EXPERIMENT NO.11

EXPERIMENT NO.11

NAME

Common Emitter or RC Coupled Amplifier

OBJECTIVE

To Design Common Emitter Or Single Stage Rc Coupled Amplifier Using Bjt.

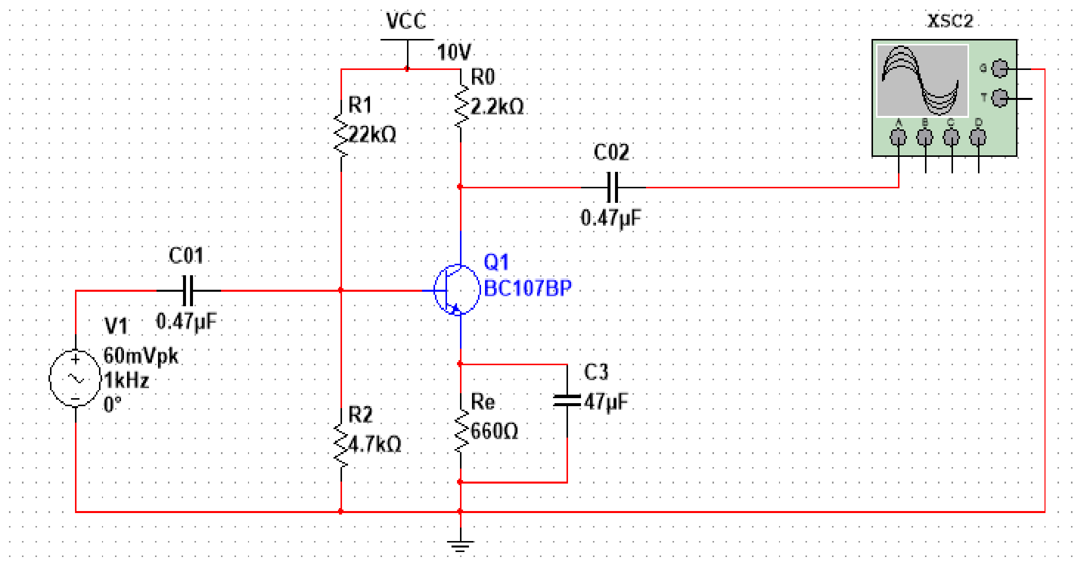
EQUIPMENTS

- BEL-TAT Trainer kit.
- Power Supply.
- Patch cords.
- Multimeter.
- Function generator.
- Oscilloscope.

THEORY

The CE amplifier provides high gain &wide frequency response. The emitter lead is common to both input & output circuits and is grounded. The emitter-base circuit is forward biased. The collector current is controlled by the base current rather than emitter current. The input signal is applied to base terminal of the transistor and amplifier output is taken across collector terminal. A very small change in base current produces a much larger change in collector current. When +VE half-cycle is fed to the input circuit, it opposes the forward bias of the circuit which causes the collector current to decrease, it decreases the voltage more –VE. Thus when input cycle varies through a -VE half-cycle, increases the forward bias of the circuit, which causes the collector current to increases thus the output signal is common emitter amplifier is in out of phase with the input signal.
Designing for a particular voltage gain requires the use of a ac negative feedback to stabilize the gain. For good bias stability, the emitter resistor voltage drop should be much larger than the base -emitter voltage. And Re resistor will provide the required negative feedback to the circuit. CE is provided to provide necessary gain to the circuit. All bypass capacitors should be selected to have the smallest possible capacitance value, both to minimize the physical size of the circuit for economy. The coupling capacitors should have a negligible effect on the frequency response of the circuit.

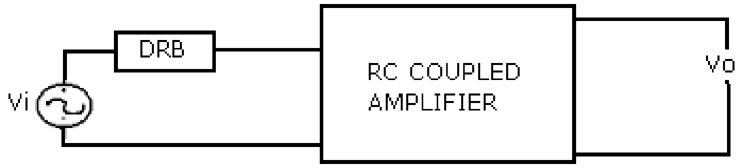
CIRCUIT DIAGRAM



PROCEDURE

- Make the connections as shown in the practical circuit diagram on BEL-TAT board using patch cord.
- Switch on the power supply.
- Set onboard power supply to required VCC using POT and voltmeter.
- Connect VCC to the practical circuit.
- Q point calculation DC parameter:- measure VC, VB and VE using multi-meter without any input to amplifier.
- Find VCE = VC-VE. Also find IE = VE / RE.
- So Q point = (VCE,IE)
- Feed a sine wave signal of amplitude 40 mV from signal generator.
- Keep the frequency of the signal generator in mid band range i.e., around 5 KHz. Increase amplitude of the input signal till the output signal is undistorted.
- Measure Vi amplitude =__________V for corresponding maximum undistorted output.
- Measure Vo amplitude =__________V.
- The ratio of (Vo/Vi) max gives the maximum undistorted gain of the amplifier.
- Now vary the input sine wave frequency from 50 Hz to 2 MHz in suitable steps. Measure output voltage amplitude at each step using CRO. (See that amplitude of Vi remains constant throughout the frequency range.)
- Note down the frequency VS VOut observations.
- Plot the frequency i.e., frequency versus Gain in dB, determine Bandwidth and G.B.W product.

