CAMEROON GENERAL CERTIFICATE OF EDUCATION BOARD

Technical and Vocational Education Examinations

ELECTRICAL POWER SYSTEMS

ELECTRICAL MACHINES 2
5235

JUNE XXXX **INTERMEDIATE LEVEL**

Subject Title	**ELECTRICAL MACHINES**
Subject Code No.	**5235**
Paper No.	**TWO**

THREE HOURS

This paper has three sections A, B and C and has a weighting of 35% of the whole subject.

Section A has **THREE** questions. Each question carries **10 Marks**. Answer any **TWO**

Section B has **THREE** questions. Each question carries **10 Marks**. Answer any **TWO**

Section C has **THREE** questions. Each question carries **30 Marks**. Answer any **TWO**

Show all steps in your calculations giving your answer at each stage and indicating the units and symbols used.

All sketches must be neat and clear.

You are allowed to use non-programmable calculators and mathematical sets

You are reminded of the necessity for good English and orderly presentation in your answers.

SECTION A – MAGNETISM AND ELECTROMAGNETISM

1.

a) State the laws of electromagnetic induction **(3marks)**

b) Inductors are used when their inductive properties are required in a circuit. Give the symbol of an inductor with;

i. iron – core **(2marks)**

ii. air – core **(2marks)**

c) Differentiate between self-induced emf and mutually induced emf **(3marks)**

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2. A conductor of useful length 0.95m cuts a magnetic field of 0.45T at a speed of 3m/s. Calculate the;

a) emf induced **(5marks)**

b) flux cut in the coil if the cross sectional area of the conductor is $3mm^2$ **(5marks)**

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3. A conductor 12cm long and carrying a current of 45A lies perpendicular to a magnetic field of flux density 1.3T.

a) Calculate the force exerted on the conductor. **(5marks)**

b) Deduce the induced emf if the conductor moves at 1m/s. **(5marks)**

SECTION B – STATIC MACHINES

4. Consider a single phase 220V/110V transformer.

a) What are the two current components of the no load current of the transformer? **(2marks)**

b) Which are the losses that will occur on the transformer on:

i. Load **(2marks)**

ii. No load **(2marks)**

c) How can Hysteresis and Eddy current losses be obtained in the transformer? **(2marks)**

d) Explain two ways in which the efficiency of a transformer can be obtained **(2marks)**

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5. A single phase 50KVA, 4400V/220V transformer has R1 = 3.45Ω and R2 = 0.009Ω. The values of reactances are X1 = 5.2 Ω and X2 = 0.015 Ω. Calculate for the transformer:

a) The equivalent resistance referred to the primary **(2.5marks)**

b) The equivalent resistance referred to the secondary **(2.5marks)**

c) The equivalent reactance as referred to the primary and secondary **(3marks)**

d) The total copper loss **(2marks)**

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6. During a no load test on a single phase transformer with primary resistance of 0.6Ω, the following test data were obtained:
   Primary voltage = 220V, secondary voltage = 110V, primary current = 0.5A, Power = 30W. Calculate

   a) The magnetizing component of the no load current **(3marks)**
   b) The active component of the no load current **(3marks)**
   c) The iron loss **(2marks)**
   d) Draw the no load phasor diagram **(2marks)**

SECTION C – ROTATING MACHINES

7.

   a) Why are rotating machines always referred to as reversible machines? **(5marks)**
   b) Give the principle of operation of the following:
      i. Generator **(7.5marks)**
      ii. Motor **(7.5marks)**
   c) D.C machines are classified according to the way their field windings are excited. With the help of diagrams, give an example of each type of excitation. **(5marks)**
   d) Why is it advisable to always include rheostats when starting d.c machines? **(5marks)**

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8. The power input to a 6 – pole, 500V, 50Hz three – phase induction motor running at 975rpm is 40KW. The stationary magnetic losses is 1KW and the friction and windage losses total 1KW. Calculate:

   a) Slip **(5marks)**
   b) Rotor Copper Loss **(10marks)**
   c) Shaft Power **(10marks)**
   d) Efficiency **(5marks)**

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9. A long shunt dynamo (d.c generator) running at 1000rpm supplies 22KW at a terminal voltage of 220V. The resistances of the armature, shunt field and series fields are 0.05Ω, 110Ω and 0.06Ω respectively. If the overall efficiency at the above load is 88%;
   a) Draw the circuit diagram of the machine described above **(5marks)**
   b) Calculate:
      i. The total copper loss of this machine **(15marks)**
      ii. The iron and frictional losses **(5marks)**
      iii. The load current **(2.5marks)**
      iv. The torque exerted on the prime mover **(2.5marks)**