MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

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QUESTION BANK

16MEE09 UNCONVENTIONAL MACHINING PROCESSES

UNIT – 1
INTRODUCTION
PART – A

1. What is the need for unconventional machining processes?
   Ans: a. High production rate
   b. Low cost of production
   c. Better surface integrity
   d. High surface finish
2. What are the characteristics of UCM processes?
   Ans: a. Performance is independent of strength barrier
   b. Use different kinds of energy in direct form
   c. In general, low MRR but better quality products
   d. Comparatively high initial investment cost
   e. Tool material need not be harder than the work piece material.
   f. Machined surface do not have any residual stresses.
3. What is meant by conventional machining processes?
   Ans: In conventional machining processes, metal is removed by using some sort of tool which is harder than work piece and is subjected to wear. In this process, tool and work piece are in direct contact with each other.
4. What is meant by Unconventional machining processes?
   Ans: The unconventional machining processes do not employ a conventional or traditional tool for metal removal. Instead they directly utilize some form of energy for metal machining. In this process there is no direct physical contact between the tool and work piece.
5. Differentiate the conventional and unconventional machining processes in terms of principles.(or) Distinguish between traditional and non traditional machining processes?
   Ans: In conventional processes, the material is removed in the form of chips by the advancing cutting tool that plastically deforms (shearing) the material ahead. In the case of the UCM processes, energy (Electrical, Chemical, Thermo-Electric, and Mechanical) in its direct form is utilized for the material removal and so there is no physical contact between the work piece and tool.
6. What are the various types of energy sources used in non-traditional machining techniques? Give examples for each. (or) How non – traditional machining processes are classified?
   Ans: Pneumatic pressure - AJM, Hydraulic pressure - WJM, USM, AWJM, Corrosion - CHM, CHB, PCM, High current density in electrolytes - ECM, High voltage - EDM (for sparking); IBM, EBM (ionizing); LBM, (Creating avalanche in lazing medium); PAM (for ionizing the plasma gases)

7. Identify the mechanism of material removal, transfer media and energy source for EDM.
   Ans: Mechanism of material removal- Fusion of materials by arcs, Transfer media - Electron stream, Energy source – Electrical spark
8. Identify the mechanism of material removal, transfer media and energy source for ECM & ECG.
   Ans: Mechanism of material removal- Ion displacement, Transfer media – Electrolyte, Energy source - High current
9. Identify the mechanism of material removal, transfer media and energy source for EBM.
   Ans: Mechanism of material removal- Vaporization, Transfer media - Electron stream, Energy source - High speed electrons
10. Identify the mechanism of material removal, transfer media and energy source for LBM.
    Ans: Mechanism of material removal- Vaporization, Transfer media - Amplified coherent light radiation, Energy source – powerful radiation
11. Identify the mechanism of material removal, transfer media and energy source for PAM.
    Ans: Mechanism of material removal- Vaporization, Transfer media - Ionised gas stream, Energy source - High voltage
12. Identify the mechanism of material removal, transfer media and energy source for USM.
    Ans: Mechanism of material removal – Erosion, Transfer media - High velocity particles, Energy source - Hydraulic pressure
13. Identify the mechanism of material removal, transfer media and energy source for AJM.
    Ans: Mechanism of material removal- Erosion, Transfer media - High velocity particles, Energy source - Pneumatic pressure (Mechanical and fluid motion)
14. Identify the mechanism of material removal, transfer media and energy source for WJM.
    Ans: Mechanism of material removal- Erosion, Transfer media - High velocity water jet, Energy source – pneumatic / Hydraulic pressure
15. Identify the energy source applied in the following processes: i) IBM ii) CHM iii) ECG iv) ECM v) EDM vi) EBM vii) AJM viii) LBM
    Ans: i) IBM – Ionised substance ii) CHM – corrosive agent iii) ECG – Electrical current and Mechanical motion iv) ECM – Electrical current v) EDM – Electrical spark vi) EBM – High speed electrons vii) AJM – Mechanical and fluid motion viii) LBM – Powerful Radiation.
16. What is the necessity for unconventional machining processes? (or) What are the importance of unconventional machining? (or) Enlist the requirement that demands the use of advanced machining process.
    Ans: A harder and difficult to machine materials such as carbides, stainless steel, nitralloy, hastalloy and many other high strength temperature resistant alloys find wide application in aerospace and nuclear engineering industries. Many of these materials also find applications in other industries, owing to their high strength to weight ratio, hardness and heat resisting qualities. For such materials the conventional edged tool machining is highly uneconomical and the degree of accuracy and surface finish attainable are poor. The unconventional machining processes have been developed to overcome all these difficulties.
17. Explain the classification of Unconventional machining according to major energy source employed.
    Ans: Unconventional machining are classified according to major energy source as follows:
    a. **Thermal Energy methods:** In this method, heat energy is concentrated on a small area of the work piece to melt and vaporize tiny bits of work material. Examples i) Laser beam machining ii) Plasma Arc machining iii) Electron beam machining iv) Ion beam machining

b. **Electrical energy methods:** In this method, electrical energy is directly used to cut the material to get the final shape and size. Examples: i) Electro Discharge machining(EDM) ii) Wire cut EDM
c. **Electro chemical energy methods**: In this method, material is removed by ion displacement of the work piece material in contact with a chemical solution. Examples: i) Electro chemical machining ii) Electrochemical grinding iii) Electro chemical honing iv) Electro chemical deburring
d. **Chemical energy method**: This method involve controlled etching of the work piece material in contact with a chemical solution. Example: Chemical machining
e. **Mechanical energy methods**: In this method, material is removed by mechanical erosion of the work piece material. Example: i) Ultrasonic machining ii) Abrasive jet machining iii) Water jet machining.

18. Name the unconventional machining processes which are i) used to remove maximum material ii) used to remove minimum material iii) consumes maximum power iv) consumes minimum power.
Ans: i) used to remove maximum material – Electro chemical machining, plasma arc machining ii) used to remove minimum material – Electron beam machining iii) consumes maximum power – Laser beam machining iv) consumes minimum power – Plasma arc machining.
19. Name the unconventional machining processes for machining following materials: i) Non metals like ceramics, plastics and glass ii) Refractories iii) Titanium iv) super alloys v) steel.
Ans:
i) Non metals like ceramics, plastics and glass – USM, AJM, EBM, LBM
ii) Refractories – USM, AJM, EBM, EDM
iii) Titanium - EDM
iv) super alloys – AJM, ECM, EDM, PAM
v) steel – ECM, CHM, EDM, PAM.
20. Mention the best suited Unconventional machining process for the following operations:
i). For producing microholes – **LBM** ii) For machining small holes – **EBM** iii) For machining deep holes – **ECM** iv) For producing shallow holes – **USM, EDM** v) For precision through cavities in work pieces – **USM, EDM** vi) For grinding operation – **AJM, EDM** vii) For honing operation – **ECM** viii) For Deburring operation – **USM, AJM** ix) For Threading operation – **EDM**.
21. Name the Unconventional machining processes which produce best surface finish.
Ans: i) Abrasive Jet machining (AJM) ii) Electro chemical grinding (ECG) iii) Electro chemical Deburring (ECD) iv) Ultrasonic machining (USM)
22. Why conventional mechanical machining process is not so effective on soft metals like aluminium?
Ans: Unconventional machining process is not so effective on soft metals like aluminium, because accuracy cannot be maintained due to more metal removal rate.
23. Name the important factors that should be considered during the selection of an Unconventional machining process for a given job.
Ans: i) Physical parameters ii) Shapes to be machined iii) Process capability or machining characteristics iv) Economic considerations.

