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.1 Attempt any Five of the following: 20M

a) State the advantages of modern industry.

ANS: -

Advantages of modern industry :- (any 4 points – 4 marks)

i) Better working conditions are available.
ii) Production rate is increased.
iii) Overall production cost is reduced.
iv) Quality and reliability of product is higher.
v) Component procedure is uniform.
vi) Human fatigue is reduced .
vii) Automatic control process

b) What is NDT? List the different methods of NDT.

ANS**:**

NDT: - (1 mark)

Nondestructive testing (NDT) is the process of inspecting, testing, or evaluating materials, components or assemblies for discontinuities, or differences in characteristics without destroying the serviceability of the part or system. In other words, when the inspection or test is completed the part can still be used.

Methods of NDT: - (Any 6 points) (3 mark)

1) Radiography testing
2) Ultrasonic testing
3) Magnetic particle testing

4) Liquid penetrant testing
5) Eddy current testing
6) Acoustic Emission testing
7) Leak testing
8) Visual Testing

c) What is circular magnetization? State it's principle.

ANS**:**

Diagram 1 mark , statement 1 mark and principle 2 marks

A circular magnetic field has magnetic lines of force that run circumferentially around the perimeter of a part. A circular magnetic field is induced in an article by either passing current through the component.

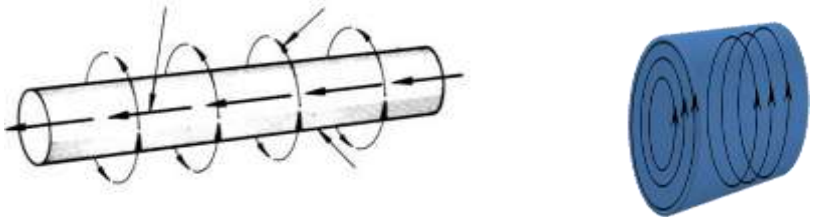
Principle:

When an electric current is pass through an conductor or a wire, magnetic flux will produce around the conductor. (Right Hand Thumb Rule).

The direction of magnetic lines of force is always 90 degree to the direction of current flow.

In circular magnetic field no poles are formed, Magnetic flux lines are in complete loop.

Diagram:-



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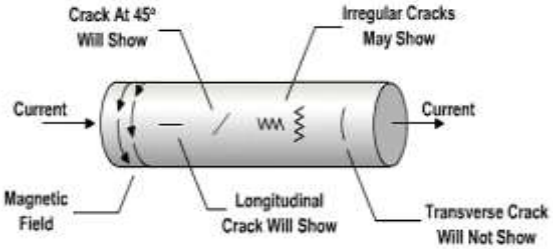
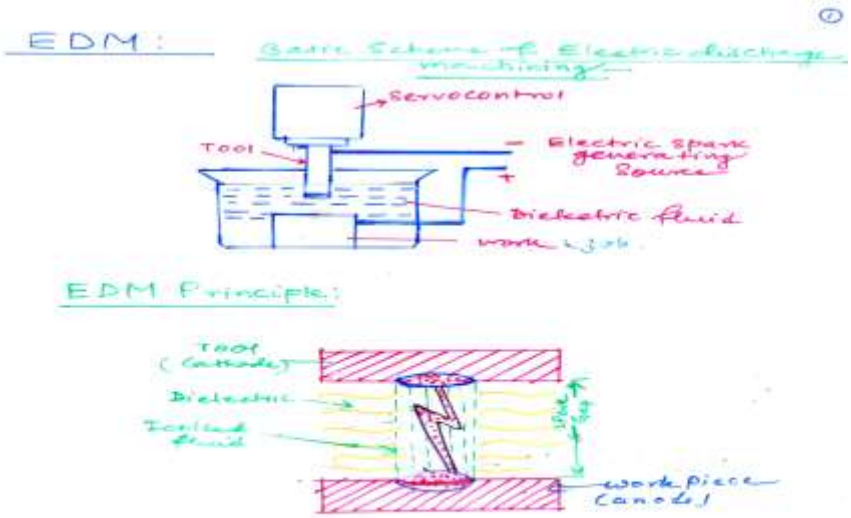


d) State the principle of EDM. Draw the basic set up of EDM.

ANS**:**

Principle of EDM 2 marks with diagram and basic set up 2 marks

Priciple Diagram:-



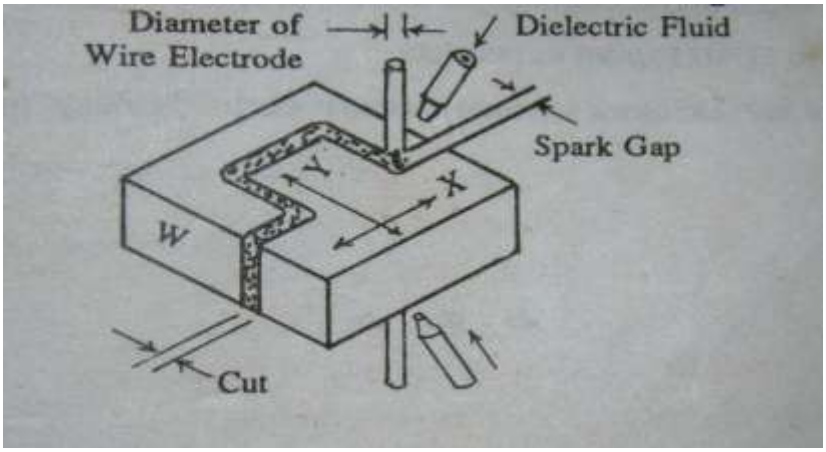
Explanation:

EDM process involved a controlled erosion of electrically conducting, material by the initialization of rapid and repetitive spark discharge between the electrode (tool)usually a cathode and work piece (anode) separated by a small gap of about 0.01 to 0.5 mm known as spark gap.
This spark gap is either flooded or immersed under the dielectric fluid.
The spark discharge is produced by the controlled pulsating direct current between work piece and tool.
The dielectric fluid in spark gap is ionized under the pulsed application of the direct current, thus enabling the spark discharge to pass between the tool and the work piece
Each spark produces enough heat to melt and vaporized a tiny volume of the work piece material leaving a small crater on its surface.
The energy contained in each sparks is discrete and it can be controlled so that material removal rate, surface finish and tolerance can be predicted.

NOTE: Any other relevant diagram showing the same concept should be credited marks.

e) Draw and describe wire cut EDM.

