STUDY MATERIAL

SUBJECT : BASIC MECHANICAL ENGG.(BME)

MODULE-III

SEMESTER :1ST /2ND

(ALL BRANCHES)

CONTENTS :

- OBJECTIVE TYPE QUESTIONS AND ANSWERS
- SHORT TYPE QUESTIONS AND ANSWERS
- LONG TYPE QUESTIONS AND ANSWERS

DEPARTMENT OF MECHANICAL ENGINEERING

Imp. Points

- Ductility is the property of a metal by virtue of which it can be drawn into wires or elongated before rupture takes place. It depends upon the grain size of the metal crystals.
- Malleability is the property of a metal to be deformed or compressed permanently into the sheet without fracture. It shows the ability of the material to be rolled or hammered into thin sheets.
- Impact strength is the energy required per unit cross-sectional area to fracture a specimen, i.e., it is a measure of the response of a material to shock loading.
- Toughness is ability of the material to absorb energy before fracture or rupture. It may be presented as impact strength of the material.
- Brittleness implies sudden failure. It is the property of breaking without warning i.e., without visible permanent deformation.
- Wear resistance is the ability of a material to resist friction wear under particular conditions, i.e., to maintain its physical dimensions when in sliding or rolling contact with a second member.
- Hook's law states that stress and strain are perpendicular to each other under elastic limit.
- Originally, Hooke's law specified that stress was proportional to strain but Thomas Young introduction constant of proportionality which is known as.
- Further, Young's modulus this name was superseded by modules of elasticity.
- In ferrous materials the main alloying element is carbon (C). Depending on the amount of carbon present these alloys will have different properties, especially when the carbon content is either less/higher than 1.5%.
- Gray cast iron alloys consists carbon in form graphite flakes, which are surrounded by either ferrite or pearlite.
- The carbon content in cast iron varies between 2% to 4%.
- Organic polymers are prepared by polymerization reactions, in which simple molecules are chemically combined into long chain molecules or three-dimensional structures.
- On heating, thermoplastics become soft and hardened again upon cooling, e.g., nylon, polythene, etc.
- Thermosetting plastics cannot be resoftened after polymerization, e.g., urea-formaldehyde, phenol-formaldehyde, etc.
- Timber is general name of wood. It is composite of cellulose and lignin. Cellulose fibers are strong in tension and are flexible. Lignin works as a binding material to bind the fibers and give them stiffness.
- Ceramics are compound of metallic and non-metallic materials. It has properties of high compressive strength, low thermal expansion, high elasticity, high hardness, high wear resistance, and low electrical and thermal conductivity.
- Abrasives are hard, non-metallic, sharp edged and irregular shaped materials used to remove small amount of materials by cutting action.
- Silica is available in abundance in nature in the form of quartz.
- It is a super cooled amorphous material. It consists of more than 50% silica and other additives such as oxides of aluminium, sodium, calcium, magnesium, titanium, lithium, lead, and potassium.

MULTIPLE CHOICE QUESTIONS

1. Ability of material to resist deformation due to stress is known as
   (a) toughness (b) stiffness
   (c) plasticity (d) hardness
2. Ability of material to resist fracture due to high impact load is known as
   (a) toughness (b) stiffness
   (c) plasticity (d) hardness
3. Ability of material to absorb energy in the plastic range is known as
   (a) resilience (b) stiffness
   (c) plasticity (d) hardness
4. Ability of material to undergo large permanent deformation in tension is known as
   (a) toughness (b) stiffness
   (c) ductility (d) hardness
5. Property of material due to which they can be drawn into wire is known as
   (a) toughness (b) stiffness
   (c) ductility (d) hardness

6. Ability of material to retain permanent deformation is known as
   (a) toughness (b) stiffness
   (c) plasticity (d) hardness
7. Property of material due to which it can be rolled or hammered into thin sheets is known as
   (a) toughness (b) stiffness
   (c) malleability (d) hardness
8. Ability of material to resist penetration by another material is known as
   (a) toughness (b) stiffness
   (c) plasticity (d) hardness
9. Hardness can be defined as resistance to
   (a) wear (b) local penetration
   (c) scratching (d) all of the above
10. When a body recovers its original dimensions on removing the external load, it is known as
    (a) elastic (b) plastic
    (c) brittle (d) none of these
11. Cast Iron is a
    (a) ductile material (b) malleable material
    (c) brittle material (d) none of these
12. Silicon steel is widely used in
    (a) cutting tools (b) connecting rod
    (c) electrical industry (d) chemical industry
13. Thermosetting plastics are the materials that
    (a) become soft on application of heat and can be moulded again
    (b) do not become hard with the application of heat and pressure and no chemical change occurs
    (c) set permanently with heat and pressure and cannot be deformed when again subjected to heat
    (d) none of these
14. Thermoplastics are the materials that
    (a) become soft on application of heat and can be moulded again
    (b) do not become hard with the application of heat and pressure and no chemical change occurs
    (c) set permanently with heat and pressure and cannot be deformed when again subjected to heat
    (d) none of these
15. Moh's scale is used in connection with
    (a) composition of metal
    (b) hardness of material
    (c) wear criterion of metals
    (d) tensile strength of metals
16. An amorphous material is
    (a) mica (b) lead
    (c) rubber (d) glass
17. Polyesters belong to the group of
    (a) Thermoplastic (b) Thermosetting plastic
    (c) Phenolics (d) PVC
18. Brinell hardness number is equal to
    (a) $\frac{P}{D-\sqrt{D^2-d^2}}$
    (b) $\frac{P}{D\left(D-\sqrt{D^2-d^2}\right)}$
    (c) $\frac{2P}{D-\sqrt{D^2-d^2}}$
    (d) $\frac{2P}{\pi D\left(D-\sqrt{D^2-d^2}\right)}$
19. Vicker's Pyramid Number (VPN) is equal to
    (a) $\frac{2P\sin\theta}{d^2}$ (b) $\frac{P\sin\theta}{d^2}$
    (c) $\frac{P\sin\frac{\theta}{2}}{d^2}$ (d) none of these
20. Knoop Harness Number (KHN) is equal to
    (a) $\frac{P}{LC}$ (b) $\frac{P}{L^2C}$
    (c) $\frac{2P}{LC}$ (d) $\frac{2P}{L^2C}$
21. Composite materials are
    (a) made mainly to improve temperature resistance
    (b) used to improve optical properties
    (c) made with strong fibres embedded in weaker and softer matrix to obtain strength better than strength of matrix
    (d) made with strong fibres embedded in weaker and softer matrix to obtain strength better than strength of both matrix and filler
22. Ceramic materials are
    (a) good conductors of electricity
    (b) basically crystalline oxides or metals
    (c) inorganic compounds of metallic and non-metallic elements
    (d) none of the above

Answers

1. (b), 2. (a), 3. (a), 4. (c), 5. (c), 6. (c), 7. (c), 8. (d), 9. (d), 10. (a), 11. (c), 12. (c), 13. (c), 14. (b), 15. (b), 16. (d), 17. (b), 18. (d), 19. (c), 20. (c), 21. (c), 22. (c)

Imp. Notes

Force can be measured easily from a load cell. Weigh bridge is one of the most common applications of load cell. Here two strain gauges are fixed so as to measure the longitudinal strain, while two other measuring the transverse strain.

