A-94

ENTRANCE EXAMINATIONS, JUNE 2012
QUESTION PAPER

Integrated M.Tech./Ph.D. and Ph.D. (Materials Engineering)

Marks: 75
Time: 2.00 hrs

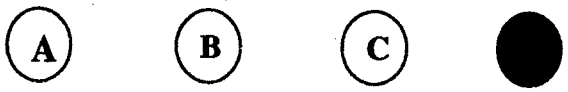
Hall Ticket no: [ ]

I. Write your Booklet Code and 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 25 objective type questions of one mark each.
There is a negative marking of 0.33 marks for every wrong answer.
The marks obtained by a candidate in this part will be used for resolving tie cases.

2. **Part 'B':** It consists of 50 objective questions of one mark each.
There is no negative marking in this part.

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 and rough work sheets provided at the end of the booklet.

4. Hand over both the question paper booklet and the OMR answer sheet at the end of the examination.

5. Calculators are permitted. Log tables are not allowed. **Mobile phones are not permitted inside the Examination Hall.**

6. This book contains 18 pages including this cover sheet.

PART 'A'

1. The Heisenberg uncertainty principle says that the product $\Delta x \Delta p_x$ is

   A. 0
   B. $\geq h/4\pi$
   C. $\leq h/4\pi$
   D. $= h$ where h is the Planck's constant

2. Malleable Cast Iron is produced

   A. From White Cast Iron by heat treatment
   B. By inoculation of cast iron melt
   C. By hot working Grey Cast Iron
   D. By cold working of nodular cast iron

3. Progressive accumulation of deformation at elevated temperatures under constant load is called as

   A. Fatigue
   B. Deformation Ratchting
   C. Creep
   D. Malleability

4. Hexagonal Closed Packed materials will have the following stacking sequence:

   A. ABABABABAB.....
   B. ABCABCABCABC.....,
   C. ABCABCACBCAB.....
   D. ABABBAABAABBA.....

5. Alumina cutting tools are produced by

   A. Pelletising
   B. Investment casting
   C. Roasting
   D. Powder Metallurgy

6. The phenomenon of a metal existing more than in one crystalline form is known as

A. Amorphous
B. Allotropy
C. Isomorphism
D. Condensation

7. The unit of stress is

A. Pascal
B. Newton
C. Dynes
D. Joule

8. Atomic density in a plane in a crystal is

A. Directly proportional to inter-planar spacing
B. Inversely proportional to inter-planar spacing
C. No relationship with inter-planar spacing
D. None of these

9. For spontaneous irreversible process at constant temperature and pressure

A. $\Delta G > 0$
B. $\Delta G < 0$
C. $\Delta G = 0$
D. None of these

10. The material that exhibits both Neel and Curie transition is

A. Ferromagnetic
B. Paramagnetic
C. Diamagnetic
D. Anti Ferromagnetic

11. Recovery of a cold worked metal can be defined as

A. Nucleation and growth of strain-free grains out of the matrix
B. Abnormal grain growth in the matrix
C. A process of annihilation and rearrangement of dislocations within the deformed metal without the movement or migration of high angle grain boundaries
D. None of the above

12. High stiffness materials exhibit

A. High value of yield strength
B. Low value of yield strength
C. Low toughness
D. Low hardness

13. Single crystal can be produced by

A. Annealing of a polycrystalline material for a long period of time at high temperature close to melting point
B. Annealing of heavily cold worked material for a short period of time
C. By recovery process in cold worked polycrystalline material
D. By forging process

14. If the absorption coefficient of a solid is 10 cm^{-1} at a wavelength of 600 nm then a light beam incident at this wavelength on the solid will get almost

