Question Bank for Advanced Machining Processes

UNIT 1: Advanced Machining Processes – I

2-Mark Questions

1. **What is the working principle of Water Jet Machining (WJM)?**
   - **Answer:** WJM uses a high-pressure jet of water to erode material from the workpiece.
2. **Name one common application of Abrasive Jet Machining (AJM).**
   - **Answer:** AJM is commonly used for cleaning and etching hard surfaces.
3. **What is the role of the abrasive in Abrasive Jet Machining (AJM)?**
   - **Answer:** The abrasive particles impact and erode the material to remove it.
4. **Describe the basic concept of Ultrasonic Machining (USM).**
   - **Answer:** USM involves using high-frequency ultrasonic vibrations to facilitate material removal through erosion.
5. **What are the key parameters affecting Water Jet Machining (WJM)?**
   - **Answer:** Key parameters include water pressure, nozzle diameter, and abrasive flow rate.
6. **List one advantage of Ultrasonic Machining (USM).**
   - **Answer:** One advantage of USM is its ability to machine hard and brittle materials with high precision.
7. **How does Water Jet Machining (WJM) avoid thermal damage to the material?**
   - **Answer:** WJM avoids thermal damage by using a cold water jet, which does not generate significant heat.
8. **What material is commonly used for the nozzle in Abrasive Jet Machining (AJM)?**
   - **Answer:** Nozzles in AJM are commonly made from materials such as tungsten carbide or sapphire.
9. **In Ultrasonic Machining (USM), what type of material is typically used for the tool?**
   - **Answer:** Tools in USM are typically made from materials like steel or carbide.
10. **What is the effect of increasing the pressure in Water Jet Machining (WJM)?**
    - **Answer:** Increasing the pressure in WJM enhances the cutting efficiency and speed of the machining process.

16-Mark Questions

1. **Discuss the working principle, advantages, and limitations of Water Jet Machining (WJM). Provide a case study of its application in the aerospace industry.**
   - **Answer:** WJM uses high-pressure water to cut materials without generating heat. Advantages include no thermal damage and the ability to cut a wide range of materials. Limitations include slow cutting speeds and limited thickness capabilities. **Case Study:** WJM is used in aerospace to cut complex shapes in composite materials, such as in aircraft fuselages.

2. **Explain the process and advantages of Abrasive Jet Machining (AJM). Discuss its applications with an industrial example.**
    - **Answer:** AJM involves using abrasive particles to erode material. Advantages include precision and the ability to work with hard materials. **Application:** AJM is used in the automotive industry for cleaning and etching engine components.
3. **Analyze Ultrasonic Machining (USM) in terms of its working principle, benefits, and limitations. Provide an example of its use in the manufacturing industry.**
    - **Answer:** USM uses ultrasonic vibrations to remove material through erosion. Benefits include precision and capability to machine hard materials. Limitations include slow material removal rates and high equipment costs. **Example:** USM is used to machine intricate patterns in ceramics for electronic components.
4. **Describe the principle and operation of Electrical Discharge Machining (EDM). Include its common applications and recent technological advancements.**
    - **Answer:** EDM uses electrical discharges to erode material from a workpiece. It is used for precision machining of hard metals. Recent advancements include improved wire EDM technologies and enhanced dielectric fluids.
5. **Compare and contrast Laser Beam Machining (LBM) and Electron Beam Welding (EBW) in terms of their process principles, applications, and benefits.**
    - **Answer:** LBM uses a focused laser beam for cutting with high precision and minimal thermal distortion, suitable for fine cuts. EBW uses a focused electron beam for deep penetration welding, ideal for thick materials. Both processes offer high precision but differ in energy sources and material handling.
6. **Discuss the working principle of Electrochemical Grinding (ECG), including its applications and recent developments.**
    - **Answer:** ECG combines electrochemical and abrasive processes to grind hard materials. Applications include machining of carbide tools. Recent developments include improved wheel materials and electrolytes.
7. **Explain the Friction Stir Welding (FSW) process, its advantages, and its industrial applications. Provide a detailed example of an application.**
    - **Answer:** FSW uses a rotating tool to generate heat and join materials. Advantages include reduced thermal distortion and strong welds. **Example:** FSW is used in aerospace to join aluminum alloys in aircraft structures.
8. **Describe the working principle of Laser Beam Machining (LBM) and its key process parameters. Discuss its advantages with a case study.**
    - **Answer:** LBM uses a laser beam to cut or engrave materials with high precision. Key parameters include laser power, beam focus, and cutting speed. **Case Study:** LBM is used in the electronics industry for precise cutting of circuit boards.
9. **Analyze the parameters affecting the performance of Ultrasonic Machining (USM) and discuss its typical applications with examples.**
    - **Answer:** Parameters include ultrasonic frequency, amplitude, and abrasive slurry concentration. **Applications:** USM is used for machining hard materials like ceramics and glass, such as in the production of optical lenses.