24. Write the importance of surface finishing in machining operations.
    Ans: i) In aerospace and medical fields ii) High pressure hydraulic systems and fuel injection systems requires high quality surface finish.

PART – B

1. Classification of UCM (or) How are unconventional machining processes classified? (or) What are the basic factors upon which the unconventional manufacturing processes are classified? Explain.
2. (i) Explain the factors that should be considered during the selection of an appropriate unconventional machining process for a given job.
   (ii) Compare and contrast the various unconventional machining process on the basis of type of energy employed, material removal rate, transfer media and economical aspects. (or) Classify unconventional machining processes based on basic mechanism involved in the process, sources of energy required for material removal, medium for transfer of energies and type of energy required shape materials.
3. Compare the mechanical and electrical energy processes in terms of physical parameters. Shape capabilities, Process capability, and Process economy. (or) Compare the process capabilities and limitations of electrical energy based, thermal energy based and mechanical energy based unconventional machining processes.
4. Explain the reasons for the development of Unconventional Machining Process. Discuss about the criteria recommended in selection of these processes. (or) Explain the need for the development of Unconventional Machining Process by considering any four simple cases of your own interest.
5. Make a comparison between traditional and unconventional machining processes in terms of cost, application, scope, Machining time, advantages and limitations.
6. For different non-conventional processes, present in the form of a table, various process parameters recommended
7. i) What exactly are the items that can be considered with respect to the analysis of economics of various non – traditional machining processes? Briefly explain.
   ii) Make a comparison among various non - traditional machining processes in terms of the following. Presentation in the form of a table is preferred. a. Pocketing operation b. Contouring a surface.
8. How will you analyze the applicability of different processes to different type of materials namely metals, alloys and non metals? Presentation in the form of a table is preferred.
9. Is unconventional machining process an alternate or complement to conventional machining process? Justify.
10. What do you understand by the word "unconventional" in unconventional machining processes? Is it justified to use this word in the context of the utilization of these processes on the shop floor?

UNIT – 2 MECHANICAL ENERGY BASED PROCESSES

PART – A

1. What are the abrasives used in AJM process?
   Ans: The various abrasive particles used in AJM process are Aluminium Oxide, Silicon Carbide, glass powder, Dolomite and specially prepared sodium bicarbonate.
2. What are the desirable properties of carrier gas in AJM?
   Ans: It should be cheap, non-toxic, easily available and should dry quickly

3. List the applications of WJM process.
   Ans: This process is very convenient for cutting relatively softer and non-metallic materials like paper boards, plastics, wood rubber, leather, fibre glass etc., Aero space industries, Automobile industries, Paper pulp industries.
4. What is meant by transducer?
   Ans: It is a device which converts one form of energy into another form of energy. Ex: Piezoelectric transducer. The device used for converting any type of energy into ultrasonic wavers or vibration is called ultrasonic transducer.
5. What is feed mechanism and state its types?
   Ans: Feed system is used to apply the static load between the tool and work piece during ultrasonic machining operation. There are three types of feed mechanism. They are: Gravity feed mechanism, Spring loaded feed mechanism, Pneumatic feed mechanism.
6. What is the effect of abrasive grain size on machining rate in USM?
   Ans: Material removal rate and surface finish are greatly influenced by grit of the abrasive. For roughing work operation, grit size of 200-400 are used for finishing operation, grit size of 800- 1000 are used. (refer book for then graph between grain size and MRR)
7. What are the types of work materials for USM?
   Ans: Hard and brittle metals like tungsten carbide, boron carbide, tool steel, germanium, etc., are used as work material in USM process. Non-metal like glass and ceramics are also used as work material.
8. Define abrasive slurry.
   Ans: Abrasive slurry is a mixture of abrasive grains and water of definite proportion (20-30%)
9. Write the typical applications of ultrasonic machining.
   Ans: i)Holes as small as 0.1mm can be drilled, ii) Precise and intricate shaped articles can be machined, iii)it is used for making tungsten carbide and diamond wire drawing dies and dies for forging and extrusion processes. iv) It has been efficiently applied to machine glass, ceramics, tungsten, precision mineral stones etc.
10. State the principle of ultrasonic machining process?
    Ans: In this process, slurry of small abrasive particles are forced against the work piece by means of a vibration tool and a causes the removal of metal from the work piece in the form of extremely small chips.
11. State the benefits of Water Jet Machining process.
    Ans: In this process, water is used as energy transfer medium. It is cheap, non-toxic and easy to dispose. The work area remains clean and dust free.
12. Define tool wear ratio.
    Ans: It is defined as the ratio of volume of material removed from the work to volume of material eroded from tool.
13. Explain water jet machining process?
    Ans: In this process, high pressure and high velocity stream of water is used to cut the relatively softer and non-metallic materials like paper board, wood, plastics, rubber, fibre glass, leather etc.,
14. What are the factors that affect the material removal rate in AJM process?
    Ans: Mass flow rate, Abrasive grain size, Gas pressure, Velocity of abrasive particles, Mixing ratio and Nozzle tip clearance.

