CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

IV Semester of B.Sc. Physic Examination April – May 2018

PD253 ANALOG SYSTEMS AND APPLICATIONS

Date: 02-05-2018 Day: Wednesday Time: 01.30 PM To 02:00 PM Maximum Marks: 20

MCQ

Important Instructions:

- Tick the correct answer and it should be written in question paper itself.
- Use of non-programmable calculator is allowed.

Q - I Choose the correct answer for the following questions. 20

1. In a semiconductor, the energy gap between valence band and conduction band is about _____.

(a) 1 eV (b) 2 eV (c) 3 eV (d) 5eV

2. A reversed biased pn junction has a resistance of the order of _____.

(a) Ω (b) mΩ (c) K Ω (d) M Ω

3. A semiconductor has usually _____ valence electrons.

(a) two (b) three (c) four (d) five

4. For silicon pn junction, the potential barrier is about _____.

(a) 0.1 eV (b) 2.1 eV (c) 0.7 eV (d) 1.7eV

5. The number of depletion layers in a transistor is _____.

(a) one (b) two (c) three (d) four

6. It is desirable that a transistor amplifier should have _____ input impedance and _____ output impedance.

(a) low, high (b) high, high (c) low, low (d) high, low

7. The maximum efficiency of a full-wave rectifier is _____.

(a) 40.6% (b) 81.2% (c) 82.1% (d) 63%

8. The end points of the d.c. load line give the _____ values of I_C and V_{CE} under d.c. conditions.

(a) Zero (b) maximum (c) minimum (d) maximum and minimum

9. For faithful amplification, the transistor must operate in the _____ region of the output characteristics.

(a) active (b) cut-off (c) neutral (d) saturation

10. For good stabilization of operating point in voltage divider bias, the current I_1 flowing through potential divider R_1 and R_2 should be equal to or greater than _____.

(a) $2I_B$ (b) $10I_B$ (c) $4I_B$ (d) $5I_B$

11. The input and output voltage of a common emitter transistor amplifier are _____.

(a) in phase (b) always equal (c) out of phase (d) always negative

12. The value of coupling capacitor in RC coupling is generally _____ .

(a) 100 μF (b) 10 μF (c) 0.001 μF (d) 1μF

13. One of the effects of negative feedback in amplifiers is to _____.

(a) increase the noise (b) increase the harmonic distortion

(c) decrease the bandwidth (d) decrease the harmonic distortion

14. A feedback circuit generally employs _____ network.

(a) inductive (b) capacitive (c) resistive (d) neutral

15. An oscillator employs _____ feedback.

(a) positive (b) negative (c) no (d) both positive and negative

16. In a phase-shift oscillator, the frequency determining elements are _____.

(a) L and C (b) R and C (c) L and R (d) L, R and C

17. To generate a 1MHz signal, the most suitable circuit is _____.

(a) Wein – Bridge oscillator (b) phase-shift oscillator

(c) Colpitt's oscillator (d) both (b) and (c)

18. An ideal OP-AMP has _____.

(a) infinite A_v (b) zero output resistance

(c) infinite input resistance (d) all the above

19. An ideal OP-AMP has bandwidth _____.

(a) zero (b) small (c) large (d) infinite

20. OP-AMPs have become very popular in industry mainly because_____.

(a) they are cheaper

(b) of their extremely small size

(c) available in different packages

(d) their external characteristics can be changed to suit any application

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PD253 ANALOG SYSTEMS AND APPLICATIONS

Date: 02-05-2018 Day: Wednesday Time: 02.00 PM To 04:30 PM Maximum Marks: 50

Instructions:

1. **Section I and II must be attempted in TWO ANSWER SHEET.**
2. Make suitable assumptions and draw neat figures wherever required.
3. Use of non-programmable calculator is allowed.
4. Show necessary calculations.

SECTION – I

Q – II Answer the following questions as directed **20**

1. Define α and β. Show that $\beta = \alpha / (1-\alpha)$ 2

2. Define four hybrid parameters h_{11}, h_{12}, h_{21} and h_{22}. 2

3. State the characteristics of an ideal op-amp. 2

4. What is an Op-Amp? Draw block diagram of a general purpose op-amp. 2

OR

Explain the working of any one block of a general purpose op-amp.

5. Draw the circuit diagram of Half wave rectifier. Explain its working. 3

OR

Prove that the ripple factor of a full wave rectifier is 0.482

6. Discuss the cut-off, saturation and active regions of the output characteristics of CE transistor circuit. 3

OR

With a neat diagram explain the operation of two-stage common emitter R-C coupled amplifier.

