



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal-500043, Hyderabad

B.Tech V SEMESTER END EXAMINATIONS (REGULAR/ SUPPLEMENTARY) - FEBRUARY 2024

Regulation: UG20

POWER ELECTRONICS

Time: 3 Hours (ELECTRICAL AND ELECTRONICS ENGINEERING) Max Marks: 70

Answer ALL questions in Module I and II

Answer ONE out of two questions in Modules III, IV and V

All Questions Carry Equal Marks

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

MODULE – I

- (a) Describe about metal oxide semiconductor field effect transistor (MOSFET) and its I-V switching characteristics. [BL: Understand| CO: 1|Marks: 7]
- (b) Classify the firing circuits used for line commutated converter. Illustrate the RC firing circuit with the necessary waveforms when $\alpha=90^\circ$. [BL: Apply| CO: 1|Marks: 7]

MODULE – II

- (a) Demonstrate the operation of single-phase half wave converter with RL load at $\alpha=30^\circ$ with necessary wave forms. Also derive the output voltage, output current and RMS output voltages. [BL: Understand| CO: 2|Marks: 7]
- (b) A single phase fully controlled converter supplies an inductive load. Assuming load current is constant=10A. Determine the following quantities if supply voltage is 230V, 50 Hz and $\alpha=40^\circ$. Calculate the
 - Average output voltage of converter
 - Supply RMS current
 - Supply fundamental RMS current
 - Fundamental power factor
 - Supply power factor
 - Supply harmonic factor.[BL: Apply| CO: 2|Marks: 7]

MODULE – III

- (a) Write the types of choppers based on voltage levels. Explain the step-up chopper with neat diagrams. [BL: Understand| CO: 3|Marks: 7]
- (b) A step-up chopper has input voltage of 220V and output voltage of 660v. If non-conduction time of thyristor is $100\mu\text{sec}$. Determine on time of chopper. If on-time is halved for constant frequency operation, find the new output voltage? [BL: Apply| CO: 3|Marks: 7]
- (a) Illustrate the boost converter operation with help of diagram and also draw the output waveforms. [BL: Understand| CO: 4|Marks: 7]
- (b) The boost converter has an input voltage of $E_{DC}=5\text{V}$. the required average output voltage is $E_0=15\text{V}$ and the average load current $I_0=0.5\text{A}$. The switching frequency is 25 kHz. If $L=150\text{mH}$ and $C=220\mu\text{F}$. Determine
 - Duty cycle
 - Ripple current of inductor δI
 - Peak current of inductor I_2
 - Ripple voltage of filter capacitor ΔV_C
 - Critical values of L and C.[BL: Apply| CO: 4|Marks: 7]

MODULE – IV

5. (a) Illustrate the principle of operation of single phase to single phase step- down bridge type cycloconverter with resistive inductive load for continuous load current.
[BL: Understand| CO: 5|Marks: 7]
- (b) The input voltage of the cycloconverter is 120V(RMS). The load resistance is 5Ω and the inductance is $L=40 \text{ mH}$. The frequency of the output voltage is 25Hz. If the converters are operated as semi converters that $0 \leq \alpha \leq \pi$. The delay angle is $\alpha_p = 2\pi/3$, determine
- RMS value of output voltage V_0
 - RMS value of output current I_0
 - Input power factor
- [BL: Apply| CO: 5|Marks: 7].
6. (a) Outline the operation of single phase full wave AC voltage controller with R-L load.
[BL: Understand| CO: 5|Marks: 7]
- (b) The single phase full wave AC voltage controller has a resistive load of $R=5\Omega$ and the input voltage $V_S=120\text{V(RMS)}, 50\text{HZ}$. The delay angles of thyristors T_1 and T_2 are equal i.e., $\alpha_1=\alpha_2=2\pi/3$. Determine
- RMS output voltage
 - Input power factor
 - Average current of thyristor
 - RMS current of thyristor.
- [BL: Apply| CO: 5|Marks: 7]

MODULE – V

7. (a) Illustrate why thyristors are not preferred for inverters? Summarize about the operation of single phase current source inverter.
[BL: Understand| CO: 6|Marks: 7]
- (b) Single phase half bridge inverter has a resistive load of 2Ω . The DC supply voltage is 24V. Calculate
- RMS output voltage at fundamental frequency
 - Output power
 - Average and peak current.
- [BL: Apply| CO: 6|Marks: 7]
8. (a) List the applications of a series inverter. Summarize about the operation of Mc Murray-Bedford half bridge inverters.
[BL: Understand| CO: 6|Marks: 7]
- (b) A single PWM full bridge inverter feeds an RL load with $R=10\Omega$ and $L= 10 \text{ mH}$. If the source voltage is 110V, calculate the total harmonic distortion in the output voltage and in the load current. The width of each pulse is 120° and the output frequency is 60Hz.
[BL: Apply| CO: 6|Marks: 7]