A. Completely absorbed
B. Completely transmitted
C. Completely reflected
D. Total internally reflected

15. In a p-n junction if the p region is highly doped then the width of the depletion region is proportional to

A. Donor density
B. 1/(Donor density)
C. $(\text{Donor density})^2$
D. $1/(\text{Donor density})^{1/2}$

16. The effective number of electrons in a filled energy band is

A. One
B. Zero
C. Infinite
D. 0.5

17. The generalized form of eutectic reaction

A. Liquid L + Solid $\beta \rightarrow$ Solid α
B. Liquid L $\rightarrow$ Solid α + Solid β
C. Liquid $L_1 \rightarrow$ Solid α + Liquid L_2
D. Solid $\gamma \rightarrow$ Solid α + Solid β

18. If the intercepts on the plane of lattice are 4, 1 and 2 respectively, then the Miller indices of the plane are

A. (124)
B. (214)
C. (412)
D. (142)

19. If $[x]$ stands for largest integer not exceeding x, then the integral $\int_{-1}^{+2}[x]dx$ equals

A. 3
B. 0
C. 1
D. 2

20. The limit of the sequence $\sqrt{2};\sqrt{2\sqrt{2}};\sqrt{2\sqrt{2\sqrt{2}}};\sqrt{2\sqrt{2\sqrt{2\sqrt{2}}}};\ldots\ldots$ is

A. 1
B. 2
C. $2\sqrt{2}$
D. ∞

21. Let f be a function of a real variable such that $f(\alpha+\beta) = f(\alpha) + f(\beta)$ for all α and β. Let m and n be integers. Then $f(m/n)$ equals

A. m/n
B. $f(1)\,x\,(m/n)$
C. $f(m)/f(n)$
D. $f(m) + f(1/n)$

22. The following steels are characterized by relatively high degree of uniformity in composition and properties

A. Killed steels
B. Rimmed steels
C. Capped steels
D. Semi-killed steels

23. Solar cells are basically

A. Photoconductive
B. Photoemissive
C. Photovoltaic
D. Photoresistive

24. A process used to produce short length of hollow shapes such a collapsible tooth paste tubes

A. Impact extrusion
B. Skinpass rolling
C. Pillgering
D. Rotary swaging

25. The metal forming process with which the term FLASH is associated with

A. Extrusion
B. Rolling
C. Forging
D. Deep drawing

PART 'B'

26. In the case of low carbon mild steel, the sharp yield point phenomenon is due to

A. The iron matrix
B. The presence of interstitial carbon or nitrogen atoms
C. The presence of nickel and chromium
D. The presence of manganese and silicon

27. Two metals are said to form substitutional solid solution if

A. Both of them have widely divergent electrochemical properties
B. The size of solute and solvent atoms differ by >15%
C. The size of solute and solvent atoms differ by < 15%
D. They possess a fixed ratio of electrons to atoms at a definite composition

28. The prime function of a cutting fluid is

A. To quench the tool during cutting to make it hard by phase transformation
B. To decrease friction, wear and heat generation in the cutting region
C. To corrode the newly machined surface
D. To impart color to the surface of the part being machined

29. The maximum improvement in creep resistance of high temperature metallic materials can be obtained by having

A. Single crystal
B. Polycrystalline material with high density of transverse grain boundaries
C. Duplex structure comprising of equal number of longitudinal and transverse grain boundaries
D. Cast structure with large number of dendrites

30. Martensite transformation is an example of

A. Reconstructive transformation
B. Diffusion phase transformation
C. Displacive transformation
D. Massive phase transformation

