

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)**

**CLASS: BE
BRANCH: EEE**

**SEMESTER : V
SESSION : MO/18**

SUBJECT: EE5205 POWERELECTRONICS

TIME: 3 HOUR

FULL MARKS: 60

INSTRUCTIONS:

1. The question paper contains 7 questions each of 12 marks and total 84 marks.
 2. Candidates may attempt any 5 questions maximum of 60 marks.
 3. The missing data, if any, may be assumed suitably.
 4. Before attempting the question paper, be sure that you have got the correct question paper.
 5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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- Q.1(a) List few applications of power electronics in the field of electrical drives. [2]
- Q.1(b) Draw static IV characteristics of a Thyristor and show all modes of conduction state and blocking state on the curve. [4]
- Q.1(c) Express anode current (I_a) of a Thyristor in terms of gate current (I_g) using two transistor model of a Thyristor. [6]
- Q.2(a) Draw forward gate characteristics of a Thyristor. Label minimum gate voltage and current to trigger the SCR and Non-triggering gate voltage. [2]
- Q.2(b) Draw switching characteristics of Turn-On and Turn-off process. Show delay time, rise time, spread time, reverse recovery time (t_{rr}). [4]
- Q.2(c) For an SCR the gate-cathode characteristics has a straight-line slope of 130. For a trigger source voltage of 15 V and allowable gate power dissipation of 0.5-Watt, compute gate to source resistance. [6]
- Q.3(a) List few applications of controlled rectifiers. [2]
- Q.3(b) Draw power circuit of fully controlled single phase bridge rectifier with highly inductive load without freewheeling diode. Also, draw the waveform of load voltage, Thyristors current and supply current. [4]
- Q.3(c) A single phase fully controlled bridge rectifier is supplied from 120V, 50 Hz. Load current is constant. (a) Compute Harmonic factor of supply current (b) if firing angle is $\pi/3$, then compute input power factor. [6]
- Q.4(a) Draw the power circuit of half wave three phase fully controlled rectifier. [2]
- Q.4(b) Draw the power circuit of three phase fully controlled bridge rectifier for a resistive load. Draw load voltage waveform for firing angle $\alpha = 0$ radian, $\alpha = \pi/6$ radian, $\alpha = \pi/2$ radian. [4]
- Q.4(c) Derive the expression for output rms voltage for a three phase fully controlled rectifier for firing angle $\alpha < \pi/3$ radian and for $\alpha > \pi/3$ radian, in case of resistive load. [6]
- Q.5(a) Give an example of a two-quadrant chopper. Draw its power circuit, load voltage and load current waveform. [2]
- Q.5(b) Draw the power circuit of a four-quadrant chopper. Explain how each quadrant of operation is achieved using load voltage and load current waveform. [4]
- Q.5(c) In continuous conduction mode show that per unit ripple in load current is maximum when duty cycle is 0.5. [6]
- Q.6(a) Draw the power circuit of a series inverter and voltage across capacitor. [2]
- Q.6(b) Explain working principle of a single-phase inverter with R-L load with the help of power circuit, load voltage waveform and load current waveform. Also show the conduction duration of each device in that waveform. [4]
- Q.6(c) Compute (a) harmonic factor of 5th harmonic, (b) total harmonic distortion (THD) for load voltage of a single-phase inverter with R-L load. [6]
- Q.7(a) What is difference between an inverter and Cyclo-converter in context of load voltage frequency control? [2]
- Q.7(b) Explain working principle of Single-phase step-down Cyclo-converter using midpoint configuration. [4]
- Q.7(c) A single-phase bridge type Cyclo-converter has input voltage of 230Vrms 50 Hz and load of $R=10\Omega$. Output frequency is one third of input frequency. For firing angle of $\alpha = \pi/3$, compute (a) RMS output voltage (b) RMS current of each thyristor. [6]