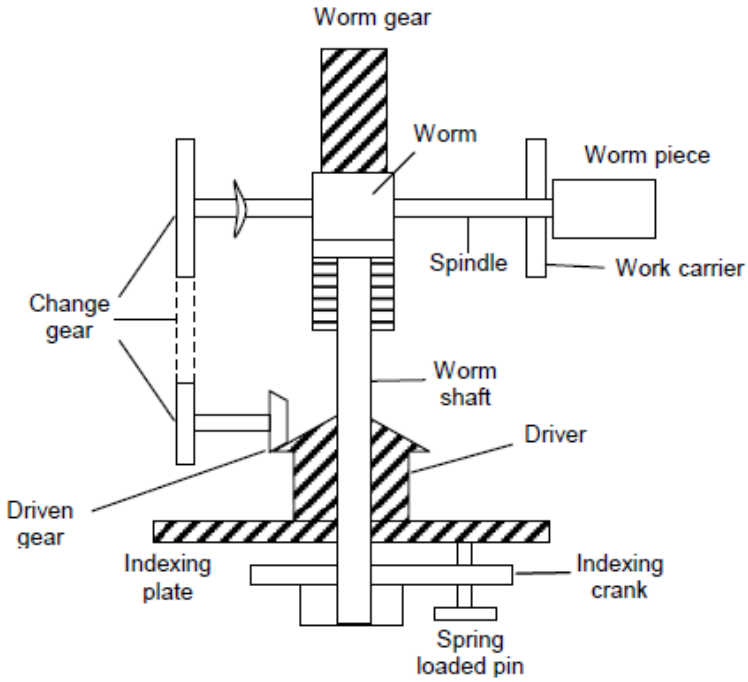
		5. Conventional machining involves the direct contact of tool and work –piece 6. Lower accuracy and surface finish. 7. Suitable for every type of material economically 8. Tool life is less due to high surface contact and wear. 9. Higher waste of material due to high wear. 10. Noisy operation mostly cause sound pollutions 11. Lower capital cost 12. Easy set-up of equipment. 13. Skilled or un-skilled operator may required 14. Generally they are manual to operate. 15. They cannot be used to produce prototype parts very efficiently and economically.	WJM mechanical energy is used to machine material, whereas in ECM electrochemical dissolution constitutes material removal. 5. Whereas unconventional machining does not require the direct contact of tool and work piece. 6. Higher accuracy and surface finish. 7. Not Suitable for every type of material economically 8. Tool life is more 9. Lower waste of material due to low or no wear. 10. Quieter operation mostly no sound pollutions are produced. 11. Higher capital cost 12. Complex set-up equipment. 13. Skilled operator required. 14. Generally they are fully automated process. 15. Can be used to produce prototype parts very efficiently and economically.	
3		**Attempt any Two of the following:**	**16**
	a.	**Write a part program for a job shown in Fig No.1. Take only finish cut. Use, spindle speed = 1500 rpm and feed rate = 0.1 mm/rev. Assume suitable data if necessary.**	**08**
	Ans	(***02 Marks for Detailed Figure and Coordinates & 06 Marks for Correct Program***) **Figure of work piece with its Coordinates**	**02 Marks for Detailed Figure, Coordinates &**

Point	X-Coordinate	Z-Coordinate
P_0	0.0	5.0
P_1	0.0	0.0
P_2	20.0	0.0
P_3	40.0	-10.0
P_4	40.0	-30.0
P_5	60.0	-80.0
P_6	60.0	-120.0
P_7	70.0	-120.0

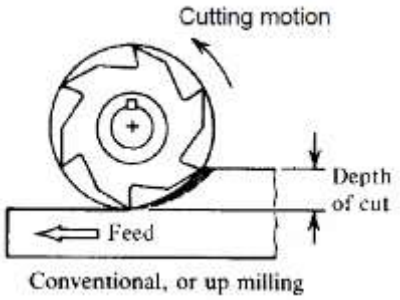
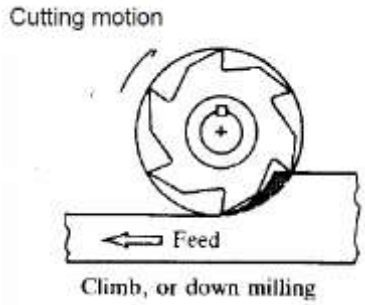