7. Discuss the advantages of negative feedback. Derive an expression for the gain of negative feedback amplifier. 3

OR

What is sinusoidal oscillator? What are its advantages? What is the Barkhausen criterion for oscillation?

8. Describe inverting and non inverting op-amp. 3

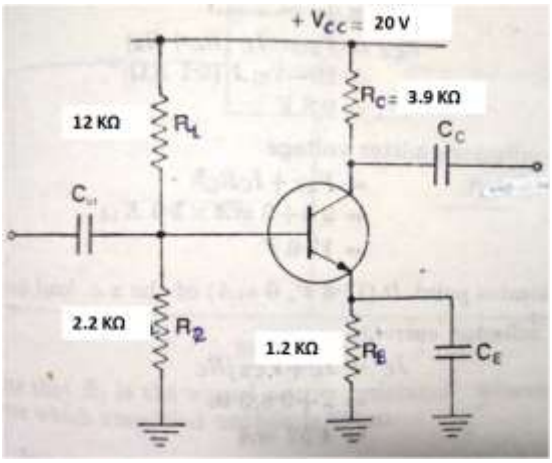
SECTION – II

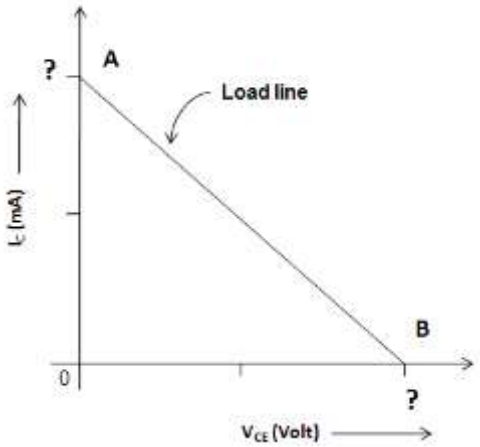
Q-III Answer the following questions **30**

1. Calculate the conductivity of pure silicon at room temperature when the concentration of carriers is 1.6×10^{10} per cm^3. Take mobility of electron (μ_e) = 1500 cm^2/volt-sec and mobility of hole (μ_h) = 500 cm^2/volt-sec at room temperature. 2

2. Calculate the built-in potential barrier of a pn junction. Consider a silicon pn junction at T = 300 K, doped $N_a = 10^{16}$ cm^{-3} in the p-region, $N_d = 10^{17}$ cm^{-3} in the n-region and $n_i = 1.5 \times 10^{10}$ cm^{-3}. 2

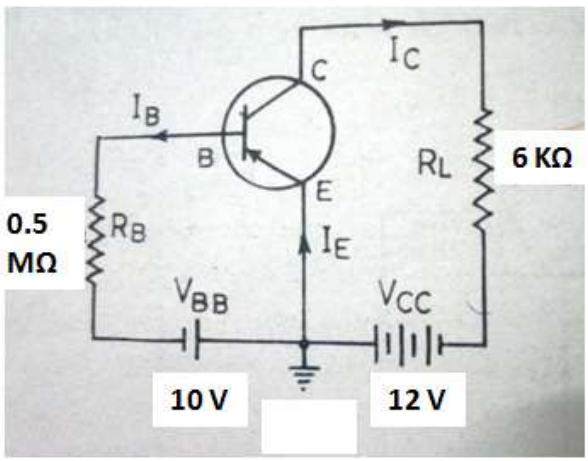
3. Figure shows the common emitter transistor amplifier circuit. Draw the dc load line for the circuit. Assume V_{BE} = 0.7 V. 2

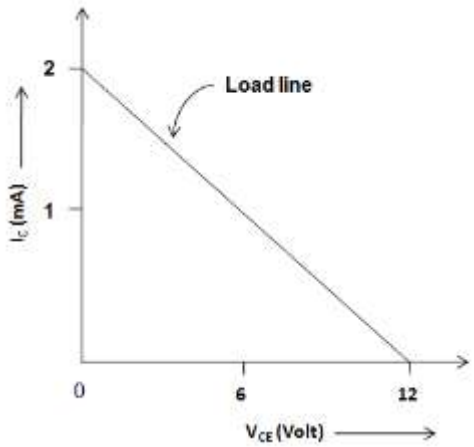




OR

For the circuit shown in Fig., draw the dc load line and locate the quiescent point. Assume β = 50 and neglect V_{BE}.





