GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (OLD) EXAMINATION – WINTER 2018

Subject Code:150902 **Date: 07/12/2018**

Subject Name: Power System Analysis And Simulation

Time: 10:30 AM TO 01:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full mark.**

Q.1 (a) A 230-kV, 60 Hz three-phase transmission line is 80 km long. The per phase series impedance and shunt admittance of the line are z = 0.05 + j0.45 Ω per km and y = j3.4 x 10^{-6} siemens per km respectively. The line delivers 200 MVA at 0.8 lagging power factor at 220 kV. Using the nominal π model, determine: (a) The transmission line ABCD constants. b) Sending end voltage and current c) Voltage regulation, d) Sending end power e) Transmission efficiency. **07**

(b) A 20 MVA, 6.6 kV, 3-phase star-connected alternator having a reactance of 25% is connected through a 10 MVA, 6.6 kV/33 kV transformer of 15% reactance to a transmission line having a resistance and reactance per conductor per kilometer of 0.25 Ω and 1.2 Ω respectively. 70 kilometers along the line, a short circuit occurs between the three conductors. Find the current fed to the fault by the alternator. **07**

Q.2 (a) For a long transmission line, using rigorous solution method, obtain the expressions relating sending end and receiving end voltages and currents and expressions for A,B,C,D constants for long transmission Line. **07**

(b) The line currents in three phase unbalanced system are I_R=(12 + j6) A, I_Y=(12 – j12) A and I_B=(-15 + j10) A. The phase sequence is RYB. Calculate the positive, negative and zero sequence components of currents. **07**

OR

(b) Draw an impedance diagram for the electric power system shown in Fig. 1, showing all impedances in per unit on a 100-MVA base. Choose 20 kV as the voltage base for generator G_1. **07**

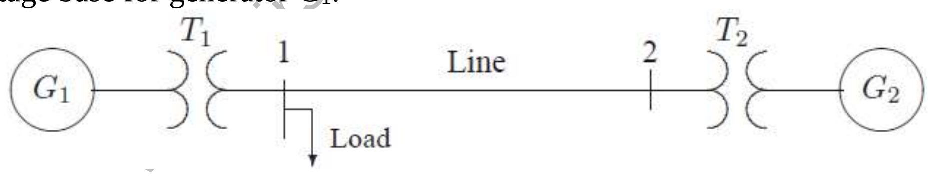

Fig. 1

The three-phase power and line-line ratings are given below:

G_1:	90 MVA	20 kV	X = 9%
T_1:	80 MVA	20/200 kV	X = 16%
T_2:	80 MVA	200/20 kV	X = 20%
G_2:	90 MVA	18 kV	X = 9%
Line:		200 kV	X = 120 Ω
Load:		200 kV	S = 48 MW + j64 Mvar

Q.3 (a) Draw and explain various transformer connections and their zero sequence networks. In the diagrams of transformer connections, clearly show the current paths through the transformer windings and through ground terminal wherever applicable. **07**

(b) With reference to Z-bus building algorithm of a power system network, explain the type-2 and type-3 modifications with necessary equations. **07**

OR

Q.3 (a) Explain sub-transient, transient and steady state reactances of synchronous machine and draw the machine circuit models using them. **07**

(b) A 3-phase transmission line, operating at 11 kV and having a resistance of 1.5 Ω and reactance of 6 Ω, is connected to the generating station bus-bars through 5 MVA step-up transformer having a reactance of 5%. The bus-bars are supplied by a 12 MVA alternator having 25% reactance. Take 12 MVA as base MVA. Calculate the short circuit MVA fed to symmetrical fault between phases if it occurs: **07**

a) at the load end of transmission line;

b) at the high voltage terminals of the transformer.

Q.4 (a) Explain the operation principle of resonant grounding with suitable line diagram and phasor diagram. Derive the expression for inductance of arc suppression coil for resonant grounding. **07**

(b) Write a short note on selection of circuit breakers. **07**

OR

Q.4 (a) If value of impedance is given in ohm, derive necessary expression and hence explain how new per unit impedance is obtained if there is a change of base kV and base MVA. Discuss any four advantages of per unit system representation. **07**

(b) Explain how the value of fault current can be computed for L-L-G fault occurring at the terminals of an unloaded synchronous generator. **07**

Q.5 (a) A transmission line, having a surge impedance of 'Z_0' ohms, is terminated through a resistance R. Derive the expression for co-efficient of reflection and refraction for (i) Voltage waves (ii) Current waves. **07**

(b) Explain: a) mechanism of corona formation, b) various characteristics of corona, c) factors affecting corona. **07**

OR

Q.5 (a) Derive the expression for attenuation of a travelling wave on transmission line. **07**

(b) A 3-phase, 220 kV, 50 Hz transmission line consists of 1.4 cm radius conductors spaced 2.5 m apart in equilateral triangular formation. If the temperature is 40°C and atmospheric pressure is 76 cm, calculate the corona loss per km of the line. Take conductor surface irregularity factor m_0=0.85. and breakdown strength of air at 76 cm of mercury and 25°C =21.2 kV/cm (r.m.s.) **07**

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