Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

VI SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)
GRADE IMPROVEMENT EXAMINATIONS, JAN 2021

POWER SYSTEM OPERATION & CONTROL [ELE 4008]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 07 January 2021** **Max. Marks: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. An isolated alternator has the following data: X_d =1, X_q = 0.6 pu; X_d^1 =0.2 pu; r =0; T_{do}^1 = 4 sec; Find V_a as a function of time when at t=0, E_{fd}=1 is applied given a) Z=1 b) Z=j1. ***(05)***

1B. A synchronous is in the steady state with δ=75°. V_a=1∠0 and I_a= 1∠-30°. Find i_d, i_q, v_d, v_q. ***(03)***

1C. For an unloaded radial line obtain the voltage profile and current profile equations. ***(02)***

2A. A Salient pole alternator is connected to infinite bus through a reactance of 0.1 pu. The generator is in steady state with the power output P_G = 0.5pu and E_a=1.5pu. At t = 0, there is a fault and the circuit breakers at the two ends of the line trip. Find the expression for $V_a(t)$.

Assume X_d = Xq = 0.9, X_d^1 =0.2, r =0, T_{do}^1 = 2 secs, δ remains constant. ***(05)***

2B. Determine the reactive power requirements of 400 km symetrical line loaded with P=1.4 Po. Derive the formula used. β=0.0013 rad/km. ***(03)***

2C. Starting from the park's voltage equations for a generator, derive the steady state phasor diagram of a generator. ***(02)***

3A. Derive the expression and plot 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. 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. ***(04)***

4B. A 500 KV line has the following parameters: β=0.0013 rad/km; The line is 600 km long and transfers power between two sources. Determine the power angle characteristics for a power transmission of $1.4P_0$ for the following cases. a) shunt compensation b) series compensation ***(04)***

4C. An electric power system with two plants has the following transmission loss equation

$$P_L = (0.5)10^{-3}{P_1}^2 + (0.2)10^{-3}{P_2}^2$$

The fuel cost model are

$$F_1 = 8.52P_1 + 0.0015\ {P_1}^2$$

$$F_2 = 8.65\ P_2 + 0.00056{P_2}^2$$

Given that the incremental cost of power delivered is 10.9, obtain the optimal power generations and the corresponding load power. ***(02)***

5A. A two area system has the following data

Area	Rated Capacity (MW)	R (Hz/per unit MW)	D (per unit MW per Hz
A	500	2.5	0.01
B	2000	2.0	0.01

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. ***(05)***

5B. Calculate the loss coefficient for the system shown in fig.5B. Select a base MVA of 100. Calculate the penalty factors L_1 & L_2 and the corresponding power loss. The two plants have an optimum loading of P_1=120 MW and P_2=100MW. The fuel cost models for the two plants are

$F_1 = \alpha + 6.69P_1 + (4.7675)10^{-3}\ P_1^2\ \$/hr$

$F_2 = \alpha + 6.69P_2 + \gamma\ P_2^2\ \$/hr$

Where P1 and P2 are in MW.

Find also λ and γ.

Assume V_1=V_2=V_3=1pu.

R_1=0.0025pu

R_2=0.02pu

R_3=0.03pu

PF_1=0.85

PF_2=0.8

PF_3=0.75 ***(05)***

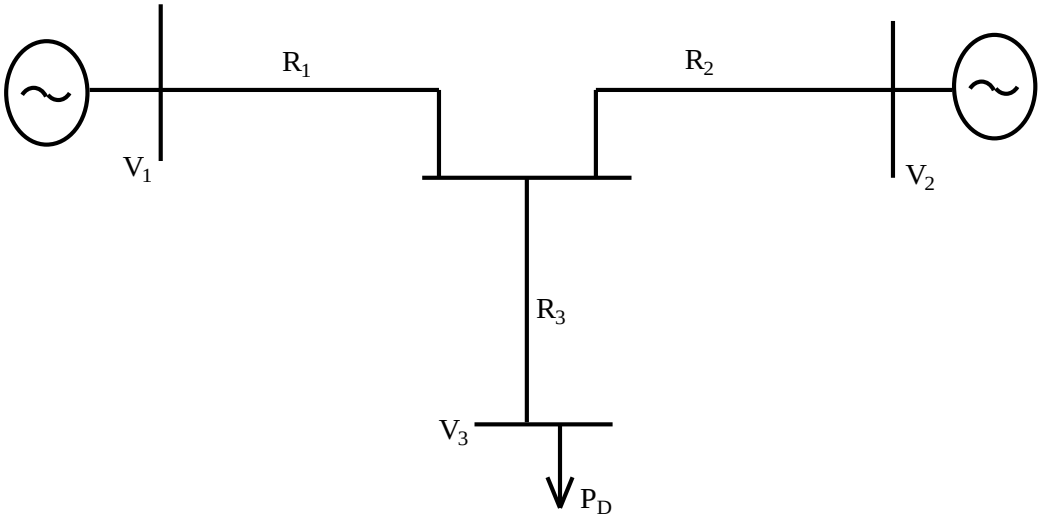

Fig.5B