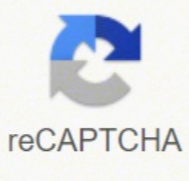I'm not robot

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Power electronics mcq with answers pdf free online download full

Advantages of SCR: It can handle large voltages, currents, and power. It can turn on accidentally due to the high dv/dt of the source voltage. It gives noiseless operation at high efficiency. Option 4 : MOSFET is majority carrier device, whereas IGBT, Diode Thyristor are minority carrier devices. India's #1 Learning Platform Start Complete Exam Preparation Daily Live MasterClasses Practice Question Bank Mock Tests & Quizzes Get Started for Free Download App Trusted by 2,74,20,154+ Students P1 and P2P2 and N2P1 and N1N1 and N2 Construction: The SCR is a four layer and three-terminal device. It is a bipolar device (current conduction by both types of carriers, i.e. majority and minority electrons and holes) It has a low input impedance. BJT: BJT's are current-driven devices. In inverter circuits, we would like the inverter output to be sinusoidal with magnitude and frequency controllable. One performs as a rectifier and the other performs as the inverter. Type B chopper (Second quadrant chopper): In type B chopper, load must always contain DC sources. AC to DC converters (Phase controlled rectifiers): These convert ac voltage to variable dc output voltage. Modes of operation of Dual converter: Non-circulating current mode: There is no circulating current between the converters in this mode as only one converter will perform at a time During converter 1 operation, firing angle (α1) will be between 0 and 90° During converter 2 operation, firing angle (α2) will be between 0 and 90° Circulating current Mode: In this mode, there is a circulating current as the two converters will be in the ON condition at the same time. We have to use special circuits called commutation circuits to turn off a conducting SCR. Types of Choppers: Type A Chopper or First-Quadrant Chopper Type B Chopper or Second-Quadrant Chopper Type C Chopper or Two-quadrant type-A Chopper Type D Chopper Type D Chopper or Two-quadrant type-B Chopper Type E Chopper or fourth-quadrant Chopper Note: Power electronic circuits can be classified as follows. When the chopper is off, \(\(V_0\) = E + I,\frac{(di)} {(dt)}\) thus V0 will be more than Vs and thus diode DB will be forward biased and begins conducting and power starts flowing to the source. As the diodes and the choppers conduct current only in one direction, the direction of load current will always be positive. 5. This is also thicker than the other layers and these two factors enable a large blocking voltage to be supported. A negative coefficient for a material means that its resistance decreases with an increase in temperature. Also known as a dc-to-dc converter. Calculation: Given that, firing angle of one bridge is 30° (i.e. α1 = 30°) We know that firing angles can never be greater than 180°. This rating is required in the choice of a fuse or other protective equipment employed for the SCR. The current through the two terminals is controlled by a current at the third terminal (base). DC to AC converters (Inverters): An inverter converts fixed DC voltage to a variable AC voltage. The output may be a variable voltage and variable frequency. Diode is both majority and minority carrier device. The input voltage may be single phase or three phase. We use a snubber circuit to control this limit. In order to produce a sinusoidal output voltage waveform at a desired frequency, a sinusoidal control signal at the desired frequency is compared with a triangular waveform. Thyristor is minority carrier device 4. The current through the two terminals is controlled by a voltage at the third terminal (gate) It is a unipolar device (current conduction is only due to one type of majority carrier either electron or hole) It has a high input impedance. These junctions are either alloyed or diffused based on the type of construction. dv/dt protection: When the SCR is forward biased, junctions J1 and J3 are forward biased and junction J2 is reverse biased. MOSFET is a majority carrier device. Two full converters are arranged in an anti-parallel pattern and linked to the same DC load. India's #1 