MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2005 Certified)

MODEL ANSWER

SUMMER– 17 EXAMINATION

Subject Title: Advance Manufacturing Processes **Subject Code: 17556**

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 judgment 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.

Que en.	Answer	Marks	Total Marks
1	**Attempt any Five**	**4 x 5**	**20 M**
a)	**Classify Non-traditional Machining Processes.** **Classify Non-Traditional Machining Processes.** Depending upon the type of energy used, the non-traditional processes are classified as:- **1) Mechanical Processes –** i. Abrasive Jet Machining (AJM) ii. Ultrasonic Machining (USM) iii. Water Jet Machining (WJM) iv. Abrasive Water Jet Machining (AWJM) **2) Electrochemical Processes –** i. Electrochemical Machining (ECM) ii. Electro Chemical Grinding (ECG) iii. Electro Jet Drilling (EJD) **3) Electro-Thermal Processes** i. Electro-discharge machining (EDM) ii. Laser Jet Machining (LJM) iii. Electron Beam Machining (EBM) **4) Chemical Processes** i. Chemical Milling (CHM)	**01 marks /point** (For Any Four)	**04 M**

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b)	**Explain the need of non-traditional machining of processes in modern industry.** The need of non-traditional processes is justified by the following points: 1. To machine the exotic material those were difficult to machine by conventional machining processes. 2. To fulfil the requirements of new age like innovative design, tighter tolerances, micromachining and economy. 3. To obtain intricate shapes. For example, a square blind hole of 15mm x 15mm with a depth of 30mm. 4. Overcome difficulty to machine the material. For example, Inconel, Ti Alloy, Carbide, Ceramics. 5. To fulfil the requirements of low stress grinding. (If done by conventional then it reduces productivity). 6. Drilling deep hole with small hole diameter (For example, 15mm diameter hole with I: d ratio of 20). 7. Machining of composites.	**01 marks /point** (For Any Four)	**04 M**
c)	**Write any eight advantages of CNC Machines.** CNC machine have many advantages, But few important are listed below: 1. Greater accuracy of job is achieved. 2. Higher repeatability and improved product quality. 3. Less operator skill is required to run CNC machine. 4. Better machine utilization hence reduces idle time. 5. High production rate as speed, feed, depth of cut are optimum for best quality. 6. Lower tooling cost, per piece in mass production. 7. Jigs and fixtures cost can be reduced. 8. Reduced cycle time. 9. Better tool life and machinability. 10. Less scrap due to consistent accuracy, less errors. 11. Excellent reliability as dimensions is based on programmes. 12. Reduced in process inventory of parts in process. 13. Design changes are possible. Any change in design is feasible at lowest cost. 14. Productivity can be improved to great extent. 15. Tool set up cost can be reduced.	**01 marks /point** (For Any Four)	**04 M**

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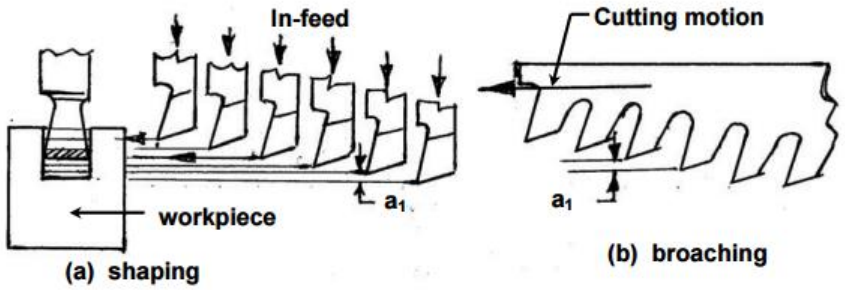
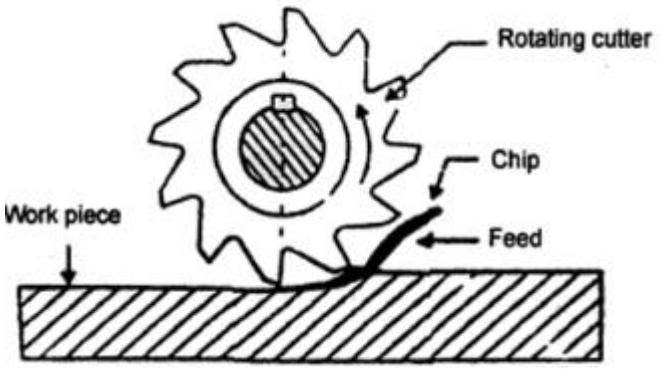
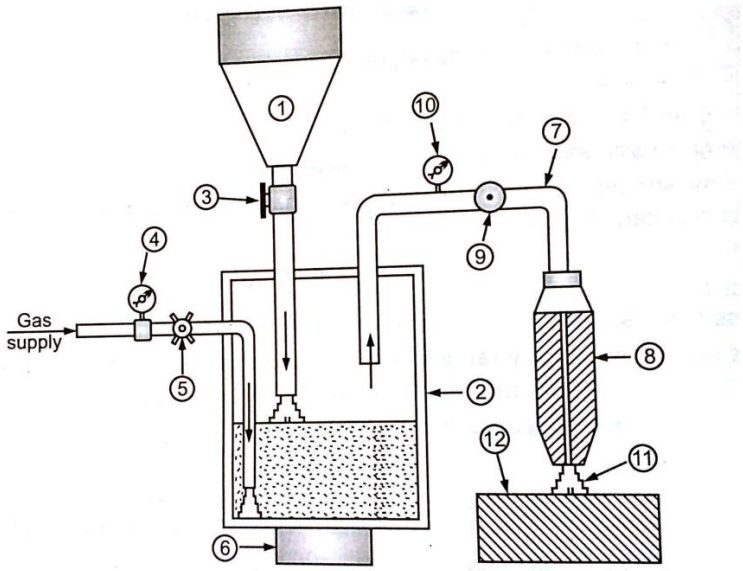
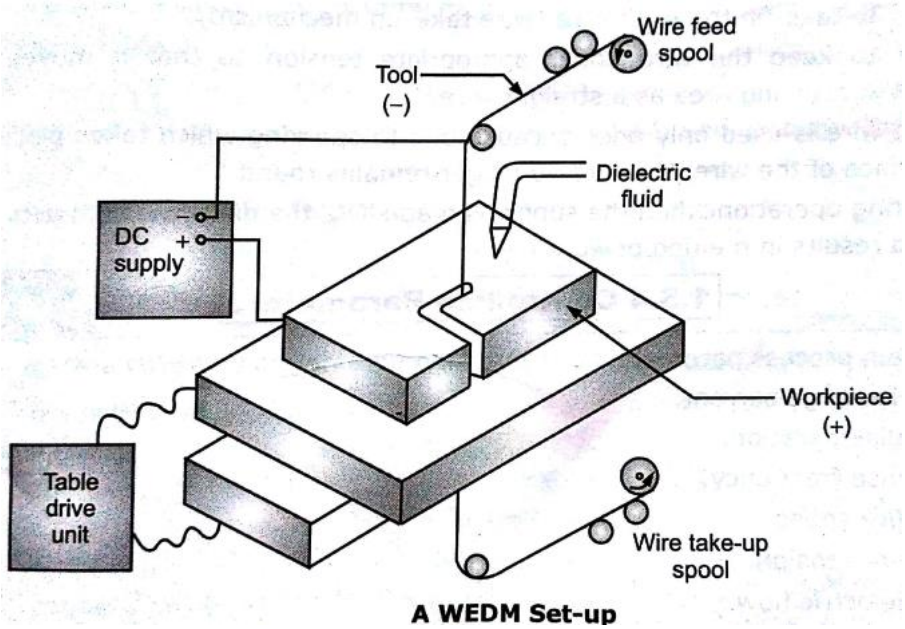
d)	**Explain principle of broaching operation.**  *Basic principle of broaching.* **Principle:-**Broaching is a machining process for removal of a layer of material of desired width and depth usually in one stroke by a slender rod or bar type cutter (Broach) having series of cutting edge with gradually increase protrusion as indicated in figure.	**02 marks** Fig. **02 Marks** Principle	**04 M**
e)	**Explain with neat sketch principle of milling machine operation.**  In this milling process, metal is removed by moving the work piece against a rotating multipoint milling cutter. The milling cutter is mounted on a rotating spindle called Arbor. The work pieces clamped on the table. The cutter rotates at required cutting speed. The work is fed slowly past the milling cutter. The work piece can be fed vertically, longitudinal or crosswise. As the work the cutting edges remove the metal in the form of chip.	**02 marks** Fig. **02 Marks** Principle	**04 M**
f)	**What are different gear manufacturing methods?** The following methods are commonly used for manufacturing gears:- 1. Casting. a. Sand casting. b. Die Casting. 2. Stamping. 3. Hot rolling. 4. Gears by powder metallurgy. 5. Extrusion of gears. 6. Machining of gears.	**01 marks /point** (For Any Four)	**04 M**

