MACHAKOS UNIVERSITY COLLEGE

(A Constituent College of Kenyatta University)
University Examinations for 2015/2016 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

SECOND SEMESTER EXAMINATION FOR DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING

MATHEMATICS VI

DATE: 1/8/2016 **TIME: 2:00 – 4:00 PM**

INSTRUCTIONS:

Answer QUESTION ONE and Any other TWO Questions

1 a) Evaluate

i) $I = \int_1^2 \int_2^4 (x+2)\, dx\, dy$ (4 marks)

ii) $I = \int_1^3 \int_{-1}^1 \int_0^2 (3x - y - 2z) dxdydz$ (6 marks)

b) Find from first principals the laplace transform of:-

i) 3 (4 marks)

ii) cos2t (5 marks)

c) Find the inverse Laplace transform of:-

i) $\frac{9s-8}{s^2-2s}$ (5 marks)

ii) $\frac{2s^2-6s-1}{(s-3)(s^2-2s+5)}$ (6 marks)

2 a) Evaluate $I = \int_1^2 \int_0^3 x^2 y\, dxdy$ (6 marks)

b) Determine I = $\int_1^2 \int_0^{\pi} (3 + sin\theta) d\theta dr$ (6 marks)

c) Find the area enclosed by the curves $y^2 = 9x$ and $y_1 = \frac{x^2}{9}$ (8 marks)

3. a) Evaluate I = $\int_1^2 \int_0^3 \int_1^{3X} y\, dydxdz$ (9 marks)

b) Find the volume of the solid bounded by the planes z =0, x = 1, x = 2, y = -1, y = 1and the surface $z = x^2 + y^2$ (11 marks)

4. a) Derive the Laplace transform of the function F(t) = $e^{2t}cos3t$ from first principals.

(8 marks)

b) Solve the differential equation $(D^2 - 3D + 2)\, y = e^{3t}$ given that when t = 0, y = 1 and $\frac{dy}{dx} = 0.$ (12 marks)

5. a) Find from first principals the Laplace transform of e^{2t}. (4 marks)

b) Determine the inverse Laplase transform of $\frac{4s^2 - 5s+6}{(s+1)(s^2+4)}$ (6 marks)

c) Use Laplace transforms to solve the differential equation

$\frac{d^2x}{dt^2} - 3\frac{dx}{dt} + 2x = 2e^{3t}$ given that at t = 0, x = 5 and $\frac{dx}{dt} = 7$ (10 marks)

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MATHEMATICS IV

DATE: 1/8/2016 **TIME: 2:00 – 4:00 PM**

INSTRUCTIONS:

Answer QUESTION ONE and Any other TWO Questions

1 a) Evaluate

i) $\int (x^6 - 1)dx$ (2 marks)

ii) $\int 3e^{4x}\,dx$ (3 marks)

b) Determine

i) $I = \int (\frac{1}{t^2} + 3 + 2t)\,dt$ (4 marks)

ii) $I = \int (4e^{2x+4} + \frac{3}{4x})\,dx$ (4 marks)

c) Evaluate

i) $I = \int_1^2 \int_2^4 (x+2)\,dx\,dy$ (5 marks)

ii) $I = \int_1^3 \int_{-1}^1 \int_0^2 (3x - y - 2z)dxdydz$ (6 marks)

d) A curve passes through the point (3,-1) and its gradient function is 2x + 5. Find its equation. (6 marks)

2 a) Evaluate $I = \int_1^2 \int_0^3 x^2 y\, dxdy$ (6 marks)

b) Determine $I = \int_1^2 \int_0^{\pi} (3 + sin\theta) d\theta dr$ (6 marks)

c) Find the area enclosed by the curves $y^2 = 9x$ and $y_1 = \frac{x^2}{9}$ (8 marks)

3. a) Evaluate $I = \int_1^2 \int_0^3 \int_1^{3X} y\, dydxdz$ (9 marks)

b) Find the volume of the solid bounded by the planes z =0, x = 1, x = 2, y = -1, y = 1and the surface $z = x^2 + y^2$ (11 marks)

4. a) Evaluate

i) $\int 2x(3x^2 + 5)dx$) (3 marks)

ii) $\int x cos\, 3x\, dx$ (4 marks)

iii) $\int \frac{x-8}{x^2-x-2}\, dx$ (4 marks)

b) Find the area bounded by $y = \frac{12}{5}x^2$, the x- axis and the ordinate at x = 5.(9m)

5. a) Evaluate the double integral

$$\int_0^{3/2} \int_0^{\sqrt{9-y^2}} (x^2 + y^2)\, dxdy.$$ (8 marks)

b) Find the volume V of the solid bounded on top by the surface $z = 5 - x^2 - y$, below by the x-y plane and the cylinder $x^2 + y^2 = 16$. (12 marks)

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SECOND SEMESTER EXAMINATION FOR DIPLOMA IN MECHANICAL ENGINEERING

MATHEMATICS III

DATE: 3/8/2016 **TIME: 8:30 – 10:30 am**

INSTRUCTIONS:

Answer QUESTION ONE and Any other TWO Questions

QUESTION ONE

a) Given the matrix $M = \begin{bmatrix} 3 & -6 & 2 \\ 6 & 2 & -3 \\ 2 & 3 & 6 \end{bmatrix}$ find MM^T and hence state M^{-1} (3 marks)

b) Find the inverse of the matrix

$$p = \begin{bmatrix} 4 & 8 & 3 \\ 3 & 5 & 2 \\ 2 & 4 & 3 \end{bmatrix}$$ (8 marks)

c) Use Cramer's rule to solve the simultaneous equation

$2x + 3y - z = -6$

$x + y - 4z = -5$

$5x + 2y + z = 17$ (9 marks)

