

STUDY MATERIAL

SUBJECT : BASIC MANUFACTURING PROCESSES (BMP)

(MODULE - I)

SEMESTER : 5TH

BRANCH : MECHANICAL ENGINEERING

CONTENTS :

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DEPARTMENT OF MECHANICAL ENGINEERING

SRINIX COLLEGE OF ENGINEERING, BALASORE

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Basic Manufacturing Processes

Objective Type

01. The most preferred process for casting gas turbine blades is : (ESE-92)

- (a) die moulding
- (b) shell moulding
- (c) investment moulding
- (d) sand casting

02. Which of the following metal shrinks most from molten state to solid state? (ESE-92)

- (a) Cast iron
- (b) Cast steel
- (c) Brass
- (d) Admiralty metal

03. **Assertion (A):** In a mould, a riser is designed and placed so that the riser will solidify after the casting has solidified.

Reasons(R): A riser can act as reservoir of molten metal which will supply molten metal where a shrinkage cavity would have occurred. (ESE-94)

04. Which of the following materials can be used for making patterns? (ESE-94)

- 1. Aluminium
- 2. Wax
- 3. Mercury
- 4. Lead

Select the correct answer using the codes below:

- (a) 1,3 and 4
- (b) 2,3 and 4
- (c) 1,2 and 4
- (d) 1,2 and 3

05. **Assertion(A):** Aluminium alloys are cast in hot chamber die casting machine.

Reason(R): Aluminium alloys require high melting when compared to zinc alloys. (ESE-95)

06. **Assertion(A):** An aluminium alloy with 11% silicon is used for making engine pistons by die casting technique.

Reason(R): Aluminium has low density and addition of silicon improves its fluidity and therefore its cast ability. (ESE-95)

07. Match List-I with List-II and select the correct answering the codes given below the lists: (ESE-95)

List - I

- A. Automobile piston in aluminum alloy
- B. Engine crankshaft in spheroidal graphite iron
- C. Carburetor housing in aluminium alloy
- D. Cast titanium blades

List - II

- 1. Pressure die-casting
- 2. Gravity die-casting
- 3. Sand casting
- 4. Precision investment casting
- 5. Shell moulding

Codes:

	A	B	C	D		A	B	C	D
(a)	2	3	1	5	(b)	3	2	1	5
(c)	2	1	3	4	(d)	4	1	2	3

08. Addition of magnesium to cast iron increases its (ESE-95)

- (a) hardness
- (b) ductility and strength in tension
- (c) corrosion resistance
- (d) creep strength.

09. Which one of the following materials will require the largest size of riser for the same casting? (ESE-95)

- (a) Aluminium
- (b) Cast iron
- (c) Steel
- (d) Copper

10. Directional solidification in castings can be improved by using (ESE-95)
 (a) chills and chaplets
 (b) chills and padding
 (c) chaplets and padding
 (d) chills, chaplets and padding.

11. Consider the following ingredients used in moulding: (ESE-96)
 1. Dry silica sand
 2. Clay
 3. Phenol formaldehyde
 4. Sodium silicate

Those used for shell mould casting include

- (a) 1,2 and 4 (b) 2,3 and 4
 (c) 1 and 3 (d) 1,2,3 and 4

12. Which of the following methods are used for obtaining directional solidification for casting design? (ESE-96)

1. Suitable placement of chills
 2. Suitable placement of chaplets
 3. Employing padding

Select the correct answer.

- (a) 1 and 2 (b) 1 and 3
 (c) 2 and 3 (d) 1,2 and 3

13. Misrun is a casting defect which occurs due to (ESE-96)

- (a) very high pouring temperature of the metal
 (b) Insufficient fluidity of the molten metal
 (c) Absorption of gases by the liquid metal
 (d) Improper alignment of the mould flasks

14. Which of the following pairs are correctly matched? (ESE-96)

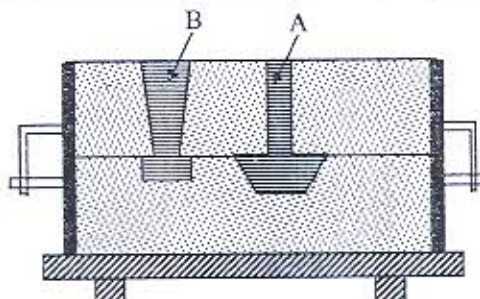
1. Pit moulding..... For large Jobs
 2. Investment moulding...Lost wax process
 3. Plaster moulding....Mould prepared with gypsum

- (a) 1,2 and 3 (b) 1 and 2
 (c) 1 and 3 (d) 2 and 3

15. Which one of the following pairs is not correctly matched? (ESE-97)

- (a) Aluminium alloy piston...Pressure die casting
 (b) Jewellery Lost wax process
 (c) Large pipes ...Centrifugal casting
 (d) Large bells Loam moulding

16. A sand casting mould assembly is shown in the given figure. The elements marked 'A' and 'B' are respectively. (ESE-98)



- (a) Sprue and Riser (b) Ingate and Riser
 (c) Drag and Runner (d) Riser and Sprue

17. Which of the following are the requirements of an ideal gating system?

1. The molten metal should enter the mould cavity with as high a velocity as possible.
 2. It should facilitate complete filling of the mould cavity.
 3. It should be able to prevent the absorption of air or gases from the surroundings on the molten metal while flowing through it.

