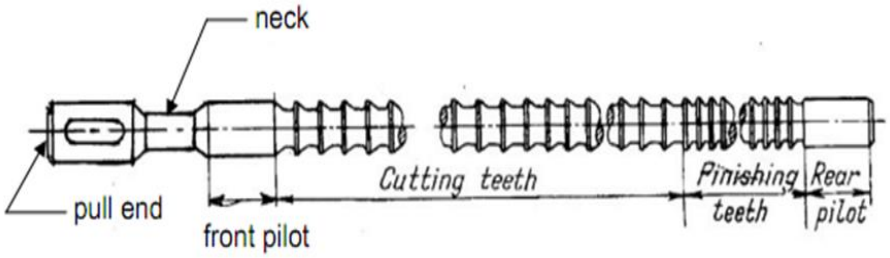
WINNTER – 15 EXAMINATIONS

Subject Code: **17556** **Model Answer** Page No: ____/ N

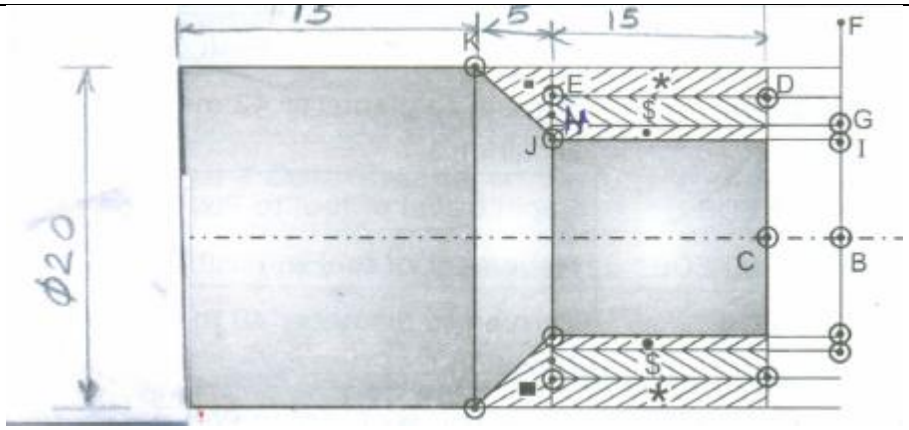
Important Instructions to examiners:

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.

Q. NO.	MODEL ANSWER	MARKS	TOTAL MARKS
1	**Attempt any FIVE**	05 x 4	20
a)	The need of non-traditional processes is justified by the following points: (i)To machine exotic material (ii)To fulfill the requirements of new age like innovative design, tighter tolerances, micromachining and economy. (iii) To obtain intricate shapes. (iv) Overcome difficulty to machine the material. (v) To fulfill the requirement of low stress qrindinq. (vi) Drilling deep hole with small hole diameter (vii) Machining of composites.	1m per point	4m
b)	TYPES OF MAINTENANCE The following are the types of maintenance followed in general: (i) Preventive maintenance. (ii) Predictive maintenance. (iii) Breakdown maintenance. (iv) Corrective maintenance. (v) Scheduled maintenance. PREDICTIVE MAINTENANCE • The name suggests that predictive maintenance means predicting the failure before it occurs. • It includes identifying the root causes for failure symptoms and eliminating those causes before they result in extensive damage to the machine tool. • In predictive maintenance, equipment conditions are measured periodically (at short intervals) or on a continuous basis. •The preditve maintaince encompasses the following three distinct stages: (1)Detection;During this stage,the initialization of defect is detected through changed symptoms. For example,unusual sounds coming out of a rotating equipment,an excessively hot electric cable etc. (2)Analysis:This stage is for analysis to findout main causes responsible to generate the detected defects. (3)Correction:During this stage,the main causes analysed in earlier stages are eliminated by conducting necessary repairs. • All the above three stages are important and should be practiced properly and in sequence. • Cost of predictive maintenance is justified by prolonging the time interval between shutdowns or repairs or overhauls. • If, on the other hand, if the operator of the car analyse the oil to determine its actual condition and lubrication properties then he/she may be able to extend the oil change until the vehicle had travelled 10,000 miles or can change the oil after 2000 miles if it is not suitable. This approach is similar to predictive maintenance.	1m for types 3m for exp	4m

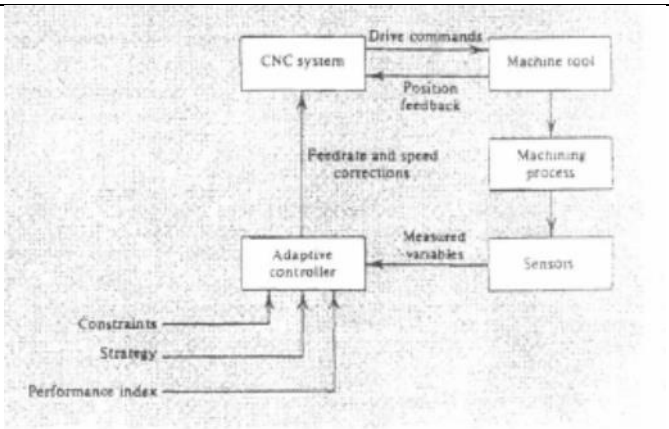
c)	Index Crank Movement = $\frac{\text{Angular displacement of work in degrees}}{9}$ $= \frac{19\frac{14}{60}}{9}$ $= \frac{19\frac{7}{30}}{9} = \frac{577}{270}$ $= 2\frac{37}{270} \approx 2\frac{3.7}{27}$ i.e 2 complete turn and 4 holes in 27 hole circle. (as the value is 3.7 , 3 or 4 holes can be taken)	3m for sum 1m for inference	4m
d)		4m	4m
e)	• A dry run is a testing process where the effects of a possible failure are intentionally mitigated. • In computer programming, a dry run is a mental run of a computer program where the computer programmer examines the source code one step at a time and determines what it will do when run. • It is a special kind of override It is activated from the control panel by the dry run switch. • No actual machining takes place when dry run switch is in effect. Its purpose is to test the program before CNC operator cuts the first cut. • During dry run part is normally not mounted in the machine. • During dry run program can be checked for all possible errors except those that relate to actual contact of cutting tool with material. JOG MODE • The mode that allows for the manual operation of tool movement via the jog buttons is called as jog mode. • Jog mode is mostly used to travel the CNC machine table slide for movement of table along x-axis or z-axis, • These axis movements can be via a jog mode button or through the CNC	2m for dry run (1m per point) 2m for jog mode (1m per point)	4m