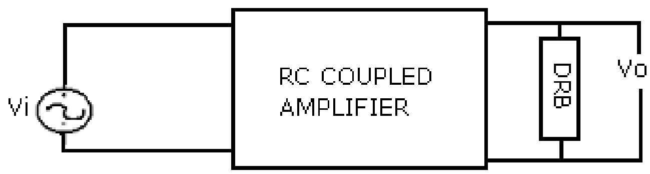
To Measure Zin



Procedure To Find Zin

- Connect the circuit as shown in above figure. Where DRB = variable10KΩ POT.
- Set POT to 0Ω
- Input sine wave amplitude to say 40 mV, 5 KHz.
- Measure amplitude of Vout p-p. Let Vo=Va say
- Increase POT (keeping Vi constant) till Vo=Va/2.The corresponding POT gives the input impedance Zin in RC coupled amplifier.

To Measure Zo



Procedure To Find Zo

- Connect the circuit as shown in the above figure.
- Set POT (DRB) to its maximum resistance value.
- Input sine wave amplitude to about 40 mV, 5 KHz.
- Measure Vop-p. Let Vo=Vb.
- Decrease DRB from its maximum value till Vo=Vb/2.The corresponding DRB gives the output impedance Zo.

<u>DESIGN PROCEDURE</u>

Select transistor BC107b having the following specifications,
Ie=Ic= 2mA; ß=215; Vce=5v; Vcc=2Vce =>10v
To find Re
Choose Ve =Vcc/10=10/10 =1 v
Ve = Ie*Re =>Re=Ve / Ie
Re = 1 / Ie =1 / 2mA = 0.5K Ω
Select Re = 560 Ω

To find Rc
Choose Vce = Vcc / 2 =10/2=5 v
Apply KVL in CE loop:
Vcc- (IcRc) - Vce - Vre=0
10v-(2mA* Rc) – 5v –1v=0
Rc = (10v-5v-1v) / 2mA
Rc = 2K Ω

Select Rc= 2.2K Ω
TO FIND R1 & R2
VB = VBE + VE => 0.7V + 1V = 1.7V
VB =(VCC*R2) / (R1 + R2)
1.7V = (10V*R2) / (R1 + R2) => R2/(R1+ R2)=1.7V/10V
10 R2 = 1.7 R1 +1.7 R2
R1= 4.8* R2
SELECT R2 =4.7K Ω
R1 = 4.8 * 4.7K Ω => R1 = 22.56K Ω
SELECT R1 = 22K Ω

To Find Bypass Capacitor CE:
LET XCE = RE / 10, AT F = 100 HZ; 1/(2Π*F*CE) = RE / 10
THEREFORE CE=10 / (2Π*100 HZ *560 Ω) =31.8 MICRO FARAD
CHOOSE CE=47 MICRO F (ELECTROLYTIC)

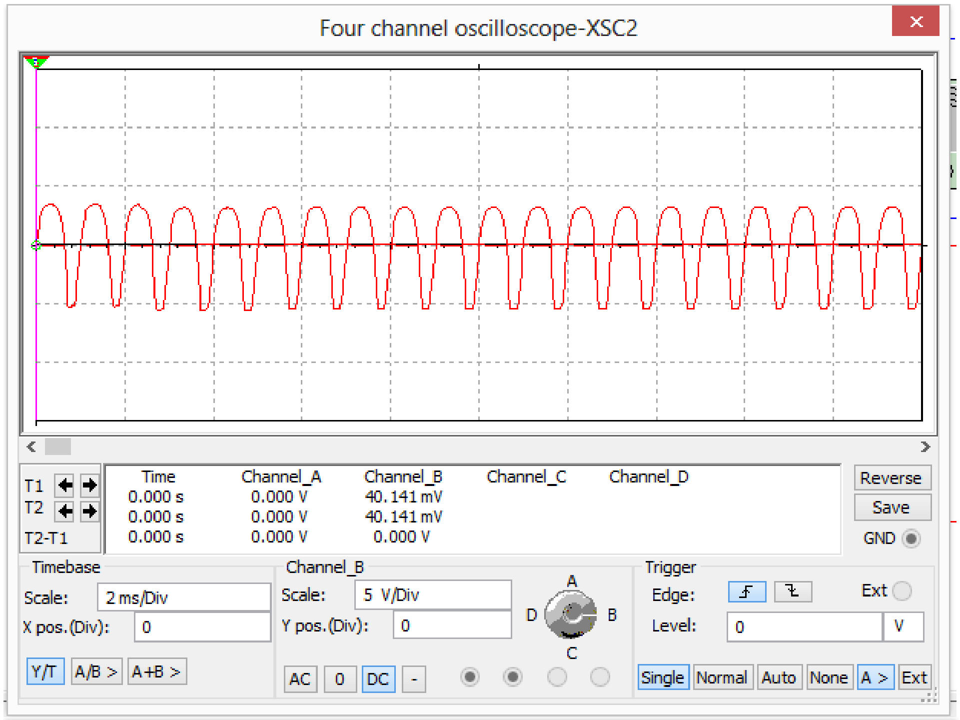
To Find CC1 And CC2
ASSUME CC1 & CC2 = 0.47 MICRO F (CERAMIC)

