

B.E. ELECTRICAL ENGINEERING
FOURTH YEAR
FIRST SEMESTER EXAM 2025
SPECIAL ELECTRICAL MACHINES AND DRIVES
(ELECTIVE-I)

Time:3 hours

Full Marks:100

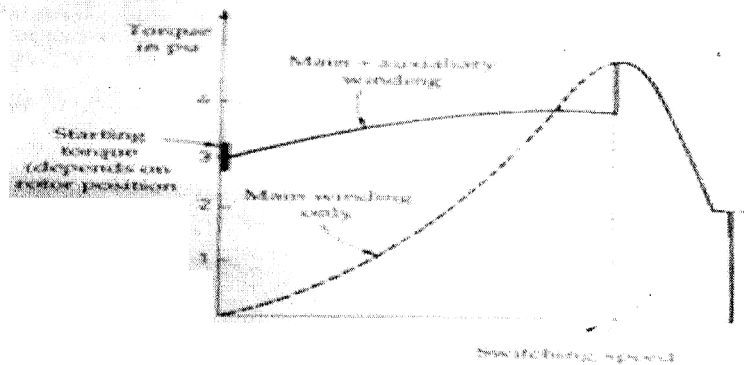
(50 marks for each part)

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) Describe the construction and principle of operation of a **single-phase reluctance motor** and explain why it is a **synchronous machine**.
 b) Describe the speed-torque characteristics of single-phase reluctance motor as shown in

**fig.1****8+8=16**

2. a) Describe the construction and principle of operation of a Permanent Magnet DC Motor with deriving expression of torque vs. speed and explain armature reaction with drawings and its impact on Permanent Magnet. Also explain how the speed is controlled.
 b) Describe types of Permanent magnet materials and applications in Permanent Magnet DC Motors.
10+6=16
3. a) Describe with a drawing of construction of stator and rotor and working method of a Hysteresis Motor.
 b) Draw and explain the speed-torque characteristic of a Hysteresis Motor and where is this required.
10+6=16
4. a) Describe with a drawing of construction of stator and rotor, working method of a Linear Induction Motor.
 b) Discuss about the applications of Linear Induction Motor.
10+6=16
5. Write short notes on :
8+8=16
 - a) Variable reluctance Stepper motor
 - b) Hybrid Stepper Motors.

Answer *all* questions from this part.

- OR

- OR

- OR

- b) A 2.7 kW, 415V, 4-pole 3 phase, 50 Hz, star connected, 1440 rpm, cage type induction machine is operating as a capacitor excited stand-alone generator at 1200 rpm with the help of a prime mover delivering a power of 0.5 kW with pf of 0.9 lag to a load at rated voltage. Determine (i) connected capacitor per phase (ii) stator current and operating frequency. (CO4)
- The per phase parameters referred to stator:
- $R_s = R_r = 0.60 \text{ ohm}$, $X_{ls} = X_{lr} = 3.5 \text{ ohm}$, $X_m = 95 \text{ ohm}$ and R_c very large (assume linear magnetic circuit).

9	a) A slip ring type 1.5kW, 1440 rpm, 3-phase, 50 Hz grid connected induction machine (DFIG) is having following ratings and parameters referred to stator side: Stator : 415 V, $R_s = 0.8 \text{ ohm}$, $X_{ls} = 2.8 \text{ ohm}$, Rotor : 230V, $X_{lr} = 2.8 \text{ ohm}$, $R_r = 1.1 \text{ ohm}$, stator to rotor turns ratio 1:1 $L_m = 120 \text{ mH}$, friction, windage and core losses negligible. Find the resistance that is to be connected in its rotor circuit so that it can deliver half the rated power to grid at a speed of 1600 rpm. Determine the reactive power with proper sign at the stator side under this condition. Assume no interconnecting reactor between DFIG stator and grid. (CO4)	10
	OR	
	b) Show with block diagram the input and output signals and their interfacing techniques along with control methodology when a DSP is employed for wind energy conversion through doubly fed grid connected induction generator (DFIG). (CO3)	10
10	Write short notes on any Two: (CO2) a) Voltage build-up procedure of self excited induction generator. b) Sub-synchronous operation of doubly fed induction generator (DFIG). c) Variable speed operation of squirrel cage induction generators.	5 + 5