



PUNJAB TECHNICAL UNIVERSITY JALANDHAR

Max. Marks: 90

Time: 90 Mins.

Entrance Test for Enrollment in Ph.D. Programme

Important Instructions

- Fill all the information in various columns, in capital letters, with blue/black ball point pen.
- Use of calculators is not allowed. Use Blue/Black ball point pen for attempting the questions.
- All questions are compulsory. No negative marking for wrong answers.
- To attempt a question, make a tick mark (✓) at the right option/answer.
- Each question has only one right answer.
- Questions attempted with two or more options/answers will not be evaluated.

Stream (Engg./Arch./Pharm./Mgmt./App.Sci./Life Sci.)

Engineering

Discipline

Mechanical Engineering

Name

Father's Name

Roll No.

Date: **15-01-2011**

Signature of Candidate

Signature of Invigilator

1. A strain gauge is usually used for measurement using
 - (a) an H-type transistor bridge
 - (b) a Wheatstone bridge
 - (c) a Voltmeter
 - (d) an ammeter
2. At the Breakeven point
 - (a) fixed cost and variable cost are equal
 - (b) sales revenue and total cost are equal
 - (c) sales revenue is more than total cost
 - (d) sales revenue is less than total cost
3. The Reynolds number for flow of a certain fluid in a circular tube is specified as 2500. What will be the Reynolds number when the tube diameter is increased by 20% and the fluid velocity is decreased by 40% keeping fluid the same?
 - (a) 1200
 - (b) 3600
 - (c) 200
 - (d) 1800
4. Direction of rotation can be measured using
 - (a) an optical encoder with two tracks mutually offset by a phase of 90°
 - (b) an optical encoder with two tracks without any phase offset
 - (c) an optical encoder with only one track
 - (d) cannot be measured using an optical encoder
5. The actual observed time for an operation was 1 minute per piece. If the performance rating of the operator was 120 and a 5 per personal time is to be provided, the standard time in minutes per piece is
 - (a) 1.000
 - (b) 1.200
 - (c) 1.250
 - (d) 1.263
6. In case of critical damping, the system
 - (a) becomes unstable
 - (b) becomes purely oscillatory
 - (c) becomes over damped
 - (d) is on the threshold of oscillation and over damped condition
7. the structures which have the highest packing of atoms are
 - (a) hexagonal close packed lattice
 - (b) body central cubic lattice
 - (c) simple cubic lattice
 - (d) none of the above
8. Resistance spot welding is performed on two plates of 1.5 mm thickness with 6 mm diameter electrode, using 15000 A current for a time duration of 0.25 s. Assuming the interface resistance to be 0.0001 ohm, the heat generated to form the weld is
 - (a) 5625 W·s
 - (b) 8437 W·s
 - (c) 22500 W·s
 - (d) 33750 W·s
9. A mass connected to a string at one end would continue to oscillate with the same amplitude if the system is
 - (a) damped
 - (b) undamped
 - (c) under damped
 - (d) critically damped

