



THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of Jkuat)

Faculty of Engineering and Technology

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

DIPLOMA IN TECHNOLOGY

ELECTRICAL & POWER ENGINEERING

EEP 33201: MACHINES & UTILIZATION III

SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: OCTOBER 2011

TIME: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- Answer booklet
- Scientific calculator
- SMP table

This paper consists of **FIVE** questions. Answer question **ONE** (**COMPULSORY**) and any other **TWO** questions

Maximum marks for each part of a question are clearly shown. This paper consists of **THREE** printed pages

SECTION A (COMPULSORY)

Question 1

- a) (i) State any **THREE** advantages in the use of variable Speed Drives
 - (ii) Distinguish between Plugging and Magnetic Flux weakening in speed DC Motor speed control
 - (iii) Draw a circuit and the corresponding waveforms for a Constant Current Inverter.
- (12 marks) b) A single quadrant chopper is used for Rheostatic Braking of a separately excited DC Motor. Ω $R_a = 0.5$, breaking Resistance = 7.5 , voltage constant = 1.4V/A/rad/s, la = 120A, and the

Field Current = 1.6A. The Duty Cycle is 0.35. Calculate:

- Average Voltage across the Chopper i.
- The power Dissipated in the Braking Resistance ii.

iii. The Motor Speed

SECTION B (Answer any TWO questions from this section - 20 marks each)

Question 2

- a) (i) With the aid of a Circuit Diagram explain the working principle odf a 3-phase full wave Converter drive
 - (ii) Derive the average output value of the converter in a (i) above (10 marks)
- b) A 230V, 50HZ, single Phase, feeds the Armature and Field Circuit of a separately excited DC Motor through a corresponding full wave converter. The armature and Field resistances are Ω Ω

respectively. The Torque and Voltage constants are 1.1. The firing angle 0.25 and 200 for the Field and Armature converters are 0° and 45° respectively, while the Armature Current is 50A. Assuming a brush contact Voltage Drop of 1V per Brush, Determine:

- The Torque Developed i.
- ii. The Motor Speed

Question 3

- a) (i) Explain any **TWO** Techniques of speed control in Induction Motors (ii) State **TWO** disadvantages for each of the methods in 3a(i) above (6 marks)
- b) A 400V, 4 pole, 50HZ, 3 Phase Star Connected Induction Motor has the following Parameters:
 - Ω i. Stator to Rotor Turns Ratio = 2.1 R2 = 0.08

(10 marks)

(8 marks)

ii.
$$X1 = 1.1$$
 Ω $X2 = 0.012$

If the Load Torque is proportional to the square of speed and is 40N-m at 1440rpm, calculate the following for a speed of 1300rpm

- i. Load Torque
- ii. Rotor Current
- iii. Voltage applied at the Stator

Question 4

- a) (i) Explain the major principle of operation of the following
 - Cyclo-converter based Drives
 - Stepper Motor Drives
 - (ii) Distinguish with the aid of Output Waveforms the Uni-polar and Bi-polar Drives

(8 marks)

b) A star connected 4-pole, 415V; 50Hz Synchronous Motor has a synchronous reactance of 0.5 Ω

/per phase and rated current of 100A. Given that it operates at a power factor of 0.5 Leading. Determine:

- i. The Load Angle
- ii. The Torque Output
- iii. The field Excitation required compared to the open circuit rated voltage (12 marks)

Question 5

- a) (i) Explain with the aid of a flow diagram, the principle process in Vapor Compression Refrigeration System
 - (ii) State any **THREE** advantages of the system in Q 5(a) (i) above over the Vapour Absorption Refrigeration System (10 marks)
- b) (i) Draw the Electrical Circuit of a domestic refrigerator to include all the types of sensors in such system
 - (ii) Explain any **THREE** major factors observed during the evaluation of a Refrigeration System (10 marks)

(14 marks)