Ref No: Ex/PG/EE/T/127A/2017

M. E.E 2ND SEMESTER EXAMINATION, 2017

(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. (a) Show how a differential equation is solved by using Finite Difference Approximation. 8

(b) Discritize 1-dimensional heat flow equation by Finite DifferenceApproximation. 8

Q2. Derive the shape function of a first order triangular element for a two dimensional problem and discretize the energy functional . 16

Q3. A pair of buried pipes is being used to transmit electrical signals, determine the distribution of voltage signal along the line by using FEM. States the assumptions clearly. 16

Q4. Describe a method to estimate the rotor winding resistance of an IM from the measured power, current and voltage. 16

Q5. Describe a lumped parameter thermal circuit of an IM. How the thermal parameters are determined? 16

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M.E.E. 2-nd Semester,(Regular) ,2017

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-pole** 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 **2-pole** can be produced when motor is supplied from a 3-phase sinusoidal AC source of 50 Hz of opposite phase sequence as in part (a). 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 having resistances and inductances of the windings, which is valid during **transient** process. 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