10. **Evaluate the role of dielectric fluids in Electrical Discharge Machining (EDM) and their impact on process performance.**
    - **Answer:** Dielectric fluids cool the workpiece, flush away debris, and provide electrical insulation. Their quality and properties significantly impact the precision and efficiency of the EDM process.

UNIT 2: Advanced Machining Processes – II

2-Mark Questions

1. **What is the purpose of the dielectric fluid in Electrical Discharge Machining (EDM)?**
    - **Answer:** Dielectric fluid cools the workpiece, flushes away debris, and provides electrical insulation during the EDM process.
2. **Name one common application of Laser Beam Machining (LBM).**
    - **Answer:** One common application of LBM is cutting intricate patterns in metal sheets for the electronics industry.
3. **What does ECG stand for in advanced machining processes?**
    - **Answer:** ECG stands for Electrochemical Grinding.
4. **Describe the basic principle of Electrochemical Grinding (ECG).**
    - **Answer:** ECG combines electrochemical machining and grinding to remove material through electrochemical reactions and abrasive action.
5. **What is a common use of Laser Beam Machining (LBM) in the automotive industry?**
    - **Answer:** LBM is commonly used for precision cutting and welding of automotive components.
6. **What is the principle behind Electro Discharge Machining (EDM)?**
    - **Answer:** EDM works by generating electrical discharges between an electrode and the workpiece to erode material.
7. **List one advantage of using Electrochemical Grinding (ECG).**
    - **Answer:** ECG offers high precision and is effective for machining hard materials.
8. **What is a recent development in Laser Beam Machining (LBM) technology?**
    - **Answer:** Recent developments include advancements in fiber laser technology, improving cutting speed and precision.
9. **How does the process of EDM ensure precise material removal?**
    - **Answer:** EDM ensures precise material removal through controlled electrical discharges that erode material with high accuracy.
10. **Name a key advantage of using Electrochemical Grinding (ECG).**
    - **Answer:** A key advantage of ECG is its ability to machine very hard materials with high precision.

16-Mark Questions

1. **Discuss the working principle, advantages, and limitations of Electrical Discharge Machining (EDM). Provide an example of its industrial application.**
    - **Answer:** EDM uses electrical discharges to erode material. Advantages include precision and ability to machine hard materials. Limitations include slow material removal rates and high operational costs. **Example:** EDM is used to create intricate molds and dies in the tool and die industry.
2. **Explain the Laser Beam Machining (LBM) process, including its working principle, key parameters, and applications. Provide a case study of its use in the medical device industry.**
    - **Answer:** LBM uses a laser beam to cut or engrave materials with high precision. Key parameters include laser power, focus, and speed. **Case Study:** LBM is used in the medical device industry for cutting and shaping components such as surgical instruments with high accuracy.
3. **Analyze the principle and applications of Electrochemical Grinding (ECG). Discuss its advantages and recent advancements in the process.**
    - **Answer:** ECG uses a combination of electrochemical reactions and abrasive grinding to remove material. Applications include machining of hard metals and carbide tools. Recent advancements include improved wheel materials and electrolytes.
4. **Compare and contrast Electrical Discharge Machining (EDM) and Laser Beam Machining (LBM) in terms of process principles, applications, and benefits.**
    - **Answer:** EDM uses electrical discharges to erode material and is ideal for precision work on hard materials. LBM uses a laser beam for cutting and engraving with high precision and minimal thermal effects. Both processes offer high precision but are suited to different types of materials and applications.
5. **Describe the working principle of Electrochemical Grinding (ECG) and discuss its impact on manufacturing processes. Include recent technological improvements and their effects.**
    - **Answer:** ECG combines electrochemical and grinding processes to efficiently machine hard materials. Recent technological improvements include advanced electrolytes and grinding wheels, enhancing precision and efficiency in manufacturing.
6. **Explain the process of Laser Beam Machining (LBM), detailing its operational parameters, advantages, and limitations. Provide a detailed example of its application in the aerospace industry.**
    - **Answer:** LBM uses a focused laser beam to cut or engrave materials. Operational parameters include laser power, beam focus, and cutting speed. Advantages include precision and versatility. **Example:** LBM is used in the aerospace industry for cutting complex shapes in titanium alloys used in aircraft components.

