A
SET

Booklet No. :

MT - 16
Metallurgy

Duration of Test : 2 Hours **Max. Marks : 120**

Hall Ticket No.

Name of the Candidate : _____

Date of Examination : _____ **OMR Answer Sheet No. :** _____

_____ _____

Signature of the Candidate **Signature of the Invigilator**

INSTRUCTIONS

1. This Question Booklet consists of **120** multiple choice objective type questions to be answered in **120** minutes.
2. Every question in this booklet has 4 choices marked (A), (B), (C) and (D) for its answer.
3. Each question carries **one** mark. There are no negative marks for wrong answers.
4. This Booklet consists of **16** pages. Any discrepancy or any defect is found, the same may be informed to the Invigilator for replacement of Booklet.
5. Answer all the questions on the OMR Answer Sheet using **Blue/Black ball point pen only.**
6. Before answering the questions on the OMR Answer Sheet, please read the instructions printed on the OMR sheet carefully.
7. OMR Answer Sheet should be handed over to the Invigilator before leaving the Examination Hall.
8. Calculators, Pagers, Mobile Phones, etc., are not allowed into the Examination Hall.
9. No part of the Booklet should be detached under any circumstances.
10. The seal of the Booklet should be opened only after signal/bell is given.

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METALLURGY (MT)

1. If 1,2 and 3 are the eigen values of A, then the eigen values of transpose of $2A+I$ are
   (A) 1/3,1/5,1/3 (B) 2,4,6 (C) 3, 5,7 (D) 1,3,5

2. A consistent non-homogeneous linear system $AX = B$ has unique solution if
   (A) rank of A is equal to the number of unknowns
   (B) rank of A is less than the number of unknowns
   (C) determinant of A is zero
   (D) determinant of A is non zero

3. The particular integral of the differential equation $(D^3 - D)y = e^x + e^{-x}$, where $D = \frac{d}{dx}$ is
   (A) $\frac{1}{2}(e^x + e^{-x})$ (B) $\frac{1}{2}x(e^x + e^{-x})$
   (C) $\frac{1}{2}x^2(e^x + e^{-x})$ (D) $\frac{1}{2}x^2(e^x - e^{-x})$

4. The Laplace transform of t^2e^{-t} is
   (A) $\frac{2}{s^3}$ (B) $\frac{2}{(s+1)^3}$ (C) $\frac{1}{(s-1)^2}$ (D) s^2e^{-s}

5. The differential equation of a two dimensional heat equation is
   (A) $\frac{\partial^2 u}{\partial t^2} = c^2(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2})$ (B) $\frac{\partial u}{\partial t} = c^2(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2})$
   (C) $\frac{\partial u}{\partial t} = c^2(\frac{\partial^2 u}{\partial x^2} - \frac{\partial^2 u}{\partial y^2})$ (D) $\frac{\partial u}{\partial t} = c^2(\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y})$

6. If $y' = x + y^2$ and $y(0) = 1$ then y(1.1) by Euler's method is
   (A) 1.1 (B) 0.1 (C) 1.11 (D) 1.011

7. The coefficient of correlation lies in the interval
   (A) (–1,0) (B) (0,1) (C) (–1,1) (D) (0,2)

8. The iterative scheme $x_{n+1} = \phi(x_n)$ converges if
   (A) $-1 \le |\phi'(x)| \le 1$ (B) $|\phi'(x)| \le 0|$
   (C) $|\phi'(x)| \le 1$ (D) $|\phi'(x)| \le 1|$

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9. If $f(x)=x+x^2$ satisfy Lagrange Mean Value theorem in $[0,2]$ at c, then
(A) c = 1.5 (B) c = 1 (C) c = 0 (D) c = 2

10. The function $f(x,y)=xy+(\frac{1}{x}+\frac{1}{y})$ is minimum at the point
(A) (1,1) (B) (0,1) (C) (1,2) (D) (0,0)

11. The magnitude of grain boundary energy is function of
(A) total interfacial energy (B) total boundary area
(C) degree of mis-orientation (D) None of these