Learning Platform Start Complete Exam Preparation Daily Live MasterClasses Practice Question Bank Mock Tests & Quizzes Get Started for Free Download App Trusted by 2,74,20,154+ Students Higher switching losses but lower conduction lossesHigher switching losses and higher conduction lossesLower switching losses and Lower conduction lossesLower switching losses but higher conduction losses Option 1 : Higher switching losses but lower conduction losses Concept: BJT MOSFET Bipolar device Unipolar device Low input impedance High input impedance Current controlled device Voltage-controlled device Low on-state voltage drop and low conduction loss Higher power handling levels and hence preferred in high power applications Lower power handling levels and hence preferred in low power applications Secondary breakdown occurs and high switching losses Free from the secondary breakdown and lower switching losses Negative temperature coefficient Positive temperature coefficient Not advisable for parallel operation Lower operating frequency(10kHz) higher operating frequency(100kHz) On state in the saturation region On state in the ohmic region Controlled turn on and turn off operation of the device Controlled turn on and turn off operation of the device Turn on and turn off time depend on junction capacitance Smaller turn off time Continuous Controlled signal requirement Continuous Controlled signal requirement India's #1 Learning Platform Start Complete Exam Preparation Daily Live MasterClasses Practice Question Bank Mock Tests & Quizzes Get Started for Free Download App Trusted by 2,74,20,154+ Students DC to DCAC to ACAC to DCDC to AC A chopper is a static device which is used to obtain a variable dc voltage from a constant dc voltage source. These converters can provide four-quadrant operations. In this type of chopper average value of current may be +ve or -ve. DC to AC converters (Inverters): An inverter converts fixed dc voltage to a variable ac voltage. The output may be a variable voltage and variable frequency. The lowest doping level is within the central N type layer. In majority carrier devices conduction is only because of majority carriers whereas in minority carrier devices conduction is due to both majority and minority carriers. We can control the power delivered to the load. Option 3 : To limit the rate of rise of voltage dv/dt. The gate and anode (P1 and P2) are the next heavily doped. The voltage drop across conducting SCR is small. The maximum frequency of its operation is 400 Hz. Gate current cannot be negative. The firing angles are adjusted such that Firing angle of converter 1 (α1) + firing angle of converter 2 (α2) = 180° Converter 1 as rectifier when 0° < α1 < 90° and converter 2 as inverter when 90° < α2 < 180° Converter 1 as inverter when 90° < α1 < 180° and converter 2 as rectifier when 0° < α2 < 90° Four quadrant operation of dual converter is shown below Application of dual converter: Direction and speed control of DC motors Application where the reversible DC required Industrial variable speed DC drives. 3. We use a series reactor to control this limit dv/dt rating of thyristor indicates the maximum rate of rising of anode voltage that will not trigger the device without any gate signal. The four layers made of P and N layers, are arranged alternately such that they form three junctions J1, J2 and J3. They can step up the DC voltage or step down the DC voltage levels. 4. AC to DC converters (Phase controlled rectifiers): These convert AC voltage to variable DC output voltage. These are two types as given below. 1. India's #1 Learning Platform Start Complete Exam Preparation Daily Live MasterClasses Practice Question Bank Mock Tests & Quizzes Get Started for Free Download App Trusted by 2,74,20,154+ Students positive resistance coefficient of the junctionnegative resistance coefficient of the junctionif the latching current is moreif the thyristor is loaded with wider current pulses. This will reduce the power dissipation in the SCR. DC to DC converters (DC Choppers): A dc chopper converts dc input voltage to a controllable dc output voltage. When a UJT is used for triggering an SCR, the wave shape of the voltage obtained from the UJT circuit is a