Roll No.:......................

National Institute of Technology, Delhi

Name of the Examination: B. Tech

Branch	**: EEE**	**Semester**	**: 5**
Title of the Course	**: Power System Analysis**	**Course Code**	**: EEL 302**

Time: 3 hrs **Maximum Marks: 50**

Section A

Attempt all question **(10×1 = 10)**

Q. [1] State the advantages of per unit system.

Q. [2] For a given base voltage and base volt amperes, the per unit impedance value of an element is x. Calculate the per unit impedance value of this element when the voltage and volt amperes bases are both doubled.

Q. [3] If the % reactance up-to the fault point is 20%, then short circuit current will be how many times of the full load current?

Q. [4] What are the data required for load flow study.

Q. [5] What is the need for short circuit studies?

Q. [6] Distinguish between symmetrical and unsymmetrical faults with neat sketch.

Q. [7] Write the symmetrical components of a three phase system?

Q. [8] What is sequence operator?

Q. [9] Define swing curve. What is the use of this curve?

Q. [10] Define transient stability of a power system

Section B

Attempt any four **(4×5 = 20)**

Q. [1] What do you understand by percentage reactance? Why do we prefer to express the reactances of various elements in percentage values for short-circuit calculations?

Q. [2] Derive and explain the equal area criterion for stability of a power system.

Q. [3] Explain the step by step procedure of load flow solution for the Fast Decoupled Load Flow (FDLF) method.

Q. [4] Three zones of a single phase circuit are identified in the following Fig. A. The zones are connected by transformer T_1 and T_2, whose rating are also shown. Given $V_s = 220\angle 0^0, X_{line} = 2\Omega$ and $Z_{load} = (0.9 + j0.2)$. Using base values of 30 kVA and 240 volts in zone 1, draw the per-unit impedance circuit and the per unit source voltage. Also calculate the load current both in per-unit and in amperes. Transformer winding resistances and shunt admittance branches are neglected.

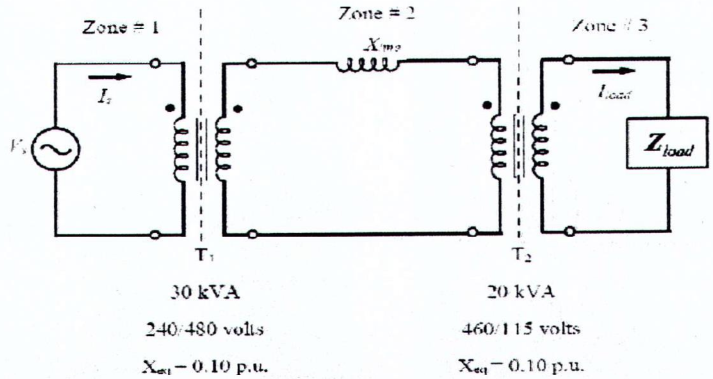

Fig. A

Q. [5] A 3-phase transmission line operating at 10 kV and having a resistance of 1ohm and reactance of 4 ohm is connected to the generating bus-bars through 5 MVA step-up transformer having a reactance of 5%. The bus-bars are supplied by a 10 MVA alternator having 10% reactance. Calculate the short-circuit current, if it occurs, (*i*) at the load end of transmission line, (*ii*) at the high voltage terminals of the transformer in fig. B.

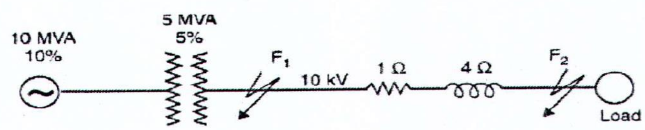

Fig. B

Section C

Attempt any two **(2×10 = 20)**

Q. [1] Derive swing equation and discuss the importance of stability studies in power system planning and operation.

Q. [2] ***Figure C*** shows the one-line diagram of a simple three-bus power system with generation at buses 1 and 3. The voltage at bus 1 is $V_1 = 1.025\angle 0°$. Voltage magnitude at bus 3 is fixed at 1.03 p.u. with a real power generation of 300 MW. A load consisting of 400 MW and 200 MVAR is taken from bus 2. Line impedances are marked in per unit on a 100 MVA base and line charging susceptances are neglected. Obtain the power flow solution by the Gauss-Seidel method up-to the first iteration. Determine the line flows and line losses. Construct a power flow diagram showing the direction of line flow.

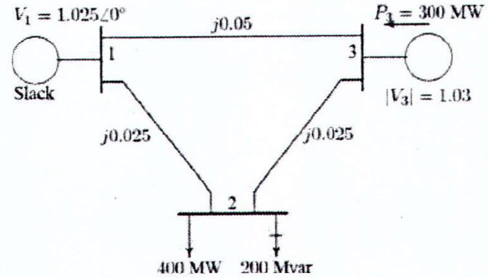

Figure: C

Q. [3] Make the Jacobian matrix for network shown in ***figure C***. What will be the matrix size of Jacobian and their sub-matrix J_1, J_2, J_3 and J_4? Also, write the step-wise solution procedure of power flow using Newton-Raphson method for ***figure C***.