12. Reducing gas used in reducibility test is
(A) CO_2 (B) CO (C) CO_2+N_2 (D) both (B) and (C)

13. Solution lose reaction is
(A) $\{CO_2\}+<C>g=2\{CO\}$ (B) $<C>g+\{CO\}=2\{CO_2\}$
(C) $2\{CO\}=<C>g+\{CO_2\}$ (D) None of these

14. Boudouard equilibrium reaction is
(A) $\{CO_2\}+<C>g=2\{CO\}$ (B) $2\{CO\}=<C>g+\{CO_2\}$
(C) $2<C>g+\{O_2\}=2\{CO\}$ (D) None of these

15. Nanman reversion reaction is
(A) $2\{CO\}=<C>g+\{CO_2\}$ (B) $<C>g+\{O_2\}=\{CO_2\}$
(C) $<C>g+\{CO\}=2\{CO_2\}$ (D) None of these

16. Oxygen potential of the gas phase
(A) $\frac{CO_2}{CO}$ (B) $\frac{CO}{CO_2}$ (C) $\frac{H}{H_2}$ (D) $\frac{O}{O_2}$

17. At the temperature 670 °C, the oxygen potential, i.e. $\frac{CO}{CO_2}$ is
(A) 0 (B) 2 (C) 1 (D) 3

18. If coke burned by air alone in tuyers region, it generates one unit of
(A) CO_2 (B) H_2 (C) CO (D) O_2

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19. Weld spatter defect in welding is due to
(A) too high welding current (B) too low welding current
(C) low voltage (D) too high voltage

20. In HyL processes, the catalyst used is
(A) W_2 (B) H_2 (C) O_2 (D) CH_4

21. The solid solubility of oxygen in pure iron is
(A) 0.3% (B) 0.03% (C) 0.003% (D) 0.0003%

22. Deoxidiser used in the steel making in the form of
(A) sinter (B) pellet (C) pure form (D) ferro alloys

23. The amount of nitrogen dissolved in iron under equilibrium condition is given by
(A) Grahm's law (B) Charle's law (C) Boyle's law (D) Sievert's law

24. Refining by oreing is
(A) an endothermic process
(B) an exothermic process
(C) an endothermic or exothermic process, depending on the furnace
(D) None of these

25. The oxidising ability of the slag in AOH is due to
(A) SiO_2 (B) O_2 (C) FeO (D) P_2O_6

26. As the impurities are oxidised, the melting point of the iron
(A) increases (B) decreases
(C) remains constant (D) uncertain

27. Gibb's phase rule is given by the expression in which F is equal to
(A) C + P (B) C – P (C) C + P – 2 (D) C – P + 2

28. Chemical potential of a component 1 in a binary solution can be defined as
(A) $\left(\frac{\partial A}{\partial n_1}\right)_{T,V,n_2}$ (B) $\left(\frac{\partial U}{\partial n_1}\right)_{S,V,n_2}$ (C) $\left(\frac{\partial H}{\partial n_1}\right)_{T,S,n_2}$ (D) $\left(\frac{\partial G}{\partial n_1}\right)_{T,P,n_2}$

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29. A number of a solid state phase transformations follow a sigmoidal pattern. In, these cases, at any time the fraction transformed can be expressed as follows
(A) $1-\exp(-a^2t)$ (B) $1+\exp(-a^2t)$ (C) $\exp(a^2t)$ (D) $\exp(a^2t)-1$

30. A peritectic reaction is
(A) $\alpha+\beta\rightarrow\gamma$ (B) $L+\alpha\rightarrow\beta$ (C) $L_1+L_2\rightarrow\beta$ (D) $L+\alpha+\beta\rightarrow\gamma$