15. State the applications of AJM process?
    Ans: 1.Machining of Hard and brittle materials like quartz, ceramics, glass sapphire etc., 2.Machining of semiconductors. 3. Fine drilling and microwelding 4. Cleaning and polishing of plastics, nylon and Teflon components.
16. State the advantages and limitations of USM.
    Ans: Adv: i) Noiseless operation, ii) Metal removal cost is low iii) High accuracy and Good surface finish iv) Extremely hard and brittle materials can be easily machined. Lim: i) Metal Removal rate is slow, ii) Softer materials are difficult to machine iii) high tool wear rate. Iv) initial cost is high.
17. Explain the abrasives used in USM process?
    Ans: The most commonly used abrasives are boron carbide, silicon carbide, aluminium oxide and diamond. Boron is the most expensive material and is best suited to cutting of tungsten carbide, tool steels etc., Aluminium oxide is the softest abrasive and it is used for machining glass ceramics.
18. What are the types of tool materials for USM?
    Ans: Generally, tough and ductile tool material is used in USM process. Low carbon steels and stainless steels are commonly used as tool materials.
19. What is water jet machining process?
    Ans: In this process, high pressure and high velocity stream of water is used to cut the relatively softer and non metallic materials like paper board, wood, plastics, rubber, fibre glass, leather etc.,
20. State the working principle of HJM process.
    Ans: In hydrodynamic jet machining process, abrasive particles are added to the high velocity stream of water jet and the material is removed from the work piece due to the combined effect of abrasion and water impact.
21. State the working principle of Abrasive Jet Machining.
    Ans: In Abrasive jet machining process, a high speed stream of abrasive particles mixed with high pressure air or gas are injected through a nozzle on the work piece to be machined.
22. What is ultrasonic machining?
    Ans: USM is a mechanical material removal process in which the material is removed by repetitive impact of abrasive particles carried in liquid medium on to the work surface, by a shaped tool, vibrating at ultrasonic frequency.
23. What are the components of USM?
    Ans: 1. Ultrasonic transducer 2. Concentrator 3. Tool 4. Abrasive slurry 5. Abrasive feed mechanism 6. Tool feed mechanism
24. What is piezoelectric effect?
    Ans: When mechanical force is applied to one pair of opposite faces of certain crystals like quartz, tourmaline etc., equal and opposite electric charges appear across its other faces.
25. Write short notes on piezoelectric crystals?
    Ans: Piezoelectric crystals are used for inducing ultrasonic vibrations since they posses the capability of changing their dimensions to the given electrical energy or in other sense they have the capability of converting electrical energy into mechanical vibrations.
26. What is magnetostrictive effect?
    Ans: When a rod of ferromagnetic material such as Nickel, or Iron – Cobalt (Permendum) or Iron – Aluminium (Alter) is kept in a magnetic field parallel to its length, the rod suffers a change in its length. This phenomenon is known as magnetostriction effect.

27. What is the purpose of concentrator used in USM?
    Ans: The main purpose of the concentrator is to increase the amplitude of the vibration obtained from the transducer.
28. What are the types of transducers used in ultrasonic machining processes?
    Ans: Transducers used in ultrasonic machining processes for the production of ultrasonic waves are of two types i) Magnetostriction Transducer ii) Piezoelectric Transducer.
29. What is inverse Piezoelectric effect?
    Ans: When an AC voltage is applied across the piezoelectric crystal, it starts vibrating at the frequency of the applied voltage. Ultrasonic wave generation is based on inverse piezoelectric effect.
30. What are the different types of concentrators?
    Ans: 1. Conical Type 2. Exponential type 3. Stepped type.
31. What are the characteristics of carrier fluid?
    Ans: 1. Good wetting characteristics 2. High thermal conductivity 3. Non-toxic and non-corrosive. 4. Should have low viscosity.
32. What are the elements of Carrier Fluid?
    Ans: 1. Act as a coolant. 2. Act as an acoustic bond between the work piece and the tool. 3. Helps efficient transfer of energy. 4. Act as medium to carry the abrasive machined materials and worn abrasives.
33. Name the carrier gas (Transfer medium) used in AJM process.
    Ans: Nitrogen, carbon dioxide, helium or compressed air are used as carrier gas (Transfer medium in AJM process.
34. What are the materials used for nozzle manufacturing in AJM process?
    Ans: Tungsten carbide or synthetic sapphire are used as nozzle materials. Nozzles made of tungsten carbide have an average life of 12 to 20 hours whereas synthetic sapphire nozzle has an average life of 300 hours.
35. List the Advantages and Disadvantages of AJM process.
    Ans: Advantages: i) Initial investment is low ii) This process is suitable for cutting all materials. Even diamond can be cut by using diamond as abrasive iii) It can be used to cut intricate hole shapes in hard and brittle materials iv) There is no heat generation during this process. So thermal damage to the work piece is avoided. Disadvantages: i) Material removal rate is slow ii) soft materials cannot be machined.
36. List the benefits and disadvantages of WJM process.
    Ans: Benefits: i) Water which is used as energy transfer medium, is cheap, non toxic and easy to dispose ii) Low operating cost iii) The work area remains clean and dust free. Iv) Low maintenance cost. Disadvantages: i) Initial cost of process is high ii) It is difficult to machine hard matwerials.
37. How does AJM differ from conventional sand blasting process?
    Ans: AJM differ from the conventional sand blasting process in the way that the abrasive is much finer and effective control over the process parameters and cutting. Used mainly to cut hard and brittle materials, which are thin and sensitive to heat.
38. Reuse of abrasives is not recommended in AJM. Why?
    Ans: Reuse of abrasives is not recommended since the cutting ability of abrasive decrease after the usage and also the contamination of wear materials clogging the nozzle and the cutting unit orifice.

39. Give a summary of the abrasive of their application for different operation?
    Ans: (1) Aluminum - Cleaning, Cutting and Debar (2) Silicon Carbide - Faster cleaning, Cutting. (3) Glass Heads - Matt polishing, cleaning (4) Crushed glass - Peening and cleaning.

PART – B

1. Explain the principle of USM and its equipment. Explain the factors, which influence the MRR in USM. Compare USM with traditional Abrasive machining.
2. Explain the following in detail i) Types of transducers for USM ii) Feed mechanisms in USM iii) USM typical applications iv) Abrasives for USM
3. i) Describe the principle and equipment for Abrasive Jet machining. (OR) Write the names of various elements of AJM and explain them in brief.
   ii) Explain the process parameter which controls the AJM machining quality.(or) With a neat sketch explain the process of AJM? Explain the process control measures to be taken to control quality and MRR.
4. i) Describe the principle and equipment for Water Jet Machining.
   ii) Explain the different applications and process control features of WJM.
5. Explain the functions of Transducer and horns used in USM. List the tool materials used.
6. Briefly explain the effect of operating parameters on MRR. List the applications of USM.
7. Discuss the process parameters, applications, advantages and disadvantages of water jet machining process.
8. Describe the principle and working of a USM with a neat sketch. List the advantages, limitations and applications of USM. Discuss about the control of quality in machining in USM.
9. Discuss the effects of the following parameters on MRR and surface finish in USM: i) amplitude and frequency ii) Abrasive size iii) Concentration of abrasives iv) Material hardness v) static load vi) effect of slurry, tool and work material.
10. Compare USM, WJM and AJM in terms of process capabilities and limitations.
11. Discuss about the control of quality in USM and the capabilities of USM.
12. Briefly explain about the mechanisms involved in material removal by USM.
13. What is the fundamental principle of abrasive jet machining? Briefly explain with a neat diagram, the AJM process. In AJM, how is material removal rate increased? Also state how nozzle life is improved in such a machining process.
14. i) Make a comparison between ultrasonic machining and conventional grinding.
    ii) What are the actions do the ultrasonic vibrations imparted to the fluid medium surrounding the tool have?
15. Draw the schematic layout of AJM and explain its operating characteristics. What are the methods adopted to have an effective control over the mass flow rate of the abrasive?

