D-4

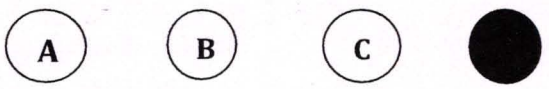
Entrance Examinations 2024

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:



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 13 pages including this cover sheet.

D-4

THIS PAGE IS INTENTIONALLY LEFT BLANK

D-4

PART A

1. An university is hiring to fill four Ph.D vacancies. There are five men and three women candidates. If every candidate is equally likely to be chosen, then the probability that at least one woman will be selected is (round off to 2 decimal places).
   A. 0.93
   B. 0.78
   C. 0.55
   D. 0.67

2. Scientific data analysis of a set of correct experiments involves
   A. qualitative analysis of the data alone
   B. detecting and possibly quantifying the relationship between the various experimental variables
   C. detecting outliers only
   D. detecting outliers for qualitative assessment of the data but not quantitative analysis

3. $\int[cos^{-\frac{3}{7}}(x) \times sin^{-\frac{11}{7}}(x)]\ dx =$
   A. $\log\left|sinx^{4/7}\{x\}\right|$ + constant
   B. $\log\left|cos^{\frac{3}{7}}(x)\right|$ + constant
   C. $\frac{4}{7}tan^{\frac{4}{7}}(x)$ + constant
   D. $-\frac{7}{4}tan^{-4/7}(x)$ + constant

4. How many two-digit numbers are divisible by 3?
   A. 33
   B. 32
   C. 30
   D. 50

5. The next number in the series 3, 7, 13 is
   A. 19
   B. 21
   C. 20
   D. 27

6. Find the 3-digit code to unlock the number lock with the clues provided below

? ? ?

- one number is correct and in right place — 4 6 0
- one number is correct but in wrong place — 4 9 2
- two numbers are correct but in wrong place — 0 8 4
- nothing is correct — 5 1 6
- one number is correct but in wrong place — 5 6 8

A. 4 2 0
B. 8 2 0
C. 4 2 8
D. 8 0 2

7. The minimum number of matches required to decide the winner of a singles knockout (loser is eliminated) tournament with a 30 player pool, assuming there are no-ties is
   A. 60
   B. 72
   C. 30
   D. 29

8. The velocity of sound in a medium depends upon
   A. intensity of sound waves only
   B. wavelength of sound waves only
   C. density and elastic modulus only
   D. amplitude and frequency of sound waves only

9. If a bimetallic strip is heated, it will
   A. bend towards the metal with lower thermal expansion coefficient
   B. twist itself into a helix
   C. bend towards the metal with higher thermal expansion coefficient
   D. expand uniformly and not bend

10. At what temperature do the Celsius and Kelvin scales have identical numerical value?
    A. 0 K
    B. 0° C
    C. 273 K
    D. not possible to compute

11. The impulse of a force is equal to
    A. rate of change of momentum
    B. change in acceleration
    C. change in velocity
    D. change in momentum

12. Multiplication of real valued square matrices of same dimension is
    A. commutative
    B. not always possible to compute
    C. always positive definite
    D. associative

13. The relationship between kinetic energy contained in each molecule of an ideal gas and absolute temperature includes
    A. Planck's constant
    B. Avogadro number
    C. Boltzmann constant
    D. universal gas constant

14. The rate of steady state conductive heat transfer does not depend on
    A. thermal conductivity
    B. surface area
    C. temperature gradient
    D. thermal expansion coefficient

15. The work done during a thermodynamic process can be calculated from the area under the
    A. P-T diagram
    B. T-S diagram
    C. H-S diagram
    D. P-V diagram

16. The number of degrees of freedom of a one component system with 3 phases is
    A. 1
    B. 2
    C. 4
    D. 0

17. An example of extensive variable is
    A. pressure
    B. volume
    C. temperature
    D. both pressure and volume

18. Which of the following occurs in a conventional coal-based powerplant?
    A. chemical energy of coal is converted to kinetic energy of steam
    B. kinetic energy of coal moving through conveyors, is converted to kinetic energy of steam
    C. potential energy of coal from mines underground is converted to kinetic energy of steam
    D. potential energy of steam is converted to mechanical energy of turbines

19. In a normal hydrogen electrode, the activity coefficient of H^+ ions is
    A. log(1)
    B. log(e)
    C. log(0)
    D. log(10)

20. Which one of the following statements is true?
    A. entropy at 0 K is 0 but enthalpy is finite
    B. enthalpy at 0 K is 0 but entropy is finite
    C. both enthalpy and entropy at 0 K is 0
    D. both enthalpy and entropy at 0 K are finite but very small

