M.E. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

First Semester

Power Electronics and Drives

PX 7101 — ANALYSIS OF ELECTRICAL MACHINES

(Common to M.E. Power Systems Engineering)

(Regulations 2013)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Compare single over and doubly excited system.
2. Define winding inductance.
4. Draw equivalent circuit of shunt connected DC machine.
5. Define arbitrary reference frame.
6. What are the commonly used reference frames?
7. State the significance of free acceleration characteristics.
8. Define Steady state operation of Inductance machine.
9. State the significance of digital computer simulation.

PART B — (5 × 13 = 65 marks)

11. (a) Derive the expression for Mutual inductance of two coils.

   Or

   (b) Derive the expression for stored magnetic energy, co-energy and force for doubly exited system.
12. (a) Explain in detail with necessary waveforms, the dynamic performance of permanent magnet DC motor during sudden increase or decrease in load torque.

Or

(b) Discuss about the time domain block diagram and state equation for shunt connected DC machine.

13. (a) Discuss about the transformation of stationary circuit variables as R, L and C into arbitrary reference frame with an example.

Or

(b) Explain with necessary mathematical equation the phase transformation and commutator transformation.

14. (a) Derive the voltage equation for induction motor using reference frame theory.

Or [www.recemquestionpaper.com]

(b) Draw the arbitrary reference-frame equivalent circuits of a 3-phase, symmetrical induction machine using voltage equations in arbitrary reference-frame variables.

15. (a) For a 2-pole, 3-phase, Y-connected, salient—pole synchronous machine, derive the voltage equations in machine variables and in arbitrary reference-frame variables.

Or

(b) Explain in detail about the digital computer simulation in synchronous machine in arbitrary reference frame.

PART C — (1 × 15 = 15 marks)

16. (a) The permanent magnet DC motor has following parameters: \( R_s = 8 \Omega, K_v = 0.01 \) \( K = 5 \times 10^{-4} \text{NMS V.s/rad} \). The shaft load torque is approximated \( T_l = K \cdot \omega \), where \( K = 5 \times 10^{-6} \text{N.m.s} \). The applied voltage is 6 V and \( B_m = 0 \). Calculate steady state rotor speed \( \omega \) in rad/s.

Or

(b) A three phase 50Hz, 400V induction motor has 4 pole star connected stator winding. The rotor resistance and reactance per phase are 0.25 \( \Omega \) and 2 \( \Omega \) respectively. Full load slip is 8%. Calculate:

(i) Total torque developed
(ii) Maximum torque
(iii) Speed at maximum torque. Assume stator and rotor ratio is 2:1.