Select the correct answer using the codes given below: (ESE-98)

- (a) 1,2 and 3 (b) 1 and 2
 (c) 2 and 3 (d) 1 and 3

18. A Spherical drop of molten metal of radius 2 mm was found to solidify in 19 seconds. A similar drop of radius 4 mm would solidify in (ESE-98)

(a) 14.14 second (b) 20 second
(c) 18.30 second (d) 40 second.

19. In solidification of metal during casting, compensation for solid contraction is (ESE-99)

(a) Provided by the oversize pattern.
(b) Achieved by properly placed risers
(c) Obtained by promoting direction solidification
(d) Made by provided chills

20. Match List I- (Process) with List II (Products/materials) and select the correct answer using the codes given below the lists: (ESE-00)

List - I

A. Die casting
B. Shell molding
C. CO₂ molding
D. Centrifugal casting

List - II

1. Phenol formaldehyde
2. C.I. pipes
3. Non-ferrous alloys
4. Sodium silicate

Codes :

	A	B	C	D		A	B	C	D
(a)	1	3	4	2	(b)	3	1	4	2
(c)	3	1	2	4	(d)	1	3	2	4

21. The main purpose of chaplets is (ESE-01)

(a) To ensure directional solidification
(b) To provide efficient venting
(c) For aligning the mould boxes
(d) To support the cores

22. **Assertion (A):** In CO₂ casting process, the mould or core attains maximum strength.

Reason (R): The optimum gassing time of CO₂ through the mould or core forms Silica gel which imparts sufficient strength to the mould or core. (ESE-02)

23. A gating ratio of 1:2:4 is used to design the gating system for magnesium alloy casting. This gating ratio refers to the cross-section areas of the various gating elements as given below: (ESE-03)

1. Down sprue
2. Runner
3. Ingate

The correct sequence of the above elements in the ratio 1:2:4 is

(a) 1, 2 and 3 (b) 1, 3 and 2
(c) 2, 3 and 1 (d) 3, 1 and 2

24. Match List-I (Products) with List-II (Casting process) and select the correct answer using the codes given below the lists: (ESE-03)

List-I(Products)

A. Hollow statues
B. Dentures
C. Aluminium alloy pistons
D. Rocker arms

List-II (Casting Process)

1. Centrifugal Casting
2. Investment Casting
3. Slush Casting
4. Shell Moulding
5. Gravity Die Casting

Codes:

	A	B	C	D		A	B	C	D
(a)	3	2	4	5	(b)	1	3	4	5
(c)	1	2	3	4	(d)	3	2	5	4

25. In gating system design, which one of the following is the correct sequence in which choke area, pouring time, pouring basin and sprue sizes are calculated? (ESE-03)

- (a) Choke area – Pouring time – Pouring basin – Sprue
- (b) Pouring basin – Sprue – Choke area – Pouring time
- (c) Choke area – Sprue – Pouring basin – Pouring time
- (d) Pouring basin – Pouring time – Choke area – Sprue

26. In shell moulding, how can the shell thickness be accurately maintained? (ESE-05)

- (a) By controlling the time during which the pattern is in contact with mould
- (b) By controlling the time during which the pattern is heated
- (c) By maintaining the temperature of the pattern in the range of $175^{\circ}\text{C} - 380^{\circ}\text{C}$
- (d) By the type of binder used

27. The gating ratio 2:8:1 for copper in gating system design refers to the ratio of areas of (ESE-05)

- (a) Sprue : Runner : Ingate
- (b) Runner : Ingate : Sprue
- (c) Runner : Sprue : Ingate
- (d) Ingate : Runner : Sprue

28. Which one of the following processes produces a casting when pressure forces the molten metal into the mould cavity? (ESE-05)

- (a) Shell moulding
- (b) Investment casting
- (c) Die casting
- (d) Continuous casting

29. According to Chvorinov's equation, the solidification time of a casting is proportional to (ESE-06)

- (a) V^2
- (b) V
- (c) $1/V$
- (d) $1/V^2$

[Where, V = volume of casting]

30. Shell moulding can be used for (ESE-06)

- (a) producing milling cutters
- (b) making gold ornaments
- (c) producing heavy and thick walled casting
- (d) producing thin casting

31. Which of the following materials are used for making patterns in investment casting method?

- 1. Wax
- 2. Rubber
- 3. Wood
- 4. Plastic

Select the correct answer using the code given below: (ESE-06)

- (a) Only 1 and 3
- (b) Only 2 and 3
- (c) Only 1, 2 and 4
- (d) Only 2, 3 and 4

32. In which of the following are metal moulds used? (ESE-06)

- (a) Greensand mould
- (b) Dry sand mould
- (c) Die casting process
- (d) Loam moulding

33. Match list I with List II and select the correct answer using the code given below the Lists: (ESE-07)

List – I (Casting Process)

- A. Die casting
- B. Investment casting
- C. Shell moulding
- D. Centrifugal casting

List – II (Principle)

- 1. The metal solidifies in a rotating mould
- 2. The pattern cluster is repeatedly dipped into a ceramic slurry and dusted with refractory
- 3. Molten metal is forced by pressure into a metallic mould

4. After cooling, the invest is removed from the casting by pressure jetting or vibratory cleaning

Codes :

A	B	C	D	A	B	C	D
(a) 2	1	3	4	(b) 3	4	2	1
(c) 2	4	3	1	(d) 3	1	2	4

34. Consider the following statements in respect of investment castings: (ESE-07)

1. The pattern or patterns is/are not joined to a stack or sprue also of wax to form a tree of patterns.
2. The prepared moulds are placed in an oven and heated gently to dry off the invest and melt out the bulk of wax.
3. The moulds are usually poured by placing the moulds in a vacuum chamber.