10. $\frac{PL^3}{3EI}$ is the deflection under the load P of a cantilever beam of length L , modulus of elasticity E , moment of Inertia I . The strain energy due to bending is
 (a) $\frac{P^2L^3}{3EI}$ (b) $\frac{P^2L^3}{6EI}$ (c) $\frac{P^2L^3}{4EI}$
 (d) $\frac{P^2L^3}{48EI}$
11. A connecting rod is made by
 (a) casting
 (b) drawing
 (c) forging
 (d) extrusion
12. The cost of providing service in a queueing system increases with
 (a) increased mean time in the queue
 (b) increased arrival rate
 (c) decreased mean time in the queue
 (d) decreased arrival rate
13. In computer aided drafting practice, an arc is specified
 (a) two end points only
 (b) radius and one end point
 (c) center and radius
 (d) two end points and center
14. The effect of rake angle on the mean friction angle in machining can be explained by
 (a) Coulomb friction model
 (b) Sticking and then sliding friction model
 (c) Sliding and then sticking friction model
 (d) Stiction model
15. Using routing, the engineer can determine in advance
 (a) flow of material in the plant
 (b) ways and means for proper utilization of manpower
 (c) inspection of the final product
 (d) none of the above
16. In D.C. welding, the straight polarity (electrode negative) results in
 (a) less heating of work piece
 (b) smaller weld pool
 (c) lower penetration
 (d) lower deposition rate
17. Two rods, one of length L and the other of length $2L$ are made of the same material and have the same diameter. The two ends of the longer rod are maintained at 100°C . One end of the shorter rod is maintained at 100°C while the other end is insulated. Both the rods are exposed to the same environment at 40°C . The temperature at the insulated end of the shorter rod is measured to be 55°C . The temperature at the mid-point of the longer rod would be
 (a) 100°C (b) 55°C (c) 50°C (d) 40°C
18. In an ultrasonic machining process, the material removal rate will be higher for materials with
 (a) higher toughness
 (b) lower toughness
 (c) higher ductility
 (d) higher fracture strain
19. The outside diameter of a hollow shaft is twice its inside diameter. The ratio of its torque carrying capacity to that of a solid shaft of the same material and the same outside diameter is
 (a) $15/16$ (b) $3/4$ (c) $1/2$ (d) $3/16$
20. A 750 hours life test is performed on ten components. If one component fails after 350 hours of operation and all others survive the test, then the failure per hour is
 (a) 0.000141 (b) 0.000133
 (c) 0.00141 (d) 0.00133
21. In a plate cam mechanism with reciprocating roller follower, the follower has a constant acceleration in the case of
 (a) cycloidal motion
 (b) parabolic motion
 (c) simple harmonic motion
 (d) involute motion
22. A milling cutter having 8 teeth is rotating at 150 rpm. If the feed per tooth is 0.1, the table speed in mm/min is
 (a) 120
 (b) 187
 (c) 125
 (d) 70
23. A dummy activity is used in PERT network to describe
 (a) resource idleness
 (b) necessary time delay
 (c) resource restriction
 (d) precedence relationship
24. The chart which is useful for scheduling and control is
 (a) Kanban (b) Gantt chart (c) Flow process chart (d) X and R chart
25. A mass of 1 kg is attached to the end of a spring with a stiffness of 0.7 N/mm. The critical damping coefficient of the system will be
 (a) 1.4 N.s/m (b) 52.9 N.s/m (c) 18.5 N.s/m (d) 529 N.s/m
26. In PERT, the distribution of activity times is assumed to be
 (a) Normal (b) Gamma (c) Beta
 (d) Exponential
27. Cutting power consumption in turning can be significantly reduced by
 (a) increasing the cutting angle of the tool
 (b) increasing the clearance angle
 (c) widening the nose radius of the tool
 (d) increasing the rake angle of the tool

