



MACHAKOS UNIVERSITY

University Examinations for 2021/2022

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING

EED 303: ELECTRICAL MACHINES AND UTILIZATION 1

DATE:

TIME:

INSTRUCTIONS; ANSWER QUESTION ONE AND ANY OTHER TWO

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) State any **four** advantage of squirrel cage induction motor (4 marks)
- b) Explain the operation of squirrel cage motor (6 marks)
- c) List any **four** differences between an induction motor and transformer (4 marks)
- d) Explain any **three** methods used to determine voltage regulation on alternators. (3 marks)
- e) Explain the operation of stepper motor (7 marks)
- f) A 4 pole ,3 phase induction motor operation from 60 Hz supply. Calculate
 - i) Synchronous speed
 - ii) Rotor speed at a slip of 6 %
 - iii) frequency of rotor current at stand still (6 marks)

QUESTION TWO (20 MARKS)

- a) List the condition maximum torque at
 - i) stand still
 - ii) running condition of a three phase induction motor (6 marks)

- b) A 415V .three phase ,50 HZ , 4 pole star connected induction motor runs at 24 rev/s on full .The motor resistance and reactance per phase is 0.5 and 5.5 respectively effective motor stator turns ratio is 0.8 : 1 Calculate
- i) Synchronous speed
 - ii) Slip
 - iii) Full speed torque
 - iv) Starting torque
 - v) Maximum torque
- (14 marks)

QUESTION THREE (20 MARKS)

- a) Explain the characteristics of the Two types of rotors of alternators (4 marks)
- b) Explain the terms
 - i) Hunting
 - ii) Pull-in torque

(6 marks)
- c) With the aid of diagrams, Explain the operation of the following special machines
 - i) Reluctance motor
 - ii) Variable stepper

(10 marks)

QUESTION FOUR (20 MARKS)

- a) Outline any **three** application of
 - i) D.C shunt motor
 - ii) D.C series motor

(6 marks)
- i) A 500v, 60Hz, 6 pole, 3 phase, star connected induction motor has a per phase stator impedance $Z_1 = (0.08 + j 0.2) \Omega$, and rotor impedance referred to stator $Z_2' = (0.09 + j 0.4) \Omega$. The magnetizing reactance is 10Ω and resistance of core-loss is 50Ω . The slip is 5%. Using approximate equivalent circuit, calculate:
 - Sotor current and its power factor.
 - ii) Developed torque.
- b) Gross efficiency. (4 marks)

QUESTION FIVE (20 MARKS)

- a) List any **three** characteristics of hysteresis motor (6 marks)
- b) In a 100-KVA, 3000v, star-connected, 3-phase, 50-Hz alternator, the effective armature resistance is 0.3Ω per phase. A field current of 40A gave short circuit current of 300A and open circuit E.M.F line voltage of 1100v. Calculate the voltage regulation at unity pf, 0.8 pf lagging and 0.9 pf leading. (4 marks)