31. Product of the first breakdown of the ingot in rolling is
(A) billet (B) bloom (C) slab (D) plate

32. The delivery speed of five stand mill will be
(A) 50 m/s (B) 30 m/s (C) 40 m/s (D) 60 m/s

33. Cold rolling of copper alloys uses
(A) High speed four high tandem mills
(B) Three high tandem mills
(C) High speed five high tandem mills
(D) None of these

34. For ferrous drawing, the drawing speed of multiple die machine is
(A) 5 m/s (B) 10 m/s (C) 20 m/s (D) 30 m/s

35. Cope in foundry practice refers to
(A) middle portion of the moulding box
(B) bottom portion of the moulding box
(C) coating on the mould face
(D) top half of mould box

36. The rate of burning of coke in blast furnace is directly proportional to
(A) the area of fuel exposed to the blast
(B) the temperature and pressure of the blast
(C) the affinity of the particular type of carbon for oxygen
(D) All the above

37. Balls for bearing are made of
(A) cast iron (B) stainless steel
(C) carbon-chrome steel (D) mild steel

38. Reducing agent used in the Rotary Kiln process is
(A) coke (B) Aluminium
(C) metallurgical coal (D) CO_2

39. The machinability of the steel is increased by
(A) silicon and sulphur
(B) sulphur, graphite and aluminium
(C) phosphorous and aluminium
(D) phosphorous, lead and sulphur

40. The refining reaction during steel making takes place at the
(A) gas-metal interface (B) gas-gas interface
(C) gas-slag interface (D) slag-metal interface

41. Coining is the operation of
(A) cold forging (B) hot forging (C) cold extrusion (D) piercing

42. Sulphur in pig iron tends to make it
(A) hard (B) tough (C) malleable (D) ductile

43. The bonding in semiconductor is
(A) ionic (B) co-ordinate (C) covalent (D) metallic

44. Blast furnaces use which of the following as fuel ?
(A) Coke (B) Coal (C) Diesel (D) Liquid oxygen

45. Which of the following steel has almost zero temperature coefficient ?
(A) Platinum steel (B) Invar steel (C) Stainless steel (D) Cobalt steel

46. Which of the following process is different from rest of the processes ?
(A) Shot peening (B) Cold extrusion
(C) Sand blasting (D) Drop forging

47. In screw dislocation, the direction of movement is
(A) parallel to the stress direction (B) perpendicular to the stress direction
(C) at 60° to the stress direction (D) None of these

48. Atomic packing factor for FCC
(A) 0.68 (B) 0.72 (C) 0.74 (D) 0.82

49. Ratio of long unit cell length to short unit cell length (c/a) for HCP is
(A) 1.633 (B) 1.733 (C) 0.633 (D) 0.733

50. Diffusion coefficient increases with
(A) decreasing temperature (B) increasing temperature
(C) diffusion flux (D) None of these

51. Number of slip system of BCC in the slip plane (3 2 1) is
(A) 6 (B) 12 (C) 24 (D) 8

52. The driving force for the recrystallization is
(A) strain energy
(B) dislocation movement
(C) internal energy between the strained and unstrained material
(D) None of the above

53. Recrystallization proceeds more rapidly in
(A) metals (B) alloys
(C) at same rate in both (A) and (B) (D) None of these

54. For alloys, recrystallization temperature is
(A) $0.2\ T_m$ (B) $0.5\ T_m$ (C) $0.7\ T_m$ (D) $0.9\ T_m$

55. Polymer with filler is
(A) fiber reinforced composite
(B) particle reinforced composite
(C) dispersion – strengthened composite
(D) concrete

56. The critical fiber length that is necessary for effective strengthening of the composite materials depend on
(A) fiber diameter
(B) its ultimate strength
(C) the interfacial fiber – matrix bond strength
(D) All of the above

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57. Plastic deformation operation is carried out at temperature
(A) above recrystallization temperature
(B) below recrystallization temperature
(C) 20 °C below recrystallization temperature
(D) None of these