saw-tooth wave. 3. AC to AC converters: The converts fixed ac input voltage into variable ac output voltage. This uncontrolled rise in temperature causes the component to get damaged. In this chopper, V0 is always +ve as F.D. is connected across it. AC to AC converters: These convert fixed AC input voltage into variable AC output voltage. False turn - ON of an SCR by large dv/dt, even without application of a gate signal can be prevented by using a snubber circuit. The operation does not produce harmonics. For regenerative breaking and motoring, there type of chopper configuration is used. Insulated gate Bipolar Transistor is also known as Conductivity-Modulated Field Effect Transistor. When the required voltage rating exceeds the SCR voltage rating, a number of SCR's are required to be connected in series to share the forward and reverse voltage. This current is enough to turn ON the SCR even without any gate signal. Doping level: The level of doping varies between the different layers of the thyristor.   Applications of SCR: Controlled rectifiers, DC to DC converters or choppers, DC to AC converters or inverters, As a static switch, Battery chargers, Speed control of DC and AC motors, Lamp dimmers, fan speed regulators, AC voltage stabilizers. This is called as dv/dt triggering of the SCR. dv/dt rating of thyristor indicates the maximum rate of rise of anode voltage that will not trigger the device without any gate signal. When chopper is off, V0 = 0 but I0 continues to flow in the same direction through freewheeling diode, thus V0 and I0 is always positive. This is the measure of the thermal energy that the SCR can absorb for a short period of time before clearing the fault by the fuse. i.e. α1 + α2 = 180° ∴ 30° + α2 = 180° α2 = 180° - 30° α2 = 150°   India's #1 Learning Platform Start Complete Exam Preparation Daily Live MasterClasses Practice Question Bank Mock Tests & Quizzes Get Started for Free Download App Trusted by 2,74,20,154+ Students The energy that the device can absorb while operating in the forward blocking modeThe energy that the device can absorb before the fault is clearedThe energy dissipated by the device when the fault occursThe power dissipated by the device when fault occurs Option 2 : The energy that the device can absorb before the fault is cleared I2t rating is used to determine the thermal energy absorption of the device. The UJT is a three-terminal, semiconductor device which exhibits negative resistance and switching characteristics for use as a relaxation oscillator in phase control applications. Diode rectifiers: A diode rectifier circuit converts ac input voltage into a fixed dc voltage. In extreme case, the voltage drop across SCR 1 (or the one having highest voltage drop) will be maximum forward blocking voltage. IGBT is minority carrier device Concept: Ripple frequency at the output = m × supply frequency fo = m × S frequency m = m = types of the pulse converter Calculation: A three-phase full-wave AC to DC converter is a 6-pulse converter Number of pulses (m) = 6 fo = 6 × supply voltage frequency ∴ f0 = 6 × 50 f0 = 300 Hz India's #1 Learning Platform Start Complete Exam Preparation Daily Live MasterClasses Practice Question Bank Mock Tests & Quizzes Get Started for Free Download App Trusted by 2,74,20,154+ Students 600 volts300 volts400 volts200 volts Formula: \(V_o=V_{in}(\frac{T}{T-T_{ON}})\)   --(1) Where, Vo is the output voltage Vin is the input voltage TON is the pulse width Application: Given, Vin = 200 volts TON = 200 μs V0 = 600 V From equation (1), \(\frac{V_o}{V_{in}}=(\frac{T}{T-T_{ON}})\) or, \(3=\frac{T}{T-200}\) or, 3T - 600 = T Hence, T = 300 μs If the Pulse width is half then, the new value of pulse width (TON) will be, \(T_{ON'}=\frac{T_{ON}}{2}=\frac{200}{2}=100\mu s\) Hence, Hence, the new value of output voltage (V0') will be, \(V_o'=V_{in}(\frac{T}{T-T_{ON'}})=200\times (\frac{300}{300-100})=300\volts\) India's #1 Learning Platform Start Complete Exam Preparation Daily Live MasterClasses Practice Question Bank Mock Tests & Quizzes Get Started for Free Download App Trusted by 2,74,20,154+ Students A snubber circuit consists of a series combination of resistance Rs and capacitance Cs in parallel with the