QUESTION TWO

a) Evaluate the double integral

$$\int_0^{3/2} \int_0^{\sqrt{9-y^2}} (x^2 + y^2)\, dxdy. \qquad \text{(8 marks)}$$

b) Find the volume V of the solid bounded on top by the surface $z = 5 - x^2 - y$, below by the x-y plane and the cylinder $x^2 + y^2 = 16$. (12 marks)

QUESTION THREE

a) Solve the differential equation $xy\frac{dy}{dx} = x^2 + y^2$ given that when x = 1 y = 0 (9 marks)

b) Use the method of undetermined coefficient to solve the differential equation

$\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + 10y = sin3x$ Given that y = 0 and $\frac{dy}{dt} = 1$ when t = 0 (11 marks)

QUESTION FOUR

a) i) Derive fourier series co efficients for half range sine series with a period T. (5 marks)

ii) Given $f(x) = \begin{cases} 3t & 0 < t > 1 \\ 3 & 1 < t > 2 \\ & f(t+2) \end{cases}$ find the fourieir series (15 marks)

QUESTION FIVE

Given that $f(x) = \begin{cases} x & 0 < x > 2\pi \\ 0 & elswhere \\ & f(x + 2\pi) \end{cases}$

i) Sketch the function between $-4\pi < x > 4\pi$ (5 marks)

ii) Obtain the fourier series of the function (15 marks)

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SECOND SEMESTER EXAMINATION FOR DIPLOMA IN EDUCATION

SMA 0205: VECTOR ANALYSIS

DATE: SCHOOL BASED **TIME:**

INSTRUCTIONS:

Answer QUESTION ONE and Any other TWO Questions

1. a) Define a

i) Scalar product (2 marks)

ii) Vector product (2 marks)

b) Given that **P** = 5**i** – 2**j** + **k** and **Q** = 2**i** + 5**j** – 6**k** evaluate

i) **P . Q** (3 marks)

ii) **P** x **Q** (4 marks)

c) If **A** = (u+3)**i** – (2u+u^2)**j** + 2u^3**k** determine

i) $\frac{d\boldsymbol{A}}{du}$ ii) $\frac{d^2\boldsymbol{A}}{du^2}$ (4 marks)

d) If **F** = 2uv**i** + (v^2-5u)**j** – (2u+v^2)**k** determine

i) $\frac{\partial \boldsymbol{F}}{\partial u}$ ii) $\frac{\partial^2 \boldsymbol{F}}{\partial u^2}$ iii) $\frac{\partial^2 \boldsymbol{F}}{\partial u \partial v}$ (6 marks)

e) i) Given $\emptyset = 2x^2y^3z$. Find grad $\emptyset$ (3 marks)

ii) Show that curl(-y**i** + x**j**) is a constant vector. (6 marks)

2. a) Given $\mathbf{A} = x^2y^3\mathbf{i} - 2xyz^2\mathbf{j} + x^2z\mathbf{k}$

$\mathbf{B} = xy^2z\mathbf{i} + 3yz^2\mathbf{j} - xyz^2\mathbf{k}$ and that

$\emptyset = xy^2z^3 - 3xy^2 + xyz^2$

Determine at the point (1,-2,1)

i) $\nabla\emptyset$

ii) $\nabla.\mathbf{A}$

iii) $\nabla \times \mathbf{B}$ (10 marks)

b) If $\mathbf{OA} = 2\mathbf{i} + 3\mathbf{j} - \mathbf{k}$ and $\mathbf{OB} = \mathbf{i} - 2\mathbf{j} + 5\mathbf{k}$ determine

i) the value of **OA . OB**

ii) the product **OA** x **OB** in terms of unit vectors

iii) the cosine of the angle between **OA** and **OB** (10 marks)

3. a) If $\mathbf{A} = 2\mathbf{i} - 3\mathbf{j} + \mathbf{k}$, $\mathbf{B} = \mathbf{i} + 4\mathbf{j} - 2\mathbf{k}$, and $\mathbf{C} = 3\mathbf{i} + \mathbf{j} + 2\mathbf{k}$, determine

ii) angle between **A** and **B**

iii) **B** x **C**

b) If $\mathbf{A} = x^2y\mathbf{i} + (xy + yz)\mathbf{j} + xz^2\mathbf{k}$

$\mathbf{B} = yz\mathbf{i} - 3xz\mathbf{j} + 2xy\mathbf{k}$ and

$\emptyset = 3x^2y + xyz - 4y^2z^2 - 3$ determine at the point (1,2,1)

i) grad $\emptyset$ ii) div grad $\emptyset$ iii) grad div **A** iv) div curl **B** (10 marks)

4. a) Given that $u = e^x[\sin(y+z) - y\cos(y+z)]$

Show that $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2} + u = 2e^x\sin(y+z)$ (10 marks)

b) Find the directional derivatives of the function $\emptyset = x^2z + 2xy^2 + yz^2$ at the point (1,2,-1) in the direction of the vector $\mathbf{A} = 2\mathbf{i} + 3\mathbf{j} - 4\mathbf{k}$ (10 marks)

5) A surface consists of five sections formed by the planes x = 0, x = 1, y = 0, y = 3, Z = 2 in the first octant . If the vector field $\mathbf{F} = y\mathbf{i} + z^2\mathbf{j} + xy\mathbf{k}$ exists over the surface and around its boundary verify Stokes theorem. (20 marks)