QUIZ – ANSWER KEY

QUIZ NO: 89

TOPIC: ELECTRICAL ENGINEERING

DATE: 15/07/2022

1. What is the value of β in a transistor having IC = 100.2mA and IE = 100mA?

   [A] 101

   [B] About 1

   [C] 501

   [D] 201

   Answer: C

   Explanation:-

For common emitter, the current gain **β** is defined as the ratio of collector current to base current at a constant V_{CE} .

$$\beta = I_C/I_B$$

For common-base dc current gain (**α**) is defined as the ratio of the collector current, I_c, and the emitter current I_E and it is represented by α. The dc current gain α can be expressed as

$$\alpha = I_C/I_E$$

Relation between α & β

$$\beta = \alpha / (1 - \alpha)$$

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Given;

Collector current I_C = 100.2mA

Emitter current I_E = 100mA

$\alpha = I_C/I_E = 100.2/100 = 1.002$

$\beta = \alpha / (1 - \alpha) = 1.002/(1 - 1.002)$

$\beta = -501$

Here negative just gives information about its direction and nothing else. Because by convention positive current is always defined as flowing into the device. So if you have a PNP common base amplifier and you source current into the emitter input, it will flow out of the collector output. Since the current is flowing out, it is a negative current, hence the gain is negative.

2. Which of the following are the functions of a transistor?

   [A] Rectifier and fixed resistor

   [B] Switching device and fixed resistor

   [C] Tuning device and rectifier

   [D] Variable resistor and switching device

   Answer: D ;

Explanation:-
The transistor is a semiconductor device made by joining together three layers of P and N-type material.

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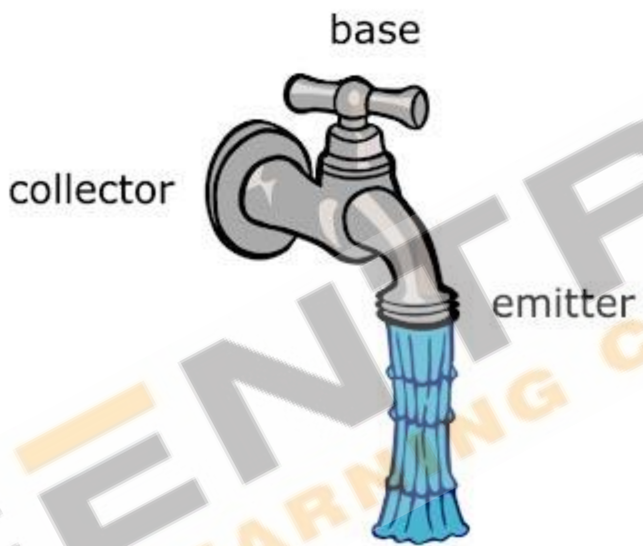
Operating a transistor

When you design a transistor circuit, you choose components that will put the transistor into the right operating mode (cutoff, active, or saturation), depending on what you want the transistor to do. Here's how:

Transistor as a variable Resistor:- The operation of a transistor could be explained by making an analogy to faucets.



The emitter is the source (as in the water supply). The handle of the faucet is equal to the base whereas the end of the opening where water will flow from is the equal of the collector. In a transistor, the collector is the output whereas the emitter is the input This leaves the base as the controller of current between the emitter and collector.

By applying a high enough voltage to the base (like exerting pressure on a faucet handle), you switch the transistor on, and current flows from the collector to the emitter (like the water flows through the pipe part of the faucet). If the voltage at the base is too low, you switch off the transistor, and no current flows from the collector to the emitter.

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When the transistor is switched on, you control the amount of current that flows from the collector to the emitter by controlling how much current flows into the base of the transistor. And the nice part about this fact is that small currents in the base control large currents flowing from the collector to the emitter.

It is correctly said that the transistor is nothing but the variable resistor. The resistance between collector and emitter depends upon the base current. Higher is the base current lower is the resistance between collector and emitter and at that time transistor is said to be in **ON** state.

Collector current, $I_C = \beta \times I_b$(base current)

Transistor amplifier: if you want to use the transistor as an amplifier (active model, you select supply voltages and resistors to connect to the transistor so that you forward-bias the base-emitter junction and allow just enough base current to flow—but not so much that the transistor becomes saturated. This selection process is known as biasing the transistor.

