



TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology

DEPARTMENT OF MECHANICAL AND AUTOMOTIVE ENGINEERING

DIPLOMA IN MECHANICAL ENGINEERING (PLANT OPTION)(DPL)

EEP 2331

PLANT ELECTRICAL IV

END OF SEMESTER EXAMINATIONS

SERIES: DECEMBER, 2013

TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

1. You should have the following for this examination:
 - Answer Booklet
2. This paper consists of **FIVE** Questions.
3. Answer **ANY THREE** Questions the marks are as shown.
4. **This paper consists of FOUR printed pages.**

Question ONE

- (a) (i) Define a transformer. **(2 marks)**
- (ii) State **TWO** advantages of star-delta transformer connection. **(2 marks)**
- (b) (i) Show from first principles that turns-ratio of a transformer is given by:
- $$\frac{E_2}{E_1} = \frac{N_2}{N_1} = K$$
- (6 marks)**
- (ii) A single phase, 80KVA, 2000/200V, 50Hz transformer has an impedance drop of 8% and a resistance drop of 4%.
- (I) Calculate its full-load regulation at 0.8 power factor lagging.
- (II) At what power factor is the regulation zero.
- (10 marks)**

Question TWO

- (a) (i) Differentiate between high voltage and low voltage windings of a transformer. **(2 marks)**
- (ii) Briefly explain the working principle of a transformer. **(4 marks)**
- (b) (i) State **TWO** causes of heat in a transformer core. **(2 marks)**
- (ii) State **TWO** functions of transformer oil. **(2 marks)**
- (iii) Explain **THREE** tests carried on a transformer oil to ensure its effectiveness. **(3 marks)**
- (c) A 3300/300V single phase transformer gives 0.6A and 60W as ammeter and wattmeter readings when supply is given to low voltage winding and high voltage winding is kept open. Calculate:
- (i) Power factor of no-load current
- (ii) magnetizing component of current
- (iii) Iron-loss component of current
- (7 marks)**

Question THREE

- (a) (i) State **FOUR** characteristics of an ideal transformer. **(2 marks)**
- (ii) Briefly explain **THREE** transformer losses. **(3 marks)**
- (b) (i) Explain the following cooling methods as used in power transformers:
- (I) ONAN/ONAF/ONAF
(II) ONAF/ODAF **(2 marks)**
- (ii) A 100KVA, 2200/400V, single phase transformer has iron loss of 850W on no load. From a short circuit test, the effective resistance in the secondary was found to be 0.0144Ω. Calculate the efficiency of the transformer when it is delivering:
- (I) Half-load unity p.f
(II) Full-load at 0.8p.f. lagging **(5 marks)**
- (c) (i) Explain why transformers are rated in KVA. **(3 marks)**
- (ii) A single-phase step-down transformer has a turn-ratio of 3. The resistance and reactance of the primary windings are 1.2Ω and 6Ω and those of the secondary winding are 0.05Ω and 0.03Ω respectively. If the h.v winding is supplied at 230V, 50Hz, with l.v. winding short-circuited, calculate:
- (a) Current in the l.v. winding
(b) Power factor **(5 marks)**

Question FOUR

- (a) (i) Briefly explain the following terms with reference to motor rating:
- (a) Continuous rating
(b) Intermittent duty **(2 marks)**
- (ii) State and explain **TWO** types of motor enclosures. **(2 marks)**
- (iii) Calculate the theoretical continuous rating of a motor which has a duty cycle of 20kW for two minutes, 5KW for two minutes, 10KW for three minutes and stopped for three minutes. **(4 marks)**

- (b) Explain the following in case of single phase induction motors:
- (i) The forward flux is several times greater than the backward flux wave at normal rotor speed but are equal at stand still position.
 - (ii) The direction of rotation is always from auxiliary winding to main winding whether a resistance or capacitance is connected in series with auxiliary winding. **(6 marks)**
- (c) The resistance and inductive reactance of each winding of a 50Hz split-phase induction motor are 75Ω and 230Ω respectively. Additional resistance R and condenser C are in series with one winding. Calculate their values to give the same current in each winding with a phase difference of 90° . **(6 marks)**

Question FIVE

- (a) (i) Explain why single phase induction motors are not self-starting. **(3 marks)**
 - (ii) Briefly explain why single phase series motors are preferred for fraction services rather than induction or synchronous motors. **(2 marks)**
 - (iii) State why reluctance motor has low efficiency. **(2 marks)**
- (b) (i) State **THREE** effects of adding a running capacitor to capacitor-start induction motors. **(3 marks)**
- (ii) State the reasons why the motor resistance of a single-phase motor is low. **(3 marks)**
- (c) (i) State **TWO** advantages of stepper motors. **(2 marks)**
- (ii) The name plate of a single phase, 4 pole induction motor gives the following data: Output = 410W, Supply voltage = 230V, Frequency = 50Hz, Input current = 3.2A, Power factor = 0.7 and Speed = 1410 rpm. Calculate:
- (I) Efficiency of the motor
 - (II) Slip of the motor when delivering the rated output
- (5 marks)**