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

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

B.Tech II Semester End Examinations (Regular / Supplementary) - May, 2018

Regulation: IARE – R16

ENGINEERING MECHANICS

Time: 3 Hours **(Common to AE | ME | CE)** **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) As a train accelerates uniformly it passes successive kilometer marks while traveling at velocities of 2m/s and then 10m/s. Determine the train's velocity when it passes the next kilometer mark and the time it takes to travel the 2km distance. **[7M]**

   (b) A ball is released from the bottom of an elevator which is traveling upward with a velocity of 6m/s. If the ball strikes the bottom of the elevator shaft in 3s, determine the height of the elevator from the bottom of the shaft at the instant the ball is released. Also, find the velocity of the ball when it strikes the bottom of the shaft. **[7M]**

2. (a) A car starts from rest and moves with a constant acceleration of 1.5 m/s^2 until it achieves a velocity of 25 m/s. It then travels with constant velocity for 60 seconds. Determine the average speed and the total distance traveled. **[7M]**

   (b) Car A starts from rest at t = 0 and travels along a straight road with a constant acceleration of 6 m/s^2 until it reaches a speed of 80 m/s as shown in Figure.1. Afterwards it maintains this speed. Also, when t = 0, car B located 6000 m down the road is traveling towards A at a constant speed of 60 m/s. Determine the distance travelled by car A when they pass each other. **[7M]**

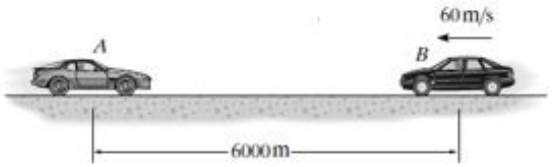

Figure 1

UNIT – II

3. (a) A small block of weight W=44.5 N is given an initial velocity 3m/s down the inclined plane shown in Figure.2. If the coefficient of friction between the plane and the block is 0.3, find the velocity of the block at B after it has travelled a distance x=15 m. **[7M]**

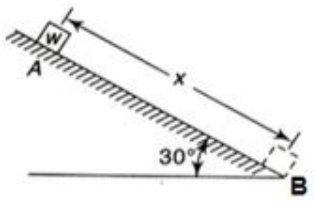

Figure 2

(b) Each of the three plates has a mass of 10kg as shown in figure.3. If the coefficients of static and kinetic friction at each surface of contact are μ_s=0.3 and μ_s=0.2, respectively. Determine the acceleration of each plate when the three horizontal forces are applied. **[7M]**

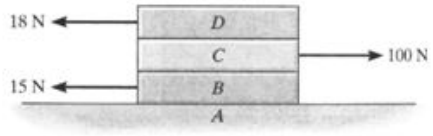

Figure 3

4. (a) A weight W = 4450N is supported in a vertical plane by a string and pulleys arranged as shown in Figure.4. If the free end A of the string is pulled vertically downward with constant acceleration a = 18m/s^2. Find the tension S in the string. Neglect friction in the pulleys. **[7M]**

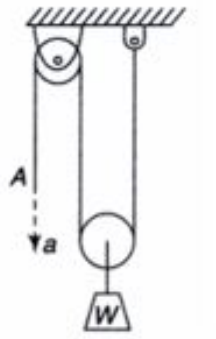

Figure 4

(b) Blocks A and B have a mass of m_A and m_B where $m_A > m_B$ as shown in Figure.5. If pulley C is given an acceleration of a_0, determine the acceleration of the blocks. Neglect the mass of the pulley. **[7M]**

Figure 5

UNIT – III

5. (a) The 100-kg crate is hoisted by the motor M as shown in Figure.6. If the velocity of the crate increases uniformly from 1.5m/s to 4.5m/s in 5s, determine the tension developed in the cable during the motion. **[7M]**

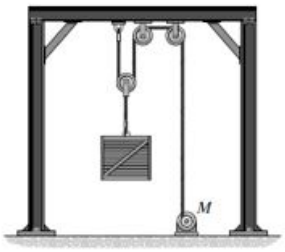

Figure 6

(b) The winch on the back of the Jeep A is turned on and pulls in the tow rope at 2 m/s measured relative to the Jeep as shown in Figure.7. If both the 1.25 tones car B and the 2.5 tones Jeep A are free to roll, determine their velocities at the instant they meet. If the rope is 5 m long, how long will this take? **[7M]**