ANS**: Diagram of wire cut EDM 2 marks and explanation 2 marks**



Explanation: - (2 mark)

- In traveling wire EDM a small diameter wire is used as the electrode to produce intricate shape in plates.
- Above fig. illustrates the arrangement of wire electrode and work piece of wire cut EDM.
- The table of the machine is provided with numerical control to perform complex motion required by the work piece. The feed rate in this process is constant. But if any abnormal condition in the spark gap are restored.
- The machine has a wire guide and tensioning device to permit continuous feeding of the expandable copper or brass wire electrode with diameter 0.2 mm or less as shown in fig.
- The spark discharge is produced in the spark gap between wire electrode and work piece by the controlled pulsing of direct current as shown in fig.
- Each spark produces enough heat to melt and vaporize a tiny volume of the work piece material.
- Deionized water is used as the dielectric medium as this process requires a dielectric with low conductivity to provide larger spark gap. The dielectric fluid is injected through nozzle in the working area to ensure proper flushing.
- The wire cut EDM is extremely well suited in the production of extrusion dies, blanking dies and punches press tools and sintered compacting dies.

f) List advantages of CNC machines (any six)

ANS:

Advantages of CNC machines are:

1) Reduced lead time:
2) Elimination of operator error:
3) Operator activity: The operator is relieved of tasks readily performed by the machine.
4) Lower labour cost:
5) Smaller Batches:
6) Longer tool life:
7) Elimination of special Jigs & Fixtures:
8) Flexibility in changes of component design
9) Less Scrap:
10) Reduced Inspection:
11) Accurate costing and Scheduling: In CNC, the time taken in machining is predictable consistent are results in a great accuracy in estimating and more consistency in costing.

g) List applications of dielectric heating and induction heating. (four each)

ANS:

Application of dielectric heating: 2 marks

- Gluing, curing and drying of woods.
- Preheating plastic performs to condition them for molding.
- Plastic sewing.
- Drying & heat treatment of natural and synthetic rubber, rayon, nylon etc.
- Processing of chemicals during manufacture.
- Sterilization of medical supplies.
- In food processing industries like pasteurizing milk, dehydrating fruits & vegetables, defrosting frozen foods disinfecting cereals and grains.

Applications of induction heating:2 marks

- Surface hardening of steel ,
- brazing ,
- soldering
- Annealing of brass and bronze metals.

Q.2 Attempt any FOUR of the following: **16M**

a) What is the role of electronics in modern industry?

ANS:

NOTE: Answer to this question will vary from student to student .Examiner shall see that how a student correlates the different techniques studied under subject AIE to the modern industry.

Because of the development in science and technology there is an requirement of new process in the industry which are developed by using different electronics components, circuits principles and new advance techniques.

Electronics has an important role in modern industry.

Electronics plays a catalytic role in enhancing production and productivity of the industry.

All industry use the modern techniques of production which involves measurement and control equipments, Automation techniques etc.

For example,

1. CNC machine use for mass production uses different electronics circuits to have control and accuracy in measurement.

2. Nontraditional machining such as EDM, Laser cut machining uses the electronics principles for the operations.

3. Modern Heating techniques use in industries such as Induction, dielectric, microwave heating is the result of development in the in the field of electronics.

4. With the development in VLSI and Embedded systems there is an revolution in computer field which gives revolution to the modern industry and hence the economy.

5. Different NDT methods used in industry for material testing and job testing also uses the electronics techniques. Good example is the testing of rail way tacks for any crack using Ultrasonic Testing.

b) State two advantages and two limitations of ultrasonic testing.

ANS**:**

Advantages of UT: - (2 marks Any 2 points)

1. Internal defects can be detected and sized accurately.
2. Access to only one side of the component is needed
3 .There is no hazard in ultrasonic testing.

3. Clean, reliable.
4. Consistent Results.
5. Highly accurate in determining the flaws
6. Long life and require no maintenance.
7. As the ultrasonic wave can passes through any type of materials hence any type of material can be tested.

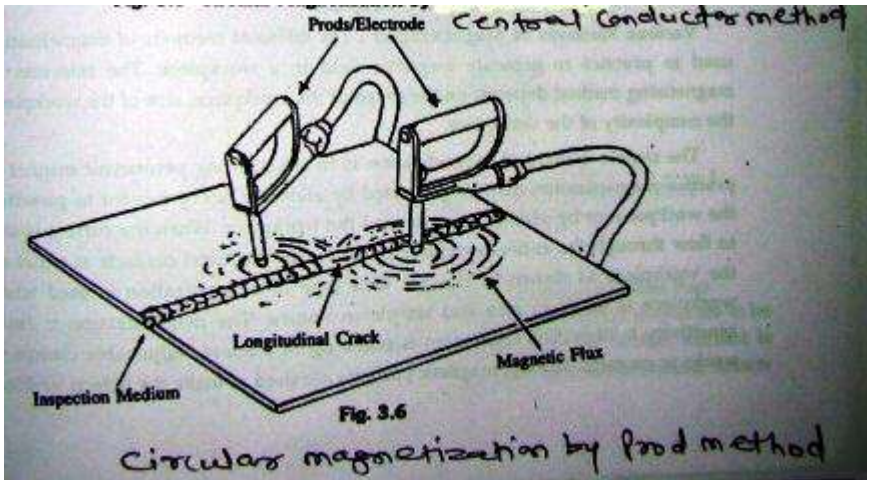
Limitations : **(2 marks Any 2 points)**

1. Surface must be accessible to transmit ultrasound.
2. Skill and professional persons are required to carry out the test and to predict the result
3. Requires a coupling medium to transfer a sound energy into test specimen.
4. Material that are rough, irregular in shape, very small, exceptionally thin or not homogeneous are difficult to inspect.
5. Cast iron and other coarse grained materials are difficult to inspect due to low sound transmission and high signal noise.
6 . No permanent record of the inspection.
7. Surface and subsurface defect goes undetected because of dead zone

c) Describe the prod magnetization testing method with neat sketch.

ANS**:**

Diagram of prod magnetization: - (2 mark)



Explanation: - (2 mark)

- Magnetization often is done using prod contact to inspect the large and massive parts.
- Prod produces local magnetization.
- Prods are electrodes with handles that are pressed against the surface of the component being inspected to make the contact for passing electrical current through metal.
- The current passing between the PRODS create a circular magnetic field around the flaws i.e. can be used in MP inspection.

- Prods are typically made from copper and have an insulated handle to protect the operator.
- One of the prods has a trigger switch so that current can be quickly and easily turned ON and OFF.
- Sometimes the two PRODS are connected by an insulator to facilitate one hand application. This is referred to as a duel probe and is commonly used for weld inspections.
- Easy portability makes prod method used for field applications.

d) State the properties of dielectric fluid used in EDM. (any six)

ANS**:**

Properties of dielectric fluid: Any six point 4 marks

1. The Dielectric fluid should have sufficient and stable dielectric strength to serve as insulation between electrode and tool.
2. It should deionize rapidly after spark discharge has taken place.
3. It should have low viscosity and good wetting capacity.
4. It should be chemically neutral to as not to attack the electrode, the work-piece and the working container.
5. Its flash point must be sufficiently high to avoid any fire hazards.
6. It should not emit any toxic vapors or have unpleasant odors.
7. It should be easily available in market at reasonable rate.
8. It should maintain its properties under all working conditions.

e) What is DNC? State It's two demerits.