Which of the statements given above are correct?

- (a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

35. Which of the following are employed in shell moulding? (ESE-07)

1. Resin binder
2. Metal pattern
3. Heating coils

Select the correct answer using the code given below :

- (a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

36. Which one of the following is the correct statement? In a centrifugal casting method (ESE-07)

- (a) no core is used
(b) core may be made of any metal
(c) core is made of sand
(d) core is made of ferrous metal

37. Which one of the following is the correct statement? (ESE-07)

- Gate is provided in moulds to
(a) feed the casting at a constant rate
(b) give passage to gasses
(c) compensate for shrinkage
(d) avoid cavities

38. Small amount of carbonaceous material sprinkled on the inner surface of mould cavity is called (ESE-08)

- (a) Backing sand (b) Facing sand
(c) Green sand (d) Dry sand

39. Which of the following casting processes does not/do not require central core for production pipe? (ESE-08)

1. Sand casting process
2. Die casting process
3. Centrifugal casting process

Select the correct answer using the code given below:

- (a) 1 and 2 (b) 2 only
(c) 2 and 3 (d) 3 only

40. Bottom gating system is sometimes preferred in casting because (ESE-08)

- (a) It enables rapid filling of mould cavity
(b) It is easier to provide in the mould
(c) It provides cleaner metal
(d) It reduces splashing and turbulence

41. Which of the following are the most suitable materials for die casting? (ESE-09)

- (a) Zinc and its alloys
(b) Copper and its alloys
(c) Aluminium and its alloys
(d) Lead and its alloys

42. Which one of the following casting processes is best suited to make bigger size hollow symmetrical pipes? (ESE-09)

- (a) Die casting (b) Investment casting
(c) Shell moulding (d) Centrifugal casting

43. Which of the following are the most likely characteristics in centrifugal casting?

(ESE-09)

- (a) Fine grain size and high porosity
- (b) Coarse grain size and high porosity
- (c) Fine grain size and high density
- (d) Coarse grain size and high density

44. Consider the following statements:

- 1. The actual entry point through which the molten metal enters the mould cavity is called in-gate.
- 2. Bottom gate in case of a mould creates unfavourable temperature gradient.
- 3. Sprue in case of a mould is made tapered to avoid air inclusion.

Which of the above statements is/are correct?

(ESE-09)

- (a) 1 only
- (b) 1 and 2
- (c) 2 and 3
- (d) 1 and 3

45. **Assertion (A) :** The investment casting is used for precision parts such as turbine plates, sewing machines etc.

Reason (R): The investment castings have a good surface finish and are exact reproductions of the master pattern.

(ESE-10)

46. Consider the following advantages of shell mould casting :

- 1. Close dimensional tolerance
- 2. Good surface finish
- 3. Low cost
- 4. Easier

Which of these are correct ?

(ESE-10)

- (a) 1,2 and 3 only
- (b) 2,3 and 4 only
- (c) 1, 2 and 4 only
- (d) 1,2,3 and 4

47. Rigid metal pieces to support cores are called.

(ESE-10)

- (a) Chaplets
- (b) Sprue
- (c) Riser
- (d) Ribs

48. Which one of the following moulding processes does not require use of core?

(ESE-10)

- (a) Sand moulding
- (b) Shell moulding
- (c) Centrifugal casting
- (d) Plaster moulding

49. Which of the following casting method utilizes wax pattern?

(ESE-10)

- (a) Die casting
- (b) Centrifugal casting
- (c) Investment casting
- (d) Semi-centrifugal casting

50. Consider the following advantages of die casting over sand casting :

(ESE-11)

- 1. Rapidity of the process
- 2. Smooth surface
- 3. Strong dense metal structure

Which of these advantages are correct?

- (a) 1, 2 and 3
- (b) 1 and 2 only
- (c) 2 and 3 only
- (d) 1 and 3 only

51. The proper sequence of investment casting steps is :

(ESE-11)

- (a) Slurry coating – pattern melt out – Shake out – Stucco coating
- (b) Stucco coating – Slurry coating – Shake out – Pattern melt out
- (c) Slurry coating – Stucco coating – Pattern melt out – Shake out
- (d) Stucco coating – Shakeout – Slurry coating – Pattern melt out

52. The method of casting for producing ornamental pieces are:

(ESE-11)

- (a) Slush and gravity casting
- (b) Pressed and slush casting
- (c) Gravity and semi permanent mould casting
- (d) Semi permanent mould and pressed casting

53. In light metal casting, runner should be so designed that: (ESE-11)

1. It avoids aspiration
2. It avoids turbulence
3. The path of runner is reduced in area so that unequal volume of flow through each gate takes place

- (a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

54. The relationship between total freezing time t_f , volume of the casting V and its surface area A , according to Chvorinov's rule is: (ESE-11)

- (a) $t = K \left(\frac{V}{A} \right)$ (b) $t = K \left(\frac{A}{V} \right)$
(c) $t = K \left(\frac{A}{V} \right)^2$ (d) $t = K \left(\frac{V}{A} \right)^2$