31. The unit for plane-strain fracture toughness

A. MN/m
B. MN/m^2
C. $MN/m^{1/2}$
D. $MN/m^{3/2}$

32. Failure in tension test of highly ductile metals and alloys at room temperature is identified by the presence of

A. Cavities on grain boundaries
B. Dimples on fracture surface
C. Cleavage facets
D. Striations

33. Elastic modulus of materials is determined using

A. Charpy impact test
B. Creep test
C. Ultrasonic wave propagation test
D. Hardness test

34. Which one of the following is an Austenite stabilizer in Stainless Steels?

A. Nickel
B. Chromium
C. Molybdenum
D. Tungsten

35. In fracture toughness characterized by K_{IC} or J_{IC}, I in the subscript indicates loading by

A. Forward shear mode
B. Parallel shear mode
C. Perpendicular shear mode
D. Crack opening mode

36. The important factor that contributes to a brittle-cleavage type of fracture

A. High temperature
B. Triaxial state of stress
C. High ductility
D. Slow rate of loading

37. The inflection point of a nonlinear function $U(r)$ is at

A. $\log U = 0$
B. $\frac{dU}{dr} = 0$
C. $\frac{d^2U}{dr^2} = 0$
D. $U = 0$

38. The material in which there is conduction primarily by holes is

A. Insulator
B. Conductor
C. n-type semiconductor
D. p-type semicondutor

39. The metal that can be extracted from Columbite

A. Niobium
B. Copper
C. Tin
D. Cobalt

40. Vickers hardness is measured by the following indenter

A. Alumina cylinder
B. Steel ball of 10 mm diameter
C. Square base diamond pyramid
D. Brale indenter

41. The manufacturing process used to produce crank shaft

A. Rolling
B. Forging
C. Continuous casting
D. Hot isostatic pressing

42. Bonding in solid carbon dioxide is

A. Hydrogen bonding
B. Metallic bonding
C. Ionic bonding
D. Covalent bonding

43. Insulators with large band gaps (> 2eV) are

A. Transparent to visible light
B. Opaque to visible light
C. Translucent to visible light
D. None of the above

44. In paramagnetic materials, magnetic induction is

A. Having no relation to the applied magnetic field strength
B. Slightly less than the applied magnetic field strength
C. Only slightly greater than the applied magnetic field strength
D. Far greater than the applied magnetic field strength

45. The mathematical relationship between pressure and volume in Boyle's law is

A. Circle
B. Ellipse
C. Hyperbola
D. Parabola

46. The density of materials can be determined from the number of atoms per unit cell as well as the lattice parameter. If the number of atoms per lattice point is doubled in a crystal structure with no change in lattice parameter, then the density

A. Increases by two fold
B. Increases by four fold
C. Decreases by half
D. Remains the same

47. High speed tool steel that exhibits red hardness contains the following elements

A. Aluminum, Tungsten, Carbon, Tin
B. Silicon, Carbon, Nitrogen, Copper
C. Carbon, Tungsten, Chromium, Vanadium
D. Nitrogen, Nickel, Chromium, Molybdenum

48. Poisson's ratio refers to

A. Strength in transverse direction/strength in the longitudinal direction
B. Minimum stress/maximum stress in a fatigue cycle
C. Strain in the longitudinal direction/strain in transverse direction
D. Strain in transverse direction/strain in the longitudinal direction

49. Grey cast iron is preferred for machine beds due to

A. Very high ductility
B. High fatigue strength
C. High damping capacity
D. Its light weight

50. Tendency for grain growth in steels can be strongly reduced by the addition of

A. Co, Ni and Sb
B. Al, Ti and V
C. Mn, Ni and C
D. Be, Cu and Mn

51. Ellingham diagram is a representative plot between:

A. ΔG vs T
B. ΔG vs P
C. ΔU vs T
D. ΔU vs P

52. X-ray diffraction is used to study

A. Surface topography
B. Residual stresses
C. Crystal structure of solids
D. Both B & C

53. In atomic force microscopy, the load used between the tip and sample surface is of the order of

A. < 1 nano N
B. 100 N
C. 500 N
D. 1 kN

54. Joule-Thompson expansion of an ideal gas is

A. Isobaric
B. Isothermal
C. Adiabatic
D. Isocoric

55. Maxwell's equations are related to

A. Electromagnetism
B. Dislocation theory
C. Thermodynamics
D. Diffraction

56. The units of magnetic flux density

A. Pascal
B. Tesla
C. Weber
D. Volts

57. The heat treatment process of steel that uses air cooling after the solutionizing treatment is

A. Normalizing
B. Annealing
C. Austempering
D. Hardening

58. The Reynolds number is the ratio

A. Gravitational forces/Inertial forces
B. Inertial forces/Gravitational forces
C. Viscous forces/Inertial forces
D. Inertial forces/Viscous forces

