EMBU UNIVERSITY COLLEGE

(A CONSTITUENT COLLEGE OF THE UNIVERSITY OF NAIROBI)

TRIMESTER EXAMINATIONS 2013/2014

SECOND YEAR EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE

SPH 204: MATHEMATICAL PHYSICS I

DATE: AUGUST 14, 2014   TIME: 8.30 – 10.30AM

INSTRUCTIONS:

Answer Question ONE and ANY Other TWO Questions.

QUESTION ONE

a) If complex number $Z_1 = 2 + 3j$ and $Z_2 = 5 - 4j$, evaluate.

   i.) $Z_1 Z_2$ (2 marks)

   ii.) $Z_1 + Z_2$ (2 marks)

   iii.) $Z_2 - Z_1$ (2 marks)

   iv.) Z_1 / Z_2 (2 marks)

b) Find the modulus of Z_1 in (a) above   (2 marks)

c) Proof that if $y = \dfrac{U}{V}$, then $\dfrac{dy}{dx} = \dfrac{V\dfrac{du}{dx} - u\dfrac{dv}{dx}}{V^2}$ (4 marks)

d) i.) Find the area bounded by the curve $y = x^2 + 4x + 3$, the lines $x = 1$, $x = 2$, and $y = 1$

(3 marks)

ii.) Find the area of the segment cut off from the curve $y = x\,(2-x)$ by the line $2y$

(4 marks)

e) Show that the line $y = 2x$ cuts the parabola $3y = x^2$ at (6.12) and find the area of the segment the line cuts off from the curve   (4 marks)

f) Given $A = 2i + 2j - k$ and $B = 6i - 3j + 2k$, find the angle between the two vectors. (4 marks)

QUESTION TWO

a) Determine a unit vector perpendicular to the plane of $A = 2i - 6j - 3k$ and $B = 4i + 3j - k$

(6 marks)

b) The displacement S meters, covered by a moving particle after time, t seconds is given by
$S = 2t^3 + 4t^2 - 8t + 3$. Find:

(i)   Velocity at $t = 3$ (3 marks)

(ii)   Instant at which the particle is at rest.   (4 marks)

c) Given $V = 4i - j + 3k$ and $W = I + j + 2k$. Find $V \times W$ (4 marks)

d) If $\dfrac{dy}{dx} = 2x^5$ what is the value of y   (3 marks)

QUESTION THREE

a) Find Z_1Z_2 if $Z_1 = r_1(\cos\theta + j\sin\theta)$ and $Z_2 = r_2(\cos\emptyset + j\sin\emptyset)$ (5 marks)

b) If the displacement of a particle at any time t(s) is given by $x(t) = t(t-2)^2$ find its velocity at maximum and minimum displacement.   (4 marks)

c) A ball is thrown straight up with an initial velocity of 3840 cm/s such that the formula for height d and time t is $d = 3840t - 16t^2$. Find the maximum height reached.   (4 marks)

d) (i) If $f(x) = x$ prove that that $f^1(x) = 1$ (3 marks)

    (ii) If $f(x) = c$ where c is a constant prove that $f(x) = f(x + h) = c$ (4 marks)

QUESTION FOUR

a) The curve passes through the origin and its gradient at any point at (x,y) is $1 - \frac{1}{3}$ x. find the area bounded by the curve, the x axis and the coordinates $x = 1$, $x = 2$ (5 marks)

b) Find the derivative of-

    i.) $Y = \sin^3 x$ (4 marks)

    ii.) $Y = e^{x2}$ (4 marks)

    (iii)   Given $u = x^2 + 3xy + y^2 + 2yz$, determine, $\frac{du}{dz}$ (2 marks)

c) Express $\cos3\theta$ and $\sin3\theta$ by use de moivre's theorem   (5 marks)

QUESTION FIVE

a) A particle moves along a curve whose parametric equations are

$X = e^{-1}$, $y = 2\cos 3t$, $Z = 2\sin 3t$, where t is the time.

    i.)   Determine its velocity and acceleration at any time.   (4 marks)

    ii.)   Find the magnitudes of the velocity and acceleration at t= 0   (4 marks)

b) The acceleration of a particle at any time $t \geq 0$ is given by;

$$A = \frac{dv}{dt} = 12\cos 2t\,i - 8\sin 2t\,j + 16t\,k$$

If the velocity v and displacement r are zero at t = 0, find v and r at any time. (8 marks)

c) Find the curve whose slope at the point p(x,y) is $3x^2$ if it passes through the point A(1,-1)

                                                  (4 marks)

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