Ref. No.: Ex/IEE/PC/B/T/214/2023

B. INS. & ELEC. ENGINEERING 2ND YEAR 1ST SEMESTER EXAMINATION 2023

ELECTRONIC CIRCUITS

TIME: 3 HOURS **FULL MARKS: 100**

List of Course Outcomes (CO):

CO1: Classify and analyze different types of diode circuits (K2, K4, A1)

CO2: Identify and interpret the importance of biasing in electronic amplifiers (K3, A1)

CO3: Describe and explain the behavior of small signal amplifiers (K2, A1)

CO4: Differentiate and examine feedback circuits of various kinds (K4, A2)

CO5: Explain and analyze the operation of oscillators (K2, K4, A1)

Instructions to the Examinees:

- Each module in the question paper matches up with the corresponding CO
- Attempt questions from **ALL** the modules for the attainment of all the COs
- Alternative questions (if any) exist within a module, not across the modules
- Different parts of same question should be answered together

[Turn over

Ref. No.: Ex/IEE/PC/B/T/214/2023

MODULE 1

ATTEMPT **ANY TWO** QUESTIONS FROM THIS MODULE

1.

(a) Draw the transfer characteristics of a diode which follows the constant voltage model.

(b) Calculate the dynamic resistance of diode at room temperature.

(c) Assume the input to a half-wave rectifier circuit is a triangular wave of 20V peak-to-peak amplitude with a zero time-average value. Let the series resistance be 1 KΩ and assume piecewise linear diode parameters of $V_\gamma = 0.6\,V$ and $r_f = 20\,\Omega$. Sketch the output voltage versus time over one cycle and label all appropriate voltages.

2+3+5

2.

(a) Determine the output voltage for the circuit in Fig. 1a for input voltage in Fig. 1b.

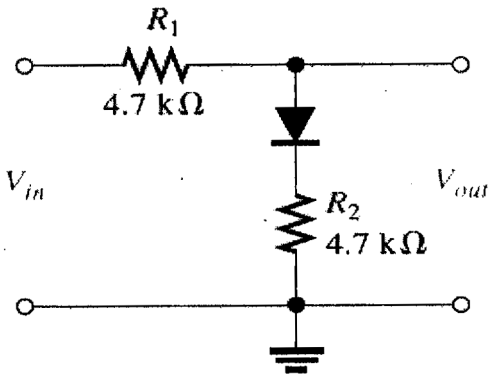

Fig. 1a

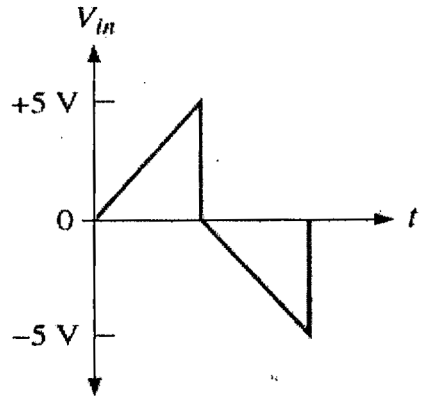

Fig. 1b

(b) What is the significance of peak inverse voltage? Find out the peak inverse voltage of each diode in a centre-tapped full wave rectifier in terms of peak output voltage.

6+ (2+2)

3.

(a) How does a zener diode act as a voltage regulator? Explain with suitable circuit diagram.

(b) In a voltage regulator circuit, input voltage is 20 V, zener voltage is 10 V, series resistance is 222 Ω and maximum power rating of zener diode is 400 mW. Determine the input current, zener current and load current if the load resistance is 380 Ω. Calculate the value of load resistance that will result in maximum power in the diode.

