

Hall Ticket No:

Question Paper Code: AEE010



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER

B.Tech V Semester End Examinations (Regular), Nov – 2019

Regulation: IARE–R16

POWER ELECTRONICS

(Electrical and Electronics Engineering)

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

UNIT – I

- 1 a) Discuss the different modes of operation of thyristor with the help of its static V-I characteristics and indicate latching and holding currents. [7M]
- b) SCRs with rating of 1100V and 210A are available to be used in a string to handle 6.6kV and 1kA. Calculate the number of series and parallel units required in case de-rating factor is (i) 0.1 and (ii) 0.2. [7M]
- 2 a) Describe triggering of SCR. classify the different types of triggering circuits. Briefly discuss the R-C triggering of SCR. [7M]
- b) For an SCR the gate-cathode characteristic has a straight line slope of 130. For trigger source voltage of 15V and allowable gate power dissipation of 0.5 watts, compute the gate source resistance. [7M]

UNIT – II

- 3 a) Explain the operation of a single phase full wave mid-point converter with R-load with the help of circuit and output waveforms [7M]
- b) A single phase transformer, with secondary voltage of 230V, 50Hz, delivers power to load $R=10\Omega$ through a half-wave controlled rectifier circuit. For a firing angle delay of 60° , determine (i) the rectifier efficiency (ii) form factor (iii) voltage ripple factor (iv) transformer utilization factor and (v) PIV of thyristor. [7M]
- 4 a) Explain the working of a three phase half wave controlled rectifier with R-L load with neat circuit diagram and waveforms. [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 – III

- 5 a) Derive the expressions for the Power dissipated in the load, for a single phase AC voltage controller feeding Resistive-inductive load for continuous operation of current. [7M]
- b) An ac voltage controller uses a TRIAC for phase angle control of a resistive load of 100Ω . Calculate the value of delay angle for having an rms load voltage of 220 volts. Also calculate the rms value of TRIAC current. Assume the rms supply voltage to be 230V. [7M]
- 6 a) Explain the operation of single phase midpoint cyclo-converter with R and RL loads with neat waveforms. [7M]

- b) In a standard A single-phase bridge-type cyclo-converter has input voltage of 230V, 50Hz and load of $R=10\Omega$. Output frequency is one-third of input frequency. For a firing angle delay of 30° , Calculate (i) rms value of output voltage (ii) rms current of each converter (iii) rms current of each thyristor (iv) input power factor. [7M]

UNIT – IV

- 7 a) Describe the principle of step-up chopper. Derive an expression for the average output voltage in terms of input dc voltage & duty cycle. [7M]
- b) A step-up chopper supplies a load of 480 V from 230 V dc supply. Assuming the non conduction period of the thyristor to be 50 microsecond, find the on time of the thyristor. [7M]
- 8 a) Explain the operation of buck boost regulator with neat circuit diagram and output waveforms. [7M]
- b) A dc chopper has an input voltage of 200 V and a load of 20Ω resistances. When chopper is on, its voltage drop is 1.5 V and the chopping frequency is 10 KHz. If the duty cycle is 80%, find. [7M]
- 1) Average output voltage
 - 2) RMS output voltage
 - 3) Chopper on time

UNIT – V

- 9 a) Draw and explain the circuit diagram of single phase half and full bridge inverter with input and output waveforms [7M]
- b) A 1 phase half bridge inverter has a resistive load of 2Ω . The dc supply voltage is 24V. Calculate a) rms output voltage at fundamental frequency b) output power c) Average and peak current. [7M]
- 10 a) Explain the operation of 3 phase bridge inverter for 180 degree mode of operation with aid of relevant phase and line voltage waveforms. [7M]
- b) A single-phase bridge Inverter feeds an R-L-C series load with $R=3$, $L=6\text{mH}$ & $C=15\mu\text{F}$. The output frequency is 120Hz, supply voltage being 180V. Express the output voltage in terms of Fourier series & determine, [7M]
- i. RMS values of thyristor current load current.
 - ii. Current at the instant of commutation considering up to 7th harmonics only.



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COURSE OBJECTIVES:

The course should enable the students to:

I	Integrate the revolutionary development in power transmission, distribution and utilization with the advent of semiconductor devices.
II	Demonstrate rectifiers, choppers and various schemes of pulse width modulated inverters.
III	Explain AC voltage converters and cycloconverters.
IV	Outline complete range of power supplies, including switched mode and uninterruptible power supplies.

