



MACHAKOS UNIVERSITY

University Examination 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

SECOND YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONICS ENGINEERING)

EEE 206: ELECTRICAL MACHINES

DATE: 21/5/2019

TIME: 8.30-10.30 AM

INSTRUCTIONS

Answer Question ONE and any other TWO Questions.

QUESTION ONE (30 MARKS)

- a) Explain the function of the following parts of a D.C machine
- (i) Field system
 - (ii) Commutator (4 marks)
- b) A 20KW, 250V D.C shunt generator has armature and field resistances of 0.1Ω and 125Ω respectively. Determine the total armature power developed when running as:
- (i) A generator delivering 20KW output
 - (ii) A motor taking 20KW input (10 marks)
- c) Show that the motor speed is given by;

$$N = \frac{V - I_a R_a}{K\phi},$$

Where,

N = motor speed

V = supply voltage

I_a = armature current

R_a = armature resistance

(8 marks)

- d) A single phase transformer has 1200 primary turns and 200 secondary turns. The primary and secondary resistances are 0.2Ω and 0.02Ω respectively and the corresponding leakage reactance are 1.2Ω and 0.05Ω respectively. Determine;
- Equivalent resistance
 - Equivalent reactance
 - Equivalent impedance
 - Phase angle of the impedance
- (8 marks)

QUESTION TWO (20 MARKS)

- a) Show that the single phase transformer EMF equation is given by:
- $$E = 4.44f\phi_m N$$
- (8 marks)
- b) With an aid of an hysteresis curve, describe hysteresis and hysteresis loss as applied in magnetic circuits.
- (8 marks)
- c) A conductor 350mm long carries a current of 10A and is at right angle to magnetic field lying between two circular pole faces each of radius 60mm. if the total magnetic flux between the pole face is 0.5mWb, determine the magnitude of the force exerted on the conductor.
- (4 marks)

QUESTION THREE (20 MARKS)

- a) Show that the maximum mechanical power is achieved when back Emf is equal to half the applied voltage.
- (6 marks)
- b) A long shunt compound generator delivers a load current of 50A at 500volts and has armature, series field and shunt field resistances of 0.05Ω , 0.03Ω and 250Ω respectively. Determine the armature current and the generated Emf. Allow 1 volt per brush for contact drop.
- (8 marks)
- c) With an aid of a diagram, describe the flux speed control method of a D.C motor.
- (6 marks)

QUESTION FOUR (20 MARKS)

- a) With an aid of a circuit diagram describe short circuit test as administered in single phase transformers.
- (8 marks)

- b) A 400KVA transformer has a primary winding resistance of 0.5Ω and a secondary winding resistance of 0.001Ω . the iron loss is 2.5kwatts and the primary and secondary voltages are 5kvolts and 320volts respectively. If the power factor is 0.85, determine the efficiency of the transformer on full load. (12 marks)

QUESTION FIVE (20 MARKS)

- a) A 250volts shunt motor on no load runs at 1000rpm and takes 5A. The total armature and shunt field resistances are 0.2Ω and 250Ω respectively. Determine the speed when loaded and taking current of 50A if armature reaction weakens the field by 3%. (10 marks)
- b) Define the following terms as applied in magnetic circuits;
- i. Reluctance
 - ii. Magneto motive force (4 marks)
- c) The maximum working flux density of a lifting electromagnet is 1.8 Tesla and the effective area of a pole face is circular in cross section. If the total magnetic flux produced is 353 Webers, determine the radius of the pole face. (6 marks)