Ref No.: Ex/ME/5/T/113/2019(Old)

BACHELOR OF ENGINEERING (MECHANICAL ENGINEERING)
FIRST YEAR FIRST SEMESTER (Old) – 2019
Subject: ENGINEERING MECHANICS - II

Time : Three Hours **Full Marks : 100**

(Answer any Five Questions)

1. (a) The 50-kg crate (**Fig. 1a**) is stationary when the force P is applied. Determine the resulting acceleration of the crate if (*i*) P=150N and (*ii*) P=300N. (5+5)

(b) Draw the shear force and bending moment diagrams for the cantilever beam (**Fig. 1b**). (10)

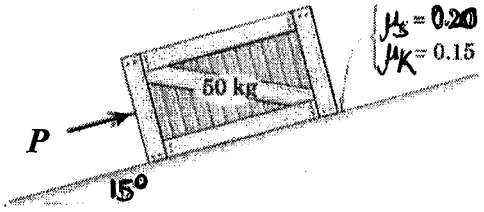

Fig. 1a

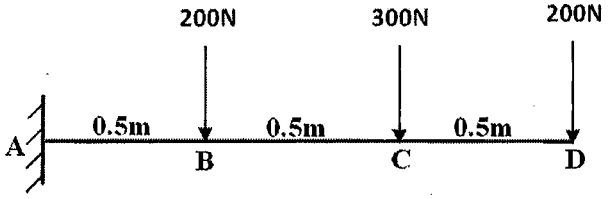

Fig. 1b

2. (a) For torsion of a circular shaft with usual notations, show that

$$\frac{T}{J} = \frac{\tau}{r} = \frac{G\theta}{L}$$

(10)

(b) A steel shaft of 6mm diameter turns at 10,000rpm. What is the power that such a shaft may develop if the allowed working stress in shear is 350kgf/cm^2. (10)

3. (a) A particle moves along x-axis with an initial velocity of 60m/s at origin when time t=0. For the first 5 seconds, it has no acceleration after that it is acted upon by a force causing a constant retardation of 10m/s^2. Calculate the velocity and coordinates of the particle for the conditions at t=10second and t=15 second. Also, find the maximum coordinate reached by the particle during its motion. (10)

(b) Derive the mathematical equation for the trajectory of a projectile launched with a velocity of 'u' and angle of projection 'α' with the ground. (10)

4. (a) For a thin walled pressure vessel having wall thickness t and subjected to an internal pressure p, deduce the governing equation $\frac{\sigma_1}{r_1} + \frac{\sigma_2}{r_2} = \frac{p}{t}$. The symbols carry their usual meanings. (10)

(b) A helical spring is made of a wire of 6mm diameter and has an outside diameter of 75mm. If the permissible shear stress is 350MPa and the modulus of rigidity is 84kN/mm^2, find the axial load which the spring can carry and the deflection per active turn. Consider the curvature effects. (10)

[Turn over

5. (a) The 50-g bullet (**Fig. 5a**) traveling at 600 m/s strikes the 4-kg block centrally and is embedded within it. If the block slides on a smooth horizontal plane with a velocity of 12 m/s in the direction shown prior to impact, determine the velocity v_2 of the block and embedded bullet immediately after impact. (10)

(b) Compute the final velocities v_1' and v_2' after collision of the two cylinders (**Fig. 5b**) which slide on the smooth horizontal shaft. The coefficient of restitution is $e = 0.6$. (10)

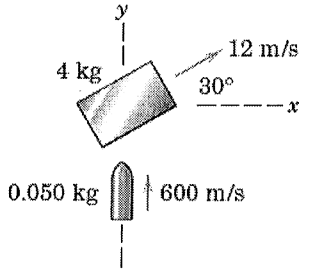

Fig. 5a

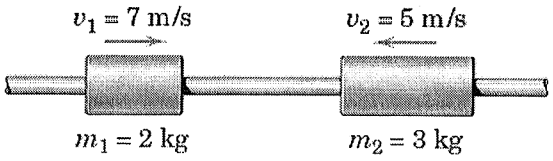

Fig. 5b

6. (a) During a brake test, the rear-engine car (**Fig. 6a**) is stopped from an initial speed of 100 km/h in a distance of 50 m. If it is known that all four wheels contribute equally to the braking force, determine the braking force F at each wheel. Assume a constant deceleration for the 1500-kg car. (8)

(b) A 75-g projectile (**Fig. 6b**) traveling at 600 m/s strikes and becomes embedded in the 50-kg block, which is initially stationary. Compute the energy lost during the impact. Calculate the percentage loss with respect to the original system energy. (8)

(c) Explain principle of conservation of momentum and its applications. (4)

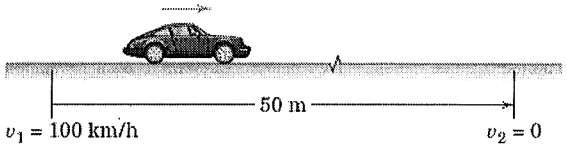

Fig. 6a

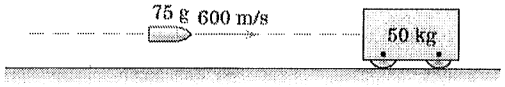

Fig. 6b

7. Write short notes on **any four** among the following: (5X4=20)

(a) Pure bending of beams

(b) Write the governing equation for the free vibration of a single-degree-of – freedom spring-mass system and find out the natural frequency of vibration.

(c) Wahl's correction factor and its importance.

(d) Stresses in thin-walled pressure vessels.

(e) Coefficient of restitution.

(f) Impulse-momentum principle.