MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

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

UPID : 003490

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. Answer any ten of the following : [1 x 10 = 10]

(i) Define plane frame.
(ii) When will be centroid and centre of mass coincide?
(iii) What is kinetic energy?
(iv) When is the motion of a particle called curvilinear?
(v) Define force.
(vi) What is free vibrations?
(vii) Define Impulse.
(viii) What is wrong with the following statement: "Coefficient of static friction for concrete is 0.6."
(ix) Define statically determinate and statically indeterminate frame.
(x) Define radius of gyration.
(xi) Differentiate between kinematics and kinetics.
(xii) Cite some engineering applications where (a) friction is undesirable, (b) friction is quite necessary.

Group-B (Short Answer Type Question)

Answer any three of the following [5 x 3 = 15]

2. Differentiate between statics, kinetics and kinematics. [5]
3. A box of mass 80kg is moving at a speed of 10m/s on a ropeway. If the box is 40m above the ground level, estimate the potential energy and kinetic energy of the box. [5]
4. An empty railway wagon weighs 0.25 MN. when it is loaded with goods weighing 0.35 MN, its spring gets compressed by 100 mm. Determine its natural period of vibration (a) when empty, (b) when loaded. [5]
5. Explain the principle of conservation of mechanical energy. [5]
6. A 200 m long passenger train running with a velocity of 72km/hr. is to overtake a 150 long goods train that is moving on a parallel track in the same direction. If the speed of the goods train is 36 km/hr. how much time will be taken for its complete overtake? [5]

Group-C (Long Answer Type Question)

Answer any three of the following [15 x 3 = 45]

7. (a) A body of 50N weight is suspended by two strings 5m and 12m long. The other ends of the strings are fastened to the extremities of a rod which is 13m long. The rod is so held that the body hangs vertically below its mid point. Workout the tensions induced in the strings for the given arrangement. [8]
   (b) A roller of weight 500N rests on smooth inclined plane and is kept free from rolling down by a string. Workout tension in the string and reaction at the point of contact. [7]
8. (a) A wooden block of weight 50N rests on a horizontal plane. Determine the force required to just (a) pull it and (b) push it. Take coefficient friction is 0.4 between the mating surfaces. comment on the result. [8]
   (b) Explain with the help of neat diagram, the concept of limiting friction. [7]
9. (a) A jet of water discharging from a nozzle hits a vertical screen placed at a distance of 6m from the nozzle at a height of 4m. When the screen is shifted by 4m away from the nozzle from its initial position, the jet hits the screen again at the same pint. Determine the angle and velocity with which the jet issues from the nozzle [8]
   (b) An object is projected at an angle of 60^0 with the horizontal. If the horizontal range of the object is 2.5km, make calculations for the velocity of projection and the maximum height attained by the object. [7]

10. Two blocks of mass 60kg and 15kg are connected by a string and move along a rough horizontal surface when a force of 300N is applied to the block of 60kg mass. Apply D'Alembert's principle to determine the acceleration of the blocks and tension in the string. Presume that coefficient of friction between the sliding surface of the blocks and the plane is 0.25. [15]

11. It is observed that the enemy has concentrated its armour behind a 6m height 'Bandh' at a horizontal distance of 40m. At what distance and what inclination the guns should be fixed so that the shot may pass just clear of the top of 'Bandh' and exactly hit the enemy position? The muzzle velocity of the gun shot be taken as 70m/s. [15]