7. **Discuss the working principle of Electrical Discharge Machining (EDM) and analyze its suitability for different types of materials. Provide a case study highlighting its application in the automotive industry.**
    - **Answer:** EDM uses electrical discharges to erode material, making it suitable for hard and complex materials. **Case Study:** EDM is used in the automotive industry for producing high-precision engine components and molds.
8. **Analyze the parameters affecting the performance of Laser Beam Machining (LBM) and discuss its applications in the manufacturing industry. Include an example of a recent technological advancement.**
    - **Answer:** Parameters affecting LBM performance include laser power, focus, and cutting speed. Applications include precision cutting of metal sheets. **Advancement:** Recent advancements in fiber lasers have increased cutting speed and accuracy.
9. **Evaluate the advantages and limitations of Electrochemical Grinding (ECG) and discuss its applications in the aerospace industry. Provide an example of recent technological improvements.**
    - **Answer:** ECG offers advantages like high precision and ability to machine hard materials, with limitations including slower material removal rates. **Example:** Recent improvements include enhanced electrolytes and wheels, improving performance for aerospace components.
10. **Describe the process of Electrochemical Grinding (ECG), detailing its working principle, benefits, and recent advancements. Provide a detailed industrial application example.**
    - **Answer:** ECG uses electrochemical reactions combined with abrasive grinding to remove material. Benefits include high precision and efficiency. **Example:** ECG is used for machining turbine blades in the aerospace industry, benefiting from recent advancements in grinding wheels and electrolytes.

UNIT 3: Advanced Joining Processes

2-Mark Questions

1. **What is the principle behind Friction Stir Welding (FSW)?**
    - **Answer:** FSW uses a rotating tool to generate frictional heat to join materials by stirring and softening them.
2. **Name one advantage of Tungsten Inert Gas Welding (TIG).**
    - **Answer:** One advantage of TIG welding is its ability to produce high-quality, precise welds with minimal spatter.
3. **What is the primary material used for the electrode in Tungsten Inert Gas Welding (TIG)?**
    - **Answer:** The primary material used for the electrode in TIG welding is tungsten.
4. **Describe the basic concept of Electron Beam Welding (EBW).**
    - **Answer:** EBW uses a focused beam of electrons to weld materials, allowing for deep penetration and minimal thermal distortion.

5. **What is the main difference between MIG and TIG welding?**
    - **Answer:** MIG welding uses a continuously fed wire electrode, while TIG welding uses a non-consumable tungsten electrode and a filler rod if needed.
6. **What is the principle of Ultrasonic Welding (USW)?**
    - **Answer:** USW uses high-frequency ultrasonic vibrations to join materials by creating localized melting at the weld interface.
7. **What material is typically used for the tool in Friction Stir Welding (FSW)?**
    - **Answer:** Tools in FSW are typically made from high-strength materials such as tool steel or tungsten carbide.
8. **List one advantage of Electron Beam Welding (EBW).**
    - **Answer:** One advantage of EBW is its ability to weld thick materials with high precision and minimal heat-affected zones.
9. **What is the key characteristic of Cold Metal Transfer (CMT) welding?**
    - **Answer:** The key characteristic of CMT welding is its ability to reduce spatter and achieve a smooth, high-quality weld with minimal heat input.
10. **Name one common application of Friction Stir Welding (FSW).**
    - **Answer:** FSW is commonly used in the aerospace industry for joining aluminum alloys in aircraft structures.