Transistor switch: If you want the transistor to act like an on/off switch, you choose values of supply voltages and resistors so that the base-emitter junction is either nonconducting (the voltage across it is less than 0.7 V) or fully conducting—with nothing in between. When the base-emitter junction is nonconducting, the transistor is in cut-off mode and the switch is off. When the base-emitter junction is fully conducting, the transistor is in saturation mode and the switch is on.

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3. In a rectifier circuit, the primary function of the filter is to?

[A] Control the DC level of the output voltage

[B] Remove ripples from the rectified output

[C] Minimize AC input variations

[D] Suppress odd harmonics In the rectifier output

Answer: B

Explanation:-

We know that rectifiers are used to convert AC to DC, but not a pure DC. The output that is obtained from a rectifier is pulsating in nature, which basically means that it has a certain amount of AC component called the ripple. These ripple components are very much unwanted and undesirable in a rectifier circuit as they reduce the efficiency of AC to DC conversion. So, in order to remove these components, filters are used. A filter (capacitor-based filter) in a circuit takes this mixed input and produces a pure DC output, bypassing the AC component to earth / neutral.

4. A rectifier for welding has voltage/current characteristics as

[A] Drooping

[B] Rising

[C] Static

[D] Variable

Answer: A

Explanation:-

It consists of a transformer (single-or three-phase) and a rectifier unit as shown in Fig. Such a unit has no moving parts, hence it has a long life. The only moving part is the fan for cooling the transformer. But this fan is not the basic part of the electrical system. Fig. shows a single-phase full-wave rectifier circuit of the welder.

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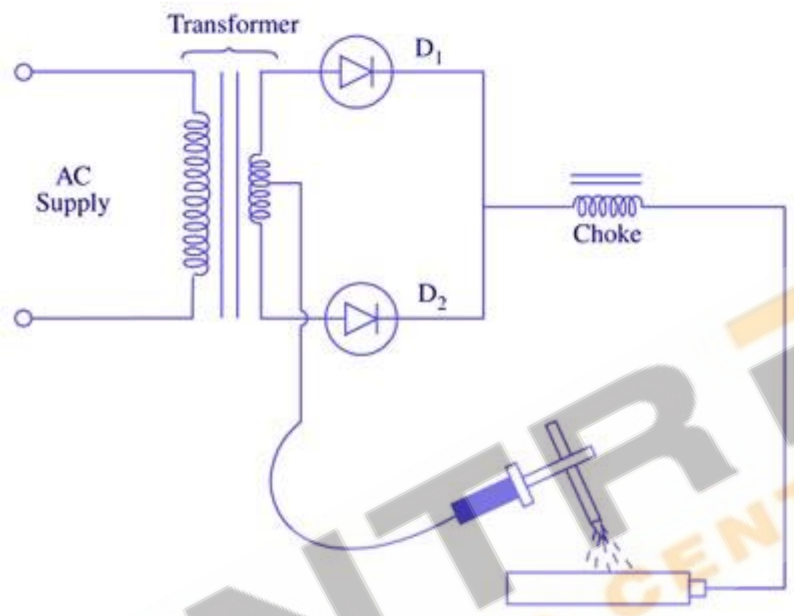
Silicon diodes are used for converting a.c. into d.c. These diodes are hermetically sealed and are almost ageless because they maintain rectifying characteristics indefinitely.



Such transformer-rectifier welding is most adaptable for shied arc welding because it provides both d.c. and a.c. polarities. It is very efficient and quiet in operation.

These welders are particularly suitable for the welding of

- Pipes in all positions
- Non-ferrous metals
- Low-alloy and corrosion-heat and creep-resisting steel
- Mild steel in thin gauges.