- A torque is a vector product of force and radial distance that measures the tendency of a force to rotate an object about an axis or centre.
- Vernier calipers are used for more accurate measurement than that of a slide caliper. It can measure internal and external dimensions; it can also be used as a depth gauge and height gauge.
- A micrometer also known as a screw gauge is a device consists of a calibrated screw and used for precise measurement of small length.
- Slip gauges are used as measuring blocks. It is also called as precision gauge blocks. They are made of hardened alloy steel of rectangular cross-section. The surfaces of slip gauges are made to a high degree of accuracy.
- A sine bar is a tool used to measure angles of a block or metal working.
- Combination set is a measuring tool which is frequently used in fitting and machine shop. It consists of a square head, centre-head, bevel protector, sprit level, and graduated steel rule.

MULTIPLE CHOICE QUESTIONS

1. Which of the following equipment is not used for temperature measurement?
   (a) RTD (b) thermistor
   (c) gas thermometer (d) rotameter
2. Which of the following is correct?
   (a) $P_{abs} = P_{atmospheric} + P_{gauge}$
   (b) $P_{abs} = P_{atmospheric} - P_{gauge}$
   (c) both
   (d) none of these
3. Manometer is used to measure
   (a) pressure (b) velocity
   (c) flow (d) temperature
4. Which of the following is not used to measure pressure?
   (a) Pirani gauge (b) ion gauge
   (c) Bourdon gauge (d) slip gauge
5. Prony brake dynamometer is a type of
   (a) transmission dynamometer
   (b) absorption dynamometer
   (c) electrical dynamometer
   (d) none of these
6. Which of the following is the correct relationship?
   (a) $\theta = \frac{TL}{JG}$ (b) $\theta = \frac{TG}{JL}$
   (c) $\theta = \frac{JG}{TL}$ (d) $T = \frac{GL}{J\theta}$
7. The length measured by vernier caliper is
   (a) Total length = Main scale reading × Least count + Vernier scale reading
   (b) Total length = (Main scale reading + Vernier scale reading) × Least count
   (c) Total length = Main scale reading + Vernier scale reading × Least count
   (d) Total length = Main scale reading + Vernier scale reading/Least count
8. Sine bar is used to measure
   (a) the angle of a workpiece
   (b) radius of cylinder
   (c) thickness of a job
   (d) all of the above
9. For the purpose of calibration of measuring instrument, which of the following is used?
   (a) screw gauge
   (b) slip gauge
   (c) dial gauge
   (d) ion gauge
10. Principle of working of micrometer is based on
    (a) screw
    (b) bush
    (c) coupling
    (d) link

Answers

1. (d), 2. (c), 3. (a), 4. (d), 5. (b), 6. (a), 7. (c), 8. (a), 9. (b), 10. (a)

Imp. Notes

- Turning is a metal removal process in which job is given rotational motion while the cutting tool is give linear (feed and depth of cut) motion.
- The operation of producing a circular hole by removing metal by rotating the cutting edges of a drill i known as drilling.
- The operation of finishing and sizing a previous drilled hole using a multi-edges straight cutting tool name as reamer is known as reaming.
- The operation of enlarging and finishing a previous drilled hole throughout its length by means of an adjust able single edge cutting tool named as boring tool is known as boring.
- In shaper, cutting takes place by reciprocating tool over the job.
- In planer, cutting takes place by reciprocating the job under the tool.
- The operation of producing a large hole (diameter over 50 mm) by removing metal along the circumferenc of a hollow cutting tool, which enters the small previously drilled hole to produce the larger hole concentri is known as trepanning.
- Radial drilling machine consists of a vertical column supporting a horizontal arm on which drill spindle ca move in radial direction.
- Gang drilling machine is used for mass production where a number of drilling operations are to be per formed in sequence. Each drill head can be equipped with different types of drill bits.
- A multi-spindle drilling machine has a number of spindles driven by a single motor. All the spindles holding the drills can be used simultaneously. It can produce a number of parallel holes simultaneously.
- Milling is a metal cutting process in which different shapes and sizes of the surface are generated by cutting action of rotating multi-point cutter fixed on a periphery of a wheel and feed is given to the work.
- If the direction of cutting and feed are opposite to each other, the milling is known as up milling, and if the direction of both are same, the milling is known as down milling.
- Slab milling, also called peripheral milling or plane milling generates flat surfaces by using the teeth located on the periphery of the cutter body.
- Side milling uses side milling cutters similar to plain milling cutters. However, in addition to teeth around the periphery, other cutters are formed on one or both sides.
- End milling is a process of machining horizontal, vertical, angular, and irregular shaped surfaces.
- Face milling is an extension of end milling where the cutter has large diameter with several cutting teeth.
- It is the milling operation which involves the use of a combination of more than two cutters, mounted on a common arbour, for milling a number of flat horizontal and vertical surfaces of a workpiece simultaneously.
- It is a milling operation in which a pair of side milling cutters is used for machining two parallel vertical surfaces of a workpiece simultaneously.
- This milling process is employed for machining those surfaces which are of irregular shapes. The cutter used, called a form milling cutter, will have the shape of its cutting confirming to the profile of the surface to be produced.
- It is the operation in which the profile of a template or the shape of the cavity of a master die is duplicated on the work surface.