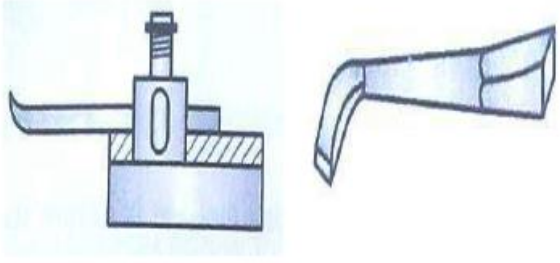
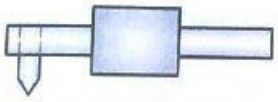
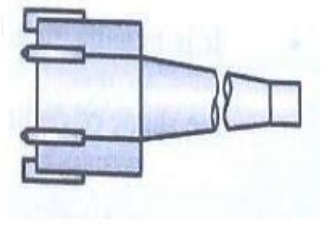
	i. Form tooth process. a. Gear cutting on milling machine. b. Gear cutting on shaping machine. c. Gear cutting on broaching machine. ii. Template process. iii. Gear generation. a. Manufacturing with a hob cutter. b. Manufacturing with rotary cutter. c. Manufacturing by a reciprocating process. d. Bevel gear generating process.		
g)	**Enlist safety precautions to be taken while operating grinding machine.** Grinding machine is used daily in machine shop. To avoid injuries follow the safety precaution listed below: 1. Wear goggles for all grinding machine operations. 2. Check grinding wheels for cracks before mounting. 3. Never operate grinding wheels at speed in excess of the recommended speed. 4. Never adjust the work piece or work mounting devices when the machine is operating. 5. Don not exceeds recommended depth of cut for the grinding wheel or machine. 6. Remove work piece from grinding wheel before turning machine off. 7. Use proper wheel guards on all grinding machines. 8. Do not tighten the flange bolts excessively in order to avoid crack in wheel.	**01 marks /point** (For Any Four)	**04 M**
2.	**Attempt any Four**	**4 x 4**	**16 M**
a.	**Explain with sketch principle of AJM process.** • A typical set up of abrasive jet machining as shown in figure. • The abrasive particles are held in the hopper (7) through which it is fed into the mixing chamber (11). • A regulator (8) controls the flow of abrasive particles. • Gas at high pressure is supplied to the mixing chamber through a pipe line as shown in figure. • A pressure gauge (9) and a regulator (10) are incorporated in the pipe line to control the gas flow and its pressure. • The mixing chamber, carrying the abrasive particles is vibrated by the device (12) and the amplitude of these vibrations controls the flow of abrasive particles. • These abrasive particles travel through the hose (4) and enter into the nozzle (3). • The control valve (5) and pressure gauge (6) controls the flow of abrasive particles. • This outgoing high speed steam that comes out of the nozzle is known as abrasive jet (2).	**02 M** Explain	**04 M**