28. The most commonly used criteria for measuring forecast error is
 (a) mean absolute deviation
 (b) mean absolute percentage error
 (c) mean standard error
 (d) mean square error
29. A fluid is said to be Newtonian when the shear stress is
 (a) independent of the velocity gradient
 (b) directly proportional to the velocity gradient
 (c) inversely proportional to the velocity gradient
 (d) none of the above
30. A key connecting a flange coupling to a shaft is likely to fail in
 (a) bending (b) torsion
 (c) tension (d) shear
31. If the ratio of the diameter of rivet hole to the pitch of rivets is 0.25, then the tearing efficiency of the joint is
 (a) 0.5 (b) 0.87 (c) 0.25 (d) 0.75
32. Which of the following techniques enables the designer to mould and shape, rather than construct an object using a series of lines?
 (a) solid modeling
 (b) surface modeling
 (c) wire frame modeling
 (d) FEM
33. Kanban is a Japanese term indicating
 (a) a method of line balancing
 (b) information for production and withdrawal of items
 (c) priority dispatching
 (d) line time employment
34. In spur gears, the circle on which the involute profile is generated is called the
 (a) base circle (b) addendum circle
 (c) pitch circle (d) clearance circle
35. In fluid flow through a pipe, the transition from laminar to turbulent flow does not depend on
 (a) velocity of the fluid
 (b) density of the fluid
 (c) length of the pipe
 (d) diameter of the pipe
36. Preheating before welding is done to
 (a) make the steel softer
 (b) burn away oil, grease, etc, from the plate surface
 (c) prevent plate distortion
 (d) prevent cold cracks
37. If at the optimum in a linear programming problem, a dual variable corresponding to a particular primal constraint is zero, then it means that
 (a) the problem is degenerate
 (b) the objective function is unbounded
 (c) changing the right hand side of the primal constraint will disturb the optimum solution
 (d) right hand side of the primal constraint can be altered without affecting the optimum solution
38. A wire of 0.1 mm diameter is drawn from a rod of 15 mm diameter. Dies giving reductions of 20%, 40% and 80% are available. For minimum error in the final size, the number of stages and reduction at each stage respectively would be
 (a) 2 stages and 80% reduction of all three stages
 (b) 5 stages and reduction of 80%, 80%, 40%, 40%, 20% in a sequence
 (c) 4 stages and 80% reduction for first three stages followed by a finishing stage of 20% reduction
 (d) none of the above
39. Preliminary work sampling studies show that machine was idle 25% of the time based on a sample of 100 observations. The number of observations needed for a confidence level of 95% and an accuracy of $\pm 5\%$ is
 (a) 400
 (b) 1200
 (c) 3600
 (d) 4800
40. The following data pertain to a single stage impulse steam turbine: Nozzle angle = 20° , Blade velocity = 200 m/s , Relative steam velocity at entry = 350 m/s , Blade inlet = 30° , Blade exit angle = 25° . If blade friction is neglected, the work done per kg steam is
 (a) 124 kJ
 (b) 164 kJ
 (c) 169 kJ
 (d) 174 kJ
41. A thick cylinder is subjected to an internal pressure of 60 MPa. If the hoop stress on the outer surface is 150 MPa, then the hoop stress on the internal surface is
 (a) 105 MPa
 (b) 180 MPa
 (c) 210 MPa
 (d) 135 MPa
42. A cutting tool has nose radius of 1.8 mm. For a theoretical surface roughness of $R_a = 5\mu\text{m}$ the feed rate should be
 (a) 0.36 mm/rev
 (b) 0.187 mm/rev
 (c) 0.036 mm/rev
 (d) 0.0187 mm/rev
43. On completion of heat treatment, the resulting structure will have retained Austenite if
 (a) Martensite formation temperature is below the room temperature
 (b) Martensite formation temperature is above the room temperature
 (c) rate of cooling is greater than the critical cooling rate
 (d) rate of cooling is less than the critical cooling rate

