THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

Faculty of Engineering and Technology

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

DIPLOMA IN TECHNOLOGY
Electrical Power Engineering (DEPE 3)
Instrumentation & Control Engineering (DICE 3)

EEP 2205

ELECTRICAL TECHNOLOGY

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.

(COMPULSORY)

Question ONE

a) i) Explain the need for a starter for dc motors

ii) With the aid of suitable diagrams explain any THREE types of dc motors. (9 marks)

b) i) Derive the e.m.f. equation of a transformer.

ii) A single phase 50Hz transformer has 80 turns on the primary winding and 400 turns on the secondary winding. The net cross sectional area of the core is 200 cm^2. If the primary winding is connected to a 240 V, 50Hz supply, determine:

I) The e.m.f induced in the secondary winding

II) Maximum value of flux density in the core. (8 marks)

c) A 2200/220 V, 50Hz single phase transformer has the following parameters. A resistance and reactance of 3Ω and 7.5Ω respectively on the high voltage primary winding, a resistance and a reactance of 0.03Ω and 0.07Ω respectively on the low voltage secondary winding. Determine the total equivalent resistance and reactance referred to:

i) Primary

ii) Secondary (8 marks)

d) Explain:

i) Why the rotor of a 3-phase induction motor rotates in the same direction as the revolving magnetic field.

ii) How the direction of rotor rotation can be reversed in a 3-phase induction motor. (5 marks)

Question TWO

a) With the aid of a diagram, explain the construction of a d.c. machine. (14marks)

b) A long-shunt compound generator supplies a current of 100A at 220V. The armature, series field and shunt field winding resistances are 0.1Ω, 0.05Ω and 44Ω respectively. Iron and frictional losses amount to 1000W. Determine:

i) emf generated

ii) Cu losses

iii) Commercial efficiency (6 marks)

Question THREE

a) i) Define the term voltage regulation as applied in transformers.
ii) Draw an equivalent circuit of a transformer referred to secondary stating all the parameters.
iii) Assuming an inductive load in (a) (ii) above, draw its phasor diagram. (6 marks)

b) i) State the significance of the following tests in transformer:
I) Open circuit test
II) Short circuit test
ii) Derive the expression for the load current corresponding to the maximum efficiency in a transformer. (7 marks)

c) A 40kW transformer has iron loss of 450W and full load copper loss of 850W. If the power factor of the load is 0.8 lagging, determine:
i) Full load efficiency
ii) The kVA loading at which maximum efficiency occurs
iii) The maximum efficiency (7 marks)

Question FOUR

a) i) Define the term slip.
ii) Explain why induction motors do not run at synchronous speed. (5 marks)

b) With the aid of diagrams explain the production of torque in the rotor of a three phase induction motor. (7 marks)

c) i) State any TWO starting methods of three phase induction motor.
ii) A 7.5kW, 415V, 3-phase, 50Hz, 6-pole induction motor operates at full load slip of 4% when rated voltage and rated frequency are applied. Determine:
I) Full load speed
II) Frequency of rotor current under this condition
III) Full load torque (8 marks)

Question FIVE

a) A complex voltage wave in a circuit is given by $v = 100\sin\omega t + 30\sin 3\omega t$. Sketch for one cycle of the waveform:

i) The fundamental

ii) Harmonic

iii) The resultant complex wave (4 marks)

b) A supply voltage v given by $v = 240\sin\omega t + 40\sin 3\omega + 30\sin 5\omega t \; volts$ is applied to a circuit comprising a resistance of 12Ω connected in series with a coil of inductance 9.55 mH. Given fundamental waveform frequency of 50Hz, determine:

i) An expression to represent the instantaneous value of the current

ii) The rms voltage the rms current

iii) The overall power factor. (13marks)

c) State any THREE causes of harmonies. (3 marks)