thyristor. Thinner layers would mean that the device would break down at lower voltages. Option 2 : negative resistance coefficient of the junction Thermal runaway is a self-destruction process in which an increase in temperature creates such a condition which in turn increases the temperature again. Cycloconverters: These circuits convert input power at one frequency to output power at a different frequency through a one stage conversion. India's #1 Learning Platform Start Complete Exam Preparation Daily Live MasterClasses Practice Question Bank Mock Tests & Quizzes Get Started for Free Download App Trusted by 2,74,20,154+ Students \(\theta = {\cos ^ { - 1}}\left({\frac{\pi }{2} - \frac{1}{2}} \right)\;\;\\(\theta = {\cos ^ { - 1}}\left({\frac{\pi }{2} + 1} \right)\)\(\theta = {\cos ^ { - 1}}\left({\frac{\pi }{2}} \right)\)\(\theta = {\cos ^ { - 1}}\left({\frac{\pi }{2}} \right)\) Option 3 : \(\theta = {\cos ^ { - 1}}\left({\frac{\pi }{2} - 1} \right)\) Concept: The average output voltage of a full-wave controlled rectifier with R load is given by: \(V_{0} =\frac{{V_m}}{\pi} \left({1 + \cos \alpha } \right)\) Calculation: Given that, the average value of the average load current is equal to half of its maximum value. They may be fed from single phase or three phase. These find wide use in induction motor and synchronous motor drives, induction heating, UPS, HVDC transmission etc. Note: BJT MOSFET IGBT Bipolar device Unipolar device Bipolar device, Three terminal device (emitter collector and gate) Low input impedance High input impedance Current controlled device Voltage controlled device Voltage controlled device Low on-state voltage drop and low conduction loss High on-state voltage drop and higher conduction loss Low forward voltage drop, low ON state power loss than MOSFET, low conduction loss than MOSFET Secondary breakdown occurs Free from the secondary breakdown Secondary breakdown does not occur Negative temperature coefficient Positive temperature coefficient Positive temperature coefficient Not advisable for parallel operation Used for parallel operation Lower operating frequency(10kHz) higher operating frequency(100kHz) moderate operating frequency (50 kHz) On state in the saturation region On state in the ohmic region Controlled turn on and turn off device Controlled turn on and turn off device Turn on and turn off time depend on junction capacitance Smaller turn off time Controlled signal requirement continuously Controlled signal requirement continuously Controlled signal requirement India's #1 Learning Platform Start Complete Exam Preparation Daily Live MasterClasses Practice Question Bank Mock Tests & Quizzes Get Started for Free Download App Trusted by 2,74,20,154+ Students Minority carrier deviceMajority carrier deviceBoth majority and minority carrier deviceNone of the above Option 2 : Majority carrier device MOSFET: MOSFET is a voltage-driven/controlled device. 6. Triggering circuits are simple. India's #1 Learning Platform Start Complete Exam Preparation Daily Live MasterClasses Practice Question Bank Mock Tests & Quizzes Get Started for Free Download App Trusted by 2,74,20,154+ Students In a three-phase semi-converter, The conduction period of each thyristor = π - α The conduction period of freewheeling diode = β - 60° Where α is the firing angle β is the extinction angle Calculation: Given that, firing angle (α) = 120° Extinction angle (β) = 110° The conduction period of each thyristor = π - α = 180 - 120 = 60° The conduction period of freewheeling diode = β - 60° = 110 - 60° = 50° India's #1 Learning Platform Start Complete Exam Preparation Daily Live MasterClasses Practice Question Bank Mock Tests & Quizzes Get Started for Free Download App Trusted by 2,74,20,154+ Students The switching speed is very high.The operation does not produce harmonics.It gives noiseless operation at high efficiency.It has no moving parts. SCR cannot be used at high frequencies or perform high-speed operations. Type E chopper (four quadrant chopper): Only in type E chopper, both current and voltage remains negative i.e. when CH3-CH2 are ON and CH2-H4 conducts (In IIIrd quadrant) India's #1 Learning Platform Start Complete Exam Preparation Daily Live MasterClasses