16-Mark Questions

1. **Discuss the working principle, advantages, and limitations of Friction Stir Welding (FSW). Provide an example of its application in the automotive industry.**
    - **Answer:** FSW uses a rotating tool to generate frictional heat and join materials. Advantages include reduced thermal distortion and high-strength welds. Limitations include the need for specialized equipment and the inability to weld certain materials. **Example:** FSW is used in the automotive industry to join aluminum panels in vehicle bodies.
2. **Explain the process and benefits of Tungsten Inert Gas Welding (TIG). Discuss its applications with an industrial example.**
    - **Answer:** TIG welding uses a tungsten electrode and inert gas to produce high-quality, precise welds. Benefits include clean welds and control over heat input. **Example:** TIG welding is used in the aerospace industry for welding titanium and other high-strength materials.
3. **Analyze the principle and applications of Electron Beam Welding (EBW). Discuss its advantages and recent advancements in the process.**
    - **Answer:** EBW uses a focused electron beam to weld materials, providing deep penetration and high precision. Advantages include minimal thermal distortion and suitability for thick materials. Recent advancements include improved vacuum technology and beam control.

4. **Compare and contrast Friction Stir Welding (FSW) and Electron Beam Welding (EBW) in terms of process principles, applications, and benefits.**
    - **Answer:** FSW uses frictional heat and mechanical stirring to join materials, suitable for soft metals like aluminum. EBW uses an electron beam for deep penetration welding, ideal for thick and hard materials. Both processes offer high precision but differ in material suitability and process conditions.
5. **Describe the Ultrasonic Welding (USW) process, including its working principle, benefits, and limitations. Provide a detailed example of its application in the electronics industry.**
    - **Answer:** USW uses ultrasonic vibrations to join materials by creating localized melting. Benefits include rapid processing and minimal thermal damage. Limitations include its effectiveness on only certain materials. **Example:** USW is used in the electronics industry to weld fine wires in semiconductor packages.
6. **Discuss the principle of Cold Metal Transfer (CMT) welding and analyze its impact on manufacturing processes. Include an example of its industrial application.**
    - **Answer:** CMT welding involves a controlled transfer of molten metal, reducing spatter and heat input. This results in high-quality welds with minimal distortion. **Example:** CMT is used in automotive manufacturing for precise welds on thin sheet metals.
7. **Explain the principles of Wire Arc Additive Manufacturing and discuss its applications. Provide an example highlighting its use in the aerospace industry.**
    - **Answer:** Wire Arc Additive Manufacturing uses an electric arc and wire feed to build up metal layers. Applications include producing complex parts with minimal waste. **Example:** It is used in the aerospace industry for creating large, complex components like turbine blades.
8. **Analyze the key factors influencing the performance of Tungsten Inert Gas Welding (TIG) and discuss its suitability for different materials. Provide an example of its use in the medical industry.**
    - **Answer:** Key factors include tungsten electrode type, shielding gas, and welding parameters. TIG is suitable for materials requiring high-quality welds like stainless steel. **Example:** TIG welding is used in the medical industry for manufacturing stainless steel surgical instruments.
9. **Evaluate the benefits and limitations of Ultrasonic Welding (USW) and discuss its applications in the automotive industry. Provide an example of recent technological advancements.**
    - **Answer:** Benefits of USW include fast welding and minimal thermal effects. Limitations include its suitability for only specific materials. **Example:** Recent advancements include improved ultrasonic transducers and generators, enhancing performance for automotive component assembly.

10. **Describe the process of Friction Stir Welding (FSW), including its operational parameters and benefits. Provide a detailed example of its application in shipbuilding.**
    - **Answer:** FSW uses a rotating tool to join materials by generating frictional heat. Operational parameters include tool rotation speed and travel rate. Benefits include strong, defect-free welds. **Example:** FSW is used in shipbuilding to join aluminum alloy plates in ship hulls, providing high-strength, corrosion-resistant joints.

