THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

Faculty of Engineering and Technology

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

DIPLOMA IN TECHNOLOGY

Electrical Power Engineering (DEPE 5)

EEP 2310

MACHINES & UTILIZATION II

SEMESTER EXAMINATIONS

SERIES: FEBRUARY 2011 SERIES

TIME: 2 HOURS

Instructions to Candidates:

1. You are required to have the following for this examination;
   - Answer booklet
   - Electronic calculator

2. Attempt Question **ONE** (**COMPULSORY)** and any other **TWO** Questions.

Question ONE **(COMPULSORY)**

a) i) Draw phasor diagrams for the following transformer groupings.
   I) Yd1
   II) Dy11 (4 marks)
   ii) Explain why laminated core is employed in the construction of transformer.(2marks)

b) A three phase, delta – connected, 3.3kV load takes a line current of 800A from a 33/3.3kV delta-star transformer. The 33/3.3kV system is supplied from a 3.3/33kV star-star transformer.
   i) Draw the circuit diagram
   ii) Determine the line the phase values of voltages and currents in each part of the circuit. (10marks)

c) i) Define the following terms as used in synchronous motors
   I) Pull-out torque
   II) Torque angle (2 marks)
   ii) Explain with the aid of phasor diagrams, how variation of excitation in a 3-phase synchronous motor will affect the following (assume constant load).
   I) Armature current
   II) Back emf
   III) Power factor (6 marks)

d) i) With the aid of a diagram, explain how to determine V-curves of a synchronous machine in a laboratory.
   ii) Sketch V-curves for no load, 50% full load and 100% full load of a synchronous motor. (6 marks)

(ANSWER ANY OTHER TWO QUESTIONS)

Question TWO

a) i) Explain the term synchronous condenser. (2 marks)
   ii) Explain why consumers of electrical energy are encouraged to improve their load power factors. (4 marks)

b) Compare any TWO operational characteristics of synchronous motors and induction motors. (4 marks)

c) The load on a factory consists of 40000kW at PF of 0.8 lagging. The managers decide to replace the worn-out three phase, 5500kW, induction motor, which operates at a lagging PF of 0.75 and efficiency of 89.46%, with a synchronous motor of the same efficiency and rated power, rated at 0.8 PF leading. Determine the new overall system PF. (10marks)

Question THREE

a) i) State THREE conditions to be met before a synchronous machine can be synchronized with infinite bus-bars. (3 marks)

ii) Explain the function of damper winding in a 3-phase synchronous motor. (2 marks)

b) With the aid of a diagram, explain the Dark Lamp method of synchronizing a synchronous motor to infinite bus. (7 marks)

c) The input to an 11kV, 3-phase, star-connected synchronous motor is 60A. The effective resistance and synchronous reactance per phase are 1Ω and 3Ω respectively. Determine:

i) The power supplied to the motor at 0.8 p.f. lagging

ii) Induced e.m.f./phase for a p.f. of 0.8 leading

iii) Induced e.m.f./phase for a p.f. of 0.8 lagging. (8 marks)

Question FOUR

a) i) State THREE conditions to be met before connecting two or more transformers in parallel. (3 marks)

ii) Explain:

I) Why transformers are rated in kVA and not kW.

II) Why iron losses are constant at all loads in a transformer. (4 marks)

b) A 500kVA, 3-phase, 33/11 kV transformer has resistance and leakage reactance voltage drops of 2.2% and 4.8% respectively, and is connected in parallel with a 750kVA, 3-phase, 33/11 kV transformer with resistance and leakage reactance voltage drops of 1.7% and 4.8% respectively. The transformers operate from 33kV, constant frequency bus-bars and supply a total load of 900kVA at power factor of 0.8 lagging. Determine the load and power factor of each transformer. (13marks)

Question FIVE

a) i) State TWO applications for each of the following motors:

I) Stepper motor

II) Hysteresis motor (4 marks)

ii) Explain the following terms as used in stepper motors:

I) Holding torque

II) Step accuracy. (2 marks)

b) With the aid of suitable diagrams, explain the construction and operation of a variable-reluctance stepper motor. (11marks)

c) A stepper motor has a 2.0^0 step angle and stepping frequency of 2500 pulses/sec. Determine:

i) Resolution

ii) Number of steps required for the rotor to make 15 revolutions

iii) Shaft speed (3 marks)