Where K is a constant

55. Match List -I with List -II and select the correct answer using the code given below the lists: (ESE-11)

List -I

- A. Top gate B. Bottom gate
C. Parting gate D. Step gate

List -II

1. Heavy and large castings
2. Most widely used and economical
3. Turbulence
4. Unfavourable temperature gradient

Codes:

- | A | B | C | D | A | B | C | D |
|-------|---|---|---|-------|---|---|---|
| (a) 3 | 4 | 2 | 1 | (b) 1 | 4 | 2 | 3 |
| (c) 3 | 2 | 4 | 1 | (d) 1 | 2 | 4 | 3 |

56. The process of making hollow castings of non circular shape and desired thickness by permanent mould without the use of cores is known as (ESE-12)

- (a) Die casting
(b) Slush casting

- (c) Pressed casting
(d) Centrifugal casting

57. The ratio of surface area of volume for a unit volume of riser is minimum in case of (ESE-12)

- (a) Cylindrical riser
(b) Spherical riser
(c) Hemispherical riser
(d) Cuboid riser

58. **Statement (I):** Mould walls of a permanent mould are kept thick.

Statement (II): The thicker mould walls retain maximum heat increasing flow of molten metal. (ESE-13)

- (a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I)
(b) Both Statement (I) and Statement (II) are individually true but Statement (II) is NOT the correct explanation of Statement (I)
(c) Statement (I) is true but Statement (II) is false
(d) Statement (I) is false but Statement (II) is true

59. **Statement (I):** In semi centrifugal casting a particular shape of the casting is produced by mould, core and the centrifugal force of molten metal.

Statement (II): The centrifugal force aids to proper feeding to produce casting free from porosity. (ESE-13)

60. **Statement (I):** In die casting process, molten metal is injected at high pressure into a metallic die.

Statements(II): In this die casting process, some excess metal as required than filling the mold is also forced into the parting plane. (ESE-14)

61. **Statement(I):** For casting of metal like magnesium, top gating is not used.

Statement(II): The gases will escape resulting in early cooling of metal.

(ESE-14)

62. **Statement (I):** In sand molding process, pouring time depends on materials being cast, complexity of casting, section thickness and size.

Statement (II): In order to maintain optimum pouring time, thickness of casting is the important factor

(ESE-14)

63. **Statement (I):** Cupola furnace is not employed for melting steel in foundry

Statement (II): The temperatures generated within a cupola are not adequate for melting steel

(IES-12)

64. Consider the following statements for an induction furnace:

(IES-14)

1. High-frequency current is generally used for the furnace
2. There is less loss of alloying elements due to oxidation.
3. Pronounced stirring action of molten metal occurs inside the furnace.
4. Slag cover is essential for the efficient working of the furnace.

Which of the above statements are correct?

- (a) 1, 3 and 4 only (b) 2, 3 and 4 only
(c) 1, 2 and 3 only (d) 1, 2, 3 and 4

65. **Statement (I):** Cupola is used in cast iron foundry.

Statement (II): Basic furnaces are used for melting low-grade steel.

(IES-14)

66. Consider the following statements:
In the shell moulding

1. a single parting plane should be provided for mould.

2. detachable pattern parts and cores could be included

3. minimum rounding radii of 2.5 mm to 3 mm should be used

4. draft angles of not less than 1° should be used.

Which of the above statements are correct?

(ESE - 15)

- (a) 1, 3 and 4 only (b) 1, 2 and 3 only
(c) 2, 3 and 4 only (d) 1, 2, 3 and 4

67. A big casting is to have a hole, to be produced by using a core of 10 cm diameter and 200 cm long. The density ρ_{metal} is 0.077 N/cm^3 and density ρ_{core} is 0.0165 N/cm^3 . What is the upward force acting on the core prints?

(ESE - 15)

- (a) 200.5 N (b) 1100.62 N
(c) 950.32 N (d) 350.32 N

68. **Statement (I) :** In shell moulding process, phenol formaldehyde is never used.

Statement (II) : The resins used in this process are basically of the thermoplastic variety.

(ESE - 16)

69. **Statement (I) :** Both sand and metal moulds can be used for centrifugal casting.

Statement (II) : In this process, sand moulds are recommended when chilling tendency is to be prevented.

(ESE - 16)

70. Consider that the following materials are usable for manufacturing dies, moulds in investment casting process for the purpose of large-scale production:

1. Aluminum alloy
2. Magnesium alloy
3. Brass
4. Low-carbon steel

Which of the above are correctly usable?

(ESE - 16)

- (a) 1, 2 and 3 only (b) 1, 2 and 4 only
(c) 3 and 4 only (d) 1, 2, 3 and 4

Answers

01. c	02. b	03. a	04. d	05. a	06. a	07. a	08. b	09. a	10. d
11. c	12. d	13. b	14. a	15. a	16. d	17. a	18. d	19. a	20. b
21. d	22. a	23. a	24. d	25. b	26. c	27. a	28. c	29. a	30. d
31. c	32. c	33. b	34. c	35. d	36. a	37. a	38. b	39. d	40. d
41. c	42. d	43. c	44. d	45. a	46. c	47. a	48. c	49. c	50. b
51. c	52. c	53. a	54. d	55. a	56. b	57. a	58. c	59. b	60. a
61. c	62. c	63. c	64. c	65. c	66. d	67. c	68. *	69. a	70. c
71. a	72. b								

Solutions

Ans: (c)

Because the Gas turbine blades are complex in shape, they will be manufactured by using investment casting. In this wax is used as a pattern material.

