

M.E. ELECTRICAL ENGINEERING EXAMINATION-2024

(FIRST YEAR, FIRST SEMESTER)

SPECIAL PURPOSE ELECTRICAL MACHINES

Paper-II

Time: 3 hours

Full Marks:100

(50 marks for each part)

Use separate Answer-script for each part

PART-I

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

1. a) Show with a stator-structure of the Induction Motor, how 2-poles are produced from 3 phase currents in a 3-phase Induction Motor.
b) Then explain linear induction motor structure and operation. What is the application and limitation of this motor? 8+8=16
2. a) Draw & describe the construction of stator and rotor of a single-phase reluctance motor.
b) Explain all the marked portion in speed-torque characteristics of single-phase reluctance motor as shown in fig.1

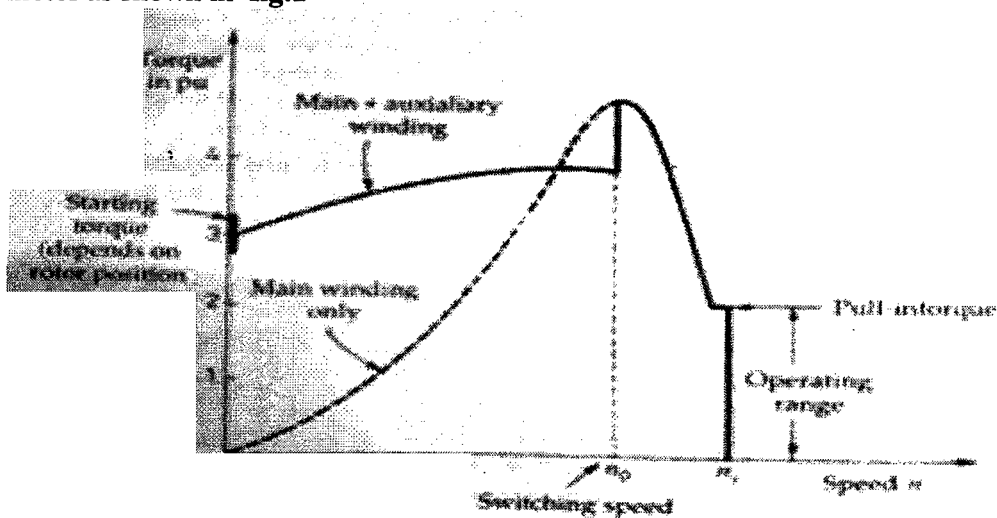


fig.1

8+8=16

3. Draw & describe the construction of stator and rotor and working method of a Hysteresis Motor deriving its speed-torque characteristic. State why it is a Silent Machine compare to others. 16
4. Draw & describe the construction of stator and rotor and principle of operation of a Permanent Magnet DC Motor deriving its speed-torque characteristic. Also explain **Armature Reaction** and how it does affects this Motor. 16
5. Draw & describe the construction of stator and rotor and principle of operation of a Permanent Magnet Synchronous Motor. Explain the difference between a Permanent Magnet Synchronous Motor and a BLDC. 16

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PART-II.

Answer *all* questions from this part.

- a) Deduce the expression for the ratio of maximum torque developed in three phase squirrel cage induction machine under generator and motor modes taking the stator parameters in to account. Comment on its nature of variation with different machine parameters. 10

OR

- b) Why reactive power is needed for induction generators? Deduce the expression for reactive power in a three phase induction generator with the help of its steady state equivalent circuit and sketch the same against operating slip.

7. a) Deduce and explain the methods of capacitor calculation techniques for three phase cage type induction machines when operating as self excited generators. Also comment on its significance on voltage regulation with load variations. 10

OR

- b) Draw the phasor diagram of a three phase doubly fed induction generator both under sub and super synchronous modes. Also explain how rotor side converter power varies under both these modes.

8. (a) Describe with block diagram the variable speed grid connected squirrel cage induction generator converter control scheme and explain the function of each block along with the merits and demerits of this scheme. 10

OR

- (b) Explain the voltage build-up procedure in a self-excited induction generator. Also show the capacitor selection affects the voltage build-up and operating points of the generator.

9. a) A squirrel cage self excited induction machine is having following ratings and parameters referred to stator side under rated conditions: 10
415 V, 1.8kW, 1440 rpm, 3-phase, 50 Hz, $R_s = 0.9 \text{ ohm}$, $R_r = 1.1 \text{ ohm}$, $L_m = 190 \text{ mH}$, $X_{ls} = X_{lr} = 3.3 \text{ ohm}$, friction, windage and core losses negligible.

It is running at 1440 rpm with the help of wind turbine. Determine the per phase capacitor requirement for the machine to generate rated voltage at this speed. Also determine the frequency of the generated voltage.

OR