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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S6 (S, FE) / S6 (PT) (S, FE) Examination December 2024 (2019 Scheme)

Course Code: MET 308

Course name: COMPREHENSIVE COURSE WORK

Max. Marks: 50 Duration: 1Hour

Instructions: ***(1) Each question carries one mark. No negative marks for wrong answers***
(2) Total number of questions: 50
(3) All questions are to be answered. Each question will be followed by 4 possible answers of which only ONE is correct.
(4) If more than one option is chosen, it will not be considered for valuation.

1. Which of the following properties remains constant for an ideal fluid?

   a) Viscosity b) Density c) Surface tension d) Compressibility

2. For a fluid with higher viscosity, the velocity gradient for the same shear stress will be:

   a) Higher b) Zero c) Infinite d) Lower

3. Which of the following is an example of a Non-Newtonian fluid?

   a) Water b) Honey c) Air d) Blood

4. In an inclined manometer, the inclination of the tube is used to:

   a) Measure high pressures b) Increase sensitivity to small pressure changes c) Measure flow rates d) Reduce sensitivity to small pressure changes

5. Pressure intensity or force due to pressure gradient for fluid at rest is considered as which of the following kind of force?

   a) Body force b) Force due to motion c) Surface force d) None of the mentioned

6. For a floating body to be in stable equilibrium, the metacentric height must be:

   a) Negative b) Zero c) Positive d) Equal to the center of gravity

7. When the velocity of fluid varies from one point to another in a flow field but remains constant with time at each point, the flow is classified as:

   a) Steady and non-uniform b) Unsteady and non-uniform c) Steady and uniform d) Unsteady and uniform

8. Which of the following is a formula for the friction factor of laminar flow through circular pipes?

a) Re/64 b) 16/Re c) 64/Re d) Re/16

9. For a two-dimensional incompressible flow, which condition must the stream function satisfy?

a) The Laplacian of the stream function is zero b) The stream function remains constant along a streamline c) The gradient of the stream function gives the pressure field d) The curl of the stream function gives the velocity vector

10. Which of the following best describes Euler's equation for fluid motion?

a) It is a conservation equation for mass b) It relates the pressure, velocity, and body forces in a fluid c) It describes the heat transfer in a fluid flow d) It represents the relationship between the velocity and temperature in a compressible flow

11 In an ionic bond, the strength of the bond is primarily determined by:

a) The size and charge of the ions involved b) The overlap of atomic orbitals c) The number of shared electron pairs d) The density of free electrons in the crystal lattice

12 The coefficient of thermal expansion is highest in materials with which of the following types of bonds?

a) Covalent bonds b) Ionic bonds c) Metallic bonds d) Van der Waals bonds

13 Which of the following correctly describes the coordination number for SC, BCC, FCC, and HCP structures, respectively?

a) 6, 8, 12, 12 b) 4, 6, 8, 10 c) 6, 12, 8, 12 d) 8, 6, 12, 8

14 Which of the following steps is not correct in determining the Miller indices of a crystal plane?

a) Identify the intercepts of the plane along the crystallographic axes. b) Take the reciprocal of the intercepts in terms of lattice parameters. c) Multiply the reciprocals by a common factor to convert to integers. d) Add the intercept values of all axes together to finalize the Miller indices.

15 Which of the following statements best describes the mechanism of slip during plastic deformation?

a) Slip involves the rotation of atomic planes to achieve deformation. b) Slip occurs due to the movement of dislocations along specific crystallographic planes and directions. c) Slip is a process where atomic bonds are broken and reformed randomly. d) Slip leads to the formation of twins due to the displacement of entire atomic planes.

16 What does the term "forest of dislocations" primarily refer to in the context of materials science?

a) A collection of dislocations forming a tree-like pattern in a crystal lattice.
b) A network of intersecting dislocations that impede the motion of other dislocations.
c) A set of edge dislocations aligned along the same crystallographic plane.
d) A dislocation arrangement that facilitates plastic deformation.

17 In a cubic crystal system, the Burgers vector for an edge dislocation is:

a) Parallel to the dislocation line.
b) Perpendicular to the dislocation line.
c) Along the slip direction only.
d) Independent of the crystal orientation.

18 In a TTT diagram, which phase transformation occurs at the "nose" of the curve?

a) Formation of pearlite
b) Formation of bainite
c) Formation of martensite
d) Formation of austenite

19 In which heat treatment process is the material heated to a temperature above its critical range and then cooled slowly in a furnace?

a) Hardening
b) Annealing
c) Quenching
d) Tempering

20 Which reaction occurs during the eutectoid transformation in the iron-carbon system?

a) Liquid $\rightarrow$ Austenite + Cementite
b) Austenite + Cementite $\rightarrow$ Pearlite
c) Austenite $\rightarrow$ Ferrite + Cementite
d) Ferrite $\rightarrow$ Austenite + Cementite

21 Which of the following is an example of a microscopic property?

a) Temperature
b) Pressure
c) Specific volume
d) Molecular velocity

22 Which of the following is a closed system?

a) A boiling water pan with no lid.
b) A sealed pressure cooker.
c) An air compressor.
d) An engine cylinder with open valves.

