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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Sixth Semester, B.E. - Electrical and Electronics Engineering

Semester End Examination; July / Aug. - 2022

Power System Analysis and Stability

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:

CO1:Modelling of PS components viz., transformers, lines and generator to represent in single line diagram.
CO2: Analysis of a given power system using per-unit system.
CO3: Design and determine the performance of a power system.
CO4: Analysis of short-circuit current face faults.
CO5: Utilizing symmetrical components to determine short-circuit currents, and phase voltages for unbalanced faults.

***Note**: I) **PART - A** is compulsory. **Two** marks for each question.*
*II) **PART - B**: Answer any **Two** sub questions (from a, b, c) for a Maximum of **18 marks** from each unit.*

Q. No.	Questions	Marks	BLs	COs	POs
	I : PART - A	**10**			
I a.	A Y-Δ 3 phase transformer bank is formed using a three numbers of 1-phase transformer each rated at 300 kVA, 127/13.2kV. What is the kVA and kV rating of the 3 phase bank?	2	L2	CO1	PO2
b.	What is meant by doubling effect?	2	L1	CO2	PO1
c.	Draw the zero sequence network of an unloaded generator grounded through a reactor and Δ-Δ transformer bank.	2	L2	CO3	PO2
d.	Draw the connection of sequence networks of a double line to ground fault at terminals of loaded generator through fault impedance Z_F. Assume that the neutral of the generator is grounded through the reactor of impedance Z_n.	2	L2	CO4	PO2
e.	Find the frequency of oscillation of a synchronizing coefficient of 0.6, inertia constant H = 4 and system frequency at 50 Hz.	2	L2	CO5	PO3
	II : PART - B	**90**			
	UNIT - I	**18**			
1 a.	What is impedance and reactance diagram? What are the approximations made in reactance diagram? Also state the advantage of the Per unit computations.	9	L2	CO1	PO2
b.	The on line diagram of the power system is shown in Fig. Q1(b). The ratings of the components are also given. A load of 60 MW at 0.9 p.f lagging is tapped from 66 kV substation bus which is to be maintained at 60 kV. Calculate the terminal voltage of the generator using p.u. method. Selecta base of 100 MVA and 220 kV on the transmission line. Assume star connected load.	9	L3	CO1	PO3

Contd… 2

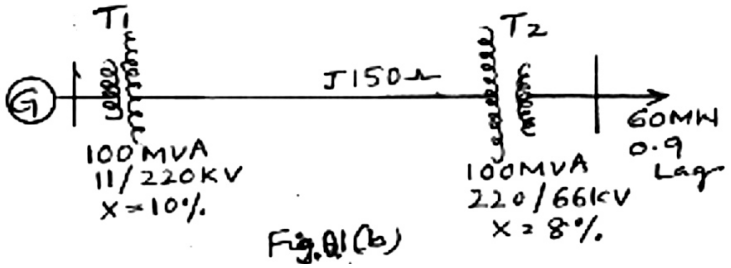

Fig.Q1(b)

c. A 300 MVA, 20 kV, 3 phase generator has a sub transient reactance of 20%. The generator suppliers to synchronous motor through a 64 km transmission line having a transformer at both the ends as shown in Fig. Q1(c). In this T_1 is a 3 phase transformer T_2 is made up of 3 single phase transformers of rating 100 MVA, 127/13.2 kV, 10% reactance.Series reactance of the transmission line is 0.5 Ω/km. Draw reactance diagram with all the reactance marked in p.u. Select the generator rating as base values. — 9 L3 CO1 PO3

