KATHMANDU UNIVERSITY
End-Semester Examination
August, 2018

Marks Scored:

Level : B.E.
Year : III

Course : EPEG 318
Semester: II

Exam Roll No. :

Time: 30 mins.

F.M. : 10

Registration No.:

Date AUG 20 2018

SECTION "A"
[20 Q × 0.5=10 marks]

Choose the most appropriate answer.

1. The major advantage of a bridge rectifier is that
   a. Centre tap transformer is not required.
   b. Peak inverse voltage of each diode is double of that for a full wave rectifier.
   c. Peak inverse voltage of each diode is half of that for a full wave rectifier.
   d. The output voltage is smoother.

2. In a three phase half wave rectifier, the output voltage is equal to
   a. The most positive input phase voltage at any instant.
   b. The difference of most positive and most negative input phases at any instant.
   c. The average value of three phases.
   d. The difference of the two positive phase voltages.

3. As the number of phases in a multiphase rectifier are increased, the output
   a. Remains the same.
   b. Becomes smoother.
   c. Decreases.
   d. Diodes will require high PIV.

4. A single phase bridge rectifier has a purely resistive load, R=10Ω, the peak supply voltage V_m=170 V, and the supply frequency, f=60 Hz. The average output of the rectifier if the source inductance is negligible will be
   a. 113.3 V. b. 54.11 V. c. 27.056V. d. 340V.

5. In a thyristor, holding current is.....
   a. more than latching current (I_L). b. less than I_L.
   c. equal to I_L. d. very small.

6. When a thyristor gets turned on, the gate drive
   a. Should not be removed as it will turn off the SCR.
   b. May or may not be removed.
   c. Must be amplified.
   d. Should be removed in order to avoid increases losses and higher junction temperature.

7. Gate characteristic of a thyristor
   a. is a straight line passing through the origin.
   b. is of the type $V_g = a + b*I_g$.
   c. is a curve between V_g and I_g.
   d. has a spread between two curves V_g to I_g.

8. In a UJT, maximum value of charging resistance is associated with
   a. Peak point.
   b. Valley point.
   c. After the valley point.
   d. Between peak and valley points.

9. Each diode of a 3 phase half-wave diode rectifier conducts for .....
   a. 60^{o}.
   b. 180^{o}.
   c. 120^{o}.
   d. 90^{o}.

10. For a three phase half wave converter, the average output voltage is given as
   a. $\frac{3V_{ml}}{2\pi}(1+\cos\alpha)$.
   b. $\frac{3V_{ml}}{\pi}(1+\cos\alpha)$.
   c. $\frac{V_{ml}}{3\pi}(\cos\alpha)$.
   d. $\frac{3V_{ml}}{2\pi}(\cos\alpha)$.

11. The forward resonating current flowing through the device is reduced to less than the level of holding current of the device particularly in
   a. Class A commutation.
   b. Class B commutation.
   c. Class C commutation.
   d. Class d commutation.

12. If the chopper frequency is 200 Hz and T_{on} is 2 ms, the duty cycle is
   a. 0.4
   b. 0.8
   c. 0.6
   d. 0.2

13. In a half wave circuit with RL load, and a freewheeling diode across the load, extinction angle β is more than π. For a firing angle α, the thyristor and freewheeling diode would conduct respectively for
   a. $(\pi-\alpha)$, β.
   b. $(\beta-\alpha)$, $(\pi-\alpha)$.
   c. $(\pi-\alpha)$, $(\beta-\pi)$.
   d. $(\pi-\alpha)$, $(\pi-\beta)$.

14. In a single pulse modulation used in PWM bridge inverter, V is the input dc voltage. For eliminating third harmonic, the magnitude of rms value of fundamental component of output voltage and pulse width are respectively
   a. $\frac{2\sqrt{2}}{\pi}V, 120^{0}$.
   b. $\frac{2\sqrt{2}}{\pi}V, 60^{0}$.
   c. $\frac{4}{\pi}V, 120^{0}$.
   d. $\frac{4}{\pi}V, 60^{0}$.

15. A Single phase voltage controller feeds power to a resistance of 10 Ohm. The source voltage is 200V. For a firing angle of 90^{0}, the rms value of thyristor current is
   a. 3A.
   b. 4A.
   c. 10A.
   d. 15A.

16. The maximum value of phase voltage for a three phase 120^{0} voltage source inverter is
   a. $V_s/3$.
   b. $2V_s/3$.
   c. V_s.
   d. $V_s/2$.

17. In dc choppers, if T_{ON} is the on period and f is the chopping frequency, then output voltage in terms of input voltage V is
   a. $V*T_{ON}/f$.
   b. $V*f/T_{ON}$.
   c. V/f *T.
   d. $V*f*T_{ON}$.

18. The fundamental component of output voltage and amplitude of other lower order harmonics in a single pulse modulated (SPM) inverter and multiple pulse modulated (MPM) inverters respectively
   a. Lowers in MPM on comparison over SPM.
   b. Lowers in SPM on comparison over MPM.
   c. Increases in both SPM and MPM.
   d. No effect in both SPM and MPM.

