Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

VII SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, NOVEMBER 2015

SUBJECT: POWER SYSTEM OPERATION AND CONTROL [ELE 421]

REVISED CREDIT SYSTEM

Time: 3 Hours | 03 December 2015 | MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** questions.
- Missing data may be suitable assumed.

1A. An isolated alternator has the following data: X_d =1, X_q = 0.6; X_d^1 =0.2; r =0.05; T_{do}^1 = 4 sec; Find V_a as a function of time when at t=0, E_{fd}=1 pu is applied given Z=0.05-j0.8. **(07)**

1B. A synchronous machine is in operation with $\theta = \omega_0 t + 2\pi/3$. V_a=100∠30° v and I_a= 50∠30° A. Find i_d, i_q, v_d, v_q and three phase power output. **(03)**

2A. A 500KV line has the following parameters: β=0.0013rad/km; Z_c=250Ω (P_0= 1000MW). The line is 600km long and transfers power between two sources. Determine the power angle and voltage regulation characteristics for a power transmission of 1.5P_0 for the following cases.

a) shunt compensation b) series compensation c) shunt and series compensation **(06)**

2B. Derive the expression for subtranscient inductance of a synchronous machine. **(04)**

3A. Derive the expression for the current profile of a 400Km symmetrical line on no load. **(05)**

3B. An alternator is working under no load conditions. A 3-phase short circuit occurs at the terminals of the alternator. Neglecting damper currents find the expression for the armature current starting from the differential equation $T'_{do}\frac{d|E'_a|}{dt}+E_a=E_{fd}$ **(05)**

4A. A Salient pole alternator is connected to infinite bus through a reactance of 0.2 pu. The generator is in steady state with E_a = 1∠20°. At t = 0, E_{fd} is changed to 2 pu. Find $E_a(t)$ & $E'_a(t)$ for $t > 0$. Find the steady state values of the current & the terminal voltage of the alternator.

Assume X_d = 1.15, X_q = 0.6, X'_d =0.15, r =0, T'_{do} = 2 secs **(07)**

4B. Starting from the Park's Voltage equations derive the phasor diagram of a Salient pole alternator under transcient conditions. **(03)**

5A. Starting from the block diagram representation of an alternator connected to infinite bus with AVR and PSS, Explain the role of PSS in damping rotor oscillations. **(06)**

5B. A two area system has the following data

Area	Rated Capacity (MW)	R (Hz/ MW)	D (MW per Hz)
A	100	0.01	1
B	1000	0.001	1

There is sudden increase in load of 30MW in area A, find a) steady state frequency deviation b) Tie-line power flow c) Power generated by each areas **(04)**

6A. The fuel cost models for the two thermal units are $F_1 = 7.74P_1 + 0.00107P_1^2$, $F_2 = 7.72P_2 + 0.00072P_2^2$. The transmission loss is $P_L = 0.5 \times 10^{-3} P_1^2 + 0.2 \times 10^{-3} P_2^2$. Where P_1 & P_2 are in MW. The optimal generation of plant 1 is 370 MW. Find the incremental cost of Power delivered, the optimal generation of second plant, the power loss and the load. **(05)**

6B. Determine the reactive power requirements of 400 km symetrical line loaded with P=1.4 P_o. Derive the formula used. β=0.0013 rad/km. **(05)**