Code : 104301

B.Tech 3rd Semester Exam., 2020
(New Course)

BASIC ELECTRONICS

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

(ii) There are ***NINE*** *questions in this paper.*

(iii) Attempt ***FIVE*** *questions in all.*

(iv) Question No. ***1*** *is compulsory.*

1. Choose the correct option of the following (any *seven*) : 2×7=14

(a) Which of the following expressions represents the correct formula for the density of electrons occupying the donor level?

(i) $n_d = N_d - N_d^+$

(ii) $n_d = N_d - N_d^-$

(iii) $n_d = N_d + N_d^+$

(iv) $n_d = N_d + N_d^-$

(b) What is the ripple factor of a half-wave rectifier?

(i) 0·31

(ii) 0·48

(iii) 0·707

(iv) 1·21

(c) Which of the following is true about the resistance of a Zener diode?

(i) It has an incremental resistance

(ii) It has dynamic resistance

(iii) The value of the resistance is the inverse of the slope of the *i-v* characteristics of the Zener diode

(iv) All of the above

(d) Which of the following is true in construction of a transistor?

(i) The collector dissipates lesser power

(ii) The emitter supplies minority carriers

(iii) The collector is made physically larger than the emitter region

(iv) The collector collects minority charge carriers

(e) Consider the following statements :

A clamper circuit

1. adds or subtracts a d.c. voltage to a waveform
2. does not change the waveform
3. amplifies the waveform

Which are correct?

(i) 1, 2
(ii) 1, 3
(iii) 1, 2, 3
(iv) 2, 3
(v) None of the above

(f) For what kind of amplifications can the active region of the common-emitter configuration be used?

(i) Voltage
(ii) Current
(iii) Power
(iv) All of the above

(g) How does the FET operate before the pinch-off region with small value of drain-to-source voltage in accordance to the control of drain-to-source resistance by the bias voltage?

(i) As a voltage controlled resistor
(ii) As a voltage dependent resistor
(iii) As a voltage variable resistor
(iv) All of the above

(h) A junction FET can operate in

(i) depletion mode only
(ii) enhancement mode only
(iii) depletion and enhancement modes
(iv) neither depletion nor enhancement mode

(i) Which of the following is not a property of an ideal operational amplifier?

(i) Zero input impedance
(ii) Infinite bandwidth
(iii) Infinite open-loop gain
(iv) Zero common-mode gain or conversely infinite common mode-rejection

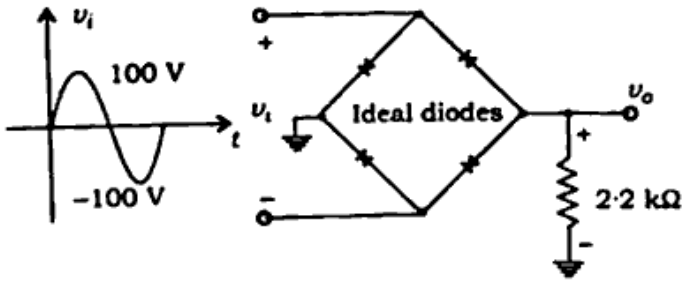
(j) Which among the following is the major responsible reason for the cause of 'slew rate'?

(i) Current limiting
(ii) Saturation of internal stages due to application of high frequency and amplitude signal
(iii) Both (i) and (ii)
(iv) None of the above

2. *(a)* Draw potential energy diagrams for a forward as well as a reverse-biased *p-n* junction and explain the flow of currents in both the cases.

(b) The *p*-silicon has resistivity of 100 Ω cm. The other parameters for silicon are : Intrinsic carrier density, $n_i = 1010\ cm^{-3}$, Hole mobility, $\mu p = 500\ cm^2/v.s$ and Electron mobility, $\mu n = 1200\ cm^2/v.s$. Calculate the number of electrons for every 5000 million holes in the semiconductor. 7+7=14

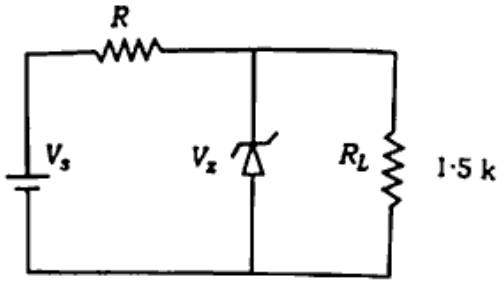
3. *(a)* Determine v_o and the required PIV rating of each diode for the configuration of the following figure :



In addition, determine the maximum current through each diode.

