

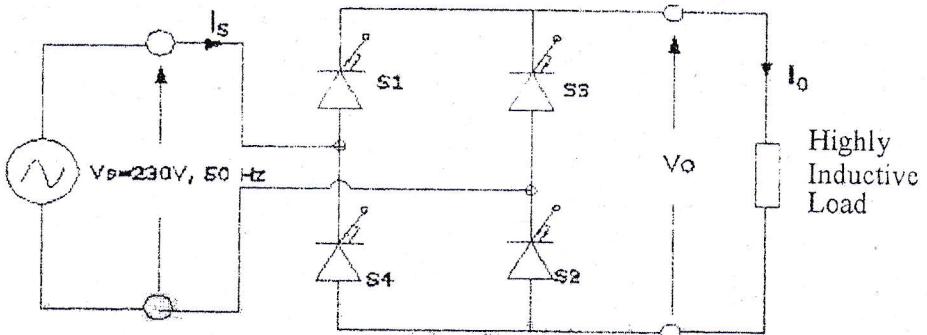
Exam.		Back
Level	BE	Full Marks 80
Programme	BEL	Pass Marks 32
Year / Part	IV / I	Time 3 hrs.

Subject: - Power Electronics (EE 701)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.



1. a) Define Commutation Techniques. Differentiate between Natural and Forced Commutation with suitable circuit examples. [8]
- b) Explain Switching Characteristics of BJT. Explain a gate signal Generating signal for BJT.
2. a) Figure below shows a single-phase controlled rectifier with 4 nos of GTO switches. The average value of the output voltage is controlled by extinction angle control method. The load current is constant and equal to 20Amp due to highly inductive load. For an extinction angle of 30°. [8]
 - i) Draw the waveform of load voltage, load current and input ac current.
 - ii) Average and RMS value of output voltage.
 - iii) Calculate the magnitude and phase of fundamental component of the input ac current.



- b) With the help of suitable circuit diagram and waveforms, explain the operation of three phase full wave bridge rectifier using diodes. Derive the expression for average value and rms value of the output voltage. [8]
3. a) Explain the operation of a single phase inverter with ac motor as load. Derive the equation for current drawn by the motor of positive half cycle.
- b) Explain the operation of a three phase sinusoidal PWM inverter with neat circuit diagram and waveforms. [8]
4. a) A single-phase inverter with resistive load $R_0 = 5$ ohms and $L_0 = 20\text{mH}$ and the input voltage is 200V dc with a centre point of dc source grounded. The inverter is operated to give an output ac voltage of 50 Hz. Find the time domain equation of the load current using Fourier series up to 3rd order. Also, find the Harmonic factor and THD of output voltage.
- b) Explain the operation single phase AC voltage controller. Derive the expression for RMS value of the output voltage. How it can be used on Elc of MHP scheme? [8]
5. a) Explain the working of three phase to single phase cyclo-converter with suitable circuit diagram and waveforms.
- b) Make a mathematical comparison between HVAC and HVDC lines to justify line conductor saving in HVDC line. [8]

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Examination Control Division
2079 Baishakh