ANS**: DNC- 2 marks:-**

Direct numerical control is defined as a manufacturing system in which a number of machines are controlled by a computer through direct connection in real time. The tape reader is omitted from the system. The information or the part program is being transferred directly to the machine tool through communication lines from the main computer. This is done in real time and the communication is two ways, both the computer and the machine tool can send information to each other. The computer sends information to the machine tool upon request of the latter and when this occurs the request for instructions must be satisfied almost instantaneously. The computer stores the information in a bulk memory and can control more than 100 machine tools

Demerits of DNC: any two points 2 mark

1. Total production stops if the main computer starts malfunctioning.
2. The system is not user friendly as any modification is difficult to make.
3. The system maintenance is another problem in central computer as well as local controller system.
4. The software logic, timing problems and interfacing vary from one system to another.

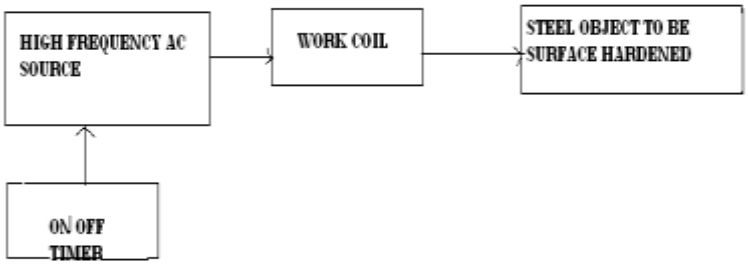
5. Lengthy cables are needed for the transmission of the machine command data from the remotely located central computer to the individual machine control units of DNC system.
6. High initial investment is required.

f) Describe the surface hardening of steel using induction heating.

ANS**:**

Diagram of Surface hardening of steel using induction heating 2 marks and explanation 2 marks

Note : Diagram illustrating work coil and job can also be considered



Explanation:

Surface hardening is the process of hardening the surface of a metal object while allowing the metal deeper underneath to remain soft, thus forming a thin layer of harder metal (called the "case") at the surface. For steel or iron with low carbon content, which has poor to no harden ability of its own?

- The object to be surface harden is kept in helical coil (work coil) made of tubing.
- A heavy current at high frequency about 400 KHz is passed through the work coil for about 5 - 10 sec.
- When the temp. of the surface up to desired depth reach the required level, current flowing through work coil is stopped.
- And the job is immediately quenched either in the coil or in the water.
- Because of very fast increase in temperature at the surface there is no bulk heating of the objects and hence the other properties of the material remain unaltered.
- Surface hardening is used in making cams, knives, and surgical needles, saw blades, crankshafts bearing etc

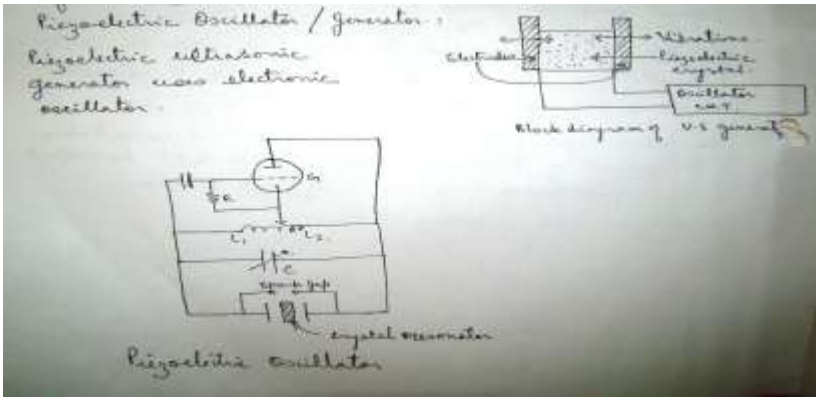
Q.3 Attempt any TWO of the following: 08M

a) What are the different methods of US generation? Describe any one electrical method in detail.

ANS: **Different methods of ultrasonic generation are:- (2marks)**

- Piezo-electric method
- Magneto-striction method,
- Modern method using laser
- Thermal method
- Mechanical method

Diagram 3marks and explanation 3 marks (for any one electrical method)



Piezoelectric method:-

The piezoelectric effect is also a reversible phenomenon. That is conversely when the electric potential is applied to the appropriate face of the crystal it develops mechanical deformation.
The crystal is placed parallel to the tank ckt. The tank ckt is made up of variable capacitor and a tapped induction. It is a Hartley oscillator. The frequency is determined by the nature and the size of the crystal. Variable capacitor help to adjust frequency equal to natural frequency. When voltage is applied mechanical vibration are set in the crystal. The amplitude of this vibration is proportional to the applied voltage.

NOTE : (transistorized circuit should also be considered)

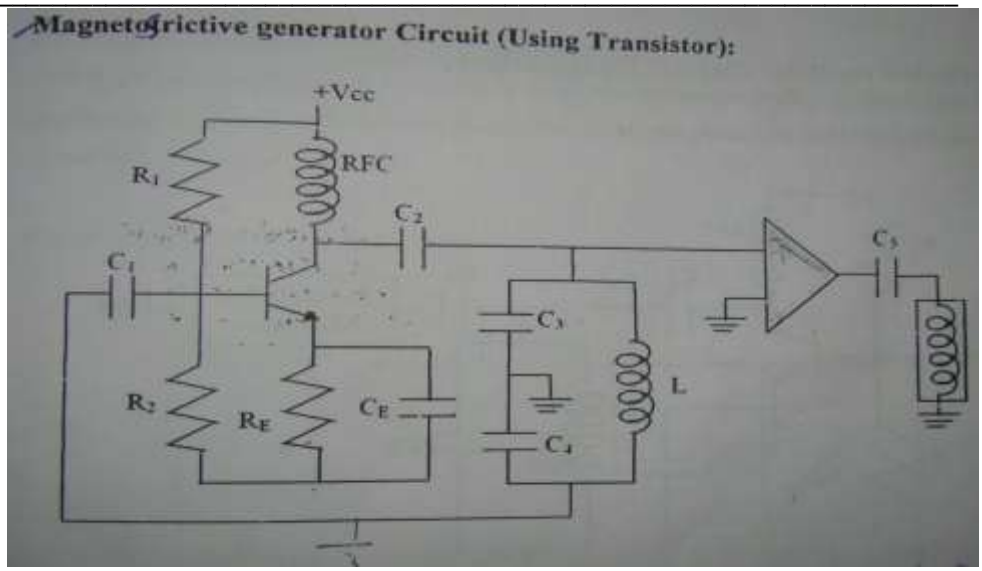
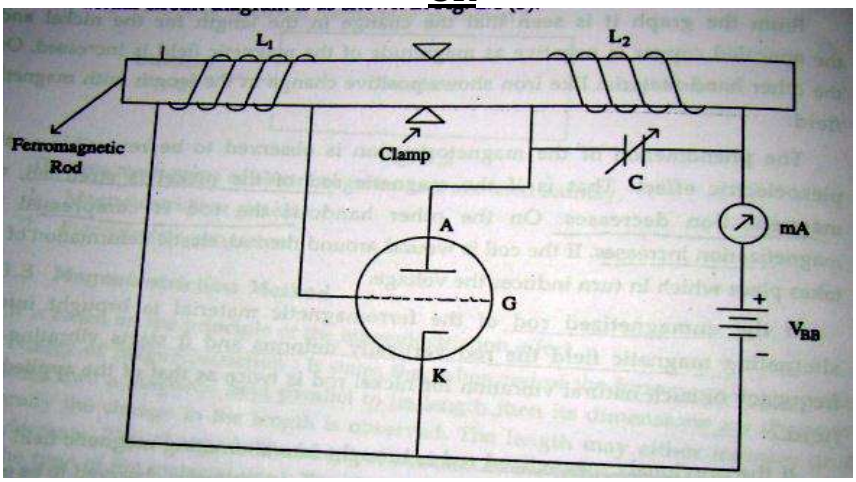


