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Paper Code : CE(ES)301/ES-AUE301/ES-ME301 Engineering Mechanics
UPID : 003490

CS/B.TECH(N)/ODD/SEM-3/3490/2023-2024/1008

Time Allotted : 3 Hours

Full Marks : 70

The Figures in the margin indicate full marks.
Candidate are required to give their answers in their own words as far as practicable

Group-A (Very Short Answer Type Question)

[1 x 10 = 10]

1. Answer any ten of the following :

- (i) What is framed structure? ✓
- (ii) What is potential energy? ✓
- (iii) State the principle of virtual work. ✓
- (iv) What do you mean by moment of force about a point? ✓
- (v) What is damped vibrations? ✓
- (vi) What is cone of friction? *tan of angle?*
- (vii) When is the phenomenon of resonance observed? ✓
- (viii) What is work done? ✓
- (ix) Define product of inertia. ✓
- (x) State the principle of conservation of linear momentum. ✓
- (xi) How a uniform motion differs from a uniformly accelerated motion? ✓
- (xii) State perpendicular axes theorem concerning moment of inertia for a plane area. ✓

Group-B (Short Answer Type Question)

Answer any three of the following :

[5 x 3 = 15]

- 2. A helical spring fixed at its upper end carries a mass of 5kg attached to it at its lower end. The mass is set into vibration and is measured to make two oscillations per second. Calculate the stiffness of spring. [5]
- 3. Name the different methods of finding out the forces in the members of a perfect frame. Which one is used and where and why? [5]
- 4. A block weighing 400N is resting on a smooth horizontal surface. What work will be done if the block is to be moved through 2m distance by applying
 - a) a horizontal force of 150N?
 - b) a force of 150N whose line of action makes an angle of 30° with the horizontal?[5]
- 5. Two cars are moving in the same direction with a speed of 45km/hr. and a distance of 10km separates them. A car coming from the opposite meets these two cars at an interval of 6 minutes. Determine the speed of this car. [5]
- 6. A sphere of radius r is cut from a larger sphere of radius R . If the distance between their centres is a , locate the centroid of the remaining volume. [5]

Group-C (Long Answer Type Question)

Answer any three of the following :

[15 x 3 = 45]

- 7. (a) A block of mass 50kg resting on a horizontal plane is required to be given an acceleration of 2m/s towards right by applying a push P at an angle of 45° with the horizontal. Assuming that coefficient of friction between the block and plane is 0.4, workout the magnitude of push P . Obtain your solution by applying D'Alembert's principle. [7]
- (b) A 750kW power engine working at full power propels a 2500 KN train up an incline of 1 in 100 at a speed of 60km/hr. If the track resistance is 5 N per KN weight of train, determine the acceleration with which the train is moving. [8]
- 8. (a) A train takes $2/3$ hour while going from station A to station B and also from station B to C. The distance between stations A and B is 25 km and, the stations B and C are 40 km apart. Calculate:
 - (a) the velocity of train at stations A and C and
 - (b) the magnitude of acceleration with which the train is running.Assume that the acceleration is uniform. [8]

(b) An electric train runs between two stations which are 2.5km apart and takes 6 minutes from start to stop. The train has a constant running speed of 36km/hr. between the end of acceleration and beginning of retardation. If the acceleration acceleration and retardation are both uniform and numerically equal to each other, make calculations for their values. [7]

9. (a) A weight of 200N is resting on a rough horizontal plane and can be just moved by a force of 80N applied horizontally. Determine the coefficient of friction and the direction and magnitude of the resultant reaction of the plane. [8]

(b) Find the least friction required to pull a body of weight W placed on a rough horizontal plane, when the force is applied at an angle with the horizontal. [7]

10. (a) Two identical springs connected in parallel are in series arrangement with another identical spring. If the system is loaded by a weight W , show that the deflection is given by $\delta = 3W/2k$ [5]

(b) A block of mass 60 kg is supported by two springs of stiffnesses 6 kN/m and 8 kN/m arranged in series. The block is pulled 40 mm down from the position of equilibrium and then released. presuming the resulting motion of block to be simple harmonic in character, determine its period of vibration, maximum velocity and maximum acceleration. [5]

(c) A series arrangement of two identical springs is connected in series with parallel combination of two similar springs. Show that overall equivalent spring stiffness is $0.4k$ where k is the stiffness of each spring of the stiffness. [5]

Two bodies of weights 50N and 10N are connected to the two ends of a light inextensible string which passes over a smooth pulley. The weight 10N is placed on a rough inclined plane of angle of inclination 20° while the weight of 50N hangs vertically downward. If the coefficient of friction between the body and the plane is 0.2, make calculations for the acceleration of the system, tension induced in the string, reaction at the pulley and the distance moved by the body in 3 seconds starting from rest. [15]

*** END OF PAPER ***

