U-89

ENTRANCE EXAMINATIONS, JUNE 2010
QUESTION PAPER

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

Marks: 75
Time: 2.00 hrs

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 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. Sound waves do not exhibit

A. interference
B. refraction
C. polarization
D. diffraction

2. 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

3. The force acting on a particle in one dimension is $F = -2x - 6x^3$. The corresponding potential energy $V(x)$, assuming $V(0) = 0$, is

A. $2x^2 - 6x^4$
B. $x^2 + (3/2)x^4$
C. $2x^2 + 6x^4$
D. $-x^2 - (3/2)x^4$

4. The type of atomic bonding most common in typical semiconductors is

A. metallic
B. covalent
C. ionic
D. hydrogen

5. The Joule-Thompson coefficient for an ideal gas is

A. zero
B. positive
C. negative
D. either positive or negative

6. The crystal structure of diamond is a variant of the

A. the orthorhombic structure,
B. the FCC structure
C. monoclinic structure
D. tetragonal structure

7. A ternary peritectic reaction can be represented as

A. $L+\alpha+\beta \leftrightarrow \gamma$
B. $L+\alpha \leftrightarrow \beta+\gamma$
C. $L \leftrightarrow \alpha+\beta+\gamma$
D. $L + \beta \leftrightarrow L + \alpha+\gamma$

8. Flux coated electrodes are used in

A. tungsten Inert Gas welding
B. shielded metal arc welding
C. submerged arc welding
D. resistance welding

9. 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

10. At Equicohesive temperature

A. grains are stronger than grain boundaries
B. grain boundaries are stronger than grains
C. both grains and grain boundaries are expected to have equal strength
D. all the grains are of equal size

11. Progressive deformation of a material at elevated temperatures (>0.35 T_M) under constant stress is called as

A. fatigue
B. ductility
C. creep
D. malleability

12. Martensite obtained on quenching-in plain carbon steel with 0.55-0.6% carbon will have a hardness of:

A. Rc 65
B. Rc 10
C. Rc 20
D. Rc 35

13. In Hall-Petch equation, $\sigma_y=\sigma_i+kd^{-1/2}$, the relative hardening contribution of the grain boundaries is described by:

A. σ_y (yield stress)
B. σ_i (frictional stress)
C. d, grain diameter
D. k, locking parameter

14. The plastic flow curve in a tensile test of a ductile material is represented by the following equation:

A. $\varepsilon = K \sigma^n$
B. $\sigma = K \varepsilon^n$
C. $\dot{\varepsilon} = K \sigma^n$
D. $\sigma = K \dot{\varepsilon}^n$

15. dG/dP at constant temperature, for a closed system, is:

A. entropy
B. negative of entropy
C. volume
D. negative of volume

16. Face Centered Cubic materials will have the following stacking sequence:

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

17. The primary requirement for age-hardening is

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

18. Zone Refining is:

A. a process of purifying metals
B. estimating grain orientation
C. estimating velocity of a rocket
D. evaluating the exact composition of a substance

19. Among the following types of power stations, which contributes the least to the global warming?

A. a coal-fired power station
B. a gas-fired power station
C. a nuclear power station
D. an oil-fired power station

20. The steel making process that uses oxygen lancing of melt is

A. LD
B. Open Hearth
C. Bessemer
D. Cupola

21. An elemental superconductor is a perfect

A. diamagnet
B. ferromagnet
C. dielectric
D. paramagnet

22. The reciprocal lattice of a BCC lattice

A. is a BCC lattice
B. is a simple cubic lattice
C. is a FCC lattice
D. does not exsist

23. A Schottky defect is

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

24. The empirical relation that incorporates yield strength for describing the effect of mean stress on fatigue life is

A. Gerber's relationship
B. Goodman's relationship
C. Soderberg's relationship
D. Coffin-Manson relationship

25. The structural state of polymers can be in

A. semi-crystalline
B. amorphous
C. liquid crystal
D. all the above

PART 'B'

26. "Thermodynamic death" is suggested by

A. the first law of thermodynamics,
B. the second law of thermodynamics
C. the third law of thermodynamics
D. zeroeth law of thermodynamics

27. The concept of "Cottrell atmosphere" is useful in explaining

A. strain ageing phenomenon
B. shape memory effect
C. Hall-Petch effect
D. Raman effect

28. β-brass, CuZn (BCC) is

A. an electron compound
B. a size factor compound
C. an electrochemical compound
D. an intermetallic compound

29. The Czochralski apparatus can be used to produce

A. polycrystals of silicon
B. single crystal ingots
C. high temperature ceramics
D. steels for cryogenic applications

30. Nernst equation is given by

A. $\Delta G=-nFE$
B. $\Delta E=-nFG$
C. $\Delta F=-nGE$
D. $\Delta S=-nGF$

31. The prime function of a cutting fluid is

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

32. Slip begins when the shearing stress on the slip plane in the slip direction reaches a threshold value called

A. critical resolved shear stress
B. Pierls-Nabarro stress
C. endurance limit
D. 0.2% offset yield strength

33. "Flash" is associated with the following manufacturing process

A. hot rolling
B. cold extrusion
C. wire drawing
D. closed die forging

34. Vegard's law (that relates lattice constant ("a" for the alloy and "a_0"for the element) and composition (X)) will have the form

A. $a = kX + a_0$
B. $a = kX$
C. $a = kX^2 + a_0$
D. $a^2 = kX + a_0$

35. The following are superalloys:

A. Ti- based alloys
B. Mo- based alloys
C. Zr- based alloys
D. Ni- based alloys

36. The following direction lies in (111) plane

A. [-1 0 1]
B. [1 0 0]
C. [0 -1 0]
D. [1 1 1]

37. The activation energy required for homogeneous nucleation is

A. zero
B. more than that of heterogeneous nucleation
C. less than that of heterogeneous nucleation
D. equal to that of heterogeneous nucleation