Fig. Circuit diagram of Piezoelectric method (3 mark)

Explanation: - (3 mark)

1) The transistor is used as a basic oscillator. The oscillator circuit may be Colpitts type or Hartley type.
2) The above circuit shows Colpitts oscillator. The transistor T works as an oscillator with the tank circuit components as C3, C4 and L1 . these components also helps to determine the frequency of ultrasonic wave.
3) The oscillations generated by transistor are applied to current amplifier where level of signal is increased so that it drives magnetostrictive coil.
4) These oscillations are coupled to the coil with the help of capacitor. Due to magnetostrictive effect, ultrasonic vibrations are generated at the output.

OR



Magnetosrictive generator using Valve

Explanation: - (3 mark)

1) The rod of the ferromagnetic material is used. It is seen that rod is clamped at center with the knife edges.

2) The two wires L1 and L2 are wound on the rod.

3) The wire L1 along with the capacitor C forms the tank circuit of the oscillator and helps to determine the frequency.

4) The wires L1 is used in the grid circuit of triode.

5) The supply voltage VBB is applied them due to the reciprocal effect of magnetostriction the vibrations are set into the rod.

6) The ammeter is used in plate circuit to detect the oscillatory condition.

7) During resonance the anode current shows maximum ammeter deviation thus for simplicity the premagnetized rod is used in circuit.

b) Describe wet method and dry method used in magnetic crack detection. Describe transparent plastic tape recording technique.

ANS**: Explanation of wet method 3 marks and dry method 3 marks each. transparent plastic tape recording technique 2 marks**

1. Dry method:

i) In this methods particles are carried in air or gas suspension.
ii) Particle cloud is produced using a mechanical powder blower or a rubber spray bulb.
iii) Dry particle inspection is well suited for the inspection which is on a rough surface.
iv) In this method surface of the component should free from grease or other adhering deposits
v) Pulsating DC current creates a pulsating magnetic field that provides mobility of the powder.
vi) Dry particle inspection is more sensitive than wet method for indication of sub surface cracks.

2. Wet method:

i) In this methods particles are carried liquid suspension.
ii) Liquid carrier is usually a water or kerosene.
ii) The liquid carrier provides mobility to particles with extended period of time which allows enough particles to float to small leakage field to form a visible indication.
iii) Wet particles are kept in the bath which has to continuously kept agitated so that no particles will settle down at the bottom
iv) High sensitivity is possible with method when florescent particles are used.

Transparent plastic tape transfer:

Most common and convenient method for preserving the records of MPI.

Excess particles after the test is removed from the job other than which are adhere to the crack

A strip of transparent tape is carefully laid over the indication and gently pressed down with fingers or a rounded stick.

After some time when the tape is peeled off, it brings the particles on the indications with it .

The strip is then laid on white paper for photographing.

This method the indication pattern remains well defined and accurate for future reference.

c) What is meant by NC, CNC, DNC, and CIM. Describe all NC words.

ANS**: NC, CNC, DNC, CIM (1 mark each)**

NC-Numerical control machines-

The machinery operations or processes are controlled by insertion of numerical data. The instructions fed to the NC machines are from external medium i.e. paper tape or magnetic tape. The part program cannot be edited.

CNC means computer Numerical control machines-

In CNC m/c a dedicated computer is used to perform all the basic NC functions. The complete part program to produce a component is stored in the computer memory and information for each operation is fed to the m/c tools. The part program can be edited and optimized. NC can be integrated with DNC systems and are more flexible than NC m/cs.

DNC-means direct numerical control machine-

DNC refers to the system of the several machine tools directly controlled by the central computer. The DNC system operates on the principle of time sharing mode. Each machine tool in DNC system has its own program along with the supervisory program linking them and establishing the priority whenever necessary

CIM - Computer Integrated Manufacturing

Computer integrated manufacturing is used to describe the complete automation of a manufacturing plant, with all processes functioning under computer control. The heart of CIM is CAD/CAM, CAD/CAM integrated systems provide design/drafting, planning and scheduling and fabrication capabilities. CIM system improves capability of the component technology.
It provides higher productivity. It also provides maximum flexibility, more reliable and saves time

Explanation of NC word 4 marks

- A typical NC word consist of X- position, Y – position feed rate etc. A collection of NC words is called a block and a block of words is a complete NC instruction.
- There are 8 types of NC words like N- word, G- word, X, Y and Z words, F- word, S- word , T-word, M- word all EOB**.**

N – Word (sequence number) :

- The sequence number is used to identify the block and the 1st word in every block is the sequence no.

G – Word (preparatory function)

- The preparatory word prepares the control unit to execute the instruction that are to follow.

Co- ordinate (X, Y, & Z word)

- These words give final co- ordinate positions for X, Y, & Z motions.

- The words I, J, K are used to specify the position of arc center in case of circular interpolation**.**

Feed function – F – word

- The feed function is used to specify the feed rate in the machining operation.

S – Word (spindle speed function)

- The spindle speed is specified either in revaluation per minutes (rpm) or as meter per minutes.

Tool selection function (T –word)

- The T - word is needed only for m/c s with programmable tool turret or automatic tool change (ATC**]**

Miscellaneous function (M – word)

- The Miscellaneous function word is used to specify certain Miscellaneous or auxiliary function which do not relate to the dimensional movements of the machine.

End of block (EOB)

- The EOB symbol identifies the end of instructions block

Q.4 Attempt any <u>FOUR</u> of the following: 16M

a) Write any four causes of accident and types of accidents.