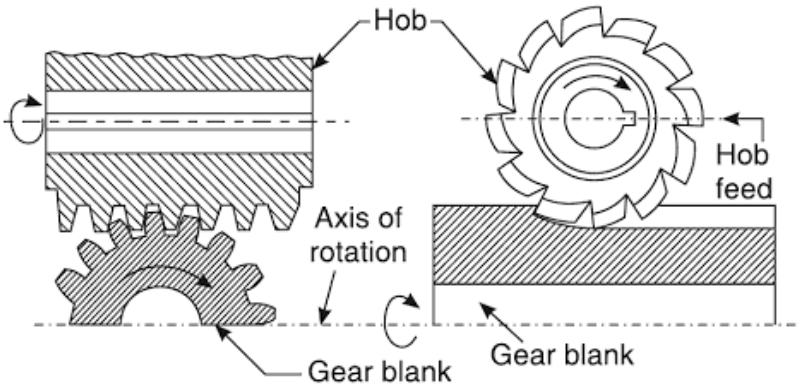
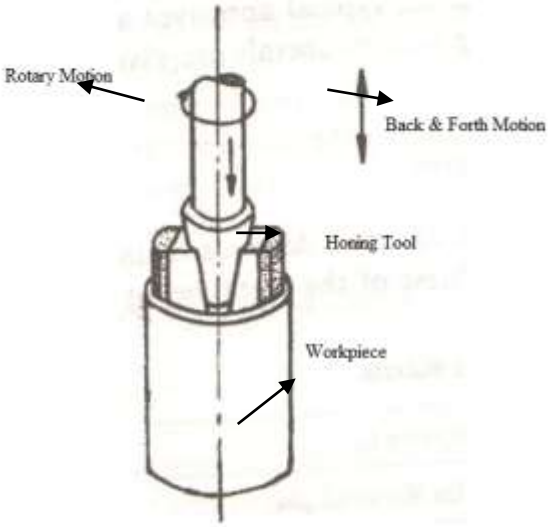
				06 Marks for Correct Program
		O1234;	Program no.	
		N001 **G28 U0.0 W0.0;**	Return to reference position	
		N002 **G21 G90 G99 G97;**	Input in mm, Absolute Programming, **G99 for Feed in mm/rev**&**G97 for speed in rpm**	
		N003 **M06 T0101 M08;**	Tool change tool no. tool offset no. coolant ON	
		N004 **M03 S1500;**	Spindle Start clockwise with 1500 rpm	
		N005 **G00 X0.0 Z5.0;**	Move the tool rapidly to point P_0	
		N006 **G01 X0.0 Z0.0 F0.1;**	Move the tool with **Feed rate of 0.1mm/rev** to point P_1 (Touch point)	
		N007 **G01 X20.0 Z0.0;**	Facing Operation up to point P_2	
		N008 **G03 X40.0 Z-10.0 R10;**	After facing circular Interpolation CCW with Radii =10 mm up to point P_3	
		N009 **G01 X40.0 Z - 30.0;**	After radius of 10 mm plain turning up to point P_4	
		N010 **G01 X60.0 Z - 80.0;**	After that taper turning up to point P_5	
		N011 **G01 X60.0 Z – 120.0;**	After taper turning plain turning up to point P_6	
		N012 **G01 X70.0 Z – 120.0;**	Lastly tool is taken away from work piece up to point P_7	
		N013 **M09 M05;**	Coolant STOP, Spindle STOP	
		N014 **G28 U0.0 W0.0;**	Return to reference position	
		N015 **M30;**	End of Program	
	b.	**Explain the working of PAM with neat labelled sketch. State its any two applications.**		**08**
	Ans	***(03 Marks for Working, 03 Marks For Sketch & 01 Mark For Each Application)*** **Plasma Arc Machining:** Plasma-arc machining (PAM) is a metal removal process in which metal is removed by directing high about 11000 to 30000 degree centigrade ionized gas on the work piece. The principle PAM is shown in the figure. In this process, plasma torch is used in which a volume of a gas such as		**03 Marks**

