TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Chaitra

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.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

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 change a 12V battery through a 2 ohm resistor. [8]
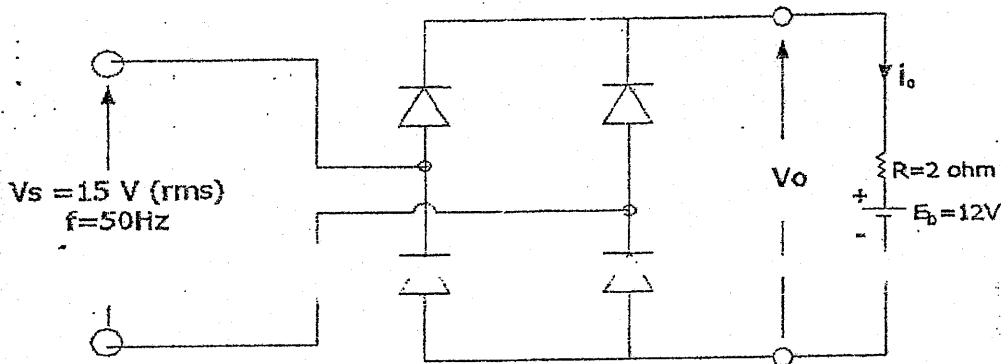

Fig.1.b

   (i) Draw the waveform of output voltage V_0 and charging current i_0.
   (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 sytem.

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 firingle 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 choper 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 {tansmit 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.
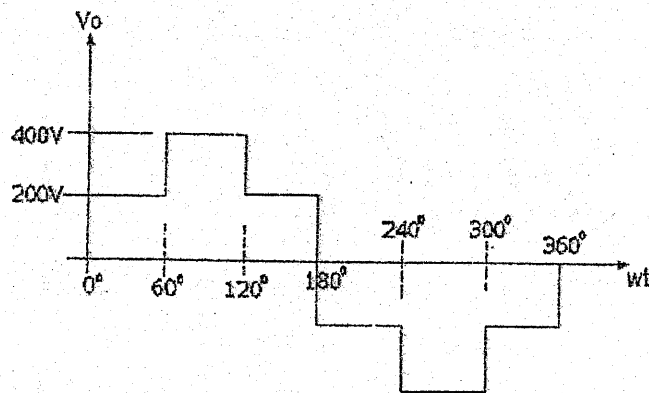
[8]

Fig.5

***

| Exam.			**Back**	
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) 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°
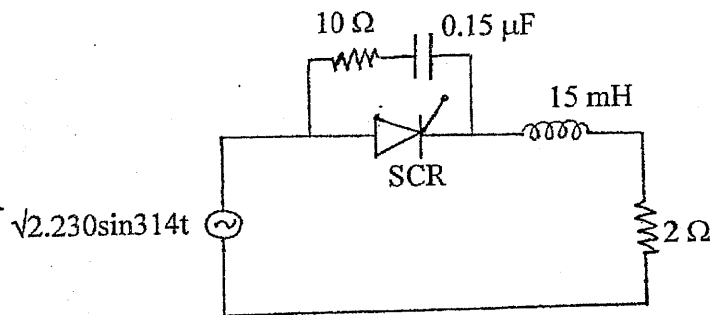
2. a) In figure below shows a full-wave rectifier circuit used to charge at 12 V battery through a 2 Ω resistor.
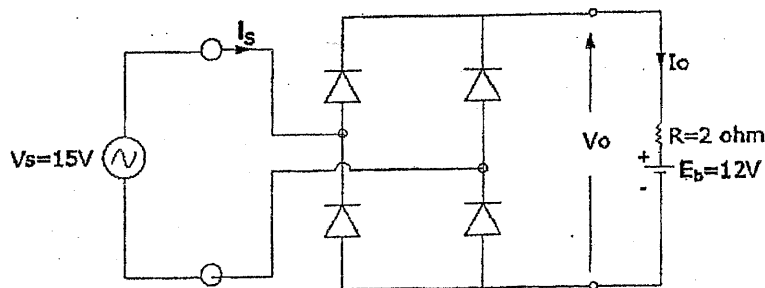
   Calculate:

   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 2 Ω 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 Ω 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.
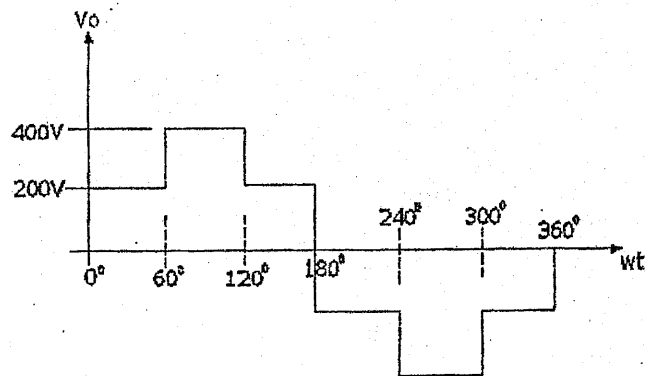
5. a) With mathematical aid, explain how full converters can be used for reverse power flow in bipolar link of HVDC transmission.

   b) Explain the operation of ac voltage controller and its application in electronic load controller for Micro-Hydro power plant.

***

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

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.
✓ *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 $\alpha = 30°$ 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.

***

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

| Exam.		Regular / 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.
✓ *All* questions carry equal marks.
✓ Assume suitable data if necessary.

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.
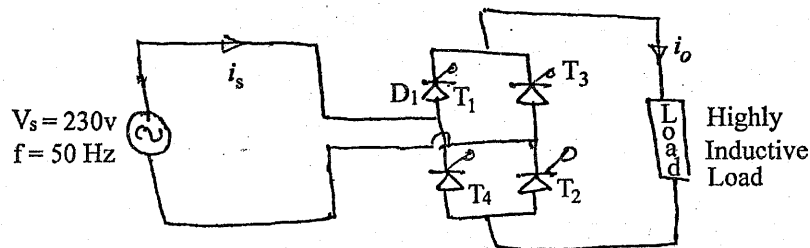
2. a) Draw the circuit diagram and waveform of output voltage of a single phase full bridge diode rectifier. The input ac voltage is 220V, 50 Hz. Calculate average value and fundamental component of output voltage.

   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 Vdc = 80 V. Determine the power absorbed by the dc voltage source and the power absorbed by the load resistor 'R'.
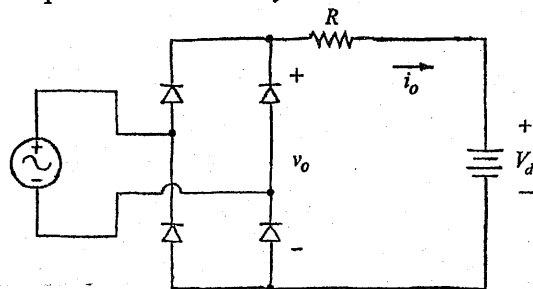

3. a) The supply voltage of a step down chopper is 230V dc, load resistance is 10 ohms. Take the voltage drop of 1V across chopper when it is ON. For a duty cycle of 0.4, calculate the average and rms value of output voltage.