ANS**: <u>Any four Causes of accident 2 marks and types 2 marks</u>**

Causes:

1. Taking shortcuts
2. Being over confident
3. Poor house-keeping
4. Ignoring safety procedures
5. Failure to preplan the work
6. Driver error

<u>Types</u>:

Physical accidents include un-intended collisions or falls, injecting poison, touching sharp objects, etc.

Non-physical includes work accident, sport injuries, road accidents, aviation accident, bicycle accident, train accidents, traffic collisions

b) Describe US cleaning and It's two advantages.

ANS**: Explanation of ultrasonic cleaning 2 marks**

- An ultrasonically agitated bath will erosively clean the dirt from the immersed articles.
- The high power generator, usually electronic, produces an ultrasonic wave which is impressed on the transducer to drive bath.
- Barium titanate transducers are used and the frequencies commonly used are in the range of 10KHz to 90 KHz, lower frequencies are generally preferred.
- The cavitation must exist for effective speed cleaning.
- The solution may be water solution of alkalines or acids.
- The bubbles collapse generates powerful local force which causes desired action of cleaning.
- The cleaning is used for the articles of jewellery, eyeglass frames, lenses, metal parts, watches, clocks, etc.

Advantages: 1 mark each (any two)

1.The process is consistent, clean , quick ,easy , not expensive and reliable**.**
2. Not hazardous to the operator.
3. Any delicate objects can be cleaned.

c) Describe any two types of circular magnetization.

ANS: Circular magnetization: Explanation 2 marks and Diagram 1 marks each

The circular magnetization is required when we want to detect longitudinal cracks (lengthwise crack).to produce the circular magnetization the magnetizing current has to be passed through the conductor in straight line i.e. lengthwise different methods of circular magnetization are-

- Central conductor method- this method is used to detect discontinuities in hollow cylindrical. Here the current is passed through the central conductor which then includes circular magnetic field in the object.
- Prod magnetization- in this method a special type of electrodes called prods are used to pass the current at right angle to the object because of which circular magnetic lines are produced in the object.

- **Types of circular magnetization:**

  1) Head shot method

  2) Central conductor method

  3) Prod Magnetization.

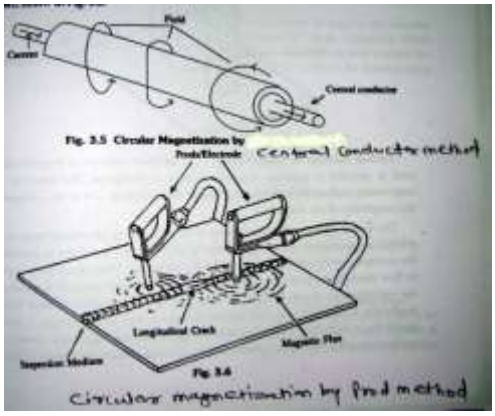


Fig:Head shot method

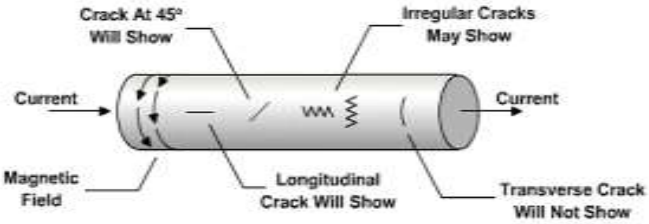
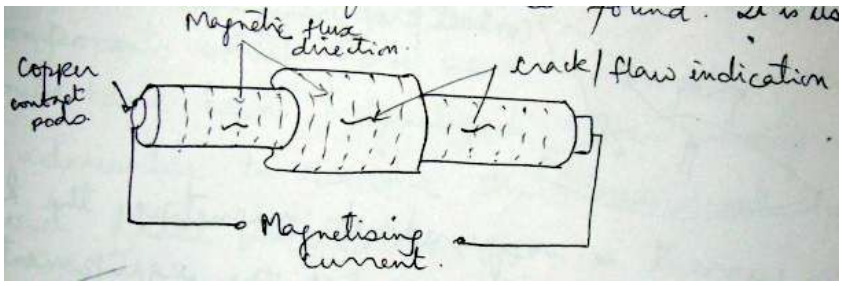


Fig:Central conductor method

OR



d) State the role of servomotor, high pressure pump, filters and dc supply in EDM.

ANS**: One mark Each**

1) Servo System :

Executes the mechanical EDM spark gap adjustment**.**During the EDM process the electrode needs to be moved specified distance to adjust the gap size according to the quality of the EDM spark.Servo system is used to move the electrode (tool) closer or farther from the work piece (job).

Two types of servo systems are commonly used

1) Electrical Servo System
2) Hydrolic servo System.
3) High pressure pump: Use to flush the dielectric fluid in the system.
4) Filter : Tiny particles removed from the job in EDM process are getting mix in the dielectric fluid in tank. To reuse the same fluid again it is pass through the filter so that swaraf particles are removed from it.
5) DC Supply: it is part of spark generating system providing the charging current to the capacitor**.**

e) List the different i/p media used for NC. Explain any one.

ANS**:**

Different media used to input the information for NC machine

Input Media For NC Machine. (1 mark)

- Punched cards
- Magnetic tapes & floppy disks
- Punched Tape

Explanation of any one type 3 mark

Punched cards:-
A typical punched card can c=be used in IBM systems has 80 columns and each columns has numbers which identify the punching position. There are 12 punch position or rows in each card designated as 12,11 and 0 to 9. For any numeric and alphabet to be punched on the card, a code is used and rectangular blocks are punched on the card at one or more places. Normally , one card is used for encoding each instruction or for storing each master record .

Diagram:-

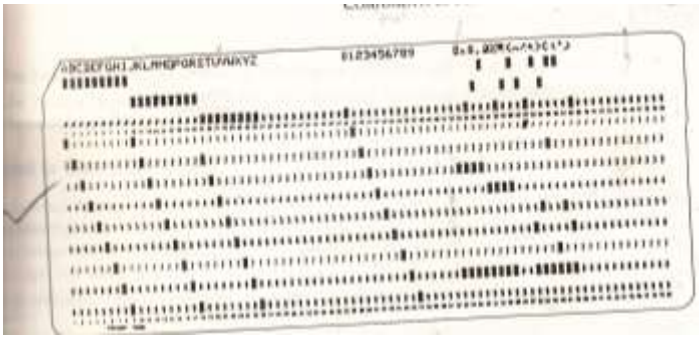


Figure : Representation of alphabetical and numerical on a computer

Magnetic Tape and floppy disk:-

The data is stored in the coded form by means of magnetized spots on magnetic medium in both cases. The magnetic tapes and magnetic disks are re-usable media. The data once stored can be erased and new data saved on the magnetic tape or disk. The width of the tape is 6mm or 25mm. Magnetic disks or floppy disks are circular disks consists of a material which can be magnetized. The commonly used sizes of magnetic disks are 5.25 inch diameter and 3.5 inch diameter. The magnetic disk is a random access device . The magnetic tapes and disks can store more data compared to other input media. But the data stored on magnetic tapes and disks can be corrupted if these are brought into magnetic fields.

