Ex/EE/5/T/323/2017

BACHELOR OF ELECTRICAL ENGINEERING (PART TIME) EXAMINATION, 2017

(3^{rd} year, 2^{nd} Semester)

POWER SYSTEM PERFORMANCE

Full Marks: 100

Time: Three hours

(50 marks for this part)

Use a separate Answer-Script for each part

PART -II

Answer any Three

(Two marks reserved for well organized answers)

1) a) Derive an expression for the complex power at the sending end of a transmission line in terms of the voltages at its two ends and the transmission line parameters. Assuming that the magnitude of the voltages at the two ends of the line to remain fixed, show that the locus of the complex power at the sending end would be a circle. Write down the expressions for its radius and coordinates of the Centre. (8)

b) A short transmission line having impedance of $100\angle 80^0$ ohm delivers a load of 60 MW at 0.85 p.f. lag at 132 kV. Draw receiving end power circle diagram with a scale of 1cm = 25MVA. Determine following from the power circle diagram (8)

   (i) the sending end voltage,

   (ii) the load angle of the above case.

2) a) Explain why the buses of a power system are classified in load flow study. Discuss all the classifications. (2+6)

b) Formulate the basic load flow problem and derive the bus admittance matrix necessary for load flow. (8)

3) a) Why reactive power compensation is needed in power system operation and control? Explain when and why the following compensations are employed (2+3+3)

i) shunt capacitive compensation

ii) shunt inductive compensation

b) Draw the per unit impedance diagram for the power system shown in figure below. (8)

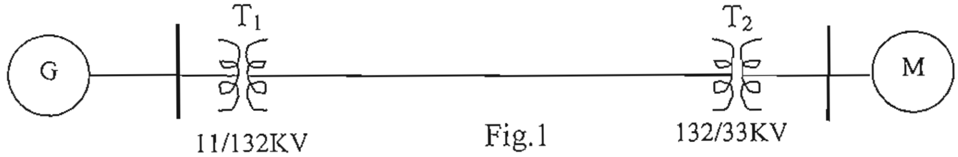

Fig.1

G: 50 MVA, 11kV, X_g= 1.0 ohm, M: 30 MVA, 33kV, X_m=3.8 ohm
T_1 : 50MVA, 11/132kV, X_{t1}=10%,
T_2 : 60MVA, 132/33kV, X_{t2}=12% Line: X_l= 80 ohm/phase

4) a) State the economic load dispatch problem ignoring transmission losses. Formulate the problem mathematically and show that for optimum loading, all generators should operate at equal incremental cost provided the generation limits are not encountered. (8)

b) The fuel costs of three units of a power plant are given by (8)

$$C_1 = 100 + 0.200\ P_1 + 0.001\ P_1^2$$
$$C_2 = 150 + 0.160\ P_2 + 0.002\ P_2^2$$
$$C_3 = 200 + 0.100\ P_3 + 0.001\ P_3^2$$

Where P_1, P_2, P_3 are output power in MW. The plant supplies a load of 240 MW. Determine the optimum distribution of the load and incremental fuel cost. Assume transmission losses to be negligible and the three units are rated at 75, 100 and 125 MW.

5) a) Prove that the per unit values of resistance and reactance remain same whether they are determined from HT side or LT side of a transformer. (8)

b) Discuss about advantages of HVDC transmission over HVAC transmission. Draw and explain the schematic of a bipolar HVDC link used in HVDC transmission. (4+4)

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B.E ELECTRICAL ENGINEERING (PART TIME) THIRD YEAR SECOND SEMESTER EXAM, 2017

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 -II Answer any Three (Two marks reserved for well organized answers)	Marks
6)	a)	Justify the following statement- "Active power can flow from point of lower potential to higher potential but Reactive power always flows from point of higher potential to lower potential".	(4)
	b)	What is Infinite bus? Explain its characteristics.	(4)
	c)	A cylindrical rotor hydro generator is feeding an active power of 0.25 p.u. into a large network bus which is held at 1 p.u. voltage. The generator is overexcited with an induced voltage of 1.5 p.u. The synchronous impedance of the generator and the connecting link are j0.75 p.u./phase and j0.11 p.u./phase respectively. Calculate the percentage change in reactive power output measured at the network bus if the turbine torque is held constant at the initial value but excitation is increased by 20 %. (Neglect saturation).	(8)
7)	a)	With relevant sketches explain the operation of the speed governor system and derive its transfer function.	(10)
	b)	The transients in excitation voltage control vanish much faster and do not affect the dynamics of Power frequency control –Explain.	(6)
8)	a)	Two synchronous generators rated 200 MW and 400 MW having governor droop characteristics of 4 % and 5 % are operating in parallel. If the generators operate on no load at 50 Hz, determine how a total load of 600 MW is shared between them and at what frequency would they now operate.	(8)
	b)	Explain the equal area criterion for stability.	(8)
9)	a)	Discuss with a neat schematic diagram the static excitation system.	(8)
	b)	Briefly discuss how auto re-closure circuit breakers and braking resistors helps in improving the transient stability of a power system.	(8)
10)	a)	Explain the statement – 'Transient Stability does not have a fixed limit for any power system'.	(4)
	b)	What do you mean by "synchronizing power coefficient".	(3)

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c)	Briefly explain the operating principle of "synchronous condenser".	(4)
d)	Explain how the energy balance is made in an Automatic Load Frequency Control after a change in demand until the system reaches a new steady state.	(5)