Ref. No.: Ex/PG/PE/T/127B/2018

M. POWER ENGINEERING EXAMINATION -2018

(2nd Semester)

SUBJECT – Advanced Electrical Drives

Time: Three hours

Full Marks: 100

Answer any ***five*** questions

Assume suitable values for missing data, if any

All parts of a question to be answered at one place

No. of Question		Marks
Q. 1. (a)	Derive the fundamental torque equation in connection with electric drive. Also explain the components of load torque.	10
(b)	Discuss the motor and input supply performance parameters of phase controlled dc electric drives with relevant expressions of the parameters. State their importance in the design of electric drives.	10
2. (a)	Briefly describe the operation of a separately excited dc motor fed from a single-phase semi converter. Sketch and explain the waveforms for armature voltage, input supply current, free-wheeling diode current and load current. Derive the expression for average motor voltage. Assume continuous motor current.	12
(b)	An inductor is added in the motor circuit in part (a) so that motor current is now ripple free and constant. Express the input supply current in Fourier series and hence derive the expressions for input performance parameters in terms of firing angle (α).	8
3. (a)	Explain the operation of a separately excited dc motor fed from a three phase full converter with the neat sketches of circuit diagram and waveforms of armature voltage, input current and load current. Derive the expression for average motor voltage.	10
(b)	The speed of a 150 hp, 650 V, 1750 rpm separately excited dc motor is controlled by a 3-phase full converter operating from a 3-phase 460 V, 50 Hz supply. The rated armature current of the motor is 170 A. The motor parameters are $R_a = 0.099\ \Omega$, $L_a = 0.73\ mH$ and motor constant $K_a\varphi = 0.33$. Neglect the losses in the converter system. Determine (i) No load speed at firing angle $\alpha = 0°$ and $\alpha = 30°$. Assume at no load, armature current is 10% of rated current and is continuous. (ii) The firing angle to obtain rated speed of 1750 rpm at rated motor current.	10

4.	A 1-ph, 230 V, 50 Hz feeds a separately excited dc motor through two 1-ph-semi converters, one for the field circuit and other for the armature circuit. The firing angle for the semi converter in the field circuit is zero and the field resistance is 200 Ω. The armature resistance $R_a = 0.30\ \Omega$. The load torque is 50 Nm at 900 rpm. The voltage constant is 0.8 V/A-rad/sec and the torque constant is 0.8N-m/A^2. Assume the armature and field currents are continuous and ripple free. Neglect the losses. Determine (i) The field current (ii) The firing angle of the semi-converter at the armature circuit (iii)The power factor of the armature circuit	20
5. (a)	Describe the operation of regenerative braking control of dc motors using chopper with relevant circuit diagrams, waveforms and speed torque characteristics.	10
(b)	A dc series motor has an armature current of 80 A and is running at 1200 rpm with 210 V DC. Assuming linear magnetization circuit, calculate the braking current and braking resistance when the motor is at twice the rated torque and running at 1000 rpm under dynamic braking condition.	10
6. (a)	Describe the operation of a separately excited dc motor controlled by a Class A chopper with relevant circuit diagram and wave form. Consider both Continuous and discontinuous motor current.	10
(b)	A separately excited dc motor is being controlled by a Class A chopper supplied from a 110 V dc supply. Motor armature parameters are: $R_a = 0.25\ \Omega$, $L_a = 1.0\ mH$. The motor back e.m.f. is 11 V. The chopper is being operated at 400 Hz with 40% duty cycle. Determine (i) Whether motor current is continuous or discontinuous (ii) Average motor current and voltage (iii) Minimum and maximum values of instantaneous current.	10
7.(a)	What are the different methods of speed control of induction motors? Describe the method of static rotor resistance control using a chopper in rotor circuit employed for the speed control of induction motors with relevant circuit diagrams and speed torque characteristics.	10
(b)	Discuss the principle of operation of Static Schervious drive with suitable circuit diagram.	10