58. For coordination number of four, anion sits at the centre of _____where corners are occupied by cation.
(A) Cube (B) Tetrahedron (C) Triangle (D) Octahedron

59. Presence of sulphur makes steel brittle. Its effect can be reduced by adding
(A) copper (B) silicon (C) magnesium (D) manganese

60. The corrosion rate increases with
(A) increasing temperature (B) decreasing temperature
(C) remains constant (D) uncertain

61. The stacking sequence of HCP is
(A) AAA BBB AAA (B) AB ABAB
(C) ABC ABCABC (D) BA BABABA

62. The strength of grain boundary and grains are equal
(A) at equicohesive temperature (B) above equicohesive temperature
(C) below equicohesive temperature (D) at recrystallization temperature

63. For better fluidity, which of the following is added in the blast furnace?
(A) Phosphorus (B) Carbon (C) Manganese (D) Sulphur

64. Stress corrosion occurs due to
(A) tensile stress
(B) compression stress
(C) shear stress
(D) combined action of tensile stress and corrosive environment

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65. Sievert's law deals with _____.
(A) dissolution of gases in metals (B) dissolution of metals in gases
(C) diffusion of ions in solutions (D) diffusion of atoms in solutions

66. Reinforcing bars used in RCC slabs are made of
(A) medium carbon steels (B) cast iron
(C) alloy steels (D) wrought iron

67. Greater the amount of deformation
(A) lower is the recrystallization temperature
(B) high is the recrystallization temperature
(C) sometimes higher and sometimes lower depends on the material
(D) None of the above

68. For diffuse necking in strength forming, the ultimate strain is equal to
(A) n (B) 2n (C) 3n (D) 4n

69. For a plastic material, the Poisson's ratio is
(A) 0.33 (B) 0.5 (C) 0.42 (D) 0.28

70. The dislocation of low mobility that is produced by a dislocation rk^n is called a
(A) dislocation climb (B) glissile
(C) sessile (D) None of these

71. Pearlite is the combination of
(A) ferrite and cementite (B) ferrite and iron graphite
(C) pearlite and ferrite (D) cementite and gamma iron

72. Recrystallization temperature can be lowered by
(A) grain refinement (B) working at lower temperature
(C) purification of metal (D) All the above

73. Basic solution is one which has pH value
(A) less than 7 (B) equal to 7 (C) greater than 7 (D) None of these

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74. Hardenability of steel
(A) is the depth of penetration obtained by vickers test.
(B) is the ability to withstand shocks.
(C) is the ability of steel resist abrasion, wear and penetration.
(D) is the property which determines the depth of the hardened zone induced by quenching.

75. Which of the following element is added to steel to import high strength and toughness ?
(A) Magnesium (B) Manganese (C) Sulphur (D) Tungsten

76. Which of the following material has more shrinkage allowance ?
(A) Lead (B) Cast iron (C) Aluminium alloy (D) Brass

77. Which one of the following has the highest specific strength of all structural materials ?
(A) Magnesium alloys (B) Titanium alloys
(C) Magnetic steel alloys (D) None of the above

78. White metal contains
(A) alloy of tin, lead and cadmium (B) Silver and Chromium
(C) malleable cast iron and silver (D) 88% copper and 10% tin and rest zinc

79. Addition of lead and bismuth to aluminium results in
(A) Improvement of corrosion resistance
(B) Improving the casting characteristics
(C) Improving machinability
(D) None of these

80. The alloy used for making electrical resistance and heating element is
(A) Invar (B) Elinvar (C) Nichrome (D) Manganese

81. The mechanical properties of steel castings can be improved by which of the following heat treatment processes?
(A) Phase annealing (B) Full annealing
(C) Normalizing (D) Tempering

82. Which of the following elements is alloyed with high carbon tool steels to increase the resistance to shock?
(A) Carbon (B) Tungsten (C) Nickel (D) Vanadium