   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.

***

INSTITUTE OF ENGINEERING

Examination Control Division

2074 Chaitra

Exam.		Regular	
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) 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.
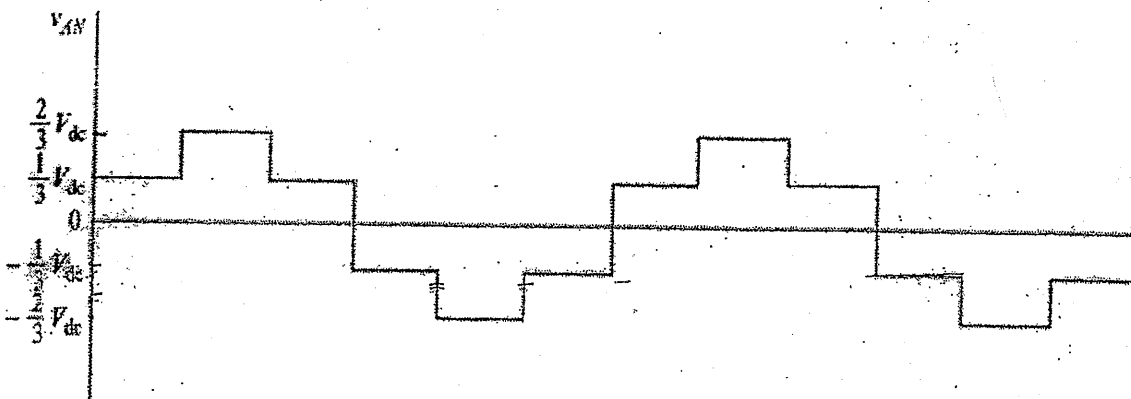

   b) The single phase ac controller has input voltage of 230V, 50Hz and the positive and negative thyristors are triggered at an angle of 90° and π+90° respectively. The series RL load has R = 20 Ω, L = 50mH then determine the rms value of load voltage and load current.

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 rectification mode and inversion mode?

***

| Exam.		Regular	
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.
✓ The figures in the margin indicate __Full Marks__.
✓ Assume suitable data if necessary.

1. a) Explain V-I characteristics of a Thyristor and explain the meaning of latching current and holding current. Describe a gate signal generating circuit for firing a Thyristor.   [8]

   b) Below figure shows a full-wave diode rectifier circuit used to charge a 24V battery through a 5 ohm resistor. Calculate: [8]

   (i) Conduction period of charging current i_o.
   (ii) Average value of charging current i_o
   (iii) Power supplied to the battery and gross power output from the rectifier
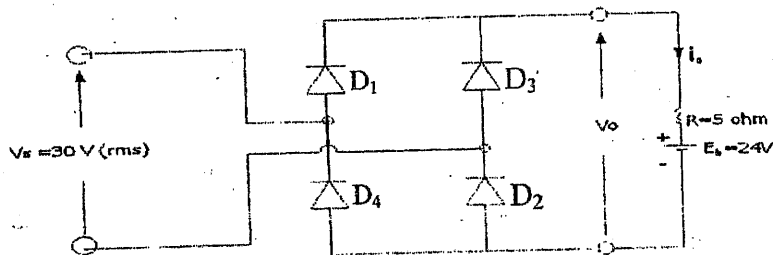

2. a) Figure shows below a full wave controlled rectifier with resistive load. The load voltage is 230V, 50 Hz and it is operated at firing angle 45°. Draw the waveform of output voltage, output current and ac input current. Calculate average value of output voltage, output dc power and input power factor.   [8]
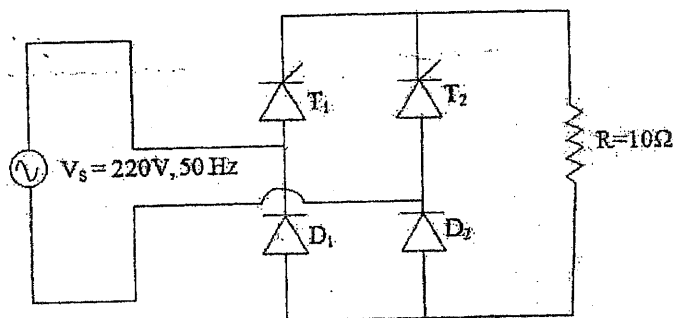

   b) Explain the operation of symmetrical angle control method for power factor improvement. Derive the expression for average and RMS value of the output voltage.   [8]

3. a) Explain the operation of single phase inverter with ac motor as load. Derive the equation for current drawn by the motor of positive half cycle and negative half cycle.   [8]

b) Figure below shows a step down dc chopper. If it is operated in variable frequency mode with ON time constant at 3msec. Calculate the OFF time for a duty cycle at 30% and average value of output voltage. [8]
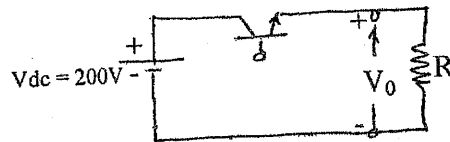
4. a) Explain the operation of a three-phase Sinusoidal PWM inverter with circuit diagram and associated waveforms. How the switching instants of the switch pair of a phase are determined. [8]

b) The following figure below shows the waveform of the output voltage of a single phase inverter with an inductive load of R = 5 ohm and L = 10mH connected in series. Calculate the magnitude and phase of fundamental component of the output voltage and write down the time domain equation of the load current considering Fourier series up to 5th Order. [8]
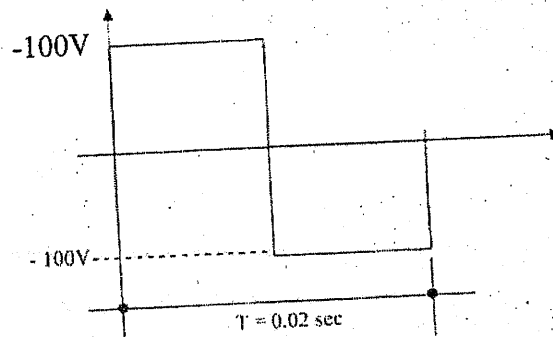


5. a) A single phase full wave ac voltage controller feeds a load of R = 10Ω with an ac input voltage of 230 V, 50Hz. Firing angle for both the thyristors is 45°. Calculate rms value of output voltage, load current, input power factor and average value of current of thyristors. [8]

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 assumption that the power loss per conductor is same for both lines and also the transmission capacity of both lines are same. [8]

***

Exam.		Regular	
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) Explain the V-I characteristics of a power thyristor and illustrate its application in power circuit. How an opto-coupler can be used to isolate the gate signal generator and power circuit?

   b) Explain the V-I characteristics of power transistor and illustrate how it can be used as a static switch?

