

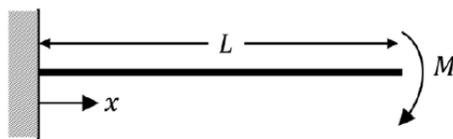
**APTITUDE TEST FOR RECRUITMENT OF CURATOR –B (MECHANICAL)**

Maximum Marks: 70

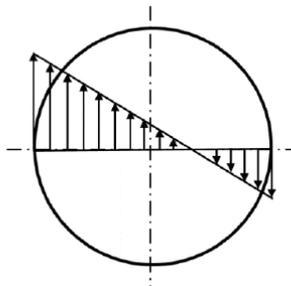
(1 x 30 = 30 Marks)

**I - Answer All Questions in Part-I**

- Q1) The value of  $\lim_{x \rightarrow 0} [(1-\cos x)/x^2]$  as  $x \rightarrow 0$  is  
a)  $\frac{1}{4}$                       b)  $\frac{1}{3}$                       c)  $\frac{1}{2}$                       d) 1
- Q2) In modern CNC machine tools, the backlash has been eliminated by  
a) Preloaded ball-screws  
b) rack and pinion  
c) ratchet and pinion  
d) slider crank mechanism
- Q3) In which of the following pairs of cycles, both cycles have at least one isothermal process?  
a) Diesel cycle and Otto Cycle  
b) Carnot cycle and Stirling cycle  
c) Brayton cycle and Rankine cycle  
d) Bell-Coleman cycle and Vapour compression refrigeration cycle
- Q4) An infinitely long pin fin, attached to an isothermal hot surface, transfers heat at a steady rate of  $Q_1$  to the ambient air. If the thermal conductivity of the fin material is doubled, while keeping everything else constant, the rate of steady-state heat transfer from the fin becomes  $Q_2$ . The ratio of  $Q_2/Q_1$  is  
a)  $\sqrt{2}$                       b) 2                      c)  $1/\sqrt{2}$                       d)  $\frac{1}{2}$
- Q5) A cantilever beam of length,  $L$ , and flexural rigidity,  $EI$ , is subjected to an end moment,  $M$ , as shown in the figure. The deflection of the beam at  $x=L/2$  is



- a)  $ML^2/2EI$                       b)  $ML^2/4EI$                       c)  $ML^2/8EI$                       d)  $ML^2/16EI$
- Q6) Shear stress distribution on the cross-section of the coil wire in a helical compression spring is shown in the figure. This shear stress distribution represents

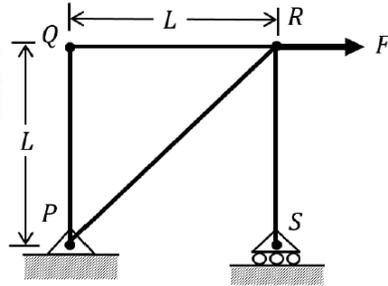


- a) Direct shear stress in the coil wire cross-section
- b) Torsional shear stress in the coil wire cross-section
- c) Combined direct shear and torsional shear stress in the coil wire cross-section
- d) Combined direct shear and torsional shear stress along with the effect of stress concentration at inside edge of the coil wire cross-section.

Q7) If the Laplace transformation of a function  $f(t)$  is given by  $(s+3)/[(s+1)(s+2)]$ , then  $f(0)$  is

- a) 0
- b)  $\frac{1}{2}$
- c) 1
- d)  $\frac{3}{2}$

Q8) A plane truss PQRS ( $PQ = RS$  and  $\text{AnglePQR} = 90^\circ$ ) is shown in the figure.



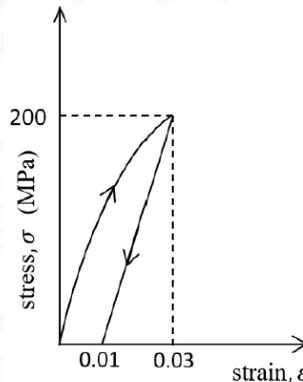
The forces in the members PR and RS, respectively, are \_\_\_\_\_

- a)  $F\sqrt{2}$  (tensile) and  $F$ (tensile)
- b)  $F\sqrt{2}$  (tensile) and  $F$  (compressive)
- c)  $F$  (compressive) and  $F\sqrt{2}$  (compressive)
- d)  $F$  (tensile) and  $F\sqrt{2}$  (tensile)

Q9) The von Mises stress at a point in a body subjected to forces is proportional to the square root of the

- a) Total strain energy per unit volume
- b) Plastic strain energy per unit volume
- c) Dilatational strain energy per unit volume
- d) Distortional strain energy per unit volume

Q10) The loading and unloading response of a metal is shown in the figure. The elastic and plastic strain corresponding to 200 MPa stress, respectively, are