MULTIPLE CHOICE QUESTIONS

1. The cutting edge of the tool is perpendicular to the direction of tool travel in
   (a) orthogonal cutting of metal
   (b) oblique cutting of metal
   (c) both
   (d) none of the above
2. The cutting edge of the tool is inclined at an angle less than 90° to the direction of tool travel in
   (a) orthogonal cutting of metal
   (b) oblique cutting of metal
   (c) both
   (d) none of the above
3. In metal cutting operations, discontinuous chip are produced while machining
   (a) brittle materials (b) ductile materials
   (c) hard materials (d) soft materials

4. In metal cutting operations, continuous chips are produced while machining
   (a) brittle materials (b) ductile materials
   (c) hard materials (d) soft materials
5. Size of shaper is specified by
   (a) length of stroke
   (b) size of table
   (c) maximum size of tool
   (d) hp of motor
6. Size of planer is specified by
   (a) length of stroke
   (b) size of table
   (c) maximum size of tool
   (d) hp of motor
7. A standard ground drill has a point angle of
   (a) 90° (b) 100°
   (c) 118° (d) 120°
8. For harder materials, point angle of drill
   (a) increases (b) decreases
   (a) kept at 118° (b) none of the above
9. One of the important parameters of lathe specification is
   (a) swing over bed
   (b) swing over tool post
   (c) distance between centres
   (d) horse power
10. Centring can be done most accurately on
    (a) four-jaw chuck (b) three-jaw chuck
    (c) lathe dog (d) collet
11. In gang milling
    (a) several jobs can be performed in one set up
    (b) one job is completed on several milling machines
    (c) two or more cutters are mounted on the arbour then all remove the metals simultaneously
    (d) none of the above
12. Spot facing is the operation of
    (a) enlarging the end of a hole cylindrically
    (b) cone shaped of the enlargement of the end of a hole
    (c) smoothing and squaring the surface around a hole
    (d) sizing and finishing a hole
13. Counter sinking is the operation of
    (a) enlarging the end of a hole cylindrically
    (b) cone shaped of the enlargement of the end of a hole
    (c) smoothing and squaring the surface around a hole
    (d) sizing and finishing a hole
14. Reaming is a operation of
    (a) enlarging the end of a hole cylindrically
    (b) cone shaped of the enlargement of the end of a hole
    (c) smoothing and squaring the surface around a hole
    (d) sizing and finishing a hole
15. Drilling is a type of
    (a) oblique cutting
    (b) simple cutting
    (c) uniform cutting
    (d) orthogonal cutting
16. Drill diameter is measured over the
    (a) main body
    (b) margins at the drill point
    (c) heel
    (d) lips
17. The chip is cut off at thinnest place and then chip thickness increases along chip length in
    (a) up milling (b) down milling
    (c) end milling (d) climb milling
18. Maximum friction is caused in
    (a) up milling (b) down milling
    (c) end milling (d) climb milling
19. The cutting force tends to lift the workpiece in
    (a) conventional milling
    (b) down milling
    (c) climb milling
    (d) form milling
20. Advantages of conventional (up) milling is
    (a) older machines have backlash in their lead screws can be used
    (b) on sand casting cutter is not damaged
    (c) better finish obtained on steel but not on aluminium
    (d) all the above
21. Disadvantage of conventional milling is
    (a) chip gets picked up and carried around the cutter, thereby spoiling the finish
    (b) on steel, finish may be slightly rougher
    (c) machine must have zero backlashes or there will be chatter as the cutter tries to pull the table faster than the feed rate.
    (d) all the above

Answers

1. (a), 2. (b), 3. (a), 4. (b), 5. (a), 6. (b), 7. (c), 8. (a), 9. (a), 10. (a), 11. (a), 12. (a), 13. (b), 14. (d), 15. (a
16. (a), 17. (b). 18. (a), 19. (a), 20. (d), 21. (d)

FILL IN THE BLANKS

1. In metal cutting operation, chips are formed due to _____ of metal.
2. In centre lathe, cutting tool is fed in _____ directions with reference to the lathe axis.
3. The workpiece cannot be held in a lathe chuck can be clamped to a _____ mounted on a headsto spindle.
4. The cutting action of a shaper occurs only on the _____ stroke of the ram.
5. Quick return motion is incorporated in a shaper, a planer, and _____.
6. A slotter can be considered as a _____ shaper having only vertical movement of _____.
7. Any number of equal divisions can be obtained on milling machine by _____.

Answers

1. Shearing, 2. Axial, 3. Faceplate, 4. Forward, 5. Slotter, 6. Vertical shaper, cutting tool, 7. Indexing,

REVIEW QUESTIONS (Practice following Questions)

1. Enumerate the operations which can be performed on lathe machine.
2. Explain the various techniques to perform a taper turning on lathe.
3. What are the differences between shaper and planer?
4. Explain quick return mechanism used in shaper with neat sketch.
5. Explain the working of radial drilling machine with a neat sketch.
6. Explain the stepped cone pulley drive in lathe.
7. Differentiate up milling and down milling.
8. Draw a neat diagram of horizontal and vertical milling machine.
9. Explain feed mechanism used in drilling machine.
10. What are the various types of milling operations, explain with neat sketch?
11. Write short notes on counter boring, counter sinking, spot facing, and trepanning.
12. What do you mean by grinding? How it differs from milling?
13. Draw a neat sketch of drill bit and explain all the terminology used for nomenclature.

The green sand is mixture of green sand, binders, and water.

- Pattern is a replica of the product, which is to be manufactured through casting. It is used to make a mould cavity of required shape and size.
- Various types of pattern materials such as wood, aluminium, steel, plastic, cast iron are used in sand casting.
- The extra dimensions or extra materials provided for the pattern are known as allowances.
- Mould making is a process of creating a replica of casting with the help of patterns and moulding sand.
- The cavity, produced in sand body, facilitates the molten metal to solidify and to take the shape of the cavity.
- Risers are provided in mould to feed molten metal into the cavity to compensate the shrinkage.
- Chills are used to improve the directional solidification with faster heat conduction by metallic chills; solidification is initiated and accelerated at desired locations.
- Sometime, it is impossible to use core print to support the core. In this case, a metallic support is used which is known as chaplet.
- Chaplet is made of same material as the material of casting. It gets fused with molten metal.
- Core is a sand body specially prepared in a core box and it is used to form a cavity/hole/recess or projection in a casting for different purposes.
- Casting defects are unwanted feature or irregularities in casting which make it of poor quality. These defects occur due to several reasons such as poor design of casting, excess moisture in mould, improper ramming of moulding sand, misalignment of cope and drag etc.
- Welding is a joining process that produces coalescence of materials by heating them to the welding temperature, with or without the application of pressure alone, and with or without the use of filler material.
- In electric arc welding, the heat required for melting the metal is generated by short circuiting the electrodes.
- In gas welding process, various types of gases are burnt in combination with oxygen and the flame is applied at the edge of metal plates to be joined. The heat of combustion of the gas melts the metal; filler material may or may not be applied to fill the groove.
- In a resistance welding, heat is generated by passing electric current through high resistance.
- Soldering is a process of joining two metals by applying low melting point metal or alloy in the gap between the joining parts. The metal or alloy used for filling or joining is known as solder.
- Brazing is a hard soldering process, but in this process, metal pieces are heated which are to be joined in this place of the bit as in soldering.