UNIT – 3 ELECTRICAL ENERGY BASED PROCESSES

PART – A

1. Define electrical discharge machining?
   Ans: EDM is the controlled erosion of electrically conductive materials by the initiation of rapid and repetitive spark discharge between the electrode tool to the cathode and work to anode separated by a small gap kept in the path of dielectric medium. This process also called spark erosion.

2. What are functions of dielectric fluid used in EDM?
   Ans: i) It acts as an insulating medium ii) It cools the spark region and helps in keeping the tool and work piece cool. iii) It maintains a constant resistance across the gap. iv) It carries away the eroded metal particles. v) It remains electrically non conducting until the required breakdown voltage has been reached.
3. What are the basic requirements of dielectric fluid used in EDM?
   Ans: i) Stable Dielectric strength. ii) It should have optimum viscosity. iii) It should have high flash point. iv) It should be chemically stable at high temperature and neutral. v) It should not emit toxic vapors.
4. What is the dielectric fluids commonly used in EDM?
   Ans: 1. Petroleum based hydrocarbon fluids. 2. Parafin, white sprite, transformer oil. 3. kerosene, mineral oil. 4. Ethylene glycol and water miscible compounds.
5. What are the prime requirements of tool material in EDM?
   Ans: 1. It should be electrically conductive. 2. It should have good machinability. 3. It should have low erosion rate. 4. It should have low electrical resistance. 5. Melting point of the tool should be high.
6. What is the effect of capacitance in EDM?
   Ans: Increasing the capacitance causes the discharge to increase and increase both the peak current and discharge time.
7. Name some of the tool material used in EDM?
   Ans: 1. Copper, brass, alloys of Zinc &tin. 2. Hardened plain carbon steel 3. Copper tungsten, silver tungsten, tungsten 4. Copper graphite and graphite.
8. What are the process parameters which affect efficiency?
   Ans: 1. Energy discharge 2. Capacitance. 3. Size of work piece. 4. M/c tool design
9. Write the formula for finding the energy discharge in EDM?
   Ans: W=(1/2) X EIT
   W-discharge energy I- Current, T-time , E-voltage
10. How do you increase the inductance of the circuit?
    Ans: A piece of iron or steel be allowed to lodge between the leads it would increase the inductance of the circuit and reduce the machining rate.
11. Define W/T (Tool Wear) ratio?
    Ans: It is the ratio of volume of work material removed to the volume of electrode (tool) consumed.
12. What is cycle time?
    Ans: It is the sum of discharge time and waiting time.
13. Define over cut?
    Ans: It is the discharge by which the machined hole in the work piece exceeds the electrode size and is determined by both the initiating voltage and the discharge energy.
14. Define Rehardening?
    Ans: While metal heated to a temperature above the critical and then rapidly cooled by the flowing dielectric fluid the metal is rehardened.
15. What is recast metal?
    Ans: Metal heated to a temperature above the melting point and which is not displaced by the action of the spark discharge, resoldifies as recast metal.

16. Explain electrode wear?
    Ans: A crater is produced in the electrode, which is likewise dependent on the electrode material and the energy of the discharge.
17. What are types of power supply circuits used in EDM?
    Ans: 1. R-C circuit. 2. Rotary impulse generator. 3. Controlled pulse (vacuum tube). 4. Oscillator controlled pulse. 5. Transistor pulsed circuit
18. What are the design factors to be considered while selecting the machine tool?
    Ans: 1. Number of parts to be produced. 2. Accuracy. 3. Size of work piece. 4. Size of electrode, 5. Depth of cavity.
19. Why the servo controlled system is needed in EDM?
    Ans: EDM requires that a constant arc gap (called spark gap) to be maintained between the electrode and the work piece to obtain maximum machining efficiency. Therefore EDM tool in corporate some form of servo control.
20. Define electrical discharge machining?
    Ans: EDM is the controlled erosion of electrically conductive materials by the initiation of rapid and repetitive spark discharge between the electrode tool to the cathode and work to anode separated by a small gap kept in the path of dielectric medium. This process also called spark erosion.
21. What are the factors affecting metal removal rate?
    Ans: i) MRR increases with forced circulation of dielectric fluid. ii) MRR increases upto optimum value of work – tool gap, after that it drops suddenly.iii) MRR is maximum when the pressure is below atmospheric pressure.
22. How the tool materials are classified?
    Ans: Tool or Electrodes can be classified into four groups: i) Metallic electrodes – Brass, copper tungsten, chromium copper, aluminium tungsten, silver tungsten ii) Non – metallic – Graphites iii) Combined metallic and non – metallic – Copper graphite iv) Metallic coating with insulators – Copper on moulded plastic and copper on ceramic.
23. Indicate the range of pulse duration and current in EDM.
    Ans: The current density in the discharge of channel is of the order of 10,000A/cm2. Spark discharge frequencies range from 200 – 500Khz pulses per second at voltage level of 30 – 250V.
24. What are the principal components of EDM process?
    Ans: Power supply, dielectric system, electrodes: work piece and tool, and servo system (tool feed)
25. Name the most commonly used spark generating circuits.
    Ans: i) Relaxation (R-C) circuit ii) R-C-L circuit, iii) Rotary pulse generator circuit iv) Controlled pulse generator circuit.
26. Give the wear ratio for Brass, Copper, copper tungsten and non metallic electrode.
    Ans: Brass – 1:1, Copper – 2:1, Copper tungsten – 8:1, Non metallic – 5:1 to 50:1
27. What are the drawbacks of using Relaxation circuit?
    Ans: i) Though the discharge current in a relaxation circuit reaches a high value, it is of very short duration. ii) The use of high frequencies is limited, since the time for changing the capacitor is high.
28. What is tool wear in EDM? How does tool wear occur in EDM?
    Ans: Partial removal of the tool material from the tool surface while machining the work piece due to discharge spark produced between the tool and work piece. Due to the spark

action, the intense heat generated near the zone melts and evaporates the material near the sparking zone. Since the tool is also within this zone, it also gets eroded.