Practice Question Bank Mock Tests & Quizzes Get Started for Free Download App Trusted by 2,74,20,154+ Students Inverter, cyclo-converter and ac voltage controllerCyclo-converter and ac voltage controllerInverter and cyclo-controllerInverter and ac voltage controller Option 3 : Inverter and cyclo-controller Power electronic circuits can be classified as follows. Important Point: di/dt rating of thyristor indicates the maximum rate of rising of anode to cathode current. The device has only one junction, so it is called the unijunction device The device, because of one P-N junction, is quite similar to a diode but it differs from an ordinary diode as it has three terminals The structure of a UJT is quite simple When it surrounds the N-type (channel) material in the case of JFET and the gate surface of the JFE It is much larger than emitter junction of UJT In a unijunction transistor, the emitter is heavily doped while the N-region is lightly doped, so the resistance between the base terminals is relatively high, typically 4 to 10 kilo Ohm when the emitter is open The type silicon bar has a high resistance and the resistance between emitter and base1 is larger than that between emitter and base2; It is because emitter is closer to base2 than base1 UJT is operated with emitter junction forward- biased while the JFET is normally operated with the gate junction reverse-biased UJT does not have the ability to amplify but it has the ability to control a large ac power with a small signal; It exhibits a negative resistance characteristic and so it can be employed as an oscillator India's #1 Learning Platform Start Complete Exam Preparation Daily Live MasterClasses Practice Question Bank Mock Tests & Quizzes Get Started for Free Download App Trusted by 2,74,20,154+ Students Concept: A dual converter is an electronic converter or circuit which comprises of two converters. Snubber limits the dv/dt across the switching device during the turnoff of the device. Static switches: The power semiconductor devices can operate as static switches or contactors. When the load current exceeds the SCR current rating, SCR are connected in parallel to share the load current. The cathode (N2) is the most heavily doped. For lower power circuits, thyristors are replaced by power transistors. So in control power only during the one-half cycle of ac. All the four are majority carrier devices.All the four are minority carrier devices.IGBT and MOSFET are majority carrier devices, whereas Diode and Thyristor are minority carrier devices.MOSFET is majority carrier device, whereas IGBT, Diode Thyristor are minority carrier devices. We use a snubber circuit to control this limit India's #1 Learning Platform Start Complete Exam Preparation Daily Live MasterClasses Practice Question Bank Mock Tests & Quizzes Get Started for Free Download App Trusted by 2,74,20,154+ Students See that SCR turns ON at a voltage much less than its forward break over voltageTo protect the gate circuitTo limit the rate of rise of voltage dv/dt.To limit the rate of rise of current di/dt. Choppers find wide applications in dc drives, subway cars, trolley trucks, battery driven vehicles, etc. It is a 4 layer PNPN device that combines an insulated gate N-channel MOSFET input with a PNP BJT output in a type of Darlington configuration. Diode rectifiers: A diode rectifier circuit converts AC input voltage into a fixed DC voltage. It is not easy to turn off the conducting SCR. It has no moving parts. This reverse-biased junction J2 exhibits the characteristics of a capacitor. Since V0 is +ve and I0 is -ve, Type B chopper is IInd quadrant chopper Type C chopper (two quadrant type A chopper): Type - C chopper is obtained by connecting type A chopper and type B chopper in parallel. AC voltage controllers: These converter circuits convert fixed AC voltage directly to a variable AC voltage at the same frequency. These are used in dc drives, metallurgical and chemical industries, excitation systems for synchronous machines. \(\frac{{I_m}}{2} = \frac{{{I_m}}}{\pi} \left({1 + \cos \theta } \right)\) \(\theta = {\cos ^ { -1}}\left({\frac{\pi }{2} - 1} \right)\) India's #1 Learning Platform Start Complete Exam Preparation Daily Live