Code No: 155CV **R18**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, January/February - 2023
POWER SYSTEM – II
(Electrical and Electronics Engineering)

Time: 3 Hours **Max. Marks: 75**

Note: i) Question paper consists of Part A, Part B.
ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.
iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART – A

(25 Marks)

1.a)	Give the formulas for transmission parameters of long lines.	[2]
b)	Give reasons for choosing π over T representation of lines.	[3]
c)	Give comparison between uncompensated and compensated lines.	[2]
d)	Explain about OLTC transformer as a voltage controller.	[3]
e)	What are the advantages of per unit system representation of system?	[2]
f)	Define reflection and refraction coefficients.	[3]
g)	Distinguish between surge diverters and rod gaps.	[2]
h)	What are volt-time curves? How are they useful?	[3]
i)	Give the classification of faults.	[2]
j)	What are symmetrical components? Explain.	[3]

PART – B

(50 Marks)

2. A long symmetrical line with A = D = 0.9 $\angle 1.5^0$ and B = 150 $\angle 65^0$ Ω has at the load end a transformer having a series impedance Z_T = 100 $\angle 67^0$ Ω. The load voltage and current are V_L and I_L. Obtain expressions for V_S and I_S in form of: [10]

$$\begin{bmatrix} V_S \\ I_S \end{bmatrix} = \begin{bmatrix} A' & B' \\ C' & D' \end{bmatrix} \begin{bmatrix} V_L \\ I_L \end{bmatrix}$$

OR

3.a) A 40 MVA generating station is connected to a three-phase line having $Z = 300 \angle 75^o\ \Omega$; $Y = 0.0025 \angle 90^o\ \mho$. There is a load of 10 MW at unity power factor at the mid-point of the line. Calculate the voltage and load at the distant end of the line. Use nominal-T circuit for the line.

b) What is Ferranti effect in transmission lines? Explain. [5+5]

4.a) Explain the transmission line voltage control using shunt and series Capacitance methods. Discuss their merits and demerits.

b) What is load compensation? Discuss its objectives in power system. [6+4]

OR

5. A short 230 kV transmission line with a reactance of 18 Ω/phase supplies a load at 0.85 lagging power factor. For a line current of 1,000A the receiving- and sending-end voltages are to be maintained at 230kV. Calculate (a) rating of synchronous capacitor required, (b) the load current, (c) the load MVA. Power drawn by the synchronous capacitor may be neglected. [10]

6. Draw the per unit impedance diagram on a common base for the system shown in below figure 1. All per unit impedances shown are with respect to their own base. Take the system base MVA same as generator MVA and system base KV as generator side voltage. [10]

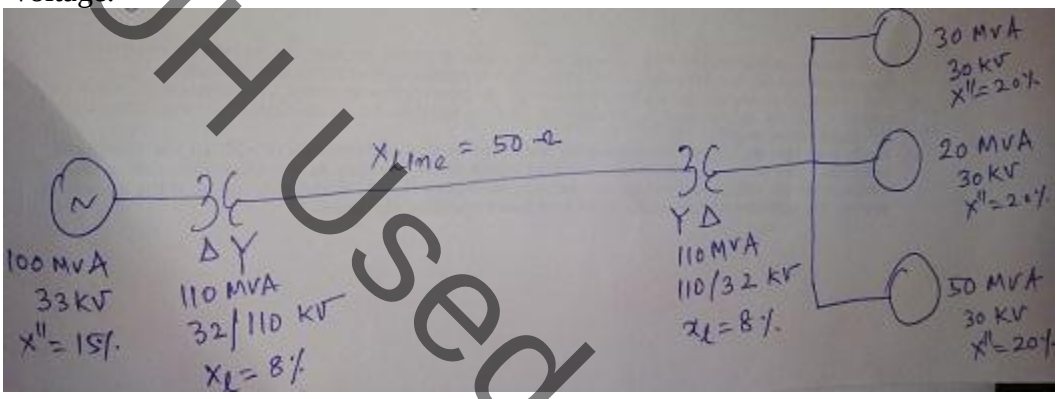

Figure 1

OR

7.a) A 500 kV, 2microsecond rectangular wave travels on a line having a surge impedance of 350 Ohm and approaches a termination with a capacitance C equal to 300 pF. Determine the magnitudes of the reflected and transmitted waves.