44. A compound cylinder with inner radius 5 cm and outer radius 7 cm is made by shrinking one cylinder on to the other cylinder. The junction radius is 6 cm and the junction pressure is 11 kgf/cm^2 . The maximum hoop stress developed in the inner cylinder is
 (a) 36 kgf/cm^2 compression
 (b) 36 kgf/cm^2 tension
 (c) 72 kgf/cm^2 compression
 (d) 72 kgf/cm^2 tension
45. In radiative heat transfer, a gray surface is one
 (a) which appears grey to the eye
 (b) whose emissivity is independent of wavelength
 (c) which has reflectivity equal to zero
 (d) which appears equally bright from all directions
46. A 750 hours life test is performed on ten components. If one component fails after 350 hours of operation and all others survive the test, then the failure per hour is
 (a) 0.000141
 (b) 0.000133
 (c) 0.00141
 (d) 0.00133
47. The alloying element mainly used to improve the endurance strength of steel materials is
 (a) Molybdenum
 (b) Tungsten
 (c) Nickel
 (d) Vanadium
48. Bending moment M and torque T is applied on a solid circular shaft. If the maximum bending stress equals the maximum shear stress developed, then M is equal to
 (a) $T/2$
 (b) T
 (c) $2T$
 (d) $4T$
49. In a point-to-point control NC machine, the slides are positioned by an integrally mounted stepper motor drive. If the specification of the motor is $1^\circ/\text{pulse}$, and the pitch of the lead screw is 3.6 mm, what is the expected positioning accuracy?
 (a) $10 \mu\text{m}$ (b) $1 \mu\text{m}$ (c) $100 \mu\text{m}$ (d) $50 \mu\text{m}$
50. In a certain heat exchanger, both the fluids have identical mass flow rate – specific heat product. The hot fluid enters at 76°C and leaves at 47°C and the cold fluid entering at 26°C leaves at 55°C . The effectiveness of the heat exchanger is
 (a) 0.16 (b) 0.58 (c) 1.0 (d) 0.72
51. Tool life of 10 hours is obtained when cutting with a single point tool at 63 m/min . If Taylor's constant $C = 257.35$, tool life on doubling the velocity will be
 (a) 25.7 min.
 (b) 5 hours.
 (c) 38.3 min.
 (d) unchanged
52. The profile of a cam in a particular zone is given by $x = \sqrt{3} \cos \theta$ and $y = \sin \theta$. The normal to the cam profile at $\theta = \pi/4$, with respect to x axis, is at an angle of
 (a) $\pi/4$
 (b) $\pi/6$
 (c) $\pi/2$
 (d) $\pi/3$
53. If $\frac{\omega}{\omega_n} = \sqrt{2}$, where ω is the frequency of excitation and ω_n is the natural frequency of vibrations, then the transmissibility of vibrations will be
 (a) 0.5
 (b) 1.0
 (c) 1.5
 (d) 2.0
54. When using a simple moving average to forecast demand, one would
 (a) give equal weight to all demand data
 (b) assign more weight to the recent demand data
 (c) include new demand data in the average without discarding the earlier data
 (d) include new demand data in the average after discarding some of the earlier demand data
55. For a medium carbon steel, having a 0.5% Carbon content, slow cooling of Austenite will cause Austenite to transform to Carbide and Ferrite. Rapid quenching of Austenite can result in
 (a) formation of Martensite, which produces a very hard and brittle steel.
 (b) retention of Austenite, at room temperature, which produces a very ductile and tough steel.
 (c) formation of large carbide particles near the grain boundaries in the steel, which makes the steel brittle but very tough.
 (d) retention of Austenite, even at room temperature, which gives a very brittle and hard steel.
56. A system of masses rotating in different parallel planes is in dynamic balance if the resultant
 (a) force is equal to zero
 (b) couple is equal to zero
 (c) force and the resultant couple are both equal to zero
 (d) force is numerically equal to the couple