Exam.		Back
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Subject: - Power Electronics (EE 701)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
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1. a) Explain the reverse recovery characteristics of Diode with necessary waveforms. The reverse recovery time of a diode is $3 \mu\text{s}$ and the rate of fall of the diode current is $30 \text{ A}/\mu\text{s}$. Determine storage charge and peak reverse current. [8]
- b) Draw the V-I characteristics curve of thyristor. What is an avalanche breakdown and forward breakdown voltage of thyristor? Mention with its symbolic diagram. [4]
- c) Explain the V-I characteristics of power transistor. How it can use as a static switch? [4]
2. a) Single phase full wave rectifier charges a battery from a single phase supply of 230 V, 50 Hz. The battery has interval emf of 200 volts and its internal resistance is 0.5 ohms. Calculate: [8]
 - (i) Average value of charging current
 - (ii) Power supplied to the battery
 - (iii) Gross power output from the rectifier
 - (iv) Additional resistance to be connected in series to reduce the charging current by 30%.
- b) Explain the operation of three phase single way controlled rectifier with purely resistive load. Derive the expression of average and RMS value of output voltage. Draw the waveforms of output voltage for $\alpha = 30^\circ$ and 60° and calculate average value of output voltage. [8]
3. a) A step down chopper has an input of 200V it is feeding on RLE load having $R = 2\Omega$, $L = 10 \text{ mH}$, $E = 20 \text{ V}$, the chopping cycle has a time period of $1000 \mu\text{s}$ and transistor is on for $300 \mu\text{s}$ in each cycle. [8]
 - (i) Find weather the load current is continuous or not.
 - (ii) Find the average load current.
- b) How does modulation index change the rms value of output voltage of inverter? Derive the Fourier series of single pulse width modulation and determine the fundamental value. [8]
4. a) Obtain the switch states for three phase VSI of 180 degree conduction mode. Draw the waveform of output phase voltages of same inverter showing suitable modes of operation. [8]
- b) A single phase full wave inverter has a resistive load of 5 ohm. The dc input voltage is 30. Find (i) rms value of output voltage (ii) rms value of fundamental component of output voltage (iii) output power (iv) peak current in each thyristors. [8]
5. a) Explain the operation of three phase Cyclo-converters with necessary circuit and waveforms. [8]
- b) Justify that the total power loss of HVDC transmission line is only $2/3$ th of total power loss in HVAC transmission line. Make necessary assumption if necessary. [8]

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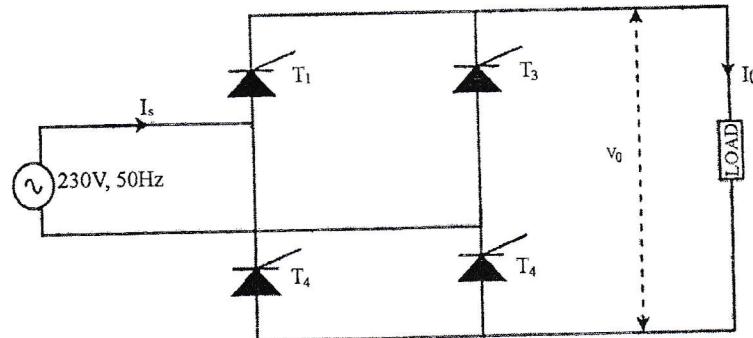
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Power Electronics (EE 701)

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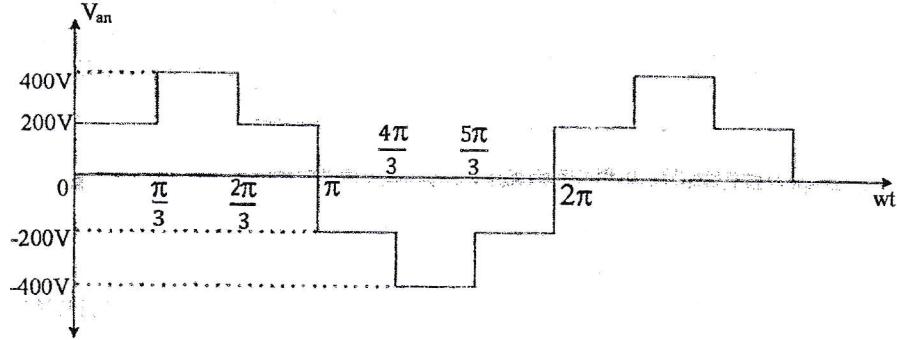


1. a) Explain how a transistor can be used as a static switch. Describe how gate signal for the base of a transistor can be generated to turn ON and OFF a transistor. [8]
- b) Explain the di/dt protection scheme and dv/dt protection scheme for a thyristor. [8]
2. a) Figure shows single phase full converter circuit with highly inductive load so that load current is constant and equal to 25 A. Explain its operation for firing angle of 30°. Draw the input and output waveforms of voltages and currents. Calculate the fundamental component of input AC current. [8]