Ans: (b)

The total shrinkage i.e., liquid shrinkage as well as solid shrinkage both together will be highest in case of steel.

Ans: (a)

Because the riser is acting as reservoir for supplying liquid molten metal to compensating liquid shrinkages taking place during solidification to avoid shrinkage cavity. By ensuring that the riser solidifies after casting, it is possible to compensate the liquid shrinkages.

Ans: (d)

Aluminum is the metal pattern, wax is the pattern used in investment casting and the

frozen mercury is used for producing very small casting of excellent surface finish.

05. Ans: (a)

06. Ans: (a)

Sol: For reducing the weight of the piston, addition of silicon increases the fluidity of molten metal.

07. Ans: (a)

Sol: Just by matching Aluminum alloy piston made by gravity die casting and carburetor by pressure die casting the answer can be identified.

08. Ans: (b)

09. Ans: (a)

Sol: Out of all the metals, aluminum has the largest liquid shrinkage and hence the riser size should be larger.

10. Ans: (d)

Sol: Chills are mainly used for producing directional solidification whereas chaplets and pads are giving directional solidification as additional functionality.

11. Ans: (c)

Sol: In shell moulding, mainly the Phenolic resin also called phenol formaldehyde will be used as mould material and for increasing the strength of the mold, dry silica sand can be used.

12. Ans: (d)

Sol: Chills are mainly used for producing directional solidification whereas chaplets and pads will also give directional solidification as additional functionality.

13. Ans: (b)

Sol: Misrun is the defect produced in casting due non-filling of farthest point of cavity from pouring point, which is because lack of molten metal and this may occur due to the solidification of molten metal is started before complete filling of the cavity

14. Ans: (a)

Sol: Large size castings like machine tool beds are produced in pit moulding and it uses polystyrene as pattern material, wax is used as pattern material in investment casting process and gypsum is used as mould material in plaster molding.

15. Ans: (a)

Sol: Aluminum alloy pistons are made by gravity die casting because the shape of the piston is simple. But for complex shapes like carburetor, pressure die casting will be used.

16. Ans: (d)

Sol: From fig 'A' is the riser so that it acts as reservoir for supplying molten metal to compensate the liquid shrinkage during casting whereas 'B' is the sprue will supply molten metal for filling the molten metal into the cavity. Riser will be straight hollow cylindrical shape where as sprue is in the tapered shape one.

17. Ans: (a)

Sol: In the point no.1, the velocity is as high as possible so it is correct, if it was the high velocity then the point 1 is wrong. The other points are general requirements of gating system.

18. Ans: (d)

Sol: Solidification time is proportional to $(V/A_s)^2$,

$$\tau_2 = \tau_1 \left[\frac{V_2 \times A_{s_1}}{V_1 \times A_{s_2}} \right]^2 = 40 \text{ sec}$$

Where V = Volume of casting,

A_s = Surface area of casting,

τ = solidification time.

19. Ans: (a)

Sol: Solid contraction can be compensated by providing shrinkage allowance on the pattern.

20. Ans: (b)

Sol: Die casting is always used for casting of non-ferrous metals, in shell moulding Phenol formaldehyde is used as mold material, in CO_2 moulding sodium silicate is used for initiating the formation of bond by chemically reacting and forming silica gel, on drying the silica gel it give very high strength to the mold.

21. Ans: (d)

Sol: Chaplets are the additional supports used to support the core without moving due buoyancy effect, they are made by same

material as that of casting because they will be retained in the casting. In addition the chaplets also provides the directional solidification as additional function.

3. Ans: (a)

In CO₂ moulding process, when the CO₂ is sent into the molding sand, the CO₂ will chemically react with sodium silicate which present in the mold and on drying it gives very high strength to the mold.

3. Ans: (a)

Gating ratio = ratio of cross sectional areas of Sprue, runner and ingate.

4. Ans: (d)

In this if we match aluminum alloy pistons to the gravity die casting then it possible to identify the answer.

5. Ans: (b)

First the molten metal is poured into the pouring basin, based on the level of molten metal in the pouring basin and height of the sprue, the total height which is responsible to obtain the velocity of molten metal can be calculated, using this velocity and choke area as well as pouring time will be calculated.

6. Ans: (c)

In shell moulding the thickness of the component will depend on the time with which the component is in contact with the mould.

7. Ans: (a)

Gating ratio = ratio of cross sectional areas of Sprue, runner and ingate.

8. Ans: (c)

In die casting the hot liquid molten metal is poured into the cavity either by gravity

force or by pressure force called as gravity die casting or pressure die casting.

29. Ans: (a)

Sol: According to Chvorinov's equation solidification time $\tau \propto (V/A_s)^2$, where, V = volume of casting and A_s is the surface area of casting

30. Ans: (d)

Sol: Shell moulding is used for thin sections, sharp corners and components having small projections which are not possible by normal sand casting

31. Ans: (c)

Sol: Generally wax and rubber pattern can be removed in the form of liquid whereas plastic (polystyrene) pattern can be removed in the form of gas, hence these three materials can be used as pattern materials in the investment casting but most popularly, the wax can be used.

32. Ans: (c)

Sol: In die casting moulds are made by using metals, hence the moulds are made by using die steel or tool steel and is used for producing the components made by low M.P materials like Al, Lead, Zinc, Cadmium etc.