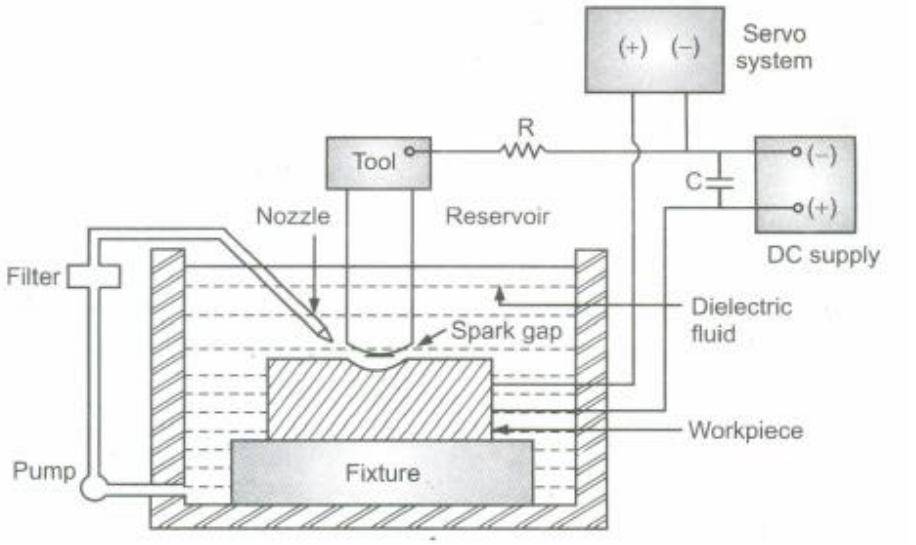
	machine hand wheel. It is also called as manual mode. • In this mode, the CNC machine behaves like a standard or conventional machine. • With the jog mode, the operator of a CNC machine is allowed to press buttons, turn 'hand wheels, and activate switches in order to attain the desired machine function. • The activation of each button or switch in the manual mode has an immediate response.		
f)	Truing: • It is the process of making the wheel face perfectly true, to ensure that its circumference is perfectly concentric with the spindle on which it is revolving. • It removes glazing defect. • It is carried out with a diamond tool. • For trueing the grinding wheel is rotated and a diamond tool is held against thewheel. • The tool is reciprocated over the wheel to cover the complete width of the wheel. Dressing • It is the process of cleaning and opening up of the face of the wheel. • It removes warm out grains from the wheel face and the sharp abrasive particles are again presented to the work. • It removes loading defect. • It is carried out by a start wheel dresser. • A dresser consists of a number of hardened steel wheels with paint on their periphery. The dresser is held against the face of the revolving wheel and moved across the face to dress the wheel surface.	2m for truing 2m for dressing	4m
g)	Advantages of AJM (i) Intricate cavities and holes of any shapes can be easily machines. (ii) Brittle material of thin section can be easily machined. (iii) Low initial investment is required. (iv) No direct contact of tool and workpiece. (v) Amount of heat generated is not appreciable. (vi) Normally inaccessible portions can be machined with fairly good accuracy. Disadvantages of AJM (i) Low metal removal rate. (ii) Once used, abrasive particles cannot be reused. (iii) Not suitable for machining of ductile material. (iv) Relatively poor machining accuracy. (v) There is possibility of abrasive particle getting embedded in the work material, hence cleaning needs to be necessarily done after the operation	2m adv 2m disadv (1m per point)	4m

2	Attempt any TWO	8 x 2	16
a)		8m	8m

Program	Description
1234	Program Number
N100 G90 G21 G94 EOB	Absolute mode, input in mm, feed in mrn/rnin.
N110 M03 S800 M08 EOB	Spindle start clockwise direction, spindle speed, coolant on.
N120 G00 X0 Z2 EOB	Rapid travel of tool to Position B
N130 G01 Z 0 F200 EOB	Movement of tool to Position C . .'
N140 X18 EOB	Facing operation. (Position D.) .
N150 Z -15 EOB	Turning to diameter 18 mm for a length of 15 mm. (Position E.)
N160 G00 X28 Z2 EOB	Rapid travel of tool to Position F.
N170 G01 X16 F200 EOB	Movement of tool to the Position G..
N180 Z-15 EOB	Turning to diameter 16 mm for a length of 15 mm. Position H.
N190 G00 X28 Z2 EOB	Rapid travel of tool to Position F.
N200 G01 X15 F200 EOB	Movement of tool to Position I.
N210 Z-15 EOB	Turning to diameter 15 mm for a length of 15 mm. (Position J).
N220 X20 Z -20 EOB	Taper Turninq for a length of 5 mm. Position K..
N230 G00 X80 Z50 EOB	Rapid travel of tool away from the work piece.
N240 G28 EOB	Rapid return to machine reference position.
N250 M05 EOB	Spindle stop.
N230 M09 EOB	Coolant-off.
N240 M30 EOB	Program end and tape rewind.

b)	Index crank movement = $\frac{40}{N}$ N=Number of divisions required on work = $\frac{40}{60}$ = $\frac{2}{3}$ (Selection of plate depends on number divisible by 3) Plate No.1 with 15 selected = $\frac{2}{3} \times \frac{5}{5}$ = $\frac{10}{15}$ Thus Index Movement will be 10 holes on a 15 holes index plate Index crank movement = $\frac{40}{N}$ N=Number of divisions required on work = $\frac{40}{35}$ = $\frac{8}{7}$ (Selection of plate depends on number divisible by 7) = $\frac{8}{7} \times \frac{3}{3}$ = $\frac{24}{21}$ = $1\frac{3}{21}$ Thus index movement will be 1 complete turn of the index crank and 3 holes on a 21 holes Index Plate	4m first part sum (1m inference) 4m secon part sum (1m inference)	8m
c)	ADAPTIVE CONTROL Adaptive control can be defined as a set of techniques for automatic adjustment of the controllers in real time, in order to achieve or to maintain a desired level of performance of the control system when the parameters of the machine tool are unknown and/or change with time. Advantages 1. Increased production rates 2. Increased tool life 3. Greater part protection 4. Less operator intervention S. Easier part programming	2m def 2m adv(1 m per point) 3m for exp 1m for dia	8m