- b) Explain the operation of 3-phase single way uncontrolled rectifier and describe expression for average output voltage. [8]
3. a) A step-down chopper is connected to RLE load with $R=10$ ohms, $L=15.5$ mH and $E = 20$ V with an input voltage of 220 V, the duty cycle, $k = 0.5$ and chopping frequency $f = 5\text{kHz}$. Determine,
 - i) Minimum instantaneous load current
 - ii) Peak instantaneous load current
 - iii) Maximum peak to peak current in the load
 - iv) Average load current
- b) With the help of suitable circuit diagram explain the 180° conduction mode of three phase inverter. And also draw the output waveforms of instantaneous phase and line voltage for star-connected load. [8]

4. a) Calculate the rms value of fundamental and 3rd harmonics component of output voltage for 180° conduction mode of three phase inverter shown in figure below. [8]



- b) With the help of suitable circuit diagram and waveform, explain the operation of single AC voltage controller with R-load and calculate the rms value of output voltage. [8]
5. a) Explain the operation of single phase step down cycloconverter with necessary circuit diagram and waveform. [8]
- b) Explain the series connection of two single phase full converter with necessary circuit and waveforms. [8]

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Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Power Electronics (EE 701)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.



1. a) Explain the switching characteristics of a power transistor. How turn on control and turn off control operation operated on base drive circuit of transistor?
 b) Explain the di/dt and dv/dt protection of the thyristor with necessary diagram and waveforms.
2. a) Draw the circuit diagram of single phase full wave rectifier with associated waveforms. A single phase full wave thyristor rectifier has an input voltage of 220V rms. The load is a resistance of 50 ohms and firing angle is 45 degree in each positive half cycle. Find average output voltage, rms output voltage.
 b) Draw and explain the output waveforms of three phase full bridge rectifier with R load. Find the average value of output voltage.
3. a) Write down the principle of step up chopper with neat diagram and waveforms. Derive the output value of load voltage and determine the condition for controllable power transfer range.
 b) For three phase 180 degree conduction river, draw the output waveforms for V_{RY} , V_{YB} , V_{BR} , V_{NO} , and V_{RN} , where the notation has their usual meaning.
4. a) Single phase full bridge inverter has an RLC load with $R = 10\Omega$, $L = 31.5\text{mH}$ and $C = 112\mu\text{F}$. The inverter frequency is 50Hz and dc input voltage is 220V.
 - (i) express the instantaneous load current in fourier series
 - (ii) RMS value of fundamental component of load current
 - (iii) THD of load current
 b) Explain the operation of single phase AC voltage controller with necessary circuit diagram and waveforms. Derive the expression for rms value of output voltage.
5. a) With suitable input frequency value explain the single phase step down cycloconverter and draw the output waveform for $\frac{1}{4}$ th of frequency.
 b) Compare AC transmission over HVDC transmission. Justify that total power loss in HVDC is only $\frac{2}{3}$ th of total power loss in HVAC transmission lines.

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Exam.	Regular		
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Programme	BEL	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Power Electronics (EE 701)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
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1. a) Explain how a transistor can be used as a static switch. Describe a base current signal generating circuit using an opto-coupler. [8]

b) Figure 1.b shows a full wave rectifier circuit used to charge a 12V battery through a 2 ohm resistor. [8]

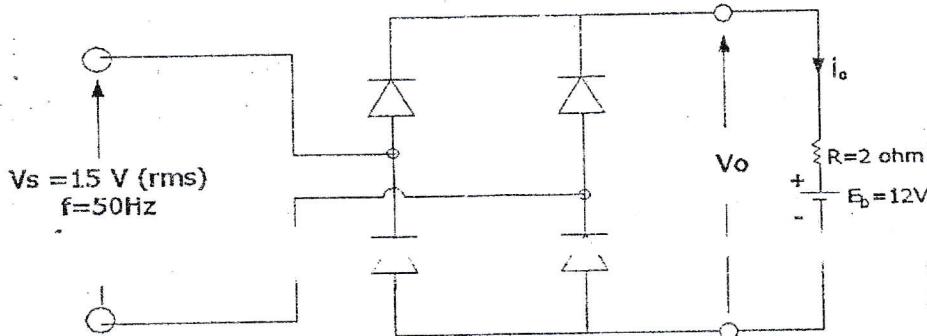


Fig.1.b

- (i) Draw the waveform of output voltage V_o and charging current i_o .
- (ii) Calculate the average and rms value of charging current.
- (iii) Power supplied to the battery.
- (iv) Power output from the rectifier.
- (v) Efficiency of the charging system.

