Code: D-06 **Subject: BASIC ELECTRONICS**

December 2005

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.**

Q.1 Choose the correct or best alternative in the following: (2x10)

a. The colour code of a resistor of nominal value $2.7K\Omega \pm 10\%$ is

(A) Red, violet, red and silver. **(B)** Red, violet, yellow and gold.
(C) Red, violet, orange and silver. **(D)** Red, violet, red and gold.

b. Capacitor that can have the highest capacitance value is

(A) Mica **(B)** Paper
(C) Electrolytic **(D)** Ceramic

c. The equivalent current-source representation for a voltage-source with open circuit voltage 12 V and internal resistance 3 ohms is

(A) a current-source of strength 4A in shunt with a resistance of 6Ω.
(B) a current –source of strength 4A in series with a resistance of 3Ω.
(C) a current-source of strength 4A in shunt with a resistance of 3 ohms.
(D) A current-source of strength 4A in shunt with a resistance of 36 ohms.

d. An intrinsic semiconductor at absolute zero temperature

(A) has a large number of holes.
(B) behaves like an insulator.
(C) behaves like a metallic conductor.
(D) has few holes and same number of electrons.

e. The current flow through a Ge PN junction diode with a forward bias of 0.22 Volt and a reverse saturation current of 1 ma at $25^{\circ}C$ is around

(A) 6.3 A **(B)** 5.22 A

(C) 4 mA **(D)** 5.1 mA

f. For the operation of a depletion-type N-MOSFET, the gate voltage has to be

(A) low positive **(B)** high positive
(C) high negative **(D)** zero

g. The typical operating voltage for LED's ranges from

(A) 0.2 V to 0.6 V. **(B)** 6 V to 10 V.
(C) 1.5V to 2.5 V. **(D)** 9 V to 10 V.

h. Capacitors for integrated circuits

(A) cannot be made using diffusion techniques.
(B) can be made with very high values of capacitance.
(C) are always discrete components connected externally.
(D) can be made using silicon dioxide as the dielectric.

i. The magnitude of variation in the output voltage for a 10 V regulated dc power supply of 0.002% regulation will be

(A) 0.2 mV. **(B)** 0.002 mV.
(C) 0.02 mV. **(D)** 0.2 μV.

j. For the circuit shown in Fig.1, the output voltage is given by

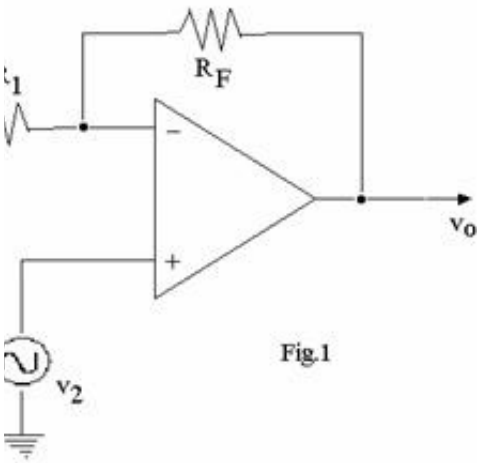

Fig.1

(A) $v_o = \frac{R_F}{R_1}(v_2 - v_1)$.

(B) $v_o = \frac{R_F}{R_1}(v_2 - v_1) - v_2$.

(C) $v_o = \frac{R_F}{R_1}(v_2 - v_1) + v_2$.

(D) $v_o = (v_2 - v_1) / (R_1 + R_F)$.