	• When such jet impinges on the work piece (1), the erosion caused by their impact enables the removal of metal.  1. Hopper 2. Mixing Chamber 3. Regulator 4. Pressure gauge 5. Gas Supply 6. Vibrating Device 7. Hose 8. Nozzle 9. Regulator Control valve for jet flow 10. Pressure gauge 11. Abrasive Jet 12. Workpiece **Abrasive Jet Machining**	**02 M** Figure	
b.	**Explain with neat sketch the setup of WEDM.** The basic elements in a WEDM process, as shown in figure are given below: **1. Power Supply System:-** • The work piece is mounted on the table. • The tool is connected to negative terminal, so that it becomes cathode, while work piece is connected to positive terminal and become anode. • The tool and work piece is connected to a DC power supply. • The supply is in the form of a pulse. A voltage of about 50V is applied to the system. • However because of very small wire size, it cannot carry current more than 30A. **2. A dielectric system:-** • Deionised water is used as a dielectric fluid in WEDM. It gives high metal removal rate and better surface finish. • A nozzle is employed to inject the dielectric fluid in the machining area. • Both the work piece and the wire are constantly flushed with dielectric fluid at the area being machined. • The dielectric also serves as a coolant. **3. A CNC Control System:-** • A CNC control system is used for the movement of work table. • The table has movement in two axes (direction). • The table can also be moved in both the direction simultaneously for taking	**02 M** Figure 02 M Explain	**04 M**

	contouring cuts. **4. Wire Drive System:-** • The system performs three functions:- i) To feed the fresh wire for machining (Wire fed mechanism). ii) To take up the used wire (Wire take up mechanism). iii) To keep the wire under appropriate tension so that it moves in the machining area as a straight wire. • The wire is used only once because due to sparking which takes place at the surface of the wire, the wire no longer remains round. • During operation when the supply is made "ON" the dielectric fluid gets ionized and results in melting of work piece.  **A WEDM Set-up**		
c.	**State the significance of following codes in part programming:** 1. G00 – Rapid positioning. 2. G01 –Linear Interpolation. 3. M 02 – Programme End. 4. G 43 – Tool length compensation in positive (+ve) direction.	**01 marks /point**	**04 M**
d.	**List importance safety procedure to be adopted during CNC machining applications.** **Safety Procedure:-** 1. Obtain instructor's permission. 2. Do not alter or modify any machinery, tooling or necessary unless you contact an instructor and obtain permission 3. Review all CNC set up and operating procedures provided. 4. Review all CNC programming instructions provided. 5. Prepare and review your programme carefully. 6. Edit your program for safety, format, correctness and clarity.	**01 marks /point**	**04 M**

	7. It is highly recommended that all programs be verified before the actual trial on the machine. Verification can be by a dry run on the machine or through graphic display of the tool path on the controller's screen. Do not operate any machine tool unless you are thoroughly familiar with it. 8. Wear safety shoe. 9. Secure hair or loose clothing that could become caught or tangled in the moving parts of machine. Long hair possesses an extreme safety hazard around machine tools, and therefore, must be netted for safety. 10. Wear safety glasses. 11. Clamp all work securely before starting machine. Only approved materials can be machined. Abrasive dust- generating materials will wear machine components. 12. Do not use compressed air to blow chips from parts, machine surfaces, cabinets, controls, or floor around machine. 13. Do not remove any guards or shield from any piece of equipment. 14. Shut off machine when not in use. 15. Do not disable hold-to-run switch.		
e.	**Distinguish between turret lathe and capstan lathe.**	**01 marks /point** (For Any Four)	**04 M**

Sr. No.	Capstan lathe	Turret lathe
01	It is light duty machine	Turret lathes are relatively more robust and heavy duty machine.
02	The turret head is mounted on the ram and the ram is mounted on the saddle and moves on the guide ways	The turret head is directly mounted on the saddle and the saddle slides over the bed ways
03	The saddle will not be moved during machining	The saddle is moved along with the turret head during machining.
04	The lengthwise movement of turret is less	The lengthwise movement of turret is more.
05	Only short work pieces can be machined	Long work pieces can be machined.
06	Collet is used to hold the work piece	Jaw chuck is used to hold the work piece.
07	It is easy to move the turret Head as it slides over the ram.	It is difficult to move the turret head along with saddle.
08	The turret head cannot be moved crosswise	The turret head can be moved crosswise in some turret lathes.
09	As the construction of lathe is not rigid heavy cut cannot be given.	As the construction of lathe is rigid, heavy cut can be given.
10	It is used for machining work pieces up to 60 mm diameter.	It is used for machining work pieces up to 200 mm diameter
11	Capstan lathes generally deal with short or long rod type blanks held in Collet.	Turret lathes mostly work on chucking type jobs held in the quick acting chucks.

		12	The turret travels with limited stroke length within a saddle type guide block, called auxiliary bed, which is clamped on the main bed	In turret lathe, the heavy turret being mounted on the saddle which directly slides with larger stroke length on the main bed.		
		13	External screw threads are cut in capstan lathe using a self-opening die being mounted in one face of the turret.	In turret lathes external threads are cut by a single point or multipoint chasing tool being mounted on the front slide and moved by a short lead screw and a swing type half nut.		
		14	The turret of capstan lathe is called as a capstan head which may be circular or hexagonal.	The turret of turret lathe is called as a turret head which may be square, octagonal or hexagonal.		
f.	**List types of boring tools and draw of any two tools.** The boring tools used on the boring machines are of mainly two types. a. Non Rotating Type. b. Rotating Type. 1. **Non Rotating Types: -** this type of tool are used when, the work piece can be conveniently held and rotate in the chuck, face plate, or fixtures. 2. **Rotating Type: -**are generally used on centre lathe, turret lathe and smaller size boring machines.  (1) Light Boring Tools (2) Forged Boring Tools (4) Double Ended Boring Tool  (3) Boring Bar  (5) Multiple Edged Boring Tool		**02 M Enlist** **01 M** per Fig (Two Fig).	**04 M**