2. a) Explain the operation of single phase half wave rectification using thyristor with resistive load. Draw the waveform of output voltage and the voltage appearing across the thyristor. Derive the expression for RMS value of output voltage. [8]

b) Explain the operation of a three phase single way controlled rectifier circuit with highly inductive load. Derive the expression for average value of the output voltage. Draw the wave form of output voltage for firing angle of 60° . [8]

3. a) Explain the principle of step up dc chopper and deduce the expression for average output voltage. [8]

b) A step down dc chopper has a 20 ohm resistor load and input voltage 220V. When the converter switch is ON, its voltage drop in chopper switch is 1V and the chopper frequency is 2KHz. If the duty cycle is 0.8, calculate: [8]

- (i) Average value of the output voltage
- (ii) Efficiency of chopper circuit

4. a) Explain the operation of single phase ac voltage controller with resistive load. If the input voltage is 220V, 50Hz, calculate the rms value of output voltage for firing angle of 90° . [8]
- b) In which circumstance, HVDC transmission line has advantages over the HVAC transmission line? Prove that a HVDC line with two conductors transmit same amount of power as transmitted by HVAC line with three conductors of same size. What type of power electronic converter is used in HVDC line and why? [8]
5. a) Explain the operation of a three phase Sinusoid PWM inverter with neat circuit diagram and associated waveforms. How switching instants for inverter switch pair of a phase are determined. [8]
- b) Figure 5 shows the waveform of output voltage (per phase) of three phase inverter. Calculate RMS value and peak value of fundamental component of the output voltage. [8]

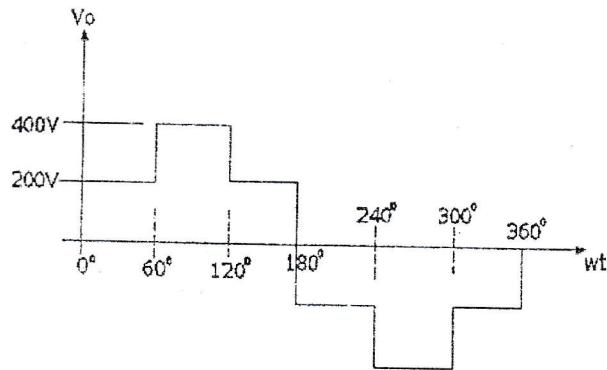


Fig.5

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Exam.	Back		
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Subject: - Power Electronics (EE 701)

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- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.



1. a) Explaining the reverse recovery characteristics of diode.
 b) Explain the V-I characteristics of a power thyristor. How an opto-coupler can be used to isolate the gate signal generator and power circuit.
2. a) Explain the operation of three phase single way controlled rectifier with highly inductive load. Derive the expression of average and RMS value of output voltage. Draw the waveforms of output voltage for $\alpha = 30^\circ$ and calculate average value of output voltage.
 b) Explain the operation of a single phase AC voltage controller. Derive the expression for RMS value of the output voltage as the function of firing angle.
3. a) Explain class C and class E dc chopper.
 b) Explain the operating principle of step up dc to dc chopper.
4. a) With the help of suitable circuit diagram, explain the operation of six steps three phase inverter. And also draw the output waveforms of instantaneous phase and line voltage for star connected load.
 b) Explain the operation of a three phase sinusoidal PWM inverter with neat circuit diagram and waveforms.
5. a) Explain Bridge configuration of single phase cyclo converter with necessary circuit diagram, waveform. Also tabulate the conduction sequence.
 b) Why HVDC transmission is preferred over HVAC transmission for transport of large power over long distance? Perform mathematical expression and make comparison between HVDC and HVAC transmission.

