

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/ Backlog), April-May 2015

B. Tech in EE/ECE Engineering, Semester VI

Roll No.....

EE603 :INDUSTRIAL ELECTRONICS

Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1A Objective type multiple choice questions (10 questions @ 1 mark)

10

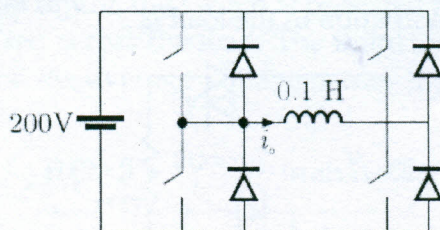
i. Modern power semiconductor device that combine the characteristics of BJT and MOSFET is

- (A) GTO (B) FCT (C) IGBT (D) MCT

ii. A 3-phase voltage source inverter is operated in 180° conduction mode. Which one of the following statements is true?

- (A) Both pole-voltage and line-voltage will have 3rd harmonic components
(B) Pole-voltage will have 3rd harmonic component but line-voltage will be free from 3rd harmonic
(C) Both pole-voltage and line-voltage will be free from 3rd harmonic Components
(D) Line-voltage will have 3rd harmonic component but pole-voltage will be free from 3rd harmonic.

iii. A single phase source inverter is feeding a purely inductive load as shown in the figure the inverter is operated at 50 Hz in 180° square wave mode. Assume that the load current does not have any dc component. The peak value of the inductor current i_0 will be



- (A) 6.37 A (B) 20 A (C) 10 A (D) 40 A

iv. A single phase full-wave half-controlled bridge converter feeds an inductive load. The two SCRs in the converter are connected to a common DC bus. The converter has to have a freewheeling diode.

- (A) Because the converter inherently does not provide for freewheeling
(B) Because the converter does not provide for free-wheeling for high values of triggering angles
(C) Or else the free-wheeling action of the converter will cause shorting of the AC supply

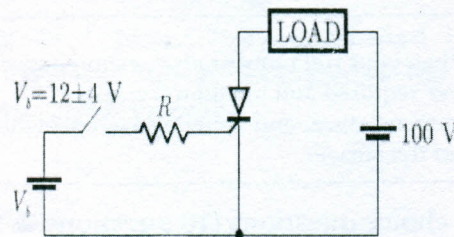
(D) Or else if a gate pulse to one of the SCRs is missed, it will subsequently cause a high load current in the other SCR.

v. AC-to-DC circulating current dual converters are operated with the following relationship between their triggering angles (α_1 and α_2)

(A) $\alpha_1 + \alpha_2 = 180^\circ$ (B) $\alpha_1 + \alpha_2 = 360^\circ$ (C) $\alpha_1 - \alpha_2 = 180^\circ$ (D) $\alpha_1 + \alpha_2 = 90^\circ$

vi. The triggering circuit of a thyristor is shown in figure. The thyristor requires a gate current of 10 mA, for guaranteed turn-on. The value of R required for the thyristor to turn on reliably under all conditions of V_b variation is

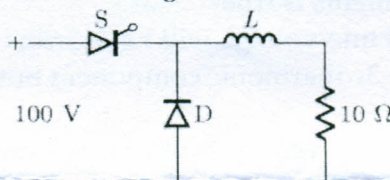
$V_g = 10 \text{ mA}$
 $V_g = I_g R$
 $R = \frac{V_g}{I_g} = \frac{10}{0.01} = 1000 \Omega$



(A) 10000 Ω (B) 1600 Ω (C) 1200 Ω (D) 800 Ω

vii. Figure shows a chopper operating from a 100 V dc input. The duty ratio of the main switch S is 0.8. The load is sufficiently inductive so that the load current is ripple free. The average current through the diode D under steady state is

$V = IR$
 $I = \frac{V}{R} = \frac{100}{10} = 10 \text{ A}$

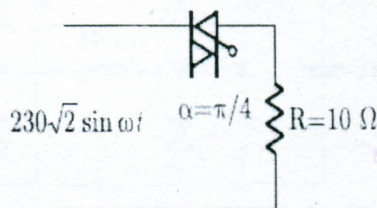


(A) 7 A (B) 6.4 A (C) 1.6 A (D) 10.0 A

viii. The main reason for connecting a pulse transformer at the output stage of thyristor triggering circuit is to

(A) Amplify the power of the triggering pulse (B) Provide electrical isolation
 (C) Reduce turn on time of SCR (D) Avoid spurious triggering of the SCR

ix. The triac circuit as shown in figure controls the ac output power to the resistive load. The peak power dissipation in the load is



(a) 3968 W (b) 5290 W (c) 7935 W (d) 10580 W

x. The anode current through a conducting SCR is 10A. If it is made one fourth, then what will be the anode current?