The open-circuit voltage of a constant-current, rectifier type power source ranges from about 50 to 100 V hence it provides the highest potential voltage when the welding current circuit is open and no current is flowing. At the start of the weld, with striking the arc, the sharp drop in voltage takes place from the OCV. A conducting column of ionized gases is formed along with the heating up of the electrode. As there is a drop in voltage, the simultaneous increase in welding current takes place. After a certain point, the voltage/current variation becomes

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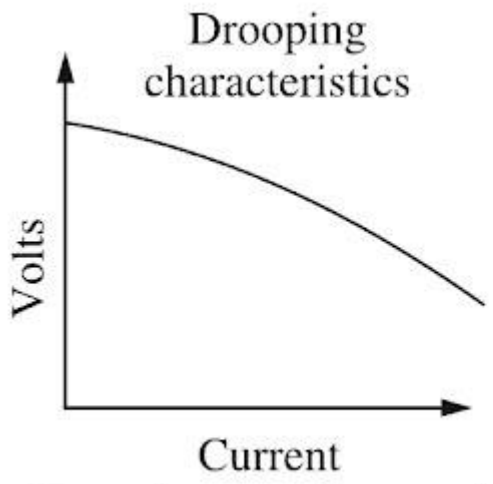
linear following Ohm's law. The static volt-ampere characteristics of a welding power source are shown in Fig.



Dropping-arc characteristics

5. During forward blocking state, the SCR has

   [A] Low current, medium voltage

   [B] Low current, large voltage

   [C] Medium current, large voltage

   [D] Large current, low voltage

   Answer: B

   Explanation:-

A **silicon-controlled rectifier** or **semiconductor-controlled rectifier** is a four-layer solid-state current-controlling unidirectional device (i.e. can conduct current only in one direction).

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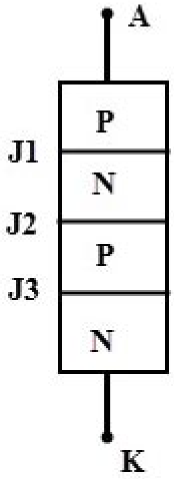

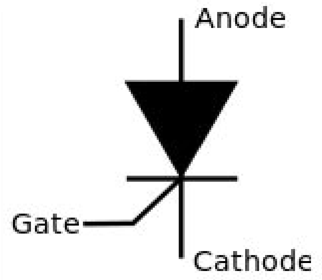

The silicon control rectifier (SCR) consists of four layers of semiconductors, which form NPNP or PNPN structures, having three P-N junctions labeled J_1, J_2 and J_3, and three terminals.

The SCR has Two state

1. High current Low Impedance ON state
2. Low current High Impedance OFF state

Forward Blocking Mode

The SCR is said to be forward-biased when the anode is made positive with respect to the cathode. Due to this forward bias, the junction J_1 and $J_3$are forward biased and J_2 is reverse biased. Hence the forward voltage is to be held by junction J_2. A very small current flows from anode to cathode. This current is called forward leakage current. This current is of the order of a few milliamperes. In the forward blocking mode, the voltage can be increased lit V_{BO}. When the forward voltage reaches VBO, the SCR turns on. During Forward Blocking Mode SCR acts as a Resistor.

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6. The function of SCR contactor in resistance welding machine is ?

[A] To provide an accurate weld time for each weld

[B] To connect the large power supply to welding by closing a small switch

[C] To provide full-wave rectification of the welding current

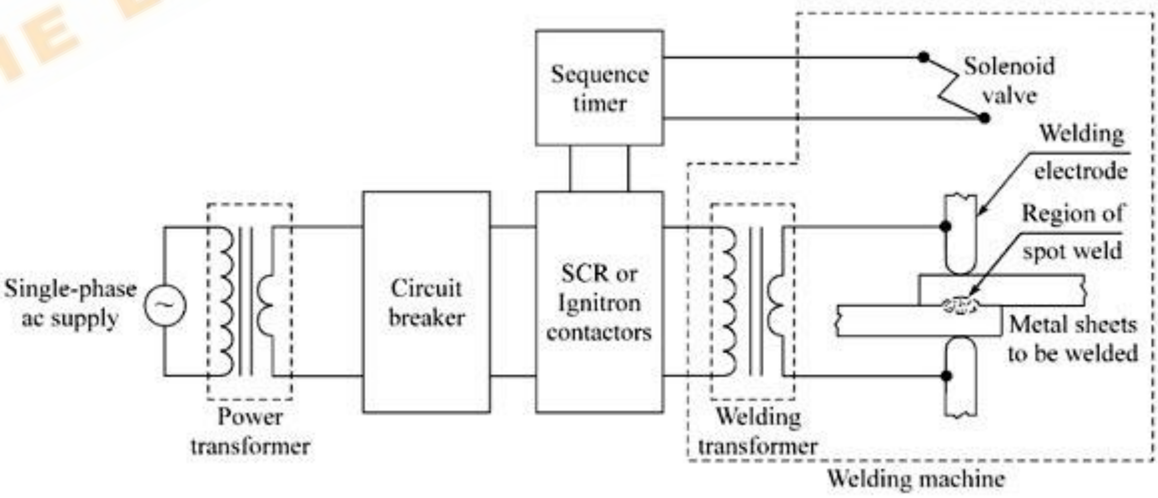
[D] To avoid saturation of transformation core