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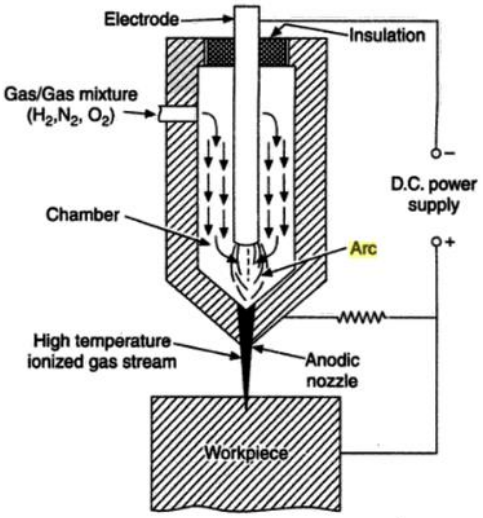
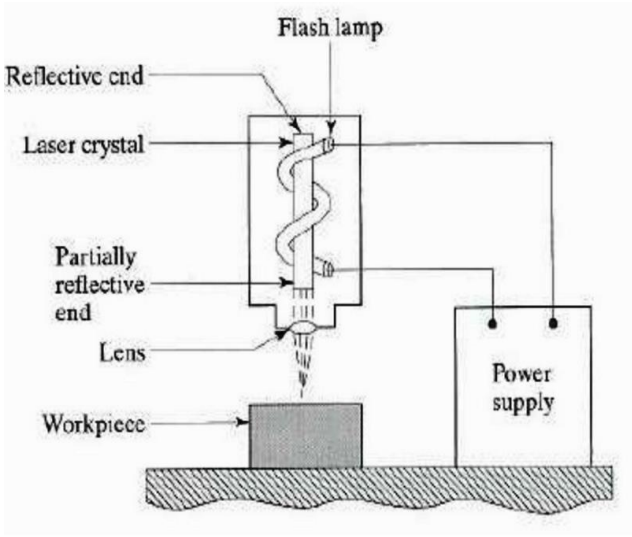
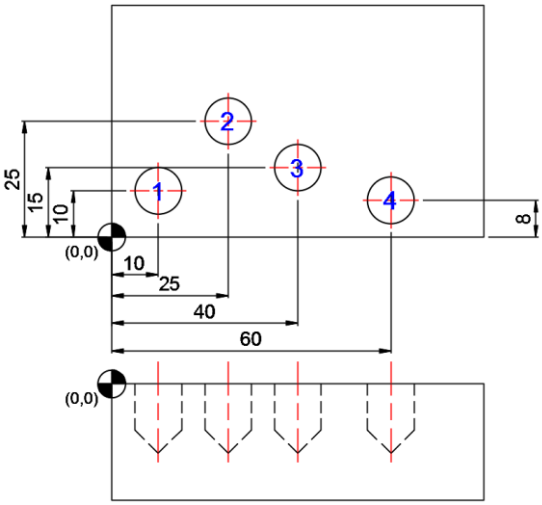
3.	Attempt any Four	4 x 4	16 M
a.	**Explain with neat sketch plasma arc machining process.** **Plasma Arc Machining Process (PAM):-** • This is a material removal process in which material is removed by directing a high velocity jet of high temperature ionized gas on the work piece. • The high temperature plasma jet melts the material of the work piece. • Plasma is the mixture of free electrons, positively charged ions and neutral atoms, which is obtained by heating a gas at very high temperature, so that it gets partially ionised. • H_2 (Hydrogen) or N_2 (Nitrogen) gas are generally used for this process, and are heated by subjecting them to electron bombardment of an electric arc produced between a cathodic electrode and an anodic nozzle. • The molecular gas gets dissociated due to their collision with the electrons generated by the arc and this result in ionisation of the atoms. • The equipment's works at 400V, 200kW output. • Arc current ranges from 50 to 1000 A and the rate of cutting generally 250-1800 mm/min. • Gases generally used for cutting are hydrogen and nitrogen, and materials generally cut are alloy steel and cast iron.  Plasma Arc Machining (PAM).	**02 M** Explain **02 M** Figure	**04 M**

b.	**Describe working principle of LBM with neat sketch.** **Working Principle of LBM:-** Laser beam Machining (LBM) is based on the conversion of electrical energy into light energy and then to thermal energy. • In the beginning in atom all the crystal are in ground state. • When the light is flash over the crystal, most of the atoms are raised to the excited state. Some light waves incline to the axis of the crystal will leave the box either after only a few reflections or without strike on mirror. • Some of the waves that travel parallel to the axis of the crystal will spontaneously emit photon from chromium ions. These photons stimulate another atom to contribute a second photon. These processes continue as the photons are reflected to and fro between the mirrors. • At the each reflection a certain loss occurs. • It is very interesting that laser has to be used on materials where it absorbs laser energy. • Upon absorption of the laser energy, there is rapid rise in the temperature leading once again to melting and vaporization and material removal. • Although several types of laser exist, all laser produce (emit) intense, coherent, highly collimated beam of single wavelength light. In material processing applications, this narrow beam is focused by an optical lens to produce a small, intense spot of light on the work piece surface.  **Fig. Laser Mechanism**	**02 M** Explain **02 M** Figure	**04 M**
c.	**Explain jog mode and block by block mode execution in CNC machines.** **Jog Mode: -** This mode of machine is useful for initial setting of machine tool before doing manufacturing of component. Jog mode means warm up of machines slides to check for initial settings. In this mode machine axes are moved by using direction keys provided on the control panel of the CNC machine. With this jog mode operator can set the tool /work piece at required position with reference to the location of machine table or chuck. **Block By Block execution**: - The CNC program consists of program blocks which are numbered as N10, N20 etc. In CNC single block mode only one block of CNC will be executed, in CNC execution of program can be done completely or Block By Block.	**02 M Each**	**04 M**

d.	**Prepare a programme using G81 canned cycle to carryout drilling operation as shown in figure. Assume suitable data if necessary.** **(Programming with different starting point should be consider, Programme may vary from students to students).**		

Position	X,Y Co-ordinates
1	10,10
2	25,25
3	40,15
4	60,8

01 M Position



01 M Fig.

04 M

Programme:-

N1 T16 M06 EOB

N1 Tool Change (M06) To Tool No.16

N2 G90 G54 G00 X10 Y10 EOB

N2 Tool rapily moves (G00) to first drilling position X10, Y10 taking into account zero offset no.1 (G54).