	 • Adaptive control system determines the correct feed and speed are automatically found and it is not necessary to spend efforts on calculations of optimum feeds and speeds. • It takes into account the variations in work-material hardness, width or depth of cut, air gaps in part geometry and so on. • Adaptive control has the capability to respond to and compensate for these variations during process. • By doing this the in-process time is reduced by using optimum speeds and/or feeds. • By increasing tool life simultaneously with time saving, the adaptive control system contribute to lower operating costs, which justifies the extra price of adding AC to a conventional NC machine.		
3	**Attempt any FOUR**	**4 x 4**	**16**
a)	Working •EDM works on the principle that heat energy generated by a spark is used to remove material from the work piece. •The tool and work piece are separated by a small gap called as spark gap. The gap varies from 0.01 mm t 0.5 mm. The tool and work piece both are immersed in the dielectric fluid. •When supply is made 'ON', thousands of sparks are produced per second. The duration of each spark is very short. •When the spark comes in contact with the dielectric fluid in the spark gap, thefluid gets ionized •A very high temperature of around 10000°C is generated in the spark region. As a result, the material gets melted and is removed from the work piece. •These melted particles of the metal are then driven away by the dielectric fluid.	1/2m diag 2m working $1^1/_2$m for construction	4m



construction

• It consists of the four major components:

(i) Tool and work piece.

(ii) Dielectric fluid system.

(iii) R-C circuit and power supply unit.

(iv) Tool feed mechanism.

(i) Tool and work piece:

The tool and work piece is kept in a reservouir and is connected to a DC power supply. The tool is connected to negative terminal, so that it becomes cathode, while work piece is connected to positive terminal and become anode.

(ii) A dielectric system:

The reservoir is filled with dielectric fluid such that the spark gap is immersed in it. Dielectric is continuously flushed into the spark gap. The used dielectric is filtered and recirculated in to the reservoir. The dielectric fluid is pumped at a pressure of 2 kg/cm^2 or less.

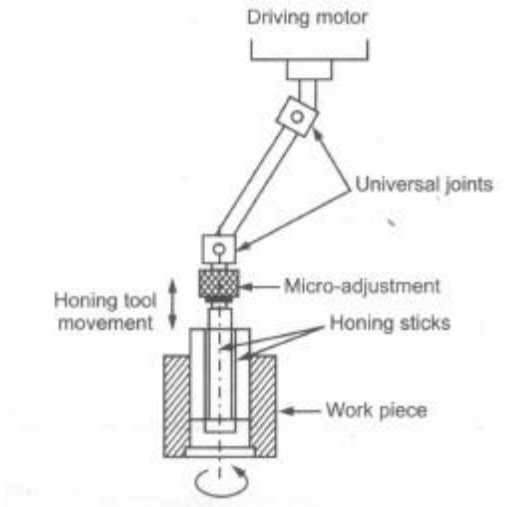
(iii) A R-C circuit: (Relaxation Circuit)

When the supply is made 'ON' the capacitor voltage starts rising continuously. When the capacitor voltage equals the breakdown voltage, (of dielectric fluid) a spark discharge will occur in the spark gap.

(iv) Tool feed mechanism:

Since during operation both the tool and work piece are eroded, it is necessary to feed the tool continuously towards the work piece so as to maintain the spark gap. This can be achieved by a suitable tool feed control mechanism along with

b)	Safety precautions in CNC •Always keep the area around the machine clear of obstacles. •Always stack material where you can reach it but where it is clear of the moving parts of the machine. •Always check that tools are sharp and set correctly.	1m per point	4m

	•Always check that the correct tool data is entered into the CNC program. •Always make sure that all guards are in position while the machine is in operation •Always make sure that all work and fixtures are clamped securely before starting machine. •Always make sure spindle direction is correct for right-hand or left-hand operation. •Always conduct a dry run to ensure the program is correct. •Always follow company policy on correct procedures when handling or lifting parts or tooling. •Do not use the machine table as a workbench. •Do not use compressed air to blow chips from the parts of the machine, machine surfaces, cabinets, controls or floor around the machine.		
c)	Honing process: • When honing is done manually, the honing tool is rotated and work piece is passed back and forth over the tool. • Length of motion is such that the stones extend beyond the work piece surface at the end of each stroke.  • Honing stones may be held in the honing head by cementing them to metal shells, which are clamped into holder or they are cemented directly into holders. • During honing operation, the spindle of the honing machine rotates the hone and simultaneously reciprocates it in a work piece. • The spindle speed is generally 2 m/sec for rotation and 0.5 m/sec for reciprocating motion. • Coolants are essential to the operation of this process, to flush away small chips and to keep temperatures uniform.	1m diag 3m exp	4m
d)	How To Use Maintenance Manual: • If you have a maintenance manual, using it to make repairs or do maintenance on machine can be much simpler and efficient. • Most manuals are self-explanatory, but here are some tips on getting more	4m	4m

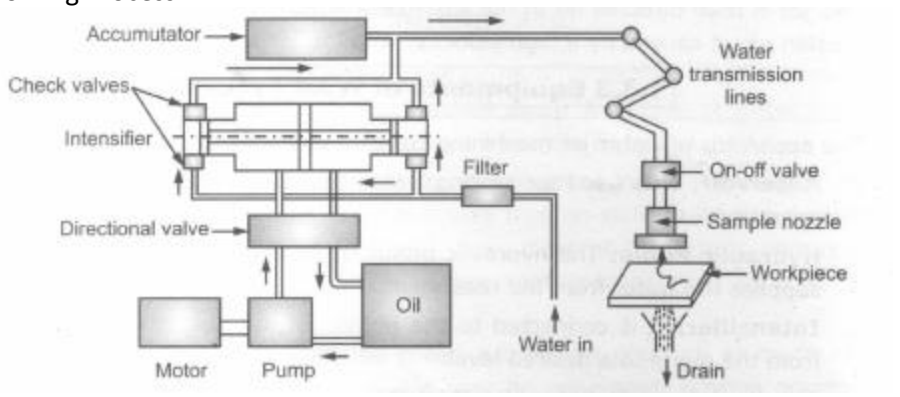
out of yours.
(i) Make sure you are reading the right manual.
(ii) Look for specific sections detailing the type of service or repair you are going to perform. For example, lubrication, inspection, repairs etc.
(iii) Read the "Table of Contents" to search for the topics that you are looking for. For example, In a lathe machine the topics may be chuck, spindle, carriage, tool post etc. The table of contents will give you the page number of the required information.
(iv) Look in the "Index" for keywords or phrases related to the specific task you intend to perform, if it is not covered in a section or table of contents.
(v) Read the section (mentioned in step iii) that describes the task you are undertaking to understand all of the steps you must complete to finish the job.
(vi) Look in the "Abbreviation" to get the complete meaning of the acronym.
(vii) Look for specific warnings if any.
(viii) Find any reference to specific tools, gauges, or other specialized equipment that is required to perform your maintenance or repair.
(ix) Follow instructions when performing the maintenance carefully, until you are familiar with the procedure. Recheck your work, and test it if possible.
(x) Put a "Tab' or "Bookmark" on pages that you refer to frequently .