PART A

21. For the emission of characteristic X-rays from the K-shell of a element, the incident energy should be
    A. less than the corresponding ionization potential
    B. greater than the corresponding ionization potential
    C. greater than the bond energy
    D. less than the bond energy

22. A monochromatic light is incident at an angle of 60° to the surface normal of a material in air. The refracted light beam travels through the material at an angle of 30° with respect to the normal to the surface. What is the refractive index of the material?
    A. $1/2$
    B. 2
    C. $\sqrt{3}$
    D. $1/\sqrt{3}$

23. The losses in a dielectric material subjected to an alternating electric field are determined by
    A. real part of the complex dielectric constant
    B. imaginary part of the complex dielectric constant
    C. both real and imaginary parts of the complex dielectric constant
    D. none of the above

24. Which one of the following statements is correct?
    A. kinetic energy of a system cannot be changed without changing the momentum.
    B. kinetic energy of a system can be changed without changing the momentum.
    C. momentum of a system cannot be changed without changing the kinetic energy.
    D. a system cannot have energy without having momentum.

25. In the periodic table of elements, which column's first four elements can share all their four hybridized orbitals with four suitable neighbors?
    A. fifth column
    B. fourth column
    C. sixth column
    D. seventh column

26. In diamond, the coordination number of the carbon is
    A. four and its unit cell has eight carbon atoms
    B. four and its unit cell has six carbon atoms
    C. six and its unit cell has eight carbon atoms
    D. four and its unit cell has four carbon atoms

27. The property that relates the magnetic flux density to the magnetic field strength is
    A. permittivity
    B. inductance
    C. capacitance
    D. permeability

28. Which one of the following statements is true for cooling rates during quenching from a fixed temperature in different media?
    A. air cooling is more rapid than oil cooling
    B. oil cooling is more rapid than water cooling
    C. water cooling is more rapid than oil cooling
    D. oil cooling is more rapid than air and water cooling

29. Which one of the following statements is not true regarding diffusion in a single phase polycrystalline material?
    A. vacancy diffusion is faster than interstitial diffusion
    B. grain boundary diffusion is faster than vacancy diffusion
    C. interstitial diffusion is faster than grain boundary diffusion
    D. grain boundary diffusion is faster than vacancy diffusion and interstitial diffusion

30. Single crystals are usually
    A. homogeneous and isotropic
    B. devoid of defects
    C. homogeneous but not isotropic
    D. isotropic but not homogeneous

31. What is the significance of reciprocal lattice in crystallography, and how does it relate to diffraction analysis?

    A. reciprocal lattice is a mathematical construct with no physical significance and is not related to the analysis of the diffraction pattern analysis

    B. the reciprocal lattice simplifies the analysis of diffraction patterns by a transformation, making it easier to apply Bragg's law and identify crystal structure

    C. the reciprocal lattice is used to model electron density distributions; it does not relate to diffraction analysis

    D. the reciprocal lattice represents the real space arrangement of atoms; it directly maps onto the observed diffraction peaks.

32. In transmission electron microscopy (TEM), how do the contrast mechanisms (such as diffraction and phase contrast) help in analyzing the microstructure of materials and what specific structural details can each mechanism reveal?

    A. diffraction contrast reveals the chemical composition; phase contrast reveals the crystallographic defects such as dislocations
    B. diffraction contrast reveals the crystallographic defects such as dislocations; phase contrast reveals the atomic scale structures and lattice fringes
    C. diffraction contrast reveals the spacing of atomic planes; phase contrast reveals the stoichiometry
    D. diffraction contrast reveals the thermal properties; phase contrast reveals the mechanical strength

33. How does the process of directional solidification enhance the performance of turbine blades and what are the critical microstructural characteristics achieved through this process?

    A. directional solidification increases the grain size enhancing thermal conductivity
    B. directional solidification promotes a columnar grain structure, improving creep resistance and high temperature strength
    C. directional solidification produces an amorphous structure, reducing brittleness
    D. directional solidification introduces random grain orientation, increasing toughness.

34. How does EBSD in SEM contribute to the analysis of crystalline materials, and what type of information can be obtained from EBSD patterns
    A. EBSD measures electron density and it provides information about state of charge
    B. EBSD detects back scattered electrons to form diffraction patterns and it provides information about the crystallographic orientation
    C. EBSD detects back scattered electrons to form diffraction patterns and it provides information about the elemental composition
    D. EBSD detects secondary electrons to form diffraction patterns and it provides information about the crystallographic orientation.

