

INSTITUTE OF AERONAUTICAL ENGINEERING

(AUTONOMOUS)

Code No: BPE002

MODEL QUESTION PAPER-2

I M. Tech I Semester Regular Examinations, February 2017

AC TO DC CONVERTERS

(Power Electronics and Electric Drives)

Time: 3 hours

Max. Marks: 70

Answer ONE Question from each Unit

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

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UNIT – I

- 1 a) Analyze the operation and construction of static induction circuit along with characteristics. Compare the characteristics, operation of MOS turn Off thyristor (MTO) and MOS Controlled thyristor (MCTs). [7M]
- b) A circuit employing parallel resonance turn off (Class B commutation) circuit has $C=50\text{Mf}$, $L=20\mu\text{H}$, $V=200\text{V}$ and initial voltage across the capacitor is 200V. Determine the circuit turn off time for main thyristor for load $R=1.5\ \Omega$. [7M]
- 2 a) Derive the equivalent circuit of insulated gate bipolar transistor (IGBT) from its structural details, describe input characteristics and transfer characteristics of an IGBT. [7M]
- b) The latching current of a thyristor with DC voltage source of 100V is 50mA. Calculate the value of minimum width of the gate pulse current when connected to a pure inductive load of 1H. Compute the effect, if a resistance of $10\ \Omega$ is connected in series with the load. [7M]

UNIT – II

- 3 a) Derive the power and power factor of three phase double converter and explain operation of three phase double converter with neat circuit diagram and wave forms. [7M]
- b) A resistive load of $10\ \Omega$ is connected through a half-wave controlled rectifier circuit to 220V, 50 Hz, single phase source. Calculate the power delivered to the load for a firing angle of 60° . Find also the value of input power factor. [7M]
- 4 a) Distinguish between the three phase controlled bridge rectifier with resistive load and ideal supply, highly inductive load and ideal supply for load side and supply side quantities. [7M]
- b) A single phase fully controlled bridge converter is supplied with 230V, 50Hz source. The load resistance is $20\ \Omega$ and a large inductance so as to reach the load current constant. For a delay angle of 60° , Determine [7M]
 - A. Average output voltage
 - B. Average output current

- C. Average values of SCR current
- D. Input power factor.

UNIT – III

- 5
 - a) Discuss about the application of single phase AC voltage controller and Compare the advantages and disadvantages of single phase AC voltage controller? [7M]
 - b) A single phase unidirectional AC voltage controller is connected with a load of $R=20\Omega$ with an input voltage of 230V, 50Hz. If the firing angle of thyristor is 90° , Determine
 - A. The RMS value of output voltage,
 - B. Power delivered to load.
- 6
 - a) Explain the working of single phase bridge type cycloconverter with RL load for continuous conduction and for discontinuous conduction with the help of neat circuit diagram and relevant output waveforms. [7M]
 - b) A single phase bridge cycloconverter is fed from 220V, 50Hz AC supply and a load of 20Ω is connected with cycloconverter. The frequency of output voltage is half of the input frequency, if the firing angle $\alpha=90^\circ$, Determine
 - A. RMS value of output voltage
 - B. RMS value of load current
 - C. RMS current of each thyristor.

UNIT – IV

- 7
 - a) Derive the expressions for the following performance factors of single phase fully controlled bridge converter [7M]
 - A. Input displacement factor
 - B. Input power factor
 - C. Voltage ripple factor
 - D. Active power input
 - E. Reactive power input.
 - b) A single phase fully controlled bridge converter is supplied at 230V, 50Hz, with source inductance of 2mH. Neglecting resistance voltage drop, when the converter is operating at a firing angle of 45° and the load current is constant at 10A. Determine the load voltage. [7M]
- 8
 - a) Explain the operation of single phase series converter with neat diagrams and compare the advantages and disadvantages of single phase series converter? [7M]
 - b) A three-phase half-wave controlled rectifier has a supply of 200V/phase. Determine the average load voltage for firing angle of 0° , 30° and 60° assuming a thyristor volt drop of 1.5V and continuous load current. [7M]

UNIT – V

- 9
 - a) Explain the working of current commutated chopper with aid of circuit diagram and necessary waveforms. Derive an expression for its output voltage. [7M]

- b) A step down chopper has a load resistance of 20 ohms and input DC voltage is 200V. When the chopper switch is ON, the voltage across semiconductor switch is 2 V. If the Chopping frequency is 1.5KHz and duty ratio is 40%, determine [7M]
- A. Average DC output voltage
 - B. RMS output voltage
 - C. Efficiency of chopper.
- 10 a) Explain the operation of DC Morgan's chopper for resistive load with neat circuit diagram and output voltage and current waveforms. [7M]
- b) A battery operated fed DC drive, the maximum possible value of accelerating current is 425A, the lower limit of current pulsation is 180A, The ON period of switch is 14ms and off period of switch is 11ms and the time constant is 63.5ms. [7M]
- Find
- A. The higher limit of current pulsation
 - B. Chopping frequency
 - C. Duty cycle.

Assume battery Voltage $V=200V$ and $R=0.1\Omega$