Punched tape:-

Punched tape issued by Electronic Industries Association of USA (EIA) and Industrial Standard Organization (ISO), are universally accepted. A standard tape is 25mm wide. The punched tape has capacity for storing 10 characters per 25 mm length. There are 8 tracks on the tape, which are used for punching the information in coded form. The edge adjacent to track 1 is called reference edge. A row of small holes between track 3 and track 4 is used for feeding the tape into tape reader. The information required to machine the component is punched on the tape by a tape punching device.

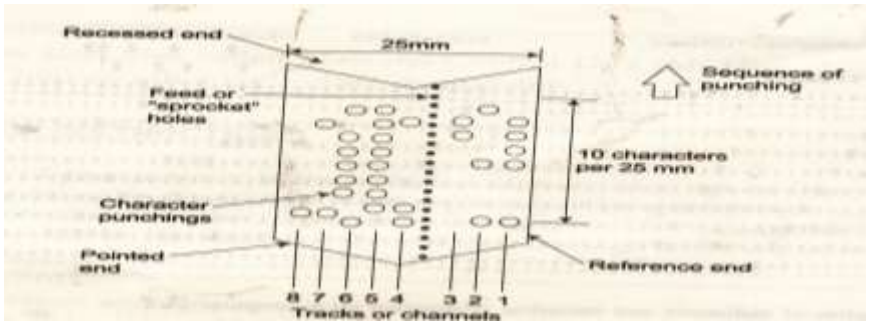


Figure:- 25 mm Wide punched tape

NOTE: Explanation of any ONE with appropriate diagram should be credited marks.

f) What is microwave heating? Give two applications of it.

ANS**:**

Microwave heating:

Microwave heating is a high frequency heating which utilizes the frequency in the microwave range i.e. from 300 to 3000 MHz . In microwave Heating, the material is subjected to an electromagnetic wave that causes the molecules in the material to oscillate, thereby generating heat. (**2marks)**

Applications: 2 marks

Microwave oven,

Industries making use of these techniques includes textiles, paper , food, plastics and chemicals

Q.5 Attempt any FOUR of the following:- 16M

a) State any two problems of traditional industry. How these problems over come in modern industry.

ANS:**Problems of traditional Industry(any two point – 2M)**

1. **Human dependency** – The various problems caused due to human dependency were quality of work non uniformity, time management.
2. **Mass production** – Mass production in specified time was not possible since methods used were time consuming and could not cope up with the increasing demand.
3. **Quality** – Inability to implement quality standards accurately and uniformly affect quality of product.
4. **Complex machining** – The traditional machining processes are inadequate to machine advanced alloy material into complex part from the standpoint of economic production.

In modern industry these problems can be overcome as:- (any two point – 2M)

1. In mass production since the quality of item required is very high with little or no variety, automatic machines are very useful.
2. As the degree of complexity of the component increases, the time to produce component also increases. If the process is operator independent , the mistakes due to inattention and tiredness can be avoided and quality can be improved
3. Complex machining processes can be performed by nontraditional machining techniques such as EDM.

b) List different types of probes used in UFD. Explain any one probe.

ANS**: (List types 2M, Explanation of any 1 probe 2M)**

Probes are classified into groups according to the application-

1) Contact Probes

a) Dual Element Probes

b) Delay Line Probes

c) Angle Beam Probes

d) Paint Brush Probes

2) Immersion Probes

Explanation:-

Contact Probes:

- Contact probes are used for direct contact inspections, and are generally hand manipulated.
- They have elements protected in a rugged casing to withstand sliding contact with a variety of materials.
- These probes have an ergonomic design so that they are easy to grip and move along a surface. They also often have replaceable wear plates to lengthen their useful life.
- Coupling materials of water, grease, oils, or commercial material are used to remove the air gap between the transducer and the component inspected.
- Contacts probes are available in a variety of configurations to improve their usefulness for a variety of applications.
- The flat contact transducer is used normal beam inspections of relatively flat surface and where near surface resolution is not critical.
- If the surface is curved, a shoe that matches the curvature of the part may need to be added to the face of the probe.
- If near surface resolution is important or if an angle beam inspection is needed, one of the special contact probes describe below might be used.

Immersion Probes

- These Probes do not contact the component. These probes are designed to operate in a liquid environment and all connections are watertight.
- Immersion probes usually have a impedance matching layer that helps to get more sound energy into the water and, in turn, into the component being inspected.
- Immersion probes can be purchased with in a planner, cylindrically focused or spherically focused lens.
- A focused transducer can improve sensitivity and axial resolution by concentrating the sound energy to a smaller area. Immersion probes are typically used inside a water tank.

Types of Contact Probes:-

Dual Element Probes or Dual Beam Probes

- Dual element probes contain two independently operating elements in a single housing
- One of the elements transmits and the other receives.
- Dual element probes are especially well suited for making measurments in application where reflector are very near the transducer since this design eliminates the ing down effect that single elements probes experience.
- When single element probes are operating in pulse echo mode, the element can not start receiving reflected signals until the element has stopped ringing from it transmit function.
- Dual element probes are very useful when making thickness measurement of thin materials and when inspecting for near surface defects.
- The two elements are angled towards each other to create a crossed-beam sound path in the test material.

Delay Line Probes

- Delay Line Probes provide versatility with a variety of replaceable options.
- Removable delay line, surface conforming membrane, and protective wear cap options can make a single probe effective for a wide range of applications.
- As the name implies, the primary function of a delay line transducer is to introduce a time delay between the generation of the sound wave and the arrival of any reflected waves.
- This allows the transducer to complete its "sending" function before it stars it "listening" function so that near surface resolution is improved.
- They are designed for use in applications such as high precision thickness gauging of this materials. They are useful in high-temperature measurement since the delay line provides some insulation to the piezoelectric element from the heat.

Angle Beam Probes

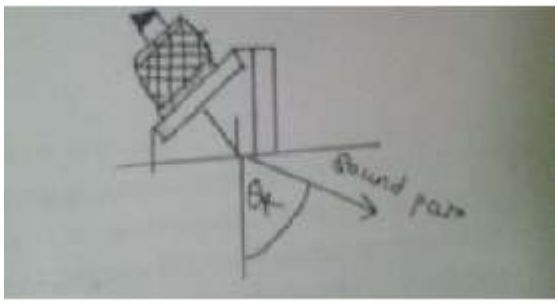


Fig: Angle beam probe

- Angle Beam Probes are typically used to introduce a refracted shear wave into the test material.
- Probes can be purchased in a variety of fixed angles or in adjustable versions where the user determines the angle of incident and refraction.
- In the fixed angle versions, the angle of refraction that is marked on the transducer in only accurate for a particular material, which is usually steel.

