

Code: DE-06

Subject: BASIC ELECTRONICS

JUNE 2007

Time: 3 Hours

Max. Marks: 100

NOTE: There are 9 Questions in all.

- Question 1 is compulsory and carries 20 marks. Answer to Q. 1. must be written in the space provided for it in the answer book supplied and nowhere else.
 - Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.
 - Any required data not explicitly given, may be suitably assumed and stated.
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Q.1 Choose the correct or best alternative in the following: (2x10)

a. Which of the following components are all active components

- (A) A resistor and a capacitor.
- (B) A microphone, a LCD and a Thyatron.
- (C) An electric bulb, a transformer and a varactor diode.
- (D) An SCR, a vacuum diode and an LED.

b. Doping materials are called impurities because they

- (A) Decrease the number of charge carriers.
- (B) Change the chemical properties of semiconductors.
- (C) Make semiconductors less than 100 percent pure.
- (D) Alter the crystal structures of the pure semiconductors.

c. Avalanche breakdown is primarily dependent on the phenomenon of

- (A) Collision
- (B) Doping
- (C) Ionisation
- (D) Recombination

d. In a rectifier, larger the value of shunt capacitor filter

- (A) Larger the peak-to-peak value of ripple voltage.
- (B) Larger the peak current in the rectifying diode.
- (C) Longer the time that current pulse flows through the diode.
- (D) Smaller the dc voltage across the load.

e. The main reason why electrons can tunnel through a P-N junction is that

- (A) They have high energy.
- (B) Barrier potential is very low.
- (C) Depletion layer is extremely thin.
- (D) Impurity level is low.

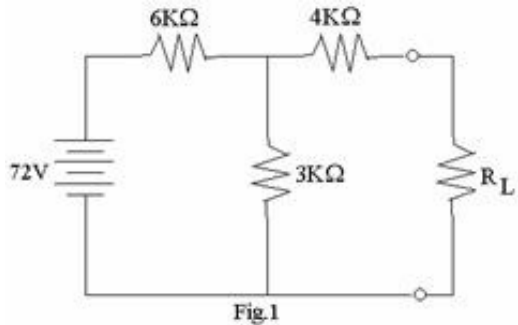
- f. If a change in base current does not change the collector current, the transistor amplifier is said to be
- (A) Saturated. (B) Cut-off.
(C) Critical. (D) Complemented.
- g. The extremely high input impedance of a MOSFET is primarily due to the
- (A) Absence of its channel.
(B) Negative gate-source voltage.
(C) Depletion of current carriers.
(D) Extremely small leakage current of its gate capacitor.
- h. After firing an SCR, the gating pulse is removed. The current in the SCR will
- (A) Remains the same. (B) Immediately fall to zero.
(C) Rise up. (D) Rise a little and then fall to zero.
- i. An inverting operational amplifier has $R_f = 2M\Omega$ and $R_1 = 2K\Omega$. Its scale factor is
- (A) 1000. (B) -1000 .
(C) 10^{-3} . (D) -10^{-3} .
- j. In the context of IC fabrication, metallisation means
- (A) Connecting metallic wires.
(B) Forming interconnecting conduction pattern and bonding pads.
(C) Depositing SiO_2 layer.
(D) Covering with a metallic cap.

Answer any FIVE Questions out of EIGHT Questions.

Each question carries 16 marks.

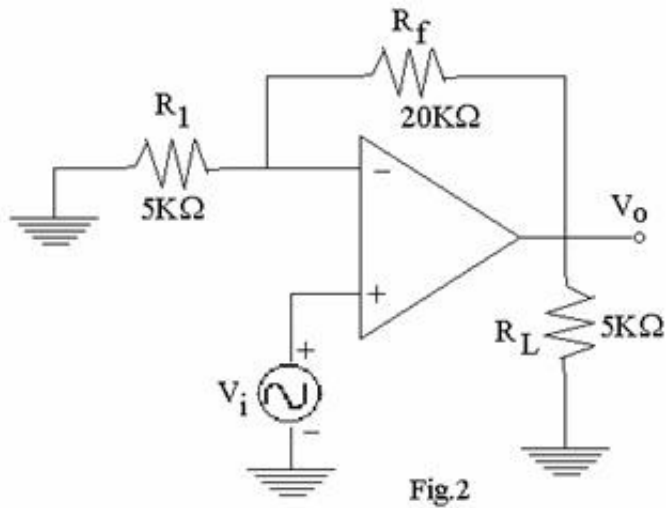
- Q.2** a. What do you mean by Passive components? Explain how the variable resistor can be used as a rheostat and Potentiometer with the help of symbols. Give their applications. (5)
- b. What is a Practical Current source; Explain its V-I characteristics. Convert an a.c. current source of 2A in parallel with an impedance of 100Ω into its equivalent voltage source. (6)
- c. Determine the current flowing through the load resistor (R_L) when $R_L = 6K\Omega$ for the network

shown below in Fig.1 by using Thevenin's theorem. (5)