Answer: B

Explanation:-

SCR contractors are electronic control devices designed to handle large amounts of current. SCRs are triggered or turned on by pulses supplied by the timing or sequencing circuits of the welder. The SCRs are usually cooled by circulating water.

During the welding process, a large amount of current is required for short periods of time. Silicon-controlled rectifiers (SCRs) are commonly used to control the starting and stopping of the large currents associated with electric welders. The current rating of these devices must be very high, sometimes in the range of 1000 to 100,000 amperes, and the power distribution equipment must be able to handle these high currents.



Block representation of an ac resistance welding scheme.

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The two main functions of SCR is in phase control mode with transformers and in converter configuration.

The common SCR phase-controlled machines are three-phase machines in either constant current or constant voltage modes. Because of electronic control of output characteristics, automatic line voltage compensation is easily achieved; this allows the machine to set the precise welding power, independent from the variations of input power. An SCR can also serve as a secondary contactor that allows the welding current to flow only when the control allows the SCRs to conduct. This is a very useful feature in spot welding and tack welding operations, in which rapid cycle operation is required. An SCR contactor does not provide electrical isolation; this requires that a circuit breaker or similar device would be provided for electrical safety.

7. A single-phase full-bridge inverter is fed from a 48 V battery and is delivering power to a pure resistance load what is the value of fundaments output voltage?

[A] 15.80

[B] 22.26

[C] 8.36

[D] 43.22

Answer: D

Explanation:-

The output dc voltage of single phase full bridge inverter is given as

$E_o = 2\sqrt{2}E_{dc}/\pi$

Where;

E_{dc} = Input DC voltage = 48 V

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$E_o = 2\sqrt{2} \times 48/\pi$

$E_o = 43.22$ V

8. A three-phase diode bridge rectifier is fed from a 400 V RMS, 50 Hz, three-phase AC source. If the load is purely resistive, then peak instantaneous output voltage is equal to?

   [A] 400 V
   [B] $\sqrt{2} \times 400$
   [C] $400/\sqrt{2}$
   [D] $\sqrt{2}/400$

Answer: B

Explanation:-
Given;

RMS voltage = 400 V

Peak voltage or Maximum voltage = $\sqrt{2}$.RMS

Peak voltage = $\sqrt{2} \times 400$

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9. The peak inverse voltage, in case of a bridge rectifier, for each, the diode is: (where Eo = Peak value of input voltage).
   - [A] Eo
   - [B] 2Em
   - [C] 3Em
   - [D] 4Em

Answer: A

Explanation:-

Peak inverse voltage:- Peak inverse voltage (P.I.V) is the maximum voltage across the diode when it is not conducting. This happens during the negative half of the applied voltage when the diode does not conduct. At this stage, the voltage across the diode is equal to the applied voltage.

Peak Inverse Voltage of the bridge Rectifier:-

Bridge Rectifier:- A bridge circuit acts as a full-wave rectifier without the use of a center-tapped transformer. It consists of four diodes in two pairs **D_1, D_3, and D_2, D_4,** connected to form a bridge as shown in **Fig.** The A.C supply to be rectified is applied to the diagonally opposite ends of the bridge through a transformer. The load resistance R_L is connected between the other Iwo ends of the bridge.

