TECHNICAL UNIVERSITY OF MOMBASA

Engineering

Electrical Department

UNIVERSITY EXAMINATION FOR:

EEE2214: MACHINES 1

END OF SEMESTER EXAMINATION

SERIES: MAY 2016

TIME: 2HOURS

DATE: MAY 2016

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **five** Questions; Question ONE is compulsory. In addition attempt any Other TWO Questions.

Do not write on the question paper.

Question ONE (Compulsory 30 marks)

Question1

1 (a) (i) Describe the principle of operation of a DC machine **(2mks)**

(ii) Derive an expression for E.M.F generated by a generator **(4mks)**

(b) A six pole dc generator runs at 1200rpm on no load and has a generated e.m.f of 250V. Its armature diameter is 350mm and the radial air gap between the field poles and the armature is 3mm. The axial length of the field poles is 260mm and the field poles effective coverage is 80%. If the armature has 96 coils having 3 turns per coil and is wound duplex lap calculate flux per pole, effective pole length arc, average air gap flux density **(4mks)**

(c) Explain how self excitation takes place in a self excited DC generator and with aid of sketches differentiate between long shunt and shunt DC generator **(5mks)**

(d) A separately excited DC generator when running at 1200rpm supplies 200A at 240V, to a circuit of constant resistance. What will be the load current, when the speed is dropped to 1000rpm if the field is unaltered? Armature resistance=0.04ohms, RL=0.625 and total voltage drop=2V **(5mks**)

Question TWO

(a)(i) Explain the importance of DC motors motors in industrial application **(2mks)**

(ii) Derive the power equation of a DC motor and express conditions for maximum power **(4mks)**

(b)The counter emf of a shunt motor is 227V, the field resistance is 160ohms and the field current is 1.5A. The line current is 39.5A. Determine the armature resistance. Also calculate the armature current when the motor is stationary **(4mks)**

(c)(i) Describe the importance of back emf during the operation of a DC motor **(2mks)**

(ii)Describe the difference between shaft and armature torque of DC motor **(4mks)**

(d) Derive the gross torque equation of a DC motor and show that it can also be given by $Ta = 9.55 \times \frac{EbIa}{N} N/M$ **(4mks)**

Question THREE

(a) (i) State any TWO types of characteristic curves which determine the performance of a DC motor and describe the N/Ia Characteristics of a DC series motor

(ii) Describe the armature diverter method of speed control of a DC series motor **(6mks)**

(b) A d.c series motor connected to a 440V supply runs at 600rpm when taking a current of 60A. Calculate the value of resistance, which when inserted in series with the motor will reduce the speed to 400rpm, the gross torque then being of the previous value. The resistance of the motor is 0.2ohms. Take flux to be proportional to field current **(4mks)**

(c)(i) State TWO strategies which can be used to control the speed of a shunt motor

(ii) Describe the ward-Leonard speed control method for DC shunt motor **(6mks)**

(d) A 10KW, 250 shunt generator having an armature resistance of 0.1ohms and field resistance of 250ohms delivers full load at rated voltage and 800rpm. The machine is now run as a motor while taking 10KW at 250V. What is the speed of the motor? Neglect brush contact drop, (**4mks)**

Question FOUR

(a)(i) Describe the phaser diagram diagrams of a practical transformer on load and on no load **(2mks)**

(ii) Describe winding resistance and leakage fluxes as used in practical transformers **(3mks**)

(b) A single phase transformer on no load takes 4.5A at a power factor of 0.25 lagging, when connected to a 230V, 50Hz supply. The number of turns of the primary winding is 250. Calculate magnetizing current, core loss and maximum flux in the core.**(5mks)**

(c) (i) Derive the E.M.F equation of a transformer **(2mks)**

(ii) Describe TWO conditions the primary current of practical transformer on load must meet for successful operation. **(3mks)**

(d) The voltage on the secondary of a single phase transformer is 200V, when supplying a load of 8KW at a power factor of 0.8 lagging. The secondary resistance is 0.04ohms and the secondary leakage reactance is 0.8ohms. Calculate the induced E.M.F in the secondary **(5mks)**

Question FIVE

(a)(i)Explain the need for testing a DC motor **(2mks)**

(ii) Show that in brake test, the efficiency of a D.C machine is given by $n = \frac{2\pi N(W-S)\times r\times 9.8}{60\times V_1}$ **(3mks)**

(b) In a brake test on a small shunt motor, the speed was 1500rpm, the load on one side of the brake band was 28.9N and the other side is 1.67N. The diameter of brake pulley was 15.2cm. If the input current was 2A at 250V, determine, Torque, brake horse power and efficiency **(5mks)**

(c)(i) Describe simplex DC motor wave winding and define its various pitches

(ii) Define the terms coil span and commutator pitch as used in DC winding systems **(5mks)**

(d) Design a 4 pole simplex lap winding suitable for an armature containing 20 slots. A ssume a single turns coil with 2 conductors per slot. **(5mks)**