



**TECHNICAL UNIVERSITY OF MOMBASA**

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FACULTY OF ENGINEERING AND TECHNOLOGY  
DEPARTMENT OF MEDICAL ENGINEERING

**UNIVERSITY EXAMINATION FOR:**  
DIPLOMA IN MEDICAL ENGINEERING

**EEP 2251: ELECTRICAL MACHINES & UTILIZATION II**

END OF SEMESTER EXAMINATION

**SERIES: AUGUST2019**

**TIME: 2HOURS**

**DATE: Pick DateAug2019**

**Instructions to Candidates**

You should have the following for this examination

*-Examination pass and student ID*

This paper consists of **FIVE** questions. Attempt any **THREE** questions.

**Do not write on the question paper.**

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**QUESTION ONE**

- a) Distinguish between true **power** and **apparent power**. (2marks)
- b) Describe the 5-wire electrical power distribution system. (2marks)
- c) A symmetrical 3-phase system supplies a balanced load of 24.9 KVA at a line voltage of 415V. Calculate the line current. (4marks)
- d) Three 100  $\Omega$  resistors are connected first in star and then in delta across 400V, 3-phase lines. Calculate.
- i) the line current
- ii) the power taken from the supply in each case. (12 marks)

## QUESTION TWO

- a) State
- i) the need for cover on terminal box of induction motor
  - ii) any **TWO** applications of 3-phase induction motor (3marks)
- b) Describe **windage losses** in 3-phase induction motor. (2marks)
- c) With the aid of a labeled diagram, explain the principle of operation of 3-phase induction motor. (6marks)
- d) The full-load speed of a 6-pole, 3-phase, induction motor, powered from a 50Hz supply, is 956 r.p.m. Calculate
- i) the synchronous speed
  - ii) the slip speed
  - iii) the percent slip. (9marks)

## QUESTION THREE

- a) Compare and contrast 3-phase synchronous motor and 3-phase synchronous generator (3marks)
- b) Explain why the 3-phase synchronous motor is not self-starting. (5marks)
- c) A 3-phase, star-connected alternator has line voltage of 25KV. The output of the a.c. generator is 12MVA at a power-factor of 0.85 lagging. Calculate
- i) the phase voltage
  - ii) the active power output
  - iii) the line current ( 12marks)

## QUESTION FOUR

- a) State ONE condition to be met for 3-phase transformers to be operated in parallel. (1mark)
- b) With the aid of a labeled diagram, explain the principle of operation of a delta-delta 3-phase transformer. (6marks)

- c) A 3-phase, 50Hz transformer has a delta-connected primary and a star-connected secondary, the line voltage being 22,000V and 400V, respectively. The secondary has a star – connected balanced load at 0.8 power-factor lagging. The line current on the primary side is 5A.

Calculate

- i) the current in the primary winding
- ii) the current in the secondary winding
- iii) the true power output of the transformer. (13marks)

### **QUESTION FIVE**

Explain how the availability of electrical machines is affected by

- i) frequency variations
- ii) mechanical load
- iii) single- phasing
- iv) line – voltage variations

(20marks)



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**QUESTION ONE**

- a) Distinguish between **apparent power** and reactive **power**. (2marks)
- b) Describe the 4-wire electricity distribution system. (2marks)
- c) Compare and contrast the **2-wattmeter** and **3-wattmeter** methods of measuring electrical power in 3-phase systems. (3marks)
- d) A balanced load consists of three coils, each of resistance  $6 \Omega$  and inductive reactance of  $8 \Omega$ , connected first in star and then in delta across a 400V, 3-phase supply. Calculate
  - i) the line current
  - ii) the power absorbed by the coils (13marks)

## QUESTION TWO

- a) Distinguish between **salient-pole rotor** and **squirrel –cage rotor** (2marks)
- b) Compare and contrast induction motor and synchronous motor. (3marks)
- c) Explain how the speed of 3-phase induction motor varies with load. (5marks)
- d) A 3-phase induction motor is wound for 4-poles and is supplied from a 50Hz system.  
Calculate.
  - i) the synchronous speed
  - ii) the speed of the motor when slip is 4%
  - iii) the rotor current frequency when the motor runs at 600 r.p.m (10marks)

## QUESTION THREE

- a) Explain how the 3-phase synchronous motor is affected by
  - i) loading
  - ii) excitation (10marks)
  
- b) A 3-phase synchronous motor has 12 poles and operates from a 415V, 50Hz supply.  
If it takes a line current of 100A at 0.8 power-factor lead, calculate
  - i) the motor speed
  - ii) the torque developed by the motor, neglecting losses. (10marks)

## QUESTION FOUR

- a) With the aid of a labeled diagram, explain the principle of operation of a star- star, 3-phase transformer. (6marks)
  
- b) A 3-phase, 50Hz transformer has a delta- connected primary and star- connected secondary, the line voltage being 25,000V and 415V, respectively. The secondary has a star- connected balanced load at 0.8 power-factor lagging. The line current on the primary side is 5A.  
Calculate
  - i) the current in the primary winding
  - ii) the current in the secondary winding
  - iii) the true power output of the transformer. (14marks)

### **QUESTION FIVE**

A machine, which is driven by an electric motor, has stopped running.

- i) state **FIVE** likely causes for this failure, if the coupling between machine and motor is gear drive.
- ii) Explain the remedial action to be taken to solve this problem. (20marks)