Object : *To study the amplification characteristics of a single stage R-C coupled amplifier.*

Apparatus Required : Transistor 2SB77, load resistance (R_L = 2 kΩ), coupling condenser (C_C = 50 μF), emitter biasing arrangement (R_E = 0·47 kΩ), (C_E = 100 μF), input condenser (C_1 = 50 μF), bias stabilising resistances (R_1 = 22 kΩ, R_2 = 5·1 kΩ), V.T.V.M. collector supply battery (= 6 V), audio frequency oscillator (0-50 kilohertz).

Description of the Apparatus : The electric circuit of the R-C coupled amplifier used in the experiment is shown in Fig. 54 in which transistor is connected in common emitter mode. The input voltage is applied between the base and emitter by means of an audio frequency oscillator an and input condenser C_1 (= 50 μF). The base bias is obtained by the potential drop across R_2 of the potential diode made by R_1 and R_2. The biasing is stabilised by the R_E–C_E circuit connected with two emitter. The collector of transistor is given the reverse bias through the collector supply battery. The output is obtained across the load resistance R_L through the coupling condenser C_C.

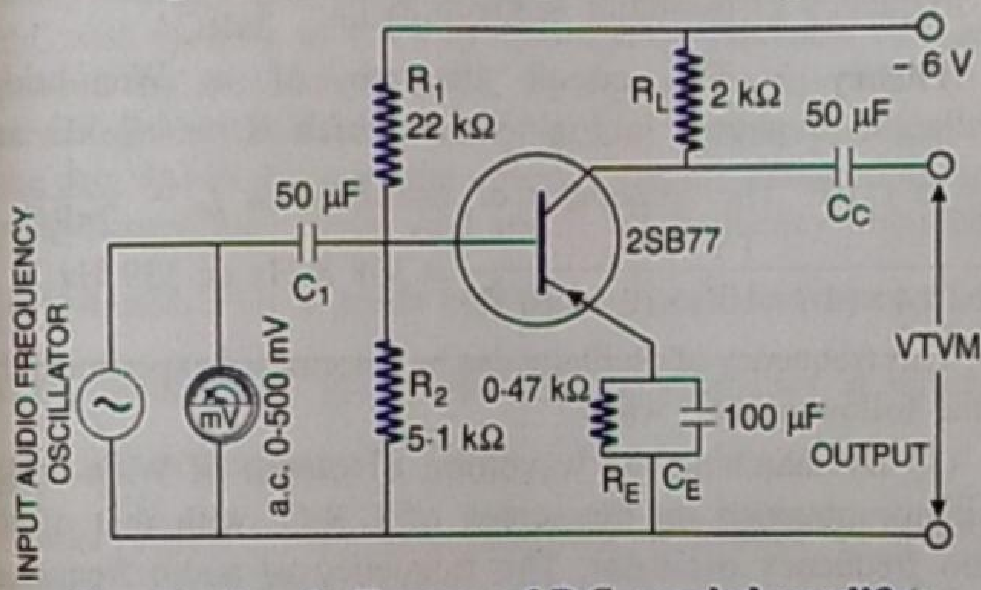

Fig. 54. Circuit diagram of R-C coupled amplifier

Theory : In a transistor, the charge carriers move from the forward biased input circuit of low resistance to the reverse biased output circuit of high resistance and so by a small change in current in the input circuit, a large change in current is obtained in the output circuit. Thus, a transistor changes a weak signal into a strong signal *i.e.*, it acts as an amplifier. The transistor is used in common emitter configuration to obtain a large current gain. To use it in class A condition *i.e.*, to obtain the output of same wave form as that of input, the input signal is applied at the base by keeping it at such a potential that output is obtained for the complete input cycle. For this, the voltage developed across R_E due to d.c. component of collector current provides the required bias voltage at the base of the transistor. The resistance R_1 and R_2 provides the stabilisation of biasing. The emitter by pass condenser C_E by passes the a.c. component of emitter current, since the value of C_E is of the order of 100 μF, so its reactance = $1/\omega C_E$ is quite small. The input condenser C_1 (= 50 μF) isolates the d.c. potential of input to be applied at the base of transistor and only the a.c. potential of input is applied at the base, otherwise the bias voltage of base will change.

The coupling condenser C_C (= 50 μF) transmits only the a.c. component of output of first stage as input to the second stage and it blocks the d.c. component of output of first stage reaching the base of the second stage.

The a.c. signal at the base of transistor gets amplified and develops a voltage across the load resistance R_L. This amplified voltage is applied to the base of the second stage through the coupling condenser C_C.

Procedure : (1) First complete the electric circuit as shown in Fig. 54. Take care that the collector is reverse biased *i.e.*, in case of PNP transistor shown in Fig. 54, the collector terminal is at negative potential and the emitter terminal of the transistor is at positive potential.

(2) Input voltage of 10 mV is applied through the audio frequency oscillator and it is maintained constant.