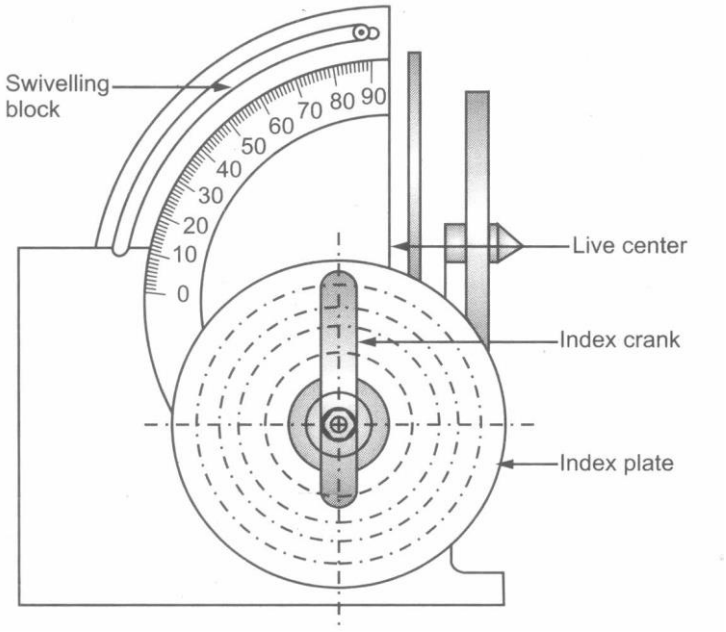
e)

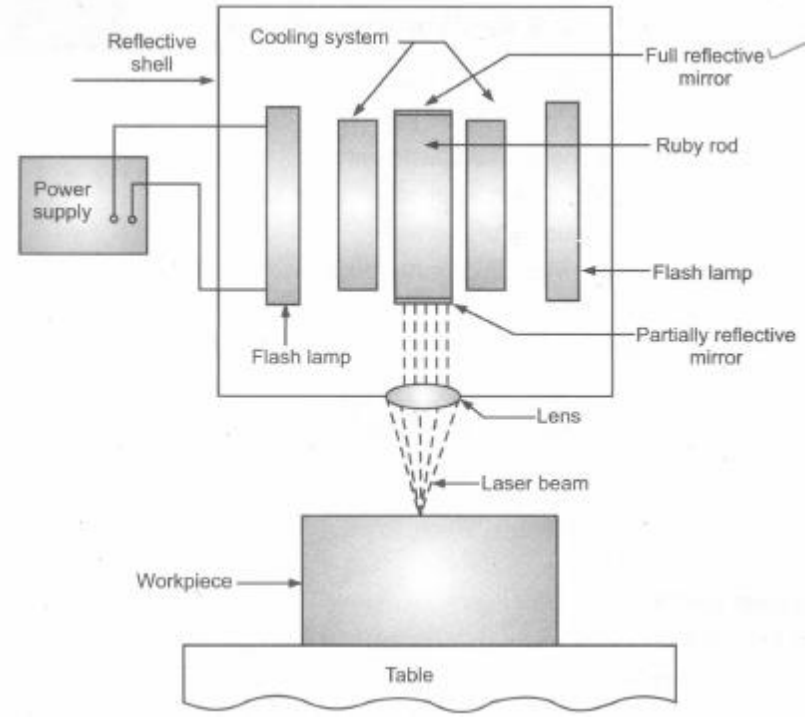
Sr.No.	Capstan lathe	Turret lathe
1.	It is a light duty machine.	Turret lathes are relatively more robust and heavy duty machine
2.	The turret head is mounted on theram and the ram is mounted on the saddle and moves on the guideways.	The turret head is directly mounted on the saddle and the saddle slides over the bed ways
3.	The saddle will not be moved during machining.	The saddle is moved along with the turret head during machining.
4.	The lengthwise movement of turret is less.	The lengthwise movement of turret is more
5.	Only short workpieces can be machined.	Long work pieces can be machined.
6.	Collet is used to hold the workpiece.	Jaw chuck is used to hold the workpiece
7.	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
8.	The turret head cannot be moved crosswise.	The turret head can be moved crosswise in some turret lathes
9.	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 workpieces up to 200 mm