57. A slot is to be milled centrally on a block with a dimension of $40 \pm 0.05 \text{ mm}$. A milling cutter of 20 mm width is located with reference to the side of the block within $\pm 0.02 \text{ mm}$. The maximum offset in mm between the center lines of the slot and the block is
 (a) ± 0.070
 (b) ± 0.020
 (c) 0.070
 (d) 0.045
58. The Boolean function $A \cdot (B + C)$ is described by which of the following
 (a) There is an output when either switch A or switch B is closed and switch C is closed.
 (b) There is an output when either switch A is closed or switch B is closed.
 (c) There is an output when switch A is closed and either switch B or switch C is closed.
 (d) There is an output when switch A is opened and either switch B or switch C is closed.
59. When the mass of a critically damped single degree of freedom system is deflected from its equilibrium position and released, it will
 (a) return to equilibrium position without oscillation
 (b) oscillate with increasing time period
 (c) oscillate with decreasing amplitude
 (d) oscillate with constant amplitude
60. Balancing of a rigid rotor can be achieved by appropriately placing balancing weights in
 (a) a single plane
 (b) two planes
 (c) three planes
 (d) four planes
61. The product of circular pitch and diametral pitch is
 (a) π
 (b) 2π
 (c) $\pi/2$
 (d) D/T
62. If the demand for an item is doubled and the ordering cost halved, the economic order quantity
 (a) increases by a factor of $\sqrt{2}$
 (b) is halved
 (c) is doubled
 (d) unchanged
63. In involute gears, the pressure angle is
 (a) dependant on the size of teeth
 (b) dependant on the size of gears
 (c) always constant
 (d) always variable
64. Identify the stress state in the flange portion of a partially drawn cylindrical cup when deep-drawing without a blank holder.
 (a) Tensile in all three directions
 (b) No stress in the flange at all because there is no blank holder
 (c) Tensile stress in one direction and compressive in the one other direction
 (d) compressive in two directions and tensile in the third direction
65. A transmission shaft subjected to bending loads must be designed on the basis of
 (a) maximum normal stress theory
 (b) maximum shear stress theory
 (c) maximum normal stress and maximum shear stress theories
 (d) fatigue strength
66. A plate 1 mm distant from a fixed plate moves at 0.25 m/s and requires a force per unit area of 1 Pa to maintain this speed. The viscosity of the fluid between the plates will be
 (a) $0.4 \text{ N} \cdot \text{s} / \text{m}^2$
 (b) $0.04 \text{ N} \cdot \text{s} / \text{m}^2$
 (c) $0.004 \text{ N} \cdot \text{s} / \text{m}^2$
 (d) $0.0004 \text{ N} \cdot \text{s} / \text{m}^2$
67. A sine bar is specified by
 (a) its total length
 (b) the center distance between the two rollers
 (c) weight of the sine bar
 (d) the size of the rollers
68. In inventory planning, extra inventory is unnecessarily carried to the end of the planning period when using one of the following lot size decision policies:
 (a) Economic Order Quantity (EOQ) lot size
 (b) Lot-for-lot production
 (c) Period order quantity (POQ) lot size
 (d) Part period total cost balancing
69. All of the following comparisons between metals, metal alloys and ceramics are true except
 (a) ceramic compounds crystallize more slowly than metallic compounds
 (b) ceramic compounds have higher melting temperatures than metallic compounds
 (c) metallic compounds are better conductors of current than ceramic compounds at higher temperatures
 (d) ceramic compounds are able to resist greater tensile stresses than metallic compounds at room temperatures

