# JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE & TECHNOLOGY UNIVERSITY EXAMINATIONS 2012/2013

## 2ND YEAR 1ST SEMESTER EXAMINATION IN DEGREE OF BACHELOR OF SCIENCE RENEWABLE ENERGY TECHNOLOGY AND MANAGEMENT

## (REGULAR)

**COURSE CODE: TET 3214**

**COURSE TITLE: ELECTRICAL POWER APPLICATIONS**

**DATE: 12/8/13** **TIME: 11.30 – 1.30 PM**

**DURATION: 2 HOURS**

**INSTRUCTIONS**

- **The exam has FIVE questions.**
- **Question Q1 is Compulsory.**
- **Answer Any other THREE questions**
- **All the Other Four questions carry equal marks.**

## Question 1

**Q1 (a)(i)** State Kirchhoff's laws, giving an algebraic expression for each law and Maxwell circulating current for an electrical circuit. **(2 marks)**

**(a) (ii)** In the of Fig.1, find the current through each resistor and voltage drop across each resistor using:

**(i)** Kirchhoff's laws **(4 marks)**

**(ii)** Maxwell circulating current **(4 marks)**

**(b) (i)** State Superposition and Thevenin's theorem for an electric circuit. **(2 marks)**

**(ii)** A network is arranged as shown in Fig. 2. Calculate the current $I_{AB}$ (through resistor $R_L$ using :

(i) Superposition theorem **(4 marks)**

(ii) Thevenin's theorem **(4 marks)**

## Question 2

**Q2 (a**) Define giving the mathematical expression, symbols, units and explain the meaning of each symbol:

(i) Capacitance. **(1 mark)**

(ii) Electric field strength. **(1 mark)**

(ii) Electric flux density. **(1 mark)**

(b) (i) A capacitor is made with six metal plates and separated by sheets of mica having a thickness of 0.4mm and a relative permittivity of 8. The area of one side of each plate is 500cm2. Calculate the capacitance in microfarads. **(1 mark)**

(b)(ii) A p.d of 400 Vis maintained across the terminals of the capacitor b in (b)(i). Calculate:

(i) The charge. **(1 mark)**

(ii) The electric field strength or potential gradient. **(1 mark)**

(ii) The electric flux density. **(1 mark)**

**(c)** For the network shown in Fig. 3, the switch is closed on to position 1 when t =0 and moved to position 2 when t=20ms.
(i) Determine the voltage across the capacitor when T=30ms. **(11 marks)**

## Question 3

**3(a) (i)** State Fleming's Left-hand and Right-hand rule and where each is applied. **(4 marks)**

**(i)** How can the direction of the force in the above magnet field be reversed? **(1 mark)**

**(ii)** How can the force on a conductor carrying a current in a magnetic field be increased? Give the mathematical expression for the force on the conductor. **(2 mark)**

**(b) (i)** A rectangular coil measuring 100mm by 50mm is mounted such that it can be rotated about the midpoints of the 50 mm sides. The axis of rotation is at right angles to a magnetic field of uniform flux density of 0.04 T. Calculate the flux in the coil for the following conditions:

(i) The maximum flux through the coil and the position at which it occurs; **(1 mark)**

(ii) The flux through the coil when the 50mm sides are inclined at 45 degree to the direction of the flux. **(1 mark)**

**(c) (i)** State Faraday's first law and the second law of electromagnetic induction. Give mathematical expression for the second law explaining the meaning the symbols. **(3 marks)**

**(c)(ii)** State Lenz's law. Give a mathematical expression for the magnitude generated or induced e.m.f in a conductor, explaining all the symbols in the expression. **(2 marks)**

**(ii)** Calculate the e.m.f generated in the axle of a car travelling at 80 km/h, assuming the length of the axle to be 2 m and the vertical component of the earth's magnetic field to be 40 micro-Teslas. **(2 marks)**

## Question 4

**4Q (a)** Define giving the mathematical expression, symbols, units and explain the meaning of each symbol:

(i) Magnetomotive force. **(1 mark)**
(ii) Reluctance. **(1 mark)**
(ii) Magnetic field strength. **(1 mark)**
(ii) Magnetic flux density. **(1 mark)**

**4Q(b)** A coil of 300 turns and resistance of 10 Ohms is wound uniformly over a steel ring of mean circumference 30 cm and a cross-sectional area of 9 cm. It is connected to a supply of 20 V D.C. If the relative permeability of the ring is 1500, find:

(i) The magnetising force. **(1 mark)**
(ii) The reluctance. **(1 mark)**
(iii) The m.m.f. **(1 mark)**
(iv) The flux **(1 mark)**

**Q4 (c) (i)** A cast steel magnetic structure made of a bar of section 2 cm by 2 cm is shown in Fig. 4. Determine the current that the 600 turn magnetising coil on the left limb should carry so that a flux of 2 m W is produced in the right limb. Take relative permeability is 600 and the neglect leakage**. (4 marks)**

**(c) (**ii) For the network shown in Fig. 5, the switch is closed on position 1 when i=0 and then moved to position 2 when t =1.5 ms.

Determine the current in the inductor when t = 2.5 **(5 marks)**

## Question Five

**Q5 (a**) Use a graph to explain the following terms in alternating voltage and current:

| | | |
|---|---|---|
| **(i)** | Cycle | **(1 mark)** |
| **(ii)** | Amplitude | **(1 mark)** |
| (iii) | Frequency | **(1 mark)** |
| (iv) | Period | **(1 mark**) |
| (v) | Instantaneous value | **(1 mark)** |
| (vi) | Peak value | **(1 mark)** |
| (vii) | Peak to peak value | **(1 mark)** |
| (viii) | Average or mean value | **(1 mark)** |
| (ix) | Root mean square value (R.M.S) value | **(1 mark)** |
| (x) | Phase and Phase angle | **( 1 mark)** |

**Q5(b**) Using a well labelled diagram of a coil AB rotating through an angle theta from horizontal position, namely zero e.m.f . Derive the e.m.f generated in A due to the component of velocity perpendicular to the magnetic field. **(4 marks)**

**Q5(c**) A coil of 200 turns is rotated at 1500r/min in a magnetic field having a uniform density of 0.04T, the axis of rotation being t right angles to the direction of the flux. The mean area per turn is 40 $cm^2$. Calculate:

| | | |
|---|---|---|
| (i) | The frequency | **(1 mark)** |
| (ii) | The period | **(1 mark)** |
| (iii) | The maximum value of the generated e.m.f when the coil has rotated through 45 degrees from the position of zero e.m.f. | **( 1 mark)** |

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