(3) Then adjust the V.T.V.M. for a.c. voltage in the range of 0-1 volt and make its zero adjustment. Then the frequency of oscillator is gradually increased from zero to 50 kilo hertz and corresponding to each frequency the output voltage is read the help of V.T.V.M.

Observation : Input voltage = ... volt.

S.No.	Frequency of input voltage f (in Hz)	Output voltage (in volt)	Voltage gain $A = \frac{\text{Output voltage}}{\text{Input voltage}}$	$\log_{10} f$
1.	10			
2.	50			
3.	100			
4.	500			
5.	1000			
6.	3000			
7.	5000			
8.	10000			
9.	20000			
10.	30000			
11.	40000			
12.	50000			

Graph : From the above observation table, a graph is plotted by taking the voltage gain A on Y-axis and the log of frequency f (*i.e.*, $\log_{10} f$) of the input voltage on X-axis, which is a curve as shown in Fig. 55.

Result : The characteristic curve of voltage gain of the given R-C coupled amplifier is shown in Fig. 55. It is clear from the graph that in the low frequency range (0 to ..... Hz), the voltage gain increases with increase in frequency; in the mid-frequency range (..... Hz to ..... Hz), the voltage gain is nearly constant; and in the high frequency range (.....Hz to 50 kHz), the voltage gain decreases with the increase in frequency.

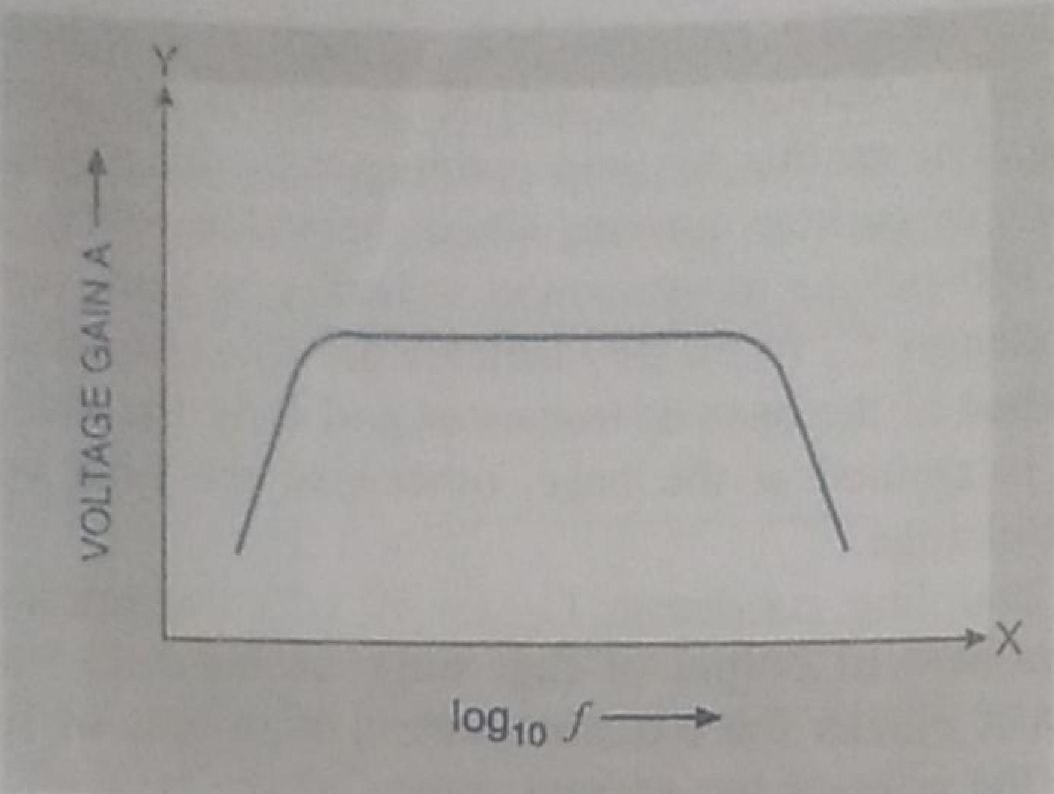

Fig. 55. Frequency response curve

Precautions : (1) The transistor must be connected in common emitter mode.

(2) The collector of the transistor must be reverse biased.

(3) The input voltage of very large amplitude must not be applied on the base.

(4) Before using the V.T.V.M., it should be adjusted for the proper a.c. voltage range and its zero adjustment must be made.

Note : (1) *If possible, the experiment can be repeated by changing the load resistance* R_L. *By doing so, we find that on increasing the load resistance, the middle part of constant voltage gain decreases.*

(2) *If possible, the experiment can be repeated for different coupling condensers (capacity* 0·01 μF, 0·02 μF, 1·04 μF). *By doing so, we find that on incresing the coupling capacity, the middle part of constant voltage gain increases.*