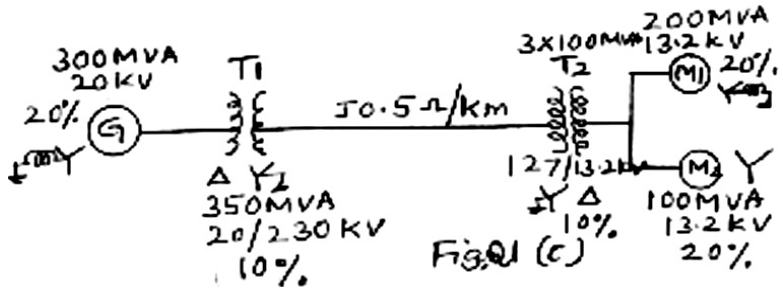

Fig.Q1 (c)

UNIT - II **18**

2 a. Explain in detail transients and transmission lines with short circuit current wave forms. — 9 L2 CO2 PO1

b. Analyze the effect of three phase short circuit fault at the terminals of an unloaded alternator. Draw the oscillogram of short circuit current clearly marking sub transient, transient and steady state regions. — 9 L2 CO2 PO2

c For the system shown in Fig. Q2(c) the rating of various companies are: G:25 MVA, 12.4 kV, X_d'' = 10%
M:20 MVA, 3.8 kV, X_d'' = 15%
T_1:25 MVA, 11/33 kV, X = 8%
T_2:25 MVA, 33/3.3 kV, X = 10%
Line: 20 Ω reactance
The system is loaded such that, the motor is drawing 15 MW at 0.9 p.f leading, the motor terminal voltage being 3.1 kV. Find the sub transient current in the generator and motor for a fault at generator bus. — 9 L3 CO2 PO3

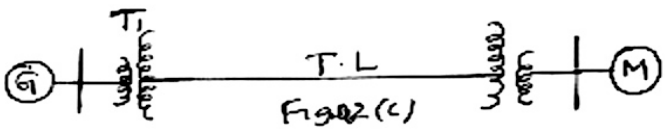

Fig.Q2(c)

Choose a base of 25 MVA, 11 kV in the generator circuit.

Contd… 3

	UNIT - III	**18**				
3 a.	Derive an expression for three phase Complex power in terms of symmetrical components.	9	L2	CO3	PO1,2
b.	Show that zero sequence impedance of a transmission line is more than the positive and negative sequence impedances.	9	L2	CO3	PO2
c.	The current flowing to a delta connected load through line a is 10 A. With the current in the line a as reference and assuming that line 'c' is open, find the symmetrical components of the line currents.	9	L2	CO3	PO3
	UNIT - IV	**18**				
4 a.	Derive the expression for fault current when unloaded generator is subjected to a single line to ground fault. Assume that generator neutral is grounded through a reactor. Also draw the connection of sequence networks to represent fault.	9	L2	CO4	PO2
b.	A Silent pole generator without dampers is rated 20 MVA, 13.8 kV and has a direct axis sub transient reactance of 0.25 p.u. The negative and zero sequence reactances are 0.35 and 0.1 p.u. The neutral of the generator is solidly grounded. Determine the sub transient current in the generator and line to line voltages for sub transient conditions when a line to line fault occurs at the generator terminals with the generator operating unloaded at rated voltage. Neglect resistance.	9	L3	CO4	PO3
c.	A 400 V star connected, neutral grounded 3 phase generator is subjected to various types of faults. The fault currents for various types of faults are: i) 120 A for 3 phase fault; ii) 150 A for L-L fault; iii) 250 A for L-G fault Determine X_1, X_2 and X_0 of the generator. Find the fault current for a double line to ground fault.	9	L3	CO4	PO3
	UNIT - V	**18**				
5 a.	With usual notation derive swing equation. Also write swing curve and its explanation.	9	L2	CO5	PO2
b.	Derive power angle equation of a salient pole synchronous machine connected to an infinite bus. Draw power angle curve.	9	L2	CO5	PO2
c.	A loss free generator supplies 50 MW to an infinite bus, steady state limit of the system being 100 MW. Determine whether the generator will remain in synchronism, if the prime mover input is abruptly increased by 30 MW.	9	L3	CO5	PO3

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