2021 SCHEME

Basavarajeswari Group of Institutions

BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

USN | | | | | | | | | | | **Course Code** | 2 | 1 | E | E | 6 | 2 |

Sixth Semester B.E. Degree Examinations, September/October 2024

POWER SYSTEM ANALYSIS-I

Duration: 3 hrs **Max. Marks: 100**

Note: 1. Answer any* FIVE *full questions choosing ONE full Question from each Module.
2. Missing data, if any, may be suitably assumed

Q. No		Question	Marks	(RBTL:CO:PI)

Module-1

1. a. Draw the per phase basis, representation of synchronous machine, transmission line and two winding transformer. **06** (2:1:1.4.1)

b. Derive an equation for per unit impedance if a change of base occurs. **06** (2:1:2.1.2)

c. The schematic diagram of a radial transmission system is shown in Fig. 1 (c). The ratings and reactance of the various components are shown there in. A load of 60 MW at 0.9 p.f. lagging is tapped from 66 kV substation which is to be maintained at 60 kV. Calculate the terminal voltages of the machine. Represent the transmission line and transformer by series reactance only. **08** (2:1:2.3.1)

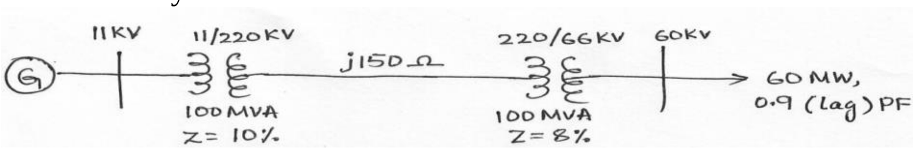

Fig. 1 (c)

(OR)

2. a. Define per unit quantity. Mention the advantages of per unit system. **06** (2:1:1.4.1)

b. Show that per unit impedance of two winding transformer will remain same referred to primary as well as secondary. **06** (2:1:2.1.2)

c. Draw the reactance diagram for the system shown in Fig. 2(c). The ratings of components are **08** (2:1:2.3.1)
Generator G : 15 MVA, 6.6 kV, X= 12%
Transformer T_1 : 20 MVA, 6.6/66 kV, X=8%
Transformer T_2 : 20 MVA, 66/6.6 kV, X= 8%
Motors M_1 & M_2 : 5 MVA, 6.6 kV, X= 20%
Transmission line : j60 Ω
Select the ratings of the generator as base values.

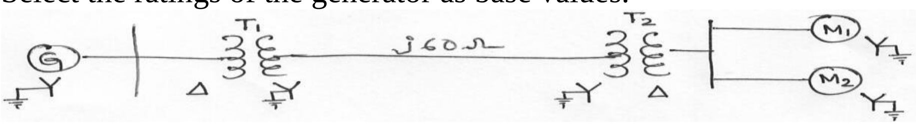

Fig. 2(c)

Module-2

3. a. What is doubling effect in transmission line? Substantiate with equations. **10** (3:2:2.1.2)

b. For the radial network shown in Fig. 3(b), a three phase fault occurs at F. Determine the fault current and the line voltage at 11 kV bus under fault conditions. **10** (3:2:2.3.1)

Note: (RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI– Performance Indicator)

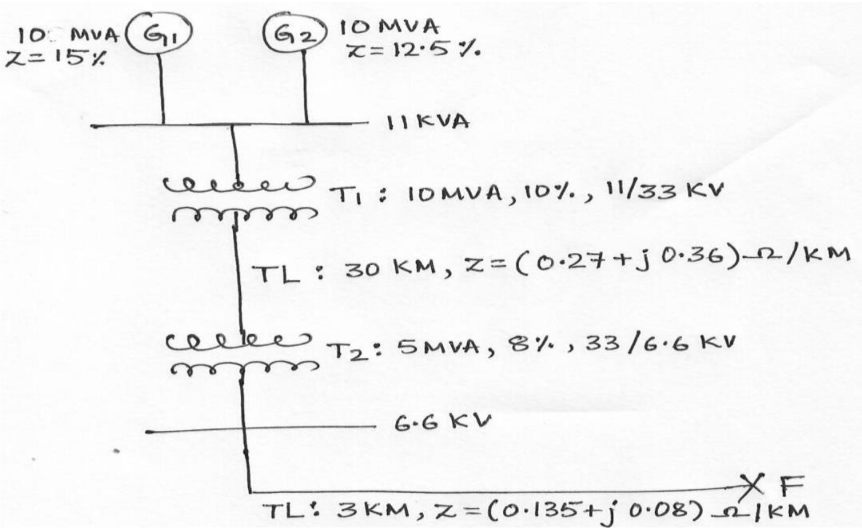

Fig. 3(b)

(OR)

