Ref. No. Ex/PE/T/326/2019

Bachelor of Power Engineering Examination, 2019
(3rd Year 2nd Semester)
Subject: Electrical Machine and Power Control

Time: Three hours **Full Marks: 100**

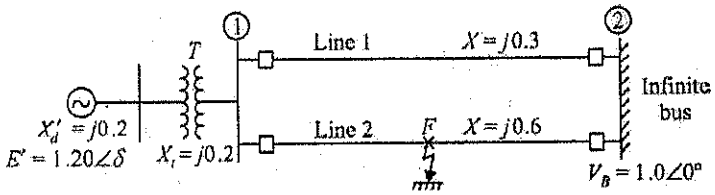
Questions No.	Questions	Marks
	Group-A (Answer Any *Two*) (2x10=20)	
1.	What are the different types of mechanical load? What are the different factors influencing the choice of electrical drives?	4+6
2.	a) In stator frequency control of a 3-phase induction motor, explain why ratio *V/f* is maintained constant for speeds below base speed.	5
	b) Scherbius drive is capable of operating in sub-synchronous and super-synchronous mode with both motoring and regeneration. Explain with diagrams	5
3.	Distinguish between transient and steady-state stability and discuss the need for performing stability analyses of power systems.	5+5
	Group-B (Answer Any *Two*) (2x10=20)	
4.	Draw the speed torque characteristic for static Kramer drive for different firing angles deriving the speed, slip and torque expressions.	10
5.	Describe the stator frequency control for speed control of a three phase induction motor. Derive the expressions for motor torque, maximum torque and the slip at which it occurs.	5+5
6.	How is the equal area criterion used to determine stability of a synchronous machine connected to an infinite bus through a transmission line applied when there is a sudden (a) increase in power input, and (b) decrease in power output due to a three-phase fault?	5+5
	Group-C (Answer Any *Three*) (3x10=30)	
7.	What is regenerative braking? Describe the regenerative braking of a chopper fed separately excited dc motor with circuit diagram and relevant waveforms.	2+8
8.	Derive the transfer function of an automatic voltage regulator (AVR) loop including a synchronous generator. Draw its block diagram	5+5
9.	Develop the swing equation for a synchronous generator based on rotational mechanics. What is the significance of inertia constant?	7+3
10.	Briefly describe the compound controlled rectifier excitation system with proper circuit diagram	10
	Group-D (Answer Any *Three*) (3x10=30)	
11.	A separately excited dc motor rated at 10 kW, 240 V, 1000 rpm is supplied from a fully controlled two pulse bridge converter. The converter is supplied at 250 V, 50 Hz supply. An extra inductance is connected in the load circuit to make the conduction continuous. Determine the speed, power factor and efficiency of operation for thyristor firing angles of 0 and 60° assuming the armature resistance of	10

0.40 Ω and an efficiency of 87% at rated conditions. Assume constant torque load.

12. A 100 hp, 460 V, 60 Hz star connected squirrel cage induction motor has the following equivalent circuit parameters. 10
r_1=0.06 Ω, r'_2=0.35 Ω; $x_1+x'_2$=0.6 Ω, Xm=8Ω
The motor drives a fan which requires 100 hp at a speed of 1000 rpm. Determine the firing angles required for a speed range of 200 to 1000 rpm.

13. The fuel cost of two units are given by 10
$C_1 = C_1 (P_{G1}) = 1.0 + 25\ P_{G1} + 0.2\ P^2_{G1}$ Rs/hr
$C_2 = C_2 (P_{G2}) = 1.5 + 35\ P_{G2} + 0.2\ P^2_{G2}$ Rs/hr
If the total demand on the generators is 200 MW, find the economic load scheduling of the two units.

14. A three-phase, 50-Hz, synchronous generator is delivering 0.9 pu real power to an infinite bus via the transmission circuit shown in Figure below. All values shown in the circuit diagram are in per unit on a common system base. A temporary three phase fault occurs in the middle of line 2. Determine the rotor angle position before the fault occurs. Also compute the critical clearing angle if the fault is cleared by opening the faulted line. Assume H = 4.5 MJ/MVA. 10



15. Assume that the fuel input in British thermal unit (Btu) per hour for Units 1 and 2 are given by 10
$C_1 = (8P_{G1} + 0.024P^2_{G1} + 80)10^6$
$C_2 = (6P_{G1} + 0.024P^2_{G2} + 120)10^6$
The maximum and minimum loads on the units are 100 and 10 MW, respectively. Determine the minimum cost of generation when the following load is supplied as shown in Figure below. The cost of fuel is Rs. 2 per million Btu.