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ENTRANCE EXAMINATIONS – 2023

(Ph.D. Admissions - January 2024 Session)

Ph.D. (Materials Engineering)

Marks: 70
Time: 2 h   Hall Ticket No:

I. Write your Hall Ticket Number on the OMR Answer Sheet given to you. Also write the Hall Ticket Number in the Space provided above.
II. Read the following instructions carefully before answering the questions.
III. This Question paper has TWO parts: PART 'A' and PART 'B'

1. Part 'A': It consists of 20 objective type questions of **1.75** marks each.
2. Part 'B': It consists of 35 objective questions of **1** mark each.
3. All questions are to be answered. Answers for these questions are to be entered on the OMR sheet, filling the appropriate circle against each question. For example, if the answer to a question is D, it should be marked as below:

(A)   (B)   (C)   ●

No additional sheets will be provided. Rough work can be done in the question paper itself.

4. Hand over the OMR answer sheet at the end of the examination to the invigilator.

5. Only non-programmable (only scientific) calculators are permitted inside the Examination Hall.

6. This book contains 11 pages including this cover sheet.

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PART A

1. A bag contains 6 white balls and 4 black balls. 2 balls are thrown at random. Find the probability that they are of the same colour?
    A. $\frac{7}{15}$
    B. $\frac{8}{21}$
    C. $\frac{9}{13}$
    D. $\frac{14}{29}$

2. There are 2 temples one on each bank of a river, just opposite to each other. 1 temple is 54m high. From the top of this temple the angles of depression of the top and foot of the other temple are 30° and 60°, respectively. Find the height of the other temple.
    A. 30 m
    B. 32 m
    C. 36 m
    D. 28 m

Based on the following table concerning the speeds of different types of transport, answer the following questions (3 and 4):

Transport type	Speed, km/hour
Running	8
Bicycle riding	16
Scooter riding	32
Car driving	50

3. Both running and bicycle riding reach a destination at the same time. If bicycle riding took 1 hour to do so, how much time earlier should the running had started?
    A. 2 hours
    B. 30 minutes
    C. 1 hour 15 minutes
    D. 1 hour

4. If all the vehicles start together from a same point, how much ahead will be the car compared to the scooter after 2 hours?
    A. 36
    B. 38
    C. 42
    D. 51

5. The diameter of the earth is
    A. 1300000 km
    B. 13 light years
    C. 13000 km
    D. 1300 km

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6. Find the odd one out; 4, 5, 7, 10, 14, 18, 25, 32
   A. 7
   B. 14
   C. 18
   D. 33

7. 0.01 m thick heat-conducting wall with two opposite heat-conducting planar surfaces, each having an area of 1 m² are at 600 K and 500 K. If the thermal conductivity of the material of the conducting wall is 11 W/mK, what is the amount of heat transfer from the high to the low-temperature side between the surfaces?
   A. 1100 W
   B. 11 kW
   C. 1100 kW
   D. 110 kW

8. Sintering is a process of
   A. conversion of powder material into solid
   B. melting of powder mass
   C. melting of solid material
   D. powder size reduction

9. Apparent density of powder is defined as the
   A. ratio between the mass of loose powder and its volume
   B. ratio between the mass of loose powder and its total surface area
   C. ratio between the mass of loose powder and its volume after sufficient tapping
   D. ratio between the mass of loose powder and its density

10. Alcoa process is used for production of which one of the following?
    A. Copper
    B. Iron
    C. Aluminium
    D. Nickel

11. The ionic bond refers to which of the following?
    A. Mutual sharing of electrons
    B. Transfer of electrons between two species
    C. Sharing of protons
    D. Temporary polarization

12. Hydrogen bonds are stronger than
    A. ionic bond
    B. covalent bond
    C. metallic bond
    D. Vander Waals forces

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13. The packing fraction in fcc crystals is
    A. 0.68
    B. 0.74
    C. 0.52
    D. 0.34

14. Effective number of atoms in a bcc unit cell is
    A. one
    B. two
    C. three
    D. four

15. Tauc relationship is an empirical formula that allows the energy of the band gap to be estimated, for which the correct formula is (α, γ – constants, h- Plank's constant, E_g – Band gap of the material, n-integer)
    A. $(\alpha h\gamma)^n = $ cont. $(h\gamma - E_g)$
    B. $(\alpha h\gamma)^n = $ cont. (E_g)
    C. $(\alpha h\gamma)^n = $ cont. $(h\gamma)$
    D. $(\alpha h\gamma)^n = $ cont. $(h\gamma\, E_g)$