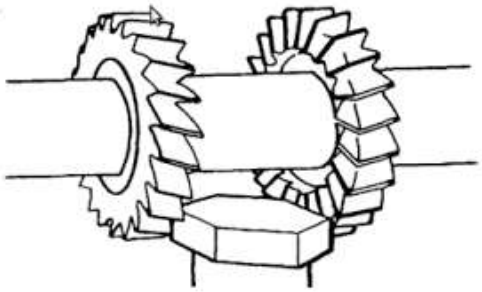
		H2,N2,O2 is passed through a small chamber in which high frequency spark is maintained between cathode and anode. The plasma jet melts the work piece material. The depth of hat zone depends on the work material ,its thickness and cutting speed.  Plasma Arc Machining (PAM). **Applications of PAM:** (1) Cutting Alloy Steels, Stainless Steels, Aluminium and its alloys (2) Used for turning and milling of difficult to machine materials (3) Used for removing of gates and risers from a casting. (4) Used in underwater operations like, in shipyards, chemical industries, nuclear power plat, etc. (5) Used for cutting of hot extrusions	**for Working , 03 Marks For Sketch & 01 Mark For Each Application**
	c	**What is the function of dividing head? Sketch and explain internal mechanism of universal dividing head.**	**08**
	Ans	***(02 Marks for Function & 04 Marks for Sketch & 02 Marks For Explanation)*** **Function of Dividing Head:** Function of dividing head is to divide the periphery of a workpiece into any number of equal parts. **For example:** (1) If we want to make a hexagonal bolt. Head of the bolt is given hexagonal shape. We do indexing to divide circular workpiece into six equal parts and then all the six parts are milled to an identical flat surface. (2) If we want to cut „n" number of teeth in a gear blank. The circumference of gear blank is divided into „n" number of equal parts and teeth are made by milling operation one by one. **Universal Dividing Head:**	

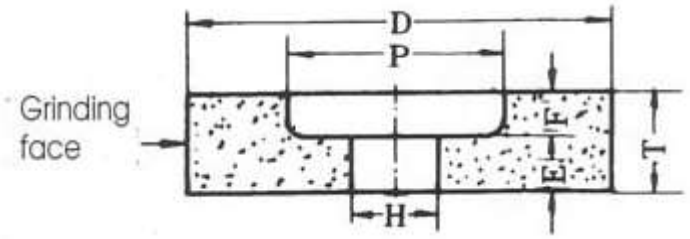
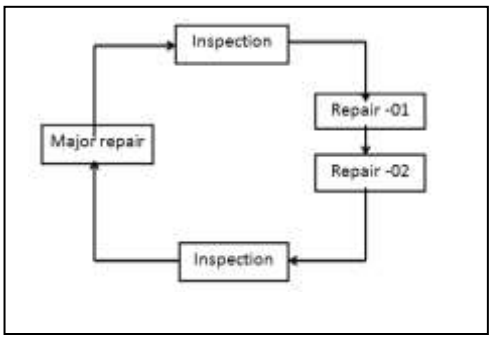
		 **Figure: Internal Mechanism of Universal Dividing Head.** The worm gear has 40 teeth and the worm has simple thread. Crank is directly attached with the worm. If we revolve crank by 40 revolutions the spindle attached with worm gear will revolve by only one revolution and one complete turn of the crank will revolve the spindle only by 1/40th revolution (turn). In order to turn the crank precisely a fraction of a revolution, an indexing plate is used. An indexing plate is like a circular disc having concentric rings of different number of equally spaced holes. Normally indexing plate is kept stationary by a lock pin. A spring loaded pin is fixed to the crank which can be fixed into any hole of indexing plate. The turning movement of the work piece is stably controlled by the movement of crank.	**02 Marks for Function & 04 Marks for Sketch & 02 Marks For Explanation**
4	**a**	**Attempt any THREE of the following:**	**12**
	i	**Difference between up-milling and down milling (Four points each)**	**04**
	Ans		**01 Mark For Each Point**