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83. Hot working operation is carried out
(A) Recrystallization temperature
(B) Near plastic stage temperature
(C) Below recrystallization temperature
(D) Above recrystallization temperature

84. The imperfection in the crystal structure of metal is called
(A) slip (B) impurity (C) dislocation (D) cleavage

85. During LD blow in steel making the impurity that gets removed first is
(A) Carbon (B) Phosphorous (C) Manganese (D) Silicon

86. Weld spatter defect in welding is due to
(A) too high welding current
(B) too low welding current
(C) low voltage
(D) too high voltage

87. For super plasticity forming, strain rate is equal to
(A) $0.1\ s^{-1}$ (B) $0.01\ s^{-1}$ (C) $0.001\ s^{-1}$ (D) $0.0001\ s^{-1}$

88. Dynamic recovery in metal occurs having
(A) Low stacking fault energy (B) High stacking fault energy
(C) There is no effect (D) None of these

89. In Brinell hardness testing the minimum thickness of the specimen should be
(A) Less than 5 times the depth of impression
(B) Less than 10 times the depth of impression
(C) Equal to 10 times the depth of impression
(D) More than 10 times the depth of impression

90. Deformation band is not observed in
(A) BCC (B) FCC (C) HCP (D) SC

91. Tungsten filament used in electric bulb is processed by
(A) Extrusion (B) Wire drawing
(C) Powder metallurgy (D) All the above

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92. The ductility of a material with work hardening

(A) Increases (B) Decreases

(C) Remains unaffected (D) Unpredictable

93. Which compound in steel leads to the Intergranular fracture ?

(A) Oxide (B) Carbide (C) Sulphide (D) Nitrides

94. Transverse cracking occurs due to the presence of

(A) N_2 (B) S (C) P (D) Si

95. The elastic stress-strain behaviour of rubber is

(A) Non-linear (B) No fixed relationship

(C) Plastic (D) Linear

96. Moh's Scale has a range of

(A) 1 to 12 (B) 1 to 15

(C) 1 to 5 (D) 1 to 10

97. In compression, a prism of brittle material will break

(A) by crushing into thousands of pieces

(B) by forming a bulge

(C) by shearing along oblique plane

(D) in direction perpendicular to application of load

98. The fatigue strength of metal is improved by setting up compressive stresses in the surface by a process known as

(A) Lancing (B) Spinning (C) Hemming (D) Shot peening

99. A test used to determine the endurance limit for a metal is known as

(A) Hardness test (B) Creep test (C) Fatigue test (D) Tensile test

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100. A test used to determine the behaviour of materials when subjected to high rates of loading, is known as

(A) Hardness test (B) Impact test (C) Fatigue test (D) Torsion test

101. Fatigue strength of steel can be increased by

(A) increasing tensile surface residual stresses

(B) increasing the grain size

(C) increasing the specimen size

(D) increasing compressive surface residual stresses

102. The tensile load-elongation curve of a metal does not describe

(A) Work hardening (B) Yield stress

(C) Anisotropy index (D) Necking strain

103. Mechanical properties of the metal improve in hot working due to

(A) Recovery of grains (B) Recrystallization

(C) Grain growth (D) Refinement of grain size

104. In general, the draft on castings is of the order of

(A) 1 – 5 mm/m (B) 5 – 10 mm/m

(C) 10 – 15 mm/m (D) 15 – 20 mm/m

105. In slush casting process

(A) molten metal is fed into the cavity in metallic mould by gravity.

(B) metal is poured into die cavity and after a predetermined time the mould is inverted to permit a part of metal still in molten state to flow out of cavity.

(C) cavity is filled with a pre calculated quantity of metal and a core or plunger is inserted to force the metal into cavity.

(D) metal is forced into mould under high pressure.