35. The family of planes representing the faces of a body centered cubic crystal is
    A. {110}
    B. {111}
    C. {121}
    D. {100}

36. Which of the following is not a point defect?
    A. void
    B. vacancy
    C. interstitial
    D. frenkel defect

37. Which one of the following is a directional bond?
    A. metallic
    B. covalent
    C. ionic
    D. None of the above

38. For materials used in electrical transformers, which of the following characteristics are desirable?
    A. area under the hysteresis loop should be relatively large.
    B. area under the hysteresis loop should be relatively small.
    C. retentivity and coercivity should be large.
    D. both A & C.

39. Which of the following is true about Gibbs energy change?
    A. it is the driving force for a chemical reaction
    B. it is the activation energy required for a chemical reaction
    C. it is governed by reaction rate
    D. it is a measure of nucleation barrier

40. Which one of the following is the preferred material for hip implants?
    A. copper alloys
    B. high-purity nickel alloys
    C. titanium alloys
    D. aluminum alloys

41. For a pure hydrostatic compressive state of stress of magnitude p, the maximum shear stress is
    A. 0
    B. p/3
    C. p
    D. 3p

42. Plastic deformation by slip preferentially occurs
    A. on close packed planes perpendicular to close packed direction
    B. perpendicular to close packed planes along close packed direction
    C. on close packed planes along close packed directions
    D. perpendicular to close packed planes and perpendicular to close packed direction

43. The process by which a pure screw dislocation can move from one slip plane to another is
    A. cross-slip
    B. nucleation
    C. glide
    D. climb

44. A rod of 5 mm diameter and 10 mm length is subjected to uniaxial tensile loading up to a maximum true strain of 5%. Assuming yielding occurs at a strain of 1%, what is the % change in volume of the rod between yielding and the maximum true strain?
    A. 0%
    B. 4%
    C. 5%
    D. 16%

45. For mode 1 fracture under a linear elastic fracture mechanics approach, the crack plane is at
    A. 0^{o} to the direction of tensile loading
    B. 45^{o} to the direction of tensile loading
    C. 60^{o} to the direction of tensile loading
    D. 90^{o} to the direction of tensile loading

46. To enhance the high temperature mechanical properties, it is desirable to have
    A. polycrystalline materials with extremely fine grain size
    B. single crystal materials
    C. fine grained materials with controlled porosity
    D. None of the above.

47. A material consists of two species – A and B. The diffusion coefficient of A in B at 500 °C and 600 °C is 4.8×10^{-14} m^2/s and 5.3×10^{-13} m^2/s, respectively. If the material is held at 600 °C for 10 hours, how long should it be held at 500 °C to achieve similar levels of diffusion of species A at a given point in the material?
    A. 12 h
    B. 10 h
    C. 110 h
    D. 14 h

48. The optimum combination of strength and ductility can be obtained in a steel by
    A. quenching to a fully martensitic structure
    B. quenching to a partially martensitic structure followed by cold rolling
    C. quenching to a fully martensitic structure followed by tempering
    D. D quenching to a fully martensitic structure followed by cold working

49. The material generally used to make patterns by investment casting is
    A. high quality teak wood
    B. wax
    C. die steel
    D. cast iron

50. Which one of the following statements is not true for arc welding?
    A. both alternating current and direct current can be used
    B. high current is required
    C. the workpiece can have positive or negative polarity
    D. flux is always required

51. Which one of the following statements is generally true?
    A. cast microstructures are finer than forged ones
    B. cast products have higher fatigue life compared to forged ones
    C. cast products have fewer defects compared to forged ones
    D. cast products are less ductile compared to forged ones

52. Which of the following materials is not suitable for processing via forging?
    A. cast iron
    B. aluminium alloys
    C. titanium alloys
    D. nickel alloys

53. Cemented carbides are usually manufactured by
    A. melting and casting
    B. friction stir welding
    C. isothermal forging
    D. powder metallurgy processing

54. Which one of the following statements is not true regarding rolling
    A. hot rolling results in better surface finish than cold rolling
    B. cold rolling results in greater strength increase compared to hot rolling for a given rolling reduction
    C. hot rolled products are less expensive than cold rolled ones
    D. internal stresses are higher in cold rolling compared to hot rolling

55. Which one of the following statements is true for Scanning Electron Microscopy?
    A. as working distance increases, resolution increases
    B. as working distance decreases, resolution increases
    C. as working distance decreases, depth of field increases
    D. as working distance changes, depth of field remains unaltered

University of Hyderabad

Entrance Examinations - 2024

Ph.D. Admissions – January 2025 session

Revised Final key (after challenges)

Course : Ph.D. **Subject : Materials Engineering (D4)**

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

Note/Remarks : Q.25- Option - B is correct

Signature
School/Department/Centre

JP Gautam