38. The improvement in high cycle fatigue resistance of steel is obtained by having

A. fine grain size
B. surface decarburization
C. tensile residual stresses on surface
D. presence of globular inclusions of oxides

39. Rotary swaging is a metal forming operation used to

A. reduce the diameter of a rod
B. reduce the thickness of a plate
C. increase the diameter of a pipe
D. make tubes of asymmetric shapes

40. Microstructure of steel produced by austempering

A. bainite
B. austenite
C. pearlite
D. martensite

41. Zirconium alloys are used widely for

A. dental implants
B. heat exchanger tubes of coal fired power plants
C. gas turbine blades
D. nuclear fuel clad tubes of thermal reactors

42. $YBa_2Cu_3O_7$ is a

A. super conductor
B. semiconductor
C. soft magnet
D. dielectric material

43. Stress corrosion cracking occurs in Austenitic stainless steels when these are exposed to a tensile stress and

A. chloride environment
B. caustic environment
C. mercury
D. water

44. The following is not a point defect:

A. vacancy
B. interstitial
C. impurity
D. inclusion

45. At room temperature, the activation energy required for vacancy diffusion

A. is more than that of interstitial diffusion
B. is less than that of interstitial diffusion
C. is equal to that of interstitial diffusion
D. none of these

46. In the limit $x \to \infty$, $\ln x - x$

A. equals zero
B. equals 2
C. equals -∞
D. equals 1

47. Which of the following is not true for the dielectric constant of a material?

A. it is frequency dependent
B. it is frequency independent
C. it is a complex quantity
D. it is non-linear for ferroelectrics

48. 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

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

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

50. pH value of a solution containing equal concentrations of hydrogen and hydroxyl ions will be

A. 0
B. 10
C. 7
D. 14

51. Martensite transformation is an example of

A. reconstructive transformation
B. displacive transformation
C. diffusion phase transformation
D. massive phase transformation

52. Solid CO_2 is called "dry ice" because

A. the critical temperature of CO_2 is above 25 °C
B. the boiling point of liquid CO_2 is above 100 °C
C. at 25 °C and 1 atm, only solid and vapor phases of CO_2 are in equilibrium
D. the melting point of liquid CO_2 is above 0 °C

53. Borax is used in preparing

A. pyrex glass
B. soda glass
C. portland cement
D. opal glass

54. Determinant of $\begin{pmatrix} 3 & 1 & 2 \\ 1 & 2 & 1 \\ 3 & 1 & 2 \end{pmatrix}$ is

A. 0
B. 1
C. 20
D. -10

55. Fatigue fracture is identified by the presence of

A. cavities on grain boundaries
B. dimples on fracture surface
C. pits on fracture surface
D. striations

56. Scanning electron microscopy is not used for

A. fractographic studies
B. compositional studies
C. polarization studies
D. topographic studies

57. The unit for plane-strain fracture toughness

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

58. A method used to produce semiconductor grade material is

A. floating zone refining
B. laser ablation
C. vacuum arc melting
D. vacuum induction melting

59. In some polymers the elongated voids having a fibrous structure that develops is known as a

A. shear zone,
B. zone of segregation,
C. craze zone
D. none of the above

60. Hot working of a metallic material is carried out

A. above its recrystallization temperature
B. below its recrystallization temperature
C. at its recrystallization temperature
D. at its melting temperature

61. Wood is a naturally occurring

A. refractory material
B. composite material
C. ceramic material
D. malleable material

62. A defect that is bounded by two mirror planes is

A. stacking fault
B. twin
C. grain boundary
D. screw dislocation

63. 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 transverse direction/strain in the longitudinal direction
D. strain in the longitudinal direction/strain in transverse direction

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

A. high fatigue strength
B. high damping capacity
C. very high ductility
D. its light weight

65. Naturally occurring uranium ore contains

A. fissile isotopes of uranium only
B. fertile isotopes of uranium only
C. both fissile and fertile isotopes of uranium
D. fertile isotopes of both thorium and uranium

66. The hardening treatment that induces carbon and nitrogen simultaneously onto the surface of a steel component

A. carburizing
B. cyaniding
C. nitriding
D. flame hardening

67. The ceramic that can be used as a cutting tool

A. yittria
B. titania
C. alumina
D. magnesia

68. A material used to make a thermocouple

A. platinum-(platinum-rhodium)
B. thoria dopped tungsten
C. molybdenum disilicide
D. super kanthal

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

A. increases with conversion
B. decreases with conversion
C. does not change with conversion
D. first increases and then decreases with conversion

70. The important design factor to be considered for automobile body is

A. damping capacity
B. crash worthiness
C. creep
D. fatigue

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

A. changes in hardness
B. thermal analysis
C. volumetric changes
D. all the above

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

A. Al, Ti and V
B. S, P and Sb
C. Mn, Ni and C
D. Ba, Cu and Mn

73. Hot isostatic pressing uses the combination of the following to produce preformed components

A. elevated temperature and high pressure
B. low temperature and high pressure
C. high pressure only
D. high temperature only

74. At room temperature, the following has the lowest toughness

A. reinforced plastics
B. thermoplastics
C. thermosets
D. glasses

75. The dynamic hardness of a metal surface is obtained using

A. Shore scleroscope
B. Rockwell C hardness test
C. Moh's hardness test
D. Brinell hardness test