b) From fundamentals obtain the expressions for reflection and transmission co-efficient on a line terminated with load impedance equal to the surge impedance of the line. [5+5]

8.a) Briefly discuss about various causes of over-voltages in the power system network.

b) Explain the various methods of transmission line protection against over voltages due to lightning strokes. [5+5]

OR

9. Explain, with a neat sketch, the working principle and constructional details of expulsion type lightning arrester. [10]

10.a) The line currents in a three phase system are:

$$I_a = 72.1\angle 33.7^\circ,\ I_b = 82.46\angle 166^\circ,\ I_c = 63.24\angle -71.56^\circ$$

Calculate the symmetrical components of current.

b) An 11.2 kV bus-bar is fed from three synchronous generators as shown in figure 2 below. Calculate the fault current and MVA if 3-phase symmetrical fault occurs on the bus-bar. [5+5]

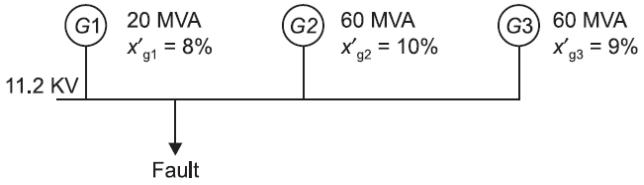

Figure 2

OR

11. A double line to ground fault occurs on phases b and c at point F in the system shown in figure 3 below. Find the fault current in phase c of G_1. Both the machines are rated 1.2MVA, 0.6kV with $X_1 = X_2 = 0.1$ p.u. and $X_0 = 0.05$ p.u. Transformers are 1.2 MVA each with leakage reactance of 0.05 p.u. Transmission line reactances are $X_{L1} = X_{L2} = 0.2$ p.u. and $X_{L0} = 0.4$ p.u. on the MVA base of the machines. [10]

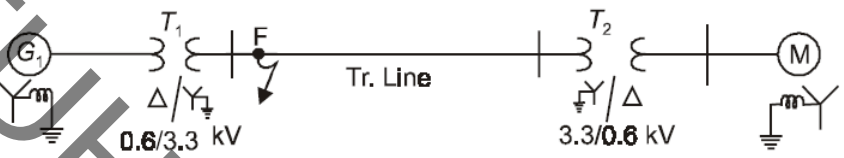

Figure 3

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, August - 2022
POWER SYSTEM – II
(Electrical and Electronics Engineering)

Time: 3 Hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks
- - -

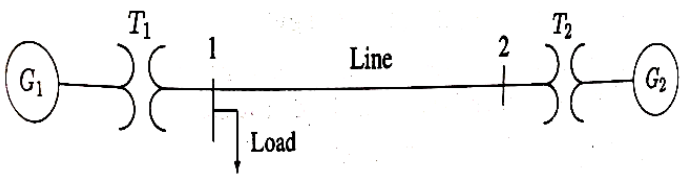
1.a) Deduce an expression for voltage regulation of a short transmission line, giving the phasor diagram.
b) A 3-phase, 50Hz, 150km line has a resistance, inductive reactance and capacitive shunt admittance of 0.1 ohm, 0.5 ohm and 3×10^{-6} mhos per km per phase. If the line delivers 50MW at 110kV and 0.8 p.f. lagging, determine the sending end voltage and current. Assume a Nominal-π circuit for the line. [7+8]

2.a) Explain the procedure how to draw the receiving end power circle diagram of a transmission line.
b) What is ferranti effect? Deduce a simple expression for the voltage rise of an unloaded transmission line. [8+7]

3.a) Describe the principle of on-load tap changing transformer? List out its merits and demerits.
b) A single circuit 3-phase, 220 kV line runs at no load. Voltage at the receiving end of the line is 205 kV. Find the sending end voltage, if the line has resistance of 20 ohm, reactance of 85 ohm and the total succeptance of 5.25×10^{-4} mho. The transmission line is to be represented by Π-model. [7+8]

4. Describe clearly what you mean by compensation of lines? Discuss different methods of compensation. [15]

5.a) What are the advantages of the per unit system for analysis of power system.
b) Draw an impedance diagram for the electric power system shown in figure showing all impedances in per unit on a 100 MVA base. Choose 20 kV as the voltage base for generator. The 3-phase power and line –line ratings are given below: [6+9]
G_1 : 90 MVA, 20 kV, X= 9%
T_1 : 80 MVA, 20/200 kV, X= 16%
T_2 : 90 MVA, 200/20 kV, X= 20%
G_2 : 90 MVA, 18kV, X= 9%
Line : 200 kV, X =120 ohms
Load: 200 kV, S = (48+j64) MVA