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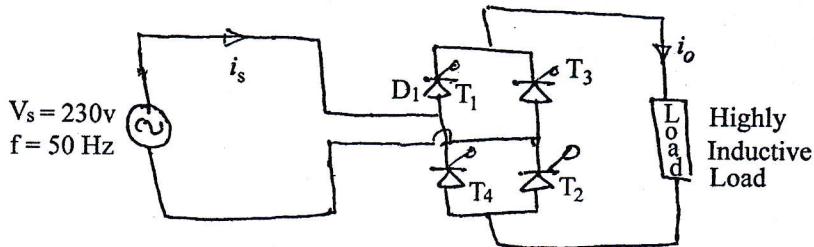
Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	I V/ I	Time	3 hrs.

Subject: - Power Electronics (EE 701)

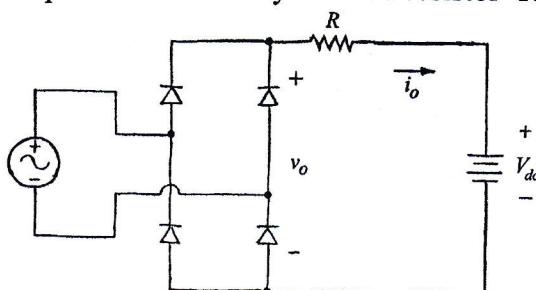
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- ✓ Attempt All questions.
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1. a) Explain the V-I characteristic of a thyristor. Also explain a thyristor firing circuit.
- b) For a circuit shown in figure below, Draw the wave forms of each diodes and thyristor also derive the expression of average and RMS value of output voltage as the function of firing angle α . Assuming load current is constant at 10A, calculate the magnitude all phase of fundamental component of input AC current i_s .



2. a) Draw the circuit diagram and waveform of output voltage of a single phase full bridge diode rectifier. The input ac voltage is 220V, 50 Hz. Calculate average value and fundamental component of output voltage.
- b) For the full-wave bridge rectifier circuit of Figure below, the ac source is 120 V rms at 50 Hz, $R = 2$ Ohm and $V_{dc} = 80$ V. Determine the power absorbed by the dc voltage source and the power absorbed by the load resistor 'R'.



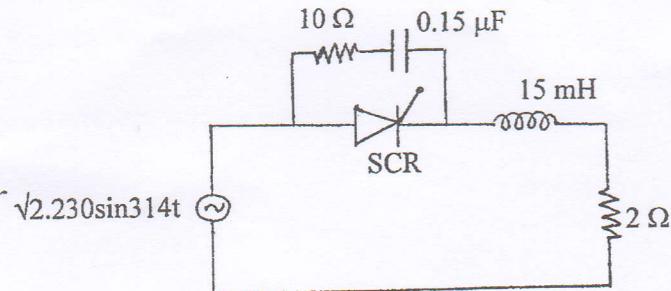
3. a) The supply voltage of a step down chopper is 230V dc, load resistance is 10 ohms. Take the voltage drop of 1V across chopper when it is ON. For a duty cycle of 0.4, calculate the average and rms value of output voltage.
- b) Draw the circuit diagram of Type-E four quadrant chopper and explain its operation for all four quadrants.
4. a) Explain the operation of three phase sinusoidal Pulse width modulation inverter.
- b) Explain the operating principle of single phase current source inverter with necessary waveforms.
5. a) Explain the bridge configuration of single phase step-down cycloconverter with necessary circuit diagram and waveform. Also tabulate the conduction sequence.
- b) What are the differences between HVAC and HVDC transmission lines? Perform a mathematical comparison between HVAC and HVDC lines.