UNIT 4: Advanced Metal Forming Processes

2-Mark Questions

1. **What is the principle of Explosive Forming?**
    - **Answer:** Explosive Forming uses the energy from controlled explosions to shape or form metal materials.
2. **Name one common application of Electromagnetic Forming.**
    - **Answer:** Electromagnetic Forming is commonly used for producing metal components with complex geometries, such as automotive parts.
3. **What is the primary advantage of High Energy Rate Forming (HERF)?**
    - **Answer:** The primary advantage of HERF is its ability to produce complex shapes with minimal material wastage.
4. **Describe the basic concept of Electro-Hydraulic Forming.**
    - **Answer:** Electro-Hydraulic Forming uses high-energy hydraulic pressure generated by electrical discharges to shape metal materials.
5. **What is the role of the electrode in Electromagnetic Forming?**
    - **Answer:** The electrode in Electromagnetic Forming creates a magnetic field that generates the necessary force to shape the metal.
6. **Name one benefit of using Explosive Forming in manufacturing.**
    - **Answer:** One benefit of Explosive Forming is its ability to form large and complex shapes quickly and with high precision.
7. **What is the primary principle behind Contour Roll Forming?**
    - **Answer:** Contour Roll Forming involves passing metal through a series of rollers to gradually shape it into a desired profile or contour.
8. **What is a key characteristic of Electro-Hydraulic Forming?**
    - **Answer:** A key characteristic of Electro-Hydraulic Forming is its ability to shape materials using rapid, high-energy hydraulic pressure.
9. **List one advantage of using Stretch Forming in metalworking.**
    - **Answer:** One advantage of Stretch Forming is its ability to produce large, lightweight components with complex shapes.
10. **Describe the basic principle of High Energy Rate Forming (HERF).**
    - **Answer:** HERF involves applying high-energy forces to a material in a short time to achieve significant deformation or shaping.

16-Mark Questions

1. **Discuss the working principle, advantages, and limitations of Explosive Forming. Provide an example of its industrial application.**
    - **Answer:** Explosive Forming uses controlled explosions to shape metal materials. Advantages include rapid processing and the ability to form complex shapes. Limitations include safety concerns and the need for precise control. **Example:** Explosive Forming is used to produce large aerospace components such as aircraft wing panels.
2. **Explain the process of Electromagnetic Forming, including its principles, benefits, and limitations. Provide an example of its application in the automotive industry.**
    - **Answer:** Electromagnetic Forming uses a magnetic field to generate high-speed deformation of metals. Benefits include high forming speeds and minimal tool wear. Limitations include high equipment costs and limitations on material types. **Example:** Electromagnetic Forming is used in the automotive industry to produce lightweight metal components with complex shapes.
3. **Analyze the principle and applications of Electro-Hydraulic Forming. Discuss its advantages and recent advancements.**
    - **Answer:** Electro-Hydraulic Forming uses electrical discharges to create high-pressure hydraulic forces for shaping metals. Advantages include high precision and the ability to form complex geometries. Recent advancements include improved discharge control and higher forming pressures.
4. **Compare and contrast Stretch Forming and Contour Roll Forming in terms of their process principles, applications, and benefits.**
    - **Answer:** Stretch Forming involves stretching metal over a form to create complex shapes, suitable for large components. Contour Roll Forming uses rollers to shape metal progressively, ideal for continuous profiles and parts. Both processes are used for creating large and complex components but differ in shaping methods and application ranges.
5. **Describe the working principle of High Energy Rate Forming (HERF) and discuss its impact on metal forming processes. Provide a detailed example of its application in the aerospace industry.**
    - **Answer:** HERF uses rapid, high-energy forces to deform metals, providing efficient shaping with minimal material wastage. **Example:** HERF is used in the aerospace industry to form complex components such as aircraft fuselage panels.
6. **Discuss the process of Electro-Hydraulic Forming, including its operational parameters, benefits, and limitations. Provide an example of its use in the defense industry.**
    - **Answer:** Electro-Hydraulic Forming involves generating high-pressure hydraulic forces through electrical discharges to shape metals. Benefits include precision and versatility. Limitations include high setup costs and complexity. **Example:** It is used in the defense industry to manufacture complex metal parts for military vehicles.