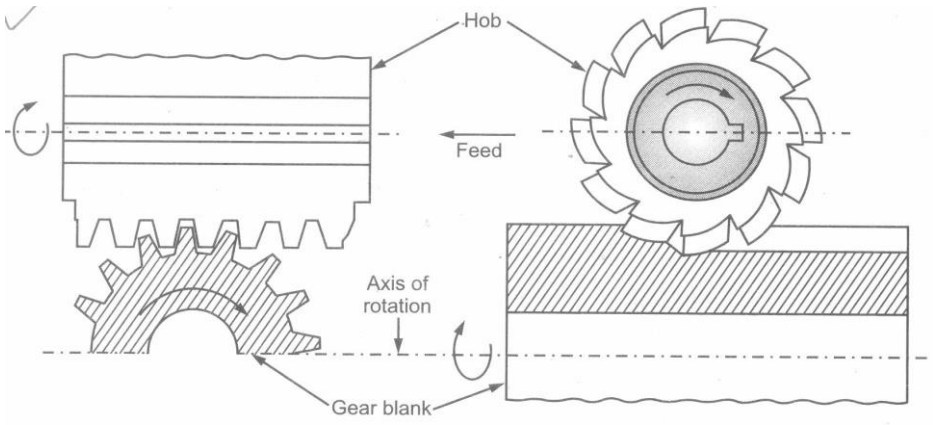
1m per point

4m

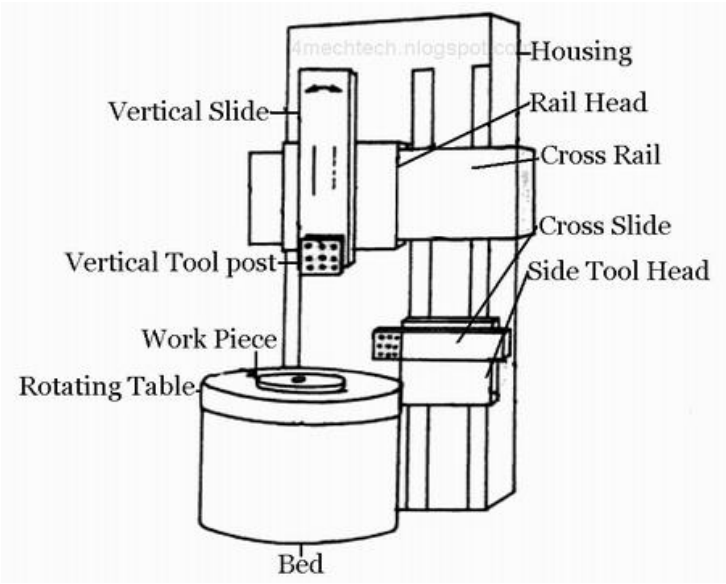
			diameter.		
	11.	Capstan lathes generally deal with short or long rod type blanks held in collet.	Turret lathes mostly work on chucking type jobs held in the quick acting chucks.		
	12.	The turret travels with limited stroke length within a saddle type guide block, called auxiliary bed, which is clamped on the main bed.	In turret lathe, the heavy turret being mounted on the saddle whichdirectly slides with larger stroke lenqth on the main bed.		
	13.	External screw threads are cut incapstan lathe using a self opening die being mounted in one face of the turret.	In turret lathes external threads arecut by a single point or multipoint chasing tool being mounted on the front slide and moved by a short leadscrew 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)	Working Process:  • Water from the reservoir is pumped to the intensifier using a hydraulic pump. • The intensifier accepts the water at low pressure and pressurizes it to around 400 MPa. • Pressurized water is then sent to the accumulator. The accumulator temporarily stores the pressurized water during the idle period and given out during cutting. • Pressurized water then enters the nozzle by passing through the control valve and flow regulator. • Control valve controls the direction of water and limits the pressure of water under permissible limits. • Flow regulator regulates and controls the flow rate of water. • Pressurized water finally enters the nozzle. Here, it expands with a tremendous increase in its kinetic energy. High velocity water jet is produced by the nozzle.			1m for diag 3m for exp	4m

	• The jet stream coming out of the nozzle strikes the workpiece and induces stresses. These stresses are used to cuts the workpiece. • The water is then collected in a drain system.		
4	**Attempt any TWO**	**8 x 2**	**16**
a)	 construction • The universal dividing head is a robust body containing the following parts: 1. Worm and worm wheel: The worm wheel is mounted on the spindle. In general the worm wheel has 40 teeths. It mesh with a worm which is single threaded. 2. Worm shaft: The work is mounted on the worm shaft. 3. The index plate is mounted on a sleeve which in turn is mounted on the worm shaft. Index plate is a circular steel plate having several concentric rows of holes which are equidistant in each separate row. 4. Crank: The crank is mounted on the worm shaft. A slot is provided radially on the crank. S. Plunger and plunger pin: The plunger is mounted on the crank. It can slide along the slot in the crank and can be adjusted along the desired hole circle on the index plate. The plunger is spring loaded and can fit into the index plate hole by means of plunger pin. 6. Spindle: The spindle is provided with a job carrier and a centre at its front end to hold the workpiece. 7. Sector arm: It is provided on the index plate. It can be set a desired angle with no one another. Working: • The plunger is pulled out and rotated in one direction. This rotates the crank. As the crank is mounted over the shaft, the shaft rotates. The worm rotates as it is formed on the shaft. The worm wheel is in the mesh with worm, so the wheel rotates. This rotates the spindle and ultimately the work	2m diag 3m for const 3m for worki ng	8m

	piece. • One rotation of crank rotates the work by 1/4 revolutions. • Or we can say when the crank is rotated by 40 turns, the main spindle and hence work will rotate through one turn. • To rotate the crank through fraction of turn, index plate is used.		
b)	 construction • The laser beam machining is shown in the Fig. and itconsist of: (i) Ruby rod with reflecting mirror. (ii) Flash lamp. (iii) Cooling arrangement. (iv) Lens. (v) Power supply. (i) Ruby Rodwith Reflecting Mirror: It is crystalline aluminium oxide which is about 10 mm in diameter and 100 mm in length. The ends of a ruby rod are made reflective by two parallel mirrors.One of these mirrors is fully reflective while the other is partially reflective to allow the beam to pass through it. (ii) Flash lamp: A flash lamp is filled with gas like Xenon, Argon, krypton etc. The flash lamp surrounds the ruby rod. When the flash lamp is charged, it starts emitting high intense flashes of light.The ruby rod and flash lamp both are kept in a highly reflectinq cylinder. (iii) Cooling arrangement: The efficiency of ruby rod reduces at higher temperature. It is therefore necessary to continuously cool the ruby rod. For this purpose liquid nitrogen at -196°C is supplied to the ruby.The flash lamp operates best when it is	2m diag 3m for const 3m for worki ng	8m

	warm. Hence, hot air is circulated around it. A vacuum chamber is provided between the two to maintain the temperature difference between them. (iv) Lens: The laser beam is passed through the lens on to the work piece. The focal length should be accurate in order to machine the work piece. (v) Power supply: When power supply is made 'ON', the flash lamp emits flashes of light. working: When power supply is made 'ON', the flash lamp emits flashes of light. The ruby rod absorbs sufficient light. This light travels to and fro between the two parallel mirrors. • This amplified stream of light comes out through partially transparent mirror and is focused on the lens.Two mirrors are parallel to each other.One is fully reflective and other is partially reflective. • The lens converge the laser beam on the work piece. • This melts the work piece and vapourizes it which results in machining of thework piece. • During operation, the work piece to be cut is placed on the aluminium work table. • The motion can be given either to work piece or to the beam or both depending upon the requirement. • The operator visually inspects the process and accordingly adjusts the motion		
c)	Hobbing Process  • The process of hobbing is shown in Fig. • In this process the hob and gear blank are mounted on the shafts that are at right angles to each other. The hob axis may be either horizontal or vertical. • For machining of spur gears, the hob must be tilted through its helix angle to result in the involute profile . •. The hob and blank are rotated about their axes with different speeds. • The blank is then moved towards the hob until proper depth is reached. • The hob is then fed into the gear blank.	**1**m diag **2**m adv($^1/_2$m per point) **2**m disadv ($^1/_2$m per point) **3**m process	8m