16. The value of h/e^2 is (where h- Plank's constant, e- Charge of an electron)
    A. 25 KΩ
    B. 26 KΩ
    C. 27 KΩ
    D. 28 KΩ

17. Which of the following particles is massless?
    A. Electron
    B. Photon
    C. Proton
    D. Neutron

18. If $A = \begin{pmatrix} 3 & -2 \\ 4 & -2 \end{pmatrix}$. I is identity matrix. If $A^2 = kA - 2I$, what is k?
    A. 0
    B. 1
    C. 2
    D. 3

19. Energy in nuclear power plants is commercially produced by
    A. Atomic fission
    B. Atomic fusion
    C. Chemical reaction
    D. Solid state diffusion

20. The solution of the differential equation $\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + y = 0$ with $y(0) = y'(0) = 1$

is

A. $(2-t)e^t$
B. $(1+2t)e^{-t}$
C. $(2+t)e^t$
D. $(1-t)e^t$

Part B

21. The dislocations are
    A. point defects
    B. line defects
    C. volume defects
    D. not defects

22. In XPS, x-ray can emit electrons from atomic energy level with kinetic energy equal to (γ_{ph} and E_{ion} are the photon energy and ionization energy)
    A. $h\gamma_{ph} - E_{ion}$
    B. $E_{ion} - h\gamma_{ph}$
    C. $E_{ion} + h\gamma_{ph}$
    D. $h\gamma_{ph}$

23. A metal powder with an apparent density of 2.5 g/cc is compacted in a cylindrical die to a density level of 5.0 g/cc. If the height of the compact is 12mm, then the fill height of the powder in (mm) would have been
    A. 24
    B. 18
    C. 36
    D. 30

24. Which of the following is a desired property of an aerospace material?
    A. High density
    B. High thermal expansion
    C. High specific strength
    D. Low specific strength

25. According to Hall-Petch equation, the yield stress of a polycrystalline metal
    A. increases as the reciprocal of the square of the grain diameter
    B. decreases as the reciprocal of the square root of the grain diameter
    C. decreases as the reciprocal of the square of the grain diameter
    D. increases as the reciprocal of the square root of the grain diameter

26. When heat is given to a gas contained in a cylinder with a piston on top, it expands. But the temperature of the gas does not change. Which of the following is not true?
    A. Gas does mechanical work
    B. Heat is converted to mechanical energy
    C. Heat increases the internal energy of the gas
    D. Internal energy of the gas remains constant

27. The surface roughness on an engineering drawing is represented by
    A. circles
    B. squares
    C. zig-zag lines
    D. inverted triangles

28. What is the change in entropy of the system when the ice melts under room conditions?
    A. the entropy change is positive because the process is giving heat to the surroundings
    B. the entropy change is negative because the process is taking heat from the surroundings
    C. the entropy change is positive because the process is taking heat from the surroundings
    D. the entropy change is negative because the process is giving heat to the surroundings

29. A beam is loaded as cantilever. If the load at the end is increased, the failure will occur
    A. in the middle
    B. at the tip below the load
    C. at the support
    D. $3/4^{th}$ of the length of the cantilever

30. The quantity of heat transfer through radiation is dependent on
    A. area of the body only
    B. shape of the body only
    C. temperature of the body only
    D. all of the above (A, B & C)

31. Which of the following abrasive will be selected for grinding tool steel and high-speed steel?
    A. Diamond
    B. Alumina
    C. Silicon carbide
    D. Boron carbide

32. Fatigue fracture surface shows
    A. dimples
    B. striation marks
    C. Herringbone pattern
    D. shear lip

33. In a tensile test of a ductile material, necking starts at
    A. lower yield stress
    B. upper yield stress
    C. ultimate tensile strength
    D. at fracture

34. Which of the following is NOT correct?
    A. Dislocations are thermodynamically unstable defects.
    B. Dislocations can move inside a crystal under the action of an applied stress.
    C. Screw dislocations can change the slip plane without climb
    D. Burger's vector of an edge dislocation is parallel to the dislocation line

35. Which of the following alloying elements increases the pitting corrosion resistance of stainless steel?
    A. Cr
    B. N
    C. C
    D. Mo

36. Which of the technique can be used to identify chemical groups in a sample?
    A. XRD
    B. FTIR
    C. FESEM
    D. EDS