02 M Program

N3 S1450 M03 EOB

N3 Drill start rotating clockwise (M03) with 1450 rpm (S1450).

N4 G43 H16 Z1 M08 EOB

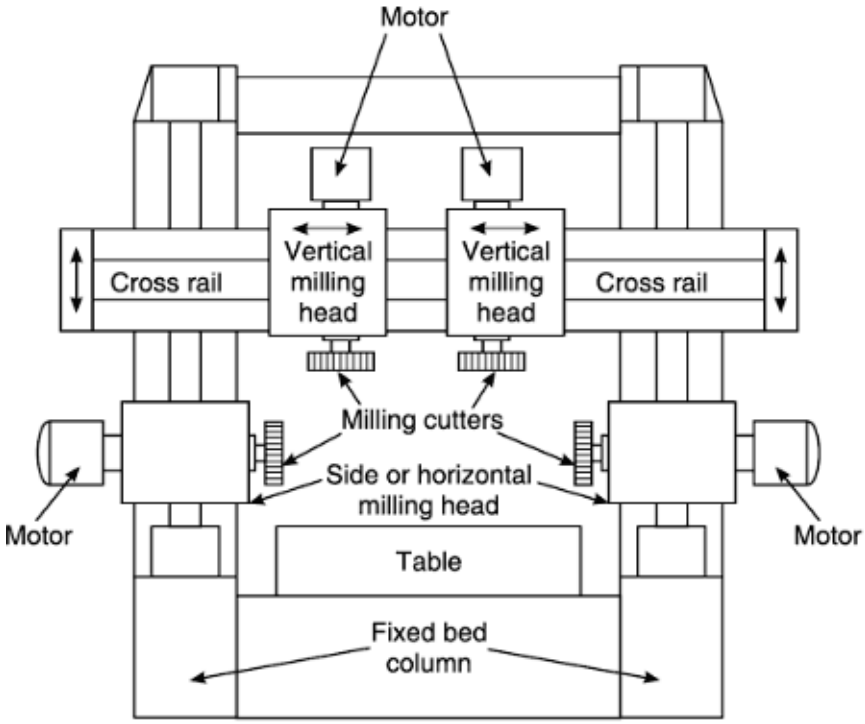
N4 Drill takes place depth Z1 taking into account tool length compensation (G43, H16) coolant is turned on (M08).

N5 G81 G99 Z-15 R0.1 F9 EOB

N5 Drilling cycle (G81) parameters, drill depth (Z) and cutting feed (F) are given, with this command frist drill is made as current position (X10, Y10)

.

	N6 X25 Y25 EOB *N6 As drilling cycle continues its work with every axis movements. So next drill is done at X25 Y25.* **N7 X40 Y15 EOB** *N7 Third drilling operation at X40, Y15.* **N8 X60 Y8 EOB** *N8 Fourth drilling operation at X60, Y8.* **N9 G80 G00 Z1 M09 EOB** *N9 Drilling cycle is canceled (G80), coolant is turned off (M09).* **N10 G53 G49 Z0 M05 EOB** *N10 Taking machine co ordinate system (G53) into account the drill taken at Z0 position. Tool length compensation is cancelled (G49), drill rotation is stopped (M05).* **N11 M30 EOB** *N11 CNC part program is ended.*		
e.	**Explain Plano Miller with sketch. Write any four advantages and any four disadvantages of broaching.** It is used for heavy duty works. It resembles a planer as it has cross rail, cutter head and column or uprights. They may be a number of independent spindles carrying cutters on the cross rail along with two tool heads on the uprights. This is most power full milling machine and the modern Plano-millers have high power driven spindles powered up to 100HP ensuring tremendous metal removal capacity.	**01 M** Explain **01 M** Figure	**04 M**



Planer type milling machine.

