

**Electrical Machines-I (EE 2001)**

**2nd Assignment**

**Instructions:**

1. Try to solve the problem on your own.
2. Correct and unique answer is expected.
3. Date of submission: 15.02.2024

**Solve all the Problems**

1. A 3 $\phi$ , 1.5 MVA, 6.6 kV, star-connected alternator has nine slots per pole and six conductors per slot. The leakage reactance drop is 10 %, and the resistance drop is 0.5% during full load condition. The rotor has salient poles wound with 150 turns on each pole, and the rotor m.m.f may be considered rectangular, the base being 3/4 of the pole pitch. Determine the approximately the exciting current required and regulation 0.8 p.f. lagging. The data for the OCC is given below:

$I_f$ (A)	18	25	31	40	45	50	60
$E_{f-Line}$ (V)	5600	6600	7260	7900	8250	8470	8750

If iron, friction and windage losses aggregate 40 kW and field coils are supplied at 180 V, estimate the efficiency at full load and p.f. 0.8 pf leading.

2. The slip test on a salient-pole synchronous machine gives  $x_d = 100\%$  and  $X_q = 80\%$ . If  $x_l = 10\%$  and OCC as given in the last problem. The resistance is 1%. In this context, 100% = 8470 V . Determine the regulation on full load at 0.9 power factor lagging considering saturation by Kingsley's saturation factor. As shown in the table below:

$I_f$ (A)	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2
$E_{f-Line}$ (V)	1	1.03	1.07	1.12	1.22	1.36	1.56	1.84	2.44

3. A 3  $\phi$ , 500V, 100 h.p.,  $\Delta$  connected cylindrical rotor synchronous machine has a per phase impedance  $0.3 + j3$  ohm. The machine runs as a motor with rated supply voltage and in over-excited condition  $E = 1.2$  p.u.. The total amount of friction windage and core loss is equal to 1 kW. Determine output power, current, power factor, and efficiency for maximum torque and maximum input power. Also, find the minimum and maximum allowable excitation current value in the p.u. representation.
4. A 3  $\phi$ , 500 kVA salient pole synchronous machine has a direct axis and quadrature axis synchronous reactance as 80% and 62.5%, respectively. The machine runs as a motor with rated supply voltage and in over-excited condition  $E = 1.32$  p.u.. The friction windage and core loss are constant at 4%. Determine a) current, power factor, and power angle for the rated torque output. b) Maximum torque and power angle for the same. c) the maximum reluctance torque.