

Hall Ticket Number:

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Code No. : 21713

VASAVI COLLEGE OF ENGINEERING (*Autonomous*), HYDERABAD

M.E. (EEE: CBCS) I-Semester Main Examinations, January-2019

(Power Systems & Power Electronics)

Power Electronic Converters

Time: 3 hours

Max. Marks: 60

Note: Answer ALL questions in Part-A and any FIVE from Part-B

| Q.No. | Stem of the question | M | L | CO | PO |
|-----------------------------------|--|---|---|----|-----------|
| Part-A (10 × 2 = 20 Marks) | | | | | |
| 1. | Find the current 'i' at t=1sec of the given circuit with $V_s=10V$, $R=20\Omega$ & $L=5H$, when switch 'S' is closed at t=0 & assume initial current through inductor is zero. | 2 | 4 | 1 | 1,2,3,4,9 |
| | | | | | |
| 2. | For the above circuit shown in Fig. (a). Draw the voltage waveform across inductor ' v_L ' | 2 | 1 | 1 | 1,2,3,4,9 |
| 3. | In 3-phase full converter with RLE load, draw the output voltage Waveform ' V_o ' for 60° firing angle in continuous conduction mode. | 2 | 2 | 2 | 1,2,3,4,9 |
| 4. | Find the Peak inverse voltage of the diode in 1-phase full wave diode bridge rectifier with R-load if source voltage $V_s=325\sin\omega t$. | 2 | 2 | 2 | 1,2,3,4,9 |
| 5. | In a buck converter to maintain regulated voltage of 10V for the input voltage variations 20-50V. Find the D_{min} and D_{max} in continuous conduction mode. | 2 | 4 | 3 | 1,2,3,4,9 |
| 6. | Draw circuit diagram of Cuk dc-dc converter. | 2 | 1 | 3 | 1,2,3,4,9 |
| 7. | Write the Fourier series expression of output voltage waveform for a single-phase half- bridge inverter. | 2 | 4 | 4 | 1,2,3,4,9 |
| 8. | List the applications of inverters. | 2 | 1 | 4 | 1,2,3,4,9 |
| 9. | Sketch the output current waveform of single-phase voltage controller with R-L load for $\alpha > \phi$. | 2 | 1 | 5 | 1,2,3,4,9 |
| 10. | Sketch the output voltage waveform of single-phase step-up cycloconverter with R-load. | 2 | 1 | 5 | 1,2,3,4,9 |
| Part-B (5 × 8 = 40 Marks) | | | | | |
| 11. a) | Derive Average and R.M.S output voltage of 1-phase Half wave Diode Rectifier with R-load. | 4 | 2 | 1 | 1,2,3,4,9 |
| b) | If $V_s=230V$ at 50Hz, $R=10\Omega$, $L=5mH$, Extinction angle $\beta=210^\circ$. Find Average value of Output Voltage and Output Current for single-phase half-wave uncontrolled rectifier connected to R-L load. | 4 | 2 | 1 | 1,2,3,4,9 |
| 12. a) | Draw circuit diagram of three-phase semi-converter with RLE load and also output voltage waveforms for firing angle $\alpha=15^\circ$ & $\alpha=90^\circ$ (assume continuous conduction mode) | 4 | 4 | 2 | 1,2,3,4,9 |
| b) | Derive Average output voltage of 1-phase full-wave mid-point converter with RL load and also draw output voltage and output current waveforms for continuous conduction mode. Estimate average output voltage for 1-phase input voltage of 230V, 50Hz with $\alpha=30^\circ$ | 4 | 4 | 2 | 1,2,3,4,9 |

Contd... 2

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|--------|---|---|---|---|-----------|
| 13. a) | Explain the operation of buck converter with neat diagram. Derive the expression for output voltage in continuous conduction mode. | 4 | 2 | 3 | 1,2,3,4,9 |
| b) | In a boost converter, consider all components to be ideal. Let V_d be 8-16 V, $V_o=24V$ (regulated), $f_s=kHz$ and $C=470\mu F$. Calculate D_{max} , D_{min} & L_{min} that will keep the converter operating in a continuous conduction mode if $P_o \geq 10W$. | 4 | 3 | 3 | 1,2,3,4,9 |
| 14. a) | Describe the working of a single-phase full bridge inverter (VSI) with neat diagram and sketch the output voltage waveform for R-load. | 3 | 3 | 4 | 1,2,3,4,9 |
| b) | Discuss the principle of working of a three-phase bridge inverter (VSI) with an appropriate circuit diagram. Draw any one phase and one line voltage waveform for 180° mode of operation of SCRs with star-connected resistive load. The sequence of firing of various SCRs should also be indicated in the diagram. | 5 | 5 | 4 | 1,2,3,4,9 |
| 15. a) | Discuss the principle of phase control in single phase full-wave ac voltage controller with R-load. Derive expression for the R.M.S value of its output voltage. | 4 | 2 | 5 | 1,2,3,4,9 |
| b) | Describe the basic principle of working of single -phase to single -phase step-up cycloconverter with the help of mid-point configuration. Illustrate your answer with appropriate circuit and waveforms. The conduction of various thyristors must also be indicated on the waveform. | 4 | 3 | 5 | 1,2,3,4,9 |
| 16. a) | Derive $i(t)$ & $v_L(t)$ for the given circuit diagram and also draw their waveforms, when switch S is closed at $t=0$ and all initial values of $i(t)$, $v_L(t)$ & $v_C(t)$ are assume to zero. | 4 | 2 | 1 | 1,2,3,4,9 |
| | | | | | |
| b) | Deduce average output voltage of 3-phase full converter with RLE load and also draw output voltage waveform for firing angle $\alpha=15^\circ$ & $\alpha=90^\circ$ (assume continuous conduction mode). | 4 | 2 | 2 | 1,2,3,4,9 |
| 17. | Answer any <i>two</i> of the following: | | | | |
| a) | Explain the operation of Buck-Boost converter in continuous mode with neat diagram. Derive expression of output voltage in continuous conduction mode. | 4 | 2 | 3 | 1,2,3,4,9 |
| b) | Derive Fourier series expression for the output voltage obtained from single-phase full bridge inverter. | 4 | 5 | 4 | 1,2,3,4,9 |
| c) | For a single -phase voltage controller feeding a R-L load, draw the waveforms of source voltage, gating signals, output voltage and output currents. Describe its working with reference to the waveforms drawn. | 4 | 2 | 5 | 1,2,3,4,9 |

M: Marks; L: Bloom's Taxonomy Level; CO: Course Outcome; PO: Programme Outcome

| S. No. | Criteria for questions | Percentage |
|--------|--|------------|
| 1 | Fundamental knowledge (Level-1 & 2) | 57.5% |
| 2 | Knowledge on application and analysis (Level-3 & 4) | 31.25% |
| 3 | *Critical thinking and ability to design (Level-5 & 6) (*wherever applicable) | 11.25% |