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(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY
(MMUST)

MAIN CAMPUS
UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER

MAIN EXAMINATIONS

FOR THE DEGREE
OF
BACHELOR OF TECHNOLOGY EDUCATION IN ELECTRICAL AND ELECTRONIC ENGINEERING

COURSE CODE: TEE 323

COURSE TITLE: ELECTRICAL MACHINES

DATE: FRIDAY, APRIL 29TH, 2022. **TIME: 8:00 – 10:00 AM**

INSTRUCTIONS TO CANDIDATES

Question ONE (1) is compulsory
Answer Any Other TWO (2) questions

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 4 Printed Pages. Please Turn Over.

QUESTION ONE (Compulsory)

(a) Define Armature reaction and state two effects on the distribution of the main magnetic field. [3 Marks]

(b) With neat diagram explain main parts of DC machine. Mention functions of each part. [6 Marks]

(c) List three areas of three phase induction machine application. [3 Marks]

(d) A 220 V shunt motor has the following parameters: Ra = 0.6 Ω, RF = 100 Ω and rotational (core, mechanical and stray) losses are 50 W. On full load, the line current is 19.5 A and the motor runs at 1200 rpm, find:

i. The developed power. [4 Marks]

ii. The output power. [3 Marks]

iii. The output torque. [3 Marks]

(e) State four types of phase transformer Connection combinations. [2 Marks]

(f) State three advantages of Star- Star Transformer connection. [3 Marks]

(g) Name three types of Single phase induction motors and state possible areas of application. [3 Marks]

QUESTION TWO

(a) Derive an expression for the e.m.f generated in a DC generator. [3 Marks]

(b) A 3-phase 60 Hz, 75 Hp, 4 pole motor operates at a rated terminal voltage of 230 V Under rated conditions it draws a line current of 186 A and has an efficiency of 90%. The following losses are measured: Core losses = 1273 W, Stator conductor losses = 2102 W, Rotor conductor losses = 1162 W Find:

a) the input power
b) the total losses
c) the air gap power
d) the shaft speed
e) the motor power factor
f) combined mechanical losses [6 Marks]

(c) A shunt machine, connected to a 200V main has an armature resistance of 0.15 Ω and field resistance is 100 Ω. Find the ratio of its speed as a generator to its speed as a motor, line current in each case being 75 A. [5 Marks]

(d) Explain principle of operation of synchronous machine. [4 Marks]

(e) Explain Magnetic Permeability and Relative Permeability. [2 Marks]

QUESTION THREE

(a) Explain commutation and state two methods of improving commutation. [1 Marks]

(b) Using a well labelled schematic diagram, explain the working principle of separately Excited D.C generator. [4 Marks]

(c) An 8-pole, wave-connected armature has 600 conductors and is driven at 625 rev/min. If the flux per pole is 20 mWb, determine the generated e.m.f. [5 marks]

(d) A Determine the terminal voltage of a generator which develops an e.m.f. of 200 V and has an armature current of 30 A on load. Assume the armature resistance is 0.30Ω [5 Marks]

(e) A lap wound DC shunt generator having 80 slots with 10 conductors per slot generates at no load emf of 400 volt, when running at 1000 r. p.m., at what speed should be rotated to generate a voltage of 220 volt on open circuit. . [5 Marks]

QUESTION FOUR

(a) List four applications of Series DC motor. [2 Marks]

(b) Derive the Torque Equation of DC Motor. [5 Marks]

(c) 100 hp 460 volt 60 Hz 4-pole, synchronous motor is operating at rated conditions and a power factor of 80% leading. The motor efficiency is 96% and the synchronous reactance is 2.72 ohms/phase. Find:

a) developed torque;
b) armature current;
c) excitation voltage (E_f);
d) power angle;
e) The maximum torque the motor can develop without loss of synchronization. (Pull-out torque). [8 Marks]

(d) Elaborate different types of transformer vector groups. [5 Marks]

QUESTION FIVE

a) Enumerate four types of DC Motors and its application. [4 Marks]

b) State four Starting methods of squirrel cage induction motors. [2 Marks]

c) State types of losses in induction machines. [4 Marks]

d) State four advantages of Parallel operation of three phase transformer. [4 Marks]

e) With a well labelled circuit diagram, represent the full model of 3 phase AC induction motor. [6 Marks]