Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

VII SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

MAKE UP EXAMINATIONS, DEC 2015 / JAN 2016

SUBJECT: POWER SYSTEM OPERATION AND CONTROL [ELE 421]

REVISED CREDIT SYSTEM

Time: 3 Hours 05 JANUARY 2016 MAX. MARKS: 50

Instructions to Candidates:

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

1A. Derive the expression for the voltage profile of a 400km symmetrical line on no load. **(04)**

1B. A Salient pole alternator is connected to infinite bus through a reactance of 0.2 pu. The generator is in steady state with $E_a = 1\angle 20^0$. At t = 0, E_{fd} is changed to 2.5 pu. Find E_a (t) & E_a^1 (t) for $t > o$. Assume $X_d = 1.15$, $X_q = 0.6$, $X_d^1 = 0.15$, r =0, $T_{do}^1 = 2$ secs **(06)**

2A. An isolated alternator has the following data:
$X_d = X_q = 1$pu; $X_d^1 = 0.2$; r =0; $T_{do}^1 = 1$ sec; Find V_a as a function of time when at t=0, E_{fd}=1 is applied for the following cases.
a) Z=0.5 b) Z= – j0.5 **(06)**

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

3A. The fuel cost models for the two thermal units are

$$C_1 = \alpha + 6.7P_1 + 4.77\times10^{-3}P_1^2 \; ; \quad C_2 = \alpha + 6.7P_2 + \gamma P_2^2$$

P1 & P2 are in MW

Determine λ , γ and the penalty factors for the two plants. The optimum loadings are P1=120 MW and P2 = 100 MW. The three bus power system has the following data

V1=V2=V3= 1 pu.

PF1=0.85; PF2=0.8; PF3=0.75

R1D= 0.0025; R2D= 0.02; R3D=0.03 **(06)**

3B. Starting from the Park's Voltage equations derive the steady state phasor diagram of a Salient pole alternator. **(04)**

4A. Draw the block diagram represnation of a two area system and hence derive the expressions for frequency deviation and tie-line power transfer. **(06)**

4B. A two area system has the following data:

Area A: Rated capacity 500MW, R= 2.5Hz/ pu MW, D= 0.02 pu MW/Hz

Area B: Rated capacity 2000MW, R= 2.0Hz/pu MW, D= 0.02 pu MW/Hz

There is a sudden increase in load of 20MW in area A, find

a) Steady state frequency deviation b) Tie-line power flow

c) extra power generated by each area. **(04)**

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. **(08)**

5B. A synchronous machine is working under steady state condition. Determine v_d, v_q, i_d, i_q and the power output, given $V_a = 1\angle 0°$ pu and $I_a = 1\angle -30°$ pu, $\delta = 30°$. **(02)**

6A. A 500KV line has the following parameters:
B=0.0013rad/km; Zc=250Ω.
The line is 600km long and transfers power between two sources. Determine the power angle characteristics for a power transmission of 1.4 P_0 for the following cases.

a) shunt compensation b) series compensation c) shunt and series compensation

Also draw the mid point voltage vs loading of the line for the above cases. **(06)**

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. **(04)**