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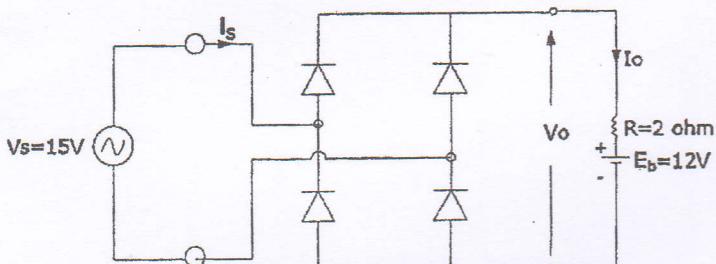
Subject: - Power Electronics (EE701)

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1. a) Explain how a transistor can be used as static switch. Also explain base signal generating circuit for transistor switch.
- b) For the circuit shown in below:
 - i) Calculate the maximum value of di/dt and dv/dt of the SCR
 - ii) Find the RMS and average current rating of SCR for firing angle delays of 90°



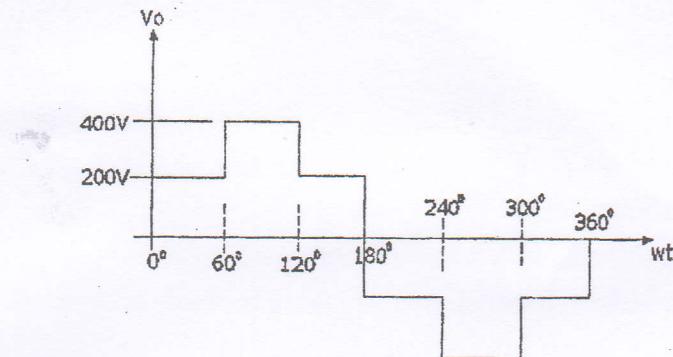
2. a) In figure below shows a full-wave rectifier circuit used to charge at 12 V battery through a 2Ω resistor.



Calculate:

- i) Average value of charging current
 - ii) Power supplied to the battery
 - iii) Gross output power from rectifier
 - iv) Additional resistance to be connected in series with 2Ω resistors to limit the average value of charging current to 0.5 amp.
- b) Explain the operation of three-phase single way-controlled rectifier circuit with necessary waveforms. Also derive the expression for average value of the output voltage.

3. a) Determine the average value of output voltage and the fundamental component of the load current of step down chopper having input voltage of 220V DC, load resistance $20\ \Omega$ and duty cycle of 45% Given: chopping frequency of chopper is 1 kHz.
- b) Explain the operation of single PWM techniques for inverter control and therefore determine the rms value of output voltage.
4. a) Explain the operation of a single phase current source inverter with ac motor as load.
- b) In figure below shows the waveform of output voltage (per phase) of three phase inverter. Calculate RMS value and fundamental component of the output voltage.

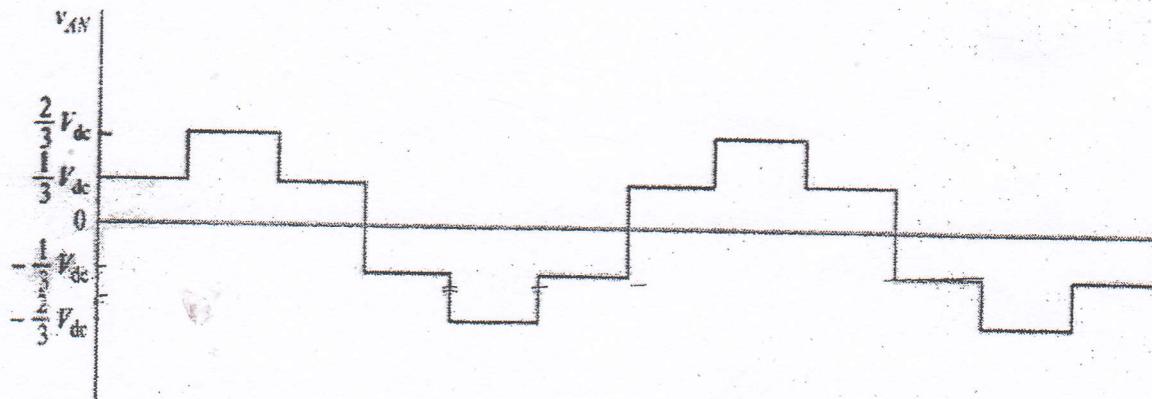


5. a) With mathematical aid, explain how full converters can be used for reverse power flow in bipolar link of HVDC transmission.
- b) Explain the operation of ac voltage controller and its application in electronic load controller for Micro-Hydro power plant.