6.a) Explain the generation of traveling waves on a transmission line.

b) A 200 kV surge travels on a transmission line of 400 ohms surge impedance and reaches a junction where two branch lines of surge impedances of 500 ohms and 300 ohms respectively are connected with the transmission line. Find the surge voltage and current transmitted into each branch line. Also find the reflected voltage and current. [7+8]

7.a) Explain the construction, principle of operation and applications of valve type lightning arrester with diagram.

b) What are ground rods and counterpoises? Discuss clearly how these can be used to improve the grounding conditions. Give various arrangements of counterpoise. [7+8]

8.a) Describe the significance of positive, negative and zero sequence components.

b) A 30 MVA, 11 kV star connected generators has positive, negative and zero sequence reactance's of 30 %, 25 % and 10% respectively. A reactor with 6% reactance based on the rating of the generator is placed in the neutral to ground connection. A line to ground fault occurs at the terminals of the generator when it is operating at rated voltage. Determine the initial symmetrical line to ground rms fault current. Also find the line to line voltages. [6+9]

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, February - 2022
POWER SYSTEM – II
(Electrical and Electronics Engineering)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks
- - -

1.a) Derive the expression for regulation and efficiency of a medium transmission line using nominal π method. Draw phasor diagram also.

b) Input to a single-phase short line is 2000 KW at 0.8 pf lagging. The line has a series impedance of (0.4 + j0.4) ohms. If the load voltage is 3 KV, find the load and receiving end power factor. Also find supply voltage and supply power factor. [7+8]

2.a) Discuss why equivalent π circuit of a long line is preferred over the equivalent T circuit.

b) A three phase 50 Hz transmission line is 150 km long and delivers 25 MW at 0.85 power factor lagging and at 110 KV. The resistance and reactance of the line per conductor per km are 0.3 ohms and 0.9 ohms respectively. The line charging admittance is 0.3×10^{-6} mho per km per phase. Compute by applying the nominal π method the voltage regulation and transmission efficiency. [6+9]

3.a) Explain the working of on-load tap changing transformer for voltage control.

b) A 3-phase line has an impedance of (20 + j60) ohm per phase. The sending end voltage is 142 kV while the receiving end voltage is maintained at 132 kV for all loads by an automatic phase modifier. If the kVAr of the modifier has the same value for zero load as for a load of 50 MW, determine the rating of the modifier and the p.f. of this load. [7+8]

4.a) Explain series and shunt compensation of lines and discuss their effect on the surge impedance loading of the lines. If shunt compensation is 100%, what happens to SIL and voltage profile?

b) A radial long uncompensated line with constant sending end voltage is terminated through an asynchronous load, derive an expression for maximum power transfer when termination is through a variable resistance. Hence discuss the voltage instability problem. [7+8]

5.a) Explain the p.u. system of analysing power system problems. Discuss the advantages of this method over the absolute method of analysis.

b) Two generators rated at 10 MVA, 13.2 kV and 15 MVA, 13.2 kV are connected in parallel to a busbar. They feed supply to two motors of inputs 8 MVA and 12 MVA respectively. The operating voltage of motors is 12.5 kV. Assuming base quantities as 50 MVA and 13.8 Kv, draw the reactance diagram. The percent reactance for generators is 15% and that for motors is 20%. [7+8]

6.a) Using Bewley's Lattice diagram, represent the voltage and current waveforms of a short-circuited line.

b) An overhead line with surge impedance 400 ohms bifurcates into two lines of surge impedance 400 ohms and 40 ohms respectively. If a surge of 20 kV is incident on the overhead line, determine the magnitudes of voltage and current which enter the bifurcated lines. [7+8]

7. Describe the construction, principle of operation and applications of
a) Expulsion gap; and
b) Valve type lightning arrester. [7+8]

8.a) Derive an expression for the fault current for a double line to ground fault as an unloaded generator and draw its equivalent circuit.

b) A generator rated 120MVA, 11kV has $X_1 = X_2 = 30\%$ and $X_0 = 15\%$. Its neutral is grounded through a reactance of 0.1Ω. The generator is operating at rated voltage, load is disconnected from the system when double line to ground fault occurs at its terminals. Find the sub-transient current in the faulted phases and line to line fault current. [8+7]