S. N.	Up – Milling	Down – Milling

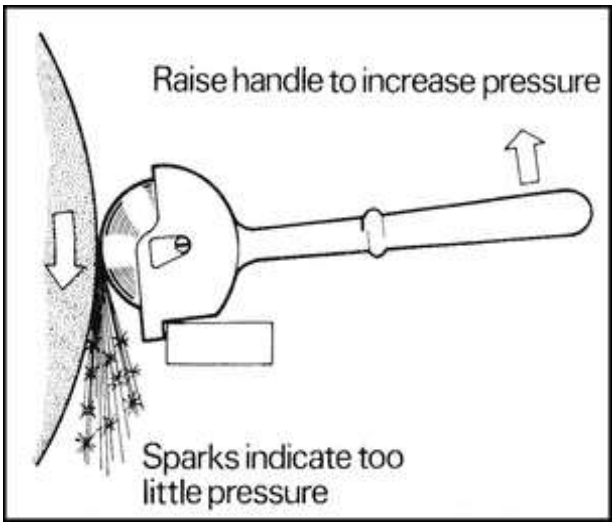
		1	 Conventional, or up milling	 Climb, or down milling	
		2	In Conventional Milling cutter rotates in direction opposite to that in which the work is fed.	In climb Milling cutter rotates in direction same to that in which the work is fed.	
		3	The chip thickness progresses gradually from start of cut to end of cut	The chip thickness is maximum at the beginning of cut and minimum at the end of cut	
		4	Cutting force tends to lift the workpiece from the fixture.	Cutting force tends to seat the work piece from the fixture.	
		5	Fixture design is complicated	Fixture design is simple	
		6	Wavy surface finish is obtained	Better surface finish is obtained	
		7	The cutter does not start cutting metal as soon as it come in contact with work piece	The cutter start cutting metal as soon as it come in contact with work piece	
		8	The cutting force is downward at the beginning of cut and reaches to upward at the end of cut.	The cutting force is upward at the beginning of cut and reaches to downward at the end of cut.	
		9	Chips get deposited on un- machined surface of work piece.	Chips get deposited on machined surface of work piece.	
	ii	**Explain gear hobbing process with neat sketch.**			**04**
	Ans	***(02 Marks For Sketch & 02 Marks For Explanation)***			**02 Marks For Sketch & 02**

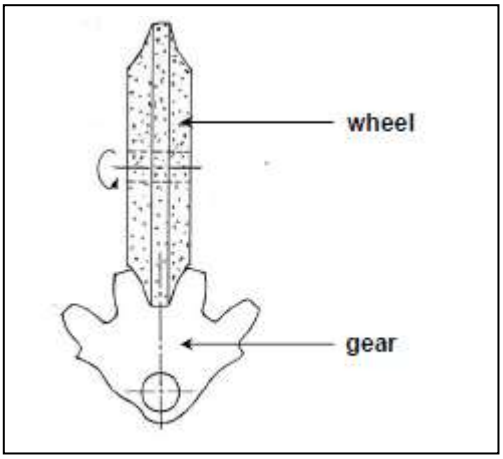
		 In this process of gear generating a tool is used known as hob. Hob teeth are shaped to match the tooth space and are interrupted with grooves to provide cutting surfaces. It rotates about an axis normal to that of the gear blank, cutting into the rotating blank to generate the teeth as shown in figure. It is the most accurate of the roughing processes since no repositioning of tool or blank is required and each tooth is cut by multiple hob-teeth, averaging out any tool errors. Excellent surface finish is achieved by this method and it is widely used for production of gears.	**Marks For Explanation**
	iii	**Explain honing process with neat sketch.**	**04**
	Ans	***(02 Marks For Sketch & 02 Marks For Explanation)*** **Honing:-** It is a superfinishing operation used for previously machined surfaces.It is used for finishing internal cylindrical surfaces, drilled or bored holes. The tool is called as Hone which is made out of bonded abrasive stone made in the form of stick. The tool moves back & fourth while rotating about its axis.Honing operation can be done by two methods. a) Hand honing; for small lot of workpieces b) Machine honing: for large scale Production Special Honing machines are used 	**02 Marks For Sketch & 02 Marks For Explanation**
	iv	**What is repair complexity? State its use in maintenance of machine tools (Any two)**	**04**