	• As soon as the proper depth is achieved, the hob is fed in a direction parallel to the axis of rotation of the gear blank. • The speeds of two are so adjusted that the blank rotates through one pitch distance for each complete revolution of the hob. • The operation is a continuous one with no break in between. • Thus the gear cutting with hob involves three basic motions, all of them occurring at the same time. o The rotation of hob. o The rotation of blank. o The axial advancement (feed) of the hob. Advantages of Gear Hobbing 1. It is faster and continuous process. 2. Rate of production is high as it cuts several teeth simultaneously. 3. Hobbing machine set-up is simple and quick. 4. High accuracy can be obtained. 5. Many gears of same size can be cut simultaneously. 6. It can cut spur gear, helical gear, worm gear, sprockets, splines etc. 7. Gap type herringbone gears can be generated only through this process. 8. Long shafts and splines can be easily accommodated on hobbing machine. 9. The heat generated during the process is evenly distributed over gear blank and hob therefore excessive heating of both is avoided. Limitations of Gear Hobbing 1. It can not generate internal gears. 2. It can not cut the gears which are having shoulders and flanges. 3. It can not produce unsymmetrical shapes.		
5	**Attempt any FOUR**	**4 x 4**	**16**
a)	vertical turret lathe A vertical turret lathe works much like an engine lathe turned up on end. The characteristic features of the vertical turret lathe are (1) a horizontal table or faceplate that holds the work and rotates about a vertical axis; (2) a side head that can be fed either horizontally or vertically; and (3) a turret slide, mounted on a crossrail that can feed nonrotating tools either vertically or horizontally. The main advantage of the vertical turret lathe over the engine lathe is that heavy or awkward parts are easier to set up on the vertical turret lathe and, generally, the vertical turret lathe will handle much larger workpieces than the engine lathe	1m diag 3m exp	4m



The size of the vertical turret lathe is designated by the diameter of the table. Feed can be given vertically toward the headstock (down), horizontally, or at an angle. In vertical turret lathe work, use offset or bent-shank cutters, special sweep tools, and forming tools, particularly when machine odd-shaped pieces. Vertical turret lathes have varying degrees of capabilities, including feed and speed ranges, angular turning limits, and special features such as threading. A typical vertical turret lathe has a system of feed trips and stops that functions similarly to those on a horizontal turret lathe. In addition, the machine has feed disengagement devices to prevent the heads from going beyond safe maximum limits and bumping into each other

b) Specification Of Grinding Wheel — 4m — 4m

• Method of grinding wheel specification differ with the manufacturer and country, in order to bring the uniformity, Bureau of Indian Standards has suggested the marking scheme consisting of following six characters in sequence.

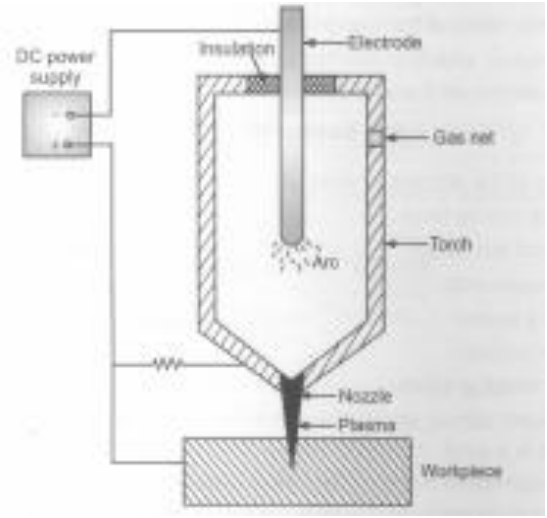
• This codlifcation IS as per Bureau Of Indian Standard Code IS 5511989

0	1	2	3	4	5	6
Prefix	Abrasive Type	Abrasive grains	Grade	Structure(Use optional)	Nature of Bond	Manufacturer's Symbol(Type of Bond)

Prefix:

• Manufacturer may use a suitable prefix preceding the type of abrasive notation to indicate his own trade brand of the abrasive used. Use of prefix is optional.

