Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY

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A Constituent Institution of Manipal University

VI SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)
MAKE-UP EXAMINATIONS JUNE 2017

SUBJECT: POWER ELECTRONICS [ELE 3201]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 13 June 2017** **Max. Marks: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.
- Sine Graphs shall be supplied

1A. With the help of a neat sketch, discuss the *I-V* characteristics of an SCR, with brief discussion on each region of operation of SCR. ***(04)***

1B. Draw a neat circuit for forced voltage commutation of an SCR. Hence, plot the waveforms for voltage across the capacitor, voltage across the SCR and voltage across the load. ***(04)***

1C. Sketch the safe operating area of power MOSFET clearly indicating all the operating limits. ***(02)***

2A. With the help of a neat sketch of Triac`s structure, explain its working in first quadrant when turned on with positive gate current. ***(03)***

2B. A controlled half-wave rectifier has a series resistance, inductance and dc voltage source with R = 2 Ω, L = 75 mH and V_{dc} = 48 V. The source is 120 V at 60 Hz. The delay angle is 50°. Determine an expression for load current and average load current. ***(03)***

2C. A three phase controlled bridge rectifier has a delay angle of 120°. The three phase ac system is 416 V (line-to-line). The load comprises of series combination of a dc source = 300 V, R = 2 Ω and L is large enough to consider the current to be purely dc. Determine the power transferred back to the ac system. Hence, plot the load voltage and load current waveforms. ***(04)***

3A. Show that the power factor for the controlled full-wave rectifier with a resistive load is

$$pf = \sqrt{1 - \frac{\alpha}{\pi} + \frac{\sin 2\alpha}{2\pi}}$$

(03)

3B. A resistive load absorbs 200 W when connected to a 120 V rms at 60 Hz ac voltage source. Determine the firing angle of the voltage controller such that 200 W is absorbed by the same resistance when the source is 240 V rms at 60 Hz. ***(03)***

3C. A boost converter has an input of 5 V and an output of 25 W at 15 V. The minimum inductor current must be no less than 50 percent of the average. The output voltage ripple must be less than 1 percent. The switching frequency is 300 kHz. Determine the duty ratio, inductor and capacitor values. ***(04)***

4A. A single phase full converter is made to deliver a constant load current. For zero degree firing angle, the overlap angle is 15°. Calculate the overlap angle when firing angle is 30°. ***(03)***

4B. A step-up dc-dc converter has input voltage of 220 V and an output voltage of 660 V. If the conducting time of the switch is 100 μs, compute the pulse width of the output voltage. If, now the output voltage pulse width is halved for constant frequency operation, find the average value of new output voltage. ***(03)***

4C. With a neat circuit schematic, explain the working of a single phase full bridge square wave inverter. Hence, plot the output voltage waveform in synchronization with the switching scheme. Also, draw the harmonic spectrum. ***(04)***

5A. With a neat circuit schematic, explain the working of a 3-level H-bridge inverter. Hence, plot the relevant waveforms. ***(03)***

5B. Discuss how unipolar switching technique can be applied to a single phase full bridge inverter. Support your answer with relevant waveforms. ***(03)***

5C. With the help of relevant waveforms explain how zero current switching can be attained for a buck dc-dc converter. ***(04)***