1/4 M per point For four point 1M

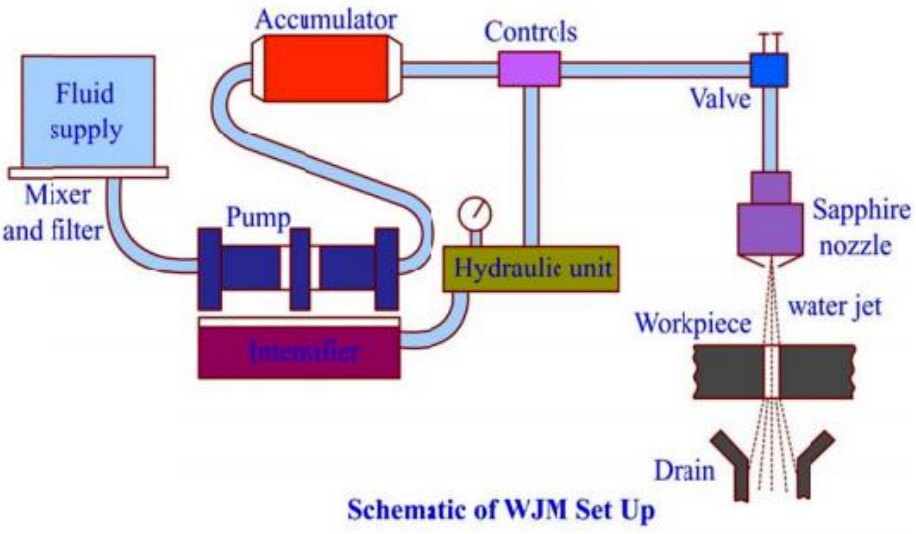
1/4 M per point For four point 1M

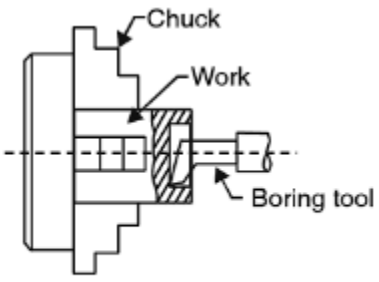
Advantages of Broaching:-

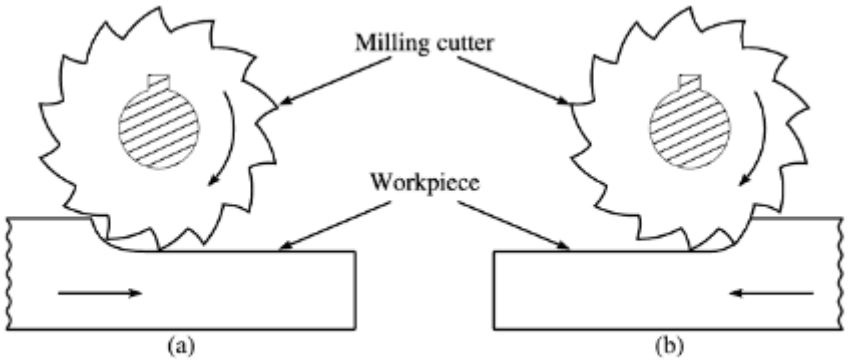
i. It is the fastest way of finishing an operation with a single stroke. The roughing as well as the finishing cuts is completed with one pass of tool.
ii. A broaching machine is a simple machine since only a single reciprocating motion is required for cutting.
iii. Internal or external surface can be broached.
iv. Production rate is high because the actual cutting time is a matter of seconds. Rapid loading and unloading of fixtures minimizes total production time.
v. Since all the machining parameters are built into the broach, very little skill is required from the operator.
vi. Any form that can be reproduced on a broaching tool can be machined into the part.
vii. Final cost of machining operation is one of the lowest for mass production.
viii. Production tolerance is suitable to interchangeable manufacture.

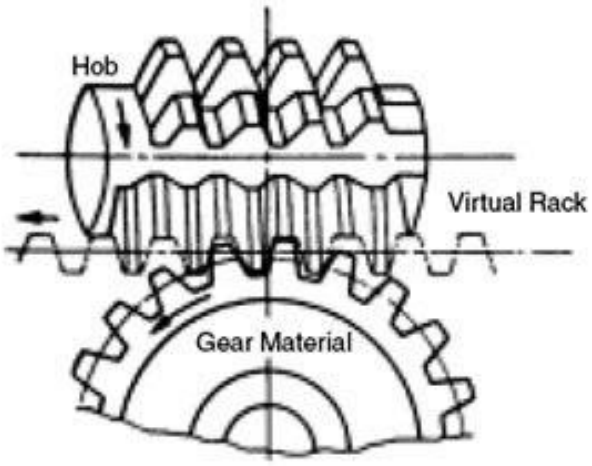
Limitation of Broaching operations:-

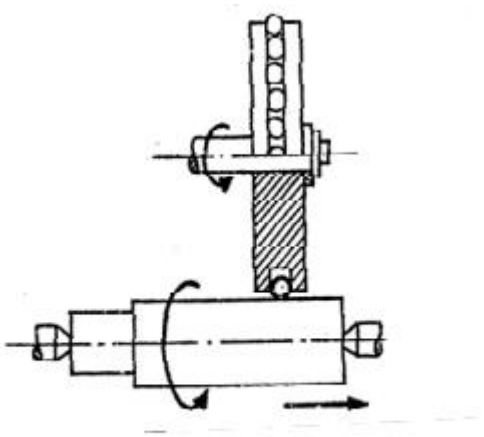
i. Very high tool cost.
ii. The work piece must be rigidly held and broach firmly guided.
iii. Large amounts of metal cannot be removed.
iv. A broach has to be designed for a specific application and can be used only for that application. Hence the lead time for manufacture is more for custom designed broaches.

4.	**Attempt any Four**	**4 x 4**	**16 M**
a.	**State the necessity of dielectric fluid in electro discharge machining process and name any two dielectric fluids.** **Necessity of Dielectric Fluid in EDM:-** • The dielectric fluid has significant role during micro EDM possess as without it, it is no longer possible to generate efficient discharge between micro tool tip and work piece surface. • The quality of surface finish and geometrical accuracy of machined parts depends on several properties of dielectric such as viscosity, dielectric strength, cooling capability, chemical compositions etc. • For safe machining operation and stable sparking condition the dielectric strength and flash point temperature of the dielectric fluid should be higher. • It acts as an insulator until the potential is sufficiently high. • It acts as a flushing medium and carries away the debris in the gap. • Provides a cooling medium. The most common dielectric fluids are mineral oils, although kerosene and distilled and deionised water may be used in specialized operations.	**1/4 M per point** For four point 2M **1M** Each For Two point 2M	**04 M**
b.	**Explain working principle of water jet machining process.**  Schematic of WJM Set Up	**02 M Figure**	**04 M**