- a) 0.01 and 0.01
- b) 0.02 and 0.01
- c) 0.01 and 0.02
- d) 0.02 and 0.02

- Q11) The latent heat of steam, with increase of pressure, \_\_\_\_\_  
(a) remains same (b) increases  
(c) decreases (d) behaves unpredictably  
(e) none of the above.
- Q12) Which one of the following statements is not correct?  
(a) the tangent of the angle of friction is equal to coefficient of friction  
(b) the angle of repose is equal to angle of friction  
(c) the tangent of the angle of repose is equal to coefficient of friction  
(d) the sine of the angle of repose is equal to coefficient to friction
- Q13) Rankine's theory of failure is applicable for following type of materials  
(a) brittle (b) ductile  
(c) elastic (d) plastic
- Q14) The fatigue life of a part can be improved by  
(a) electroplating (b) polishing  
(c) heat treating (d) shot peening
- Q15) The valve rod in a steam engine is connected to an eccentric rod by  
(a) cotter joint (b) gib and cotter joint  
(c) knuckle joint (d) universal coupling
- Q16) In hydrostatic bearings,  
(a) the oil film pressure is generated only by the rotation of the journal  
(b) the oil film is maintained by supplying oil under pressure  
(c) do not require external supply of lubricant  
(d) soft grease is used for lubrication
- Q17) Characteristic gas constant of a gas is equal to \_\_\_\_\_ where  $C_p$  is the heat capacity at constant pressure and  $C_v$  is the heat capacity at constant volume  
(a)  $C_p/C_v$  (b)  $C_v/C_p$   
(c)  $C_p - C_v$  (d)  $C_p + C_v$
- Q18) Which of the following represents the perpetual motion of the first kind  
(a) engine with 100% thermal efficiency  
(b) a fully reversible engine  
(c) transfer of heat energy from low temperature source to high temperature source  
(d) a machine that continuously creates its own energy

- Q19) Oldham's coupling is the  
(a) second inversion of double slider crank chain  
(b) third inversion of double slider crank chain  
(c) second inversion of single slider crank chain  
(d) third inversion of slider crank chain
- Q20) For fluctuating loads, well suited bearing is  
(a) ball bearing  
(b) roller bearing  
(c) needle roller bearing  
(d) thrust bearing
- Q21) Which of the following mechanism produces mathematically an exact straight line motion?  
(a) Grasshopper mechanism  
(b) Watt mechanism  
(c) Peaucellier's mechanism  
(d) Tchebycheff mechanism
- Q22) The metallic structure of mild steel is  
(a) body centred cubic  
(b) face centred cubic  
(c) hexagonal close packed  
(d) orthorhombic crystal
- Q23) By severely deforming a metal in a particular direction it becomes  
(a) ductile  
(b) malleable  
(c) anisotropic.  
(d) isotropic
- Q24) The loss of strength in compression with simultaneous gain in strength in tension due to overloading is known as  
(a) hysteresis  
(b) inelasticity  
(c) visco elasticity  
(d) Bauschinger effect
- Q25) Weld decay is the phenomenon found with  
(a) cast iron  
(b) mild steel  
(c) stainless steel  
(d) non-ferrous materials
- Q26) Pearlite is a combination of  
(a) ferrite and cementite  
(b) cementite and gamma iron  
(c) ferrite and austenite  
(d) ferrite and iron graphite
- Q27) Euler's dimensionless number relates the following  
(a) inertial force and buoyancy force  
(b) viscous force and inertial force  
(c) viscous force and buoyancy force  
(d) pressure force and inertial force
- Q28) If the radius of wire stretched by a load is doubled, then its Young's modulus will be  
(a) doubled  
(b) halved  
(c) become four times  
(d) remain unaffected

- Q29) A hot steel spherical ball is suddenly dipped into a low temperature oil bath. Which of the following dimensionless parameters are required to determine instantaneous center temperature of the ball using a Heisler chart?
- Biot number and Fourier number
  - Reynolds number and Prandtl number
  - Biot number and Froude number
  - Nusselt number and Grashoff number
- Q30) The mean and variance, respectively, of a binomial distribution for 'n' independent trials with the probability of success as 'p' are
- $\sqrt{np}$  ,  $np(1-2p)$
  - $\sqrt{np}$  ,  $\sqrt{np(1-p)}$
  - $np$  ,  $np$
  - $np$  ,  $np(1-p)$

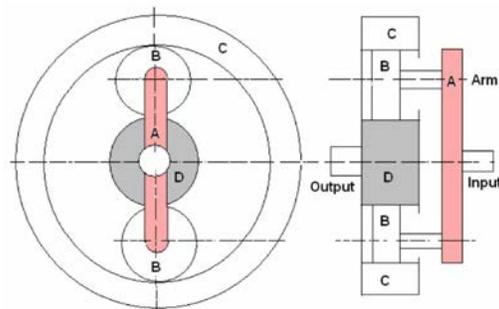
**II - Write Short Notes (min.150 – 200 words) on any 5 of the following:**

4 x 5 = 20 Marks

- Green Manufacturing
- Interconnected Machines
- Digital Manufacturing
- Smart materials
- 4D printing technology
- Beamed Energy Propulsion
- Hyperloop technology
- Honeycomb Composites
- Nano Electro Mechanical systems
- Industry 4.0

**III – Answer All Questions**

- Design a V-Belt drive to the following specifications: Power transmitted – 75 kw; speed of driving wheel – 1440 rpm; speed of driven wheel – 400 rpm; diameter of driving wheel – 300 mm; Centre distance – 2500 mm and duty cycle is 16 hrs/day. - 5 Marks
- An epicyclic gear box has a fixed sun Gear 'D' and the internal Gear 'C' is the output with 300 teeth. The planet Gears 'B' have 30 teeth. The input is the arm/cage 'A'. Calculate the number of teeth on the sun gear and the ratio of the gear box. - 5 Marks



3. An earthquake platform is required to be designed for creating experience to a group of 50 numbers of grade 8-10 students. The platform should have movement in X-Y-Z directions with Z direction movement extent is around 10-15% maximum of movement in X or Y direction. Prepare the necessary conceptual design of structure, mechanisms and drives/ motors to be used in this exhibit. (Note: the platform should have randomized movement with varying acceleration in all three directions.)

- 10 Marks

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