7. **Explain the principle and applications of Contour Roll Forming. Discuss its advantages and limitations with an example of its use in the construction industry.**
    - **Answer:** Contour Roll Forming shapes metal by passing it through rollers that progressively form it into a desired profile. **Example:** It is used in the construction industry for producing continuous steel profiles for building structures.
8. **Analyze the factors influencing the performance of Explosive Forming and discuss its industrial applications. Include a case study highlighting recent advancements.**
    - **Answer:** Factors include explosive energy, material properties, and mold design. **Case Study:** Recent advancements include improved safety protocols and precision control, enhancing the use of Explosive Forming in aerospace component production.
9. **Evaluate the benefits and limitations of Electromagnetic Forming and discuss its applications in the manufacturing industry. Provide an example of recent technological improvements.**
    - **Answer:** Benefits include high-speed forming and minimal tool wear. Limitations include high equipment costs. **Example:** Recent improvements include advanced magnetic field control systems, enhancing performance in automotive part manufacturing.
10. **Describe the process of Stretch Forming, including its operational parameters and benefits. Provide a detailed example of its use in the aerospace industry.**
    - **Answer:** Stretch Forming involves stretching metal over a mold to create complex shapes. Operational parameters include stretching force and temperature. **Example:** It is used in the aerospace industry to produce large, lightweight aircraft wing panels.

UNIT 5: Advanced Foundry Processes

2-Mark Questions

1. **What is the principle behind Metal Mould Casting?**
    - **Answer:** Metal Mould Casting involves pouring molten metal into a metal mold, which is then cooled to form the desired shape.
2. **Name one advantage of Squeeze Casting.**
    - **Answer:** One advantage of Squeeze Casting is its ability to produce high-strength components with reduced porosity.
3. **What is the primary benefit of Vacuum Mold Casting?**
    - **Answer:** The primary benefit of Vacuum Mold Casting is its ability to reduce gas porosity and improve the surface finish of castings.
4. **Describe the basic concept of Multiple-Use Mold Casting Processes.**
    - **Answer:** Multiple-Use Mold Casting Processes involve using molds that can be used repeatedly for casting different parts, improving efficiency and reducing costs.

5. **What is a common defect in castings and its cause?**
    - **Answer:** A common defect is porosity, which can be caused by trapped gases or improper mold venting.
6. **List one advantage of using Metal Mould Casting over sand casting.**
    - **Answer:** One advantage is the ability to produce high-precision and complex parts with better surface finish.
7. **What role do maskants play in casting processes?**
    - **Answer:** Maskants are used to protect specific areas of a mold or casting from being coated with molten metal, ensuring selective material deposition.
8. **What is the principle of squeeze casting?**
    - **Answer:** Squeeze Casting involves applying pressure to the molten metal in the mold to ensure better filling and reduce porosity.
9. **Name one common use of Vacuum Mold Casting in the industry.**
    - **Answer:** Vacuum Mold Casting is commonly used for producing high-quality, precision castings in the aerospace industry.
10. **Describe the basic process of melting steel in foundry operations.**
    - **Answer:** Melting steel involves heating it in a furnace until it reaches a liquid state, allowing it to be poured into molds for casting.

16-Mark Questions

1. **Discuss the working principle, advantages, and limitations of Metal Mould Casting. Provide a detailed example of its application in the automotive industry.**
    - **Answer:** Metal Mould Casting involves pouring molten metal into a metal mold, which provides high precision and repeatability. Advantages include better surface finish and dimensional accuracy. Limitations include high mold costs. **Example:** Metal Mould Casting is used in the automotive industry to produce engine blocks and transmission cases.
2. **Explain the Squeeze Casting process, including its working principle, benefits, and limitations. Provide an example of its use in the aerospace industry.**
    - **Answer:** Squeeze Casting uses high pressure to force molten metal into a mold, reducing porosity and improving mechanical properties. Benefits include high strength and reduced defects. **Example:** Squeeze Casting is used in the aerospace industry to manufacture high-strength components like aircraft landing gear parts.
3. **Analyze the principle and applications of Vacuum Mold Casting. Discuss its advantages and recent technological advancements.**
    - **Answer:** Vacuum Mold Casting involves creating a vacuum environment to pour molten metal, reducing gas porosity and improving surface finish. **Advancements:** Recent advancements include improved vacuum systems and mold materials, enhancing casting quality.
4. **Compare and contrast Multiple-Use Mold Casting Processes and traditional sand casting in terms of efficiency, cost, and application.**
    - **Answer:** Multiple-Use Mold Casting Processes are more efficient and cost-effective for high-volume production due to reusable molds, whereas sand casting is less expensive for low-volume, custom applications but less precise.