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1. a) Explain the V-I characteristics of a thyristor. Also explain a thyristor firing circuit.
 b) Explain the dv/dt protection and di/dt protection methods for a thyristor.
 2. a) Draw the circuit diagram of single phase full converter with highly inductive load and explain its operation. If the load current is constant at 15A, draw the waveform of input as current and calculate the fundamental component of the input ac current.
 b) A single phase fullwave rectifier charges a battery from a single phase supply of 230 V, 50 Hz. The battery has interval emf of 200 volt and its internal resistance is 0.5 ohm. Calculate:
 - i) Average value of charging current
 - ii) Power supplied to the battery
 - iii) Gross power output from the rectifier
 - iv) Additional resistance to be connected in series to reduce the charging current by 30%
 3. a) Explain the operation of step up dc chopper.
 b) Draw the circuit diagram of Type-E four quadrant chopper and explain its operation for all four quadrants.
 4. a) The given waveform in figure below is the output voltage and three phase inverter. Calculate the fundamental component and 3rd harmonic component of the output voltage.



- b) The single phase ac controller has input voltage of 230V, 50Hz and the positive and negative thyristors are triggered at an angle of 90° and $\pi+90^\circ$ respectively. The series RL load has $R = 20 \Omega$, $L = 50\text{mH}$ then determine the rms value of load voltage and load current.
5. a) Explain the operation of single phase cyclo-converter. What are its applications?
 b) Explain the series connection of two single phase full converter with necessary circuit diagram and waveforms. How these series connected circuit can be operated in

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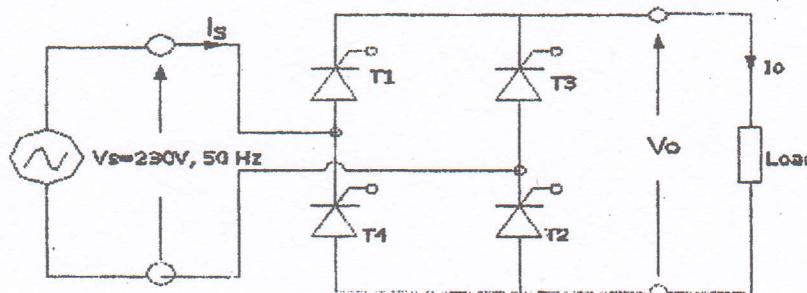
Subject: - Power Electronics (EE701)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
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1. a) Discuss a method of thyristor turn ON mechanism. Also explain about thyristor forced commutation techniques. [8]

b) Explain how a transistor can be used as a power switch. [8]

2. a) Figure shows a single phase full converter circuit with highly inductive load so that load current is constant and equal to 25 amp. Explain its operation for firing angle = 30°. Draw the waveforms of input voltage V_s , output voltage V_o and input current i_s . Calculate the fundamental component of input current and Input power factor. [8]



b) Explain the operation of three-phase single way rectifier with diode with neat circuit diagram and waveforms. Derive the expression for average and rms values of the output voltage. [8]

3. a) Explain the operation of three phase AC to DC conversion using three Thyristors. Draw the input and output voltage waveform and find average and rms value of output voltage expression from the obtained waveform. Assume highly inductive load. [8]

b) Explain the operation of step up chopper. Derive the expression for the average and rms value of output voltage. [8]

4. a) Explain the operation of single phase PWM inverter. Derive the expression for rms value of output voltage and also write down the output voltage in the form of Fourier expression. [10]

b) With the help of suitable circuit diagram and waveform, explain the operation of single phase cycloconverter. [6]

5. a) Explain the operation of ac voltage controller and its application in electronic load controller for micro hydro plant. [8]

b) Explain the series connection of two single phase full converter with necessary circuit diagram and waveforms. How these series connected circuit can be operated in rectification mode and inversion mode? [8]