23 In a cyclic process, the net change in which of the following properties is zero?

a) Internal energy
b) Enthalpy
c) Entropy
d) Work done

24 A Carnot engine operates between two reservoirs at temperatures 600 K and 300 K. If the engine absorbs 1000 J of heat from the hot reservoir, how much work does it perform?

a) 333 J
b) 500 J
c) 667 J
d) 1000 J

25 In a thermodynamic system, thermal equilibrium implies which of the following?

a) No temperature gradients exist within the system.
b) No pressure gradients exist within the system.
c) No chemical reactions occur within the system.
d) The system is isolated from its surroundings.

26 In a cyclic process, the First Law of Thermodynamics implies that:

a) The change in internal energy is zero.
b) The system has no energy interactions.
c) The heat added to the system equals the work done by the system.
d) Work done is independent of the path taken.

27 A closed system absorbs 100 J of heat while performing 60 J of work on the surroundings. What is the change in the internal energy of the system?

a) 40 J
b) -40 J
c) 160 J
d) -160 J

28 A reversible heat engine rejects 300 kJ of heat to a sink at 300 K while producing 200 kJ of work. What is the temperature of the source?

a) 500 K
b) 450 K
c) 600 K
d) 400 K

29 During an adiabatic reversible process, the entropy of the system:

a) Increases
b) Decreases
c) Remains constant
d) Cannot be determined

30 For an ideal gas undergoing a polytropic process (PV^n = constant), the change in entropy is calculated using:

a) Only the heat transfer
b) The temperature and specific heat capacities
c) The work done in the process
d) The external pressure applied

31 Which of the following is the primary function of sand in sand casting?

a) To withstand high temperatures and provide a mold cavity
b) To act as a cooling agent for the molten metal
c) To provide strength to the metal cast
d) To ensure the removal of impurities from the molten metal

32 In which situation would the use of a gated pattern be more advantageous compared to a simple pattern?

a) When producing multiple identical castings in a single mold
b) When casting complex parts with internal cavities
c) When the casting material has a high melting point
d) When the mold needs enhanced permeability

33 Which of the following is a non-destructive testing (NDT) method for evaluating welded joints?

a) Tensile testing
b) Charpy impact test
c) Ultrasonic testing
d) Bend test

34 Which materials are commonly used in the thermit mixture for thermit welding?

a) Aluminum and iron oxide
b) Copper and magnesium
c) Graphite and silica
d) Zinc and lead

35 In friction welding, the joining of materials occurs in which state?

a) Solid state
b) Liquid state
c) Gaseous state
d) Plasma state

36 In resistance welding, the heat generated at the joint is proportional to:

a) Current and time
b) Voltage and speed
c) Pressure and time
d) Filler material and current

37 Which of the following electrodes is used in shielded metal arc welding (SMAW)?

a) Tungsten electrode b) Consumable electrode c) Non-consumable electrode d) Carbon electrode

38 In rolling, what does the term "draft" refer to?

a) The reduction in thickness during one pass b) The speed of the rolling mill c) The width of the metal sheet d) The angle between the rolls

39 Which defect in rolled products is caused by uneven deformation during rolling?

a) Alligatoring b) Edge cracks c) Scale formation d) Waviness

40 Which of the following is a major advantage of forging over casting?

a) Less material waste and more precise dimensions b) Improved material strength due to alignment of grain structure c) Greater flexibility in part design d) Lower energy consumption

41 Which of the following mechanisms is an inversion of a four-bar linkage?

a) Watt's mechanism b) Slider-crank mechanism c) Peaucellier-Lipkin mechanism d) Geneva mechanism

42 The degree of freedom (DOF) of a planar mechanism with n links and j lower pairs is given by:

a) $3(n-1)-2j$ b) $2(n-1)-3j$ c) $3(n-1)-j$ d) $2(n-1)-j$

43 What does a kinematic diagram represent?

a) The physical appearance of a mechanism b) The relative motion of components c) The electrical circuit of a system d) The mass distribution in a mechanism

44 How many degrees of freedom does a planar mechanism with one fixed link have?

a) 1 b) 2 c) 3 d) 6

45 In relative velocity analysis, the velocity of a point B relative to point A is:

a) The sum of their absolute velocities b) The difference between their absolute velocities c) Independent of the motion of A d) Always perpendicular to the line joining A and B

46 For a mechanism with 4 links, how many instantaneous centers exist?

a) 2 b) 4 c) 6 d) 8

47 The Coriolis acceleration component is present when:

a) A point moves along a fixed straight line b) There is rotational motion only c) A point moves relative to a rotating frame d) Motion occurs in a non-inertial frame without rotation

48 Which follower motion provides the smoothest operation in a cam mechanism?

a) Uniform velocity motion b) Simple Harmonic Motion (SHM) c) Cycloidal motion d) Uniform acceleration and retardation motion

49 In SHM of a cam follower, the acceleration is maximum when:

a) Displacement is zero b) Velocity is maximum c) Displacement is maximum d) Velocity is zero

50 In a cam profile design, the maximum pressure angle occurs:

a) At the start of the follower's motion b) At the midpoint of the lift c) At the end of the follower's motion d) At the point of maximum velocity