MULTIPLE CHOICE QUESTIONS

Casting

1. In sand moulding, the middle part of box is called
   (a) cope (b) drag
   (c) cheek (d) flask-middle
2. Core is used to
   (a) make desired recess in casting
   (b) strengthen moulding sand
   (c) support loose pieces
   (d) remove pattern easily
3. Shrinkage allowance is made up by
   (a) adding to external and internal dimensions
   (b) subtracting from external and internal dimensions
   (c) subtracting from external dimension and adding to internal dimension
   (d) adding to external dimension and subtracting from internal dimension
4. Facing sand in foundry work comprises of
   (a) silica and clay (b) clay and alumina
   (c) silica and alumina (d) clay and silica
5. The purpose of sprue is to
   (a) feed the casting at a rate consistent with the rate of solidification
   (b) act as reservoir for molten metal
   (c) help in feeding the casting until the solidification takes place
   (d) feed molten metal from pouring basin to gate
6. The purpose of riser is
   (a) feed the casting at a rate consistent with the rate of solidification
   (b) act as reservoir for molten metal
   (c) help in feeding the casting until the solidification takes place
   (d) feed molten metal from pouring basin to gate

7. Down sprue in casting is given a taper shape for
   (a) easy flow of molten metal
   (b) easy withdrawal of casting
   (c) preventing aspiration of gases through sprue
   (d) preventing bulging of sprue during pouring

8. Draft on pattern is provided for
   (a) easy flow of molten metal
   (b) easy withdrawal of casting
   (c) preventing aspiration of gases through sprue
   (d) preventing bulging of sprue during pouring

9. True centrifugal casting is used to
   (a) ensure purity and density at extremities of a casting
   (b) cast symmetrical object
   (c) obtain high density and pure casting
   (d) use heavy cast iron mould to act as chill

10. Semi-centrifugal casting is used to
   (a) ensure purity and density at extremities of a casting
   (b) cast symmetrical object
   (c) obtain high density and pure casting
   (d) use heavy cast iron mould to act as chill

11. Surfaces to be machined are marked on the pattern by
   (a) black (b) yellow
   (c) red (d) blue

12. Centrifugal method of casting is used to
   (a) ensure purity and density at extremities of a casting
   (b) cast symmetrical object
   (c) obtain high density and pure casting
   (d) use heavy cast iron mould to act as chill

13. Blind risers
   (a) assist in feeding the metal into casting proper
   (b) help to trap slag or other lighter particles
   (c) supply the hottest metal when pouring is completed
   (d) do not exist

14. Shift is a casting defect which
   (a) results in a mismatching of the top and bottom parts of casting
   (b) is due to enlargement of the mould cavity by metal pressure
   (c) occurs near the gates as rough lumps on the surface of the casting
   (d) is due to thin projection of metal not intended as a part of the casting

15. Swell is a casting defect which
   (a) results in a mismatching of the top and bottom parts of casting
   (b) is due to enlargement of the mould cavity by metal pressure
   (c) occurs near the gates as rough lumps on the surface of the casting
   (d) is due to thin projection of metal not intended as a part of the casting

16. Sand wash is a casting defect which
   (a) results in a mismatching of the top and bottom parts of casting
   (b) is due to enlargement of the mould cavity by metal pressure
   (c) occurs near the gates as rough lumps on the surface of the casting
   (d) is due to thin projection of metal not intended as a part of the casting

17. Fin is a casting defect which
   (a) results in a mismatching of the top and bottom parts of casting
   (b) is due to enlargement of the mould cavity by metal pressure
   (c) occurs near the gates as rough lumps on the surface of the casting
   (d) is due to thin projection of metal not intended as a part of the casting

18. Slag inclusion in casting is a
   (a) surface defect
   (b) internal defect
   (c) superficial defect
   (d) none of these

19. Felting of casting is done to
   (a) produce uniformly cooled casting
   (b) remove extra metals from casting
   (c) smoothen surface
   (d) all of the above

20. Casting defect developed due to inadequate venting is
   (a) inclusion (b) blow holes
   (c) cold shuts (d) none of these

Welding

21. In gas welding maximum temperature occurs at
   (a) inner cone
   (b) outer cone
   (c) next to inner cone
   (d) tip of the flame

22. In oxyacetylene as welding, flame temperature used is
    (a) 1,200°C (b) 1,800°C
    (c) 2,400°C (d) 3,200°C
23. Grey cast iron is generally welded by
    (a) gas welding (b) arc welding
    (b) TIG welding (d) MIG welding
24. In thermit welding, aluminium and iron oxides are mixed in the proportion of
    (a) 1:1 (b) 1:2 (c) 1:3 (d) 3:1
25. For proper mixing of oxygen and pressure regulation of acetylene and oxygen in oxyacetylene welding, the device used is
    (a) welding torch (b) cylinder
    (c) hose pipe (d) none of the above
26. In arc welding, penetration is deepest for
    (a) DCRP (b) DCSP
    (c) AC (d) none of these
27. The hard filler material used in brazing is
    (a) solder (b) flux
    (c) spelter (d) electrode
28. Solder is essentially a
    (a) tin silver base (b) tin lead base
    (c) silver lead base (d) bismuth lead base
29. Oxygen to acetylene ratio in case of neutral flame
    (a) 1:1 (b) 1.2:1 (c) 0.8:1 (d) 2:1
30. Oxygen to acetylene ratio in case of oxidizing flame
    (a) 1:1 (b) 1.2:1 (c) 1.5:1 (d) 2:1
31. Oxygen to acetylene ratio in case of carburizing flame
    (a) 1:1 (b) 1.2:1 (c) 0.9:1 (d) 2:1
32. Main advantage of MIG welding over TIG welding is that
    (a) former can be used to weld hard metals
    (b) former permits use of large currents there by allowing higher deposition
    (c) welding rate is very fast
    (d) welding is completely automatic
33. Flux used for brazing cast iron is
    (a) mixture of boric acid, borax, and a wetting agent
    (b) mixture of boric acid, borax of fluoride with a wetting agent
    (c) chlorides and fluorides mixed with water
    (d) none of the above
34. Soldering iron is made of wedge shape in order to
    (a) apply high pressure at edge
    (b) retain heat
    (c) retain solder
    (d) facilitate molecular attraction
35. Carburizing flame is used to weld metal like
    (a) steel
    (b) copper and brass
    (c) aluminium, stainless steel, zinc die casting, nickel, Monel metal
    (d) none of the above

Answers

1. (c), 2. (a), 3. (d), 4. (a), 5. (d), 6. (c), 7. (c), 8. (b), 9. (b), 10. (a), 11. (c), 12. (a), 13. (c), 14. (a), 15. (b), 16. (c), 17. (d), 18. (a), 19. (b), 20. (b), 21. (c), 22. (c), 23. (a), 24. (c), 25. (a), 26. (b), 27. (c), 28. (b), 29. (b), 30. (c), 31. (c), 32. (b), 33. (b), 34. (b), 35. (c)

FILL IN THE BLANKS

1. Pipes of large length and diameters are made by _____.
2. Felting in casting is used to _____.
3. The process of removal of sprue and riser from casting is known as _____.
4. Chills are metal inserts that are placed at appropriate location in the mould to help _____.
5. Core print is an added projection on the pattern and forms a seat to support and locate _____.
6. The maximum quantity moisture content in the moulding sand can be up to _____.
7. Acetylene gas is produced from _____ by reacting with _____.
8. Thermit welding employs _____ for generating high heat.