29. How to minimize tool wear in EDM?
    Ans: Tool wear can be minimized by using a tool material that has a high melting point and high thermal conductivity. Also by properly configuring the tool design, tool wear can be minimized.
30. Identify the characteristics of an electrode material in order to serve as a good tool.
    Ans: i) It should be a good conductor of heat and electricity. ii) It should be easily machinable to any shape at a reasonable cost. iii) It should produce efficient material removal rates from the work piece. iv) It should resist the deformation during erosion process. v) It should exhibit low tool wear rates.
31. What are the advantages and limitations of EDM?
    Ans: Advantages: i) Machining of very thin sections is possible ii) It does not leave any chips or burrs on the work piece iii) Fine holes can be easily drilled. iv) Since there is no cutting forces act on the job, error due to elastic deformation is eliminated. v) Well suited for complicated components.
    Limitations: i) only electrically conductive materials can be machined. ii) Metal removal rate is slow. iii) more time in the fabrication of electrodes iv) high cost involved.
32. What is an arc gap? How is the arc gap controlled in EDM?
    Ans: Optimum distance between the tool and work piece so that spark can run and cause useful erosion. Servomechanism is used to control the arc gap – Average voltage is measured and as long as it is within a certain limit, no correction signal is fed to the feed drive.
33. List the applications of EDM.
    Ans: i) Production of complicated and irregular shaped profiles. ii) Thread cutting in jobs iii) Drilling of micro holes iv) helical profile drilling v) curved profile drilling.
34. List the advantages and disadvantages of wire – cut EDM
    Ans: Advantages: i) It gives high surface finish ii) Complicated shapes can be efficiently machined. iii) tool manufacturing and storage is avoided iv) economical for small batch production. Disadvantages: Capital cost is high ii) Cutting rate is slow. iii) it is not suitable for large work piece.
35. List the applications of WEDM.
    Ans: It is best suited for the production of gears, tools, dies, rotors, turbine blades, press tools and cams.
36. What is meant by wire cut EDM? Mention its salient feature.
    Ans: The principle and working of WEDM is similar to EDM, but instead of using a solid electrode, a wire about 0.05 to 0.3mm diameter is used as an electrode in WEDM.
    Since WEDM uses a very small diameter wire as a tool electrode, which produces a very narrow kerf in the work. So very sharp corners can be easily produced.

PART – B

1. With the help of a neat sketch, explain the working of a spark erosion machine. (or) With the help of neat sketch, describe the EDM process.
2. What are the desirable properties of a dielectric fluid? Give some examples for dielectric fluids. Explain the functions of dielectric fluid.

3. What are the important process parameters that control the material removal rate in EDM? Explain any four factors
4. Explain the process of wire cut EDM and list any two of its advantages, limitations and applications. (or) Explain the process of wire cut EDM with respect to process equipment, applications, advantages and limitations.
5. Explain the process of Electrical discharge grinding (EDG) and list any two of its advantages, limitations and applications.
6. Explain the process of Electrical discharge wire cutting processes and list any two of its advantages, limitations and applications.
7. Explain the different types of power generator circuits in EDM.
    a. Explain the servo system used to control the feed rate in EDM process.
    b. With a typical component explain the working of a wire EDM system.
8. List out the three types of spark generators used in EDM. Describe them.
9. Explain how MRR and quality is controlled in EDM process.
10. List the recent developments in EDM process and state the limitations of EDM process.
11. Explain the classification and characteristics of various spark erosion generators?
12. Explain the working principle, elements and characteristics of wire EDM.
13. Explain how the stratified wire works. Also discuss about the recent developments in WEDM?
    a. Discuss in detail, the EDM process and its principle of operation with the help of a neat diagram.
    b. What are the significant process parameters used in the EDM process?
14. How will you carry out the analysis for optimization of MRR in EDM process? What are the steps that are to be adopted in sequence while applying the linear programming technique to optimize the MRR in EDM process?
15. Draw the scheme of Electro discharge wire cutting machine and explain its principle of operation. Also discuss the operating process parameters and their effects.
    a. Explain the different types of control circuits used in EDM process.
    b. Write about various types of flushing system employed in EDM process.
16. Sketch difference feasible dielectric flushing techniques applicable in case of EDM process?
17. Draw and explain the relaxation circuit (RC) used in EDM process?
18. Sketch and discuss the effects of the following parameters on MRR during EDM
    a. Pulse duration on material removal rate,
    b. Surface finish and relative electrode wear rate
19. With the help of a neat diagram the sequence of events constituting the process of metal removal from the work piece by a single discharge in EDM process?
20. Explain the following on wire EDM technology: i) Dielectric system ii) Deionized water iii) Positioning system iv) Wire drive system.

UNIT – 4 CHEMICAL & ELECTRO - CHEMICAL ENERGY BASED PROCESSES

PART – A

1. Define ECM?

    Ans: It is the controlled removal of metals by the anodic dissolution in an electrolytic medium, where the work piece (anode) and the tool (cathode) are connected to the electrolytic circuit, which is kept, immersed in the electrolytic medium.

2. Write the Faraday's first law of electrolysis?
   Ans: The amount of any material dissolved or deposited is proportional to the quantity of electrolyte passed.
3. Write the Faraday's second law of electrolysis?
   Ans: The amount of different substances dissolved or deposited by the same quantity of electricity are proportional to their chemical equivalent weight.
4. Write Ohm's law?
   Ans: Current, I = V/R V = Voltage (volt), R = resistance (ohm)
5. What are the factors that influence oxidation in ECM?
   Ans: Nature of work piece. 2. Type of electrolyte. 3. Current density. 4. Temperature of the electrolyte.
6. What are the materials used to make the tool electrode? (or) What are the materials used for tools in ECM?
   Ans: Copper and copper alloys, titanium, aluminum, Graphite, platinum, tungsten carbide, brass, bronze, carbon, Monel and reinforced plastic.
7. What are the main functions of electrolysis in the ECM?
   Ans: i) For completing the electric circuit between the tool and the work piece and to allow the reaction to proceed efficiently. ii) To remove the products of machining from the cutting region. iii) To carry away the heat generated during the chemical reaction. iv) To avoid ion concentration at the work piece- tool gap. v) It cools the cutting zone which becomes hot due to the flow of high current.
8. What are the properties are expected from the electrolysis used in the ECM?
   Ans: 1. High thermal conductivity. 2. Low viscosity and high specific heat.3. Should chemically stable even at high temperature. 4. Should be non-toxic and non-corrosive.
9. What are the electrolytes commonly used in ECM?
   Ans: 15 -20 % NaCl in water, sodium nitrate, potassium nitrate, sodium sulphate, sodium chromate and potassium chloride.
10. What are the results due to improper selection of electrolyte in ECM?
    Ans: 1. Low machining rate. 2. Over cut and stray cutting.
11. What are the methods generally used to filter the electrolyte?
    Ans: 1. Running the system until it is contaminated completely and replaces it. 2. Centrifugal separation. 3. Sedimentation. 4. Use of clarifiers.
12. What are the characteristics(requirements) of a good ECM tool?
    Ans: 1. It should be a good conductor of electricity and heat. 2. Easily machinable.3. Resistant to chemical reaction. 4. It offers resistance to the high electrolyte pressure.
13. What are the parameters that affect the MRR?
    Ans: 1. Feed rate. 2. Voltage. 3. Concentration of the electrolyte. 4. Temperature of the electrolyte. 5. Current density. 6. Velocity of the electrolyte.
14. How the current density affect the MRR?
    Ans: Current density is controlled not only by the amount of current but also by the size of the gap between the tool and the work piece. A small gap results in high current densities, which in turn produce more material removal.
15. What are the advantages and Disadvantages of ECM?
    Ans: Advantages:1.ECM is simple, fast and versatile method. 2. Surface finish can be extremely good.3. Fairly good tolerance can be obtained. 4. No cutting forces are involved 5. Wear and tear of tool is negligible 6. Metal removal rate is high.