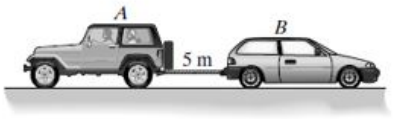

Figure 7

6. (a) Determine the vertical force P that must be applied at G to maintain the equilibrium of the linkage as shown in Figure.8. **[7M]**

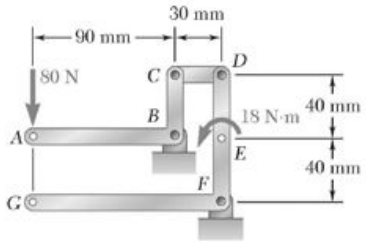

Figure 8

[7M]

(b) Rod AD, hinged at 'D' is acted upon by a vertical force P at end A, and by two equal and opposite horizontal forces of magnitude Q at points B and C as shown in figure.7. Derive an expression for the magnitude Q of the horizontal forces required for equilibrium. **[7M]**

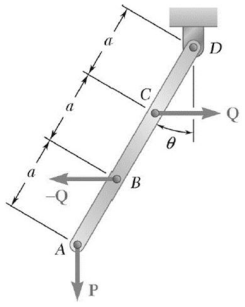

Figure 9

UNIT – IV

7. (a) The crate, which has a mass of 100 kg, is subjected to the action of the two forces as shown in Figure.10. If it is originally at rest, determine the distance it slides in order to attain a speed of 6 m/s. The coefficient of kinetic friction between the crate and the surface is $\mu_k = 0.2$. **[7M]**

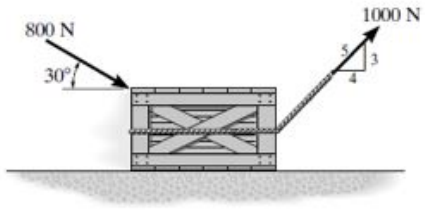

Figure 10

(b) When the driver applies the brakes of a light truck traveling 10 km/h, it skids 3 m before stopping as shown in Figure.11. How far will the truck skid if it is traveling 80 km/h when the brakes are applied? **[7M]**

Figure 11

8. (a) The 10-kg block A is released from rest and slides down the smooth plane as shown in Figure.12. Determine the compression x of the spring when the block momentarily stops. **[7M]**

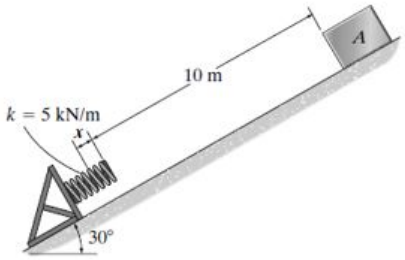

Figure 12

(b) The cylinder has a mass of 20 kg and is released from rest when h = 0 as shown in Figure.13. Determine its speed when h = 3m. The springs each have an unstretched length of 2 m. **[7M]**

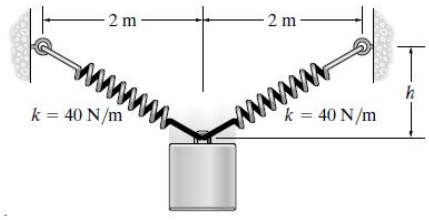

Figure 13

UNIT – V

9. (a) Derive an expression for the time period of a torsional pendulum. **[7M]**

(b) A simple pendulum consisting of a bob attached to a cord oscillates in a vertical plane with a period of 1.3s as shown in Figure.14. Assuming simple harmonic motion and knowing that the maximum velocity of the bob is 0.4m/s, determine

i. the amplitude of the motion in degrees

ii. the maximum tangential acceleration of the bob.

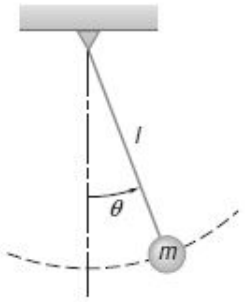

Figure 14

10. (a) A 5-kg block, attached to the lower end of a spring whose upper end is fixed, vibrates with a period of 6.8s. Knowing that the constant k of a spring is inversely proportional to its length, determine the period of a 3-kg block which is attached to the center of the same spring if the upper and lower ends of the spring are fixed. **[7M]**

    (b) A particle has simple harmonic motion. Its maximum velocity was 6 m/sec and the maximum acceleration was found to be 12 m/sec^2. Determine its angular velocity, amplitude. Also determine its velocity and acceleration when displacement is half the amplitude. **[7M]**

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