



TECHNICAL UNIVERSITY OF MOMBASA  
**Faculty of Engineering &  
Technology**

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING  
**DIPLOMA IN MECHANICAL ENGINEERING (PLANT OPTION) (DPL 6)**

EPL 2306: PLANT ELECTRICAL IV

**END OF SEMESTER EXAMINATION**

SERIES: APRIL 2014

**TIME ALLOWED: 2 HOURS**

**Instructions to Candidates:**

You should have the following for this examination

- Answer booklet
- Scientific Calculator

This paper consists of **FIVE** questions. Answer any **THREE** questions  
 Maximum marks for each part of a question are as shown  
 This paper consists of **TWO** printed pages

**Question One**

- a) (I) Define the following terms as used in power transformers:
- (i) Primary and secondary windings
  - (ii) High voltage and low voltage windings **(4 marks)**
- (II) Briefly explain THREE transformer ratings as used in power transformer. **(7 marks)**
- b) (I) State how the following conditions are achieved in core-type transformers:
- (i) Reduction in core losses for a given flux density
  - (ii) Reduction in high voltage insulation **(4 marks)**
- (II) (i) State TWO characteristics of an ideal transformer. **(2 marks)**
- (ii) Explain briefly the functions of conservator and the breather in an oil cooled transformer. **(9 marks)**
- (iii) A single phase transformer is connected to a 230V, 50Hz supply. The cross-sectional of the core is 60cm<sup>2</sup>. The number of turns in the primary is 500 and in the secondary 100. Calculate:
- a) Transformation ratio
  - b) Emf induced in the secondary
  - c) Maximum value of flux density in the core **(4 marks)**

**Question Two**

- a) (i) Define transformer oil
- (ii) State THREE functions of transformer oil
- (iii) Explain briefly THREE important tests carried on transformer oil to ensure its effectiveness. **(8 marks)**
- b) (i) Explain the working principle of a power transformer.
- (ii) Show that the total impedance of the transformer as referred to primary is given by:
- $$Z_{01} = \sqrt{R_{01}^2 + X_{01}^2}$$
- (6 marks)**
- (iii) A 50Hz, single phase transformer has a turn ratio of 5. The resistances are 0.8  $\Omega$  and 0.02  $\Omega$  and reactance 4  $\Omega$  and 0.12  $\Omega$  for high voltage and low-voltage windings respectively. Calculate:
- a) Voltage applied to the 1.v side to obtain full load current of 180A in the 1.v winding on short circuit.

- b) The power factor on short circuit
- c) Sketch the equivalent circuit **(6 marks)**

### Question Three

- a) (i) State THREE losses in power transformers
- (ii) Define transformer all-day efficiency **(5 marks)**
- b) (i) Define the term “auto-transformer”
- (ii) State THREE disadvantages of auto-transformers **(4 marks)**
- c) (I) State THREE conditions necessary for parallel operation of two or more single phase transformers.
- (II) A 15KVA, 2300/230V, 50Hz single phase transfer gave the following test data:
  - Open Circuit Test,  $V_o = 2300\text{v}$ ,  $I_o = 0.21\text{A}$ ,  $P_o = 50\text{W}$
  - Short Circuit Test  $V_{cc} = 47\text{V}$ ,  $I_{ss} = 6\text{A}$ ,  $P_{ss} = 160\text{W}$
  - (i) Sketch the equivalent circuit referred to the high voltage side
  - (ii) Calculate full load voltage at 0.8p.f. lagging when the load voltage is held at 220V
  - (iii) Calculate the efficiency at half the rated load at unity p.f.
  - (iv) Calculate the maximum efficiency and corresponding output power. **(11 marks)**

### Question Four

- a) To remove and replace the starter motor from the engine
- b) Testing the armature for:
  - (i) Open circuit
  - (ii) Short circuit
  - (iii) Earthed circuit **(20 marks)**

### Question Five

A faulty alternator is brought into the workshop. Describe a practical procedure for caring out a complete overhaul on the unit. **(20 marks)**