Disadvantages: 1. Large power consumption and the related problems. 2. Non conducting materials cannot be machined.3. Maintenances of higher tolerances require complicated contours. 4. Initial investment is quite high 5. More space is required.

16. What are the applications of ECM?
    Ans: ECM is used for sinking, profiling and contouring, multi hole drilling, trepanning, broaching, honing, steel mill applications, surfacing, sawing, contour machining of hand to hand machine materials. It is also used for 1. Machining complicated profiles 2. Drilling small deep holes 3. Machining of hard materials and heat resistant materials 4. Machining of cavities and holes of irregular shapes.
17. Define ECG. (or) State the principle of ECG process.
    Ans: ECG is the material removal process in which the material is removed by the combined effect of Electro- Chemical effect and conventional grinding operation. The major portion of the metal (about 90%) is removed by electrochemical effect.
18. Which material is used to make the grinding wheel?
    Ans: Metal bonded diamond (or) Aluminum oxide.
19. What are the important functions of abrasive particles used in ECG?
    Ans: It acts as insulator to maintain a small gap between the wheel and work piece. They are electrolysis products from the working area. To cut chips if the wheel should contact the work piece particularly in the event of power failure.
20. What are the advantages and disadvantages of ECG?
    Ans: Advantages: 1. No thermal damage to work piece. 2. Wheel wear is negligible. 3. No distortion of the work piece. 4. good surface finish is obtained 5. Very little cutting force is applied to the work piece. 6. Burr free and stress free components are produced.
    Disadvantages: i) High capital costs, because of the special wheel tool. Ii) Power consumption is quite high. iii) Electrolyte is corrosive. iv) MRR is lower than conventional grinding.v) Non conducting materials cannot be machined.
21. What are the limitations of ECG?
    Ans: 1. The work material must be conductive.2. Not suitable for machining soft material. 3. Require dressing tools for preparing the wheels.
22. What is the application of ECG?
    Ans: 1.Best suited for precision grinding of hard metals economically. 2. Grinding Carbide cutting tools inserts. 3. Cutting thin sections of hard materials without any danger or distortion. 4. to grind end mill cutters more precisely.
23. State the principle of chemical machining process.
    Ans: In chemical machining process, material is removed from the work piece through a controlled etching or chemical attack of the work piece material.
24. What is the purpose of etchants in CHM?
    Ans: Etchants are used to remove the metal from the work piece. The metal is removed by the chemical conversion of the metal into metallic salt.
25. Name the etchants used in CHM.
    Ans: Caustic soda, Hydrochloric acid, Nitric acid, Iron chloride.
26. What is the use of maskant in CHM?
    Ans: In CHM, the areas of work piece which are not to be machined are covered with a resistant, called a resist or maskant.
27. Name some of the maskants used in CHM.
    Ans: Butyl rubber, Neoprene rubber, polymers, polyethylene etc.,
28. Write the principle of ECM process.
    Ans: ECM is based on the principle of Faradays laws of electrolysis and reverse electroplating. In this process, the work piece is connected to positive terminal (anode) and the tool is connected

to negative terminal (cathode). When the current is passed, the work piece loses metal and the dissolved metal is carried out by circulating an electrolyte between the work and tool.

29. What are the factors to be considered while designing the tool?
    Ans: 1. Determine the tool shape so that the desired shape of the job is obtained under existing machining conditions. 2. Design the tool by considering the electrolyte flow, insulation strength and fixing arrangements.
30. Name the electrolyte for the following metals: i) Iron base alloys ii) Ni base alloys iii) Ti base alloys iv) Co – Cr base alloys v) WC based alloys
    Ans: i) Iron base alloys - 20% of NaCl solution in water ii) Ni base alloys – mixture of brine and H_2So_4 iii) Ti base alloys 10% HF + 10%HCl + 10% HNO_3 iv) Co – Cr base alloys - NaCl v) WC based alloys – Strong Alkaline solution.
31. What are the process parameters of ECM?
    Ans: Current density, gap between tool and work piece, type of electrolyte used and tool feed rate.
32. What are the Limitations of ECM process,
    Ans: i) Sharp internal corners cannot be obtained ii) Tool design is very complicated and it requires cut and try method to achieve the final shape. iii) post machining cleaning is needed to reduce the corrosion of the work piece.
33. What is the difference between ECG and conventional grinding?
    Ans: In conventional grinding process, metal is removed from the work piece using grinding wheel. In ECG process, the work is machined by the combined action of electrochemical effect(about 90%) and conventional grinding operation.

PART - B

1. Describe the principle of ECG and ECH. Discuss about the process parameters that influences the ECM. List their applications and advantages.
2. Explain the working principle of electrochemical discharge grinding and discuss the process capabilities and applications.
3. Explain the ECM process. Explain how a replica of the tool is obtained. Mention the advantages and applications.
4. Discuss about electrochemical Honing and Electrochemical Grinding with suitable sketches.
    a. List out the advantages of ECG over conventional grinding.
    b. Mention the product application of ECG.
5. With suitable sketches, explain the need for the insulation in an ECM process. List the advantages, disadvantages and applications for this process.
6. Explain the process of electrochemical machining with neat sketch and discuss about influences of process parameters in machining output.
    a. Explain the chemistry involved in the ECM process?
    b. Briefly discuss about the effect of high temperature and pressure of electrolyte on the ECM process.
7. Briefly explain the following with respect to chemical machining: i) Characteristics of cut peel maskants ii) Selection of maskants iii) Advantages of photoresist maskant iv) Limitations of chemical machining.
8. What are the three methods of metal removal by electrolyte action in combination with rubbing of work piece in ECG process? Explain the diagram. What are the conditions to be satisfied to ensure high effectiveness of ECG method of machining?

