THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of JKUAT)

Faculty of Engineering and Technology

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

DIPLOMA IN TECHNOLOGY

EEP 2310: MACHINES & UTILIZATION II

END OF SEMESTER EXAMINATION

SERIES: DECEMBER 2011

TIME: 2 HOURS

Instructions to Candidates:

This paper consists of **FIVE** questions

- *Answer Booklet*
- *Non-programmable Calculator*
- *Mathematical table*

Answer any **THREE** questions

Marks are indicated for each part of the question

This paper consists of **THREE** printed pages

Question One

a) State any **TWO** applications of synchronous motor (2 marks)

b) A 75Kw 400v, 4 pole 3Q star connected synchronous motor has resistance and syndronous radiance of 0.004 Ω and 4 Ω per phase. Calculate:
   (i) The full load Emf per phase
   (ii) The mechanical power developed at 0.8p.f
   (iii) The Gross torque developed by the machine.
   Assume the efficiency of the machine to be 92.5% (8 marks)

c) Name any **TWO** methods for starting synchronous motors (2 marks)

d) With the aid of a well labeled diagram, explain the lamp in sequence method of synchronizing the three phase synchronous motors (8 marks)

Question Two

a) Explain the construction of a 3Q transformer core by use of a labeled diagram (6 marks)

b) State any **FOUR** conditions necessary for transformer to be connected in parallel (4 marks)

c) A 3-phase 50Hz transformer has a delta-connected primary and a star-connected secondary the line voltage being 22000v and 400v respectively. The secondary has a star-connected balanced load at 0.8pf lagging. The line current on the primary side is 5A, Determine the current in each coil of the primary and in each secondary i.e. line current (6 marks)

d) A 3-phase 6600/415V, 2000KVA transformer has a per unit resistance of 0.02 Ω and a per unit leakage reactance of 0.1 Ω. Calculate the copper losses and the transformer regulation at full load for a power factor of 0.8 lagging. (4 marks)

Question Three

a) State any **TWO** applications of the following special machines
   (i) Hysteresis motors
   (ii) Stepper motors
   (iii) Linear induction motor (6 marks)

b) A stepper has a 2.0 step angle and the motor makes 20.6 revolutions at a stepping frequency of 1800 pulses/second. Determine:
   (i) Resolution
   (ii) Number of steps
   (iii) Shaft speed (4 marks)

c) Explain any **THREE** unique characteristics of the hysteresis motor which makes them more suitable for their applications

d) A 3-phase moving-rail linear induction motor has three poles and a pole pitch of 0.24m. the Lim is operated from a 50Hz system. Determine:
   (i) The synchronous speed of the machine
   (ii) The rail speed

   Assume the slip of the motor to be 16.7% (10 marks)

Question Four

a) Explain the following types of torques with regard to synchronous motors
   (i) Running torque
   (ii) Pull-in torque
   (iii) Pull-out torque

b) Explain any **TWO** differences between synchronous motor and induction motors. (10 marks)

c) A synchronous motor absorbing 75kw is connected in parallel with a factory load of 250kw having a lagging power factor of 0.8. If the combined load has a p.f of 0.9 what is the value of the KVAR leading supplied by the motor and at what p.f is the motor operating (10 marks)

Question Five

a) Draw the phasor representation of the following 3-phase transformer displacements
   (i) 0 (zero) O'clock
   (ii) 6 (six) O'clock
   (iii) 1 (one) O'clock
   (iv) 11 (eleven) O'clock

b) Explain why the ($\Delta - \lambda$) delta-star method is commonly used for electrical supplies (10 marks)

c) A 500KVA 3ϕ 50Hz transformer has a voltage ratio of line voltages 33Kv/11Kv and is a Delta-star connected transformer. The restance per phase are; for high voltage side 35Ω and for low voltage side is 0.876Ω. The iron losses amount to 3050w. Calculate the value of the transformer efficiency at full load at unity power factor (10 marks)