- The angle sound path allows the sound beam to be reflection from the back wall to improve detection of flaws in and around welded areas.
- They are also used to generate surface waves for use in detecting defects on the surface of a component.

Paint Brush Probes

- Paint brush probes are used to scan wide areas. These long and narrow probes are made up of an array of small crystals that are carefully matched to minimize variation of performance and maintain uniform sensitivity over the entire area of the transducer.
- Paint brush probes make it possible to scan a larger area more rapidly for discontinuities. Smaller and more sensitive probes are often then required to further define the details of a discontinuity.

(c) Compare longitudinal and circular magnetization. (four points)

ANS**: (1M each point)**

COMPARISON BETWEEN LONGITUDINAL AND CIRCULAR MAGNETIZATION :-

Logitudinal magnetization	Circular magnetization
1. Magnetic flux lines are longitudinal in nature. 2. In longitudinal magnetization current is passed using coils & yoke. 3. Logitudinal cracks are not detected but angular and transverse cracks s are detected. 4. Types are: i. Coil shot method ii. Torroidal method iii. Yoke method	1. Magnetic flux lines are circular in nature. 2. In circular magnetization current is passed through work piece. 3. Transverse cracks are not detected but longitudinal & angular cracks are detected. 4. Types are: i. Head shot method ii. Central conductor method iii. Prod magnetization method

(d) Describe classification of NC system.

ANS: **(1M each)**

NC machines are classified as:-

1. According to control system –
   a) Point to point control system
   b) Straight line control system
   c) Continuous path or contouring control system
2. According to co-ordinate system-
   a) Incremental system
   b) Absolute system
3. According to feedback-
   a) Open loop system
   b) Closed loop system
4. According to structure-
   a) Analog system
   b) Digital system

(e) Describe any four advantages of CNC machines.

ANS: (**Any four 1M EACH**)

1. REDUCED LEAD TIME:

   The time needed for planning ,design &manufacturing is called lead type. Once part program is written & checked it can be used. Lead time is long for the first time running of program but for multiple run it is nearly zero.

2. ELIMINATION OF OPERATOR ERROR:

   The MIC is controlled by programme of instructions stored in the memory of the computer. The programme is checked before it goes to the MIC so no errors will occurs in the job.

3. OPERATOR ACTIVITY:

   The operator is relived of tasks performed by MIC and is free to attend to matters for which his skills & abilities are required.

4. LOWER LABOUR COST:

One operator can run two or more MICS or multiple pallet machines are used resulting in reduced labour cost.

5. LONGER TOOL LIFE:

Tools can be used at optimum speeds & feeds because this functions are controlled by the part program.

6. ELIMINATION OF SPECIAL JIGS & FIXTURES:

Standard locating fixtures are often not used in CNC MIC's & cost of special jigs & fixtures is eliminated.

7. FLEXIBILITY IN CHANGES OF COMPONENT DESIGN:

The changes in component design can be easily done by reprogramming & changing concern instructions which

8. ACCURATE COSTING & SCHEDULING:

In CNC MIC the time taken for machining is predictable & consistent. This results in a great accuracy & more consistency is consistency is costing.

f) Describe dielectric heating with neat diagram.

ANS:**Explanation 2M, Diagram 2M:**

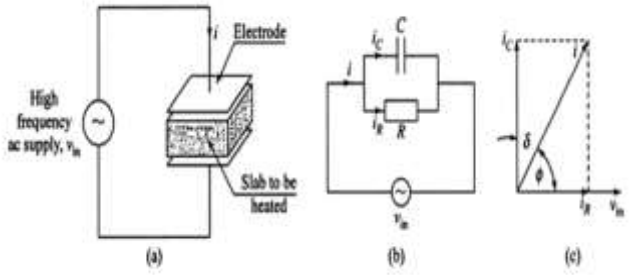


Fig: DIELECTRIC HEATING

It is employed for heating non-metals like wood, plastic etc.

Principal of Dielectric Heating:

- The material to be heated is placed between two electrodes which may be two parallel plates across which high frequency voltage is applied. The material acts as a dielectric between two electrodes of capacitor.
- When a capacitor is placed in electric field its molecules are subjected to stress are disturbed. The current drawn by it is never leading the voltage by exactly 90 degrees.
- The angel between current and voltage is less than 90 degrees as a result of which there is a small in phase component of the current (1cosθ) as shown in above diagram.
- This current produces power loss in a dielectric of a capacitor. This power loss increases with the increase in frequency. It is this power loss that is utilized in dielectric heating.

Q6 Attempt any FOUR of the following. 16M

a) List any four features of modern industry.

ANS**: (Any four 1M each)**

Features of modern industry:-

1. Today's market demand is good quality product at lowest cost and within or before time so with modern industry it is possible to reduce the production cost, maintain the quality and increase the production rate.
2. In modern industry nondestructive techniques such as ultrasonic testing and magnetic particle testing are used. Because of which internal structure of material will not be affected.
3. New machine in techniques such as EDM is used to improve accuracy and quality of the product.
4. Automatically operated machines like NC/CNC are used for mass productions.
5. For controlled heating different heating techniques like Induction heating and Dielectric heating are used.

b) Describe US cold welding.

ANS: **(4Marks)**

Explanation:

- The properties of some metals change on heating and therefore, such metals cannot be welded by
- electric or gas welding.
- In such cases, the metallic sheets are welded together at room temperature by using ultrasonic waves.
- For this purpose, a hammer H is attached to a powerful ultrasonic generator as shown in Figure.

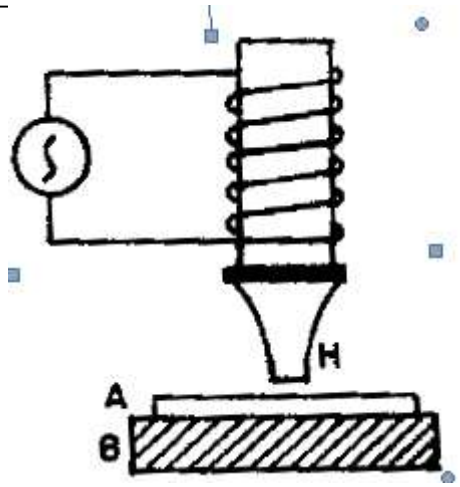


Fig: Cold welding

- The metallic sheets to be welded are put together under the tip of hammer H.
- The hammer is made to vibrate ultrasonically. As a result, it presses the two metal sheets very rapidly and the molecules of one metal diffuse into the molecules of the other.
- Thus, the two sheets get welded without heating. This process is known as **cold welding**.

c) What is the necessity of demagnetization?