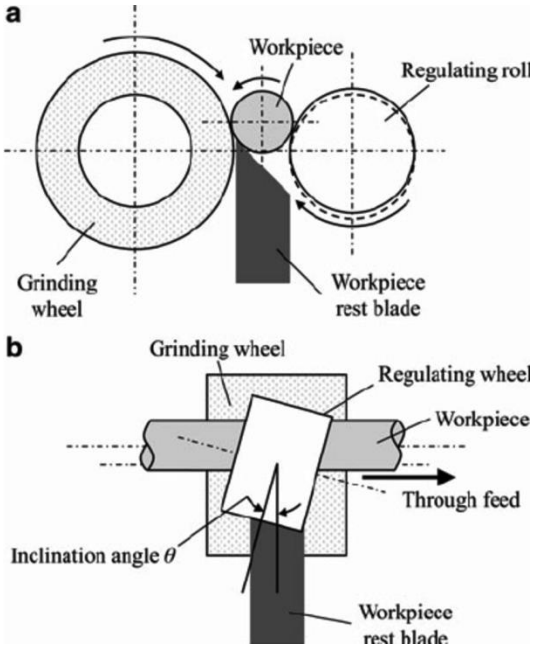
	• In water jet marching process a high velocity water jet is made to impinge on to the work piece. • This jet pierces the work material and performs a sort of slitting operation. • Water under pressure from a hydraulic accumulator is passed through the orifice of a nozzle to increase its velocity. • The nozzle orifice size (dia.) usually varies from 0.08mm to 0.5mm and the exit velocity of the water jet from the nozzle varies up to 920 m/s. • These high velocity jets can be used to cut relatively softer and non-metallic materials like Paper boards, woods, plastics asbestos, rubber, fibreglass, leather etc.	**02 M Explain**	
c.	**Compare absolute and incremental coordinate system.** **Absolute Coordinate System** / **Incremental Coordinate System** The coordinate will measured with respect to the origin of the coordinate system also called zero point. / The coordinate of any point is calculating reference to the previous point. It is easy to check and correct the program / It is difficult to check the part program incremental mode. The main advantage of the absolute system as compared with the incremental system is in the case of interruption that forces the operator to stop the machine. / In incremental system, any time the work interrupted, before switching on again operator must bring the tool manually exact place of the last operation occur. Almost all the point to point positioning system used absolute system. / Incremental systems are not often used controlling point to point machine tool. Absolute system is used for general program. / Incremental system is used for canned loop and subroutine program.	**01 marks /point** (For Any Four)	**04 M**
d.	**Explain principle of boring machine.** It is an operation of enlarging of a previously made hole in a work piece. In this operation a boring tool or a bit mounted on a rigid bar is held in post and fed into the work by hand or power in the similar way as for turning.  Boring.	**02 M Figure** **02 M Explain**	**04 M**
e.	**Explain with simple sketch up milling and down milling.** **Up milling**:- • It is the conventional milling process which is most commonly used. In this, the		**04 M**

	material is removed by the cutter which is rotating against the direction of travel of the work piece. • The thickness of the chip in the up milling is minimum at the beginning of the cut and it reaches maximum when the cutter terminates. • As the chip thickness per tooth is not uniform, the cutting force in up milling increases from zero to maximum. • The cutting force is directed upwards and it tends to lift the work from the fixture. Due to this, difficulty is experienced in pouring coolant just on the cutting edge from the chip begins. • As the cutter progresses, the chip gets accumulated at the cutting zone which spoils the machined surface. The surface milled by up milling is slightly wavy as the cutter teeth do not begin their cut as soon as they touch the work surface. **Down milling:-** • It is also known as climb milling. In this, material is removed by the cutter which is rotated in the same direction of travel of the work piece.  (a) Up milling and (b) down milling. • The thickness of the chip is maximum when the tooth begins the cut and it reduces to minimum when the cut terminates. • The cutter tooth starts removing the metal immediately on reaching the work piece, without sliding. • The cutting force in down milling is maximum when the tooth begins its cut and is minimum when the tooth leaves the work. Here the chips are disposed off easily and do not interfere with the work. • Fixture design is easier as the cutting force tries to seat the work firmly in work holding devices. • Coolant can be poured directly at the cutting zone. This results in improved surface finish. • If there is any backlash in feed screw, it causes vibrations and damages work surface.	**01 M Explain** **02 M** Figure **01 M** Explain	
f.	**Explain process of gear hobbing.** **Gear Hobbing:-**	**03 M** Explain	**04 M**

	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.  	**01 M** Figure	
5.	**Attempt any Four**	**4 x 4**	**16 M**
a.	**Differentiate between face milling and peripheral milling.** **Face Milling** | **Peripheral Milling** In face milling the cutting action occurs primarily at the end corner of the milling cutter. | In peripheral the cutting action occurs primarily along the circumference of the cutter. Face milling is used to cut flat surfaces (Faces) into the work piece, or to cut flat bottomed cavities. | Peripheral milling is well suited to the cutting of deep slots, threads and ear teeth. In face milling the axis of the cutter is perpendicular to the surface being created and metal is removed by cutting edges on both the end and outside periphery of the cutter. | In peripheral milling the axis of tool is parallel to surface being milled, and material is removed by cutting edges on the outside periphery of the milling cutter. e.g.:- conventional face milling, end milling, pocket milling, surface countering. | e.g.:- slab milling, slot milling, side milling, straddle milling, form milling.	**01 marks /point** (For Any Four)	**04 M**
b.	**State the various method of gear finishing and objectivise of gear finishing.** **Methods of Gear Finishing:-** 1. Gear Shaving. 2. Gear Grinding. 3. Gear Burnishing. 4. Gear Lapping. 5. Gear Honning. **Objectives:-** • For smooth running, good performance and long service life. • To achieve be accurate in dimensions and forms.	**02 M** **02 M**	**04 M**

	• To achieve high surface finish. • To be hard and wear resistive at their tooth flanks. • To remove inaccuracies produced through gear generating process.		
c.	**Define the following terms related with grinding:-** **1) Grain Size:-**The grit or grain number indicates the size of abrasive used for making a grinding wheel. These sized particles are called grains or grits. The grain size may be classified as, Coarse, Medium, Fine, And Very Fine. **2) Bond:-**The bond is the substance which when mixed with the abrasive grains, holds them together enabling the mixture to be shaped to form grinding wheel. e.g. Vitrified bond, Silicate Bond, Shellac Bond, Resinoid Bond, Rubber Bond. **3) Grade: -** The grade means degree of hardness of the wheel means the hardness with which the bond holds the cutting point or abrasive grains in a place. Hard wheels are recommended for soft material and soft wheels are recommended for hard material. e.g. Soft wheels, Medium wheels, Hard wheels. **4) Structure: -** The relative spacing is referred to as the structure and denoted by the number of cutting edge per unit area of wheel face as well as by number and size void space between grains. Wheel structures commonly used an indicated by number varying from 1 to 15 or higher, 1 being closet and 15 being most open. Soft and ductile material and heavy cut requires open structure. Hard and brittle and finishing cut requires a dense structure.	**01 M** (For Each)	**04 M**
d.	**Explain burnishing process and give its two applications.** • Burnishing is a cold working process, by which improvement in the surface finish, dimensional accuracy and work hardening can be obtained without removing the metal. • It is process of producing bright shining and smooth surface on metals. • It is finishing operation and it is normally done on parts which are turned, bored, reamed and ground. • In this process instead of abrasive particles a highly polished medium steel ball are used.  Scheme of ball burnishing • The ball rubs over the metal surface in contact pressure or compresses it to remove the surface irregularities from there producing fine lustre. **Application of Burnishing:-** Hydraulic system components, seals, valves, spindles and fillets on shafts.	**02 M** Explain **01 M** Figure **01 M** Appl^{n}	**04 M**
e.	**Explain the need of machine tool maintenance.**	**04 M**	**04 M**