2. a) With the help of suitable circuit diagram and waveforms, explain the operation of extinction angle control for power factor improvement in rectifier circuit. Derive the expression for average value and rms value of output voltage.

   b) For the circuit shown in figure below, the battery voltage is E = 12 V. The average charging current should be 10A.
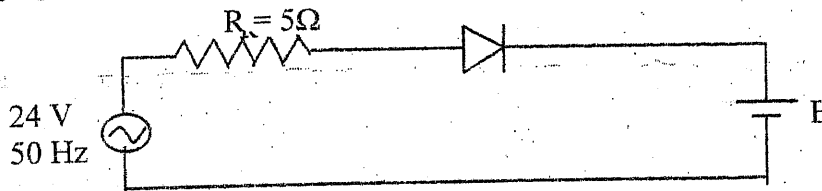

   Calculate:
   i) The conduction angle of the diode
   ii) Power supplied to the battery
   iii) Average value of charging current
   iv) The rectifier efficiency

3. a) Describe the principle of step up chopper. Derive an expression for the average output voltage in terms of input voltage and duty cycle.

   b) Explain the operation of a three phase inverter for 180 degree conduction with neat circuit diagram and waveforms. How the fundamental component of output (per phase) voltage can be calculated?

4. a) Explain the operation of signal phase square wave inverter. Derive the expression for rms value of output voltage and fundamental component of output voltage.

   b) With the help of suitable circuit diagram and waveform, explain the operation of single phase ac voltage controller using resistive load. Derive the expression for rms value of output voltage.

5. a) Explain bridge configuration of single phase cycloconverter with necessary circuit diagram, waveform. Also tabulate the conduction sequence.

   b) Justify the statement "HVDC power transmission is only economical than HVAC transmission if bulk amount of power has to be transmitted over a long distance". And also justify that the power transmission capacity of HVDC and HVAC lines are equal.

***

Exam.		Back	
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.
✓ The figures in the margin indicate **Full Marks**.
✓ Assume suitable data if necessary.

1. a) Discuss a method of thyristor turn ON mechanism. Also explain about thyristor force commutation techniques. [8]

   b) Explain how a transistor can be used as a power swith. [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 Vs, output voltage V_0 and input current i_s. Calculate the fundamental component of input current and Input power factor. [8]
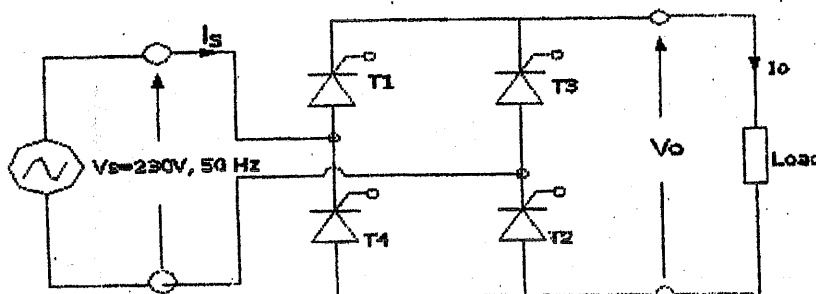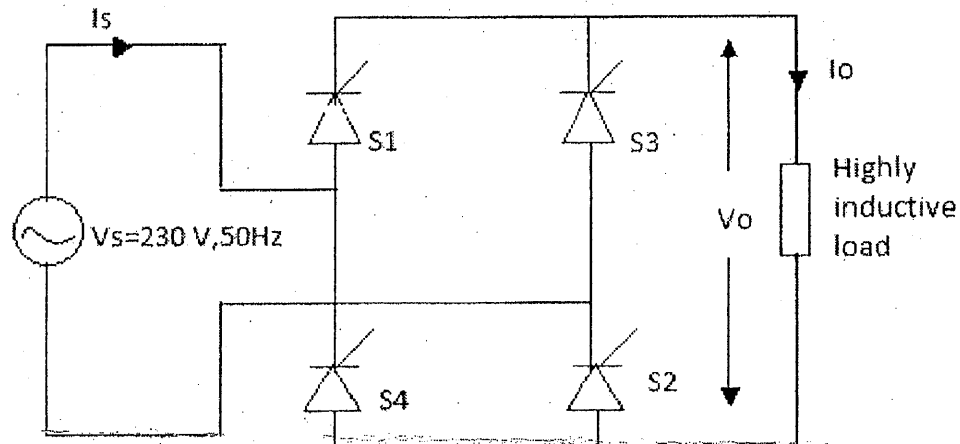

   b) Explain the operation of three-phase single way rectifier with diode with neat circuit diagram and waveforms. Derive the expression for average and rms values of the output voltage. [8]

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]

***

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 Ω and L=50mH. Calculate the magnitude and phase of fundamental component and third harmonic component of output voltage and load current.
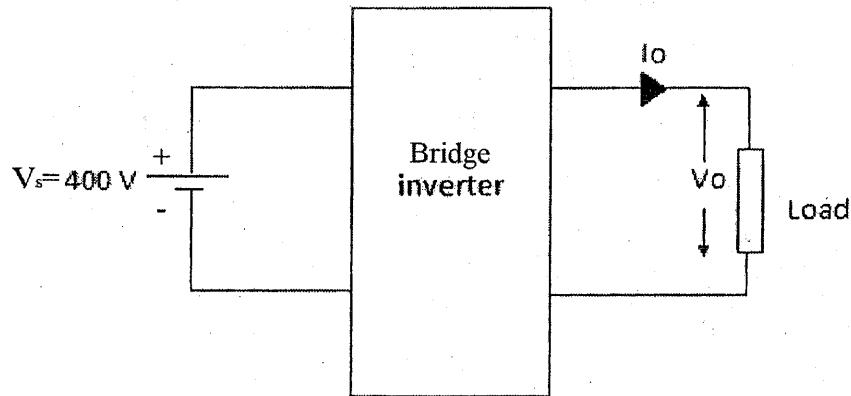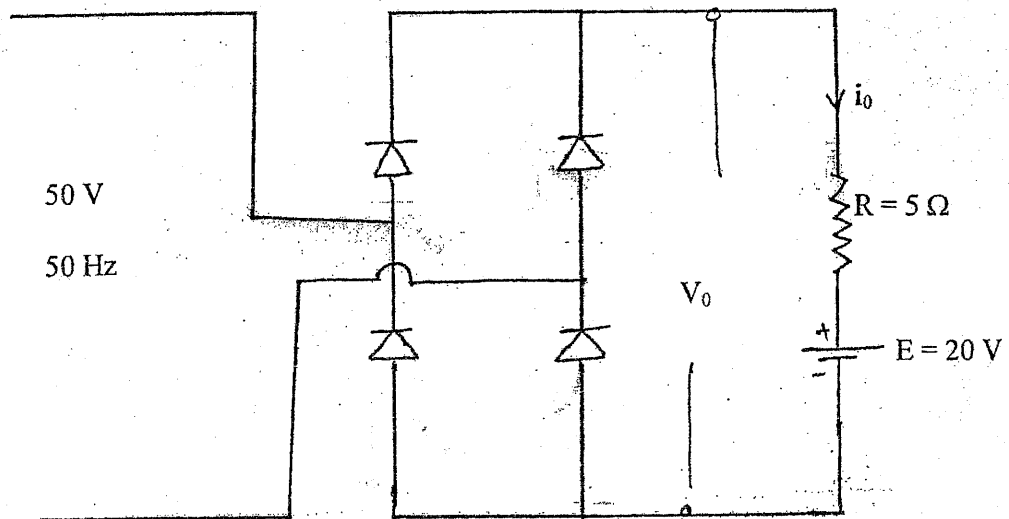

b) Explain the operation of ac voltage controller with purely resistive load. Also explain the use of ac voltage controller in ELC

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.

