Ref No: Ex/EE/5/T/323/2018

B.E. ELECTRICAL ENGINEERING (PART TIME) THIRD YEAR SECOND SEMESTER 2018

SUBJECT: - POWER SYSTEM PERFORMANCE

Full Marks: 100

Time: Three hours (**50** marks for this part)

Use a separate Answer-Script for each part

No. of Questions		PART -I Answer any Three (Two marks reserved for well organized answers)	Marks
1)	a)	Derive the active power versus power angle curve for a cylindrical rotor synchronous generator.	(6)
	b)	Why the system voltage in a power system network has to be kept constant?	(4)
	c)	"In a power system, P-δ and Q-V are strongly coupled" – justify the statement.	(6)
2)	a)	For a generator delivering constant power to an infinite bus, the variation of excitation results in change of power factor – Explain with the help of proper phasor diagrams. Also explain "Synchronous Condensor".	(8)
	b)	Briefly explain Supplementary control in connection with Load Frequency Control.	(8)
3)	a)	Two generators rated 400 MW and 600 MW are operating in parallel. The droop characteristics of their governors are 3% and 4% respectively from no load to full load. Assuming that the generators are operating at 50 Hz at no load, how would a load of 800 MW is shared between them and What will be the system frequency at this load? Assume linear governor operation.	(8)
	b)	Derive the "Swing Equation".	(8)
4)	a)	Explain the equal area criterion for stability.	(8)
	b)	The K.E stored in the rotor of a 20 MVA, 4 pole, 50 Hz alternator is 60 MJ. The input to the machine is 15 MW at a developed power of 13.5 MW. Calculate the accelerating power assuming that acceleration remains constant for 10 cycles. Determine the value of load angle at the end of 10 cycles.	(8)
5)		Write short notes on (**any two**): (i) Methods of improving steady state stability in Power System. (ii) Brushless Excitation System. (iii) Static Excitation System. (iv) Critical Clearing Angle.	(2×8)

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PART - II

Answer any Three

(Two marks reserved for well organized answers)

1) a) Explain the purpose served by the slack bus in a load flow study. How is it chosen? (4)

b) Point out the difference between a P-Q type and a P-V type bus bar. (2)

c) Calculate the bus admittance matrix of a 4-bus power system whose line data in per unit are as follows: (10)

Line no.	From bus	To bus	Line impedance (p.u.)	Half- line charging admittance (p.u.)
1	1	2	0.01+j0.2	j0.01
2	1	3	0.01+j0.1	j0.01
3	2	3	0.01+j0.15	j0.01
4	2	4	0.01+j0.2	j0.01
5	3	4	0.01+j0.25	j0.01

2) a) Analytically prove that the locus of complex power at the sending end is a circle. What is the importance of power circle diagrams in power system operation? (8)

b) A three phase over-head line has circuit constants $A = 0.95\angle 9^0$ and $B = 150\ \angle 80^0$ ohm. The voltages at the sending and receiving end are held constant at 225 kV and 220 kV respectively. Draw receiving end power circle diagram with a scale of 1cm = 50MVA. (8)

3) a) What is symmetrical fault? What is unsymmetrical fault? Name different types of symmetrical and unsymmetrical faults. (6)

b) Draw the reactance diagram for the power system shown in Fig.1. Also compute the fault MVA and fault current when three phase short circuit occurs at (i) point A (ii) point B of the shown figure. (10)

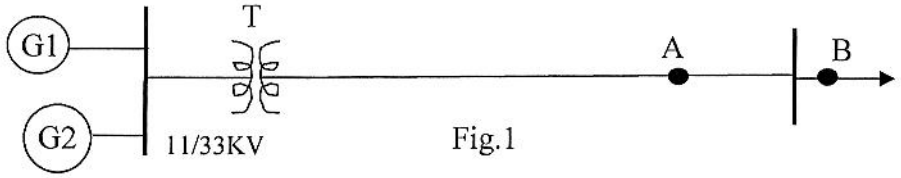

Fig.1

G1: 10 MVA, 11kV , X= 0.1 pu,
G2: 5 MVA, 11kV , X=0.075 pu
T : 15MVA, 11/33kV, X=0.06 p.u.,
Transmission Line: Z= (5+j20) ohm

4) a) Discuss different types of HVDC links with necessary schematic diagram. (10)

b) Explain the terms 'input-output curve' and 'fuel cost' in relation with a thermal power generator. (6)

5) a) How the per unit quantities are calculated in a three phase balanced circuit? (5)

b) What are the advantages of per unit method? (4)

c) Assuming base voltage and base MVA to be 20kV and 5MVA respectively, convert 600kVA, 0.01A, 17.6 Ω in per unit. Also calculate the per unit value of a 0.66 per unit impedance if the base voltage is changed from 20kV to 25 kV. (7)