4.	**a.**	With the help of Oscillogram of short circuit current of synchronous generator, operating on no load, distinguish between sub-transient, transient and steady state periods. Prove that $X_d'' < X_d' < X_d$	**10**	(3:2:2.1.2)
	b.	Generator G_1 & G_2 are identical and rated 11 kV, 20 MVA and have transient reactance of 0.25 p.u. at own base. The transformer T_1 & T_2 are also identical and are rated 11/66 kV, 5 MVA and have a reactance of 0.06 p.u. to their own MVA base. The tie-line is 50 kM long each conductor has a reactance of 0.848 Ω/km. The three phase fault is assumed at F, 20 km from Generator G_1 as shown in Fig 4(b). Find the short circuit current. Select generator ratings as base values.	**10**	(3:2:2.3.1)

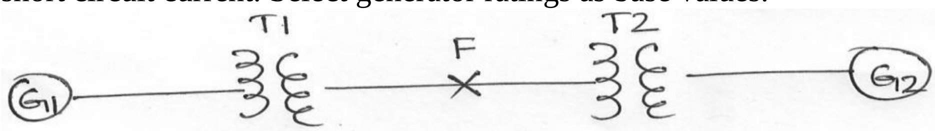

Fig. 4(b)

<u>Module-3</u>

5.	**a.**	Derive an expression for phase voltages in terms of symmetrical components.	**06**	(2:3:2.1.2)
	b.	Derive an expression for complex power in terms of symmetrical components.	**06**	(2:3:2.1.2)
	c.	A balanced delta connected load is connected to three phase symmetrical supply. The line currents are each 10 A in magnitude. If fuse in one of the lines blows out, determine the sequence components of line currents.	**08**	(2:3:2.3.1)

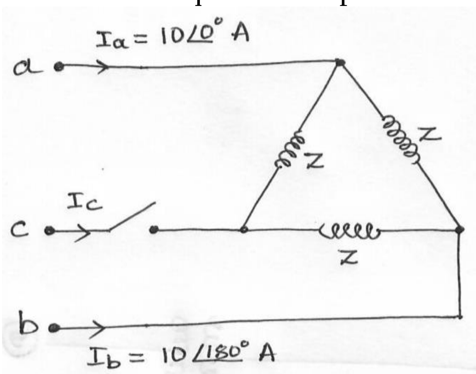

Fig. 5(c)

(OR)

6.	**a.**	Obtain the relationship between line and phase sequence components of voltages in star connection.	**08**	(2:3:2.1.2)
	b.	What is sequence impedance? Obtain expression for sequence impedance of a symmetrical circuit.	**06**	(2:3:2.1.2)
	c.	A single-phase resistive load of 100 kVA is connected across line BC of a balanced supply of 3 kV. Compute the symmetrical components of line currents.	**06**	(2:3:2.3.1)

<u>Module-4</u>

7.	**a.**	Define faults. Classify the unsymmetrical faults with its frequency of occurrence.	**06**	(3:4:1.4.1)
	b.	Derive an expression for fault current when an L-G occurs on the terminals of an unloaded generator. Show the inter connection of sequence network.	**08**	(3:4:2.1.2)
	c.	A three phase generator with an open circuit voltage of 400 V is subjected to an LG fault through a fault impedance of j2 Ω. Determine the fault current if Z_1 = j4 Ω, Z_2 = j2 Ω and Z_0 = j1 Ω. Also find the fault current if it is L-L and L-L-G faults.	**06**	(3:4:2.3.1)

(OR)

8.	**a.**	Discuss "Open Conductor Faults".	**06**	(3:4:1.4.1)
	b.	Derive an expression for fault current when an L-L fault through impedance Z_f in a power system. Show the inter connection of sequence network	**06**	(3:4:2.1.2)
	c.	A 30 MVA, 11 kV generator has $Z_1 = Z_2$ = j0.2 pu and Z_0 = j0.05 pu. A L-L fault occurs at the generator terminals. Find the line currents and line to neutral voltages during the fault condition. Assume that the generator neutral is solidly grounded.	**08**	(3:4:2.3.1)

<u>Module-5</u>

9.	**a.**	Define power system stability. Briefly explain (i) Steady state stability (ii) Transient stability (iii) Dynamic stability	**06**	(3:5:1.4.1)
	b.	Derive an expression for swing equation with usual notations.	**08**	(3:5:2.1.2)
	c.	A two pole, 50 Hz, 11 kV turbo alternator has rating of 100 MW, power factor 0.85 lagging. The rotor has moment of inertia of 10,000 kg-m^2. Calculate H and M	**06**	(3:5:2.3.1)

(OR)

10	**a.**	State and explain Equal Area Criterion (EAC). What are the assumptions made in applying EAC?	**06**	(3:5:1.4.1)
	b.	Derive the power angle equation of non-salient pole synchronous machine connected to an infinite bus. Draw the power angle curve.	**06**	(3:5:2.1.2)
	c.	The transfer reactance between a generator and an infinite bus bas operating at 200 kV under various conditions on inter connections are: Prefault : 150 Ω per phase During fault : 400 Ω per phase Post fault : 200 Ω per phase If the fault is cleared when the rotor has advanced 60^0 electrical from the prefault position, determine the load that could be transferred without loss of stability.	**08**	(3:5:2.3.1)

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Note: (RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI– Performance Indicator)