Manufacturer's symbol: Manufacturer may use a suitable suffix to the type of

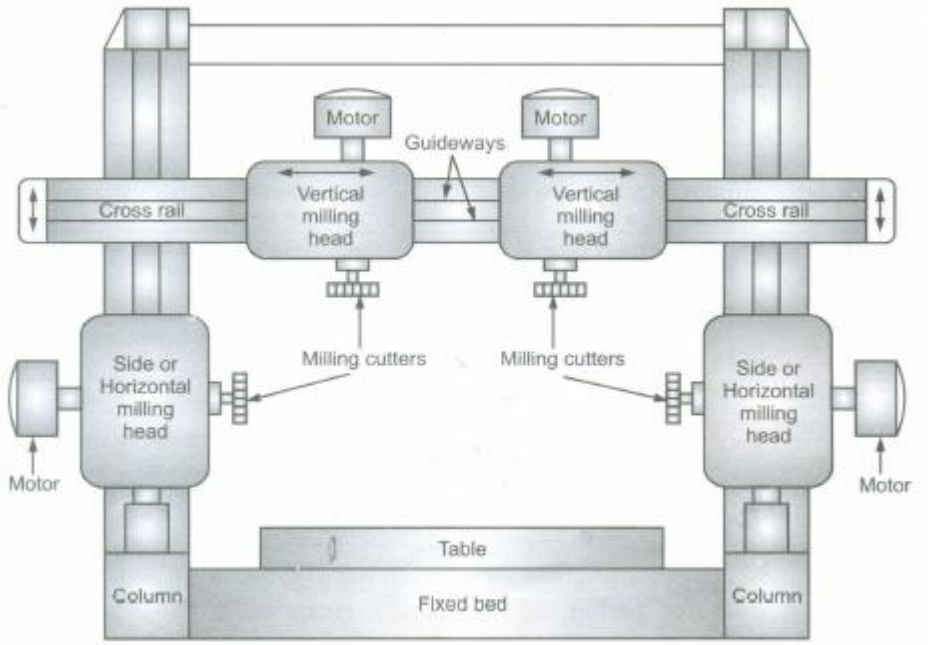
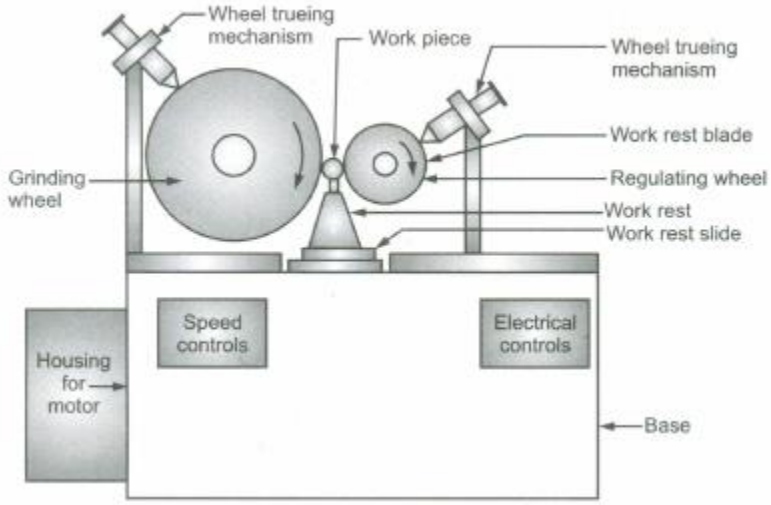
	bond. Use of suffix is also optional. For eg:WA46K5V17 W Prefix A Abrasive Type 46 Abrasive grains size K Grade 5 wheel Structure V Nature of Bond 17 Manufacturer'sSymbol		
c)	• When a high velocity jet of plasma is directed on the workpiece surface by means of a plasma arc cutting torch, the metal from the workpiece melts which results in to the machining of the workpiece. • The continuous attack of electrons on the workpiece which transfer the heat energy of plasma on the workpiece causes the workpiece to melt. •When a gas is heated, then the number of collisions between the atoms Increases. Due to this the gas ionizes, which results in electrons and ions. The electrons thus produced, in turn, collide with atoms, increase their kinetic energy and ionize them so that more electrons and ions are produced. Thus, the plasma has an ability to conduct electricity due to the presence of electrons.  • When the gas is completely ionized, then the temperature of the central part of the plasma is between 11000°C to 28000°C. • When such an ionized gas is directed on the workpiece through a high velocity jet, the metal is removed by melting. Applications of PAM (i) For stock cutting, plate beveling, shape cutting and piercing. (ii) In manufacture of automotive and rail road components. (iii) It can cut hot extrusions to desired length. (iv) For removal of gates and riser from casting in foundary.	1m diag 1m app 2m princi ple	4m

<table>
<tr><td>d)</td><td>COMPARISON
<table>
<tr><th>Features</th><th>Gear Hobbing</th><th>Gear Shaping</th></tr>
<tr><td>Accuracy</td><td>Better with respect to tooth spacing and runout. Equal so far lead accuracy is required.</td><td>Better with respect to tooth form.</td></tr>
<tr><td>Surface finish</td><td>Hobbing produces a series of radial flats based on feed rate of hob across the work</td><td>Shaping produces a series of straight lines parallel to the axis of the gear. Surface finish may be better</td></tr>
<tr><td>Versatility</td><td>Cannot be used for internal gears</td><td>Can be used for internal gears</td></tr>
<tr><td>Limitation</td><td>Faster for gears with larger face width.</td><td>Time cycle will be 2-3 times of hobbing for wider gears</td></tr>
<tr><td>Production rate</td><td>Stacking can make hobbing faster than shaping even for gears with narrow face widths</td><td>With high speed stroking, narrow width job can be finished in lesser time than by hobbing.</td></tr>
</table></td><td>1m per point</td><td>4m</td></tr>
<tr><td>e)</td><td>NEED FOR MACHINE TOOL MAINTENANCE
As every person requires maintenance, machine tool also requires maintenance to keep it in proper working condition.
The need for machine tool maintenance is:
• Its accuracy does not deteriorate.
• It manufactures the components most economically.
• It remains in working condition at all the times.
• to minimize the number of breakdown.
• minimize the loss of production
• improve the quality of product

For this, machine tools are inspected periodically against
(a) Dust, heat and humidity.
(b) Vibration and Chatter.
(c) Use of wrong or inadequate lubrication.
(d) Wrong use and overloading of the machine tools.
(e) Wear of slideways, bearings and other components.
(f) Corrosion of some parts due to the use of wrong lubricants etc.

IMPORTANCE OF MAINTENANCE ACTIVITY
(i)Quality of product
(ii) Cost control
(iii) Customer service
(iv) Market reputation
(v) Cost of investment</td><td>2m need 2m imp</td><td>4m</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>

