Hall Ticket No | | | | | | | | | | | Question Paper Code: AME002

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

B.Tech I/II Semester Supplementary Examinations - July, 2017

Regulation: IA-R16

ENGINEERING MECHANICS

[Common for : II Semester (AE, ME and 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) On a straight road, a smuggler's car passes a police station with a uniform velocity of 10 m/s. After 10 seconds, a police party follows in pursuit in a jeep with a uniform acceleration of 1 m/s^2. Find the time necessary for the jeep to catch up with smugglers car. **[7M]**

2. (a) Distinguish between the linear velocity of a point on a body rotating about a fixed axis and its angular velocity. Derive the relation between them. **[7M]**

   (b) An air-craft is moving at a speed of 150 kmph at an altitude of 750 m towards a target on the ground, release a bomb which hits the target. Estimate the horizontal distance of the air-craft from the target when it released the bomb. Calculate also the direction and velocity with which the bomb hits the target. **[7M]**

UNIT – II

3. (a) A lift carries a weight of 110 N and is moving with a uniform acceleration of 3 m/s^2. **[7M]**
   Determine the tension in the cables supporting the lift, when
   i. lift is moving upwards, and
   ii. lift is moving downwards. Take g = 9.80 m/s^2.

   (b) Two blocks A and B are released from rest on a 30° incline, when they are 18m apart as shown in Figure 1. 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]**

4. (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]**

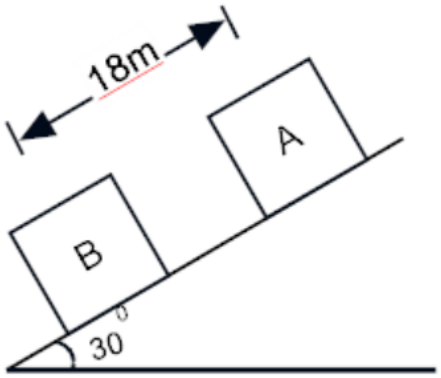

Figure 1

(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 **[7M]**

i. The acceleration of the system

ii. The tension in the string

UNIT – III

5. (a) 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 5/6, then determine the velocity of each ball after impact. **[7M]**

(b) A bullet of mass 50 gm is fired into a freely suspended target of mass 5 kg. On impact, the target moves with a velocity of 7 m/s along with the bullet in the direction of firing. Find the velocity of bullet. **[7M]**

6. (a) State the principle of virtual work and explain its applications. **[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 car of mass 1000 kg descends a hill of 9.59° upward inclination. The frictional resistance to motion is 200 N. Using work energy method , calculate the average breaking effort to bring the car to rest from 48 km/h in 30 m. **[7M]**

(b) A body weighing 20 N is projected up a 200 inclined plane with a velocity of 12 m/s, coefficient of friction is 0.15. Find **[7M]**

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.

8. (a) Derive the expression for work energy equation of a body rotating about a fixed axis. **[7M]**

(b) A hammer of mass 400 kg falls through height of 3 m on a pile of negligible mass. If it drives the pile 1 m into the ground, find the average resistance of the ground for penetration. **[7M]**

UNIT – V

9. (a) Explain the terms Simple harmonic motion, amplitude, frequency, oscillation and period of simple harmonic motion. **[7M]**

   (b) A body is moving with simple harmonic motion and has velocities of 8 m/s and 3 m/s at a distance of 1.5 m and 2.5 m respectively from the centre. Find the amplitude and time period of the body. **[7M]**

10. (a) Derive an expression for the time period of a simple pendulum of length 'l' performing simple harmonic motion. **[7M]**

    (b) A vertical shaft 5 mm in diameter and 1 m in length has its upper end fixed to the ceiling. At the lower end it carries a rotor of diameter 200 mm and weight 20 N. the modulus of rigidity for the material of the rotor is $0.85 \times 10^5 N/mm^2$. Calculate the frequency of torsional vibrations for the system.

    [7M]

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