4. For a common base connection 2

i. I_E = 1 mA, I_C = 0.95 mA. Calculate the value of I_B.

ii. I_E = 1 mA, current amplification factor = 0.9, determine the value of base current.

5. i. Find the value of β if (a) α = 0.9, (b) α = 0.98, (c) α = 0.99. 2

ii. Calculate I_E in a transistor for which β = 50 and I_B = 20 μA.

6. An amplifier having a gain of 500 without feedback. If negative feedback is applied, the gain is reduced to 100. Calculate the fraction of the output fed back. If, due to ageing of components, the gain without feedback falls by 20% calculate the percentage fall in gain with feedback. 2

7. Find the operating frequency of a transistor Collpit's oscillator if C_1 = 0.001 μF, C_2 = 0.01 μF, L = 15 μH. 2

8. Calculate the output voltage of an integrator after (a) 1 sec, (b) 1.5 sec and (c) 2 sec for the input voltage of 1 V dc. Given that the input resistance = 1 MΩ, feedback capacitance = 0.1 μF, and the power supplier = ± 15 V. 2

9. The overall gain of a multistage amplifier is 140. When negative feedback is applied, the gain is reduced to 17.5. Find the fraction of the output that is fed back to the input. 2

10. A transistor uses potential divider method of biasing. R_1 = 50 KΩ, R_2 = 10 KΩ and R_E = 1 KΩ. 3

If V_{CC} = 12 V, find:

i. the value of I_C (given V_{BE} = 0.1 V)

ii. the value of I_C (given V_{BE} = 0.3 V).

Comment on the result.

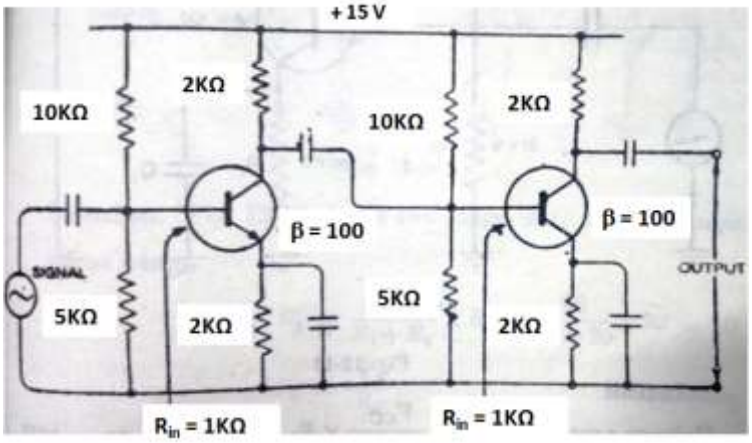
11. Calculate the junction capacitance of a silicon pn junction diode. Consider that the diode is at room temperature (T = 300°K), with doping concentrations of $N_a = 1.5 \times 10^{16}$ cm^{-3}, $N_d = 1.0 \times 10^{15}$ cm^{-3} and let C_{j0} = 1.5 pF. Calculate the junction capacitance at reverse bias 3.5 V. 3

12. Figure shows two-stage RC coupled amplifier. If the input resistance R_{in} of each stage is 1 KΩ, find: 3

i. Voltage gain of first stage

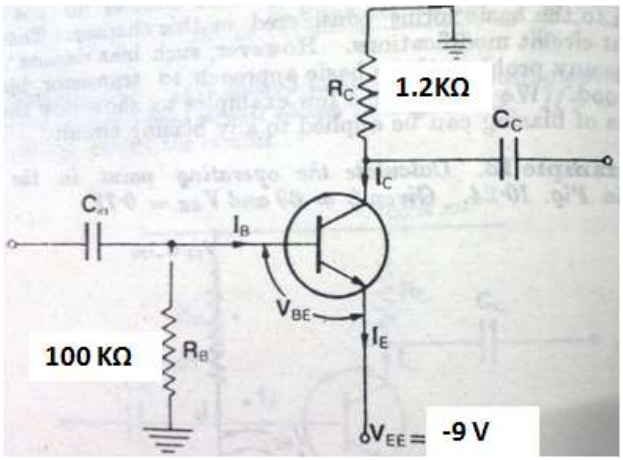
ii. Voltage gain of second stage

iii. Total voltage gain



OR

Obtain the operating point for the circuit shown in Fig. Assume β = 45 and V_{BE} = 0.7 V.



13. Find the closed-loop voltage gain of a differentiator for input voltage of frequency 100 kHz, if R_f = 1 MΩ and C = 1 μF. What will be the g 3

ain if a resistor R = 0.01R_f is connected in series with C?