TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR:

DIPLOMA ELECTRICAL ENGINEERING

ELECTRICAL POWER OPTION, TELECOMMUNICATION OPTION

INSTRUMENTATION AND CONTROL OPTION

YEAR II SEMESTER I

AMA 2250: ENGINEERING MATHEMATICS III

SPECIAL/ SUPPLIMENTARY EXAMINATIONS

SERIES: SEPTEMBER 2018

TIME: 2HOURS

DATE: SEPTEMBER 2018

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student I Mathematical table, calculator

This paper consists of **FIVE** questions. Attempt question **ONE** (Compulsory) and any other **TWO** questions.

Do not write on the question paper.

QUESTION ONE (compulsory) **30marks**

(a) Show that the differential equation

$3x^2y^2dx + 2x^3ydy - 2xdx = 0$ is exact and hence solve it (5marks)

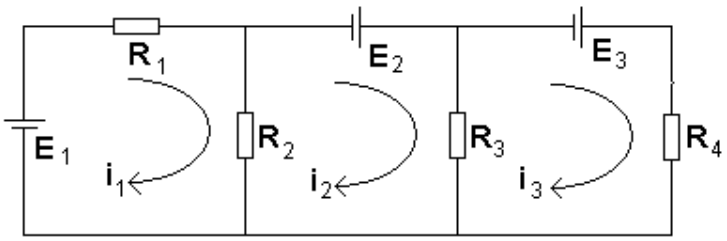
(b) The deflection of a galvanometer is governed by he equation.

$\frac{d^2\theta}{dt^2} + 2\frac{d\theta}{dt} + \theta = 4$ Find the deflectionθ, at any time t (6marks)

(c) (i) Using the circuit diagram in figure 1, find the matrix of the system of

Simultaneous equations formed by the current i_1 i_2 and i_3. Given that

$R_1 = R_2 = R_3 = R_4 = 1$, $E_1 = 3$, $E_2 = 2$, $E_3 = 1$,



(ii) Hence determine the current i_1 i_2 and i_3 using Crammers. (7marks)

(d) The current I flowing in a circuit where $E = 20V$ is the applied voltage, $L = 2H$ is the

Inductance and $R = 150\Omega$ the resistance.

i) Obtain the differential equation governing the circuit as a function of the current i

ii) Use integrating factor to obtain the current I given that when $t = 0, i = 0$. (6marks

e) Given that $V = e^{3x+4y}\cos 5z$. Show that $\frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} + \frac{\partial^2 V}{\partial Z^2} = 0$ (6marks)

QUESTION TWO **(20mark)**

a) Given that $u=\frac{x-y}{x+y}$ show that $\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}=\frac{4u}{(x+y)^2}$ (6marks)

b) Find the rate of change of volume of a cone at an instant when its base is 6cm and height is 8cm. If the radius decrease at the rate of 0.6cm/sec and height decrease at the rate of 0.2cm/sec (5marks)

c) Locate the stationary points of the function $f(x,y)=x^2-3y^2+2xy-4x+8y$ and state their nature (9marks)

QUESTION THREE **(20mark)**

a) Given $A=\begin{bmatrix}1 & 2 & 1\\ -2 & -1 & 2\\ 1 & 3 & 2\end{bmatrix}$, $B=\begin{bmatrix}1 & -1 & 1\\ 3 & -1 & 2\\ 1 & 2 & 1\end{bmatrix}$ Determine $C=A^2-4B$ (6marks)

b) Solve the equation $\begin{vmatrix}x & 3 & 2\\ 1 & 1 & x\\ x & 1 & 2\end{vmatrix}=0$ (3marks)

c) Three e.m.f in a three loop d.c circuit satisfy the equations

$$3E_1+2E_2-E_3=12$$
$$-2E_1+E_2-2E_3=-12$$
$$E_1-2E_2+3E_3=10$$

Use inverse matrix method to determine the values of e.m.f (11marks)

QUESTION FOUR **(20marks)**

a) Solve the differential equations

i) $x^2\frac{dy}{dx}=xy+x^2+y^2$ (6marks)

ii) $\frac{dy}{dx} + y\cot x = \cos x$ (6marks)

b) The response of a linear system is characterized by the differential equation

$\frac{d^2x}{dt^2} - 2\frac{dx}{dt} + x = e^{-t}$ Given that $t = 0, x = 0$ *and* $\frac{dx}{dt} = 1$. Use D-operator method

to solve the differential equation (8marks)

QUESTION FIVE **(20marks)**

(a) Using the circuit diagram in figure 2.

i) Form a differential equation in terms of charge q, satisfying the circuit diagram hence.

ii) Solve the differential equation formed to find the charge q and the current

i given that when $t = 0, q = 0$ when $i = 0$ (12marks)

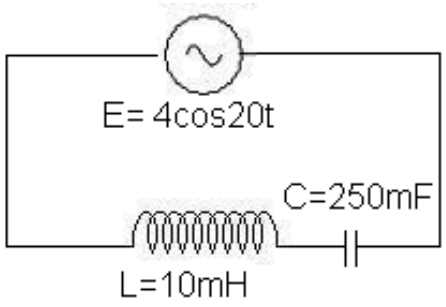


Fig 2.

b) The module of rigidity G is given by: $G = \frac{R^4\,\theta}{L}$ where R is the radius θ is the angle

twist L is the length. Use partial derivatives to find the percentage change in G where

R is increased by 2%, θ decreased by 5% and L increased by 3%. (8marks)