# KADI SARVA VISHWAVIDHYALAYA

## M.E. Semester-II

**Subect Code:**-EEC **Subject Name:**-Power System Dynamics & Control

**Date:**-11/06/2013 **Time:**-10:30 am to 01:30 pm **Total Marks:**-70

**Instructions:**

1. Answer each section in separate Answersheet.
2. Use of Scientific Calculator is permitted.
3. All questions are Compulsory.
4. Indicate Clearly, the options you attempt along with its respective question number.
5. Use the last page of main supplementary for rough work.

## Section-I

**Q-1** **[A]** Derive Park's voltage equation in reference with synchronous machine. **[05]**

**[B]** Explain Armature reaction in details. **[05]**

**[C]** For synchronous generator connected to an infinite bus, Explain the behavior of the generator when mechanical power changes and $I_f$ is fixed. **[05]**

**OR**

**[C]** Explain Power delivered by generator. **[05]**

**Q-2** **[A]** State basic assumptions made in steady state analysis of an alternator and derive open circuit voltage equation of it. **[05]**

**[B]** Explain energy conversion in electromechanical system. **[05]**

**OR**

**Q-2** **[A]** Derive expression of stator self-inductances of ideal salient pole synchronous machine in terms of rotor position with usual notation. **[05]**

**[B]** Explain the role of synchronous machine excitation in controlling reactive power. **[05]**

**Q-3** **[A]** Draw a block diagram of excitation control system. Also explain function of each block. **[05]**

**[B]** Given a round-rotor generator with $V_a = 1.0$, Xs = 1.6, r = 0.004 and $I_a = \angle 1\text{-}60$. Find Ea, draw a phasor diagram also. **[05]**

**OR**

**Q-3** **[A]** Derive equation for direct axis and quadrature axis voltages (Vd,Vq) for non-synchronous operation of an alternator considering balanced terminal voltages with Va (t) = $\sqrt{2}\,|V| \cos(\omega_0 t + \angle V)$. The rotation of generator is described by, $\theta = \omega_0 t + (\pi/2) + \delta$. **[05]**

**[B]** Derive expression for transfer function for separately excited DC generator considering type DC1 excitation system. **[05]**

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## Section-II

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| Q-4 | [A] | Carry out small signal analysis of excitation system of synchronous machine connects to infinite bus through transmission line. Also draw its block-diagram. | [05] |
| | [B] | State all assumptions made to develop dynamic model of synchronous machine and derive its all equations and draw phasor diagram also. | [05] |
| | [C] | Derive rotor mechanical equations of SMIB. From that draw a Torque-angle loop. | [05] |
| | | **OR** | |
| | [C] | Prove that, if the armature flux linkage components, w.r.t. a synchronously rotating reference frame, are constants, then the transformer emf terms and terms introduced by the variations in the rotor speed cancel each other. | [05] |
| Q-5 | [A] | 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. | [05] |
| | [B] | Discuss small signal stability analysis of SMIB with the help of state space representation. | [05] |
| | | **OR** | |
| Q-5 | [A] | A single machine system connected with infinite bus through resistance $R_e$ and reactance $X_e$. Derive expression for $\Delta V_d$ and $\Delta V_q$ using machine model 1.0 and neglecting armature resistance. | ] |
| | [B[ | A generator is connected to an infinite bus through an external impedance of $jx_e$. If $E_b$=$V_{to}$= $P_t$=1.0 p.u. Find the initial conditions. Assume $X_e$=0.25p.u. The generator data: $x_d$=1.8, $x_q$=1.7, $x'd$=0.17, $x'_q$=0.23, $R_a$=0.0, $T'_d$=0.4sec, $T'_q$=0.1sec, H=4 sec, $f_B$=60 Hz. | [05] |
| Q-6 | [A] | State assumption made in Multi machine system and develop simplified system model for the same. | [05] |
| | [B] | Explain field controlled alternator rectifier excitation system with diagram. | [05] |
| | | **OR** | |
| Q-6 | [A] | Draw and explain speed-governing system and model of speed-governing system for hydro turbines. | [05] |
| | [B] | Explain multi machine power system detailed model: Case I for generator with necessary assumptions. | [05] |

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