FACULTY: ENGINEERING
SECOND SEMESTER EXAMINATIONS
2015/ 2016 ACADEMIC SESSION

HOD'S SIGNATURE

COURSE CODE: GNE212
COURSE TITLE: ENGINEERING MATHEMATICS
DURATION: 2 HOURS 30 MINUTES

INSTRUCTIONS

1. ATTEMPT ANY **FOUR** QUESTIONS OF YOUR CHOICE
2. SEVERE PENALTIES APPLY FOR MISCONDUCT, CHEATING, POSSESSION OF UNAUTHORIZED MATERIALS DURING EXAM
3. YOU ARE NOT ALLOWED TO BORROW CALCULATORS AND ANY OTHER WRITING MATERIALS

1a. A spring of mass of 2 kg has a natural length 0.5 m. A force of 25.6 N is required to maintain it stretched to a length of 0.7 m. If the spring is stretched to a length of 0.7 m and then released with initial velocity 0, find the position of the mass at any time t.

b. Solve the equation $\frac{d^2y}{dx^2} - 3\frac{dy}{dx} + 2y = x^2, at x = 0; y = \frac{3}{4}; \frac{dy}{dx} = \frac{5}{2}$

(15 marks)

2a. A series circuit consist of a resistor $R = 20\ ohm$, an inductor $L = 1H$, a capacitor with $c = 0.002f$, and a generator producing voltage at $E(t) = 12sin10\ t$. If the initial charge and current are both zero. Find the charge at time t.

b. Solve the equation $y'' - 3y' + 2y = \sin t \ \ at\ t = 0,\ y = 0, y' = 0$

(15 marks)

3a. Find the volume of the solid below the plane $x + 2y$ and above the region R in the xy plane bounded by $y = 2x$ and $y = x^2$

b. (i) Evaluate the double integral

$\int_0^2 \int_1^x e^{x^2}\, y\, dydx$

(ii) Evaluate the double integral

$\int_0^3 \int_1^2 x^2\, y\, dydx$ $\qquad$ $\int_1^2 \int_0^3 x^2\, y\, dxdy$

(15 marks)

4a. Find the work done if a particle moves from $(-1, 3)$ to $(2, 2)$ along the parabola $y = x^2$, while subject to the force

$$\boldsymbol{F}(x, y) = x^3y\boldsymbol{i} + (x - y)\boldsymbol{j}$$

The path of the particle is represented in vector notation as

$$\boldsymbol{r}(t) = t\boldsymbol{i} + t^2\boldsymbol{j} \qquad (-2 \leq t \leq 1)$$

b. Evaluate $\int_c \boldsymbol{F}.\, d\boldsymbol{r}$ if $\boldsymbol{F}(x, y, z) = yz\boldsymbol{i} + xz\boldsymbol{j} + xy\boldsymbol{k}$ and C is the curve $\boldsymbol{r}(t) = t\boldsymbol{i} + t^2\boldsymbol{j} + t^3\boldsymbol{k}\ (0 \leq t \leq 1)$

(15 marks)

5a. (i) Let $w = f(z) = z^2 + 4z$. Find u and v and calculate the value of f at $z = 1 + 3i$

(ii)Show that $u = x^2 - y^2 - y$ is harmonic in the whole complex plane, find a harmonic conjugate function v of u, and the corresponding analytic function $f(z) = u + iv$.

b. Map the straight line joining A(0 + i) and B(2 + 3i) in the z plane onto the w plane when $w = 3 + i2z$

(15 marks)