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. What is a passive circuit element? Name the most commonly used passive circuit elements. Briefly explain the following :

(i) Thin film resistors.
(ii) Wire-wound resistors. **(8)**

b. Describe the V-I characteristic of a practical voltage source. Find the largest practical value of load resistance to provide constant current from a current source with $I_s = 30mA$ and $R_s = 15K\Omega$. Comment on the variation of current from the short-circuited value. **(8)**

Q.3 a. What is an N-type semiconductor? Write its energy band diagram. **(5)**

b. An intrinsic semiconductor (Si) has 5×10^{28} atoms/ m^3 at $20^\circ C$ room temperature. There are 1.5×10^{16} electron-hole pairs at this temperature. If the conductivity increases at the rate of 5% per degree centigrade, find the conductivity of Si at $34^\circ C$. Take the mobility of hole and electron as 0.048 $m^2 / volt - sec$ and 0.135 $m^2 / volt - sec$, respectively. **(5)**

c. What is a PN junction? Draw its circuit symbol. What is the convention followed in writing its symbol? Illustrate its characteristic and make it self explanatory. **(6)**

Q.4 a. Explain the operation of a two-diode full wave rectifier circuit. **(7)**

b. Briefly explain half-wave voltage doubler circuit with neat illustrations. **(5)**

c. A 4:1 transformer supplies a bridge rectifier that is driving a load of 200 ohms. If the transformer input is 230 V/ 50 Hz supply, calculate the dc output voltage, PIV, and the output frequency. Assume the rectifier diodes to be ideal. **(4)**

Q.5 a. How are Zener diodes specified? Define the important specification factors for the device. **(5)**

b. Establish the theory of a Zener diode shunt regulator. **(7)**

c. For a Zener shunt regulator, if $V_Z = 10V$, $R_S = 1K\Omega$, $R_L = 2K\Omega$ and the input voltage varies from 22 V to 40 V, find the minimum and maximum values of Zener current. **(4)**

Q.6 a. What are the three modes in which a transistor can operate? Explain the meaning of each mode of operation. **(9)**

b. Draw the circuits of an NPN and a PNP transistor in CE configuration. Define the following:
(i) CE dc current gain.
(ii) CE ac current gain. **(4)**

c. A transistor has $\beta = 150$. Calculate the approximate collector and base currents if the emitter current is 10 mA. **(3)**

Q.7 a. What is a field effect transistor (FET)? Which are the different types of FET's available? Draw the circuit arrangement for obtaining the drain characteristics of a JFET and explain the procedure for obtaining the above characteristic curves. Illustrate the typical drain characteristic curves for the device. **(13)**

b. The data sheet for an N-channel JFET provides the following:

$$I_{D,SS} = 20mA, V_P = -8V, g_{m,o} = 5000\,\mu$$

Determine the values of the drain current and transconductance for the device at $V_{GS} = -4 volts$. **(3)**

Q.8 a. What is an unijunction transistor? Compare it with an ordinary diode & briefly describe its construction. Draw its circuit symbol and equivalent circuit. **(9)**

b. What is an integrated circuit? What are its limitations? **(5)**

c. Define the term 'work-function' of a metal. What is thermionic emission? **(2)**

Q.9 a. List the characteristics of an ideal and a practical OPAMP. **(6)**

b. In the circuit shown in Fig.2, if $v_i = 1V$, calculate I_1, v_0, I_L and I_o. **(4)**

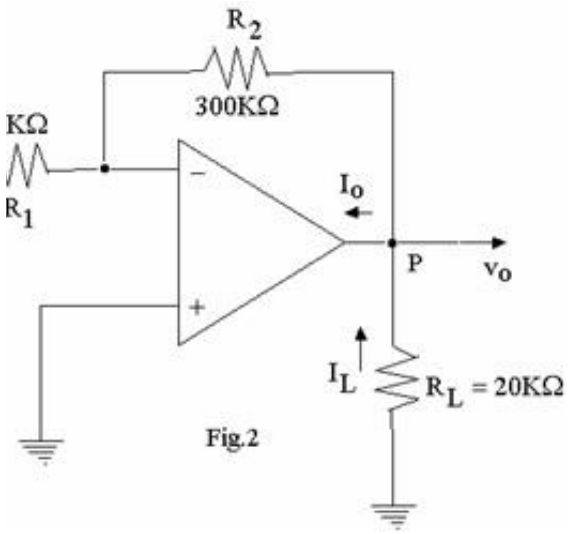

Fig.2

c. Draw the circuit of an OPAMP V-to-I converter with grounded load and derive the equation for the current through the load. **(6)**