9. In submerged arc welding, the metal arc is shielded by _____.
10. The porosity in welded metal is caused by _____.
11. In straight polarity, workpiece is connected to _____.
12. In reverse polarity, workpiece is connected to _____.
13. In DC arc welding, maximum heat is generated at _____.
14. Main function of the flux is to form _____ and protect the _____.
15. In arc welding, the electric arc is produced between the work and electrode by _____.

Answers

1. Centrifugal casting, 2. To romove the external metals, 3. Flogging, 4. Directional solidification, 5. Cor 6. 8%, 7. Calcium carbide and water, 8. Exothermic reaction, 9. Flux, 10. Defective work materials, 11. +v terminal, 12. –ve terminal, 13. +ve terminal, 14. Slag, molten metal, 15. Contact resistance.

REVIEW QUESTIONS Practice

Casting

1. What is casting? How it differs from other primary shaping process?
2. Enumerate and explain various allowances provided for pattern making.
3. Explain the application of various hand tools used in casting with neat sketch.
4. What are the various types of patterns? Explain them with their uses.
5. What are the required properties of moulding sands? Classify the moulding sand.
6. Explain the various types of moulding sands and their uses.
7. Explain the advantages and disadvantages of sand casting.
8. Justify the statement that casting is the most versatile forms of mechanical process for producin components.
9. Briefly explain hot chamber and cold chamber die casting.
10. What are the advantages of special casting techniques?
11. What purpose is served by risers in sand casting? Why they are not provided in die casting.
12. What are the advantages and disadvantages of die casting?
13. What is centrifugal casting? For what type of jobs would you recommend this casting process? Explain th process with the help of neat sketch.
14. What are the casting defects? Explain the causes and remedies for these defects.
15. Explain the various cleaning process of castings.

Welding

16. Describe the working principle of arc welding. Explain the shielded arc welding. How does it save th weldment from oxidation and absorption of nitrogen? What precautions need to be observed in ar welding?
17. Describe the basic fusion welding process. Explain the process details of electroslag welding.
18. What is role of flux in welding? Explain in detail.
19. What for thermit welding is used.

Imp

- In manufacturing systems, the term workstation refers to a location in the factory where some well-defined operation is accomplished by man and/or machines.
- A computer system is required to control the functions of the machines and to participate in the overall coordination and management of the manufacturing system.
- The objectives of a computer system is to give instructions to workers, transform part programs to machine language, control material handling system, schedule production, monitor safety measures, control the quality of job to be produced, etc.
- In a computer integrated manufacturing system, all the manufacturing and business functions are integrated through computer networking.
- CAD/CAM involves the use of the computer to accomplish certain functions in design and manufacturing.
- CAD is concerned with the use of the computer to support the design engineering functions and CAM is concerned with the computer to support manufacturing engineering functions.
- CAM is mainly used for manufacturing planning and manufacturing control.
- Geometric modelling is concerned with mathematical description of the geometry of an object. The mathematical description called a model is contained in computer memory. The image is displayed on graphics terminal to perform certain operations on the model.
- Numerical control can be defined as a form of programmable automation in which the machining process is controlled by numbers, letters, and symbols. NC technology has been applied for a wide variety of operations but principal application is in machining operations.
- In CNC, the entire program is entered once and stored in computer memory. The machining cycle for each part is controlled by the program contained in memory rather than from the tape itself.
- Direct numerical control (DNC) can be defined as a manufacturing system in which a number of machines are controlled by computer through direct connection and in real time.

MULTIPLE CHOICE QUESTIONS

1. A manufacturing system consists of
   (a) all the resources required to transform the material from its raw form to finished form
   (b) purchasing and selling activities of products
   (c) marketing systems
   (d) all of the above
2. The resources involved in this transformation process may be
   (a) man and materials
   (b) money and machine
   (c) management and energy
   (d) all of the above
3. In manufacturing systems, the term workstation refers to a location in the factory where
   (a) services are provided to customer
   (b) enquiry if provided
   (c) some well-defined operation is accomplished by men and/or machines
   (d) all of the above
4. A computer system is required to
   (a) control the functions of the machines
   (b) participate in the overall coordination and management of the manufacturing system
   (c) both (a) and (b)
   (d) none of these
5. The objectives of a computer system is to
   (a) give instructions to workers and transform part programs to machine language
   (b) control material handling system, schedule production, monitor safety measures
   (c) control the quality of job to be produced.
   (d) all of the above
6. In a computer integrated manufacturing system, all the manufacturing and business functions are integrated through
   (a) computer networking
   (b) Mmanual network
   (c) electrical network
   (d) none of these
7. CAD is concerned with the use of the computer to support
   (a) the design engineering functions and CAM is concerned with the computer to support manufacturing engineering functions
   (b) marketing network
   (c) supplier network
   (d) all of the above

8. Geometric modelling is concerned with
   (a) mathematical description of the geometry of an object
   (b) the image is displayed on graphics terminal to perform certain operations on the model
   (c) both (a) and (b)
   (d) none of these
9. Numerical control can be defined as a form of programmable automation in which the machining process is controlled by
   (a) numbers
   (b) letters and symbols
   (c) both (a) and (b)
   (d) none of these
10. An operational NC system consists of:
   (a) program of instruction
   (b) controller unit
   (c) machine tools
   (d) all of the above

Answers

1. (a), 2. (d), 3. (c), 4. (c), 5. (d), 6. (a), 7. (a), 8. (c), 9. (c), 10. (d)

REVIEW QUESTIONS

1. What is manufacturing system? Explain it.
2. Write notes on computer integrated manufacturing system and CAD/CAM.
3. Explain all the four phases of computer aided design.
4. Explain the activities involved in computer aided manufacturing.
5. What is NC machine? Explain its applications and limitations.
6. Explain all features of CNC machine.
7. Explain the programming methods used in CNC machine. Also mention the advantages of CNC machine over NC machine.
8. Write notes on DNC machine. How does it differ from CNC?

