Reg. No.



MANIPAL INSTITUTE OF TECHNOLOGY MANIPAL

(A constituent Institution of MAHE, Manipal)

I SEMESTER M.TECH (POWER ELECTRONICS & DRIVES) END SEMESTER EXAMINATIONS, NOVEMBER 2018

SUBJECT: POWER ELECTRONICS DEVICES & CONVERTER TOPOLOGIES [ELE 5121]

REVISED CREDIT SYSTEM

Time	e: 3 Hours Date: 24, November 2018 Max. Mark	s: 50
Instructions to Candidates: ◆ Answer ALL the questions. ◆ Missing data may be suitably assumed.		
1A.	Explain the switching characteristics of IGBT.	(05)
1B.	A series SCR string with ratings 4 kV and 800 A uses thyristors with 850 V and 200 A rating, the derating factor is of 40%, the maximum forward blocking current and maximum difference in recovery charge are as 10 mA and 40 μ C respectively. Find the number of SCR's to be connected in series and in parallel and also determine the values of R and C of static and dynamic equalizing circuits.	(03)
1C.	What are the different types of thyristor protection schemes?	(02)
2A.	Draw the circuit diagram of single-phase fully controlled bridge converter and explain its operation in continuous conduction mode with relevant waveforms.	(05)
2B.	Draw the power circuit diagram of a dual converter and explain its operation.	(03)
2C.	A three-phase full bridge converter is connected to a 440 V, 50 Hz supply having a source inductance of 7 mH. The load current is constant at 30 A. If the load consists of a dc voltage source of 440 V, having an internal resistance of 1 Ω , Calculate the firing angle α and overlap angle μ .	(02)
3A.	A single-phase voltage controller controls the power input to a load consisting of $R = 4 \Omega$ and $\omega L = 5 \Omega$. If the supply voltage is 220 V at 50 Hz, calculate (i) control range of firing angle, (ii) maximum value of rms load current, (iii) maximum power input to the load, (iv) maximum power factor, (v) maximum value of average and rms thyristor current.	(05)
3B.	Describe the principle of working of a three-phase to three-phase 6 pulse cycloconverter.	(03)
3C.	Write short notes on dc-link converter.	(02)
4A.	Draw the circuit diagram and explain the operation of boost dc-dc converter with associated waveforms and also derive the expression for ΔI and ΔV_c .	(05)
4B.	The buck-boost regulator has an input voltage of 15 V. The duty cycle and switching frequency are 0.3 and 30 kHz. The inductance and filter capacitance values are 160 μ H and 230 μ F. The average load current maintained is 1.3 A. Determine (a) average output voltage, (b) peak to peak output voltage ripple, (C) peak to peak ripple current of inductor, (d) peak current of transistor.	(05)

- **5A.** The three-phase inverter has wye connected load of $R = 40 \Omega$ with 180° conduction. The inverter frequency is 50 Hz and the dc input voltage is 600 V. Determine (a) rms values of line and phase voltage, (b) fundamental line and phase voltage, (c) THD, HF and DF of lower order harmonic, (d) line, phase currents and load power, (e) average and rms transistor currents. (05)
- **5B.** Draw the circuit diagram and explain the operation of diode-clamped multilevel inverter. **(03)**
- **5C.** Write short notes on single-phase push-pull inverter.

(02)