33. Ans: (b)

Sol: In Die casting molten metal is poured with pressure, centrifugal casting the mould is rotated until the molten metal solidifies, shell moulding pattern is dipped in a phenolic resin or ceramic slurry.

34. Ans: (c)

Sol: To produce large size castings as pieces of pattern are stacked to get large size pattern. Hence option no. 1 is wrong.

35. Ans: (d)

Sol: In shell moulding, resin binder called as phenolic resin (phenol formaldehyde) can be used as binder, to get good surface finish and reusability metal patterns are used, and to control the thickness of mould heating coils are used.

36. Ans: (a)

Sol: Centrifugal casting is the process which is mainly used to produce large size hollow castings without the use of core, so that due to centrifugal force the molten metal is distributed around mould and the rotation of mold is continued until the molten metal gets solidified.

37. Ans: (a)

Sol: The gating system is used to give the passage to the molten metal into the casting cavity at constant rate, it consists of pouring basin, sprue, runner, ingate as the basic elements and strainer, skim bob & splash core are the accessories of the gating system.

38. Ans: (b)

Sol: In die casting process to avoid the formation of bond between the solidified metal and die (or) metal mould small quantities of carbonaceous material is sprinkled on the mould surface is called as facing sand.

39. Ans: (d)

Sol: Centrifugal casting is the process which is mainly used to produce large size hollow castings without the use of core, so that due to centrifugal force the molten metal is distributed around mold and the rotation of mold is continued until the molten metal gets solidified.

40. Ans: (d)

Sol: With bottom gating system, because the flow of molten metal from the bottom most

point of cavity there is no impact loads are acting by the molten metal jet into the cavity, hence no splashing and no turbulence will occur inside the cavity.

41. Ans: (c)

Sol: Even though lead, zinc and its alloys also can be casted but they are not used commonly in engineering hence aluminum and its alloys are the most commonly used materials in the die casting.

42. Ans: (d)

Sol: Centrifugal casting is the process which is mainly used to produce large size hollow castings without the use of core, so that due to centrifugal force the molten metal is distributed around mold and the rotation of mold is continued until the molten metal gets solidified.

43. Ans: (c)

Sol: In centrifugal casting because of high speed rotation of the mold, the heat transfer is also high and hence normalizing effect will take place which produces fine grains and due to centrifugal force high density of the parts are produced.

44. Ans: (d)

Sol: In-gate is the last point of gating system from where the molten metal enters into the casting cavity and sprue is made tapered to avoid the aspiration effect in casting.

45. Ans: (a)

Sol: Because of usage of wax pattern the surface finish produced is very good and hence no machining is required. Therefore casting is the exact reproduction of pattern and due to complex shape of the turbine blades and sewing machines investment casting is preferred.

6. Ans: (c)

Q1: The advantages of shell molding are close dimensional tolerances, good surface finish, easy to make thin components and best suitable for automation and mass production but the disadvantages are because of resin the cost increases, due to metal mold also cost increases etc.

7. Ans: (a)

Q1: Chaplets are used for supporting cores to avoid the core movement due to buoyancy forces.

8. Ans: (c)

49. Ans: (c)

9. Ans: (b)

Q1: Strength and density will not vary in die casting process

51. Ans: (c)

52. Ans: (c)

53. Ans: (a)

Q1: Aspiration will be avoided by tapered sprue only and turbulence also can be avoided by tapered sprue.

54. Ans: (d)

55. Ans: (a)

56. Ans: (b)

Q1: Slush casting is used for making hollow castings without use of core, but mainly used for producing decorative parts.

57. Ans: (a)

Q1: In cylindrical riser the surface area to the volume ratio is minimum hence the heat transfer is minimum and the solidification time of riser is maximum.

58. Ans: (c)

Q1: Thicker walls will reduce the heat transfer rate and hence flow of molten metal will take place.

59. Ans: (b)

Sol: In semi-centrifugal casting, the axis of mould and axis of rotation are not coinciding, hence the thickness of the casting around the circumference is varying. Because of centrifugal force acting on the molten metal, any air particles present in the molten metal will come out and hence the porosity defects are eliminated.

60. Ans: (a)

Sol: In pressure die casting molten metal is filled into the die due to the application of external pressure and to fill the molten metal at the parting and building the pressure, so excess amount molten metal will be supplied.

61. Ans: (c)

Sol: For all the reactive metals the bottom gating system is preferred because when top gating system is used, the air which is already present in the casting cavity will try to oxidize the molten metal.

62. Ans: (c)

Sol: The pouring time of molten metal into the casting cavity mainly depends on the velocity of molten metal, C.S. area of the gating system and fluidity of the molten metal. But the pouring time does not depend on the thickness of the casting.

63. Ans: (c)

Sol: Cupola furnace generates around 1200°C temperature where as blast furnace generates 1500°C . Hence cupola used to produce cast iron and blast furnace is used for making steels.

64. Ans: (c)

Sol: By sending 'i' current in heating element i^2Rt equivalent heat energy is generated where by using high frequency current

within in short time more heat energy can be generated. The heating element contains low oxidation tendency which allow stirring action for long duration of time.

