Date: 25/05/2016.

Student Exam No:-_____

GANPAT UNIVERSITY
M.TECH SEM-II ELECTRICAL ENGINEERING
REGULAR EXAMINATION APRIL-JUNE-2016
3EE202:-POWER SYSTEM DYNAMICS & CONTROL

Time: 3 Hours **Total Marks:-60**

Instructions: - 1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
3. Attempt each section in separate answer book.

SECTION-I

Que-1 **(A)** Derive T'do dE'a/dt= [E'a + (Xd-X'd) id + Efd] for synchronous machine of model 1.1. **[05]**

(B) Derive an expression of stator self-inductances of ideal salient-pole synchronous machine in terms of rotor position with usual notations. **[05]**

OR

Que-1 **(A)** Obtain a value of internal voltage Ea for a round-rotor generator having terminal voltage Va = 1.0 pu supplying a load of armature current 1 ∠ -60°. Machine has a synchronous reactance Xs = 1.6 and resistance r = 0.004. Also draw a phasor diagram. **[05]**

(B) Develop dynamic model of synchronous machine with field circuit and two equivalent damper windings on q-axis (Model 2.2). Develop stator equations and draw its equivalent circuit and phasor diagram. **[05]**

Que- 2 **(A)** Sketch model of speed governing system for hydro-turbines and discuss permanent droop and transient droop. **[05]**

(B) Explain field controlled alternator rectifier excitation system with diagram. **[05]**

OR

Que- 2 **(A)** Develop the block diagram of excitation system and discuss the basic functions of each components. **[05]**

(B) An alternator is synchronized with an infinite bus. At synchronization field current is unchanged to $i_F = 1*10^3$ A (actual) .The infinite bus voltage being reference is 1 ∠0° and synchronous reactance is 1.5 pu. With i_F unchanged the steam valves at the turbine are adjusted until PG=0.2. Then (a) Find Ia. (b) With PG unchanged, i_F is unchanged to 1600 A (actual). Find current Ia. **[05]**

Que-3 Attempt any two. **[10]**

(A) Draw and Explain various types of steam turbine system models.

(B) State basic assumptions made in steady state analysis of an alternator and Explain the open circuit voltage of a synchronous generator and derive related expressions using usual notations.

(C) Show that if the armature flux linkage components, with respect to synchronously rotating reference frame (ψD and ψQ) are constant, then the transfer EMF terms (dψd/dt and dψq/dt) and terms introduced by the variations in the rotor speed cancel each other.

SECTION-II

Que-4 (A) Derive Heffron-Phillips state space model of single machine infinite bus system. [06]

(B) Write a short note on classification of different modes of oscillations. [04]

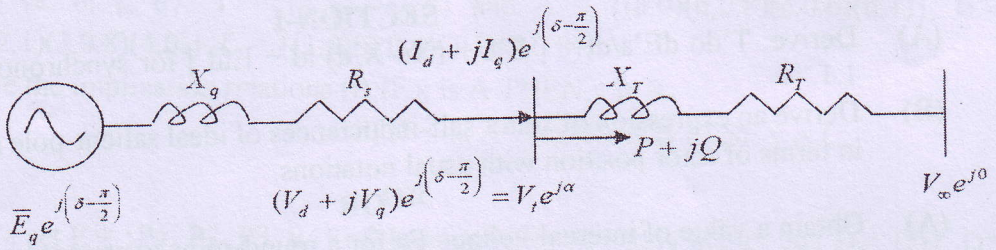
OR

Que- 4 (A) A synchronous generator is connected to an infinite bus through an external reactance x_e = 0.41 pu. Compute the Heffron-Phillips constants at the below operating point. [05]
$P_g = 0.5$, $V_t = 1.0$, $E_b = 1.0$, Machine data: $x_d = 1.61$, $x_q = 1.54$, $x'_d = 0.31$, $T'_{do} = 5.9$, $H = 4.9$, $D = 0$, $f_B = 60$ Hz.

(B) Explain the induction motor modeling in SI unit. [05]

Que- 5 (A) Define the Park's transformation. And write the Park's transformation matrix. [04]

(B) The equivalent circuit of single machine connected to infinite bus is shown in figure. [06]



single machine connected to an infinite bus

Draw the phasor diagram of steady state SMIB system, and derive the output torque equation for synchronous machine

OR

Que- 5 (A) A generator is connected to an infinite bus through an external impedance of jx_e. If E_b = V_{to} = 1.0 p. u., P_t = 1.0 p. u. Find the initial conditions. Assume x_e = 0.2 p.u. The generator data: $x_d = 1.8$, $x_q = 1.7$, $x'_d = 0.17$, $x'_q = 0.23$, Ra = 0.0, T'_d=0.4 sec, T'_q=0.1 sec, H = 4 sec, $f_B = 60$ Hz. [05]

(B) Discuss how flux decay phenomenon is represented in single machine system. [05]

Que-6 (A) Explain Static Var Compensator Modeling. State their applications. [05]

(B) Explain transmission line modeling for stability analysis. [05]

END OF PAPER