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INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

B.Tech II Semester End Examinations (Supplymentary) - July, 2018

Regulation: IARE-R16

ENGINEERING MECHANICS

(Common to AE|ME|CE)

Time: 3 Hours

Max Marks: 70

Answer ONE Question from each Unit

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

UNIT – I

1. (a) A particle under a constant deceleration is moving in a straight line and covers a distance of 20 m in first 2 seconds and 40 m in the next 5 seconds. Calculate the distance it covers in the subsequent 3 seconds and the total distance covered, before it comes to rest. [7M]
- (b) A stone is dropped gently from the top of a tower. During its last one second of motion it falls through 64% of the height. Find the height of the tower. [7M]
2. (a) A wheel is rotating about its axis with a constant acceleration of 1 rad/s^2 . If the initial and final angular velocities are 5.25 rad/s and 10.5 rad/s , determine the total angle turned through during the time interval this change of angular velocity took place. [7M]
- (b) A projectile is aimed at a mark on the horizontal plane through the point of projection and falls 12 m short when the angle of projection is 15° , while it overshoots the mark by 24 m when the same angle is 45° . Find the angle of projection to hit the mark. Neglect the resistance of air. Take $g = 9.81 \text{ m/s}^2$. [7M]

UNIT – II

3. (a) Two weights 800 N and 200 N are connected by a thread and move along a rough horizontal plane under the action of a force of 400 N applied to the first weight of 800 N. The coefficient of friction between the sliding surfaces of the weights and the plane is 0.3. Determine the acceleration of the weights and the tension in the thread using D'Alembert's principle. [7M]
- (b) Two bodies of weights 40 N and 25 N are connected to the two ends of a light inextensible string, which passing over a smooth pulley. The weight 40 N is placed on a rough inclined plane while the weight 25 N is hanging free in air. If the angle of the inclined plane is 15° and the coefficient of friction between the weight 40 N and the rough inclined plane is 0.3, determine
 - i) The acceleration of the system and ii) The tension in the string [7M]
4. (a) A cage, carrying 10 men each weighing 500 N, starts moving downwards from rest in a mine vertical shaft. The cage attains a speed of 12 m/s in 20 meters. Find the pressure exerted by each man on the floor of the cage. Take $g = 9.80 \text{ m/s}^2$. [7M]
- (b) Two blocks A and B are released from rest as shown in Figure 1 on a 30° incline, when they are 18m apart as shown in below figure. The Coefficient of friction under the upper block A is 0.2 and that under the lower block B is 0.4. In what time block 'A' reaches the block B? After they touch and move as a single unit, what will be the contact force between them? Weights of the block A and B are 100N and 80N respectively [7M]

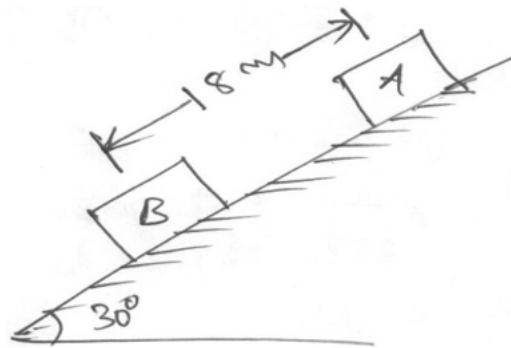


Figure 1

UNIT – III

5. (a) A hammer of mass 700 kg drops from a height of 1.5 m on a pile of mass 25 kg. Find the depth of penetration of the pile into the ground, if the average resistance of the ground is 80 kN. Assume the impact between the hammer and pile to be plastic. [7M]
- (b) A ball of mass 20 kg moving with a velocity of 5 m/s strikes directly another ball of mass 10 kg moving in the opposite direction with a velocity of 10 m/s. If the coefficient of restitution is equal to $\frac{5}{6}$, then determine the velocity of each ball after impact [7M]
6. (a) Explain the terms i) Impact ii) Momentum iii) Impulse and iv) Coefficient of restitution [7M]
- (b) A beam AB of span 10 m carries two point loads of 15 kN and 20 kN at 4 m and 6 m from the end A respectively. Determine the beam reactions by the principle of virtual work. [7M]

UNIT – IV

7. (a) A truck of weight 20 kN is travelling at 45 km/h on a level road. It is brought to rest in a distance of 20 m, what is the average force of resistance acting on the truck. [7M]
- (b) A body weighing 20 N is projected up a 20° inclined plane with a velocity of 12 m/s, coefficient of friction is 0.15. Find i) the maximum distance the body will move up the inclined plane ii) the velocity of the body when it returns to its original position [7M]
8. (a) A railway 4 wheeler wagon weighing 150 kN runs down a gradient of one in hundred. Determine its speed when it has rolled down one kilometer on a straight track. The axle friction is 5 N per kN. The weight of axis and wheels is 20 kN. The wheels have a radius of 0.4 m and a radius of gyration of 0.3m. [7M]
- (b) A glass marble, whose mass is 0.02 kg, fall from a height of 10m and rebounds to a height of 8m, find the impulse and the average force between the marble and the floor if the time during which they are in contact be one-tenth of a second. [7M]

UNIT – V

9. (a) Define the term free vibration and explain different types of vibrations. [7M]
- (b) A pendulum having a time period of 1 second is installed in a lift. Determine its time period when (a) the lift is moving upwards with an acceleration of $\frac{g}{10} \text{ m/s}^2$, and (b) the lift is moving downwards with an acceleration of $\frac{g}{10} \text{ m/s}^2$. [7M]

10. (a) For the simple harmonic motion, explain the terms: i) Amplitude
ii) Periodic time
iii) Frequency [7M]
- (b) A spindle of diameter 3 cm and of length 3.5 m, carries a weight of 280 N at one end. The other end of the spindle is fixed. The weight is pulled downwards and released so that the spindle is having free longitudinal vibrations. Neglecting the weight of the rod, determine the frequency of vibration. Take the modulus of elasticity of the material of the spindle as $2 \times 10^{11} \text{ N/m}^2$. [7M]

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