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Question Paper Code: AME002

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

B.Tech II Semester End Examinations (Regular) - May, 2017

Regulation: IARE – R16

ENGINEERING MECHANICS

(Common for AE/CE/ME)

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 body moving with uniform acceleration is observed to travel 33m in eighth second and 53m in the thirteenth second of its travel. Calculate the velocity at start and uniform acceleration. **[7M]**

   (b) A bullet is fired upwards at an angle of 30° to the horizontal from a point P on a hill and it strikes a target which is 80m lower than P. The initial velocity of the bullet is 100 m/s. Calculate
   i. The maximum height to which the bullet will rise above the horizontal. **[7M]**
   ii. The actual velocity with which it will strike the target.
   iii. The total time required for the flight of the bullet.
   iv. Horizontal distance between hill position and the target.

2. (a) Two stones are thrown vertically upwards, one from the ground with a velocity of 30 m/s and another from a point 40m above with a velocity of 10 m/s. When and where will they meet? **[7M]**

   (b) A cannon ball has a range 'r' on a horizontal plane. It h and h' are the greatest heights in the two paths for which this is possible, show that $r = \sqrt{hh'}$ **[7M]**

UNIT – II

3. Two blocks A and B are held on an inclined plane as shown in 1. The coefficient of friction for block A and B with inclined plane are 0.3 and 0.2 respectively. If the blocks begin to slide down simultaneously calculate the time and distance traveled by each block before block B touches block A. Suppose if they continue to move as a single unit. Determine the contact force exerting between them. Weight of block A = 300N and Weight of block B = 500N. **[14M]**

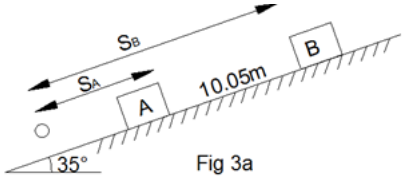

Figure 1

4. (a) A bullet of mass 0.8 kg is fired from a cannon of mass 920 kg with a velocity of 280 m/s in a horizontal direction. A cannon rests on a smooth horizontal surface against a spring buffer whose spring constant is 12 N/mm compression. Calculate the amount of compression of spring due to fire. **[7M]**

   (b) The block A weighs 250N, B weighs 500 N as shown in figure2. The coefficients of friction are 0.4 between A and B, 0.1 between B and the plane and 0.3 between the fixed drum C and the cable. Determine the least value of block D for motion of the block D to impend. **[7M]**

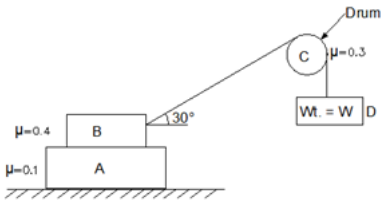

Figure 2

UNIT – III

5. Two bodies of mass 15kg and 9kg respectively hang on light strings 3m long side by side and are just in contact. The heavier body is drawn aside, keeping string taut, until its centre of gravity is raised through a vertical distance of 700 mm. It is then released and on impact, the two masses adhere. Calculate **[14M]**

   i. the velocity of 15kg mass just before impact.

   ii. the common velocity immediately after the impact

   iii. the loss of kinetic energy on impact.

   iv. the vertical height through which the centre of gravity of the combined system will rise.

   v. tension in the string of 15 kg mass just before impact.

6. (a) A mass 12 kg travelling to the right with a speed of 7.5 m/s collides with another mass 24 kg, travelling to the left with a speed of 25 m/s. If the coefficient of restitution is 0.6, find the velocities of the particles after collision and loss in kinetic energy. What is the impulse acting on either particle during the impact? **[7M]**

   (b) A machine raised a load of 360 N through a distance of 200mm. The effort, a force of 60 N moved 1.8m during the process. Calculate by using virtual work method. **[7M]**

   i. Mechanical advantages.

   ii. Velocity.

   iii. Efficiency at this load.

   iv. Effort of friction.

UNIT – IV

7. (a) A block of weight 12N falls at a distance of 0.75 m on top of the spring. Determine the spring constant if it is compressed by 150 mm to bring the weight momentarily to rest. **[7M]**

   (b) A 5 kg block slides from rest at point A along a frictionless inclined plane making an angle of 25° with horizontal. Determine the speed of the block at B at a distance of 3m from A. **[7M]**

8. A pile driver of mass M kg falls from a height of h metre on to the top of a pile of mass m kg and drives it into the ground, a distance of x metre. Assume the resistance of the ground to be constant and the pile to be inelastic, determine **[14M]**

   i. The resistance of the ground.

   ii. The time the pile is in motion.

   iii. kinetic energy lost due to impact.

UNIT – V

9. (a) Explain the concept of Simple Harmonic Motion. **[2M]**

   (b) Mention the causes of 'vibrations' in machines and 'structures'. **[2M]**

   (c) A particle executes Simple harmonic motion with a frequency of 12 oscillations per minute.when the particle lies at a distance of 10cm from the mean position,its velocity equals 65 percent of maximum velocity.Determine **[10M]**

      i. The distance between two extreme positions of the particle.

      ii. The maximum acceleration of the particle

      iii. Velocity of the particle and the time that lapses when it is at a distance of 8cm from the center of oscillation.

10. (a) Mention some of the Harmful effects of vibrations. **[4M]**

   (b) A horizontal steel disc 40cm in diameter and 4cm thick is fitted at its centre to a 1m diameter as shown in the 3.The upper end of the shaft is fixed.Calculate the Frequency and Time period of the assembly.Assume the Modulus of Rigidity of brass as $35 \times 10^9 N/m^2$ and Density of steel as 7860kg/m^3. **[10M]**

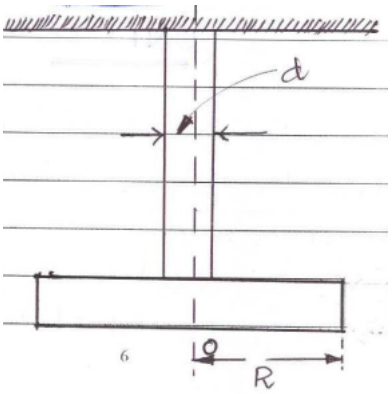

Figure 3