Student Enrollment No._____

GANPAT UNIVERSITY

B.TECH SEM-VI ELECTRICAL ENGINEERING

REGULAR EXAMINATION APRIL-JUNE- 2016

2EE602 : POWER SYSTEM ANALYSIS

TIME:-3 HOURS **TOTAL MARKS- 70**

INSTRUCTIONS:-
1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Answer to two sections must be written in separate answer books.
3. Figures to the right indicate full marks.

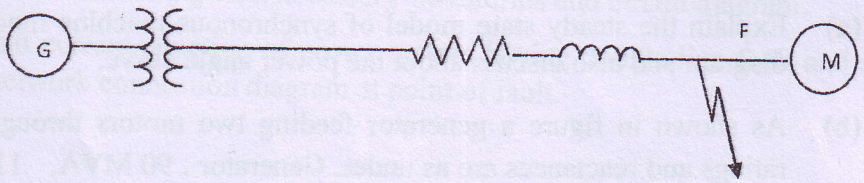
SECTION I

Que-1 **(a)** Write the equation of short circuit current of synchronous machine and also discuss transient, sub transient and steady state reactances with the help of S.C. current waveform. **(05)**

(b) The one line diagram for a radial system network consists of two generators, rated 10 MVA, 15% and 10 MVA, 12.5 % respectively and connected in parallel to a bus bar A at 11 KV. Supply from bus A is fed to bus B (at 33 KV) through a transformer T1 (rated: 10 MVA, 10%) and OH line (30 KM long). A transformer T2 (rated: 5 MVA, 8%) is used in between bus B (at 33 KV) and bus C (at 6.6 KV). The length of cable running from the bus C up to the point of fault, F is 3 KM. Determine the current and line voltage at 11 kV bus A under fault conditions, when a fault occurs at the point F, given that Zcable = 0.135 + j 0.08 ohm/ kM and ZOH-line = 0.27 + j 0.36 ohm/km. **(06)**

OR

Que-1 **(a)** A 3-phase transmission line operating at 10 kV and having a resistance of 1 ohm and reactance of 4 ohm 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 10 MVA alternator having 10% reactance. Calculate the short circuit kVA fed to symmetrical fault between phases if it occurs at the load end of transmission line **(06)**



(b) Develop an algorithm for Short Circuit Studies of power system. **(05)**

Que-2 **(a)** A 100 MVA, 33 KV, 3-phase generator has a sub transient reactance of 15%. The generator supplies 3 motors through a step-up transformer - transmission line – step down Transformer arrangement. The motors have rated inputs of 30 MVA, 20 MVA and 50 MVA, at 30 KV with 20% sub transient reactance each. The 3-phase transformers are rated at 100 MVA, 32 KV-Y/110 KV-Y with 8 % leakage reactance. The line has a reactance of 50 ohms. By selecting the generator ratings as base values in the generator circuit, determine the base values in all the other parts of the system. Hence evaluate the corresponding pu values and draw the equivalent per unit reactance diagram. **(06)**

(b) Explain Z bus building algorithm using different types of modifications. **(06)**

OR

Que-2 **(a)** A 120 MVA, 19.5 kV generator has Xs = 0.15 per unit and is connected to a transmission line by a transformer rated 150 MVA, 230 Y/18Δ kV with X = 0.1 per unit. If the base to be used in the calculation is 100 MVA, 230 kV for the transmission line, find the per unit values to be used for the transformer and generator reactances. **(06)**

Que-2 (b) Answer the following question in short.

(i) What is symmetrical fault?

(ii) Obtain the value of following: $a + a^2 + 1, a - a^2$

(iii) Why do we use reactors in power system? (12)

Que-3 Attempt any two.

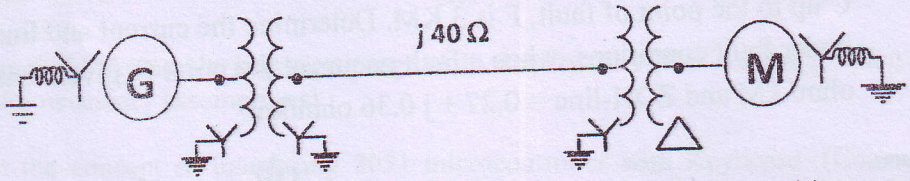
(a) Develop an algorithm for Short Circuit Studies of power system.

(b) Prove that mutual sequence impedance of transmission line having negligible resistance is zero.

(c) Classify various types of fault in power system in detail.