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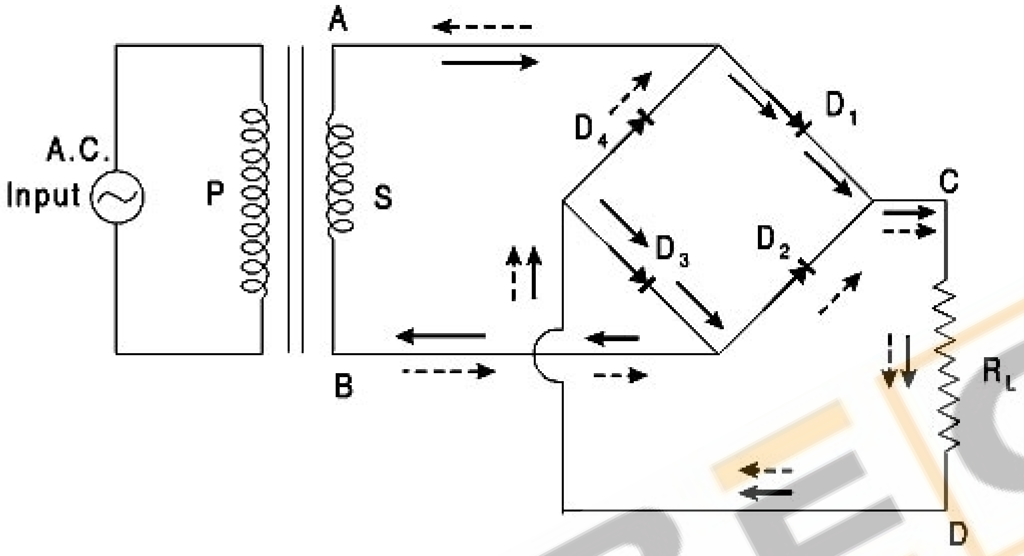

Working:- During the positive half cycle of A.C when the end A of the secondary of the transformer is positive and the end B is negative the diodes **D_1, D_3** is forward biased while the diodes **D_2, D_4** are reverse biased. Therefore, only the diodes **D_1, D_3** conduct and the direction of flow of current are shown by full line arrows. The current flows from A to the first diode D, to C, through the load resistance R_L lo D, to the second diode D_3, and then to B. thus completing the circuit.

During the negative half-cycle when the end B of the secondary of the transformer is positive and the end A is negative the diodes **D_2, D_4** are forward biased, whereas the diodes **D_1, D_3** are reverse biased. Therefore. only the diodes **D_2, D_4** conduct, and the direction of flow of current is shown by dotted line arrow heads. The current flows from B to the first diode D2 to C through the load resistance R_L to D, the second diode D_4, and then to A thus completing the circuit. During both the half cycles the current through the load resistance R_L, flows in the same direction I.e., C to D. The peak inverse voltage of each diode is equal to the maximum secondary voltage, E_o of the transformer as proved below.

Peak inverse voltage:- If during the half-cycle of a c. input the end A of the secondary of the transformer is positive and end B is negative, diodes **D_1 and D_3** are forward biased, while the diodes **D_2 and D_4** are reverse biased. Since the diodes are

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considered ideal. the diodes **D_1 and D_3** have negligible forward resistance and can be taken to be simple connecting wires. In such a case the two reverse-biased diodes **D_2 and D_4** and the secondary of the transformer are in parallel. Hence the peak inverse voltage of each diode **D_2 or D_4** is equal to the maximum E_o across the secondary. Similarly, during the next half-cycle, **D2 and D4** are forward biased and can be taken to be simple connecting wires. In such a case diodes **D_1 and D_3** and the secondary of the transformer are in parallel. Hence again the peak inverse voltage of **D_1 or D_3**. is equal to the maximum voltage **E_o.**

Hence each diode has only transformer voltage across it on the inverse cycle. In other words, the peak inverse voltage is equal to the peak transformer secondary voltage **E_m or E_o**

10. The fully controlled thyristor converter in the figure is fed from a single-phase source. When the firing angle is 0°, the DC output voltage of the converter is 300 V. What will be the output voltage for a firing angle of 60°, assuming continuous conduction?

    [A] 300
    [B] 150
    [C] 200
    [D] 700

Answer: B

<u>Explanation:-</u>
The output voltage of a fully controlled single-phase rectifier is given by

$V_o = 2V_m\cos\alpha/\pi$

Now at $\alpha = 0°$ Dc output is 300 V

$300 = 2V_m\cos 0°/\pi$

$300 = 2V_m/\pi$————(1)

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For firing angle 60° the output voltage will be

$V_o = 2V_m\cos 60°/\pi$

Putting the value of $2V_m/\pi$ in equation 1 we get

$V_o = 300\cos 60°$

$V_o = 150$ V

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