ANS: - **(Any 4 points each – 1mark)**

Necessity of demagnetization:

1. Residual fields will affect the magnetic compass or create problems with delicate instruments.
2. Residual fields in rotating parts will attract metal particles, causing excessive wear.
3. Magnetic particles can be removed for further wear.
4. Particles could adhere to magnetized surface and interfere with subsequent operations such as painting or electroplating.
5. If a magnetized part is machined, chips could adhere to the surface being machined and adversely affect the surface finish, dimensions and tool life.
6. Residual fields can cause 'Air Blow' which defects the molten metal during welding operations.

4. Complex machining – The traditional machining processes are inadequate to machine advanced alloy material into complex part from the standpoint of economic production.

(d) Compare induction heating and dielectric heating.(four points)

ANS**:** - **(Any 4 points each – 1mark)**

Comparison between Induction Heating and Dielectric Heating:

INDUCTION HEATING	DIELECTRIC HEATING
1. It is used for heating magnetic materials. 2. It uses eddy current loss for heating. 3. Death of penetration is an important factor. 4. Power dissipation in induction heating is given by, $\omega_e = nBm^2f^2$ 5. Less costly 6. Frequency range from few Hz tofew KHz 7. It has no losses like conduction convection losses 8. Applications: Brazing ,annealing of brass or bronze, surface hardening of steel etc.	1. It is used for heating non-conducting materials. 2. It uses dielectric loss for heating. 3. Distance between two conducting plates is an important factor. 4. Power dissipation in dielectric heating is given by, $P = \omega v^2 c \tan\delta$ 5. Expensive 6. Very high frequency range of MHz 7. It has many losses like conduction, convection, radiation losses 8. Applications: preheating of plastic wood gluing, food processing, electronic sewing etc.

e) Draw the Oscillator used in induction heating system. State its frequency range.

ANS: **(circuit 3M, frequency 1M)**

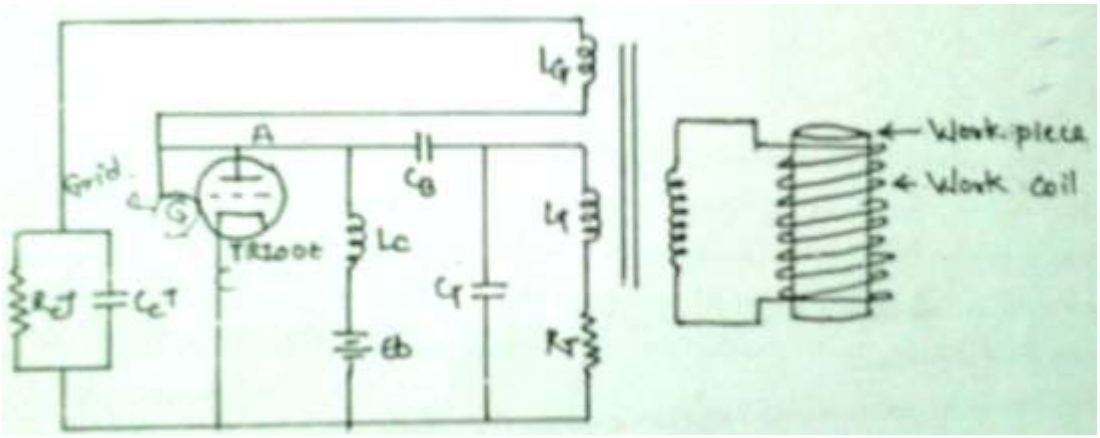


Fig: Oscillator used in induction heating system

OR

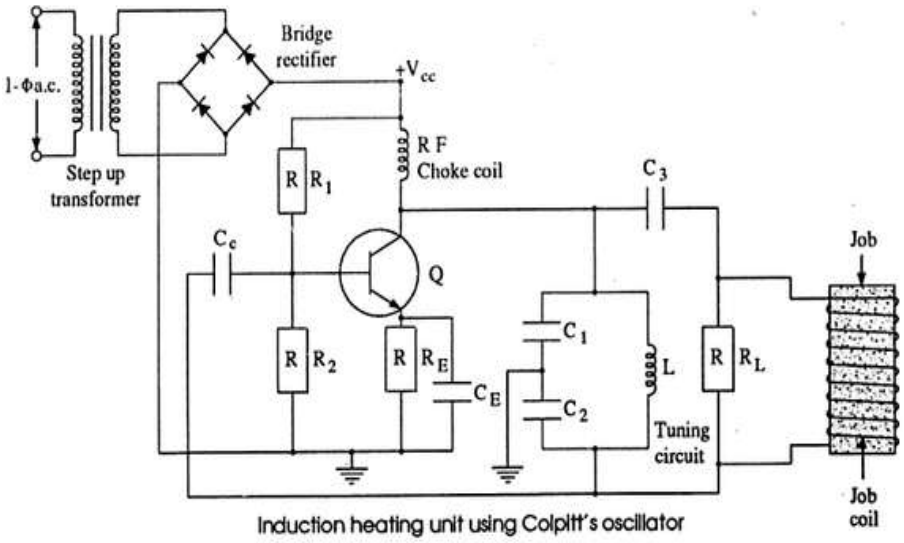


Fig: Introduction Heating Unit using Colpitt's Oscillator

Frequency of these oscillations is given by:-

$$f = \frac{1}{2\pi\sqrt{LCr}}$$

Where,

$$Cr = \frac{C1 \times C2}{C1 + C2}$$

f) State four losses taking place in dielectric heating.

ANS: **(4 losses 1M each)**

1) Conduction loss:

Each molecule of the substance gets heated and transfers the heat to the neighboring one. Thus making heat travel from one point to another. The conduction losses do not remain constant during the entire heating interval.

2) Convection losses:

In convention process the heat is transferred due to convection current which are set up in the material for the heating period.

$P_{cv} = 4.66 \times 10^{-4} \Delta t^{1.33}$ (watts)

Where, Δ is temperature rise of material over room temperature in F.

The temperature involved in dielectric heating, the convention losses is generally insignificant.

It is taken into account for large surface only.

3) Radiation loss:

It reaches the object from the source without heating the medium in between. Stefon's law of heat radiation is.

$$\text{Heat Dissipated} = 5.72 \times 10^{4} K.e\left[\left(\frac{T1}{1000}\right)^{4} - \left(\frac{T2}{1000}\right)^{4}\right] \text{in watts/m}^2$$

Where k = constant called as radiating efficiency

E = emissivity

T_1 = temperature of source in ^{0}C

T_2 = temperature of object in ^{0}C

4) Specific heat power/Thermal power:

This is the power required to raise the temperature to desired final temperature with a specified heating time.

P_s=17.6xmCΔt

Where m= mass

C= specific heat

Δt= temperature rise