SECTION II

Que-4 (a) Draw the per unit impedance diagram for the power system shown in figure. Neglect resistance and use a base of 200 MVA, 220 kV in 40 Ω line. The rating of generator, transformers and motor are: Generator : 200 MVA, 25 kV, X" = 10 %:: Motor : 100 MVA, 11 kV, X" = 20 %; Y – Y transformer : 200 MVA, 12Y / 220Y kV, X = 15 %; Y - Δ transformer : 200 MVA, 11Δ / 220Y kV, X = 15 %. **(06)**



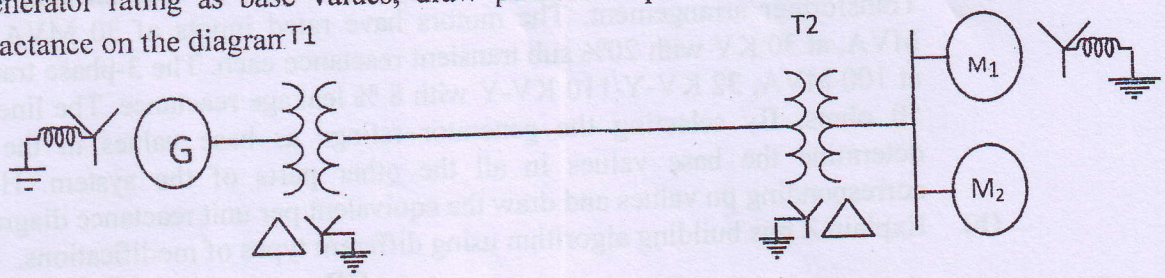
(b) Draw the zero sequence network for (1) star-delta transformer with neutral earthed (2) Delta- Delta transformer (3) Delta–Star with unearthed neutral. **(03)**

(c) Suppose for a given base voltage and base volt-amperes, the per-unit impedance value of an element is Z. What will be the per-unit impedance value of this element when the voltage and volt-amperes bases are both doubled? **(02)**

OR

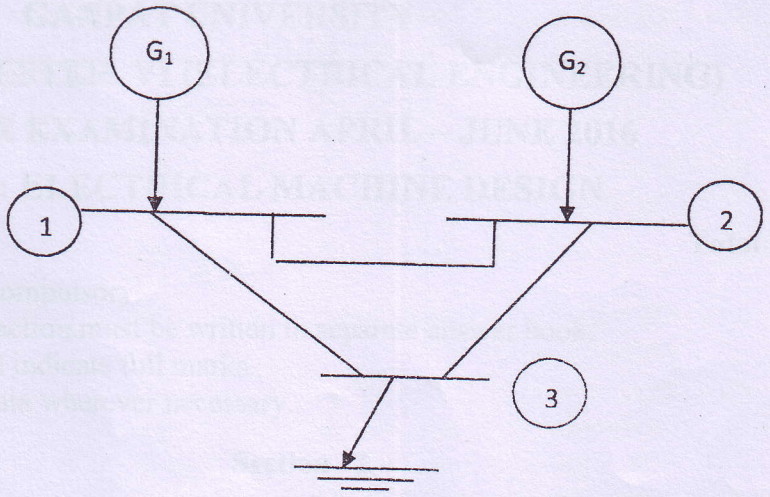
Que-4 (a) Explain the steady state model of synchronous machine modelling with necessary phasor diagram and also discuss about the power angle curve. **(05)**

(b) As shown in figure a generator feeding two motors through transformers and line. The ratings and reactances are as under. Generator : 90 MVA, 11 kV, X = 25 %,Transformer T_1 : 100 MVA, 10 / 132 kV, X = 6 % ,Transformer T_2 : Bank of three single phase transformers each rated at 30 MVA, 66 / 10 kV, X = 5 % Motor M_1 : 50 MVA, 10 kV, X = 20 %,Motor M_2 : 40 MVA, 10 kV, X = 20 %,Transmission line : X = 100 Ω. Select generator rating as base values, draw positive sequence network and indicate per unit reactance on the diagram. **(06)**



Que-5 (a) What do you mean by transient? Which are the necessary conditions to have a transient in the circuits? Discuss transient in circuit having R-L-C components. **(06)**

(b) Develop Z bus for the system shown in figure. Transient reactance of each generator = 0.15 pu. Leakage reactance of each transformer =0.05 pu. Z_{12}=j0.1, Z_{13}=j0.12, Z_{23}=j0.08. **(06)**



OR

Que-5 (a) A 30 MVA, 11 kV, three-phase synchronous generator has a direct sub-transient reactance of 0.25 pu. The negative and zero sequence reactances are 0.35 and 0.1 pu respectively. The neutral of the generator is solidly grounded. Determine the sub-transient fault currents in the generator and line to line voltages for the sub-transient conditions when a single line to ground fault occurs at the generator terminals with the generator unloaded at rated voltage. **(05)**

(b) Explain travelling waves of transmission line when receiving end is open circuited. **(04)**

(c) Define per unit value. What are the advantages and disadvantages of per-unit computations? **(03)**

Que-6 **Attempt Any two.** **(12)**

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

(b) Explain capacitance switching with necessary waveforms and circuit diagram.

(c) Deduce the fault current equation of power system having double line fault and also draw the sequence network connection diagram at point of fault.

END OF THE PAPER