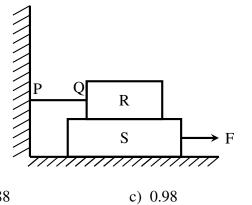
2014-ME

EE24BTECH11020 - Ellanti Rohith

- 1) The state of stress at a point is given by $\sigma_x = -6$ MPa, $\sigma_y = 4$ MPa, and $\tau_{xy} = -8$ MPa. The maximum tensile stress (in MPa) at the point is _____ [GATE 2014]
- 2) A block R of mass 100 kg is placed on a block S of mass 150 kg as shown in the figure. Block R is tied to the wall by a massless and inextensible string PQ. If the coefficient of static friction for all surfaces is 0.4, the minimum force F (in kN) needed to move the block S is [GATE 2014]



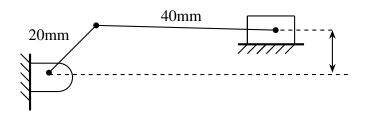
a) 0.69

b) 0.88

d) 1.37

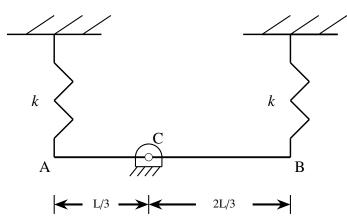
1

- 3) A pair of spur gears with module 5 mm and a center distance of 450 mm is used for a speed reduction of 5:1. The number of teeth on pinion is ______ [GATE 2014]
- 4) Consider a cantilever beam, having negligible mass and uniform flexural rigidity, with length 0.01 m. The frequency of vibration of the beam, with a 0.5 kg mass attached at the free tip, is 100 Hz. The flexural rigidity (in $N \cdot m^2$) of the beam is _____ [GATE 2014]
- 5) An ideal water jet with volume flow rate of 0.05 m³/s strikes a flat plate placed normal to its path and exerts a force of 1000 N. Considering the density of water as 1000 kg/m³, the diameter (in mm) of the water jet is [GATE 2014]
- 6) A block weighing 200 N is in contact with a level plane whose coefficients of static and kinetic friction are 0.4 and 0.2, respectively. The block is acted upon by a horizontal force (in newton) P = 10t, where t denotes the time in seconds. The velocity (in m/s) of the block attained after 10 seconds is ______
- 7) A slider crank mechanism has slider mass of 10 kg, stroke of 0.2 m and rotates with a uniform angular velocity of 10 rad/s. The primary inertia forces of the slider are partially balanced by a revolving mass of 6 kg at the crank, placed at a distance equal to crank radius. Neglect the mass of connecting rod and crank. When the crank angle (with respect to slider axis) is $30\hat{A}^{\circ}$, the unbalanced force (in newton) normal to the slider axis is [GATE 2014]
- 8) An offset slider-crank mechanism is shown in the figure at an instant. Conventionally, the Quick Return Ratio (QRR) is considered to be greater than one. The value of QRR is



[GATE 2014]

9) A rigid uniform rod AB of length L and mass m is hinged at C such that AC = L/3, CB = 2L/3. Ends A and B are supported by springs of spring constant k. The natural frequency of the system is given by



[GATE 2014]

a)
$$\sqrt{\frac{k}{2m}}$$

b)
$$\sqrt{\frac{k}{m}}$$

c)
$$\sqrt{\frac{2k}{m}}$$

d)
$$\sqrt{\frac{5k}{m}}$$

- 10) A hydrodynamic journal bearing is subject to 2000 N load at a rotational speed of 2000 rpm. Both bearing bore diameter and length are 40 mm. If radial clearance is 20 μ m and bearing is lubricated with an oil having viscosity 0.03 Pa.s, the Sommerfeld number of the bearing is _____[GATE 2014]
- 11) A 200 mm long, stress-free rod at room temperature is held between two immovable rigid walls. The temperature of the rod is uniformly raised by $250^{\circ}C$. If the Young's modulus and coefficient of thermal expansion are 200 GPa and $1 \times 10^{-5}/^{\circ}C$, respectively, the magnitude of the longitudinal stress (in MPa) developed in the rod is ______ [GATE 2014]
- 12) 1.5 kg of water is in saturated liquid state at 2 bar ($v_f = 0.001061 \text{ m}^3/\text{kg}$, $u_f = 504.0 \text{ kJ/kg}$, $h_f = 505 \text{ kJ/kg}$). Heat is added in a constant pressure process till the temperature of water reaches $400^{\circ}C$ ($v = 1.5493 \text{ m}^3/\text{kg}$, u = 2967.0 kJ/kg, h = 3277.0 kJ/kg). The heat added (in kJ) in the process is [GATE 2014]
- 13) Consider one dimensional steady state heat conduction across a wall (as shown in figure below) of thickness 30 mm and thermal conductivity 15 W/m.K. At x = 0, a constant heat flux, $q'' = 1 \times 10^5$ W/m² is applied. On the other side of the wall, heat is removed from the wall by convection with a fluid at 25°C and heat transfer coefficient of 250 W/m²·K. The temperature (in °C), at x = 0 is [GATE 2014]