19. In a sinusoidal pulse modulated (SPWM) inverter there are N pulses per half cycle if
    a. Triangular carrier wave peak coincides with zero of reference sinusoid waveform.
    b. Triangular carrier wave zero coincides with zero of reference sinusoid waveform.
    c. Triangular carrier wave peak coincides with peak of reference sinusoid waveform.
    d. Sinusoid reference wave peak coincides with zero of carrier triangular waveform.

20. The cycloconverter requires natural or forced commutation as under
    a. Natural commutation in both step up and step down cycloconverters.
    b. Forced commutation in both step up and step down cycloconverters.
    c. Forced commutation in step up cycloconverters.
    d. Forced commutation in step down cycloconverters.

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SECTION "B"
[5 Q.×8=40 marks]

*Attempt **ANY FIVE** questions. Assume any suitable data if required.*

1.

a. Describe a three phase to single phase cycloconverter feeding RL load and with output frequency, f_o equal to one fourth of input frequency, f_s. Illustrate your answer by showing one cycle of low frequency of output voltage with clear indication of triggering of various thyristors. [5]

b. A single phase half wave controlled rectifier operated from 120V, 60 Hz supply has a purely resistive load, R_L of 10 Ohm and delay angle, $\alpha = \pi/3$. Determine,
   i. Rectification efficiency.
   ii. Transformer utilization factor.
   iii. Peak inverse voltage (PIV) of thyristor. [1+1+1=3]

2.

a. Describe a three phase voltage source bridge type inverter using six thyristors and six diodes with 180^0 conduction mode. Obtain the waveform for a phase voltage, V_{an} for a period of $0 \leq \omega t \ll 2\pi$. [5]

b. A step up chopper has input voltage of 220 V and output voltage of 660V. If the non-conducting time of thyristor is 100μsec. compute the pulse width of output voltage. [3]

3.

a. Explain the working principle of a three phase half wave controlled converter with resistive load for a firing angle of, $\alpha = 0^0$ and verify that average output voltage, $Vo = \frac{3Vml}{2\pi} * cos\alpha$, where, V_{ml} = maximum value of line voltage. [5]

b. Prove that for a buck-boost converter, output voltage $V_o = V_{in} *[D/(1-D)]$; where V_{in} is the input voltage to the converter and $D = T_{ON} / T$ is the duty cycle of the converter. [3]

4.

a. Explain the working principle of a three phase twelve pulse rectifier with necessary waveforms. [4]

b. The reverse recovery time of a diode is $t_{rr} = 5\mu s$, and the rate of fall of the diode current is $di/dt = 80A/\mu s$. If the softness factor is SF = 0.5, determine a) the storage charge Q_{rr} and b) the peak reverse current I_{RR}. [2+2=4]

5.

a. A three phase thyristor ac switch with configuration as shown in Figure 1 is used between a three phase 440V, 60Hz supply and a three phase Y-connected load. The load power is 20kW at a power factor of 0.95 lagging. Determine

i. Peak load current of thyristors.
ii. Average current of thyristor.
iii. R.m.s current of thyristor.
iv. Peak inverse voltage of thyristor.
v. Firing angles of each thyristors. [1+1+1+1+1=5]

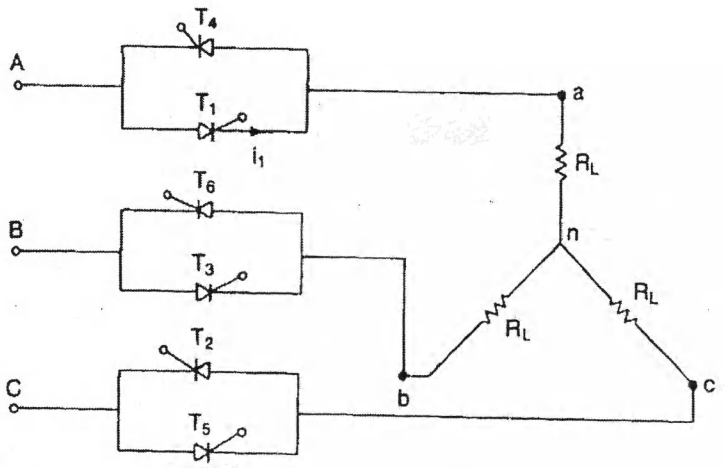

Figure 1. Three phase static ac switch

b. Plot the output voltage and load current waveform for a single phase full converter with discontinuous current mode of operation assuming firing angle, $\alpha=30^0$, extinction angle, $\beta=190^0$. [3]

6.

a. Explain the working principle of short break uninterruptible power supply (UPS) and no break UPS with suitable diagram. [2+2=4]

b. A single phase bridge inverter, fed from 230 V dc is connected to load R=10 Ω and L=0.03 H, Determine the power delivered to load considering upto 9^{th} harmonics for a square wave output with inverter operating at frequency of 50 Hz. [4]