5. **Describe the process of melting and pouring non-ferrous alloys in foundries. Discuss the quality control measures and common defects associated with these processes.**
    - **Answer:** Melting non-ferrous alloys involves heating them in a furnace, followed by careful pouring into molds. Quality control measures include temperature monitoring and chemical composition analysis. Common defects include porosity and segregation.
6. **Discuss the working principle of sand casting and analyze its advantages and limitations. Provide an example of its application in the construction industry.**
    - **Answer:** Sand casting involves creating a mold from sand, pouring molten metal into it, and allowing it to solidify. Advantages include low cost and flexibility. Limitations include lower precision and surface finish compared to other methods. **Example:** Sand casting is used in the construction industry for making large metal components like cast iron manhole covers.
7. **Explain the principle and benefits of using metal molds over sand molds in casting processes. Provide an industrial example highlighting its application.**
    - **Answer:** Metal molds provide better precision, surface finish, and dimensional accuracy compared to sand molds. **Example:** Metal molds are used in the automotive industry for producing high-precision components like engine pistons.
8. **Analyze the impact of process parameters on the quality of castings in foundry operations. Discuss how controlling these parameters can improve casting outcomes.**
    - **Answer:** Parameters such as pouring temperature, mold material, and cooling rate impact casting quality. Controlling these parameters can reduce defects, improve surface finish, and ensure dimensional accuracy.
9. **Evaluate the benefits and limitations of Vacuum Mold Casting and discuss its applications in the medical industry. Provide an example of recent technological improvements.**
    - **Answer:** Benefits include reduced porosity and improved surface finish. Limitations include higher costs and complexity. **Example:** Recent improvements include enhanced vacuum systems, improving casting quality for medical implants.
10. **Describe the process and advantages of using squeeze casting in the production of high-strength components. Provide a detailed example of its use in the automotive industry.**
    - **Answer:** Squeeze casting involves applying high pressure to molten metal to reduce porosity and improve strength. **Example:** Squeeze casting is used in the automotive industry for manufacturing high-strength alloy wheels and engine components.

UNIT 6: Advanced Machining Techniques

2-Mark Questions

1. **What is the principle behind Electrical Discharge Machining (EDM)?**
    - **Answer:** EDM uses electrical discharges to erode material from a workpiece, shaping it with high precision.
2. **Name one advantage of using Laser Beam Machining (LBM).**
    - **Answer:** One advantage of LBM is its ability to cut or engrave with high precision and minimal thermal damage.
3. **What is the primary material used for the electrode in Electrical Discharge Machining (EDM)?**
    - **Answer:** The primary material used for the electrode in EDM is graphite or copper.
4. **Describe the basic concept of Laser Beam Machining (LBM).**
    - **Answer:** LBM uses a focused laser beam to cut or engrave materials, relying on high-intensity light to remove material.
5. **What is the key advantage of using Electrical Discharge Machining (EDM) for hard materials?**
    - **Answer:** The key advantage is its ability to machine hard and complex materials with high precision.
6. **List one common application of Laser Beam Machining (LBM).**
    - **Answer:** LBM is commonly used for cutting intricate designs in metal sheets and materials.
7. **What is the principle of the Electrochemical Grinding (ECG) process?**
    - **Answer:** ECG combines electrochemical reactions and abrasive grinding to machine hard materials.
8. **Name one benefit of using Electrical Discharge Machining (EDM).**
    - **Answer:** One benefit is its ability to produce highly precise and intricate features in hard materials.
9. **What is the role of the electrolyte in Electrochemical Grinding (ECG)?**
    - **Answer:** The electrolyte facilitates the electrochemical reaction, helping to remove material and cool the grinding process.
10. **Describe the basic working principle of Laser Beam Machining (LBM).**
    - **Answer:** LBM uses a highly focused laser beam to melt or vaporize material, allowing for precise cutting or engraving.