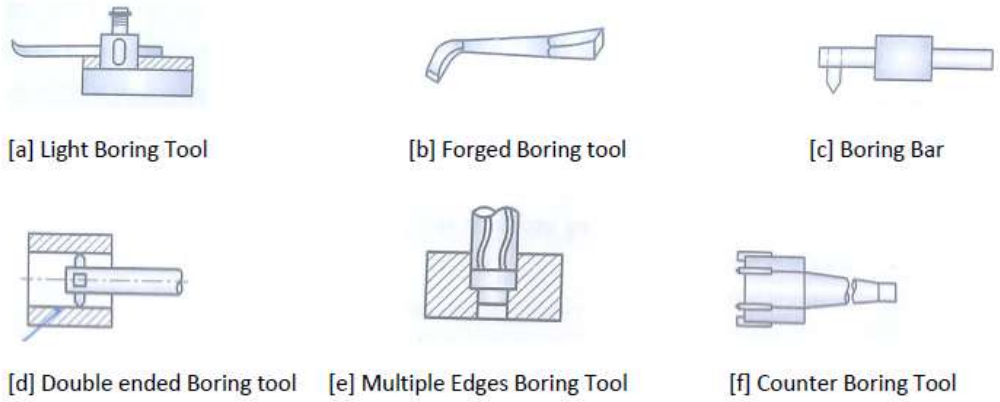
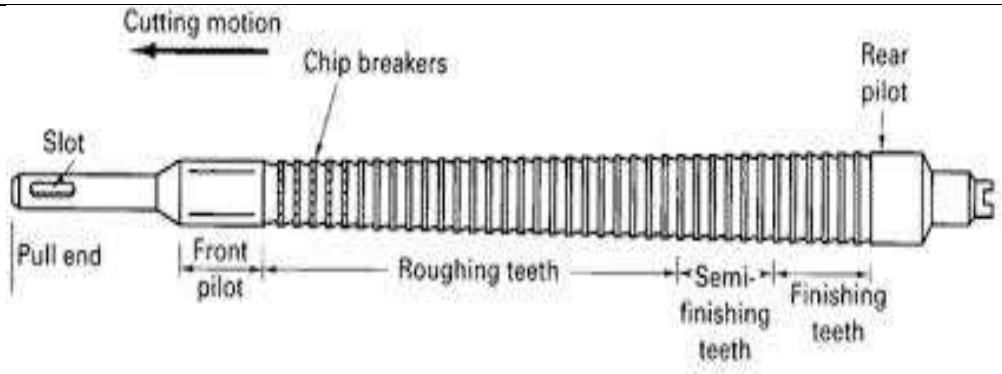
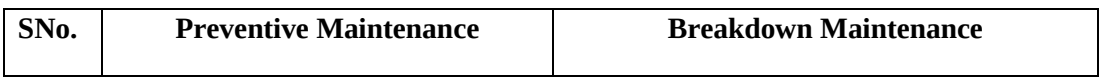
	Ans	*(02 Marks For Definition & 01 Mark For Its Each Use)* **Repair Complexity:** Repair Complexity is defined as the extent of complexity of machine tool considered for the maintenance work which is represented by a comparative index number. This number is called as repair complexity number . **Use of Repair Complexity in Maintenance of Machine Tool:** (1) If the repair complexity number is high, then repair cycle of the machine is longer because it consist high number of maintenance activities. (2) Repair complexity number is useful to decide the number of staff required for maintenance. (3) To decide inventory of spares required for maintenance. (4) To decide the repair cycle of the particular machine. (5) To find out the number of critical maintenance points of the machine. (6) To forecast the maintenance cost of the machine or plant. (7) Also repair complexity decides the time interval of repair cycle. (8) On the basis of repair complexity number maintenance schedule is prepared for the machine or plant. **(9)** For higher number long schedule is prepared while for small complexity number short schedule is needed.	**02 Marks For Definition & 01 Mark For Its Each Use**
4	**b**	**Attempt any ONE of the following:**	**06**
	i	**Explain the stepwise process of manufacturing hexagonal shape on milling machine.**	**06**
	Ans	*(03 Marks for Explanation & 03 Marks For Figure)* **Straddle Milling Operation For Hexagonal Shape:** [1] This is similar to the side milling operation. Two side milling cutters are mounted on the same arbour. [2] Distance between them is so adjusted with the help of spacing collars such that both sides of the work piece can be milled simultaneously. [3] Hexagonal Shape can be produced by this operation by rotating the work-piece only two times as this operation produces two parallel faces of hexagonal shape simultaneously. 	**03 Marks for Explanation & 03 Marks For Figure**