59. Passivity refers to protection from corrosion in aqueous media or atmospheric weathering of any metal or alloy by

A. By ensuring a surface cover of an inert gas like Argon
B. Stable and naturally existing film
C. Corrosion protection achieved by uniform polymeric coating
D. Application of negative potential

60. Which of the following materials does not exhibit glass transition?

A. Ceramic
B. Metallic glass
C. Polymer
D. Glass

61. Quantum dots are clusters of atoms of a

A. Semiconductor material
B. Insulator
C. Polymer
D. None of the above

62. The property of a material that cannot be significantly changed by heat treatment is

A. Elastic modulus
B. Yield strength
C. Ultimate tensile strength
D. Percentage elongation

63. In FCC crystals the dislocations glide on the following

A. {0001}planes
B. {111} planes
C. {100} planes
D. None of the above

64. From the stress-strain curve of a typical engineering material, Resilience is calculated by

A. Measuring the slope of stress-strain curve
B. Measuring the fracture stress
C. Calculating the area under the entire stress-strain curve
D. Calculating the area under only the elastic part of stress-strain curve

65. Bonding in Si_3N_4 comprises of

A. Mixture of covalent and ionic bonds
B. Fully ionic bonds
C. Fully covalent bonds
D. Metallic bonds

66. For a metal to undergo stress corrosion cracking, the criteria to be satisfied

A. Shear stress and specific corrosive medium
B. High temperature and specific corrosive medium
C. Compressive stress and specific corrosive medium
D. Tensile stress and specific corrosive medium

67. Knife Line Attack (KLA) occurs in a narrow band in parent metal immediately adjacent to the weld due to intergranular corrosion. The material susceptible to KLA is

A. 316 Stainless Steel
B. 347 Stainless Steel
C. 430 Stainless Steel
D. 17-7 PH Stainless Steel

68. The primary requirement for age-hardening is

A. An increase in solubility of precipitating phase in the matrix with decrease in temperature
B. A decrease in solubility of precipitating phase in the matrix with decrease in temperature
C. A decrease in solubility of precipitating phase in the matrix with increase in temperature
D. The ability of the coherent precipitates to coarsen rapidly

69. Phase transformations in metals and alloys can be determined by

A. Volumetric changes
B. Thermal analysis
C. Changes in hardness
D. All the above

70. During the chain growth of polymerization, the molecular weight of the polymer

A. Decreases with conversion
B. Increases with conversion
C. Does not change with conversion
D. First increases and then decreases with conversion

71. A Schottky defect is

A. A line defect in metals
B. A point defect in metals
C. A line defect in ionic crystals
D. A point defect in ionic crystals

72. The alloys used for nuclear fuel clad tubes in pressurized heavy water reactors are

A. Austenitic stainless steels
B. Zirconium alloys
C. Nickel base superalloys
D. Niobium alloys

73. It is given that $(\log_2 x)(\log_3 x)(\log_5 x) = (\log_2 x)(\log_3 x) + (\log_3 x)(\log_5 x) + (\log_5 x)(\log_2 x)$ and $x \neq 1$. Then x is

A. 10
B. 30
C. 31
D. 100

74. Let $\alpha = 1! + 2! + 3! + \cdots\cdots\cdots\cdots + 94!$; when α is divided by 15 the remainder is

A. 14
B. 1
C. 3
D. 4

75. A method used to produce semiconductor grade material is

A. Floating zone refining
B. Laser ablation
C. Vacuum arc melting
D. Vacuum induction melting