



Technical University of Mombasa

Faculty of Engineering and Technology

DEPARTMENT OF MEDICAL ENGINEERING

DIPLOMA IN MEDICAL ENGINEERING
(DME JAN 2013/S-PT Y2)

EHL 2207

ELECTRICAL MACHINES AND UTILISATION

SPECIAL/SUPPLEMENTARY EXAMINATIONS

SERIES: JUNE 2013
TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

You should have the following for this examination

- Answer booklet

This paper consists of **FIVE** questions.

Question **ONE** is **COMPULSORY**

Attempt any other **TWO** questions

This paper consists of **4 PRINTED** pages

QUESTION ONE (COMPULSORY)

- (a) Define the term “transformer”. (1 marks)
- (b) Compare the synchronous motor and induction motor on the criteria of
- (i) speed
 - (ii) construction
 - (iii) starting torque (6 marks)
- (c) Describe any **TWO** problems with d.c. motors (8 marks)
- (d) With the aid of labeled diagrams, explain how current transformer and potential transformer can be connected to a wattmeter to measure power in a high-voltage circuit. (15 marks)

QUESTION TWO

- (a) State the main difference between motor and generator (1 marks)
- (b) Describe the following in d.c machines
- (i) Armature reaction
 - (ii) Commutation (4 marks)
- (c) A 230 v d.c shunt motor takes 5A at no-load and runs at 1000 r.p.m. Calculate the speed when loaded and taking a current of 30 A. The armature and field resistances are 0.2 Ω and 230 Ω , respectively. (7 marks)
- (d) A 220 v d.c series motor runs at 900 r.p.m. When taking a line current of 40 A. The armature resistance and series field resistance are 0.06 Ω and 0.04 Ω , respectively. If current taken remains the same, calculate the series resistance required to reduce the speed to 600 r.p.m. respectively. (8 marks)

QUESTION THREE

- (a) State any **THREE** advantages of 3-phase power systems over single-phase power system. (3 marks)
- (b) Define the term “power-factor” (1 mark)
- (c) Compare any **SIX** advantages of star and delta connected systems. (6 marks)

- (d) Explain why the two-wattmeter method is most suitable for measuring power in 3-phase loads. **(5 marks)**
- (e) The power input to a 2000 v, 50 Hz 3-phase motor running on full-load at an efficiency of 90% is measured by two wattmeter's which indicate 300 kw and 100 kw, respectively. Calculate.
- (i) the input power
 - (ii) the power – factor
 - (iii) the line current
 - (iv) the output power. **(5 marks)**

QUESTION FOUR

- (a) Describe function of the following parts of induction motor.
- (i) Stator
 - (ii) Rotor **(4 marks)**
- (b) A 4-pole, 3-phase induction motor operates from a supply whose frequency is 50 Hz. Calculate:
- (i) the speed at which the magnetic field of the stator is rotating.
 - (ii) the speed of the rotor when the slip is 0.04
 - (iii) the frequency of the rotor currents when the slip is 0.03.
 - (iv) the frequency of the rotor currents at standstill **(8 marks)**
- (c) A 7.46 kw, 230, 3-phase 50 Hz, 6-pole squirrel cage induction motor operates at full-load slip of 4% when rated voltage and rated frequency are applied. Calculate the
- (i) speed of rotation of stator m.m.g.
 - (ii) full-load speed
 - (iii) frequency of rotor current under this condition
 - (iv) full-load torque **(8 marks)**

QUESTION FIVE

- (a) State any **TWO** applications of the auto-transformer. **(2 marks)**
- (b) Explain why the power rating of a transformer is in KVA **(4 marks)**
- (c) Describe the following methods of cooling transformers.
- (i) oil-filled self-cooled

(ii) oil-filled water –cooled

(iii) air-blast type.

(6 marks)

(d) The input current to a 3-phase step-down transformer connected to an 11 KV Supply system is 14 A. Calculate the

(i) secondary line voltage

(ii) secondary line current for delta-star if the turn ratio is 44.

(8 marks)