***

| Exam.		Regular	
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) In which circumstances, a thyristor may subjected to high di/dt and dv/dt. Why these are harmful to thyristor. Explain how a thyristor can be protected against high di/dt and dv/dt.

   b) 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.

2. a) In figure below shows a full wave rectifier circuit which is used to charge a 24 V battery through 5Ω resistor. Draw the necessary waveforms related with the operation of this circuit and hence determine:

   i)   Average value of charging current
   ii) Power supplied to the battery
   iii) Gross output from rectifier
   iv) Efficiency of rectifier

   b) Explain the operation of three phase single way controlled rectifier for firing angle $\alpha = \pi/6$ with associated waveforms and hence deduce the expression for average and root mean square value of the output voltage assuming highly inductive load.

3. a) With the help of suitable circuit diagram and waveforms, explain the operation of 3 phase full wave bridge rectifier using diodes. Derive the expression for average value and rms value of output voltage.

b) Explain the operation single phase full converter with highly inductive load. How it can be operated in rectification as well as in inversion mode?

4. a) Explain the operation of a three phase Sinusoidal PMW inverter with neat circuit diagram and waveforms.

b) In figure below shows the schematic diagram of a single phase inverter giving square wave AC output voltage V_0 with frequency of 50 Hz. Calculate the magnitude and phase of fundamental and third harmonic component of the output voltage and load current.
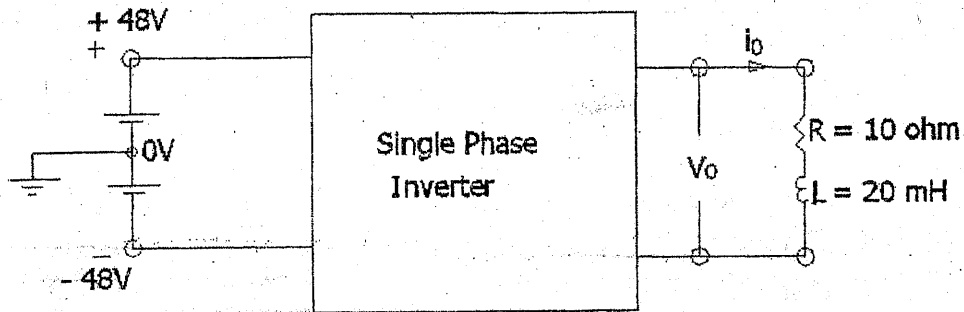

5. a) Why HVDC transmission is preferred over HVAC transmission for transport of large power over long distance? Perform mathematical operation and make comparison between HVDC and HVA Transmission.

b) Explain the operation of single phase AC voltage controller with necessary circuit diagram and waveforms. Derive the expression for RMS value of the output voltage.

***

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) Explain the di/dt and dv/dt protection scheme of a thyristor. What factors should be considered while designing gate control circuit.

   b) Explain the operation of pulse train generation for gate firing circuit for thyristor showing all the necessary components.

2. a) In figure below shows a full-wave rectifier circuit used to charge a 12V battery through a 2 ohm resistor.
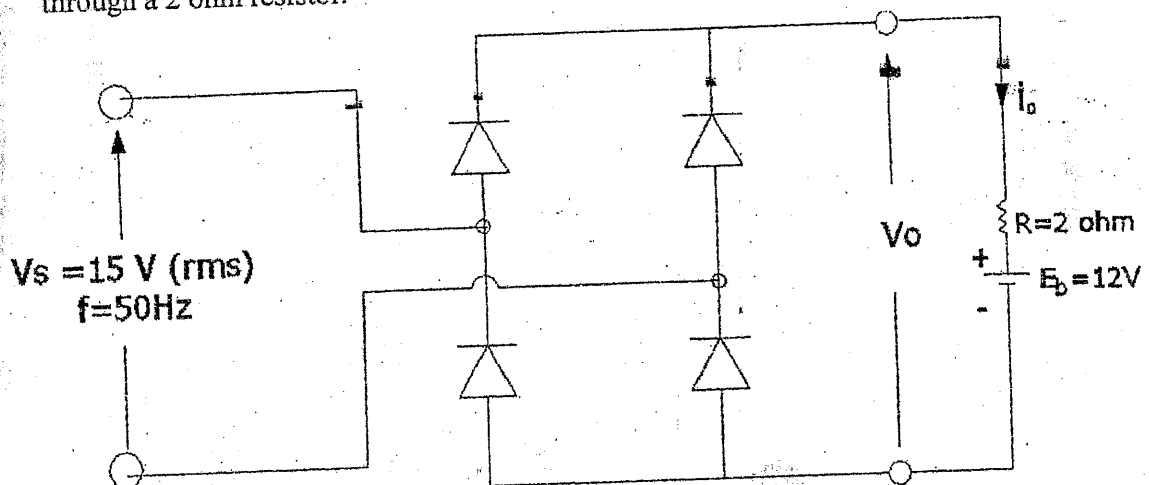
   Vs =15 V (rms)
   f=50Hz

   R=2 ohm
   E_b =12V

   Vo
   i_0

   i) Draw the waveform of output voltage V_0 and Charging current i_0
   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

   b) Explain the operation of three-phase single way controlled rectifier with highly inductive load. Derive the formula for average value of output voltage. Draw the waveform of output voltage for firing angle equal to 60°.

3. a) Explain the operation of step up chopper with necessary diagrams and expressions.

   b) Explain the operation of type E chopper with armature of dc motor as load.

4. a) Explain the operation of three phase inverter consisting of three sets of single phase inverter and each set is conducted with a phase difference of 120° to each other. Take the loads to be purely resistive. Draw the waveform of each phase voltage (V_R, V_Y and V_B) along with the neutral voltage (V_N). Also draw the waveform of V_{RN}.

b) Draw the circuit of a three phase to single phase bridge type cycloconverter and explain its working.

5. a) Explain the operation of single phase ac voltage controller with resistive load. If the input voltage is 220V, 50 Hz, calculate the RMS value of output voltage for firing angle of 90°.

b) In which circumstance, HVDC transmission line has advantages over the HVAC transmission line? Prove that a HVDC line with two conductors can 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?

***

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.
✓ The figures in the margin indicate *Full Marks*.
✓ Assume suitable data if necessary.

