CLO # 5 Analyze an Induction motor circuit

Q1: **[marks =25]**

A textile unit uses 12 three phase induction motors in addition to some other motors. Each of the aforementioned motors is rated at 440-V 50-Hz 4-pole Y-connected and is rated at 70 kW. The equivalent circuit parameters are;

170kW

$R_1 = 0.08\Omega$, $R_2 = 0.07\ \Omega$, $X_M = 8\ \Omega$, $X_1 = X_2 = 0.2\ \Omega$,

Some of the losses are given as under

$P_{Mech} = 1$ KW, $P_{Misc} = 150$ W, $P_{Core} = 1.1$ KW

The motor is running at a speed of 1425 rpm under loaded conditions, **analyze** the motor circuit to find out following

1. The stator current and power factor
2. The stator copper losses P_{SCL}
3. The air-gap power P_{AG}
4. The induced torque τ_{ind}

CLO # 4: Appraise the existence of a rotating magnetic field and its application to a Synchronous Motor

Q2: **[marks =25]**

List down the names of all motors that operate on the principle of rotating magnetic field.

A small factory uses a synchronous motor to adjust its power factor and reactive power. The said synchronous motor is rated at 400V, 55 HP, 60 Hz, 8 pole, Y connected and has per phase synchronous reactance of 0.4 Ω. The motor is initially working at 0.8 pf lagging and delivering an output power of 32000 W. The field current of the motor is changed so that the motor is now operating at a pf of 0.7 leading keeping output power constant. The field circuit of the motor has a voltage source of 250 V (DC), and all the losses of the motor are ignored. The motor is operating at rated voltage and frequency. **Analyze** the motor model to find out following

a) Field current in the initial case at 0.8 lagging pf
b) The torque angle in final case at 0.7 leading pf
c) Reactive power delivered by motor in part (b)

The OCC is shown below

I_F (A)	2	4	6	8	10
$V_{T,NL}$ (V)	200	400	500	550	600

OCC for above synchronous machine

CLO #2: Investigate working of a DC Machine

Q3: **[marks =25]**

A 240V compensated, separately excited DC motor has armature resistance of 0.3 Ω. Its rated line current is 125A, field resistance is 80 Ω and adjustable resistance connected in series with field coil can vary from 70 Ω to 300 Ω.
Its no load characteristic curve at a speed of 1300 rpm is tabulated as under.

I_F (A)	0.3	0.6	0.9	1.2	1.4	1.6
E_A (V)	130	230	274	288	292	295

Investigate the DC machine to find out following quantities assuming rated terminal voltage in all cases.

a) No load speed of motor if adjustable resistance connected in series with field coil has been set to a value of 130 ohm.
b) Assume that the machine is drawing 70% of its rated lined current, find out converted power and induced torque in this condition, with same field current as in part (a)
c) Draw a fully labeled Circuit diagram for part (b)
d) Also draw the general torque speed curve of a compensated DC series motor

CLO #3: Analyze Synchronous Generator performance along with special emphasis towards environmental cost of generation

Q4: **[marks 25]**

A **2400** V, **1.25** MVA, 0.85-PF-lagging, 50-Hz, 28 pole, Y-connected synchronous generator, has a synchronous reactance of 1 Ω and an armature resistance of 0.2 Ω. At 50 Hz, its friction and windage losses are 28 KW, and its core losses are 24 KW. The field circuit has a dc voltage of 220 V, and the maximum I_F is 10 A. The resistance of the field circuit is adjustable over the range from 12 to 200 Ω.
The generator is providing full rated load at rated power factor, rated terminal voltage and 6A field current. ***Analyze*** the Synchronous Generator circuit to find out the following quantities

a) Rotational speed, also comment about possible environmental impact of prime mover (strictly one line/sentence only)
b) Field circuit resistance
c) Voltage regulation
d) Efficiency