f)	Functions of broaching machine are as follows • Broaching machine is widely used as a metal cutting machine used for surface finishing by pressing a broaching tool on a workpiece surface. • Broaching machines are designed and manufactured to meet most industry specifications. • Broaching machines are widely used for stampings, screw machine parts, forging, and casting operations. Broaching machines are also used for providing fine surface finishes in automotive industry, aerospace industry, and power sector for designing electrical equipments • A broach machine is designed to run at a maximum ram speed of 150 FPM. Applications of Broaching Machine 1. In automotive industry for manufacturing gears, cylinder block, pistons, carburetors etc. 2. Forming of teeth in internal and external gears, in cutting suitable grooves or splines in casting or forging. 3. Cutting of keyways and holes square, hexagonal and other shapes very efficiently. 4. Machining irregularly shaped holes of considerable length very economically in mass production.	2m funct 2m app (1m per point)	4m
6	**Attempt any four**	**4 x 4**	**16**
a)	FACTORS CONSIDERED FOR SELETION OF GRINDING WHEEL • Important factors considered for selection of grinding wheel are as follows. 1. Constant Factors: (a) Work-piece Material (b) Amount of Stock to be Removed (c) Area of Contact (d) Type of Grinding Machine Used 2. Variable Factors: (a) Wheel Speed (b) Work Speed (c) Condition and Capacity of Machine (d) Personal Factor: Skilled operator can handle softer wheel carefully and give better and economic production.	4m	4m
b)	PLANOMILLER The workpiece can be machined in four different ways according to requirements. (a) By moving the table and cutter rotate in its position. (b) By keeping the table stationary and feeding the cutters by moving the milling heads. (c) By moving the table and the milling heads simultaneously. (d) By heaping the table stationary, moving the cross-rail downwards and the side cutter up and down. Each milling head carries one cutter. Two vertical milling head are fitted on the cross-rail which can move towards each other. Two horizontal milling	1m for diag 3m for exp	4m

	head are mounted on the column which can move vertical over it. Two vertical columns, one on each side of the bed are mounted on the bed. A cross rail is fitted on the column. It may be lowered or raised to suit the height of the workpiece. As the construction of this machine is similar to a double housing planer, it is called as plano miller.  		
c)	CENTRE-LESS TYPE GRINDERS  • In centre-less grinding, work is not held between the centers as in cylindrical grinding. • Here the work piece is held by a combination of two rotating wheels a regulating wheel and also on a work rest blade.	1m diag 3m exp	4m

	• The machine carries a grinding wheel at one end mounted on the wheel head. A regulating wheel, smaller in size than the grinding wheel is mounted on the outer end of the machine. • The wheel carries a rubber bond and helps in the rotation of work piece, apart from giving support to it. • The work rest is mounted on the work rest slide on the base of the machine. A blade is provided on the top of the work rest, which supports the work piece. • A speed control panel and electric control panels provided on the front face of the machine to controls the speed adjustment of the two trueing mechanisms and the infeed grinding mechanism. • The other panel carries control for hydraulic mechanism, speed adjusting of regulating wheel etc. • During working the work piece is held and rotated by two wheels and supported by work rest blade. Both the wheels rotates in same direction. • The feed in centre-less grinding is given to the work piece in one of following methods: 1. Through feed grinding 2. In feed grinding 3. End feed grinding		
d)	ADVANTAGES OF BROACHING 1. The process can be done for both internal and external machining. 2. It is simple operation, hence does not require highly skilled operator. 3. As loading and unloading is rapid, the rate of production is high. 4. As both roughing and finishing can be done in one .r.ass, so broaching is fast operation. 5. Broaching is faster than any other machining process. 6. High accuracy and higher surface finish can be obtained. 7. The cutting force of the broach serves to clamp the work piece and hold it firmly in position. 8. Any form that can be produced on a broaching tool can be produced by the tool. DISADVANTAGES OF BROACHING 1. It is a single purpose tool. 2. Tool cost is very high, so the process is justified only for mass production. 3. In some cases, it is not suited for low production rates. 4. The parts to be broached must be strong enough to withstand high cutting forces. 5. Surface to be broached must be accessible. 6. Blind holes cannot be easily prod d. 7. Tool sharpening is difficult and expensive process	2m adv 2m disadv	4m
e)	Basic Maintenance Practice for Bearing • Bearing may fail before its expected life, if its proper care and maintenance is not taken. Many bearings require periodic maintenance to prevent premature failure,although some such as fluid or magnetic bearings may	2m bearin g 2m	4m

	require little maintenance. • Most bearings in high cycle operations need periodic lubrication and cleaning and may require adjustment to minimize the effects of wear. • Bearing life is often much better when the bearing is kept clean and well lubricated. • The following care is required to increase the life of bearing. o Keep the bearings dirt-free, moisture free, and lubricated. o Water will rust the bearings and dirt will destroy the smoothness of the super finish on your bearing races, increasing friction. o Clean the bearings when they become dirty or noisy with the most environmentally friendly cleaner. o Do not add oil to dirty bearings. It will not clean the bearing, but merely flush the existing dirt further into the bearing. o Clean the bearings before re,:lubricating them. o Additional supply of grease should be given to the newly procured bearings before they are started running, or to the bearings that have stopped running for more than 2 months before they are re-started for running. o The discharged grease should be removed timely. Basic Maintenance Practices for Coupling • Gasket should be placed in the female coupling to make the connection water tight. Gasket should be checked every time a connection is made and should be replaced if there is an indication of wear cut etc. • To facilitate making and breaking connections, couplings are furnished with rocker lugs. • All couplings are attached to the hose jacket by an expansion ring. This expansion ring is pressed outward, securing the hose jacket to the coupling. • The lug portion, the locks and the race way of the coupling should be lubricated. • Do not lubricate the gasket or seals. Replace the gasket periodically. • Following practice should be followed for coupling: o require a regularly scheduled inspection of each coupling. o It consists of performing visual inspections, checking for signs of wear or fatigue, and cleaning couplings regularly. o Checking and changing lubricant regularly if the coupling is lubricated. o This maintenance is required annually for most couplings and more frequently for couplings in adverse environments or in demanding operating conditions. o Documenting the maintenance performed on each coupling, along with the date.	coupli ng	
f)	• WEDM works on the principle that the heat energy generated by a spark is used to remove material from the work piece. • The process can be used only when the workpiece to be cut has a through hole in it or the cut is to be taken from the outer edge into the workpiece • The wire (electrode) is made-up of copper or tungsten. It uses a wire of	½ diag 3m worki ng	4m

about 0.3 mm diameter as an electrode or tool.

• A constant gap of 0.5 mm is maintained between the wire and work piece with the help of control system. The wire is continuously moved at a constant speed through the work piece.

• When the machine tool is switched 'ON', sparks are generated between the tool and work piece.

• When the spark comes in contact with the dielectric fluid in the gap, the fluid gets ionized and it allows the current to flow between the tool and work piece.

• Heat generated during the sparking process results in melting of the work piece. These melted particles of the metal are then driven away by the dielectric field.

• In order to create the desired shape on the work piece the table motions are controlled by the positioning unit (control system).