SUMMARY

This chapter can be summarized as follows:

- Unconventional machining (UCM) process is completely non-mechanical. In this process, there is no chip formation.
- In AJM process, material removal takes place due to tiny brittle fracture of metallic layer with high velocity impact of abrasive particles.
- AJM is used for machining, cleaning, etching, marking, deburring for brittle materials like glass, ceramics, refractories, germanium, silicon, quartz, mica, etc.
- The mechanism of material removal in ultrasonic machining is brittle fracture of the layer work material. A tool of ductile and tough material is used for vibration with high frequency and a continuous flow of abrasive slurry is used between the vibrating tool and work surface.
- Electrochemical machining is a depleting process, based on Faraday's low of electrolysis. Workpiece works as an anode and tool acts as a cathode.
- The tool material used is copper and brass. Sometimes stainless steel is also used as a tool material.
- Electron beam machining is also a thermal process of material removal. Here, a stream of high-speed electrons impinges on the work surface whereby the kinetic energy, transferred to the work material, produces intense heating.
- Laser (Light Amplification by Stimulated Emission of Radiation) is a highly coherent (in space and time) beam of electromagnetic radiation with wavelength varying from 0.1 to 70 mm.
- The efficiency of the LBM process is very low (about 0.3–0.5%). The typical output energy of a laser is 20 J with pulse duration of 1 ms.
- In this machining process, metal removal takes place due to erosion caused by electric spark.
- This process may be used for machining any material, irrespective of its hardness, which is an electrical conductor.
- The rate of metal removal and the resulting surface finish can be controlled by proper variations in the energy and the duration of spark discharge.
- A liquid dielectric, like paraffin or some light oil, transformer oil or kerosene oil, is always used in the process.
- Plasma arc can produce a temperature as high as 33,000°C.
- Plasma refers to a gas which has been raised to such a high temperature that it gets ionized and becomes electrically conductive.

MULTIPLE CHOICE QUESTIONS

1. In electro-discharge machining, the tool is made of
   (a) tungsten carbide (b) alloy steel
   (c) diamond (d) brass or copper
2. In electrochemical milling operation, the gap between tool and work is kept of the order of
   (a) 0.25 mm (b) 1.25 mm
   (c) 0.75 mm (d) 5 mm
3. In the electro-discharge machining process, the workpiece and electrode are submerged in
   (a) a dielectric fluid (b) electrolyte
   (c) abrasive slurry (d) chemical reagent
4. The machining process in which the workpiece is dissolved into an electrolyte solution is known as
   (a) electrochemical machining
   (b) electro-discharge machining
   (c) laser machining
   (d) electron beam machining
5. The size of abrasive grains in abrasive jet machining varies between
   (a) 1 and 10 microns
   (b) 10 and 50 microns
   (c) 50 and 100 microns
   (d) 100 and 500 microns
6. Laser stands for
   (a) light amplification by stimulated emission of radiation
   (b) light amplification by strong emission of radiation

(c) light amplification by stimulated energy of radiation
(d) light amplification by stimulated emission of radioactivity

7. Laser beam machining process is used for machining
(a) very thick materials
(b) thin materials
(c) heavy sections
(d) only electrical conductor

8. Ultrasonic machining removes material by
(a) direct vibration of tool with work
(b) using abrasive slurry between tool and work
(c) both (a) and (b)
(d) none of these

9. Electron beam machining is suitable for following type of materials
(a) low melting point and high thermal conductivity
(b) low melting point and low thermal conductivity
(c) high melting point and low thermal conductivity
(d) high melting point and high thermal conductivity

10. Very hard, fragile, and heat sensitive materials can be machined by
(a) hot machining
(b) explosive forming
(c) electrical discharge machining
(d) high velocity forming

11. Ultrasonic machining is best suited for
(a) brittle material (b) stainless steel
(c) plastics (d) lead

12. Photo-chemical machining operation is carried out on
(a) grinder
(b) milling machine
(c) tank containing etching solution
(d) special machine

13. Following electrolyte is used in electrochemical machining
(a) brine solution (b) kerosene oil
(c) transformer oil (d) water

14. Electro-discharge machining uses the following dielectric fluid
(a) water (b) salt solution
(c) sodium hydroxide (d) kerosene

15. The selection of tool material in EDN is based on its
(a) high resistance
(b) poor thermal conductivity
(c) low melting point
(d) high electro-erosive strength

Answers

1. (d), 2. (a), 3. (a), 4. (a), 5. (b), 6. (a), 7. (b), 8. (b), 9. (c), 10. (c), 11. (a), 12. (c), 13. (a), 14. (d), 15. (d)

FILL IN THE BLANKS

1. For machining of tungsten carbide by USM _____ is used as abrasive.
2. The average frequency of sparks in EDM is _____ per second.
3. Ruby rod is associated with _____ machining.
4. Cathodic deposition during ECM does not take place due to _____ flow of electrolyte.
5. The cathode and anode in EDM is separated by _____.

Answers

1. Boron carbide, 2. 10000, 3. LBM, 4. High speed, 5. Electrolyte.

SUMMARY

The chapter can be summarized as follows:

- Heat treatment is a process to control the mechanical properties of engineering materials by heating, cool and alloying the metal as per requirement.
- Iron–carbon (Fe–C) phase diagram shows the solubility of carbon in iron at different temperature and responding structure of the steel.
- Firstly, there is the A_1, temperature at which the eutectoid reaction occurs, which is 723°C in the bin diagram.
- Secondly, there is the A_3, temperature when α-iron transforms to γ-iron. For pure iron this occurs at 910 but the transformation temperature is progressively lowered along the line GS by the addition of carbon.
- The third point is A_4 at which γ-iron transforms to δ-iron, 1,390°C in pure iron, hut this is raised as carb is added.
- The time–temperature–transformation curves correspond to the start and finish of transformations wh extend into the range of temperatures where austenite transforms to pearlite.
- Above 550°C, austenite transforms completely to pearlite. Below 550°C, both pearlite and bainite formed and below 450°C, only bainite is formed.
- Normalizing is a process of heating about 30–50°C above higher critical point for the time duration 15 min and cooling in still air.
- The purposes of the process normalizing are (a) to reduce grain size of steel, (b) to remove internal stre caused by working, and (c) to improve some of the mechanical properties.
- The purposes of annealing are (a) to soften the metal for easy machining, (b) to remove internal stress caused working, (c) to increase ductility, (d) to refine grain size, and (e) to modify electrical and magnetic properti
- Normalized steel is less ductile and have more yield point and tensile strength than the annealed steel.
- Tempering is a process of reheating of hardened steel below critical range and cooled at the decreased ra (approximately 4–5 min for each mm of the section). There is partial transformation of martensite to secon ary constituent troosite and sorbite.
- The purposes of tempering are (a) to reduce some amount of hardness produced during hardening an increase the ductility, and (b) to remove strain produced during heating.
- Carburizing is a heat treatment process in which iron or steel absorbs carbon liberated when the metal heated in the presence of a carbon rich atmosphere, such as charcoal or carbon monoxide, with the intent making the metal harder.
- Steel parts may be surface hardened by heating in contact with a cyanide salt, followed by quenching.
- This process involves heating applied rapidly and locally to the steel component followed by quenching High frequency electric fields quickly heat the surface of the component via induction coils, which is the quenched using water.

