

**TECHNICAL UNIVERSITY OF MOMBASA**

**University Examinations 2015/2016**

**THIRD YEAR EXAMINATION FOR THE DIPLOMA OF SCIENCE IN MARINE  
ENGINEERING**

**EMR 2316: MARINE ELECTRICAL TECHNOLOGY II**

**DATE:**

**TIME:**

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**INSTRUCTIONS**

Answer any three questions. All questions carry 20 marks each.

**QUESTION ONE**

a) A transformer has 400 primary turns and 250 secondary turns. The primary and secondary resistances are  $0.25 \Omega$  and  $0.01 \Omega$  respectively and the corresponding leakage reactance's are  $1.0 \Omega$  and  $0.04 \Omega$  respectively. Determine

- i. the equivalent resistance referred to the primary winding,
- ii. the equivalent reactance referred to the primary winding,
- iii. the equivalent impedance referred to the primary winding, and
- iv. the phase angle of the impedance. **(8 marks)**

b) A 400 kVA transformer has a primary winding resistance of  $0.5 \Omega$  and a secondary winding resistance of  $0.00 \Omega$ . The iron loss is 2.5kW and the primary and secondary voltages are 5 kV and 320V respectively. If the power factor of the load is 0.85, determine the efficiency of the transformer (a) on full load, and (b) on half load **(6 marks)**

c) With the aid of a well labeled diagram explain the system characteristics and advantages of an TT system directly earthed system **(6 marks)**

**QUESTION TWO**

a) A single-phase, 50 Hz transformer has 25 primary turns and 300 secondary turns. The cross-sectional area of the core is  $300 \text{ cm}^2$ . When the primary winding is connected to a 250V supply, determine

- i. the maximum value of the flux density in the core, and
- ii. the voltage induced in the secondary winding. **(5 marks)**

b) A three-phase transformer has 500 primary turns and 50 secondary turns. If the supply voltage is 2.4 kV find the secondary line voltage on no-load when the windings are connected

- (a) Star-delta, (b) delta-star. **(5 marks)**

c) State the advantages and disadvantages of autotransformers ( **6 marks**)

d) A 2400V/400V single-phase transformer takes a no-load current of 0.5A and the core loss is 400W. Determine the values of the magnetizing and core loss components of the no-load current. **(4 marks)**

### **QUESTION THREE**

a) With the aid of a schematic diagram, briefly explain the working principle of the transformer **(6 marks)**

b) Explain the factors that determine the number of feeders that are connected to a ring main electrical power distribution system **(6 marks)**

c) The ohmic values of the circuit parameters of a transformer having a turn ratio of 5 are  $R_1=0.5\Omega$ ,  $R_2=0.021\Omega$ ,  $X_1=3.2\Omega$ ,  $X_2=0.12\Omega$ . Draw appropriate equivalent circuit of transformer and show numerical values of circuit parameters referred to

- i. The primary. **(4marks)**.
- ii. The secondary **(4 marks)**.

### **QUESTION FOUR**

a) A 100-kVA single-phase transformer steps down from 2000/400 V. It has a primary resistance of  $0.17\Omega$  and a secondary resistance of  $0.0068\Omega$ ; the reactance's are  $0.25\Omega$  and  $0.01\Omega$  respectively. Calculate the total resistance, reactance and impedance referred (scaled) to the secondary. Hence find the percentage voltage regulation on full secondary load of 250 A at a PF of 0.8 lagging. **(9 marks)**

b) Briefly explain the different types and different configurations of earthed systems **(6 marks)**

c) State two types of systems depending on the earthing **(2 marks)**

d) Explain the open circuit test and derive the parameters that can be determined from it. **(3 Marks)**

### **QUESTION FIVE**

a) A 5 kVA single-phase transformer has a turns ratio of 10:1 and is fed from a 2.5 kV supply. Neglecting losses, determine (a) the full-load secondary current, (b) the minimum load resistance which can be connected across the secondary winding to give full load kVA, (c) the primary current at full load kVA. **(6 marks)**

b) State the 5 main parts of an electrical power distribution network **(5 marks)**

c) State and explain the two main types of electrical power distribution system **(4 marks)**

d) A 75 kVA transformer has step-down ratio of 12:1, 2400 primary turns and a primary voltage of 3.3 kV. Calculate

- i. the number of secondary turns
- ii. the secondary voltage

- iii. the volts per turn
- iv. The full load primary and secondary currents. **(5 marks)**