TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

ELECTRICAL AND ELECTRONIC ENGINEERING DEPARTMENT

UNIVERSITY EXAMINATION FOR:

HIGHER DIPLOMA IN TECHNOLOGY

ELECTRICAL POWER ENGINEERING

AMA 3151: **Engineering Mathematics I**

END OF SEMESTER EXAMINATION

SERIES: OCTOBER 2016

TIME: 2HOURS

DATE: OCTOBER 2016

Instructions to Candidates

1.You should have the following for this examination

- *Answer Booklet*
- *examination pass*
- *student ID*
- *Electronic calculator*

2. This paper consists of FIVE Questions.

3. Attempt ANY THREE questions.

4. All questions carry equal marks.

5. This paper consists of FOUR printed pages.

Do not write on the question paper.

<u>Question One (30 Marks)</u>

a)

i) Evaluate $\lim_{x\to 7}\left(\frac{x^2-12x+35}{x-7}\right)$ *(4 marks)*

ii) From first principles determine the gradient function of

$f(x)=\frac{1}{3x^2}+x$ *(3 marks)*

iii) Determine the derivatives of $f(\theta)=\frac{2}{e^{3\theta}}$ *(3 marks)*

b) Determine

i) $L\{6\sin 3t-4\cos 5t\}$ using standard list of Laplace transforms *(3 marks)*

ii) $L^{-1}\left\{\frac{4s-3}{s^2-4s-5}\right\}$ *(6 marks)*

c)

i) Determine $\int\left(\frac{2m^2+1}{m}\right)dm$ *(2 marks)*

ii) Evaluate $\int_0^2 \frac{3x}{\sqrt{(2x^2+1)}}dx$, taking positive values of square roots only

(4 marks)

d) Determine the particular solution of

$\frac{d\theta}{dt}=2e^{3t-2\theta}$, given that $t=0$ when $\theta=0$ *(5 marks)*

Question Two (20 Marks)

a) Determine $\int\frac{11-3x}{x^2+2x-3}dx$ *(6 marks)*

b) A sinusoidal voltage $v=100\sin\omega t$ volts. Use integration to determine over half a cycle

i) The mean value *(6 marks)*

ii) The r.m.s value *(8 marks)*

Question Three (20 Marks)

a) A curve is defined parametrically by $y=\frac{2x}{1+x}$ and $t=\frac{1-x^2}{1+x^2}$. Determine $\frac{dy}{dt}$ when $x=1$

(6 marks)

b) Determine the equation of the normal and tangent to the curve $y=\frac{1}{x}$ at point $\left(3,\ \frac{1}{3}\right)$

(6 marks)

c) The voltage across the plates of a capacitor at any time t seconds is given by $v=Ve^{-t/CR}$, where V, C and R are constants. Given $V=300$ volts, $C=0.12\times10^{-6}F$ and $R=4\times10^{6}\Omega$, determine the following:

i) The initial rate of change of voltage *(5 marks)*

ii) The rate of change of voltage after $0.5s$ *(3 marks)*

Question Four (20 Marks)

a) Determine the Laplace transform of $f(t)$ defined as

$$f(t)=\begin{cases}\frac{t}{k}, & 0<t<k\\ 1, & t>k\end{cases}$$

(4 marks)

b) Determine the inverse Laplace transform of $\frac{s-2}{6s^2+20}$ *(5 marks)*

c) The current flowing in an electrical circuit is given by the differential equation $Ri+L\left(\frac{di}{dt}\right)=E$ where E, L and R are constants. Use Laplace transform to solve the equation for current given that when $t=0$, $i=0$ *(11 marks)*

Question Five (20 Marks)

d) Given the differential equation $(x-2)\frac{dy}{dx}+\frac{3(x-1)}{(x+1)}y=1$, use the integrating factor to determine its particular solution taking boundary conditions to be $y=5$ when $x=-1$

(10 marks)

e) The equation $\frac{d^2i}{dt^2}+\frac{Rdi}{Ldt}+\frac{1}{Lc}i=0$ represents a current i flowing in a electrical circuit containing resistance R inductance L and capacitance C connected in series. If $R=200$ ohms, $L=0.20$ henry and $C=20\times10^{-6}$ farads, solve the equation for i given the boundary conditions that $t=0$, $i=0$ and $\frac{di}{dt}=100$

(10 marks)