1. a) Describe the switching characteristics of power MOSFET. What is meant by threshold gate voltage? [8]

   b) A power diode has a reverse recovery time of 2.4 µs. If di/dt is 30 A/ µs, find (i) stored charge (ii) peak inverse current. [4]

   c) What is latching current and holding current? [4]

2. a) A diode whose internal resistance is 20Ω is to supply power to 1000 Ω load from a 230 V ac supply in case of half wave rectification. Calculate the following . [8]

   i) Peak load current

   ii) dc load current

   iii) dc diode volatge

   b) A three phase full wave converter is operated from three phase star connected, 230 V, 50 Hz supply with resistance R = 10 ohm. An average output voltage of 50% of the maximum possible output voltage is required. Determine (i) the firing angle (ii) average and rms values of load current and (iii) rectification efficiency. [8]

3. a) Explain the operation of a step down chopper in variable frequency mode. If it is operated with on time constant at 5msec. Calculate the OFF time for a duty cycle of 40% and average value of the output voltage. [8]

   b) Describe the series operation of two single phase full converter to obtain high output voltage. Also find the average value and rms value of the output voltage waveform. [8]

4. a) Obtain the Fourier series of line to line output voltage of square wave inverter and hence show that all triplen harmonics are absent from it. [8]

   b) What is sinusoidal pulse-width modulation? How is it obtained? Explain with the help of neat diagram. [8]

5. a) A single-phase full wave ac voltage controller feeds a load of resistance 20 ohm with an input voltage of 230 V, 50 Hz. If the firing angle for both thyristor is 45°, calculate: [8]

   i) rms value of output voltage

   ii) Load power and input power factors

   iii) Average and rms current of thyristors

   b) A single phase bridge type cyclo-converter has input voltage of 230V, 50Hz and load of R = 10Ω. The output frequency is one third of input frequency. For firing angle of 30°, calculate: [8]

   i) rms value of output voltage

   ii) rms value of output current

   iii) rms current of each converter

   iv) rms current of each thyristyor

***

Exam.		Regular	
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.
✓ The figures in the margin indicate *Full Marks*.
✓ Assume suitable data if necessary.

1. a) Explaining the reverse recovery characteristics of diode and show that

$$I_{RR} = \left[2 * Q_{RR} * \left(\frac{di}{dt} \right) \right]^{1/2}$$ [8]

   b) 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]

2. a) Show that the fundamental component of input current leads input voltage by a phase angle of $\beta/2$ in case of extinction angle control method of power factor improvement assuming highly inductive load and β be the extinction angle.   [8]

   b) Explain the operation of three-phase bride rectifier with 6 numbers of diodes. Derive the expression for Average and RMS values of output voltage.   [8]

3. a) The supply voltage of a step down chopper is 230V dc, load resistance is 10Ω. Take the voltage drop of 2V across chopper when it is on. For a duty cycle of 0.4, calculate average and rms value of output voltage.   [8]

   b) Explain the process of reversible power flow on HVDC line and obtain the relation between firing angle of both converters.   [8]

4. 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 and negative half cycle.   [8]

   b) Figure below show 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]
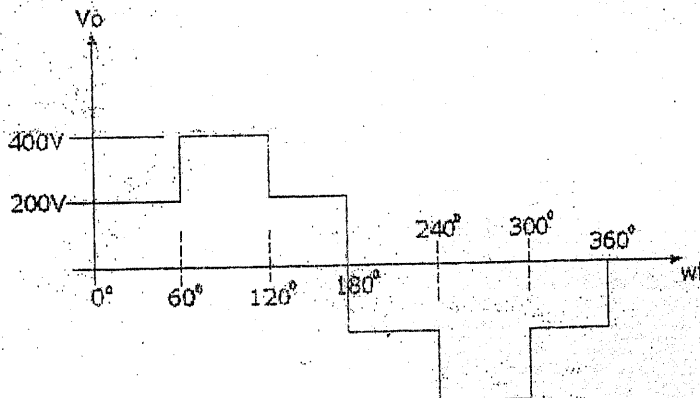
5. a) Draw the circuit of a single phase cycloconverter using a center tapped transformer; Prepare a table showing the conduction pattern of thyristors and current paths for an output frequency of one-third the input frequency.   [8]

   b) Explain the role of ACVC in ELC while explaining the operating mechanism of ELC.   [8]

***

| Exam.		Regular	
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) Explain how a power transistor can be used as a switch in the electric circuit. How an opto-coupler can used to isolate the gate signal generator and power circuit? [8]

   b) Explain the di/dt protection scheme and dv/dt protection scheme for a thyristor. [8]

2. a) Figure below shows a single phase full converter circuit with highly inductive load so that load current is constant and equal to 10 amp. Explain its operation for firing angle of 45^0 and draw the waveforms of input voltage Vs, output voltage V_0 and input current Is. Calculate the fundamental component of input current. [8]
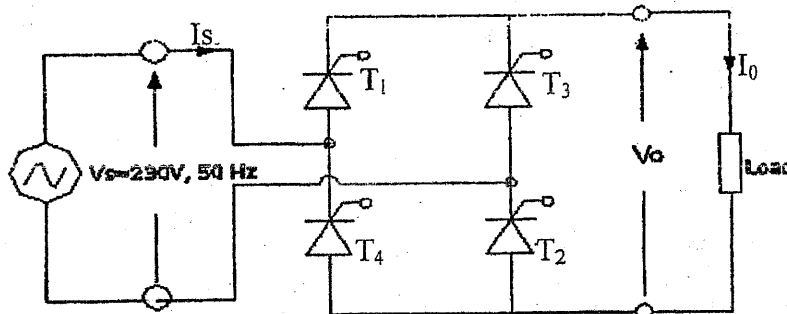

   b) Explain the operation of three-phase single way controlled rectifier with thyristor with neat circuit diagram and waveforms. Derive the expression for average value of the output voltage. [8]

3. a) Explain the operation of type-E dc chopper illustrating its capability of driving a dc motor in all four quadrants. [8]

   b) What are the differences between HVAC and HVDC transmission lines. Perform a mathematical comparison between HVAC and HVDC lines. [8]

4. a) Figure below shows the circuit diagram of single phase square wave inverter with inductive load The required frequency of output voltage is 120 Hz. Calculate the ON period and OFF period of switches S_1 and S_2. Derive the time domain equation of load current for first positive half cycle of output voltage. [8]
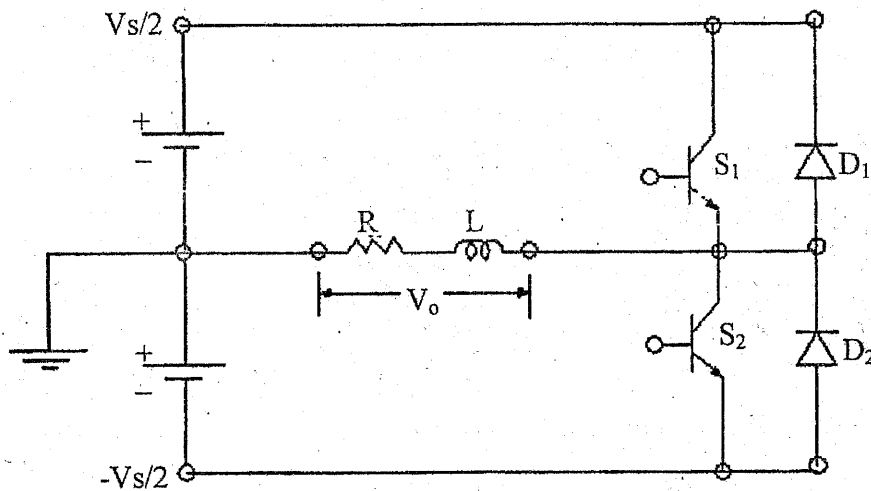
b) The single phase inverter shown in Figure above is operated as pulse width modulated (PWM) inverter with frequency ratio = 1 and modulation index = 0.5 The intersection between the triangular carrier wave and square wave ac modulating signal is used to determine the switching instant of switches S_1 and S_2. Assuming purely resistive load [8]

   i) Draw the waveforms of triangular carrier wave, square wave ac modulating signal and output voltage.
   ii) Determine the switching instant of switches S_1 and S_2
   iii) Determine the RMS value of output voltage