MULTIPLE CHOICE QUESTIONS

1. The heat treatment process in which steel is heated above upper critical temperature and then cooled in air is known as
   (a) annealing (b) normalizing
   (c) austempering (d) martempering
2. The heat treatment process in which steel is heated above upper critical temperature and then cooled in furnace is known as
   (a) annealing (b) normalizing
   (c) austempering (d) martempering
3. In nitriding steel components, the following atmosphere is generally used in the furnace
   (a) inert
   (b) nascent nitrogen
   (c) liquid nitrogen
   (d) ammonia
4. Austempering is the heat treatment process used to obtain greater
   (a) hardness (b) toughness
   (c) softness (d) brittleness

5. Low carbon steel can be hardened by
   (a) hardening
   (b) heating and quenching in oil
   (c) heating and quenching in water
   (d) carburizing and cyaniding
6. The hardening strains are reduced and the toughness of the part increased by the following process after hardening
   (a) annealing (b) tempering
   (c) carburizing (d) anodizing
7. A small selected portion of the job can be hardened by
   (a) flame and induction hardening
   (b) pack hardening
   (c) cyaniding
   (d) case hardening
8. Which of the following is a case hardening process?
   (a) spherodizing (b) tempering
   (c) cyaniding (d) parkerizing
9. Martensite is a supersaturated solution of carbon in
   (a) iron (b) steel
   (c) α-iron (d) δ-iron
10. Martensite is a structure obtained by
   (a) quenching austenite
   (b) quenching austenite and heating into the range of 200–375°C
   (c) quenching austenite and heating into the range of 375–660°C
   (d) quenching austenite and heating into the range of 600–700°C

Answers

1. (b), 2. (a), 3. (d), 4. (a), 5. (d), 6. (b), 7. (a), 8. (c), 9. (a), 10. (b).

FILL IN THE BLANKS

1. Troosite is the structure obtained by quenching austenite and heating at _____ °C.
2. Line A_1 on iron–carbon diagram indicates completion of austenite transition to _____.
3. Line A_{cm} on iron–carbon diagram indicates limit of carbon solubility in _____.
4. Line A_3 on iron–carbon diagram indicates the beginning of transition from austenite to _____.
5. Eutectoid composition of carbon steel at room temperature is known as _____.

Answers

1. 600, 2. Ferrite, 3. Austenite, 4. Ferrite, 5. Pearlite.

REVIEW QUESTIONS

1. What is heat treatment? Discuss its importance in metallurgy.
2. Write the importance of Fe–C diagram? Draw the diagram and explain the solubility of carbon in iron at different temperature.
3. Draw the TTT diagram and explain the isothermal transformation process.
4. Differentiate between normalizing and annealing.
5. Write notes on process and full annealing.
6. Differentiate between austempering and martempering.
7. Differentiate between hardening and tempering.
8. Write notes on (a) case hardening, (b) pack carburizing, (c) nitriding, (d) cyaniding, and (e) induction hardening.

MODULE 3

Production Process and Engineering Materials

3.1 What is casting?

Casting is a manufacturing process by which a liquid material is usually poured into a mould, which contains a hollow cavity of the desired shape, and then allowed to solidify. The solidified part is also known as a *casting*.

3.2 Define mould.

Mould is the cavity of the required shape to be made in the moulding sand or in other material.

3.3 What is Sand Casting?

Sand casting is a method involving pouring a molten metal into sand mould. Sand casting, also known as sand moulded casting, is a metal casting process characterized by using sand as the mould material.

3.4 What is a pattern?

The geometry of the cavity is created by the use of a wooden object, called the pattern. The shape of the patterns is (almost) identical to the shape of the part we need to make.

3.5 What is the function of Vent rod?

Vent rod is a thin spiked steel rod or wire carrying a pointed edge at one end and a wooden handle or a bent loop at the other. It is utilized to pierce series of small holes in the molding sand called vents holes which allow the exit or escape of steam and gases.

3.6 Differentiate between the terms 'mould' and 'Core'.

S.No.	Mould	Core
1.	Mould is a cavity whose geometry determines part shape (Casting)	Cores are compact mass of core sand (special kind of molding sand) prepared separately that when placed in mould cavity at required location with proper alignment does not allow the molten metal to occupy space for solidification in that portion and hence help to produce hollowness in the casting.

S.No.	Mould	Core
2.	Actual size and shape of cavity must be slightly oversized to allow for shrinkage of metal during solidification and cooling.	Actual size should be smaller than that desired hole.

3.7 Define forging.

Mechanical working of metals by which metals and alloys are plastically deformed by the application of compressive force is known as forging process.

3.8 Define open-die forging.

Open-die forging also called hammer forging or flat-die forging is a process in which the work piece is heated in the blacksmith furnace and then beating it over an anvil. Examples are upsetting, swaging, flattening, etc.

3.9 Give some basic forging operations.

Upsetting, Drawing, Bending, Flattening, etc.,

3.10 What are the classification of forging processes?

1. Open-die forging (hand forging, hammer forging and power press)
2. Closed-die forging (drop forging, press forging, upset forging)
3. Roll forging

3.11 Define closed die forging.

In closed die forging, the impression are cut in the die block and the metal is forced into it to get the final shape. Examples are drop forging, press forging & upset forging.

3.12 Define press forging.

The press forging is a process in which the metal is plastically deformed by squeezing action to get the required shape.

3.13 Define upsetting.

Upsetting is a process of increasing the thickness of a bar at the expense of its length.

3.14 What are the types of hot extrusion process?

1. Forward (or) Direct extrusion 2. Backward (or) Indirect extrusion

3.15 Give some cold extrusion process.

1. Cold impact extrusion 2. Hydrostatic extrusion.

3.16 What is meant by wire drawing?

Drawing of metal through a small aperture die and wounding in the form of coil is called wire drawing. The aperture is generally below 16 mm diameter.

