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MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

I SEMESTER M.TECH (POWER ELECTRONICS & DRIVES)

END SEMESTER EXAMINATIONS, NOVEMBER 2017

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

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 21 November 2017** **Max. Marks: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. Explain dv/dt and di/dt protection for SCR. Also explain UJT oscillatory triggering circuit for generating gate pulse for SCR. ***(03)***

1B. Derive an approximate and exact equivalent circuit of an IGBT from its structural details. Also describe the switching characteristics. ***(05)***

1C. A 20V DC source is connected to an R-L load through an SCR with R = 10 Ω and L = 20 mH. If the minimum pulse width of the gate current pulse required to turn ON the SCR is 100 μs, find the latching current of the SCR. ***(02)***

2A. With the help of circuit diagram and waveforms of load voltage and load current, explain the working of a single phase fully controlled full wave rectifier feeding an RL load with continuous current. And also derive the RMS output Voltage. ***(05)***

2B. Controlled full bridge rectifier has discontinuous current with supply voltage 120V RMS at 60Hz, R=10Ω, L=20mH and $\alpha=60°$ Determine (i) The average load current (ii) power absorbed by the load. ***(05)***

3A. Explain the operation of a three-phase fully controlled converter feeding an RL load with continuous current. Draw the circuit diagram and waveforms of load voltage and load current at firing angle is 60°. Indicate the triggering instants of the devices on the waveform and also derive the output voltage. ***(05)***

3B. What are the schemes used for the improvement of power factor in AC-DC converters? With the help of neat diagram and waveform explain the extinction angle control. ***(05)***

4A. The boost converter has the input voltage is 6V. The average output voltage is 18V and the average load current is 4 Amp. The switching frequency is 20kHz of L=250μH and C= 420μF. Determine i) The duty cycle ii) The ripple current of Inductor iii) The peak current of the inductor iv) Ripple voltage of filter capacitor. ***(05)***

4B. Discuss the switching scheme for 120° mode of operation of three-phase square wave inverter. Hence plot the phase voltages and any one line voltage waveform. ***(05)***

5A. With the help of neat circuit diagram and relevant waveforms explain the working of diode-clamped multilevel inverter. ***(03)***

5B. With the help of neat circuit diagram and waveform, explain the operation of ZVS resonant-switch dc-dc converter. ***(04)***

5C. Explain Bipolar voltage switching of 1ϕ full bridge voltage source inverters with the help of suitable waveforms. Also draw and explain its harmonic spectrum. ***(03)***