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INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

M.Tech I Semester End Examinations (Regular) - February, 2017

Regulation: IARE-R16

SPECIAL MACHINES AND CONTROLLERS

(Power Electronics and Electric Drives)

Time: 3 Hours

Max Marks: 70

Answer ONE Question from each Unit

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

UNIT – I

- (a) Describe the constructional features of axial and radial flux synchronous reluctance motor with their operating characteristics. [7M]

(b) Derive the voltage and torque equations of synchronous reluctance motor. [7M]
- (a) Differentiate between axial and radial air gap synchronous motors. Compare the performance of synchronous reluctance motor with switched reluctance motor [7M]

(b) Draw and discuss the torque – speed characteristics of synchronous reluctance motor. Explain in detail the construction and operation of Vernier motor and draw its phasor diagram. [7M]

UNIT – II

- (a) A 3-phase, 3 stack variable reluctance stepper motor has 20 poles on each rotor and stator stack. Compute the step angle of the stepper motor. Assume double layer winding. [7M]

(b) Discuss the static and dynamic characteristics of stepper motor with a neat diagram. [7M]
- (a) Discuss the dual voltage driver circuit for 2- phase on drive of a 4 - phase stepper motor and explain the nature of current build up in dual drive. [7M]

(b) Explain the constructional features and operation of a hybrid motor. Describe step position error and holding torque resulting from load torque T_L . Draw the torque-angle curve. [7M]

UNIT – III

- (a) Illustrate the various modes of operation of switched reluctance motor with relevant plots. [7M]

(b) With a neat block diagram explain the closed loop speed control of a switched reluctance motor. [7M]
- (a) Enumerate the procedure for the prediction of torque and control mechanism with relevant voltage and flux waveforms for switched reluctance motor in single pulse mode. [7M]

(b) Discuss the various converter topologies for a 3-phase switched reluctance motor with merits and de-merits. [7M]

UNIT – IV

7. (a) Draw and explain the operation of electronic commutators. [7M]
- (b) Derive the torque and emf equations of a permanent magnet brushless DC motor. [7M]
8. (a) Explain the magnetic circuit analysis of brushless DC motor on open circuit. [7M]
- (b) Sketch the structure of controller for PMBLDC motor and explain the functions of various blocks. [7M]

UNIT – V

9. (a) Derive the expression for power input and torque of a permanent magnet synchronous motor. Explain how its torque – speed characteristics are obtained? [7M]
- (b) Draw the equivalent circuit and vector diagram of a permanent magnet synchronous motor with relevant voltage equations and flux linkage components. [7M]
10. (a) Explain how a smooth torque is ensured in a permanent magnet synchronous motor. Draw the phasor diagram corresponding to leading power factor operation. [7M]
- (b) Discuss the different current control schemes in permanent magnet synchronous motor and mention the effects of demagnetizing mmf. [7M]