Ref No:EX/ PG/EE/T/127A/2018

M. E. ELECTRICAL ENGINEERING FIRST YEAR 2ND SEMESTER EXAMINATION, 2018

(1st /2nd Semester/~~Repeat/Supplementary/Annual/Bi-Annual~~)

SUBJECT: - MODELING AND ANALYSIS OF ELECTRICAL MACHINES AND DRIVES

Time: ~~Two hours~~/Three hours/ ~~Four hours/ Six hours~~

Full Marks 100
(50 marks for each part)

Use a separate Answer-Script for each part

PART I

Answer any Three Questions

ALL questions carry equal marks

Two marks are for neat and systematic answers

Q1. What do you understand by FEM? Derive the shape function of a first order triangular element for a two dimensional FEM analysis. State all the assumptions. 10+4+2

Q2. Why thermal modeling is necessary? Describe a lumped parameter thermal model to determine the temperature rise of an IM. Clearly state all the assumptions. 16

Q3. In IM thermal modeling, how the following thermal resistances are estimated: 16

a) Thermal resistance between surfaces to ambient
b) Thermal resistance of the air gap between stator and rotor
c) Thermal contact resistance between stator and frame

Q4. What do you understand by Finite Difference Approximation? Discretize one dimensional heat flow equation by Finite Difference Approximation. 16

Q5. Develop the H-G diagram of an induction motor from its equivalent circuit 16

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M.E.E. 2-nd Semester ,2018

Modeling and Analysis of Electrical Machines & Drives

Time:3 hours Full Marks:100

(50 marks for each part)

Use separate Answer-script for each part

PART-II

Answer any three questions. Two marks for neatness. All symbols have their usual significance

1. a) With the help of suitable current configurations in the **stator** of a 3-phase induction motor, describe how rotating magnetic fields having **2-poles** can be produced when motor is supplied from a 3-phase sinusoidal AC source of 50 Hz. What is synchronous speed?
   b) With the help of suitable current configurations in the **stator** of a 3-phase induction motor, describe how rotating magnetic fields having **4-poles** can be produced when motor is supplied from a 3-phase sinusoidal AC source of voltage. What is synchronous speed? 8+8=16

2. a) What are meant by space vectors for flux, voltage and currents ($\overline{\psi_s}$, $\overline{u_s}$ and $\overline{i_s}$) in a **stator** of 3-phase induction motor? Using space vectors derive stator vector-voltage equation $\overline{u_s} = \overline{i_s} R_s + \frac{d\overline{\psi_s}}{dt}$

   b) Derive the transformed **rotor** vector-voltage equation of a 3-phase induction motor if the stator voltage equation is $\overline{u_s} = \overline{i_s} R_s + \frac{d\overline{\psi_s}}{dt}$

   8+8=16

3. Using space vectors for flux, voltage and currents ($\overline{\psi}$ $\overline{u}$ and $\overline{i}$) in a 3-phase induction motor, develop the equivalent circuit valid during **transient** process having resistances and inductances of the windings. 16

4. A 3-phase induction motor is started by applying 3-phase AC balanced voltages; obtain expressions for total **transient currents** in the machine until rotor starts rotating. Discuss about the time constants related to this transient currents. 16

5. Using **Lyon's method** of instantaneous **symmetrical** components, derive the expression for **total torque** on the rotor of a 3-phase induction motor. 16