

KATHMANDU UNIVERSITY
End Semester Examination
May/June, 2022

Marks Scored:

Level : B.E.

Year : III

Exam Roll No. :

Time: 30 mins.

Course : EPEG 318

Semester : II

F. M. : 10

Registration No.:

Date :

SECTION "A"
[20 Q. × 0.5 = 10 marks]

Encircle the most appropriate answer.

- Which of the following is wide band gap semiconductor material?
a. Si b. SiC c. Ge d. PbS
- Which of the following is semi-controlled semiconductor device?
a. Power diode b. Thyristor c. MOSFET d. IGBT
- Which of the following semiconductor device can be used for high switching frequency applications?
a. IGBT b. GTO c. MOSFET d. GTO
- Time constant of series RL circuit connected with diode is
a. L/R b. R/L c. $1/LR$ d. RL
- In thyristors
a. Latching current (I_L) is associated with turn-off process and holding current (I_H) with turn on process.
b. Both I_L and I_H are associated with turn off process.
c. I_H is associated with turn off process and I_L with turn on process.
d. Both I_L and I_H are associated with turn on process.
- Which of the following is **NOT** the turn on mechanism of the thyristor?
a. Thermal b. Light
c. Positive gate current d. Negative gate current
- The semiconductor devices DIAC and TRIAC conducts in
a. forward direction and reverse direction respectively
b. forward direction only
c. reverse direction only
d. both forward and reverse directions
- DC static switch are
a. naturally commutated b. forced commutated
c. both naturally and forced commutated d. not at all commutable

9. The firing angle (α) of a static switch with antiparallel combination of two thyristors connected to a resistive load is
 a. 0° b. 45° c. 60° d. 90°
10. The bidirectional operation of converters requires
 a. A parallel combination of controllable switch and diode.
 b. A parallel combination of controllable switch and a capacitor.
 c. A series combination of controllable switch and a capacitor.
 d. A series combination of controllable switch and an inductor.
11. The Form Factor of a rectifier is the ratio of
 a. Root mean square value of voltage (or current) to its peak value
 b. Root mean square value of voltage (or current) to its average value
 c. Average value of voltage (or current) to its root mean square value
 d. Peak value of voltage (or current) to its root mean square value
12. A single-phase full-wave rectifier is constructed using thyristor. If the peak value of the sinusoidal input voltage is V_m and the delay angle is $\frac{\pi}{3}$ radian, then the average value of the output voltage is
 a. $0.32V_m$ b. $0.48V_m$ c. $0.54V_m$ d. $0.71V_m$
13. The modulation ratio of the inverter operating in linear region is
 a. Less than 1 b. Equal to 1 c. Greater than 1 d. Between 1 and 3.24
14. For a Pulse Width Modulated (PWM) inverter
 a. The amplitude of the voltage is only controllable
 b. The angle of the voltage is only controllable
 c. Both amplitude and phase of the voltage are controllable
 d. The amplitude, phase and frequency of voltages are all controllable
15. Computers and allied equipment frequently require AC sources that have no more than total harmonic distortion (THD), with the largest single harmonic being no more than..... of the fundamental voltage respectively.
 a. 5%, 3% b. 3%, 5% c. 5%, 1% d. 3%, 1%
16. A step-up dc-dc converter is operated in the continuous conduction mode (CCM) in steady state with a constant duty ratio of 0.25. For an input voltage of 12 V, the corresponding output voltage is
 a. 15V b. 6V c. 16V d. 48V
17. A DC-to-DC converter operating in the second quadrant has characteristic.
 a. Load voltage negative and load current positive
 b. Both load voltage and load current positive
 c. Both load voltage and load current negative
 d. Load voltage positive and load current negative

18. The operative voltage range for most of High Voltage Direct Current (HVDC) link lies in between
- a. 100 kV to 800 kV
 - b. 10 kV to 80 kV
 - c. 100 kV to 500 kV
 - d. 500kV to 800 kV
19. The HVDC converter station requires % of its power rating as reactive power when line commutated converts are used.
- a. 40 to 60
 - b. 30 to 50
 - c. 50 to 60
 - d. 20 to 40
20. Which of the following is not the characteristics of ideal Uninterruptible Power Supply (UPS)?
- a. Low Total Harmonic Distortion
 - b. High reliability
 - c. High Electro Magnetic Interference
 - d. Zero transition time from normal to back up mode and vice versa



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F.M. : 40

SECTION "B"
[5 Q × 8 = 40 marks]

Attempt ANY FIVE questions. Assume any suitable data if necessary.

1.

