BACHELOR OF POWER ENGINEERING EXAMINATION, 2013
(3rd Year 2nd Semester)
SUBJECT: ELECTRICAL MACHINE AND POWER CONTROL
(Use separate answer script for each part)

Time: Three hours **PART: I (50 marks)**

No. Of Questions	Part I Answer any *three* questions (2 marks for neatness)	Marks
1.	a) What is electrical drive? What are the different components of an electrical drive system and explain their functions.	2+6
	b) What are the speed-toque conventions for drive system? Describe the four quadrant operation of a motor driving a hoist load.	2+6
2.	a) What is steady state stability of electrical drive? Derive the condition for steady state stability.	2+6
	b) A 480V, 3-ph induction motor has rated speed at full load of 1120 rpm, stator resistance of 1 ohm, rotor resistance referred to stator of 1 ohm and equivalent winding reactance of 5 ohm. The inertia of the motor is 4 Nm-sec^2/rad. Compute the starting time of the motor at no-load and at full voltage and frequency.	8
3.	a) What are the factors influencing the choice of electrical drives?	6
	b) Describe how the speed of a separately excited dc motor is controlled through the use of a three phase full-converter. Discuss how two quadrant drive can be obtained from this scheme.	6+4
4.	a) Describe the operation of single phase semi-controlled converter fed separately excited dc motor in both continuous and discontinuous modes.	8
	b) The speed of a separately excited dc motor is controlled by means of 3-ph semi-converter from a 3-ph, 415 V, 50 Hz supply. The motor constants are: inductance 10 mH, resistance 0.9 ohm and armature constant 1.5 V/rad/s (Nm/A). Calculate the speed of this motor at a torque of 50 Nm when the converter is fired at 45^0. Neglect losses in the converter.	8
5.	a) Derive appropriate expression to obtain speed-torque characteristic of static Kramer drive.	8
	a) A static Kramer drive is used for the speed control of a 4-pole SRIM fed from 3-ph, 415 V, 50 Hz supply. The inverter is connected directly to the supply. If the motor is required to operate at 1200 rpm, find the firing advance angle of the inverter. Voltage across the open circuited slip rings at standstill is 700 V. Allow a voltage drop of 0.7 V and 1.5 V across each of the diodes and thyristors respectively. Inductor drop is neglected.	8

Bachelor of Power Engineering 3rd Year 2nd semester Examination, 2013

ELECTRICAL MACHINES AND POWER CONTROL

Time: Three hours | Full marks: 100

(50 marks for each part)

USE SEPARATE ANSWER SCRIPT FOR EACH PART

PART-II

Answer any three questions.

(2 marks for neatness)

1. Figure 1 shows the one line diagram of a 3-bus power system with generation at bus 1 and 3. The voltage at bus 1 is $V_1 = 1.025\angle 0^0$ *pu*. The voltage magnitude at bus 3 is fixed at 1.03 *pu* with a real power generation of 300 MW. A load consisting of 400 MW and 200 MVAR is taken from bus 2. The line impedences are marked in *pu* on a 100 MVA base. Compute the bus admittance matrix. Using Gauss-Seidel method and initial estimates of $V_2^{(0)} = 1.0 + j0$ and $V_3^{(0)} = 1.03 + j0$ and keeping $|V_3| = 1.03\,pu$, determine the phasor values of V_2 and V_3. 16

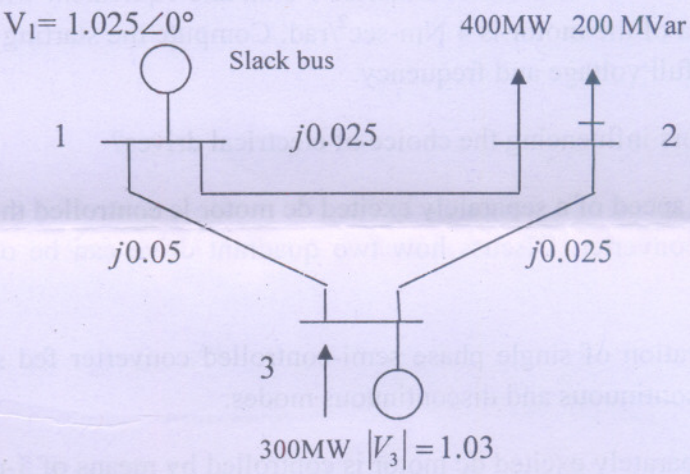

Figure 1

2. (a) Derive swing equation. 4

(b) A cylindrical rotor synchronous motor, connected to an infinite bus, is working under full load conditions with a load angle of 30°.

(i) If the shaft load is suddenly increased to 1.5 times the full load, determine whether or not the synchronism is maintained.

(ii) Determine the maximum additional safe load that can be suddenly thrown on to the motor shaft. 12

3.(a) Draw the complete block diagram of load frequency control of an isolated power system and obtain the expression for steady state change in the system frequency for a sudden change in load demand. Also draw the steady state load – frequency characteristic of the same. 8

(b) Two generators rated at 400 MW and 600 MW are operating in parallel. The drop characteristics of their governors are 3 % and 4% respectively from no load to full load. Assuming that the generators are operating at 50 Hz at no load, how would a load of 1000 MW be shared between them? What will be the system frequency at this load? Assume linear governor operation. 8

4. (a) Discuss the operating cost characteristics of fossil fuel plant. 4

(b) Three generating units have a total capacity of 500 MW. The incremental costs of production are given as follows:

$IC_1 = 0.2P_1 + 25, \quad 20 \le P_1 \le 100\,\text{MW}$

$IC2 = 0.3P_2 + 30, \quad 30 \le P_2 \le 200\ \text{MW}$

$IC_3 = 0.25P_3 + 20, \quad 30 \le P_3 \le 200\ \text{MW}$

Allocate a total load of 100MW optimally amongst the three units. Assume the initial value of $\lambda = 32.83$. 12

5. Write short notes on any two of the followings: 2×8

1. Equal Area Criterion.
2. Unit Commitment.
3. Static excitation system of synchronous generator.
4. Modeling of turbine speed governing system.