Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

I SEMESTER M.TECH (EMAL / PESC)

END SEMESTER EXAMINATIONS, NOVEMBER 2015

SUBJECT: POWER SYSTEM OPERATION AND CONTROL [ELE 505]

REVISED CREDIT SYSTEM

Time: 3 Hours 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 $E_a^1 = 1\angle 20^0$. At t = 0, E_{fd} is changed to 2.5 pu. Find E_a (t) & E_a^1 (t) for t > o. Find the steady state values of the current and the terminal voltage of the alternator.

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. Prove that for a tie-bus system the fault MVA is independent of the number of sections. **(04)**

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

$$C_1 = \alpha + 6.7P_1 + 4.77 \times 10^{-3} P_1^2 \; ; \quad C_2 = \alpha + 6.7P_2 + \gamma P_2^2$$

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)**

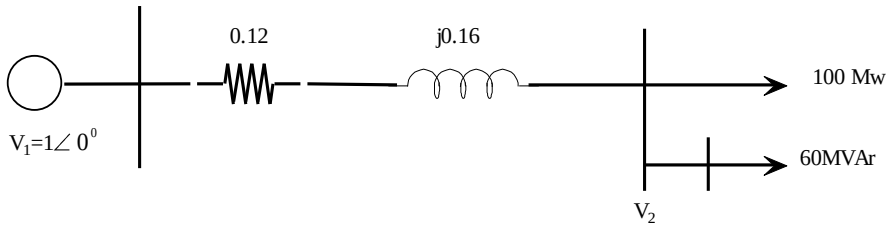
3B. Starting from the Park's Voltage equations derive the steady state phasor diagram of a Salient pole alternator. **(04)**

Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

4A. Find the voltage and angle of bus 2 using NR method for one iteration.



(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. A 50 Hz, Synchronous generator has H= 5 MJ/MVA, and Xd′= 0.3 p.u. It is connected to an infinite bus through a transformer and a double circuit line. Transformer reactance is 20%. Each line has a reactance of 30%. The voltage behind transient reactance of generator is 1.17 p.u. A three phase fault occurs at the middle of one of the lines. The fault is cleared by the opening of the faulted line. Determine the critical clearing angle & critical clearing time. **(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
Also draw the mid point voltage vs loading of the line for the above cases. **(05)**

6B. 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. **(05)**