MasterClasses Practice Question Bank Mock Tests & Quizzes Get Started for Free Download App Trusted by 2,74,20,154+ Students Sine wave Saw tooth waveTrapezoidal waveSquare wave Option 2 : Saw tooth wave Uni Junction Transistor (UJT): The uni-junction transistor is a solid-state three-terminal device that can be used in gate pulse, timing circuits, and trigger generator applications to switch and control both thyristors and triacs for AC power control type applications. For single-phase semi converter or delayed full-wave rectifier, \((V_0) =\frac{{{V_m}}}{\pi} \left({1 + \cos\alpha} \right)\) Calculation: Given that, \((V_0) = \frac{{{V_m}}}{3} = \frac{{{V_m}}}{\pi} \left({1 + \cos\alpha } \right)\) or, \(\frac{n }{3} = \left({1 + \cos\alpha } \right)\) \(\cos \alpha = 0.047 \alpha = \cos-1(0.047) India's #1 Learning Platform Start Complete Exam Preparation Daily Live MasterClasses Practice Question Bank Mock Tests & Quizzes Get Started for Free Download App Trusted by 2,74,20,154+ Students Bipolar Junction TransistorMetal Oxide Semiconductor Field Effect Transistor MOS- controlled ThyristorInsulated gate Bipolar Transistor Option 4 : Insulated gate Bipolar Transistor Insulated Gate Bipolar Transistor (IGBT) is a three-terminal power semiconductor device primarily used as an electronic switch. Depending upon the input supply, the static switches are called as static switches or dc static switches. i. DC to DC converters (DC Choppers): A dc chopper converts DC input voltage to a controllable DC output voltage. The main advantage of IGBT over SCR is its self-commutating capability i.e. it has a capability of being turned-on or turned-off at will by use of some form of low power (either voltage or current controlled) signal into a third (gate or base) terminal. 2. ∴ Vmax = 350 = (I - 6) R   ----(2) Put (I - 6) R = 350 in equation (1), we get Vs = 350 + 350 - 3 R + 350 - 6 R (350 + 300 + 250) = 1050 - 9 R 900 = 1050 - 9 R 9 R = 1050 - 900 \(R = \frac{(150)}{9}\)\(rm{\Omega }}\) R = 16.66 Ω Therefore the value of equalising resistor is based across each thyristor is 16.66 Ω. These are primarily used for slow speed large ac drives like rotary kiln etc. They find use in electric traction, battery charging, electroplating, electrochemical processing, power supplies, welding and UPS systems. Type D chopper (Two quadrant type B chopper) When the two choppers are ON, V0 = Vs Average output voltage V0 will be +ve when the chopper turns ON time 'TON' will be more than their turn off time 'Toff', otherwise it will be negative. Application: According to the question: Given that SCR 1 voltage = 350 V; current = 6 A SCR 2 voltage = 300 V; current = 9 A SCR 3 voltage = 250 V; current = 12 A Let us take the total current to be 'I' Current through resistor R in shunt with SCR 1 is I1 = I - 6 Similarly, current through resistor R is shunt with SCR 2 I2 = I - 9 And, current through resistor R in shunt with SCR 3 I3 = I - 12 Now, the string voltage becomes Vs = 11R + I2R + I3R Vs = (I - 6) R + (I - 9) R + (I - 12) R Vs = (I - 6) R (I - 6) R + (I - 6) R - 3 R + (I - 6) R ......(1) Note that We should consider the extreme case from the calculation of resistance R for voltage equalization in string of SCR. 2. Option 1 : The switching speed is very high. Easy to turn on. If the rate of the forward voltage applied is very high across the SCR, charging current flows through the junction J2 is high. When chopper is ON, V0 = 0 but load E drives the current through the inductor and the chopper and thus inductor stores energy during the time TON of the chopper. These are widely used for lighting control, speed control of fans, pumps, etc. AC voltage controllers: These converter circuits convert fixed ac voltage directly to a variable ac voltage at the same frequency.   Drawbacks of SCR: It can conduct only in one direction. India's #1 Learning Platform Start Complete Exam Preparation Daily Live MasterClasses Practice Question Bank Mock Tests & Quizzes Get Started for Free Download App Trusted by 2,74,20,154+ Students cos-10.047cos-10.678cos-10.866cos-10.386 Concept: Considered Vm is the maximum value of AC input voltage of converter and V0 is the average output voltage converter and α is delay angle.