- a. The switch (S) is closed at time ($t = 0$) for the circuit shown in Figure 1. Derive the expression for inductor current $i_L(t)$ and capacitor voltage $v_C(t)$ for $t > 0$, and plot the waveform of corresponding expressions. Assume the initial inductor current and initial capacitor voltage are zero, i.e., $i_L(t = 0) = 0$ and $v_C(t = 0) = 0$. [4]

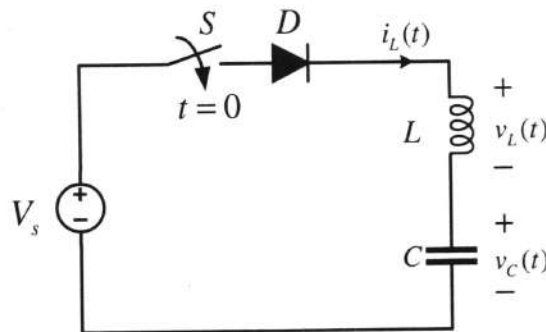


Figure 1

- b. Explain the different methods of thyristor protection with circuit diagrams. [4]

2.

- a. A single phase static ac switch with configuration as shown in Figure 2 is used between a 230 V, 50 Hz supply and a load of 10 kW at power factor of 0.707 lagging. Determine,
i) Voltage and current ratings of thyristor ii) Firing angle of thyristors. [4]

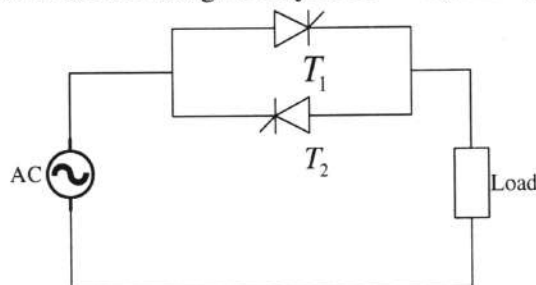


Figure 2

- b. Explain the working of single-phase full wave ac voltage controller as electronic load controller (ELC) used in microhydro power plants with proper schematic diagram and waveforms. Also, derive the expression for average output voltage of the considered converter. [4]

3.

- a. The input current waveform of a controlled two pulse converter connected to a 230V, 50 Hz supply is given in Figure 3. Express the given input current waveform in a Fourier series. Determine the harmonic factor (HF) of the input current, displacement factor (DF) and input power factor (P.F). [4]

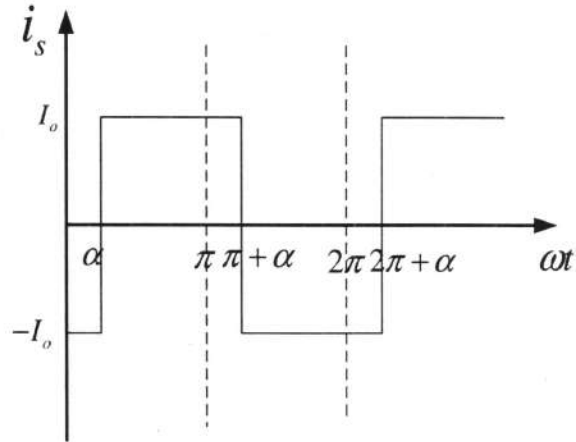


Figure 3

- b. Explain the operation of single-phase step down cycloconverter. [4]

4.

- a. The single-phase H-bridge inverter shown in Figure 4 has a resistive load of $R = 2.4\Omega$ and the dc input voltage $V_s = 48V$. Determine [4]
- The rms output voltage at fundamental frequency, V_{o1}
 - The output power, P_o
 - The peak reverse blocking voltage V_{br} of each transistor
 - THD of output voltage.

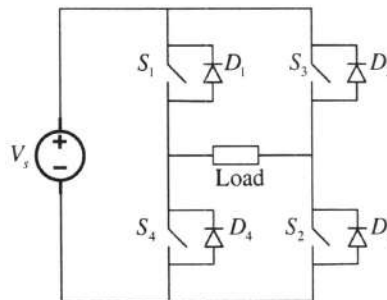


Figure 4

- b. Explain about grid following and grid forming inverters. What are current source inverter (CSI) and voltage source inverters (VSI)? [4]

5.

- a. Describe the operation of a controllable full wave AC-to-DC converter connected to a resistive load with the aid of waveforms. Derive the expression for rms output voltage. [5]
- b. The output voltage of the battery inside a laptop is 19 Volts. The USB port has a specifications of 15 Watt that operates at 5 Volts. A buck converter is required to step down the voltage from 19 V to 5 V. Design parameters of the buck converter are given as follows: $\frac{\Delta V_o}{V_o} < 0.1\%$, $f_1 = 100kHz$, $I_{min} > 0$. Find the following parameters [5]
- Duty cycle (d)
 - Filter inductance (L)
 - Filter capacitance (C)
 - Peak voltage rating of each switching device
 - Sketch the schematic of designed buck converter

6.

- a. Describe the different HVDC configurations with proper schematic diagram. [4]
- b. Explain the working principle of an online and offline Uninterruptible Power Supply (UPS) with a suitable diagram. [4]

