B.Sc. Electronics
Third Sem – 2013
PAPER CODE – AS-2792

Section-A

Q.1 (i) — Answer — (d) L/CR

(ii) — Answer — (c) Selectivity

(iii) — Answer — (c) $1/2\pi RC$

(iv) — Answer — (c) R and C

(v) — Answer — (c) −10 V

(vi) — Answer — (a) Infinite ohm

(vii) — Answer — (b) Differentiator

(viii) — Answer — (a) 0

(ix) — Answer — (c) A_v/A_c

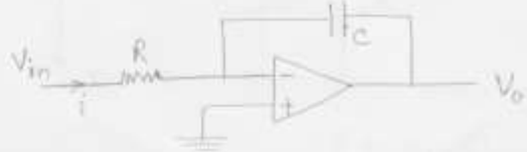
(x) — Answer — (c) Balanced bridge.

Section-B

Q.2 Answer —

operational amplifier — It is a direct coupled, high gain, differential-input amplifier capable of performing a wide variety of linear and non-linear mathematical operations.

Use of an op-amp as an integrator —



(figure-1)

from the circuit, $i = \frac{V_{in}}{R}$

and $i = \frac{d(-CV_o)}{dt}$

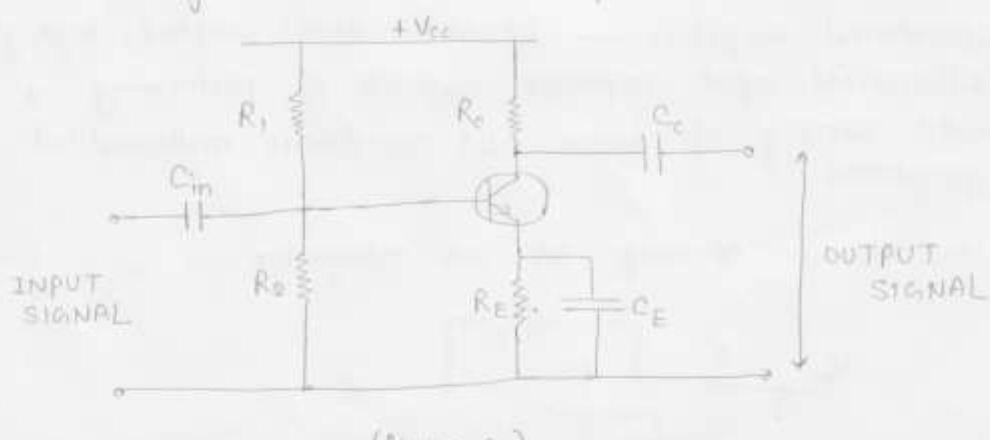
$$\Rightarrow \frac{dV_o}{dt} = -\frac{1}{RC} V_{in}$$

$$\Rightarrow V_o = -\frac{1}{RC} \int V_{in}\, dt$$

Thus the ~~given~~ circuit shown in the figure-1 behaves like an integrator with a time constant equal to RC.

(Q.3) Amplifier — An amplifier is defined as a circuit or a system which raises the strength of a weak signal.

Single stage transistor amplifier — When only one transistor with associated ~~circuitry~~ circuitry is used for amplifying a weak signal, the circuit is known as single state transistor amplifier.



(figure-2)

In the circuit diagram, there are various circuit elements which are given below—

(i) Biasing circuit — The resistances R_1, R_2 and R_E form the biasing and stabilisation circuit. The biasing circuit must establish a proper operating point, othewise a part of the negative half cycle of the signal may be cut-off in the output.

(ii) Input capacitor — An electrolytic capacitor C_{in} is used to couple the signal to the base of the transistor. If it is not used, the signal source resistance will come across R_2 and thus change the bias. The capacitor C_{in} allows only a.c. signal to flow but isolates the signal source from R_2.

(iii) Emitter bypass capacitor C_E — It is used in parallel to R_E to provide a low reactance path to the amplified a.c. signal.

(iv) Coupling capacitor C_C — It is used to couple one stage of amplification to the next stage. If it is not used, the ~~biasing bai~~ bias conditions of the next stage will be drastically changed due to the shunting effect of R_C.

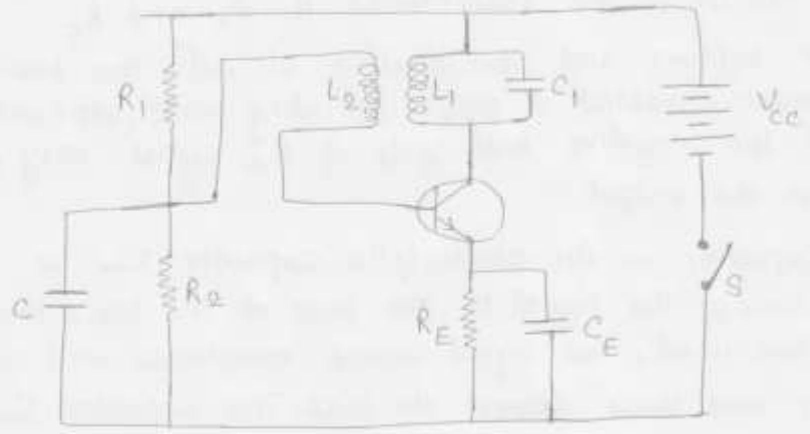
—x—x—

(Q.4) Answer —

Sinusoidal oscillator — An electronic device that generates sinusoidal oscillations of desired frequency is known as a sinusoidal oscillator.