	ii	**Explain, how grinding wheels are specified**	**06**
	Ans	***(02 Marks for Size Specification & 04 Marks For Remaining Specification)****(Note: Figure is not compulsory)* **Grinding Wheel Specification:** **Example:**  ***450 X 75X 101.6 ROS 200 X 2*****551 A 36 L 5 40** ***D = 450*** = Outer diameter of grinding wheel ***T = 75*** = width of grinding wheel ***H = 101.6*** = Bore of grinding wheel ***ROS*** = Recess One Side ***P = 200*** = Diameter of Recess ***F= 25*** = Depth of Recess **51** = Manufacturers Symbol. **A** = Type Of Abrasive (Aluminium Oxide) **36** = Grain size (Medium) **L** = grade (Medium) **5** = structure (Dense) **V** = bond (Vitrified) **40** = manufacture symbol *(Optional)*	**02 Marks for Size Specification & 04 Marks For Remaining Specification** *(Note: Figure is not compulsory)*
5		**Attempt Any Four of the following**	
	a	**Explain repair cycle analysis. State its uses in maintenance of machine**	
	Ans	**Repair Cycle Analysis** The repetitive performance of maintenance activities between two overhauling (inspection) is called as repair cycle analysis. For maintenance planning repair cycle analysis is important. 	**2 Marks foe Explanation and 2 Marks for Use**

		Repair cycle analysis involves: **[1] Primary Inspection:-** Proper examination of the machine tool is carried to identify the problem. In this stage root cause of the problem can be found out. **[2] Small Repair-01:-** In this stage as per the problem complexity cleaning or lubrication, type of small repair is performed. **[3] Small Repair-02:** **A**fter repair one if the problem still exists another small repairs like alignment, proper assembly, nut and bolt tightening is performed. **[4] Inspection:-** After small repair the machine tool is inspected for its performance. **[5]Major repair:-** If the small problem exists after small repair the major repair takes place like replacement of component or machining is required. **[6] Inspection:** After major repair the inspection carried out for effective and efficient performance of that machine tool. **Use of Repair Cycle Analysis** • It gives idea about staff required. • Number of small/minor repairs. • Number of major repairs. • Number of spare parts (quantity required for maintenance)	
	b	**What is Burnishing State its advantages**	
	Ans	**Burnishing** Burnishing is super finishing process of obtaining a very fine surface finish having grainless appearance on metal objects. This process is used on various flat,cylindrical or conical surfaces. It removes scratches and tool marks on the surface. **Advantages of Burnishing** 1.There is no cutting action in this process. Only rubbing and peening action takes place.	**2 Marks for Explanation and** **1 Mark each for any 2 correct Advanta**

		2.It produces mirror like glazed and geometrically smooth surfaces. 3.Average 0.002 to 0.02 mm stock is removed from the surface. 4.Economical process as compare d to the other super finishing processes.	**ges**
	c	**What is meant by grinding wheel dressing? Why wheel dressing is necessary?**	
	Ans	**Dressing** Dressing removes loading and breaks away the glazed surface so that sharp abrasive particles are again presented to work. A common type of star dresser is used to dress the wheel. The dresser is held against the wheel and moved across the face of revolving wheel. Dressing is done to regain grinding wheels cutting capability. The dressing improves the surface finishing obtained while grinding. It is carried out where high degree of surface finishing is desired.  **Dressing of Grinding Wheel** **Necessity of Grinding Wheel Dressing** [1] Dressing of grinding is done to improve the surface finishing obtained of the work piece [2] Accuracy of the work piece. [3] It also increases the material removal rate [4] Increase the life of grinding wheel	**2 Marks for explanation** **and** **2 Marks for necessity**
	d	**Explain with neat sketch gear grinding using form wheel**	
	An	**Gear Grinding**	**2 Marks**

	s	Gear Grinding is a very accurate method and is, though relatively expensive, more widely used for finishing teeth of different type and size of gears of hard material or hardened surfaces. The properly formed and dressed wheel finishes the gear teeth flanks by fine machining or abrading action of the fine abrasives.  The grinding wheel is dressed to the form that is exactly required on the gear. Need of indexing makes the process slow and less accurate. The wheel or dressing has to be changed with change in module, pressure angle and even number of teeth. Form grinding may be used for finishing straight or single helical spur gears, straight toothed bevel gears as well as worm and worm wheels.	**for Explanation** **and** **2 Marks for sketch**
	e	**Differentiate between capstan and turret lathe**	
	Ans	**Sr. No.** / **Capstan Lathes** / **Turret Lathes** 1 / The turret of capstan lathe is mounted on slides on the saddle / The turret of the turret lathe is directly mounted on bed 2 / Less rigidity provided to the tool / More rigidity provided to the tool 3 / Suitable for light weight bar works / Suitable for Larger and heavier loads 4 / Handy for small components / Larger works can be machined easily 5 / High production rate as fast cut is possible / High production rate cannot be achieve easily as larger and heavier parts do not permit fast cut	**1 Mark each for any 4 correct points**
	f	**Sketch any two types of boring tools**	