(a) 0A (b) 5A (c) 10A (d) 20A

$(I_g) \text{ made}$

Q.2 Short answer type questions (4 questions @ 2.5 marks)

10

- What is meant by positive converter group in a cycloconverter?
- What are the applications of cyclo-converter?
- What is main difference between voltage and current commutation?

$\rightarrow 10 \text{ A}$
 $\alpha \rightarrow \frac{1}{4} \alpha$

iv. What is meant by PWM control in dc chopper?

Q.3A Explain operating principle and characteristic of IGBT. 05

Q.3B A three phase half wave controlled converter is fed from 3 phase, 400 V, 50HZ AC source and is connected to load taking a constant current of 36 A. Thyristor have a voltage drop of 1.4 V. Calculate 05

- Average value of load voltage for a firing angle of 30°
- Average power dissipated in each thyristor.

Q.4A A single phase full bridge inverter has RLC load of $R=4\ \Omega$, $L=35\text{ mH}$ and $C=155\ \mu\text{F}$. The dc input voltage is 200V and the output frequency is 50HZ. Calculate 05

- Find an expression for load current up to fifth harmonics.
- RMS and peak value of each thyristor.

Q.4B Describe three performance parameter inverter. 05

Q.5A A single phase full converter feeds power to RLE load with $R=6\ \Omega$, $L=6\text{ mH}$ and $E=60\text{V}$. The AC source voltage is 230 V, 50HZ. For continuous conduction, find the average value of load current for a firing angle delay of 50° . 05

Q.5B Describe the principle of step-down chopper. Derive an expression for the average output voltage in terms of input dc voltage & duty cycle. 05

Q.6A Derive following expressions for a single phase full wave converter for RL Load. (Assume continuous conduction) 05

- Rectification efficiency
- Form factor

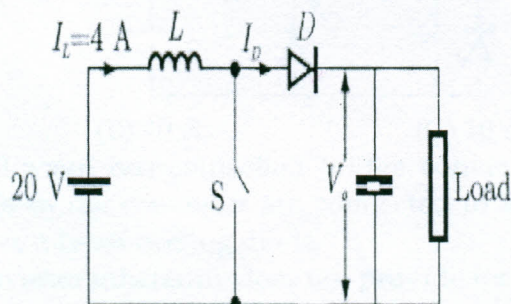
Q.6B Explain the different working modes of SCR and differentiate between hard-driving and over-driving of an SCR. 05

OR

Q.6B An ideal diode connected to a pure inductor and is connected to a purely sinusoidal 50 Hz voltage source. Under ideal conditions the draw voltage and current waveform through the capacitor. 05

Q.7A Explain the operation of class C commutation with aid of relevant wave form source voltage, capacitor voltage and main thyristor voltage waveforms. 05

Q.7B In the circuit shown in the figure, the switch is operated at a duty cycle of 0.5. A large capacitor is connected across the load. The inductor current is assumed to be continuous. Determine the average voltage across the load and the average current through the diode. 05



OR

Q.7B What are techniques for pulse width modulation (PWM) for dc chopper? Explain multi pulse modulation with aid of relevant waveforms. 05

Q.8 Explain the operation of 3 phase bridge inverter for 120° degree mode of operation with aid of relevant phase and line voltage waveforms. 10

Q.9A Describe the working of 3 phase half wave cyclo-converter with aid of source voltage and output voltage waveforms. 10

Q.9B Explain operation of a three phase half wave controlled converter with RL Load. Draw waveforms of input phase voltages, thyristor voltage, thyristor current and output voltage. Assume firing angle = 60° . Assume constant load current. 10

OR

Q.9B Describe the working of 1 phase fully controlled bridge converter in the rectifying mode and inversion mode. Also derive the expressions for average output voltage and rms output voltage. 10