	Need For Machine Tool Maintenance:- 1. Its accuracy does not deteriorate. 2. It manufactures the components most economical. 3. It remains in working condition at all the times. 4. To keep it proper working condition.	(1M Each)	
f.	**List merits and demerits of preventive maintenance.** **Merits of Preventive Maintenance:-** 1. Flexibility allows for the adjustment of maintenance periodicity. 2. Reduced equipment or process failure and increased equipment life. 3. Reduced breakdown and connected down time. 4. Greater safety for workers. 5. Fewer large scale and repetitive repairs. 6. Identifications of equipment are requiring high maintenance cost. 7. Reduced down time as the machine work smoothly. 8. Minimized loss of production due to breakdown. **Demerits of Preventive Maintenance:-** 1. Catastrophic failures still likely to occur. 2. Labour intensive. (A group of labour is required). 3. Includes performance of unneeded maintenance (Maintenance is carried out of those parts also which does not required maintenance). 4. Reduction of output as machine is called off for maintenance (Closed for maintenance). 5. Direct loss of profit.	**02 M** Merits (1/2 M per Point) **02 M** Demerits (1/2 M per Point)	**04 M**
06	**Attempt any Two**	**8 x 2**	**16 M**
a.	**What is indexing? State the different methods of indexing and explain any one in detail.** **Indexing:-** The process of dividing a circular or straight part into equal spaces by means of a dividing head is known as indexing. The indexing head Is also known as dividing head. The process of dividing a circular or straight part into equal spaces by means of a dividing head is known as indexing. The indexing head Is also known as dividing head. 1. Simple indexing or plain indexing. 2. Direct indexing. 3. Differential indexing. 4. Compound indexing. **Direct indexing:-** • For direct indexing the worm and worm wheel of index head is disengaged. • Index plate having 24, 30 and 36 hole circle is the fitted to the front end of the spindle nose. • A spring loaded pin can be pushed into any hole to lock the spindle with frame. • While indexing, the pin is first taken out and then the spindle is rotated by hand. • After required position is reached, index pin is once again locked with frame. • With 24 hole plate we can divide the periphery of work into 2, 4, 6, 8, 12 and 24 equal divisions.	**02 M** Def. **02 M** Types **04 M** Exp.	**08 M**

	• Direct indexing is used for milling of square, hexagonal nut and bolts on milling machine. **Example:-** To divide the work periphery in 8 division with the help of 24 hole plate. The index movement is 24/8=3. Thus, we should move the pin by 3 holes after each teeth is cut.		
b.	**Explain principle of centre less grinding and explain:** **Centre less Grinding principle:-** • When the work piece is supported by the centres between grinding wheel regulating wheel by work rest blade then it is called as the centre-less grinding. • In this both wheel rotate in the same direction and the rotation of the grinding wheel force the work piece on the work-rest blade against the regulating wheel. • The regulating wheel controls the speed of work and longitudinal feed movement. **In feed centre less grinding.** • In the method there is no axial movement of the work-piece, the only movement is the rotating movement. • During the process the work-piece is placed on the work rest against an end stop and then the control wheel is advanced towards the grinding wheel by some lever arrangement. • The regulating wheel is given slight inclination of (1/2)°in order that work piece remain tight against the end stop. • The length of work-piece that can be ground is 30cm by this process. Form grinding is also possible with this method. • This method is used when work-piece is of heated, stepped or taper form. **End feed centre less grinding.** • The work-piece is fed as in case of in feed method and after certain portion of length of work-piece has been ground ,the axial movement takes place until whole length has been ground. • It is used for the headed components which are too long to be ground by in feed method. • It is also used for the tapered work; usually both grinding wheel and regulating wheel are trued to obtain the required taper. 	**02 M** Principle **02 M** Fig. **02 M** In feed **02 M** End feed	**08 M**
c.	**What are the various types of maintenance? Explain the information recorded in maintenance record.**		**08 M**

Types of Maintenance:-

1. Preventive Maintenance.
2. Predictive maintenance.
3. Breakdown maintenance.
4. Corrective maintenance.
5. Schedule maintenance.

02 M (Types)

Maintenance records are the various documents of maintenance activities carried out by staff of the maintenance section. These documents are used for improvements as well as to get the history of maintenance of a particular machine or equipment. The maintenance records include following reports.

- Machine history card.
- Preventive maintenance chart.
- Break down Report.

By using these previous record and its analysis it is easy for fast decision making when faults occur in the machine.

02 M (Expl.)

Preventive Maintenance Chart

1. Company Name :_____
2. Department /Section :_____
3. Name of machine : Lathe (HMT) Maintenance staff :

Sr. No	Machine Part	Check for	Status required	Status observed	Action	Remark

Break down Maintenance Chart

1. Company Name :_____
2. Department /Section :_____
3. Name of machine : Lathe (HMT) Maintenance staff :

Sr. No	Name of Defective Part	Action taken	Repair details	Break down			
				Date	Time	Date	Time

Machine History Card

1. Company Name :_____
2. Department /Section :_____
3. Name of machine : Lathe (HMT)

Sr. No	Date	Nature of fault	Action taken	Lost Hours	Lost Hrs	Lost in Quantity	Remarks	Sign

04 M (02 M) Each

(Any Two)