65. Ans: (c) 66. Ans: (d)

67. Ans: (c)

Sol: Net buoyancy force = $V(\rho - d)$
 $= (\pi/4) \times 10^2 \times 200 \times (0.077 - 0.0165)$
 $= 950.32 \text{ N}$

68. Ans: (*)

Sol: Both are False (No answer)

In shell moulding, Phenolic resin (or) Phenol formaldehyde is used as mould material and it is a thermosetting plastic material.

69. Ans: (a)

Sol: Due to high "k", of metal chilling tendency is high

70. Ans: (c)

Sol: Due to low melting point of aluminum, it is not used and due to reaction problem magnesium alloy is not used.

71. Ans: (a)

Sol: Soft ramming of sand and continuous large flat surface on the mould causes cracks.

72. Ans: (b)

Sol: Due to high thermal conductivity of metal moulds used in die casting, rapid cooling (chilling) of molten metal will take place and produces fine grains, high strength and greater hardness at the surface.

STUDY MATERIAL

SUBJECT : BASIC MANUFACTURING PROCESSES

MODULE-I

SHORT TYPE QUESTIONS AND ANSWER

Module- 1

Basic Manufacturing Process

QUESTIONS WITH ANSWERS

1. *What are various factors that you will keep in mind while selecting pattern material?*

- Ans.
- (i) Number of castings to be made.
 - (ii) Method of moulding to be used i.e. hand or machine.
 - (iii) Type of casting method to be used.
 - (iv) Degree of accuracy in dimension and the quality of surface finish required in the casting.
 - (v) Design of casting.

2. *Why plastics are gaining popularity in modern foundries as pattern materials ?*

Ans. Plastics have the following specific characteristics

- (i) It is lighter in weight.
- (ii) High resistance to wear.
- (iii) High resistance to corrosion due to moisture.
- (iv) Fine surface finish,
- (v) Very reasonable cost.

3. *What are various allowances provided in a pattern ?*

Ans. Following are the allowances :

- (i) Shrinkage allowance,
- (ii) Machining allowance.
- (iii) Draft allowance
- (iv) Rapping or shake allowance
- (v) Distortion allowance

4. *What is green sand ?*

Ans. It is also known as tempered sand. It denotes a well prepared foundry sand which contains just enough moisture to give it sufficient bond. Moulds made in this sand are known as green sand moulds and do not require any baking before pouring the molten metal into them.

5. *What do you mean by facing sand ?*

Ans. It is also known as 'fat' sand. These terms are used for that sand which forms the face of the mould i.e. rammed around the pattern surface. It is nothing but fresh prepared and well tampered foundry sand. Initial coating around the pattern surface is given by this sand and the remainder of the flask is filled with floor sand to effect economy.

6. *What is parting sand ?*

Ans. This term denotes that sand which is sprinkled on the pattern and the parting surfaces of the mould so that the sand mass of one flask does not stick to that of the other or the pattern. The 'burnt' sand and dry silica sand are used for this purpose.

7. *What are the main constituents of moulding sand ?*

Ans. The main constituents are :

(i) Silica sand, (ii) Binder, (iii) Additives, (iv) Water/moisture

8. *What is the purpose of binders in the moulding sand ?*

Ans. The purpose of adding a binder to the moulding sand is to impart it sufficient strength and cohesiveness so as to enable it to retain its shape after the mould has been rammed and the pattern withdrawn. However, it produces an adverse effect on the permeability of the sand mould.

9. *What do you mean by permeability ?*

Ans. It is that property of the sand which allows the gases and steam to escape through the sand mould. When the hot molten metal is poured in the mould a very large volume of gases and steam is formed due to heating of moisture, coal dust, oil and similar other materials present in the sand. If these gases are not allowed to go out they will either make the casting unsound or blast the mould. Therefore, this is a very important property required in the moulding sand. It largely depends upon the

sand grain size and shape and proportion of moisture and clay present in the sand. Rounded grains of uniform size lead to a high permeability. This property is also effected by ramming of sand. A soft ramming will increase the permeability and hard ramming will reduce it. In practice it is further increased by applying vent wires in the prepared mould.

10. *What is collapsibility of the moulding sand ?*

Ans. Collapsibility is the property due to which the sand mould automatically collapses after solidification of the casting to, allow a free contraction of the metal. In absence of this property the contraction of the cast metal will be hindered by the mould and this will result in tears and cracks in the casting.

11. *What are blow holes in castings ? What are the possible causes ?*

Ans. Blow holes appear as cavities in a casting. When they are visible on the upper surface of the casting, they are called open blows. These blows are normally rounded and have smooth wall. When they are concealed in the casting and are not visible from outside, they are known as blow holes. They are due to the entrapped bubbles of gases in the metal and are, exposed only after machining.

1. Excess moisture content in moulding sand-leading to the production of too much of steam and thereby rendering the permeability of the mould as inadequate.
2. Cores not sufficiently baked.
3. Use of rusted or highly moistured chills, chaplets or other metal inserts-giving rise to the production of a high amount of steam and gases.
4. Excessive use of organic binders resulting in the production of high amount of gases.
5. Moulds inadequately vented-resulting in their low permeability.

12. *What remedies should be made to avoid blow holes ?*

Ans. Blow holes are not accidental but it is due to some steps of the process is wrong and also blow hole can be avoided by considering following remedies:

- i. Moisture content in the moulding sand should be properly controlled.

- ii. Cores should be adequately baked.
- iii. Chills, chaplets and metal inserts used should be clean and free from rust.
- iv. Organic binders should be used with restraint.
- v. Cores and moulds should be adequately vented.
- vi. Moulds should not be rammed excessively hard.