3.17 Define tube drawing.

Making hollow cylinder and tubes by hot working processes like extrusion, piercing is called tube drawing. Tube drawing is of 3 types

1. Tube sinking
2. Tube drawing with a plug
3. Tube drawing with a moving mandrel

3.18 Define an electric arc.

An electric arc is a discharge across a gap in a circuit. In arc welding, the arc is sustained by a thermally ionized column of gas through which the current can flow.

3.19 Define resistance welding.

RW consists of a group of fusion welding processes that utilize a combination of heat and pressure to accomplish coalescence of the two faying surfaces. Most prominent in the group is resistance spot welding.

3.20 Define lathe

Lathe is a machine to remove metal from the job to give it the desired shape and size producing principally a cylindrical surface.

3.21 How steels and cast irons are identified?

The alloys of iron - carbon system containing from 0.008 to 2.14% C are classified as **steels**.

And the alloys of iron - carbon system containing from 2.14 to 6.7% C are called **cast irons**.

3.22 What is Steel?

The ferrous alloy having the carbon composition ranging from 0.008 to 2% is known as steel.

- Steels that contain 0.8% C (the eutectoid amount of carbon) are called **eutectoid steels**.
- Steels having less than 0.8% C are known as **hypoeutectoid steels**.
- Steels having more than 0.8% C are known as **hypereutectoid steels.**

3.23 How common steels are classified?

1. Low carbon (or) mild steel 0.05 to 0.25% C
2. Medium carbon steels 0.25 to 0.6% C
3. High carbon steel 0.6 to 0.9% C
4. Tool steel (High carbon steel) 0.9 to 1.5% C

3.24 Distinguish between steel and cast iron. Also classify steel with respect to carbon percentage.

	Steels	Cast Iron
1.	It has carbon content upto 2% C.	It has carbon content of 2-6.67% C
2.	Eutectoid reaction takes place during solidification	Eutectic reaction takes place during solidification.
3.	Due to less carbon content, it tends to make ductile.	Due to higher carbon content it tends to make them brittle.

3.25 Distinguish between elasticity and plasticity.

Elasticity is the property of a material by which it will retain its original shape and size after the removal of the load.

Plasticity is the property of a material by which a permanent deformation (without fracture) takes place, when it is subjected to the external forces.

3.26 Differentiate between ductility and malleability.

Ductility is the property of a material by which it can be drawn into wires before rupture takes place.

Malleability is the property of a material by which it can withstand deformation under compression without rupture.

3.27 Define the terms brittleness and hardness.

Brittleness is the property of a material by which it can withstand deformation under compression without rupture.

Hardness is the property of a material by which it will resist abrasion, indentation (or penetration), machining, and scratching.

3.28 What do you mean by toughness and stiffness?

Toughness is the property of a material by which it can absorb maximum energy before fracture takes place.

Stiffness is the property of a material by which it resists deformation.

3.29 Define fatigue.

Fatigue is the fracture that occurs under repeatedly applied fatigue stresses. This fracture occurs at a stress well below the tensile strength of the materials.

3.30 What is creep?

Creep is the fracture that takes place due to excessive temperature of metals under steady loading.

3.31 What is an alloy steel?

A steel in which elements other than carbon are added in sufficient quantity in order to obtain special properties, is known as alloy steel.

3.32 What are the effects of alloy additions on steel?

The alloying of steel is generally done to increase its

- Strength
- Hardness
- Toughness
- Resistance to abrasion and wear and
- To improve electrical and magnetic properties.

3.33 Mention any two aluminium base alloys and their applications.

Aluminium alloys can be classified as cast alloy (or) wrought alloy. An important wrought alloy is known as **Duralumin**. It is composed of 3.5 to 4.5% Cu, 0.4-0.7% Mn, 0.4-0.7% Mg. It is used for forgings, stampings, sheets, tubes and rivets.

Another alloy containing copper, Nickel and Magnesium is known as **Y-alloy**. It has the characteristic of retaining a good strength at high temperature. It is used for making pistons and other components in aero-engines.

3.34 What are the required properties of a tool steel?

Tool steels should have the following requirements:

(i) Good toughness.

(ii) Good wear resistance.

(iii) Very good machinability

(iv) Slight change of form during hardening.

(v) Little risk of cracking during hardening.

3.42 How are polymers classified?

Polymers are classified according to the mechanical behaviour at elevated temperatures as

1. Thermoplasts (or thermoplastic polymers)
2. Thermosets (or thermosetting polymers)

3.43 Name some commercially available thermoplasts

1. Polyvinyl chloride (PVC) and Polystyrene used in articles such as plastic wall and floor tile.
2. Polystyrene - Fluorescent light reflectors.
3. Polymethyl Methacrylate - plastic lenses.

3.44 With property and application, explain the following polymers: (a) PVC (b) PMMA

(a) **PVC**

Properties: Good, low cost, often copolymerized; susceptible to heat distortion.

Applications: Floor coverings. Pipe Electrical wire insulation, Hose, Photograph records.

(b) **PMMA**

Properties

1. PMMA has outstanding light transmission characteristics.
2. It has resistance to weathering.
3. It has got only fair mechanical properties.
4. It is easy to fabricate

Applications

1. Light covers 2., Lamp shades 3. Lenses 4. Sign boards 5. Drafting equipment 6. Plastic jewellery etc.

3.45 What is the characteristic of thermoplasts?

Thermoplasts (or) thermoplastic polymers **soften** when heated (and eventually liquify) and **harden** when cooled. They can be repeatedly moulded and remoulded to the desired shapes.

3.46 What is the characteristics of thermosetting polymers?

Thermosetting polymers become soft when they are heated initially and then become hard permanently upon cooling. They do not suffer upon further heating. Hence they cannot be remoulded (or) reshaped by subsequent heating.

3.47 Distinguish between thermoplastics and thermosetting plastics.

S. No.	Thermoplastics	Thermosetting plastics
1.	They are formed by addition polymerisation.	They are formed by condensation polymerisation.
2.	They are linear polymers, so they are composed of chain molecules.	They are composed of three dimensional network of cross-linked molecules,
3.	Softening is possible on reheating (because of the weak secondary forces).	Softening is not possible on re-heating (because of strong co-valent bonds).
4.	They can be easily moulded (or) remoulded into any shape.	They cannot be remoulded into any new shape.
5.	They can be recycled again.	They cannot be recycled.

3.48 Define plastics.

A plastic is defined as an organic polymer, which can be moulded into any desired shape and size with the help of heat, pressure (or) both. The plastic, in its liquid form, is known as **resin.**