9. Explain the working of electro chemical grinding process with a neat sketch and explain why the life of the ECG wheel is much higher than conventional grinding. Also list down its advantages and limitations?
10. Briefly discuss about electro chemical deburring process parameters of chemical machining process that influence the performance of the machining?
11. Compare the CHM with ECM with respect to their process parameters.

UNIT – 5 THERMAL ENERGY BASED PROCESSES

PART – A

I. LASER BEAM MACHINING

1. What is Laser?
   Ans: It is acronym of light amplification by stimulated emission of radiation. It is an electromagnetic radiation. It produces a powerful, monochromatic, collimated beam of light in which the waves are coherent.
2. State the principle of LBM.
   Ans: In laser beam machining process, laser beam is focused on the work piece by means of lens to give extremely high energy density to melt and vaporize the work material.
3. What is Maser?
   Ans: Laser can melt diamond when focused by lens system. The energy density being of two orders 100,000 KW/cm^2 This energy is due to atoms that have light energy level. when such an atom impinge with electromagnetic waves having resonant frequency.
4. What are the characteristics of laser used in laser machining?
   Ans: (i) It can be focused to maximum intensity or to minimum intensity as needed. (ii) It can be moved rapidly on the work piece. (iii) It is projected on the work piece at particular distance from the lens. (iv) Dedicated to an online process. (v) Power is shared on a job.
5. Give the examples of i) solid state laser ii) gas laser.
   Ans: i) solid state laser – Ruby laser, Neodymium doped Yitrium – Aluminium – Garnet(YAG) laser, Neodymium doped glass laser ii) gas laser – carbon dioxide laser, Helium – Neon laser.
6. What are basic requirements of laser welding?
   Ans: (i) The focus of the beam should be adjusted to the thickness of the material.
   (ii) The wave length of the laser beam must be compatible with the material being welded.
7. What is solid state Laser?
   Ans: Solid state Laser is the Lasers, which consist of a hot nat, which may be crystalline solid / glass, doped with an active material whose atoms provide the lasing action.
8. How does Laser melting works?
   Ans: It melts and vaporizes the unwanted material by means of narrow pulsed laser operating at 2 to 100 pulses/sec Because of this high accuracy is not possible to micro sized holes.
9. What are the characteristics of Laser beam?
   Ans: 1. Material removal 2. Material shaping 3. Welding 4. Thermo kinetic change.
10. What are the fundamentals of photons used in Laser?
    Ans: In the Laser the photons are in ground state at 0°C they are brought to the excited state by means of absorption of energy by temperature change, collision etc.,
11. What are the advantages of Laser drilling?
    Ans: No physical contact between work root pair hence there is no possibility if breakage or wear of root. Precision location is ensured by focusing of the beam Large aspect ratio can be achieved.

12. What are the emission lines?
    Ans: The atoms when they are bringing down goes to the excited state by stimulated emission and emit photons within 10 nano secs. They have the same wavelength as the excited photons.
13. What is population inversion?
    Ans: If the atoms in the excited state are greater than that of the ground state then it is known as population inversion.
14. What are the characteristics of Laser used in Laser machining?
    Ans: 1. Can be focused to maximum intensity or to lower intensity as needed. 2. Can be moved rapidly on the work. 3. Remote cutting over long standoff distances.
15. What materials can be machined by using Laser Beam?
    Ans: All materials except those having high thermal conductivity and high reflectivity.
16. List the advantages and limitations of LBM.
    Ans: Advantages: i) Machining of any materials including non metal is possible ii) Micro sized holes can be machined iii) Heat affected zone is small around the machined surface. Limitations: i) Highly skilled operators are needed ii) Rate of production is low iii) initial investment is high iv) Life of flash lamp is short.
17. List the applications of LBM.
    Ans: i) It is used for making small holes, difficult welding of non conductive and refractory materials, cutting complex profiles in thin and hard materials ii) It can be used for mass micro machining production iii) It can also be used for selective heat treating of materials.

II. PLASMA ARC MACHINING

18. What is the principle of plasma arc machining? What are the two stages in which the process of material removal is affected?
    Ans: In plasma arc machining process, material is removed by directing a high velocity jet of high temperature (11,000°C to 28,000°C) ionized gas on the work piece. This high temperature plasma jet melts the material of the work piece. Plasma formation and melting of work piece are the two stages in which the process of materials removed is affected.
19. What is the main industrial application of plasma cutting systems?
    Ans: (i) It is used for cutting alloy steels, stainless steel, cast iron, copper, nickel, titanium, aluminum and alloy of copper and nickel ,etc. (ii) It is used for profile cutting.
20. What do you understand by fourth state of matter?
    Ans: The dynamical properties of this gas of free electrons and ions are sufficiently different from the normal unionized gas. So it can be considered a fourth state of matter, and is given a new name, 'PLASMA'
21. What are the gases used in PAM?
    Ans: The commonly used gases are nitrogen, hydrogen, air, mixture of nitrogen-hydrogen and argon – hydrogen etc.
22. Define plasma.
    Ans: Plasma is defined as the gas, which has been heated to a sufficiently high temperature to become ionized.
23. What are the advantages of plasma arc welding?
    Ans: a. Exothermic oxidation takes place. b. DC power supply
24. What are the metals that can't be machined by plasma arc machining?
    Ans: A. Stainless steel b. Monel c. Super alloys

25. What is the basic heating phenomenon that takes place in plasma arc welding?
    Ans: The basic heating phenomenon that takes place at the work piece is a combination of anode heating due to direct electron bombardment recombination of molecules on the work piece.
26. How the initial ionization is accomplished in plasma arc machining?
    Ans: A high voltage arc established between electrode and nozzle accomplishes initial ionization.
27. Why does gas formed in plasma do in P.A.M?
    Ans: This gas stabilizes the arc and prevents it from diverging.
28. How another source of heating achieved in P.A.M?
    Ans: It is desirable to achieve a third source of heating by injecting oxygen into work area to take advantage of exothermic oxidation.
29. Write the principle of P.A.M
    Ans: Once the material has been raised to molten point the high velocity gas stream blows the material away.
30. Write the circuitry details in PAM.
    Ans: + ve terminal connected to work piece and -- ve terminal connected to electrode.
31. Which type of power supply is used in P.A.M?
    Ans: DC power supply is used.
32. Which part is constricted by plasma?
    Ans: Nozzle duct is constricted by plasma.
33. How does the basic plasma is generated?
    Ans: The basic plasma is generated by subjecting a stream of gas to the electron bombardment of the electric arc.
34. What are the metals that can't be machined by plasma arc machining?
    Ans: 1. Stainless steel 2. Monel 3. Super alloys
35. State the working principle of PAM.
    Ans: In PAM process, material is removed by directing a high velocity jet of high temperature (11000°C to 28000°C) ionized gas on the work piece. This high temperature plasma jet melts the material of the work piece.
36. What are the types of plasma arc torches?
    Ans: i) Direct arc plasma torches (or) Transferred arc type ii) Indirect arc plasma torches (or) Non transferred arc type.
37. What is transferred arc type plasma?
    Ans: In this process, electrode is connected to the negative terminal of the DC power supply and work piece is connected to the positive terminal of a DC power supply. So more electrical energy is transferred to the work, thus giving more heat to the work.
38. What is non - transferred arc type plasma?
    Ans: In this process, electrode is connected to the negative terminal of the DC power supply and nozzle is connected to the positive terminal of a DC power supply. When the working gas passes through the nozzle, a part of the working gas becomes heated, ionized and emerges from the torch as plasma jet. This plasma feeds the heat to the work piece. This type of torches are used for non conducting materials.
39. List the advantages and limitations of PAM.
    Ans: Advantages: i) It can be used to cut any metal ii) cutting rate is high iii) As compared to ordinary flame cutting process, it can cut plain carbon steel four times faster.
    Limitations: i) Cost of equipment is high ii) It produces tapered surface iii) work surface may undergo metallurgical changes.

