



K. K. Wagh Institute of Engineering Education & Research, Nashik
(An Autonomous Institute From A.Y. 2022-23)

SUMMER-2024	
Exam Seat No.:	
Academic Year:2023-2024	Semester:IV
Class: SY BTech Electrical Engineering	Program: BTech Electrical Engineering
Branch Code:ELE	Pattern:2022
Name of Course:Power Electronics	Course Code:ELE222013
Max. Marks:60	Duration:2.30 Hrs.

Instructions: Candidates should read carefully the instructions printed on the Question Paper and on the cover page of the Answer Book, which is provided for their use.

1. This question paper contains 03 page(s).
2. Answer to each new question is to be started on a new page.
3. Assume suitable data wherever required, but justify it.
4. Draw the neat labelled diagrams, wherever necessary.
5. The last columns indicates the Course Outcome and level of Blooms Taxonomy of the Question/sub-question.

Question No. 1 Attempt following Question

- 1 A single phase fully controlled converter fed from AC supply is used to control DC voltage across R (6) CO2 load, draw the following waveforms with firing angle 30 degree
- (i) Output voltage—(2 Marks)
 - (ii) Output Current—(2 Marks)
 - (iii) Source current—(2 Marks)

Question No. 2 Attempt following Question

- 2 The data sheet of MOSFET NTB5860NL is given with the paper. From this data sheet fill in the (6) CO1 blank
- (i) Voltage rating of MOSFET= _____
 - (ii) Maximum value of drain-source ON state resistance ($10V V_{GS}$ and $20A I_D$)= _____
 - (iii) Terminal 1= _____ Terminal 2= _____ Terminal 3= _____
 - (iv) Typical turn ON time of MOSFET= _____
 - (v) Typical turn OFF time of MOSFET= _____
 - (vi) Maximum Gate threshold voltage = _____

Question No. 3 Attempt following Question

- 3a) Draw the circuit diagram and waveform of boost converter and derive the equation for duty cycle? (8) CO2

OR

- 3b) Draw the circuit diagram and explain the working of class E chopper? (8) CO2

- 3c) Draw the circuit diagram and waveform for single phase full bridge voltage source inverter with sinusoidal pulse width modulation. Explain the working of the same (8) CO2


OR

- 3d) Draw the circuit diagram and waveform for three phase voltage source inverter with 180 degree of conduction. Explain the working of the same. (8) CO2

Question No. 4 Attempt following Question

- 4a) What are different techniques used to control the output voltage in voltage source inverter? Derive the formula of rms output voltage in multiple pulse width modulation. (8) CO3

OR

- 4b) A step up-down chopper is having input 400V. If on time of chopper is  and switching frequency is 5kHz calculate (8) CO3

(i) Duty cycle **(1 Marks)**

(ii) Output voltage**(1 Marks)**

(iii) Output voltage, if the pulse width is reduced to half keeping switching frequency constant. **(3 Marks)**

(iv) Pulse width required, if the required output voltage is 500V with same switching frequency. **(3 Marks)**

- 4c) A single phase AC voltage controller is used with to control output voltage with RLload. Derive (8) CO3

(i) minimum firing angle—**(1 Mark)**

(ii) rms output voltage—**(2 Marks)**

(iii) current—**(2 Marks)**

(iv) power—**(2 Marks)**

(v) conduction angle of each thyristor—**(1 Marks)**

OR

- 4d) Derive the rms output voltage and fundamental component of rms output voltage in three phase voltage source inverter with (8) CO3

(i) 120 degree mode of operation**(4 Marks)**

(ii) 180 degree mode of operation**(4 Marks)**

Question No. 5 Attempt following Question

- 5a) A single phase AC voltage controller is used in RL load. If input voltage is 230V, 50Hz and load is $(50+j50)$ ohm, calculate (8) CO3
- (i) Minimum firing angle where output voltage is not controllable.—(3Marks)
 - (ii) rms output voltage and current, if firing angle is 90 degree. (3 marks)
 - (iii) conduction time of each thyristor, if firing angle is 90 degree.(2 marks)

OR

- 5b) A single phase full bridge inverter is used to utilize solar energy. The output of solar PV cell is 108 V. The load is resistance of 10 Ohm. Calculate: (8) CO3
- (i) rms output voltage(1 Marks)
 - (ii) fundamental rms output voltage(1 Marks)
 - (iii) fundamental output current(2 Marks)
 - (iv) Fifth harmonic voltage and current—(2 Marks)
 - (v) Total harmonic distortion (THD)(2 Marks)

- 5c) Design a buck converter to transfer battery to motor of electric vehicle with following specifications (8) CO4 and also draw circuit diagram.

Battery output voltage=72V.

Motor specification= 1000W at 60V

Allowable ripple in output voltage 2% of average output voltage

Allowable in ripple in inductor current is 15%.

Switching frequency=50kHz

OR

- 5d) Design a buck boost converter with following specifications and also draw circuit diagram (8) CO4

Input voltage=50V

Output voltage=150V

Output power=1500W

Allowable ripple in output voltage 2% of average output voltage

Allowable in ripple in inductor current is 10% of load current.

Switching frequency=50kHz

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