



COLLEGE OF ENGINEERING, SCIENCE AND TECHNOLOGY
SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING
B.E. (HONORS) (ELECTRICAL ENGINEERING) PROGRAMME, (BENG 3)

EEB 712 ELECTRICAL MACHINES

FINAL EXAMINATION **(SEMESTER 2, 2018)**

DATE/TIME/ROOM – Refer to Timetable

Total Marks – 100

Time Duration – 3 hours & 10 Minutes

INSTRUCTIONS TO CANDIDATES

1. You are allowed 10 minutes extra time during which you are not to write.
2. Begin each answer on a fresh new page and use both sides of the sheets.
3. Write your identification number on the top of each attached sheet.
4. Insert all written foolscaps, graph paper, drawing paper etc. in their correct sequence and secure with string provided.
5. For all sheets of paper in which rough work has been done, cross it through and you must attach to your answer script.
6. Write clearly the number(s) of the question(s) attempted on the top of each sheet.
7. *ANSWER ALL QUESTIONS.*

TRANSFORMER

1. (a) Describe the operation of a single –phase transformer and explain the emf induced in a winding of transformer is related to the number of turns and the flux density in the core. [6Marks]
- (b) A 130 kVA transformer having primary voltage of 3000 V at 50 Hz has 190 primary and 60 secondary turns. Neglecting losses, calculate (i) the full load primary and secondary currents (ii) the maximum flux in the core. [4 Marks]
2. (a) Determine the number of turns per phase in each winding of a two winding transformer with a ratio of 20,000/2000 V at 50 Hz. The high voltage winding is star connected and the low voltage winding is delta connected. Each core has a cross section of 500 cm². Assume a flux density of about 1.2 Wb/m². [6 Marks]
- (b) What is an auto transformer? State its merits and demerits over the two winding transformer (at least two points). [4 Marks]

SYNCHRONOUS MACHINE

3. (a) What is meant by voltage regulation of a synchronous alternator? Explain the Synchronous Impedance method for the determination of voltage regulation. [7 Marks]
- (b) A three phase, 6 pole, star connected synchronous generator revolves at 1000 rpm. The stator has 90 slots and 8 conductors per slot. The flux per pole is 0.05 Wb. Calculate the voltage generated, if the winding factor is 0.96. [3 Marks]
4. (a) Why does a synchronous motor not self-starting? Explain briefly, describe, with neat diagram the method of starting a synchronous motor. [5 Marks]
- (b) What conditions should be satisfied to connect two three phase alternators in parallel? Write in sequence the steps needed to connect a synchronous generator with infinite bus bar by one dark and two bright lamp method. [5 Marks]

INDUCTION MACHINE

5. (a) Write short notes on ANY ONE of the following [6 Marks]
- (i) Principle of working of an induction motor.
- (ii) Torque-slip characteristics of a three-phase induction motor.
- (b) The stator loss of three phase induction motor is 2 KW. When the input is 90 KW, what will be rotor mechanical power developed and rotor copper loss, if the motor is running at slip of 4%. [4 Marks]

6. A 746 kW three phase, 50 Hz, 16 pole induction motor has a rotor impedance of $(0.02+j0.15)$ ohm at stand still. Full load torque is obtained at 360 rpm. Calculate (a) the ratio of maximum to full load torque (b) the speed at maximum torque (c) the rotor resistance to be added to get the maximum starting torque. [10 Marks]

DC MACHINE

7. (a) A shunt generator delivers a load current of 50 A at 500 V and has armature, series and shunt field resistance of 0.05 ohm, 0.03 ohm and 250 ohm respectively. Calculate the generated voltage and the armature current. Allow 1V per brush for contact drop. [4 Marks]
- (b) Derive from first principle an expression for e.m.f. equation of a dc machine and derive an expression for the electromagnetic torque developed in a dc motor. [6 Marks]
8. (a) A 4 pole, 500V shunt motor has a total of 720 armature conductors which are wave connected. The full load armature current is 60 A and the flux per pole is 0.03 Wb. The armature resistance is 0.2 ohm. The voltage drop across a brush is 1 volt. Calculate the full load speed of the motor. [5 Marks]
- (b) A 25 kW, 250 V dc shunt generator has armature and field resistances of 0.06 Ω and 100 Ω respectively. Determine the total armature power developed, when (i) working as a generator delivering 25 kW output and (ii) as a motor taking 25 kW input. [5 Marks]
9. (a) Draw the following characteristics for DC Series and DC Shunt Motor
- (i) Torque and Armature current (T- I_a) [2 Marks]
 - (ii) Speed and Armature current (N – I_a) [2 Marks]
 - (iii) Speed and Torque (N – T) [2 Marks]
- (b) Discuss the speed control methods for the DC motor. Explain anyone in details. [5 Marks]

SINGLE PHASE MOTORS

10. Find the mechanical power output and efficiency of 4 pole, 110 V, 50 Hz single phase induction motor at a slip of 0.05, whose constants are given below:
 $R_{1m} = 1.86 \Omega$, $R_2 = 3.56 \Omega$, $X_{1m} = X_2 = 2.56 \Omega$, and $X_M = 53.5 \Omega$.
Core loss = 3.5 watts and Friction and windage loss = 13.5 watts. [10 Marks]

[THE END]