5. a) Explain the operation of ac voltage controller with purely resistive load. Derive the expression for calculating rms value of the output voltage. If the load is inductive (R-L load), derive the expression for time domain equation for load current. [8]

   b) Starting from the operation of single Phase cyloconverter, discuss step up and stepdown single phase cycloconverter with suitable waveform and circuit diagram. [8]

***

INSTITUTE OF ENGINEERING

Examination Control Division

2070 Ashad

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.
✓ The figures in the margin indicate __Full Marks__.
✓ Assume suitable data if necessary.

1. a) Explain the dv/dt protection method for a thyristor. [6]

b) Describe a micro-controller based firing circuit for a thyristor with opto-coupler as isolation circuit. [6]

c) Fig.1c shows the single phase half-wave controlled rectifier with di/dt protection provided by the series inductor. The load is a purely inductive having an inductance of 100 mH. Calculate the value of L_S so that di/dt is limited to 500A/sec. [4]
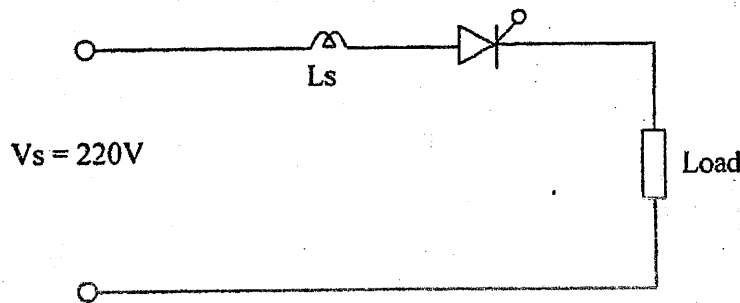
Fig.1c

2. a) Fig. 2a shows a full-wave rectifier circuit used to charge a 24V battery through a 5 ohm resistor. Calculate: [8]

i) Conduction period of charging current i_o.

ii) Average value of charging current i_o
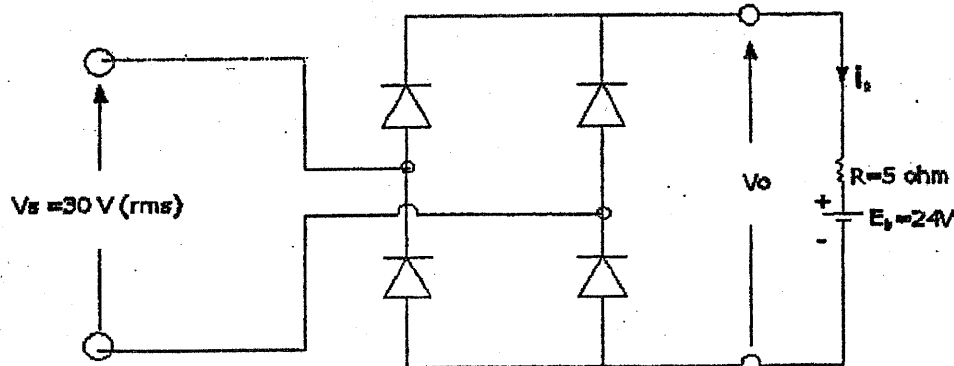
iii) Power supplied to the battery

Fig. 2a

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 Type-B and Type-C dc chopper with neat circuit diagram. [8]

b) Explain the series connection of two single phase full converter with necessary circuit diagram and waveforms. [8]

4. a) Explain the operation of a three-phase Sinusoidal PWM inverter with circuit diagram and associated waveforms. How the switching instants of the switch pair of a phase are determined. [8]

b) The following Fig.4b shows the waveform of the output voltage of a single phase inverter with an inductive load of R= 10 ohm and L= 20mH connected in series. Calculate the magnitude and phase of fundamental component of the output voltage and write down the time domain equation of fundamental component of load current. [8]
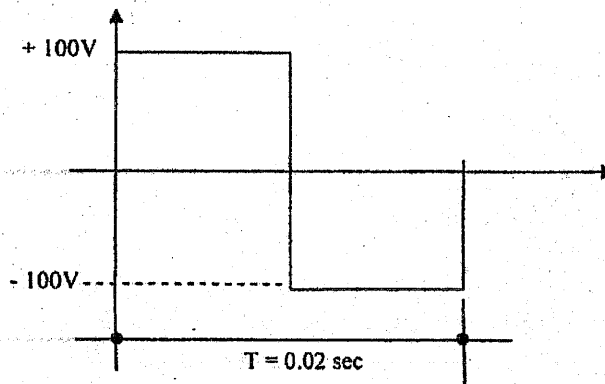
Fig.4b

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

b) Explain the operation of single phase cyclo-converter with required mathematical expression and waveform. [8]

***

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Baishakh

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

Subject: - Power Electronics

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

1. a) A single phase controlled rectifier bridge consists of one SCR and three diodes as shown in figure. Sketch output voltage waveform for a firing angle α of the SCR and hence obtain an expression for the average output voltage under the assumption of constant load current. Also draw the waveform of current through T_1, D_1, D_2 and D_3 with the same assumption.
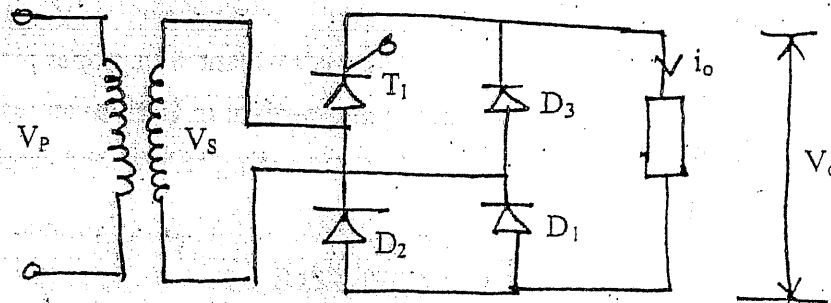
   b) Describe the V-I curve of a thyristor. Define the following terms:

   i) Latching current
   ii) Holding current
   iii) Turn ON and Turn OFF process

   What are the advantages of GTO over SCR?