	Ans		2 Marks each for any 2 correct drawing
6		**Attempt any Four of the following**	
	A	**Define feed / tooth and feed / revolution in milling operations**	
	Ans	**a) Feed per tooth (Sz):-** The feed per tooth is defined by the distance the work advances in the time between engagement by the two successive teeth. It is expressed in mm/tooth of the cutter. **b) Feed per revolution (Srev):-**The feed per cutter revolution is the distance the work advances in the time when the cutter turns through one complete revolution.	2 Marks each for each definitions
	b	**Draw sketch showing different elements of broach and state the function of any two elements**	
	Ans	 **Elements of Broaches:-** 1) **Pull end:-** this is designed to permit engagement of the broach with the broaching machine 2) **Front pilot:-** this centres the broach in the hole before teeth begins to cut 3) **Roughing and semi finish teeth:-** They remove most of the stock in the hole 4) **Finishing teeth:-** they are for sizing the hole and must required shape of the finishing hole 5) **Rear Pilot:-** They support the broach after last teeth leaves the work piece 6) **Land :-** the top portion of the tooth is called as land	2 Marks for Sketch and 1 Mark each for any 2 correct points
	c	**Compare preventive maintennace with breakdown maintenance**	
	Ans		1 Mark each for

		1	Actions performed on a time- or machine-run-based schedule that detect, preclude, or mitigate degradation of a component.	Breakdown maintenance is basically the "run it till it breaks" maintenance mode. No actions or efforts are taken to maintain the equipment	**any 4 correct points**
		2	Reduced equipment or process failure.	Increased cost due to unplanned downtime of equipment	
		3	Less labor cost because of planned maintenance.	Increased labor cost, especially if overtime is needed.	
		4	Estimated 12% to 18% cost savings over breakdown maintenance program.	Cost is involved with repair or replacement of equipment	
		5	Increased component life cycle.	Possible secondary equipment or process damage from equipment failure	
		6	Efficient use of staff resources	Inefficient use of staff resources	
	d	**Enlist the advantages and limitations of broaching**			
	Ans	**Advantages** [1] **Advantages:-** 1) Rate of production is very high 2) Semiskilled operator can perform the operation 3) High accuracy 4) High surface finishing 5) Both roughing and finishing cuts are perform in one pass 6) The process can be used for internal and external surfaces **Disadvantages:-** 1) High tool cost 2) Very large work pieces cannot be machined 3) The surfaces to be broach cannot have an obstruction 4) Large amount of stock (Material removal) cannot be removed 5) Work pieces must be rigidly supported			**1 Mark each for any 2 correct advantages** **And** **1 Mark each for any 2 correct disadvantages**
	e	**What is cutter tool compensation? Why it is necessary in CNC machine part programming**			
	Ans	When milling a contour, the tool radius center is used as the reference point on the tool while writing the program, but the part is actually cut by the point on the cutter periphery. This point is at 'r' distance from the tool center. This means that the programmer should shift the tool center away from the part in order to perform the cutting by the tool cutting edge. The shift amount depends upon the part geometry and tool radius. This technique is known as tool radius compensation or cutter radius compensation.			**2 Marks for Explanation**

		Necessity of Cutter Tool Compensation [1] Cutter compensation allows programming the geometry and not the toolpath. [2] It also allows adjusting the size of the part, based on the tool radius used to cut part. [3] This is useful when cutter of the proper diameter is not found.	**and** **2 Marks for Necessity**
	f	**State any four criteria of selecting the grinding wheel for any specific application**	
	Ans	**Selection criteria:-** 1) **Material to be ground:-** Grain size , grade, structure, bond 2) **Amount of stock to be removed:-** This involves accuracy and surface finishing, coarse grain is used for fast cutting & fine grains are used for fine finish 3) **Area of contact:-** Fine grain and closed grain spacing are useful where area of contact is small 4) **Type of grinding machine:-** Heavy rigidly constructed machine used softer wheel. 5) Wheel speed 6) Work speed 7) Condition of the machine 8) Personal factor	**1 Mark each for any 4 correct points**