

6E3112

Roll No. _____

Total No of Pages: 7

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B. Tech. VI Sem. (Main & Back) Exam., May/June-2014
Advanced Power Electronics
6EE4 Elect. Engineering
Common for EX, EE

Time: 3 Hours

Maximum Marks: 80
Min. Passing Marks: 24

Instructions to Candidates:-

Attempt any five questions, selecting one question from each unit. All Questions carry equal marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly.

Units of quantities used/ calculated must be stated clearly.

Use of following supporting material is permitted during examination.

1. _____

2. _____

UNIT-I

Q.1 (a) Describe the operation of 3- ϕ , 3-wire AC thyristor controlled controller with neat power diagram and V-I waveforms. Also, discuss, why 3- ϕ , 3-wire AC regulators are preferred over 3- ϕ , 4-wire system. [8]

(b) A single phase 220V, 1KW electric room heater is connected across 220V power supply through a TRIAC. For a delay angle of 90° , calculate the power dissipated by the heater element. [4]

- (c) In open loop volts/ Hz control of induction motor drive, why should non- linear volts/Hz gain is preferred in over-modulation region of PWM. [4]

OR

- Q.1 (a) A capacitor is connected across a Thyristor Control Rectifier to control the fire capacitance VAR. Calculate for $\alpha = 135^\circ$ (for figure 2.1)
- (i) total reactive power.
 - (ii) fundamental components of input – line current.
 - (iii) total harmonic distortion of inductive current alone.
 - (iv) total harmonic distortion of line current. [10]

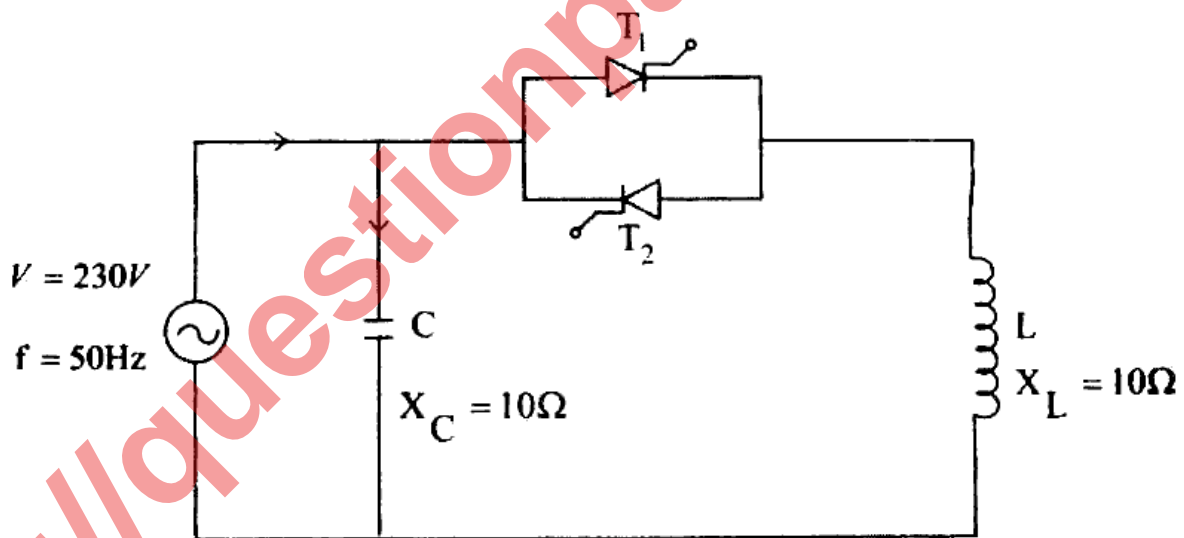


Figure 2.1

- (b) For a 1- ϕ AC voltage regulator, develop a relation between conduction angle γ and firing angle α , and plot their variation as a function of load phase angle ϕ . Under what condition, conduction angle γ , becomes equal to π . [6]

UNIT-II

- Q.2 (a) A 3- ϕ bridge inverter is fed from 200V DC source. The inverter is operated in 180° conduction mode and is supplying inductive, star connected load with $R=10\Omega$ and $L=20\text{mH}$. The inverter frequency is $f_o = 50\text{ Hz}$. Calculate:
- (i) Instantaneous line-to-line voltage & current is fourier series.
 - (ii) Total harmonic distortion.
 - (iii) Distortion factor
 - (iv) Average & rms switch current. [10]
- (b) State the need for reduction of harmonics in Inverter. Discuss various methods for reduction of harmonics or improvement in wave shapes. [6]

OR

- Q.2 (a) What is the function of circuit shown in fig 2.1. Also, discuss its advantages over a conventional thyristor converter. [6]