COURSE OUTCOMES (COs):

CO 1	Describe the characteristics of basic elements, turn on and turn off methods of SCR, protection, ratings of SCRs and series parallel operations of SCRs.
CO 2	Discuss the operation of single phase, three phase rectifiers and single phase, three phase dual converters.
CO 3	Analyze the principle of operation of AC voltage controllers and cycloconverters
CO 4	Discuss the principle of operation of chopper, classification of choppers, AC chopper and switched mode regulators
CO 5	Describe the operation of series, parallel inverters, single phase inverters, three phase inverters, voltage source inverters and current source inverters

COURSE LEARNING OUTCOMES (CLOs):

AEE010.01	Understand the characteristics of basic elements of power electronics
AEE010.02	Understand the turn on and turn off methods of Silicon controlled rectifier
AEE010.03	Describe the protection, series parallel and ratings of thyristors
AEE010.04	Understand the operation of single phase rectifiers with different loads
AEE010.05	Understand the operation of three phase rectifiers with different loads
AEE010.06	Describe the operation of single phase and three phase dual converter
AEE010.07	Understand the principle of operation of AC voltage controller and modes of operation
AEE010.08	Compute input power factor, total harmonic distortion of various input and output waveforms of AC voltage controllers
AEE010.09	Describe the principle of operation and classification of cycloconverters.
AEE010.10	Understand the principle of operation and control strategies of chopper
AEE010.11	Describe the classification of choppers
AEE010.12	Describe the importance of AC chopper and switched mode regulators
AEE010.13	Understand the concept of single phase voltage source inverters and waveforms
AEE010.14	Understand the principle of operation of three phase voltage source inverters and waveforms

AEE010.15	Understand the principle of operation of current source inverters and waveforms
AEE010.16	Apply the concept of power electronics and converters to solve real time world applications
AEE010.17	Explore the knowledge and skills of employability to succeed in national and international level competitive examinations

MAPPING OF SEMESTER END EXAMINATION - COURSE OUTCOMES

SEE Question No		Course Learning Outcomes		Course Outcomes	Blooms Taxonomy Level
1	a	AEE010.01	Understand the characteristics of basic elements of power electronics	CO 1	Understand
	b	AEE010.03	Describe the protection, series parallel and ratings of thyristors	CO 1	Understand
2	a	AEE010.02	Understand the turn on and turn off methods of Silicon controlled rectifier	CO 1	Remember
	b	AEE010.01	Understand the characteristics of basic elements of power electronics	CO 1	Understand
3	a	AEE010.04	Understand the operation of single phase rectifiers with different loads	CO 2	Understand
	b	AEE010.04	Understand the operation of single phase rectifiers with different loads	CO 2	Understand
4	a	AEE010.05	Understand the operation of three phase rectifiers with different loads	CO 2	Understand
	b	AEE010.05	Understand the operation of three phase rectifiers with different loads	CO 2	Understand
5	a	AEE010.07	Understand the principle of operation of AC voltage controller and modes of operation	CO 3	Understand
	b	AEE010.08	Compute input power factor, total harmonic distortion of various input and output waveforms of AC voltage controllers	CO 3	Understand
6	a	AEE010.09	Describe the principle of operation and classification of cycloconverters.	CO 3	Understand
	b	AEE010.09	Describe the principle of operation and classification of cycloconverters.	CO 3	Understand
7	a	AEE010.10	Understand the principle of operation and control strategies of chopper	CO 4	Remember
	b	AEE010.10	Understand the principle of operation and control strategies of chopper	CO 4	Understand
8	a	AEE010.12	Describe the importance of AC chopper and switched mode regulators	CO 4	Understand
	b	AEE010.10	Understand the principle of operation and control strategies of chopper	CO 4	Understand
9	a	AEE010.13	Understand the concept of single phase voltage source inverters and waveforms	CO 5	Understand
	b	AEE010.13	Understand the concept of single phase voltage source inverters and waveforms	CO 5	Understand
10	a	AEE010.14	Understand the principle of operation of three phase voltage source inverters and waveforms	CO 5	Understand
	b	AEE010.13	Understand the concept of single phase voltage source inverters and waveforms	CO 5	Understand

Signature of Course Coordinator

HOD, EEE