(Knowledge for Development)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS

2019/2020 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER

SPECIAL/ SUPPLEMENTARY EXAMINATION

FOR THE DEGREE OF BACHELOR OF SCIENCE

MATHEMATICS

COURSE CODE: MAT 326

COURSE TITLE: DYNAMICS II

DATE: 15/02/2021 **TIME:** 8 AM - 10 AM

INSTRUCTIONS TO CANDIDATES

Answer Question One and Any other TWO Questions

TIME: 2 Hours

This Paper Consists of 3 Printed Pages. Please Turn Over.

QUESTION ONE (20 MARKS)

a) Define the following terms as used in dynamics. (4 Marks)
   i) Scalar Quantity
   ii) Dynamics
   iii) Velocity
   iv) Rigid body

b) A model can move around a circular track of radius 0.8m at 4 rev/sec. What is its:
   (i) Period, T. (2 Marks)
   (ii) Angular Velocity ω. (4 Marks)

c) A body of mass m_0 moving at a speed of V, collides with and sticks to an identical body at rest. What is the mass and momentum of the final clump? (6 Marks)

d) A particle starting 46m from the origin has moved to 86 m in 10 seconds. Find the average velocity of the particle. (4 Marks)

e) State quantum fluid theory. (2 Marks)

f) State Lagrange's Theorem. (2 Marks)

g) If $\phi(x, y, z) = x + 3y - z^2$. Find the $\bar{\nabla}\phi$ at a point (1,-2,1) (4 Marks)

h) (i) Use equation to express center of mass vector $\bar{R}_{CM}$ of two bodies of masses M_1 and M_2

(1 Mark)

(ii) The mass of the system having N particles labeled by index i=1,2,3,…,N. (1 Mark)

QUESTION TWO (20 MARKS)

a) A sailor measured the length of the distant tracker as an angle distance of $1^0, 9^1$ (one degree nine minutes) with a divided Circe. He knows from the shipping chart that the tracker is 140 m in length. Approximately how far away is the tracker? (20 Marks)

QUESTION THREE (20 MARKS)

a) Show that $\bar{\nabla} \bullet (\phi \vec{A}) = \phi(\nabla \bullet A) + A \bullet (\nabla \phi)$ (12 Marks)

b) Consider yourself in a car (A) travelling a long a straight line, level highway with a speed of $V_A = 45 Km/s$. Another car B travels at a speed of $V_B = 70 Km/s$. Find the difference in velocities $V_{BA} = V_B - V_A$ when:

(i) The other car travels in the same direction in front of you. (4 Marks)

(ii) When the other car is approaching you travelling in the opposite direction. (4 Marks)

QUESTION FOUR (20 MARKS)

a) From the equation of acceleration in terms of both initial and final velocities derive the three main linear vertical motion equations. (10 Marks)

b) A block of mass m, hangs from a spring wrapped around a frictionless disk-shaped pulley of mass M and radius R. If the block descends from rest under the influence of gravity, what is the magnitude of the linear acceleration of the block, also apply a diagram? (10 Marks)

QUESTION FIVE (20 MARKS)

i) Solve the problem of the simple pendulum of mass m and length L by first using the Cartesian coordinates to express the Lagrangian and then transform into a system of cylindrical coordinates. (10 Marks)

j) A field vector $\vec{A}$ is given by $\vec{A} = (x+2)\hat{i} + yz\hat{j} + 3z^2\hat{k}$. Find $\vec{A}$. (4 Marks)

k) Find (i) $\vec{C} \times \vec{D}$ and (ii) $\vec{C} - \vec{D}$ provided that $\vec{C} = 7\hat{i} - 2\hat{j} + 3\hat{k}$ and $\vec{D} = 12\hat{i} + 7\hat{j} - 2\hat{k}$ (6 Marks)