(b) The circuit shown below uses a 9 V Zener diode. If the load resistance R_L is equal to 1·5 kΩ and the d.c. source

equals 24 V, find the maximum value of resistor R required to maintain a constant voltage of 9 V across the load. 7+7=14



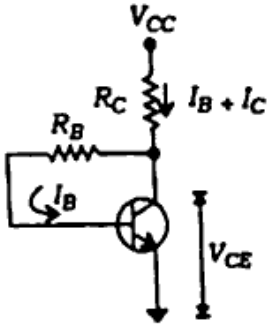
4. *(a)* Draw the cross-sectional view of an *n-p-n* transistor and explain its operation in active region of operation. What are the different current components of the transistor? How can one use a transistor as amplifier?

(b) Define α_{dc} and β_{dc}. Derive the relationship between α_{dc} and β_{dc}. If the base current in a transistor is 30 μA, when the emitter current is 7·2 mA, what are the values of α_{dc} and β_{dc}? Also, calculate the collector current. 7+7=14

5. *(a)* Draw and explain the input and output characteristics of CB configuration. Where can we use the CB configuration in a transistor circuit? Explain with proper justification.

(b) Design a collector to base bias circuit shown in the figure below for the specified conditions : 7+7=14

$V_{CC} = 15V, V_{CE} = 5V, I_C = 5\ mA, \beta = 150$

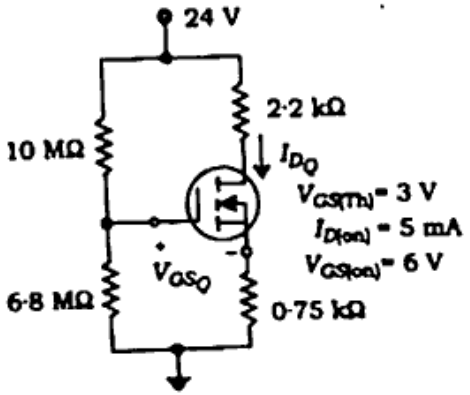


6. (a) Draw the structure of JFET and discuss its working. What is pinch-off voltage? How to get its value experimentally?

(b) For the voltage-divider configuration of the figure shown below, determine : 7+7=14

(i) I_{DQ} and V_{GSQ}

(ii) V_D and V_S



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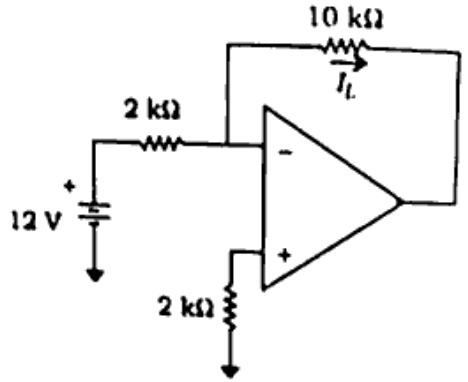
7. (a) Define an ideal operational amplifier. Draw the approximate block diagram of an OPAMP giving various stages of the amplifier.

(b) Find the output voltage of the following OPAMP circuit : 7+7=14



8. (a) Draw the gain-frequency response of an RC coupled amplifier. Discuss fall in gain at very low and at very high frequencies.

(b) Common emitter (CE) amplifier shown in the figure has voltage gain of 150 when $R_E = 0$. Stability is brought through negative feedback by adding resistor R_E. Calculate the value of resistor R_E using feedback

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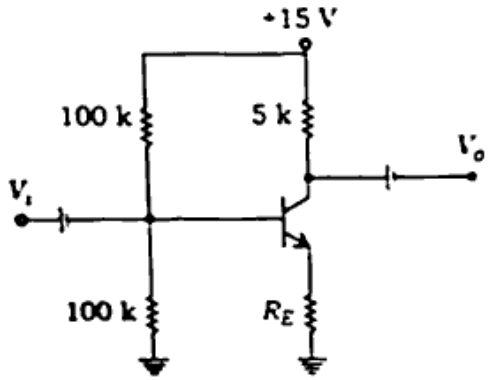
concepts so that final voltage gain ($= A_{FB}$) is equal to 100.

7+7=14



9. *(a)* Explain the construction and working principle of a photo diode (PD).

   (b) Explain the construction and working principle of an SCR. Write the applications utilizing SCR. 7+7=14

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