3+7

Ref. No.: Ex/IEE/PC/B/T/214/2023

MODULE 2

ATTEMPT **Q NO 4 AND ANY ONE** FROM THE REST

4. Calculate the terminal voltages of the BJT in Fig. 2.

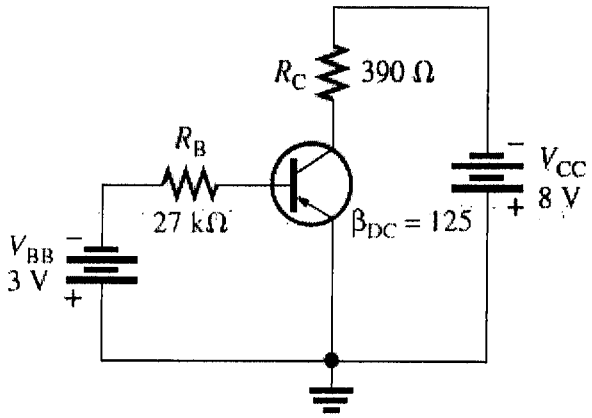

Fig. 2

5

5.

(a) What is the limitation of self-bias circuit? How is this limitation overcome?

(b) Determine the DC input resistance looking in at the base of the BJT in Fig. 3. Assume $\beta_{DC} = 125$ and $V_B = 4\,V$.

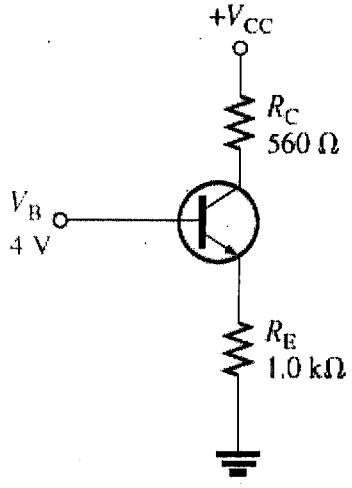

Fig. 3

(2+2)+6

Ref. No.: Ex/IEE/PC/B/T/214/2023

6.

(a) What happens to the behavior of a BJT amplifier if the DC load line shifts in parallel?

(b) For a finite dc input resistance looking in at the base, find out the base potential for stiff and non-stiff voltage divider bias.

(c) How can a BJT be biased so as to use it as a switch?

2+5+3

MODULE 3

ATTEMPT **Q NO 7 AND ANY TWO** FROM THE REST

7.

(a) Draw and explain expanded hybrid-π equivalent circuit.

(b) Two common emitter amplifiers are connected in cascade. What would happen if one common collector stage is inserted between them?

(c) Calculate the input impedance of a common base amplifier.

(d) Indicate the typical capacitance value of a bypass capacitor in any amplifier circuit. Justify the reason of selecting such a value for this purpose.

(e) Name the capacitors which are responsible in controlling the higher cut-off frequency of BJT amplifier.

(f) What do you mean by differential signal?

4+4+6+3+1+2

8.

(a) Draw a neat diagram of cascode amplifier. Clearly mention its advantage over common emitter amplifier.

(b) Find out the expression of current gain for a voltage buffer.

(c) Calculate the maximum possible excursion of the differential input in order to have a linear gain for a differential amplifier. Derive the necessary equations for your calculation.

5+4+6

9. Assume that a 600Ω, 12μV rms voltage source is driving the amplifier in Fig. 4. Determine the overall voltage gain by taking into account the attenuation in the base circuit, and find the total output voltage (dc and ac). Also draw the total collector voltage waveform and total output voltage waveform.