2. a) The rectifier shown in figure is used as a battery charger. Find the conduction angle of diode and draw the output voltage V_0 and load current i_L.
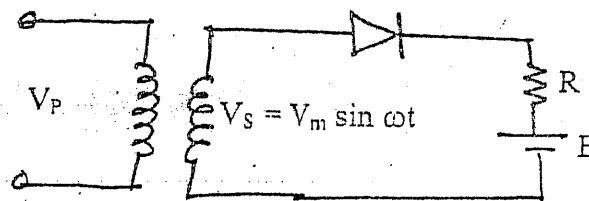
   b) A step down dc to dc chopper is operated in constant frequency mode of operation with chopping frequency of 200 Hz. Calculate the ON time and OFF time of the chopper for a duty cycle of 35% and corresponding output voltage magnitude. Given that input dc voltage is 400 volts.

3. a) With the help of suitable circuit diagram and waveform, explain the operation of 3-ϕ full wave bridge rectifier using diodes. Derive the expression for average value and rms value of output voltage.

b) Why it is necessary to have pulse width modulation in inverter? Describe the various PWM technique applied in inverter with necessary circuit diagram and waveform.

4. a) Starting with a typical circuit arrangement for HVDC transmission line, discuss the advantages and disadvantages of HVDC over HVAC.

   b) A single phase full converter bridge is connected to a dc motor. (DC motor can be considered as RLE load as marked in figure below). The source voltage is 230V, 50Hz. The average load current of 10A is constant over the working range. For R = 0.4Ω and L = 2 mH, compute firing angle for E = 120V and E = –120V. Comment on the result. The inductor is short circuited during steady state operation.
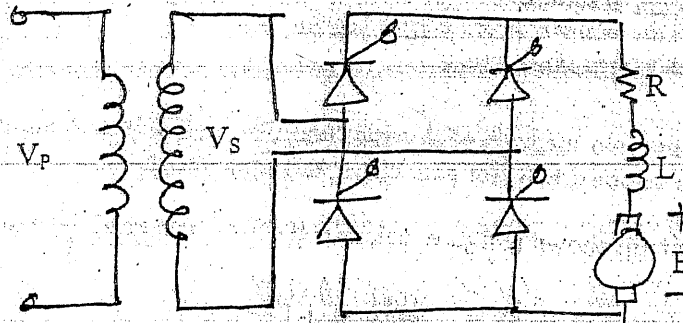
5. a) The input to a single phase ac voltage controller is 220V ac. Calculate the magnitude and phase angle of fundamental component of the output voltage at firing angle of 90°.

   b) Starting from the Fourier series of a single phase inverter output, write the Fourier series for three phase inverter having six step output voltage. If an induction motor is supplied with this output voltage, discuss the performance of the induction motor on the basis of Fourier analysis of this output voltage. Also show that the line voltage of the inverter does not consists of third harmonic content.

6. a) Explain the frequency control method for the speed control of induction motor. Explain the need of constant volt/Hz control in speed control method.

   b) Explain how a single phase converter can be operated in rectification as well as inversion mode.

***

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2067 Ashadh

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

Subject: - Power Electronics

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt any _Five_ questions.
✓ The figures in the margin indicate _Full Marks_.
✓ Assume suitable data if necessary.

1. a) A simple phase half wave diode rectifier with load resistance R and the load emf E is shown in figure below. Explain the operation and draw the waveforms of the output voltage V_0 and i_0. Also find the average value of i_0 and rms value of this current. [8]
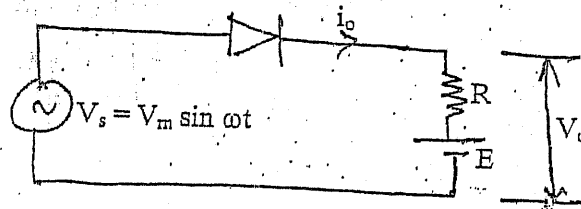
b) For the circuit in the figure above, the source voltage is 235V, 50Hz and R = 8Ω, E = 150V, find. [8]

   i) the average value of current i_0.
   ii) the power supplied to battery and the power dissipated in resistor.
   iii) PIV of the diode.

2. a) A single phase semi-converter shown below is connected to a highly inductive load. [8]
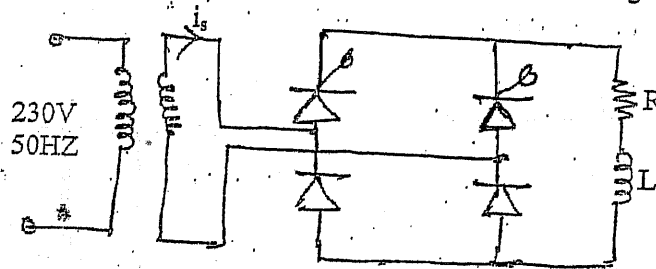
   Taking firing angle of $\pi/6$, derive the followings:

   i) Fundamental component of supply current (i_s)
   ii) Rms value of supply current (i_s)

   b) For the following single phase controlled bridge rectifier, explain the operation and draw the output voltage (V_0), output current (i_0), current through the diode and thyristor and supply current (i_s). Also find the average value and rms value of the output voltage waveform. [8]
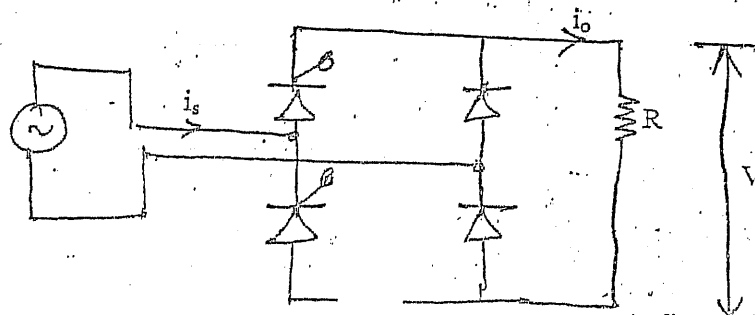
3. a) Figure below shows a three phase star connected rectifier with a purely resistive load R. Determine: [8]

   i) the rectification ratio
   ii) the ripple factor
   iii) the transformer utilization factor
   iv) the peak current through a diode if the rectifier deliver $I_{dc} = 30A$ at an output voltage of $V_{dc} = 140V$.
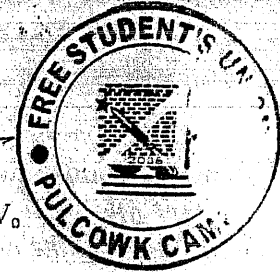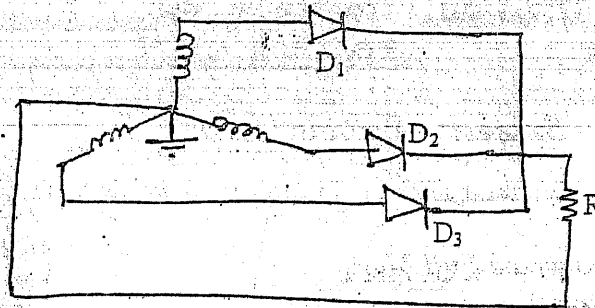