13. *What are hot tears found in castings ?*

Ans. Hot tear may be internal or external discontinuity in the casting parts and is identified by its ragged fracture line and by the blued appearance of the fracture surface. Some metals have low strength just after solidification and if at that time the casting undergoes a hindered contraction, it may result in the development of high stresses and the metal will fail with a resulting hot tear. Hot tear may not be disclosed by visual inspection only and so some other means are employed.

14. *What is porosity ? How it can be eliminated ?*

Ans. This defect occurs in the castings in the form of pinhole porosity or gas porosity. These porosities are caused by the gases absorbed by the molten metal. The gases commonly absorbed are hydrogen, oxygen and nitrogen, the latter two forming oxide and nitride respectively. It is mainly hydrogen that is responsible for pinhole porosity. During solidification the gas is released and in driving itself out of the metal it creates very small voids throughout the casting, called pin holes.

It is necessary, therefore, that to avoid the above defects proper melting temperature should be maintained, adequate amount of flux should be used, casting should be made to solidify quickly by proper gating and risering, the permeability of the mould should be increased and the moisture content of the mould should be kept as low as possible.

15. *What are buckles ?*

Ans. Buckles are found on high melting temperature metal castings. Due to the heat of the molten metal, the surface of mould may expand but pieces of that do not fall in case of scab. The defect appears in the shape of an irregular long break of small width on the casting surface. A rat tail is a minor buckle. Mold hardness should be reduced. Some additives should be added to the sand for reducing its expansion characteristics and for improving the resistance against thermal shock.

16. *What are misrun and cold shuts and how it is eliminated ?*

Ans. When the molten metal fails to reach all the sections of the mould such that a certain part of it remains unfilled, resulting in an incomplete casting the defect is known as misrun. When two streams of molten metal approach each other in the mould from opposite directions, establish a physical contact between them, but fail to fuse together, resulting in a discontinuity between them, it is known as a cold shut. Both these defects occur due to lack of fluidity in the molten metal and faulty design incorporating very thin sections. As such they can be eliminated by improving the design and adjusting the pouring temperature to ensure proper fluidity.

17. *What is shot metal and what is its remedy ?*

Ans. The defect appears in the form of small metal shots embedded in the casting, which are exposed on the fractured surface of the latter. It so happens that when the molten is poured into the mould particularly when its temperature is relatively lower, it may splash. The small particles separated from the main stream during the spray are thrown ahead and solidify quickly to form the shots. These shots, if fail to fuse with the flowing metal, give rise to this defect. Excess sulphur content in the metal may also help in promoting this defect. Faulty gating and higher moisture content in the moulding sand are other causes of this defect. Proper control over pouring temperature, sulphur content of metal moisture content of sand and improved gating system are the main remedies of this defect.

18. *Why chills are used in moulds ?*

Ans. Chills are used in moulds for achieving directional solidification in sand mould.

19. *Why Riser is provided in the mould ?*

Ans. (i) To ensure the filling of mould by visualization.
(ii) It will compensate the shrinkage volume of melt for avoiding short fill of component.

20. *Why coke powder is used in mould cavity making ?*

Ans. This coke powder when come in contact with molten matt. It creates a gaseous envelopes inside the cavity which reduces the friction of mould wall to material. So that surface finish of the casting is improved noticeable.

21. *What is the consideration of direction solidification of mouldings during design?*

Ans. Direction of solidification in castings is made from thinnest section towards the heaviest section.

Direction of solidification should be from farthest end of the pouring basin.

22. *What do mean by 'fettling' ?*

Ans. This is the operation which is performed after moulding is over to separate the unwanted portion like, gate, risers, to clean and finishing the castings.

23. *What is the basic difference between hot chamber die casting and cold chamber die casting process ?*

Ans. **Cold Chamber die casting**

1. High temperature melting partially.
2. Melting unit is not an integral part of machine.

Hot Chamber die casting

1. Low temperature melting power.
2. Melting unit is an integral part.

24. *What is inoculation and why it is done ?*

Ans. Inoculation is an addition made to molten metal usually at subsequent stage of melting operation for modification of solidification structure and properties of alloys. Aluminium is added in controlled amount in steel to produce free grain size.

25. *Why centrifugal casting is termed as 'Core less' casting ?*

Ans. In this process no core is used and material is filled under the effect of centrifugal force developed by rotation of the mould.

26. *What is core print ?*

Ans. For supporting the cores in the mould cavity an impression in the form of a recess is made in the mould. This is known as core print. It should be adequate size and shape to support the weight of core.

27. *What is aspiration effect?*

Ans. When the molten metal velocity is more then the pressure reduces considerable as per Bernoulli's equation. When pressure goes below atmospheric pressure then gas originating from baking of organic compounds may enter into the molten metal stream which leads to produce defective castings. This effect is termed as aspiration effect.

28. *Why plaster of Paris is not used as mould material for ferrous metal casting?*

Ans. Plaster of Paris is nothing but the gypsum with some water particle ($\text{CaSO}_4 \cdot n\text{H}_2\text{O}$). Basically sulphur of the gypsum reacts chemically with ferrous metals at high temperature to which provides very bad casting surfaces. So for ferrous casting plaster of Paris is not used as mould materials but same time for casting aluminium, copper and bronze it is quite fruitful as mould material.