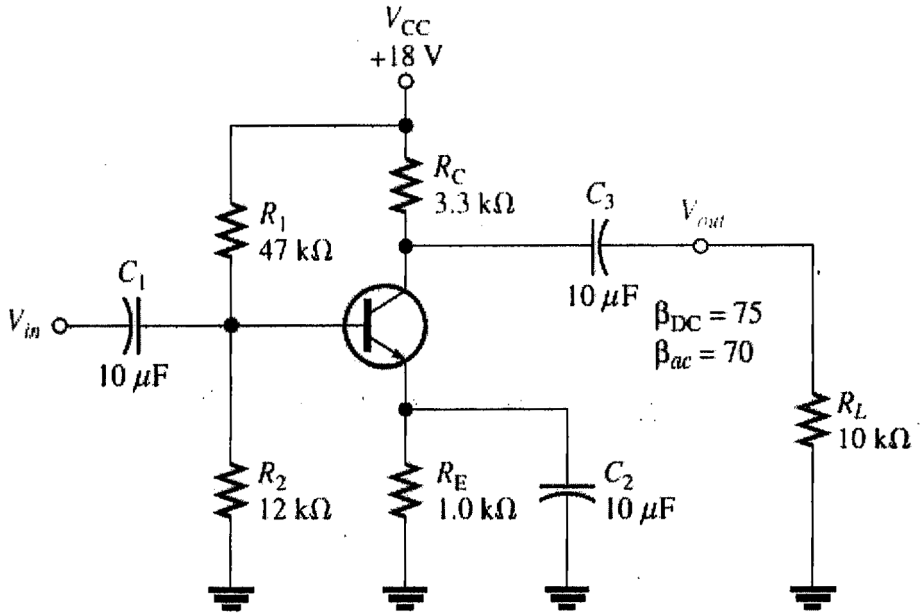

Fig. 4

15

10. Derive the equivalent high-frequency input RC circuit for the BJT amplifier in Fig. 5. Use this to determine the upper critical frequency due to the input circuit. The transistor's datasheet provides the following: $\beta_{ac} = 125, c_\pi = 20\,pF, c_\mu = 2.4\,pF$.

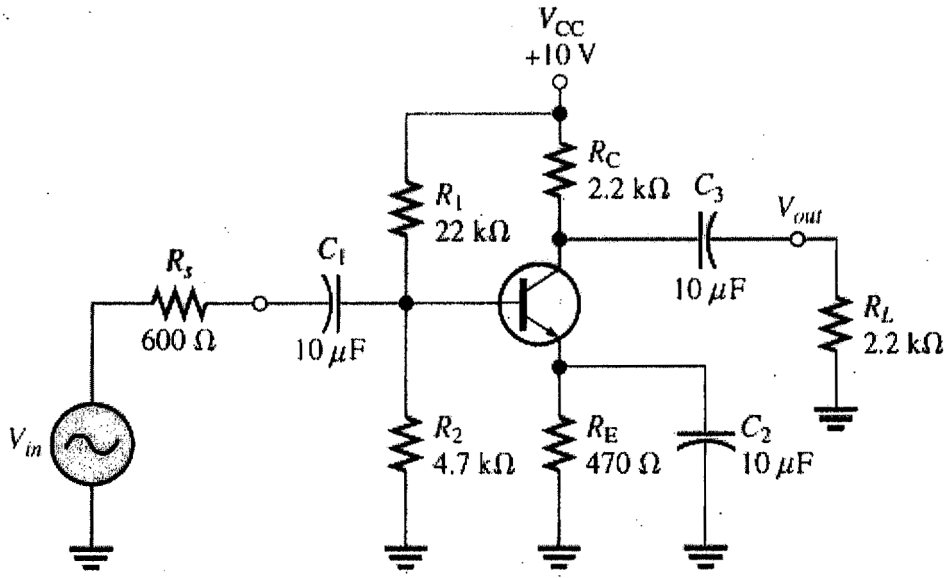

Fig. 5

15

Ref. No.: Ex/IEE/PC/B/T/214/2023

MODULE 4

ATTEMPT **ANY TWO** QUESTIONS FROM THIS MODULE

11.

(a) What do you mean by desensitivity factor? Why is it so called?

(b) Determine the type of feedback configuration that should be used in a design to achieve high input and high output resistance. Draw and explain using an appropriate schematic diagram.

(c) How can an un-bypassed emitter resistance act as a feedback element? Discuss.

3+5+2

12. Draw a multistage common emitter amplifier to demonstrate voltage-series feedback. Using small signal analysis, determine the expression of gain with feedback.

10

13. Show that a common base amplifier can exhibit current-shunt feedback. Using small signal analysis, find out the expression of gain with feedback.

10

MODULE 5

14.

(a) What do you understand by Barkhausen criterion for oscillation?

(b) Draw and explain the operation of an RC phase-shift oscillator circuit. Show that the circuit will oscillate at a frequency of $f_0 = \frac{1}{2\pi\sqrt{6}RC}$. Find out the value of the closed-loop gain for sustained oscillation.

(c) Draw the circuit diagram of Hartley oscillator.

2+5+3

----------X----------