70. A cylindrical body of cross-sectional area A , height H and density ρ_s is immersed to a depth h in a liquid of density ρ , and tied to the bottom with a string. The tension in the string is
- $(\rho_s - \rho)ghA$
 - ρghA
 - $(\rho - \rho_s)ghA$
 - $(\rho h - \rho_s H)gA$
71. Two plates of the same metal having equal thickness are to be butt welded with electric arc. When the plate thickness changes, welding is achieved by
- adjusting the current
 - adjusting the duration of current
 - changing the electrode size
 - changing the electrode coating
72. Which of the following materials requires the largest shrinkage allowance, while making a pattern for casting?
- Aluminium
 - Brass
 - Cast iron
 - Plain carbon steel
73. If u , v and w are components of velocity in x , y and z directions respectively, the general equation of continuity for 3-dimensional flow of a compressible fluid for steady flow is
- $\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 0$
 - $\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 1$
 - $\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = u v w$
 - $\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y} = \frac{\partial w}{\partial z} = 0$
74. In an orthogonal machining operation, the chip thickness and the uncut thickness are equal to 0.45 mm. If the tool rake angle is 0° , the shear plane angle is
- 45°
 - 30°
 - 60°
 - 12°
75. A pilot operated valve is operated
- using system pressure through another pilot valve of small capacity
 - mainly using electrical energy
 - mainly using mechanical energy
 - none of the above
76. A dummy activity is used in PERT network to describe
- precedence relationship
 - necessary time delay
 - resource restriction
 - resource idleness
77. In Electro- Discharge Machining (EDM), the tool is made of
- Copper
 - High speed steel
 - Cast iron
 - Plain carbon steel
78. The line traced by a single fluid particle as it moves over a period of time is called
- line of force
 - filament line
 - flow line
 - path line
79. Silicon steel used for electrical purpose has silicon percentage of
- 0.5%
 - 2.5%
 - 3.4%
 - 12.5%
80. Inter electrode gap in ECG is controlled by
- controlling the pressure of electrolyte flow
 - controlling the applied static load
 - controlling the size of diamond particle in the wheel
 - controlling the texture of the work piece
81. For butt-welding 40 mm thick steel plates, when the expected quantity of such jobs is 5000 per month over a period of 10 years, choose the best suitable welding process out of the following available alternatives.
- Submerged arc welding
 - Oxy-acetylene gas welding
 - Electron beam welding
 - MIG welding
82. The height of the down-sprue is 175 mm and its cross-sectional area at the base is 200 mm^2 . The cross-sectional area of the horizontal runner is also 200 mm^2 . Assuming no losses, indicate the correct choice for the time (in seconds) required to fill a mold cavity of volume 10^6 mm^3 . Use $g = 10 \text{ m/s}^2$.
- 2.67
 - 8.45
 - 26.72
 - 84.50
83. Prandtl's mixing length in turbulent flow signifies
- the average distance perpendicular to the mean flow covered by the mixing particles.
 - the ratio of mean free path to the characteristic length of the flow field.
 - the wavelength corresponding to the lowest frequency present in the fluid field.
 - the magnitude of turbulent kinetic energy.
84. Suppose X is a normal random variable with mean 0 and variance 4. The mean of the absolute value of X is
- $1/\sqrt{2\pi}$
 - $2\sqrt{2}/\sqrt{\pi}$
 - $2\sqrt{2}/\pi$
 - $2/\sqrt{\pi}$

85. Selection of electrolyte for ECM is as follows:
 (a) non-passivating electrolyte for stock removal and passivating electrolyte for finish control
 (b) non-passivating electrolyte for stock removal and non-passivating electrolyte for finish control
 (c) selection of electrolyte is dependant on current density
 (d) electrolyte selection is based on tool-work electrodes

86. A filmwise condensation on outside of the tube, the horizontal positioning has greater heat transfer than the vertical one for length to diameter ratio of
 (a) greater than 5.89 (b) greater than 3.89
 (c) greater than 3.89 (d) greater than 3.89

87. Programmable controllers
 (a) are programmed using relay ladder logic and are widely used in many different machines
 (b) are poor industrial controllers with limited use
 (c) cannot perform functions other than relay logic
 (d) all of the above

88. Coefficient of friction for laminar flow through a circular pipe is:

- a) $f = \frac{0.0791}{(\text{Re})^{1/4}}$
 b) $f = \frac{16}{\text{Re}}$
 c) $f = \frac{64}{\text{Re}}$
 d) None of above

89. Pressure variation along the radial direction for vortex flow along a horizontal plane is given as:

- a) $\frac{\partial p}{\partial r} = -\rho \frac{V^2}{r}$
 b) $\frac{\partial p}{\partial r} = \rho \frac{V^2}{r^2}$
 c) $\frac{\partial p}{\partial r} = \rho \frac{V^2}{r}$
 d) None of above

90. The time period of oscillation of floating body is given by

- a) $T = 2\pi \sqrt{\frac{GM \times g}{k^2}}$
 b) $T = 2\pi \sqrt{\frac{k^2}{GM \times g}}$
 c) $T = 2\pi \sqrt{\frac{GM}{gk^2}}$
 d) $T = 2\pi \sqrt{\frac{gk^2}{GM}}$

where, k is radius of gyration, GM is metacentric height and T is time period