B.E.INSTRUMENTATION AND ELECTRONICS ENGINEERING EXAMINATION, 2018.

(1st Year, 2nd Semester)

Engineering Mechanics- II.

Time: 3 hrs.

Full marks: 100.

GROUP- A(50 marks)

Attempt any one from (a) or (b) in Question-1.

1. (a)   A particle starts from rest with an acceleration $a = (3-0.2v^2)$ along the **x-axis**, until the acceleration is **zero**, determine the **equation of velocity** as a function of **displacement** also **find** the velocity of the particle in this range.   (5)

   (b)   **Show** that for small oscillations, the vibrating spring mass system is **conservative**. (5)

2.   When a particle moving in a curvilinear path, **express** the **velocity** and **acceleration** of the particle in **polar form**.   (10)

Attempt any two from (a), (b) and (c) in Question-3.

3. (a)   **Calculate** the natural frequency 'ω_o' of the system as shown in **FIGURE- 1**, neglecting friction and mass of the pulley.   (5)

   (b)   A particle moves at a constant speed of **3m/sec** along a parabolic path $y = 3x^2$, what is the acceleration 'a' at the position P as shown in **FIGURE-2**, at which x= 1.5m?   (5)

   (c)   A particle is moving along a straight line with an acceleration following the equation $a=(Kt - \mu^2 x)$, when 'K' and 'μ' are positive constants and where both x and $\dot{x}$ are **zero**, when t=0. Find the value of x as a function of time t.   (5)

4. (a) A **30 Kgs** block is suspended from two light wires as shownin **FIGURE-3.** What is the **frequency** at which the block will swing back and forth in the x-direction if it is slightly disturbed i direction.

   (b) From a point in a smooth horizontal plane a particle is projected with a velocity of '**u**' at angle '**θ**' with horizontal. If '**e**' be the co-efficient of restitution, **show** that the distance describe along the plane before the particle cease to rebound is **(u² Sin2θ)/ g(1-e).**

5. (a) The rotation of the **3metres** arm **OA** as shown in **FIGURE-4,** is defined by the relatio $0.20 t^2$, where '**θ**' is expresses in radian and **t** in **second**. The block '**B**' slides along the arm in st way that its distance from '**O**' is **r = (3 - 0.40 t²)**, where '**r**' is expressed in **metre**. Determine the t **velocity** and the **total acceleration** of the Block '**B**' in vector form after the arm **OA** has rotated through **30°**.

<div align="center">Or</div>

Derive the equation of a **trajectory** of a particle under a **central force motion**.

   (b) A ball is dropped onto a smooth horizontal surface from **height** h_o. The **co-efficient** **restitution** is '**e**'. Show that the total vertical distance '**D**', travelled by the ball before it comes to is **D = h$_o$(1+e²)/(1-e²)**, also find the **time elapsed** before the **bouncing ceases**. (1

   '(c) A **50Kgs**. Block '**A**' on a **30°** plane and a **100Kgs** Block '**B**' on a **60°** plane connecte an inelastic string as shown in **FIGURE-5,** are just set free. If **μ=0.25** for both the planes,
   Find : (i) **the acceleration of the blocks 'A' and 'B';**
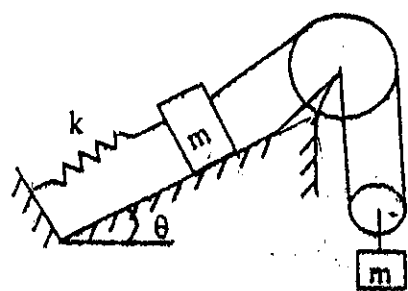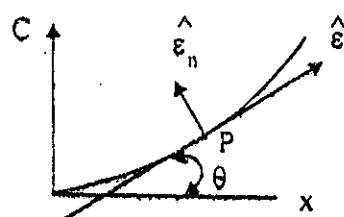   (ii) **tension in the string.** (5

k

m

θ

m

FIGURE: 1.

C

$\hat{\varepsilon}_n$

$\hat{\varepsilon}_t$

P

θ

x

FIGURE: 2.

y

0.80 m

100 mm

30 I g

rectangular of block

FIGURE: 3.

A

r

B

O

θ

FIGURE: 4.

P

$M_a = 50 \text{Kg}$

A

$\mu = 0.25$

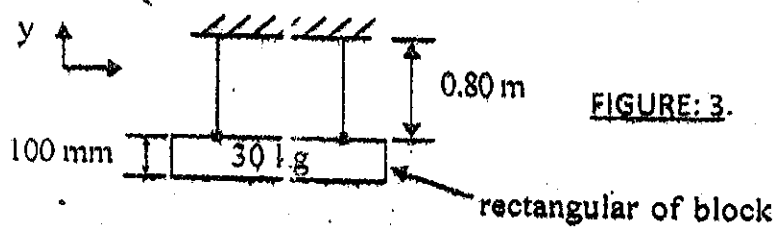$\theta_a = 30°$

P

$\mu = 0.25$

$M_b = 100 \text{Kg}$

B

$\theta_b = 60°$

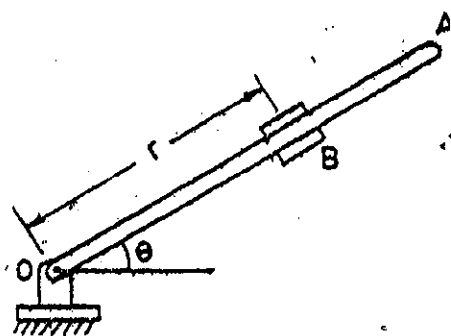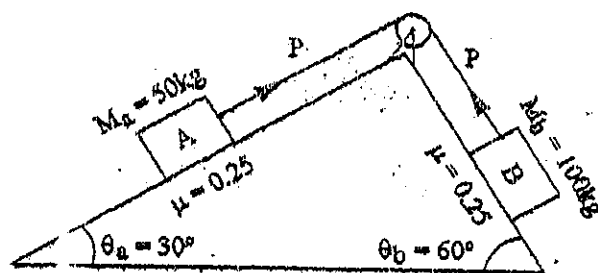**FIGURE: 5.**

Answer any five (5) from the followings. Each question carries 10 Marks

1. A ball is dropped from the top of a tower 30 m high. At the same instant a second ball is thrown upward from the ground with an initial velocity of 15 m/sec. When and where do they cross and with what relative velocity?

2. A bullet is fired from a height of 120 m at a velocity of 360 km/hr. at an angle of $30°$ upwards. Neglecting air resistance, find

(a) Total time of flight.

(b) Horizontal range of the bullet,

(c) Maximum height reached by the bullet, and

(d) Final velocity of the bullet just before touching the ground.

3. Two ships move from a port at the same time. Ship A has velocity of 30 km/hr. and is moving in $N30°W$ while ship B is moving in south-west direction with a velocity of 40 km/hr. Determine the relative velocity of A with respect to B and the distance between them after half an hour. (Solve with figure)

4. A body weighing 300N is pushed up a $30°$ plane by a 400 N force acting parallel to the plane. If the initial velocity of the body is 1.5 m/sec and coefficient of friction is $\mu=0.2$, what velocity will the body have after moving 6 m? Use Work-Energy Equation.

5. A 800N man, moving horizontally with a velocity of 3 m/s, jumps off the end of a pier into a 3200 N boat. Determine the horizontal velocity of the boat, (i) if it had no initial velocity and (ii) if it was approaching towards the pier with an initial velocity of 0.9 m/s.

6. Derive the equation of trajectory for inclined projectile motion on level ground with assumptions and also find the time of flight of the projectile.