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, September - 2021
POWER SYSTEM – II
(Electrical and Electronics Engineering)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks
- - -

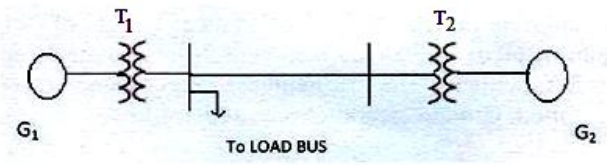
1.a) Explain the Ferranti effect with a phasor diagram and its causes.
b) Explain the classification of lines based on their length of transmission. [8+7]

2.a) What are the factors which govern the performance of a transmission line?
b) What is an equivalent π circuit of long line? Derive expression for parameters of this circuit in terms of line parameters. [6+9]

3.a) Describe about shunt and capacitors role in voltage control.
b) Discuss about tap changing transformers used for voltage control. [8+7]

4.a) What is difference between compensated and uncompensated transmission line?
b) Describe about radial line with asynchronous load. [8+7]

5.a) What is per unit system and list its advantages?
b) Draw the impedance diagram for the electric power system shown in figure showing all impedances in per unit on a 100 MVA base. Choose 12 kV as the voltage base for generator. Three phase power and line ratings are as below:
G1:90MVA, 12kV, X=9%
T1:80MVA, 12/220kV, X=16%
T2:80MVA, 220/7.2kV, X=20%
G2:90MVA, 7.2kV, X=9%
Line:220kV, X=120Ω
Load Bus:220kV,S=48MW+j64MVAr [6+9]



6.a) Determine the equations for the reflection and refraction coefficients for a short circuited line.
b) A surge of 200 KV travelling on a line of surge impedance 400Ω reaches a junction of the line with two branch lines of surge impedance of 500Ω and 300Ω respectively. Find the surge voltage and current transmitted into each branch line. [8+7]

7. What is insulation coordination and describe its significance in selection of protective equipment? Explain with volt-time characteristics. [15]

8.a) Find symmetrical components for the given three phase voltages:
$V_a = 300\angle -120^\circ, V_b = 200\angle 90^\circ$ and $V_c = 100\angle -30^\circ$
b) Develop the connection diagram of sequence network when a line to line fault occurs in a power network. [8+7]

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, March - 2021
POWER SYSTEM – II
(Electrical and Electronics Engineering)

Time: 3 Hours **Max. Marks: 75**

Answer any five questions.
All questions carry equal marks.
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1.a) Explain clearly the 'Ferranti effect' with a phasor diagram.
b) A 3-phase 50 Hz transmission line has resistance, inductance and capacitance per phase of 10 ohm, 0.1 H and 0.9 μF respectively and delivers a load of 35 MW at 132 kV and 0.8 p.f. lag. Determine the efficiency and regulation of the line using (i) nominal-T, (ii) nominal-π. [6+9]

2.a) Derive the ABCD parameters of a nominal π represented medium length transmission line with neat phasor diagram.
b) Classify the transmission lines. [9+6]

3.a) How do you determine the capacity of the phase modifier if the net reactive power required to maintain certain voltages at the two ends is known? Explain.
b) What is the need of compensation in power system? Explain about Load ability characteristics of overhead lines. [7+8]

4.a) Explain the surge impedance loading with necessary expressions.
b) How voltage control can be achieved by using Off-load tap changing transformers? [8+7]

5.a) Discuss the advantages of p.u. system method over the absolute method of analysis.
b) Show that a travelling wave moves with a velocity of light on the overhead line and its speed is proportional to $1/\sqrt{\varepsilon_r}$ on a cable with dielectric material of permittivity ε_r. [7+8]

6.a) Describe about Attenuation of travelling waves.
b) State the advantages of p. u system. [8+7]

7.a) What is volt-time curves? What is their significance in power system studies?
b) What are ground rods and counterpoises? Explain clearly how these can be used to improve the grounding conditions. Give various arrangements of counterpoise. [6+9]

8.a) Obtain the symmetrical components of the following set of unbalanced currents $I_a = 1.6 \angle 250^0$, $I_b = = 1.0 \angle 180^0$ and $I_c = 0.9 \angle 132^0$. Also find out the neutral current.
b) Derive an expression for the fault current for a double line to ground fault as an unloaded generator and draw its equivalent circuit. [7+8]

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