BRAINWARE UNIVERSITY

Term End Examination 2018 - 19

Programme – B.Sc. (Honours) in Computer Science

Course Name – Analog Electronic Circuits

Course Code – BECE010602

(Semester – 1)

Time allotted: 3 Hours **Full Marks: 70**

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

Group –A

(Multiple Choice Type Question) 10 x 1 = 10

1. *Choose the correct alternative from the following*

(i) At 0K an intrinsic semiconductor behaves like

a. super conductor b. insulator
c. semiconductor d. p-type semiconductor

(ii) A Si diode operating at room temperature has the reverse saturation current in the order of

a. mA b. μA
c. nA d. A

(iii) In BJT, I_c = 10 mA for I_b =100 μA, the approximate value of β is

a. 100 b. 10
c. 1000 d. 1

(iv) Most heavily doped region in BJT is the

a. emitter b. base
c. collector d. none of these

(v) If α =0.98, then β is equal to

a. 0.49 b. 49
c. 50 d. 0.5

(vi) Wein Bridge Oscillator is used in the range

a. Audio frequency b. Radio frequency
c. Very high frequency (VHF) d. Microwave frequency

(vii) Which of the following devices is expected to have the highest input impedance

a. MOSFET b. FET
c. BJT d. OPAMP

(viii) The transconductance of a FET is

a. directly proportional to $\sqrt{V_{DS}}$ b. directly proportional to I_{DS}
c. directly proportional to $\sqrt{I_{DS}}$ d. none of these

(ix) FET is a

a. voltage controlled device b. current controlled device
c. impedance controlled device d. resistance controlled device

(x) The common mode rejection ratio of an OP AMP is

a. much smaller than unity b. much larger than unity
c. unity d. none of these

Group – B

(Short Answer Type Questions) 3 x 5 = 15

Answer any *three* from the following

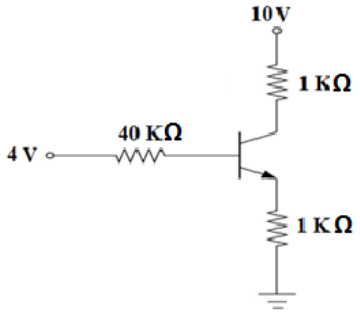
2. With the help of the energy band diagram, differentiate between metal, insulator and semiconductor. 5

3. Find out the relation between α and β for a transistor, where notations have their usually meanings. Find α and I_C of a transistor with β =49 and I_E =12 mA. 3+2

4. Sketch the structure of a p channel depletion type MOSFET. Explain how the depletion region is produced in the channel. Can a depletion MOSFET work in the enhancement mode? If so how? 5

5. Calculate the output voltage for the summing amplifier circuit using OPAMP. Given V_1=0.2V, V_2=2V, V_3=1V and R_1=5KΩ, R_2=20KΩ, R_3=50KΩ and R_f=30KΩ, where notations carry the usual significance. 5

6. The CE configuration of an n-p-n transistor is shown in the figure where V_{BE} = 0.7 V and V_{CE} = 0.2 V. If the emitter current is 3 mA, find out the collector current and the base current. . 5



Group – C

(Long Answer Type Questions) 3 x 15 = 45

Answer any *three* from the following

7. (a) Derive an expression for conductivity of a semi-conductor in terms of carrier concentration. 5

   (b) At 300K the intrinsic concentration of silicon is 1.5×10^{16} m^{-3}. If the electron and the hole mobilities are 0.13 $m^2/(Vs)$ and 0.05 $m^2/(Vs)$ respectively, determine the intrinsic conductivity and resistivity of silicon at 300K. 5

   (c) Draw the circuit diagram of a full wave rectifier using p-n junction diodes and explain its operation. 5

8. (a) Illustrate the formation of depletion region in p-n junction diode. Write down Shockley's equation, stating the meanings of different terms used stand for. 3+2

(b) The reverse saturation current at 300 K of a p-n junction Ge diode is 5 μA. Find the voltage to be applied across the junction to obtain a forward current of 50 mA. (Mass of electron=1.6 X 10^{-19} kg; Boltzmann Constant=1.38 X 10^{-23} J/k) 5

(c) A p-n junction Ge diode has reverse saturation current of 1.5 μA at 300 K. Obtain d.c and a.c. resistances of diode at forward bias of 0.3 V. 1+4

9. (a) Explain with the help of a block diagram, the working principle of a feedback amplifier. Hence deduce Barkhausen criterion of oscillation for both positive and negative feedback. 7+2

(b) Illustrate the merits of negative feedback in amplifier. 2

(c) An amplifier has voltage gain equal to -100. The feedback ratio is -0.04. Find i) Voltage gain with feedback, ii) the output voltage of feedback amplifier for an input voltage of 40 mV, iii) the feedback factor and iv) the feedback voltage. 4

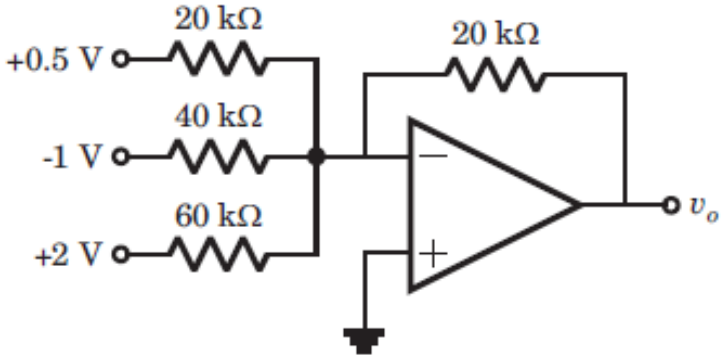
10. (a) Explain different current components of a transistor. 5

(b) A n-p-n transistor is operating in CE mode. Calculate V_{CE} if β= 125. Take V_{BE} = 0.6V, V_{BB} (base supply voltage)= 10 V, V_{CC} (collector supply voltage) = 20 V, R_B = (series resistance in base circuit) = 310 kΩ and R_C = (series resistance in collector circuit)= 5 kΩ. 5

(c) For a transistor, I_C = 7mA, I_{co} = 25 μA and I_B = 0.1mA, calculate α ,β and I_E, where notations carry their usual meanings. 5

11. (a) Describe the use of an OPAMP as differentiator. 5

(b) Find out the output voltage v_o and voltgae gain of the circuit given below 5



(c) A 5 mV, 1 KHz sinusoidal signal is applied to the input of an OPAMP integrator for which R = 100 KΩ and C = 1 μF. Calculate output voltage. 5