It is important to note that oscillations are produced without any external signal source. The ~~ow~~ only input power to an oscillator is the d.c. power supply.

Tuned collector oscillator —



(figure-3)

figure-3 shows the circuit of tuned collector oscillator. It contains tuned circuit $L_1 - C_1$ in the collector and hence the name. The frequency of oscillations depends on the values of L_1 and C_1 and is given by $f = \frac{1}{2\pi\sqrt{L_1C_1}}$.

When switch S is closed, collector current starts increasing and charges the capacitor C_1. When this capacitor is fully charged, it discharges through coil L_1, setting up oscillations of frequency $f = \frac{1}{2\pi\sqrt{L_1C_1}}$. These oscillations induce some voltage in coil L_2 by mutual induction. The frequency of the voltage in the coil L_2 is the same as that of tank circuit. The voltage across L_2 is applied between base and emitter and appears in the amplified form in the collector circuit, thus overcoming the losses occurring in the tank circuit. The number of turns of L_2 and coupling between L_1 and L_2 are so adjusted that oscillations across L_2 are amplified to a level just sufficient ~~of~~ to supply the losses to the tank circuit.

(Q.5) Answer —

Feedback fraction $m_v = \frac{C_1}{C_2}$

$$\Rightarrow 0.25 = \frac{C_1}{C_2} \Rightarrow C_2 = 4C_1$$

Now, $f = \frac{1}{2\pi\sqrt{LC_T}}$

or $C_T = \frac{1}{L(2\pi f)^2}$

$$= \frac{1}{(1\times 10^{-3})(2\times 3.14 \times 1\times 10^{6})^2} \text{ F}$$

$$= 25.3 \times 10^{-12} \text{ F}$$

$$= 25.3 \text{ pF}$$

or, $\frac{C_1 C_2}{C_1+C_2} = 25.3$ pF

but $C_2 = 4C_1$

$$\Rightarrow \frac{C_1 \times 4C_1}{C_1 + 4C_1} = 25.3 \text{ pF}$$

$$\Rightarrow C_1 = 31.6 \text{ pF}$$

& $C_2 = 126.5$ pF

(Q.6) Answer —

Given, $f_r = 1200$ KHz and $Q = 60$

$\therefore$ BW $= f_r/Q = \frac{1200 \text{ KHz}}{60} = 20$ KHZ

$\therefore$ lower cut-off frequency $f_1 = 1200 - 10 = 1190$ KHz

Upper cut-off frequency $f_2 = 1200 + 10 = 1210$ KHZ.

(Q.7) Answer —

The output ~~of~~ voltage of the summing amplifier is given by $V_{out} = -R_f\left(\frac{V_1}{R_1} + \frac{V_2}{R_2}\right)$

here, $R_f = 200\ k\Omega$, $R_1 = 400\ k\Omega$, $R_2 = 100\ k\Omega$

$V_1 = +0.6\ V$ and $V_2 = -1.4\ V$.

$$\therefore\ V_{out} = -200 \times 10^3 \left[\frac{0.6}{400 \times 10^3} + \frac{-1.4}{100 \times 10^3}\right] V$$

$$= 2.5\ V$$

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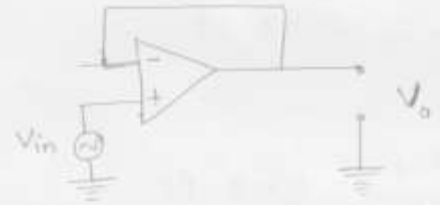
(Q.8) Answer —

(a) voltage follower circuit —



The voltage follower circuit is a special case of non-inverting amplifier where all of the output voltage is fed back to the inverting input.

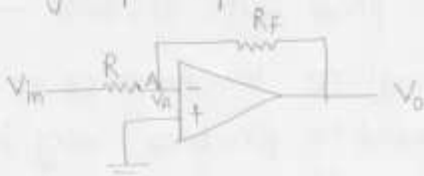
$$\text{voltage gain } A = 1 + \frac{R_f}{R_i}$$

$$= 1 + \frac{0}{R_i} \quad \{\because R_f = 0\,\Omega\}$$

$$= 1$$

Thus the closed loop voltage gain of the voltage follower circuit is 1. The most important features of the voltage follower configuration are its very high input impedance and its very low output impedance.

(Q.8) (b) Inverting op-amp —



As the name implies, this amplifier inverts the phase of the input signal while amplifying it.

Because of the high impedance at the inverting input, no appreciable current flows into this input and thus,

$$\frac{V_{in} - V_A}{R} = \frac{V_A - V_0}{R_f}$$

Since the point A is at virtual ground, the above equation yields,

$$\frac{V_{in}}{R} = \frac{-V_0}{R_f}$$

Hence the gain of the amplifier $A_V = \frac{V_0}{V_{in}} = -\frac{R_f}{R}$

(Q.8) (c) Differential amplifier — It is a circuit that can accept two input signals and amplify the difference between these two input signals.

(Block diagram of differential amplifier)

V_1 and V_2 are two input signals. Differential amplifier amplifies the difference between the two input voltages. therefore the output voltage is $V_0 = A(V_1 - V_2)$. where A is the voltage gain of the amplifier.

(Q.8) (d) Advantages of phase shift oscillator —

(i) It doesnot require transformers or inductors.
(ii) It can be used to produce very low frequencies
(iii) The circuit provides good frequency stability.