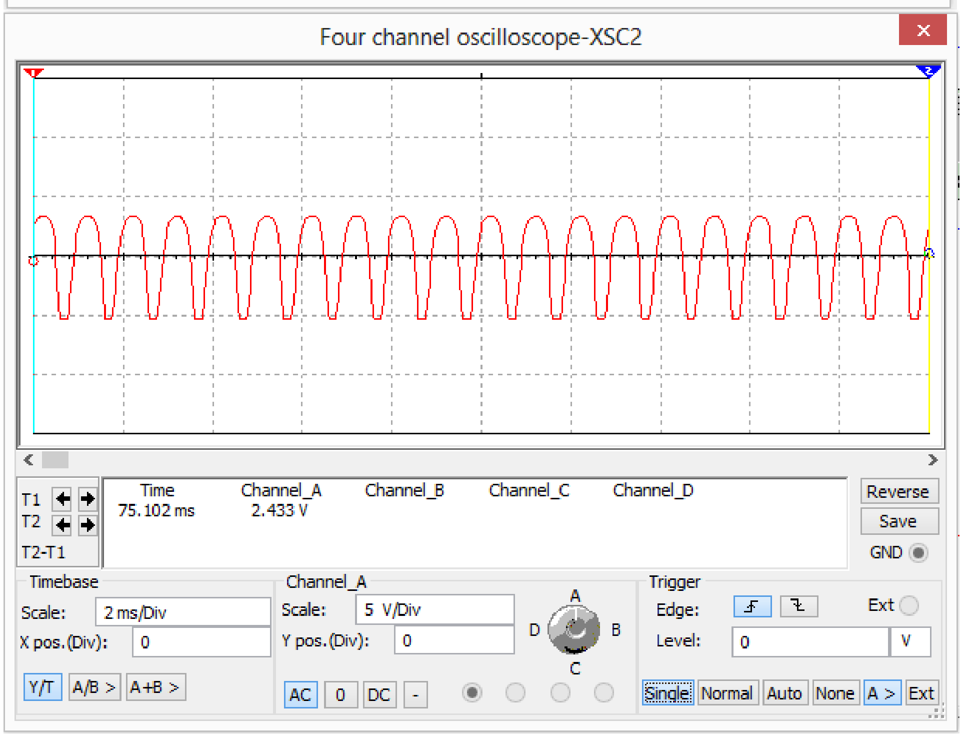
To Design
XCC1 = (Hie||RB)/10, XCC1 =1/ (2Π*F*CC1), CC1=?
XCC2 = (RC||RL)/10, XCC2 =1/ (2Π*F*CC2), CC2=?

Q Point Calculation
VC = 6.325V
VB = 2.098V
VE=1.462V
VCE = VC-VE = 6.325-1.462 = 4.863V
Observed VCE using multi-meter = 4.866V
IE = VE /1K = 1.462 /1K = 2.6mA
SO, QPOINT = (VCE,IE) = (4.863,2.6mA)

WAVEFORM

When Vin = 40mVp-p, 5KHz sine wave then observed output is 2.48V. so gain = Vout / Vin = 2.48V/40mV = 62.





OBSERVATION TABLE

Sr. no.	Vin = 40mV, frequency (Hz)	Vout (Volt)	Voltage Gain Vo / Vi	Gain =20 log (Vo / Vi)
1	50			
2	100			
3	200			

4	300			
5	400			
6	500			
7	600			
8	700			
9	800			
10	900			
11	1K			
12	2K			
13	3K			
14	4K			
15	5K			
16	6K			
17	7K			
18	8K			
19	9K			
20	10K			
21	20K			
22	30K			
23	40K			
24	50K			
25	60K			
26	70K			
27	80K			
28	90K			
29	100K			
30	200K			
31	300K			
32	400K			
33	500K			
34	600K			
35	700K			
36	800K			
37	900K			
38	1M			
39	2M			
40	3M			

CONCLUSION

Thus the RC Coupled common emitter Amplifier was designed and studied. Gain = 62 Bandwidth (3dB) = Gain-Bandwidth product = Input Resistance = 2.663KΩ when Vout = 1.24. Output Resistance =1.512 KΩ when Vout = 1.24.