106. Radiography technique of detecting defects is based on the principle of

(A) Diffraction (B) Reflection (C) Interference (D) Absorption

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107. Slag inclusion in casting is a

(A) surface defect (B) internal defect

(C) crack (D) notch

108. Semi-centrifugal casting

(A) is used to ensure purity and density at extremities of a casting.

(B) is used to cast symmetrical objects.

(C) is used to obtain high density and pure castings.

(D) uses heavy cast iron mould to act as chill.

109. Spruce in casting refers to

(A) horizontal passage (B) runner

(C) riser (D) vertical passage

110. Scales or buckles are the casting defects

(A) which occur due to some sand shearing from the cope.

(B) which take the form of internal voids or surface depression due to excessive gaseous material not able to escape.

(C) which occur due to discontinuity in metal casting resulting from hindered contraction.

(D) caused by two streams of metals that are too cold to fuse property.

111. Down spruce in casting is given a tapered shape for

(A) easy flow of molten metal

(B) easy withdrawal of casting

(C) preventing aspiration of gases through spruce

(D) preventing bulging of spruce during poring

112. Cold working process can be applied on the components having diameter upto

(A) 12 mm (B) 25 mm (C) 49 mm (D) 50 mm

113. Pre-heating and post-heating is essential in welding

(A) low carbon steel (B) medium carbon steel

(C) high carbon steel (D) nickel

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114. Hot press forging

(A) causes a steadily applied pressure instead of impact force.

(B) is used to force the end of a heated bar into a desired shape.

(C) is a forging operation in which two halves of a rotating die open and close rapidly while impacting the end of the heated tube or shell.

(D) is a forging method for reducing the diameter of a bar and in the process making it longer.

115. In a solid extrusion die, purpose of knock out pin is

(A) shopping the part to extrude through the hose.

(B) ejecting the part after extrusion.

(C) allowing the job to have better surface finish.

(D) reducing the waste of material.

116. In drawing operation the metal flows due to

(A) ductility (B) work hardening

(C) plasticity (D) shearing

117. In arc welding, too low welding speed results in

(A) wastage of electrode

(B) excessive pilling up of weld metal

(C) overhauling without penetration edges

(D) All of the above

118. In welding magnesium with TIG arc welding

(A) direct current with reverse polarity (DCRP) is used.

(B) direct current with straight polarity (DCSP) is used.

(C) A.C. is used.

(D) All of the above are used.

119. Porosity of welded joint is due to

(A) high welding speed (B) low welding speed

(C) wrong size of electrode (D) poor base metal

120. The width of heat affected zone is more in

(A) plasma arc welding (B) electron beam welding

(C) electro – slag welding (D) electric resistance welding

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METALLURGY (MT)
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Question No	Answer	Question No	Answer
1	C	61	B
2	A	62	A
3	A	63	C
4	B	64	D
5	B	65	C
6	A	66	A
7	C	67	A
8	D	68	A
9	B	69	B
10	A	70	C
11	C	71	A
12	D	72	D
13	C	73	A
14	C	74	D
15	A	75	B
16	B	76	A
17	C	77	B
18	C	78	C
19	A	79	C
20	A	80	C
21	C	81	A
22	D	82	D
23	D	83	D
24	A	84	C
25	C	85	D
26	A	86	A
27	D	87	B
28	D	88	B
29	B	89	D
30	B	90	C
31	B	91	D
32	B	92	B
33	A	93	D
34	B	94	B
35	D	95	A
36	D	96	D
37	C	97	C
38	C	98	D
39	D	99	C
40	D	100	B

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41	A	101	D
42	A	102	C
43	C	103	D
44	A	104	B
45	B	105	B
46	D	106	D
47	B	107	A
48	C	108	A
49	A	109	D
50	B	110	A
51	C	111	C
52	C	112	B
53	A	113	C
54	C	114	A
55	B	115	B
56	D	116	C
57	A	117	D
58	B	118	A
59	D	119	D
60	A	120	C

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