b) The dc chopper shown below has a resistive load $R_0 = 10\Omega$ and il : input voltage $V_s = 220V$. When the chopper switch remains ON, its voltage drop i. negligible and the chopping frequency is $f = 1$ KHz. If the duty cycle is 50%, deter ine the Fourier series of the output voltage and also determine the rms value of ne fundamental component of output voltage. [8]
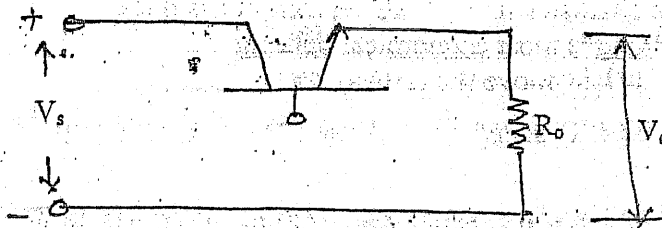
4. a) Explain the operation of sinusoidal pulse width modulation techr que applied to inverter with the help of defining terms modulation index and frequen y ratio. [8]

   b) Why extinction angle control scheme is used in single phase full co verter? With the help of necessary circuit diagram and waveform, explain the operat on of extinction angle control. Also derive the expression for rms value of output vol age obtained by this scheme? [8]

5. a) Explain the operation of three phase full converter for a firing angle $\alpha = 120°$. Also derive the expression for rms value of output voltage. [8]

   b) Draw the circuit diagram and explain the operation of single phase ac voltage controller with series R-L load and free wheeling diode across the load. Derive the expression for rms value of load voltage at a firing angle α. Take load not to be highly inductive. [8]

6. a) Illustrate the major advantages of HVDC transmission over HVAC transmission with necessary mathematical expression and assumption made. [8]

   b) What are the methods used for speed control of induction motor? Explain the static Cramer drive used in induction motor control. [8]

***

DISTRIBUTED BY FSU
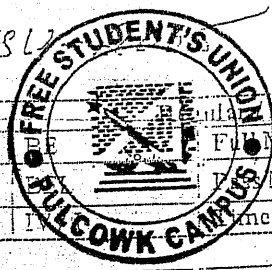
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2066 Bhadra

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

Subject: - Power Electronics

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

1. a) Discuss any two methods of thyristor turn ON mechanism. Also mention the various factors to be considered for gate circuit implementation. [8]

   b) For the circuit shown in figure, calculate the max. values of $\dfrac{di}{dt}$ and $\dfrac{dv}{dt}$ for SCR. [8]
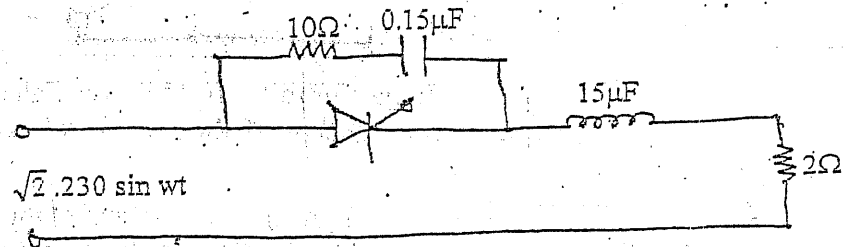
2. a) For the circuit shown in figure below, draw the waveform for output voltage and find average value of output voltage of the waveform when free wheeling diode is not connected. Also draw the waveform when free wheeling diode is connected in parallel with the load as shown by dotted line. Take load not to be highly inductive. [8]
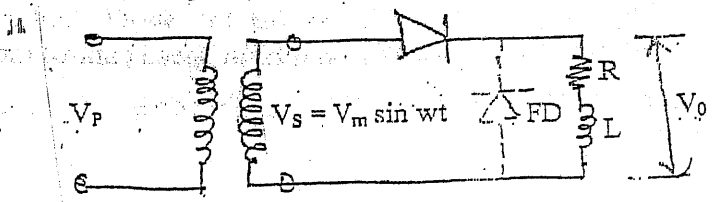

   b) A single phase bridge rectifier is supplied from a 120V, 50Hz source. The load resistance is $R = 500\Omega$. (i) Find the value of C-filter connected in parallel with the load so that ripple factor of the output voltage is less than 5%. (ii) With the value of capacitor obtained in part (i), calculate the average voltage V_r. [8]

3. a) Explain the operation of three phase bridge rectifier with diodes. Also obtain the mathematical expression for V_{dc} and V_{rms}. [8]

   b) A single phase bridge rectifier shown below is required to supply an average output voltage $V_{dc} = 400V$ to a resistive load of $R = 10\Omega$. Determine the voltage V_p and current rating of diodes and transformer. [8]
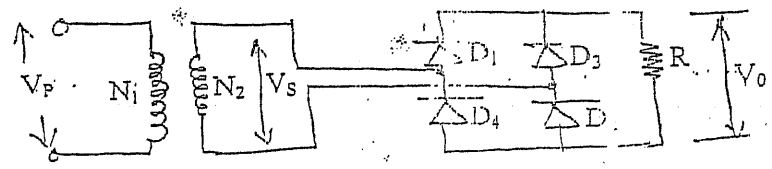
   $$K = \frac{N_1}{N_2} = 2$$

4. a) Figure below shows a dc chopper with inductive load $V_S = 220V$, $R = 10\Omega$. $L = 15.5mH$, $f = 5$ KHZ and $E = 20V$. Calculate
   i) Minimum instantaneous value of load current
   ii) Peak instantaneous value of load current
   ii) Maximum peak to peak ripple current in load
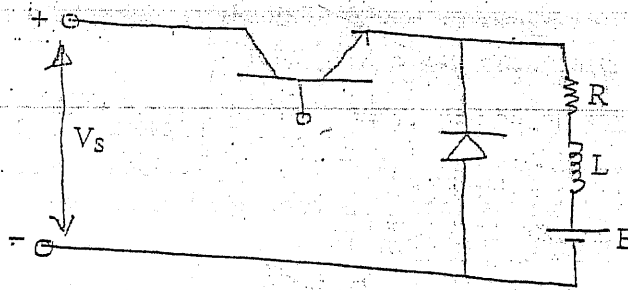
   b) Explain the operation of three phase inverter consisting of three sets of single phase inverter and each set is conducted with a phase difference of 120° to each other. Take the loads to be purely resistive. Draw the waveform of each phase voltage (V_R, V_Y and V_B) along with the neutral voltage (V_N). Also draw the waveform of V_{RN}. [8]

5. a) The input voltage to a single phase ac voltage controller is 220V ac. Calculate the magnitude and phase of fundamental component of the output voltage at firing angle = 90°. [8]

   b) Starting with a typical circuit arrangement for HVDC transmission line, compare HVDC transmission line with HVAC transmission. Also discuss the advantages and disadvantages of HVDC over HVAC. [8]

6. a) Explain the PID controller for speed control of dc shunt motor. [8]

   b) Explain the following methods of speed control of induction machine. [8]
   i) Frequency control only
   ii) Constant Volt/HZ control

   Discuss the advantage of constant volt/HZ control over frequency control.

   ***