



**THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE**

***Faculty of Engineering & Technology***

**DEPARTMENT OF MECHANICAL AND AUTOMOTIVE ENGINEERING**

**CERTIFICATE IN MECHANICAL ENGINEERING (PRODUCTION  
OPTION)**

**SEMESTER II EXAMINATIONS**

**APRIL/MAY 2010 SERIES**

**ELECTRICAL SCIENCE**

**TIME: 2 HOURS**

**Instructions to Candidates**

You should have the following for this examination:

- Answer booklet.
- Answer booklet(s).

The paper consists of **FIVE** Questions attempt any **THREE** Questions.

## **SECTION A**

### **Question ONE**

- (a). (i). Compare and contrast electric and magnetic circuits. **(6 Marks)**
- (ii). Sketch a magnetic circuit for a two pole motor. **(3 Marks)**
- (b). The magnetic flux in a magnetic circuit follows a path of length 0.5m in a material having a cross-sectional area of 300mm<sup>2</sup> and a relative permeability of 750. What is the value of m.m.f required to produce a flux of 0.32mwb in this material?  
( $m_o = 4\pi \times 10^{-7}$ ). **(6 Marks)**
- (c). (i). Sketch the hysteresis loops for both magnetically soft and hard materials.
- (ii). Explain the difference in the shape of the two loops mentioned above in Q1.  
C(i). **(5 Marks)**

### **Question TWO**

- (a). (i). Explain the following terms used in electromagnetism:
- (I). Back emf of d.c motor  
(II). Self Inductance
- (ii). State Lenz's law. **(3 Marks)**
- (b). With the aid a sketch describe the construction of a simple generator using a commutator. **(3½ Marks)**
- (c). A conductor of length 80mm moves at a speed of 2000mm/s at right angles to a uniform magnetic field of flux density 0.6 Tesla.
- (i). Determine the emf induced in the conductor.  
(ii). Explain **THREE** methods of increasing the emf generated. **(5 Marks)**
- (d). A shunt-wound d.c generator has armature resistance of 0.25 ohms and a shunt resistance of 125 ohms. If it delivers 150A to a load with a terminal voltage of 460V and assuming brush drop of 2V, determine:
- (i). armature and field currents.  
(ii). generated emf **(8½ Marks)**

### **Question THREE**

- (a). (i). List **THREE** types of d.c motors.  
(ii). With the aid of circuit diagram describe **ONE** method of reversing the direction of rotation of any two motors in 3a(i).  
**(7 Marks)**
- (b). A 460V d.c shunt motor, running on load has an armature resistance of  $0.12\Omega$ . Calculate:  
(i). The value of the back emf when the current in the armature is 150A.  
(ii). The value of the armature current when the back emf is 452V.  
**(7 Marks)**
- (c). (i). Explain the **TWO** ways of controlling the speed of d.c motors.  
**(2 Marks)**  
(ii). With the aid of a sketch describe the construction of a simple motor.  
**(4 Marks)**

### **Question FOUR**

- (a). With an aid of a diagram, describe the construction and operation of a repulsion type moving drum ammeter.  
**(8 Marks)**
- (b). A moving iron instrument requires 500 ampere turns to give a full scale deflection. Calculate:  
(i). The number of turns required if the instrument is to be used as an ammeter reading up to 50A and  
(ii). The number of turns and the total resistance of the instrument if it is to be arranged as a voltmeter reading upto 300V with full scale deflection when the current is 20mA.  
**(6 Marks)**
- (c). Briefly explain **THREE** advantages and **THREE** disadvantages of a moving iron instruments.  
**(6 Marks)**

### **Question FIVE**

- (a). Describe the basic chemical operation of a single cell that make a lead acid battery.  
**(8 Marks)**
- (b). Briefly explain the factors that affect charging in a lead acid battery.  
**(6 Marks)**
- (c). A battery of 30 lead acid cells is to be charged at a constant current of 8A from an 110V dc supply. The terminal voltage per cell is 1.9V at the commencement of charging and 2.6V at the end. Calculate the maximum and minimum values of the resistor required in series with the battery.  
**(6 Marks)**