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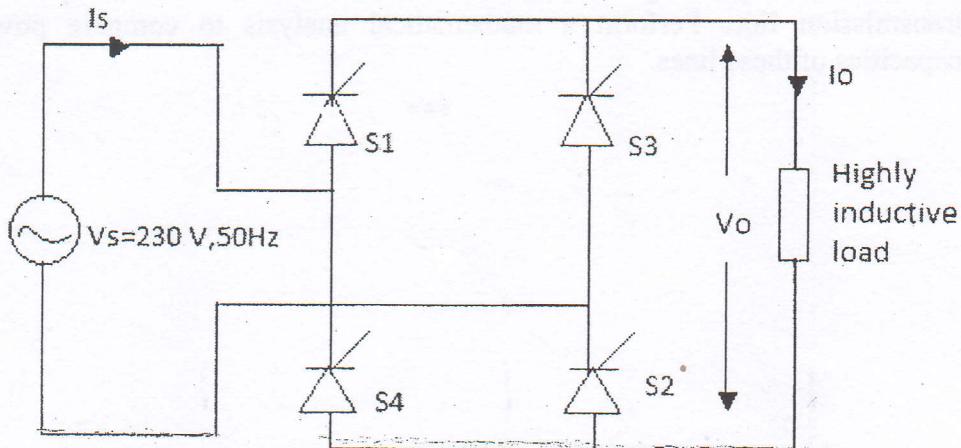
2073 Shrawan

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

Subject: - Power Electronics (EE701)

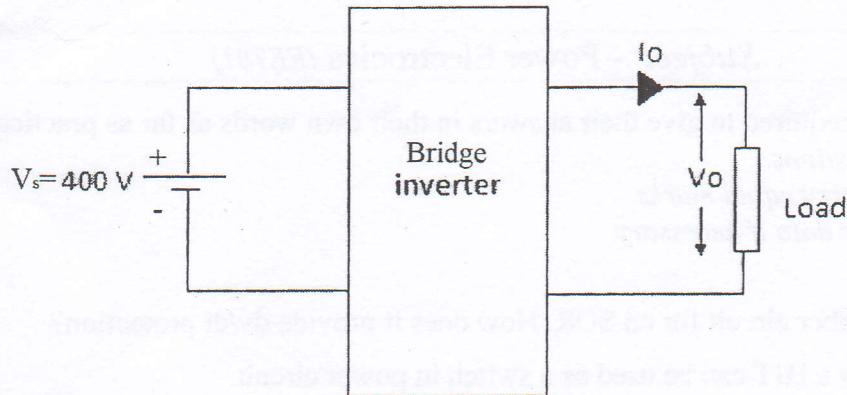
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. a) Draw a snubber circuit for an SCR. How does it provide dv/dt protection?
- b) Explain how a BJT can be used as a switch in power circuit.
2. a) The average value of output voltage of single phase full converter with 4 GTO switches is controlled by extinction angle control method. The load current is constant and equal to 20Amp due to highly inductive load. For the extinction angle of 30° , draw the waveforms of load voltage, load current and input ac current. Also find RMS value of output voltage, magnitude and phase of fundamental component of the input ac current.



- b) Explain the operation of three phase single way controlled rectifier with thyristor with neat diagram and waveforms. Derive the expression for average and RMS value of the output voltage.
3. a) Explain the operation of a step down chopper with dc motor as load.
- b) With the help of suitable circuit diagram explain 180° conduction mode of three phase inverter? And also draw the output waveforms of instantaneous phase and line voltage for star connected load.

4. a) A single phase full bridge inverter with dc input voltage of $V_s = 400V$ and generating output square wave of 50Hz is connected to inductive load having $R=10 \Omega$ and $L=50mH$. Calculate the magnitude and phase of fundamental component and third harmonic component of output voltage and load current.



- b) Explain the operation of ac voltage controller with purely resistive load. Also explain the use of ac voltage controller in ELC
5. a) With the help of suitable circuit diagram, describe the operation of reversible power flow on DC line.
 b) What are the advantages of HVDC transmission line with compare the HVAC transmission line. Perform a mathematical analysis to compare power transfer capacities of these lines.
