



MACHAKOS UNIVERSITY

University Examinations for 2019/2020 Academic Year

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: 15/12/2020

TIME: 8:30 – 10:30 AM

INSTRUCTIONS

Answer Question One and Any Other Two Questions

QUESTION ONE (30 MARKS)

- a) State the Faraday's laws of electromagnetic induction. (2 marks)
- b) A long shunt compound D.C generator delivers a load current of 50A at 500V and has armature, series, and shunt field resistances of 0.05Ω , 0.03Ω and 250Ω respectively. Draw its circuit diagram hence determine the armature current and the generated electromotive force. Allow a 1V per brush voltage drop. (9 marks)
- c) Show that torque developed by D.C motor is given by;
- $$T_a = 0.159 \frac{P\Phi Z I_a}{A}, \text{ where;}$$
- P = number of poles
 Φ = magnetic flux
Z = total number of armature conductors
 I_a = armature current
A = number of parallel paths (9 marks)
- d) A mild steel ring has a radius of 50mm and a cross sectional area of 400mm^2 . A current of 0.5A flows in a coil wound uniformly around the ring and flux produced is 0.1mWb. if the relative permeability at this value is 200. Determine:
- (i) The reluctance of the mild steel
(ii) The number of turns on the coil (10 marks)

QUESTION TWO (20 MARKS)

- a) Explain two reasons why D.C motors are not operated at maximum power (4 marks)
- b) A 20Kw, 250volt D.C shunt generator has armature and field resistances of 0.1Ω and 125Ω respectively. Determine the total armature power developed when running;
- (i) As a generator delivering 20kw
- (ii) As a motor taking 20kw (8 marks)
- c) A 200v d.c shunt motor running at 1000rpm takes an armature current of 17.5A . The armature resistance is 0.4Ω and armature current is constant. Determine the value of resistance to be inserted to the armature circuit to reduce the speed to 600rpm. (8 marks)

QUESTION THREE (20 MARKS)

- a) State any four probable causes of sparking at the brushes of a D.C motor. (4 marks)
- b) A closed magnetic circuit of cast steel contains a 6cm long path of cross-sectional area of 1 cm^2 and a 2cm path of cross sectional 0.5 cm^2 . A coil of 200 turns is wound around the 2cm length circuit and a current of 0.4A flows. Taking the relative permeability of the cast steel to be 750; determine
- (i) The flux density in the 2cm path
- (ii) Total reluctance (8 marks)
- c) Draw a ward Leonard system hence describe speed control of a D.C motor. (8 marks)

QUESTION FOUR (20 MARKS)

- a) With an aid of a circuit diagram describe open circuit test as administered in single phase transformers. (8 marks)
- b) A 1ϕ , 50HZ transformer has a 25 primary turns and 300 secondary turns. The cross sectional area of the core is 300 cm^2 , when the primary winding is connected to a 250 volts supply.

Determine;

- (i) The maximum value of the flux density in the core
- (ii) The voltage induced in the core (8 marks)
- c) Show that the transformation ratio of a single phase transformer is given by;
- $$\frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{I_2}{I_1} \quad (4 \text{ marks})$$

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) With an aid of a construction diagram of a D.C generator, describe the functions of its five principal components. (10 marks)