16-Mark Questions

1. **Discuss the working principle, advantages, and limitations of Electrical Discharge Machining (EDM). Provide an example of its application in the aerospace industry.**
    - **Answer:** EDM uses electrical discharges to erode material from a workpiece, suitable for complex shapes and hard materials.

- Advantages include high precision and ability to machine intricate details. Limitations include slow material removal rates and electrode wear. **Example:** EDM is used in the aerospace industry to produce precise components like turbine blades and molds.

2. **Explain the process of Laser Beam Machining (LBM), including its operational parameters, benefits, and limitations. Provide an example of its use in the automotive industry.**
    - **Answer:** LBM uses a focused laser beam to cut or engrave materials. Operational parameters include laser power, focus, and speed. Benefits include high precision and versatility. Limitations include material thickness constraints and high equipment costs. **Example:** LBM is used in the automotive industry for cutting complex shapes in metal sheets for body panels.
3. **Analyze the principles and applications of Electrochemical Grinding (ECG). Discuss its benefits and recent advancements.**
    - **Answer:** ECG combines electrochemical reactions with grinding to machine hard materials efficiently. Benefits include high precision and reduced tool wear. Recent advancements include improved electrolytes and grinding wheels for better performance.
4. **Compare and contrast Electrical Discharge Machining (EDM) and Laser Beam Machining (LBM) in terms of their process principles, applications, and limitations.**
    - **Answer:** EDM uses electrical discharges to erode material, suitable for hard and complex shapes with high precision. LBM uses a laser beam to cut or engrave, offering high speed and versatility. EDM is limited by slow material removal rates and electrode wear, while LBM is constrained by material thickness and high costs.
5. **Describe the process of Laser Beam Machining (LBM), including its working principle, benefits, and recent technological advancements. Provide an example of its application in the aerospace industry.**
    - **Answer:** LBM uses a focused laser beam to melt or vaporize material, allowing for precise cutting or engraving. Benefits include high accuracy and minimal thermal distortion. **Advancement:** Recent advancements include the development of fiber lasers for improved speed and precision. **Example:** LBM is used in the aerospace industry for cutting intricate components like turbine blades.
6. **Discuss the working principle and applications of Electrical Discharge Machining (EDM). Provide a detailed example of its use in the medical industry.**
    - **Answer:** EDM erodes material using electrical discharges, suitable for creating intricate and precise shapes. **Example:** EDM is used in the medical industry to manufacture high-precision surgical instruments and implants.

7. **Analyze the process of Electrochemical Grinding (ECG), including its operational parameters, benefits, and limitations. Provide an example of its application in the aerospace industry.**
    - **Answer:** ECG combines electrochemical reactions and grinding to machine hard materials efficiently. Operational parameters include electrolyte composition and grinding wheel speed. **Example:** ECG is used in the aerospace industry for machining turbine blades and other hard components.
8. **Evaluate the advantages and limitations of Laser Beam Machining (LBM) and discuss its applications in the manufacturing industry. Provide an example of recent technological improvements.**
    - **Answer:** Advantages of LBM include high precision and minimal material wastage. Limitations include high equipment costs and material thickness constraints. **Example:** Recent improvements include advancements in laser technology, such as fiber lasers, enhancing performance in various manufacturing applications.
9. **Describe the working principle of Electrochemical Grinding (ECG) and discuss its impact on manufacturing processes. Provide an example of its use in the automotive industry.**
    - **Answer:** ECG uses electrochemical reactions combined with grinding to efficiently machine hard materials. **Example:** ECG is used in the automotive industry for producing precision components such as engine parts and molds.
10. **Explain the principles of Laser Beam Machining (LBM) and analyze its impact on modern manufacturing. Provide an example of its application in the electronics industry.**
    - **Answer:** LBM uses a focused laser beam to cut or engrave materials, impacting modern manufacturing by providing high precision and flexibility. **Example:** LBM is used in the electronics industry for cutting fine features in circuit boards and components.