40. List the applications of PAM.
    Ans: i) It is used for cutting alloy steels, stainless steel, cast iron, copper, nickel, titanium, aluminium and alloy of copper and nickel etc., ii) It is used for profile cutting.

ELECTRON BEAM MACHINING

41. State the working principle of EBM.
    Ans: When the high velocity beam of electrons strike the work piece, its kinetic energy is converted into heat. This concentrated heat raises the temperature of work material and vaporizes a small amount of it, resulting in removal of metal from the work piece.
42. In electron beam machining, why is a high vacuum created in the apparatus?
    Ans: In electron beam machining process, high velocity focused beam of electrons are used to remove the metal from the work piece. These electrons are travelling at half the velocity of light i.e.,1.6×10^{8} m/s. EBM process is performed in a vacuum chamber, i) to avoid collision of accelerated electrons with air molecules. ii) protect the cathode from chemical contamination and heat losses.iii) the possibility of an arc discharge between the electrons is prevented.
43. State any four limitations of EBM?
    Ans: (i) The metal removal rate is very slow. (ii) It is not suitable for large work pieces. (iii) Cost of equipment is very high. (iv) A little taper produced on holes.v) it is applicable only for thin materials.
44. How is the work table protected from getting damaged by EBM while machining the work piece?
    Ans: The running and guidance rail of the table in particular against dirt, spatter and metal condensate. Hoods and ductwork should be constructed for fire resistant materials. Since x-rays are produced as a byproduct the work table should be enclosed and shielded with lead or other materials suitable for preventing x-ray exposure.
45. What are the important process parameters of electron beam machining processes?
    Ans: (i) Control of current (ii) Control of spot diameter (iii) Control of focal distance of magnetic lens.
46. What is the drawback of electron beam machining?
    Ans: One major diameter of electron beam welding has been the requirement of high degree of vacuum essential or satisfactory operation of this process because of degassing.
47. Write the application of electron beam?
    Ans: 1. Thin film machining. 2. Surface treatment. 3. Engraving metals and non-metals.4. Cutting of materials.
48. Write any four application of EBM?
    Ans: (i) Micro machining application on materials. (ii) Drilling of apertures for electron microscope. (iii) Drilling of holes in ruby and diamond crystal.
49. Define EBM.
    Ans: It is the thermo-electrical material removal process on which the material is removed by the high velocity electron beam emitted from the tungsten filament made to impinge on the work surface, where kinetic energy of the beam is transferred to the work piece material, producing intense heat, which makes the material to melt or vaporize it locally.
50. What is the characteristic of the electron beam?
    Ans: i. High concentrated energy. ii. Deep penetration into the metals. iii. Low distortion. iv. Any material either conductive or non-conductive can be processed.
51. What are the main elements of the EBM equipment?
    Ans: 1. Electron Gun. 2. Beam focusing and deflecting units. 3. Work Table. 4. Vacuum chamber
52. What is the function of magnetic lens used in EBM?
    Ans: It converges the beam into a narrow spot into the work piece.

53. What are the two types of EBM? Explain

Ans: (i) Thermal type. (ii) Non-thermal Type.

In thermal type, type the electron beam is used to heat the material up to the point where it is selectively vaporized.

In Non - thermal type, the EBM produces a chemical reaction.

54. Write the advantages and disadvantages of EBM?

Ans: Advantages: (i) High accuracy. (ii) Any type of material can be processed. (iii) No mechanical or thermal distortion. (iv) No physical or metallurgical damage results.

Disadvantages: (i) High cost of equipment. (ii) Skilled operator is required for operation. (iii) Limited to 10mm material thickness.

PART B

1. Describe the Laser Beam Machining equipment and Electron Beam Machining equipment.
   i) Explain the production of laser beam and working principle of LBM?
   ii) What are the applications of EBM process?
2. Explain the features of EBM unit. Explain the effect of increasing the accelerating potential on MRR.
3. Explain the process of LBM and PAM with neat sketches.
   i) Discuss the process parameters of EBM and their influence on Machining quality.
   ii) Explain the process capabilities of PAM.
4. Explain the principle of LBM with neat sketch and list out the advantages and disadvantages?
5. Explain the process of PAM with a neat sketch. With respect to principle, equipment process parameter, advantages, disadvantages and applications.
6. Explain the thermal features of Laser beam machining. Discuss the performance of various types of Lasers.
7. Discuss about the process capabilities of EBM and the process parameters of EBM in improving machining quality.
8. i) What are the unique characteristics a Laser machining technique possesses that make it the only choice for the job?
   ii) What is meant by "optical pumping" briefly explain the "population inversion between energy levels" with respect to laser beam machining?
9. Why is EBM carried out in vacuum? Explain the process with a neat sketch.
10. Explain the production of Laser beam and working principle of LBM process.
11. Write short notes on: i. Process characteristics of EBM ii. Why vacuum is need and what is its order in EBM process iii. What is spontaneous emission and what is laser? iv. Advantages of laser
12. What is plasmatron? Explain various types of plasmatron.
13. What are the types of laser used for material processing applications? Describe how the system can be used for machining purpose.
14. Make a comparison between LBM and EDM on the basis of their application and limitation.
15. Explain the principle, construction and working of electron beam machining. Also how a complex shape can be cut using EBM process.
16. Write a brief notes on underwater plasma arc cutting system.
17. With the help of a neat diagram, explain plasma arc machining process mentioning how heating of the work piece takes place in the process.