- Q.3** a. Explain what do you understand by intrinsic, P-type and N-type semiconductors. Discuss the position of Fermi Level in each case with the help of Energy Band Diagram. (7)
- b. Distinguish between Mobile Charge Carriers and Immobile Ions. (5)
- c. Calculate the Intrinsic conductivity of silicon at room temperature if $n = 1.41 \times 10^{16} \text{ m}^{-3}$, $\mu_e = 0.145 \text{ m}^2/\text{Vs}$, $\mu_n = 0.05 \text{ m}^2/\text{Vs}$ and $e = 1.6 \times 10^{-19} \text{ C}$. What are the individual contributions made by electrons and holes? (4)
- Q.4** a. What is breakdown diode? What is its use? Describe physically how two mechanisms of breakdown occurs in a p-n junction diode. (7)
- b. Find the static and the dynamic resistance of a p-n junction Germanium diode, if the temperature is 27°C and $I_S = 1\mu\text{A}$ for an applied forward bias of 0.2V. (4)
- c. What is Schottky diode? Why is it also called Hot-Carrier diode? How does it differ in construction from a normal P-N junction diode. (5)
- Q.5** a. Draw the circuit diagram of Four-diode Full-wave Bridge Rectifier and explain its operation. What are its advantages and disadvantages. (6)
- b. A half-wave rectifier using silicon diode has a secondary e.m.f of 14.14V (r.m.s.) with a resistance of 0.2Ω . The diode has a forward resistance of 0.05Ω and a threshold voltage of 0.7V. If the load resistance is 10Ω . Determine
 (i) d.c. load current. (ii) d.c. load voltage.
 (iii) Voltage regulation. (iv) Efficiency. (5)
- c. Draw the functional block diagram of Three-Terminal Voltage Regulator IC and describe its operation. (5)

- Q.6** a. Define a Transistor. Draw the circuit diagrams of p-n-p and n-p-n transistors with proper biasing voltages. Also indicate the reference directions for the currents and the reference polarities for the voltage. (5)
- b. Define Transistor characteristics? Sketch the output characteristics of a transistor in its CB mode. Explain the Active, cut-off and saturation Regions. (7)
- c. The current gain α of an n-p-n transistor is 0.98. It is connected in the CB mode and gives a reverse saturation current $I_{c0} = 12\mu\text{A}$. Find the Base and the collector currents for an Emitter current of 2mA. (4)
- Q.7** a. What is MOSFET? How does MOSFET differ from JFET? Why MOSFETs are more widely used than the JFETs? (4)
- b. Draw the structure of an N-channel JFET and explain its principle of operation with neat diagrams along with V-I characteristics. Define Pinch-off voltage and mark it on the characteristics. Explain its significance in the operation of JFET. (8)
- c. Determine the Pinch-off voltage for an N-channel silicon JFET with a channel width of $5.6 \times 10^{-4} \text{ cm}$ and a donor concentration of 10^{15} cm^{-3} ; Given that dielectric constant of silicon is 12. (4)
- Q.8** a. What is an SCR? Explain the construction, working and V-I characteristics of an SCR for different gate currents and indicate there-upon holding current, latching current and breakover voltage. (8)
- b. What is an integrated circuit? Explain how a capacitor can be constructed in a monolithic IC. (4)
- c. What is photo-electric emission? Explain how is this emission affected if the frequency and the intensity of the incident radiations are increased. (4)
- Q.9** a. Draw the circuit of an OP-AMP Differential Amplifier and derive an expression for its output voltage. (5)
- b. In the circuit shown below in Fig.2, calculate
 (i) V_o (ii) A_{CL} (iii) The Load Current I_L
 (iv) The output current I_o indicating proper direction of flow. (6)



- c. Explain the operation of an OPAMP current-to-voltage converter with the help of circuit diagram. (5)