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(Knowledge for Development)

KIBABII UNIVERSITY
UNIVERSITY EXAMINATIONS
2021 / 2022 ACADEMIC YEAR
SECOND YEAR FIRST SEMESTER
EXAMINATION
FOR THE DEGREE OF BACHELOR OF SCIENCE

COURSE CODE: MAA 212 / MAT 223

COURSE TITLE: DYNAMICS 1

DATE: 04/02/2022

TIME: 9:00 AM - 11:00 AM

INSTRUCTIONS TO CANDIDATES

Answer Question One and Any other TWO Questions

TIME: 2 Hours

This Paper Consists of 4 Printed Pages. Please Turn Over.

QUESTION ONE (30 MARKS)

- a) Definition (3mks)
- A vector
 - A unit vector
- b) Given $r_1 = 3i + 2j - k$, $r_2 = 2i - 4j - 3k$ and $r_3 = -i + 2j + 2k$. (5mks)
- Find;
- $|r_2|$
 - $|r_1 + r_2 + r_3|$
- c) If $r_1 = 2i - j + k$, $r_2 = i + 3j - 2k$, $r_3 = -2i + j - 3k$ and $r_4 = 3i + 2j + 5k$. (6mks)
- Find scalars a, b and c such that $r_4 = ar_1 + br_2 + cr_3$
- d) Find the angle between $\vec{A} = 2i + 2j - k$ and $\vec{B} = 6i - 3j + 2k$ (5mks)
- e) If $\vec{A} = 2i - j + 2k$ and $\vec{B} = -i - 3k$. Find the unit vector perpendicular to both \vec{A} and \vec{B} (4mks)
- f) Given $a = 2i - j - 2k$, $b = 3i - 4k$, $c = i - 5j + 3k$. (7mks)
- Verify that $a \cdot (b \times c) = (a \times b) \cdot c$

QUESTION TWO (20 MKS)

- a) A particle moving with initial velocity $v = 50j$ undergoes an acceleration $a = (35 + 2t^3)i + (4 - t^2)j$. What are the particles position and velocity after 3 seconds assuming that it starts at the origin? (8mks)
- b) A fish swimming in a horizontal plane has a velocity $v_0 = 4i + j$ at a point in the ocean whose position vector is $r_0 = 10i - 4j$ relative to a stationary rock at the shore. After the fish swims with constant acceleration for 20 secs, its velocity $v = 20i - 5j$. (5mks)
- What are the components of acceleration? (3mks)
 - What is the direction of the acceleration with respect to the fixed x axis? (3mks)
 - Where is the fish at $t = 25$ secs, what is its speed and in what direction is it moving (4mks)

QUESTION THREE (20MKS)

- a) A ball is thrown with a speed of 25m/s at an angle of 40° above the horizontal directly towards a wall. The wall is 22m from the release point of the ball. (4mks)
- How long does the ball take to reach the wall (4mks)
 - How far above the release point does the ball heat the wall (4mks)
 - What are the horizontal and vertical components of its velocity as it heats the wall (4mks)
 - When it heats, has it passed the highest point on its trajectory. Explain (4mks)

- b) A wheel rotates with angular acceleration given by $\alpha(t) = 4at^3 - 3bt^2$ where t is the time and a and b are constants. If the wheel has an initial angular velocity ω_0 . Write equations for the
- Angular velocity (4mks)
 - The angle turned as a function of time (4mks)

QUESTION FOUR (20mks)

- a) A particle sliding along a radial groove in a turn table has polar co-ordinates at time t , $r = ct$, and $\theta = \Omega t$ where c and Ω are positive constants. Find the velocity and acceleration vectors of the particle at time t and find the speed of the particle at time t . Deduce that $\Omega > 0$, the angle between the velocity and acceleration vectors are always acute. (12mks)
- b) The angular acceleration of a body rotating about an axis is directly proportional to the time when $t = 0$, the angular velocity of the body is -15rad/sec given that $\omega = 0$ and $\theta = 16\text{ rad}$ when $t = 5\text{ sec}$. Determine the equation of the motion of the body (8mks)

QUESTION FIVE (20MKS)

- a) A rigid body is rotating with a constant angular speed 7 rads/sec about a fixed axis through the points $A(2, 3, -1)$ and $B(-4, 0, 1)$ distances being measured in centimeters. The rotation is left handed relative to \overrightarrow{AB} . Find the instantaneous velocity, speed and acceleration of the particle P of the body at the point $(-3, 3, 5)$ (12mks)
- b) A grinding wheel is attached to a shaft of an electrical motor of rated speed 1500rpm , when the power is switched on, the unit attains the rated speed in 5 secs and when the power is switched off the unit comes to rest in 90 secs . Assuming uniform accelerated motion, determine the number of revolutions the unit turns. (8mks)
- To attain the rated speed
 - To come to rest