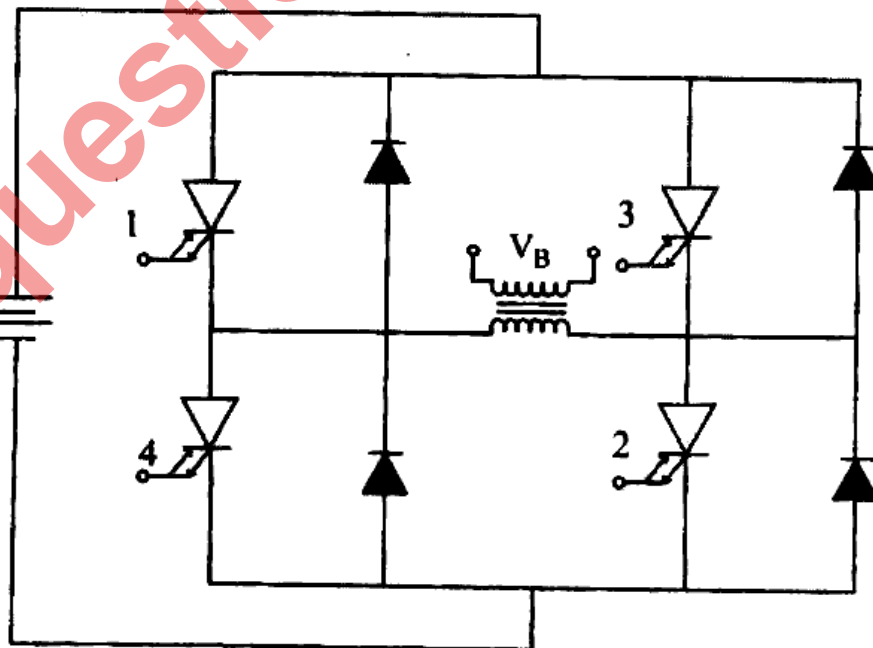


Figure 2.1

- (b) Explain the operation of an auxiliary-commutated (McMurray inverter) single-phase bridge inverter by drawing voltage & current waveforms. [10]

UNIT-III

Q.3 (a) A 3- ϕ to 1- ϕ cycloconverter employs six pulse bridge converters. Each converter is supplied from delta/star transformer with per phase turns ratio of 3:1. The supply voltage is 410V, 50Hz. The R_L load has $R=4\Omega$ and at low frequency $\omega_o L=3\Omega$. The commutation overlap and thyristor turn-off time limits the firing in inversion mode to 160° . Calculate -

- (i) Fundamental rms output voltage
- (ii) R M S output current
- (iii) Output power [8]

(b) A 1- ϕ to 1- ϕ centre-tapped cyclo-converter is delivering power to a resistive load. The supply transformer has turns ratio of 1:1:1. The frequency ratio is $f_o/f_s = 1/3$. The firing delay angle α for all the thyristors are the same. Sketch the time variations of the following waveforms for $\alpha = 0^\circ$ and $\alpha = 45^\circ$.

- (i) Supply voltage.
- (ii) Output current.
- (iii) Supply current. [8]

OR

- Q.3 (a) A six- pulse, blocked group cycloconverter is fed from a three phase, 600V (line), 50Hz supply. The supply has an inductance of 1.146mH /Phase. If the cycloconverter is supplying a variable resistive load with a current of 28A, estimate the peak and RMS value of load voltage for firing angles of 0° , 30° and 60° . [8]
- (b) Describe the control scheme for a cycloconverter using voltage- sensing principle of converter group selection. Also, draw the various voltage waveforms of a control scheme. [8]

UNIT-IV

- Q.4 (a) A fly back converter is operated in a continuous mode from a supply of 14V to 30V with two outputs 12V at 0.6A and -12V at 0.6A. The switching power supply is used to power some drivers that have intermittent load demands. The load can vary from 0.1 to 0.5 Amp. Assuming the efficiency of the converter to be 80% and switching frequency to be 50 KHz, determine:
- (i) Ratings of transistor
 - (ii) Ratings of rectifying diode
 - (iii) Primary winding inductance & the number of turns of the primary and the secondary, if the core exhibits 80MH per 1100 turns. [16]

OR

- Q.4 (a) With the help of neat circuitry and waveform, explain the operation of forward converter with tertiary winding. Also test the advantage and disadvantage of the same. [10]
- (b) Explain the effect of series coupling capacitor on the performance of half bridge Q₁ converter. [6]

UNIT-V

- Q.5 (a) A SMPS is to be designed with following specification: $E_o = 12V$, $I_o = 12A$, $f_s = 60 \text{ KHz}$, AC rectified mains with LC filter: 230V, 50Hz. A forward converter operating in continuous-conduction mode with demagnetizing winding is chosen. Assuring all ideal conditions, except presence of transformer magnetizing inductance, determine:
- turns ratio of demagnetizing winding with primary winding at maximum duty cycle of 0.6.
 - switch voltage rating allowing 50% voltage of input voltage as spike.
 - d.c. supply current at full load. [10]

(b) Write short note on:

[2x3]

(i) Resonant AC power supply

(ii) SMPS

OR

Q.5 (a) Discuss the operation of Bidirectional AC power supply.

[8]

(b) Discuss various control applications used in AC power supply in detail.

[8]