37. When the light is transmitted from the air into solid, (Index of refraction - n_s) then reflectivity (R) is
    A. $R = \left(\frac{n_s-1}{n_s+1}\right)$
    B. $R = \left(\frac{n_s+1}{n_s-1}\right)^2$
    C. $R = \left(\frac{1}{n_s+1}\right)^2$
    D. $R = \left(\frac{n_s-1}{n_s+1}\right)^2$

38. Crack initiation is essentially a surface phenomenon in
    A. work hardening
    B. phase transformation
    C. yielding
    D. fatigue

39. Classification of metal forming processes into hot and cold working is based on which one of the following parameters?
    A. Stacking fault energy
    B. Recrystallization temperature
    C. Solidus temperature
    D. Phase transformation temperature

40. Which of the following dimensionless number is used to compare the speed of any flying object with the speed of sound?
    A. Reynold number
    B. Mach number
    C. Nusselt number
    D. Prandtl number

41. Which one of the following joining methods is a solid state method?
    A. MIG welding
    B. TIG welding
    C. Electroslag welding
    D. Friction stir welding

42. Dynamic strain ageing is
    A. plastic instability
    B. elastic instability
    C. necking
    D. fracture

43. For better Fatigue resistance, a polycrystalline material should have
    A. large grain size
    B. surface compressive residual stresses
    C. high melting point
    D. low density

44. Homologous temperature of a given material is the
    A. ratio of working temperature to melting temperature
    B. ratio of melting temperature to working temperature
    C. ratio of working temperature to boiling temperature
    D. ratio of boiling temperature to working temperature

45. Most unsymmetrical Bravais lattice system is
    A. Cubic
    B. Hexagonal
    C. Rhombohedral
    D. Triclinic

46. To design a better creep-resistant material, which of the following combinations is required?
    A. Fine grain size and grain boundary carbides
    B. Large grain size and grain boundary carbides
    C. Amorphous matrix and nanocrystalline pockets
    D. Nanocrystalline matrix and nano dispersions

47. During plastic deformation, the diffusion of solute atoms to the dislocation core is called as
    A. Cottrell atmosphere
    B. Bauschinger effect
    C. Coble creep
    D. Suzuki interaction

48. Identify the equilibrium lattice defects from the following.
    A. Dislocations
    B. Stacking faults
    C. Grain boundaries
    D. Vacancies

49. In an electron microscope the probe current and probe diameter controlled by the
    A. Condenser-lens
    B. Objective lens
    C. Aperture
    D. Filament

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50. The work function of a metallic surface can be measured by
    A. scanning Kelvin probe microscopy
    B. back-scattered electron imaging
    C. electron back-scattered diffraction
    D. energy dispersive X-ray spectroscopy

51. Which of the following is the false representation of point functions?
    A. enthalpy, entropy
    B. work, density
    C. density, enthalpy
    D. entropy, density

52. The most significant difference between Wavelength Dispersive Spectroscopy (WDS) and Energy Dispersive Spectroscopy (EDS) is their energy resolution therefore
    A. amount of overlap between peaks of similar energies is much smaller in WDS
    B. amount of overlap between peaks of similar energies is much smaller in EDS
    C. amount of overlap between peaks of similar energies is much higher in WDS
    D. amount of overlap between peaks of similar energies is same in EDS and WDS

53. Which of the following substance is magnetic?
    A. Aluminium
    B. Magnesium
    C. Manganese
    D. Nickel

54. In ferrimagnetism
    A. the number of atoms with opposite spins are zero
    B. the number of atoms with opposite spins are equal
    C. the magnetic moment is zero
    D. the number of atoms with opposite spins are unequal

55. Energy discharge time is the shortest in which of the following energy storage devices?
    A. Electrochemical capacitor
    B. Electrostatic capacitor
    C. Battery
    D. Solid oxide fuel cell

University of Hyderabad
Entrance Examinations – 2023
(Ph.D. Admissions - January 2024 Session)

Key for Ph.D. Materials Engineering

Key for ME Winter 2024 (C-42)

Q No	Ans	Q No	Ans	Q No	Ans
1	A	21	B	41	D
2	C	22	A	42	A
3	D	23	A	43	B
4	A	24	C	44	A
5	C	25	D	45	D
6	C	26	C	46	B
7	D	27	C	47	A
8	A	28	C	48	D
9	A	29	C	49	A
10	C	30	D	50	A
11	B	31	B	51	B
12	D	32	B	52	A
13	B	33	C	53	D
14	B	34	D	54	D
15	A	35	D	55	B
16	B	36	B		
17	B	37	D		
18	B	38	D		
19	A	39	B		
20	B	40	B		