

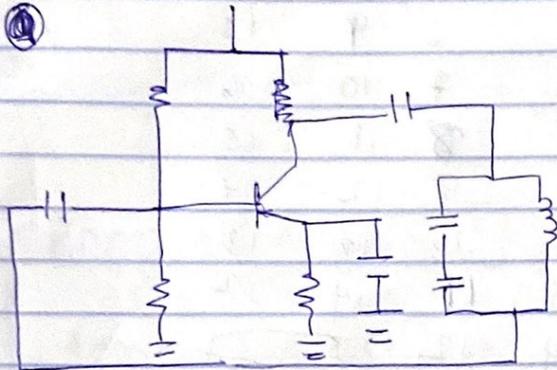
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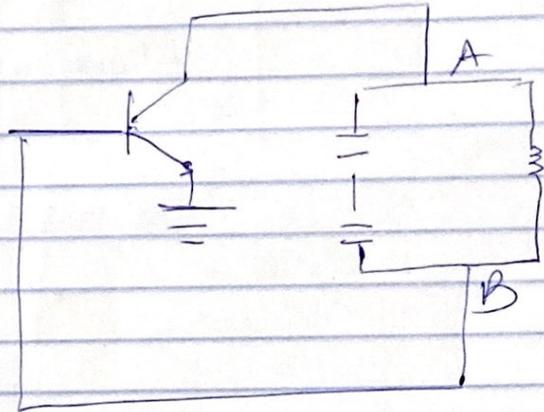
ELECTRONICS

### ASSIGNMENT.

1 a)



Colpitts oscillator



The key difference between Colpitts oscillator and any other oscillators is that it uses tapped capacitance. This capacitance  $C_1$  &  $C_2$  are connected in series with each other across the Each parameters function same

b) solution

$$L = 40 \text{ mH}; C_1 = 100 \text{ pF}; C_2 = 500 \text{ pF}$$

$$(i) f_0 = \frac{1}{2\pi\sqrt{LC_{eF}}} \quad \text{--- Eqn (i)}$$

$$C_{eF} = \frac{C_1 \times C_2}{C_1 + C_2} = \frac{[100 \times 10^{-12}] \times [500 \times 10^{-12}]}{[100 \times 10^{-12}] + [500 \times 10^{-12}]} = \left[ \frac{5 \times 10^{-20}}{6.0 \times 10^{-10}} \right] \text{ F}$$

$$C_{eF} = 8.3 \times 10^{-11} \text{ F}$$

Substitute the value of  $C_{eF}$  in Eqn (i)

$$f_0 = \frac{1}{2 \times 3.142 \times \sqrt{40 \times 10^{-3} \times 8.33 \times 10^{-11}}}$$

$$f_0 = 87172.75 \text{ Hz}$$

$$f_0 = 87.173 \text{ kHz}$$

(ii) Recall,  $V = 10V$

$$\text{Gain} = \frac{C_2}{C_1} = \frac{500\text{pF}}{100\text{pF}} = 5$$

$$\text{feedback voltage} = \frac{V_c}{\text{gain}}$$

$$\text{feedback volt} = \frac{10V}{5} = 2V$$

(iii) minimum gain only depends on the capacitors and not inductor  $L$ ; therefore,

$$\text{Gain} = \frac{C_2}{C_1} = \frac{500\text{pF}}{100\text{pF}} = 5.$$

(iv) value of  $C_f$  is given is 10

$$\text{gain} = \frac{C_2}{C_1}$$

$$\omega = \frac{500\text{pF}}{C_1}$$

$$C_1 = 50\text{pF}.$$

$$(v) f_0 = \frac{1}{2\pi \sqrt{LC_{\text{eff}}}}$$

$$C_{\text{eff}} = \frac{C_1 \times C_2}{C_1 + C_2} = \frac{(50 \times 10^{-12}) (500 \times 10^{-12})}{(50 \times 10^{-12}) + (500 \times 10^{-12})}$$

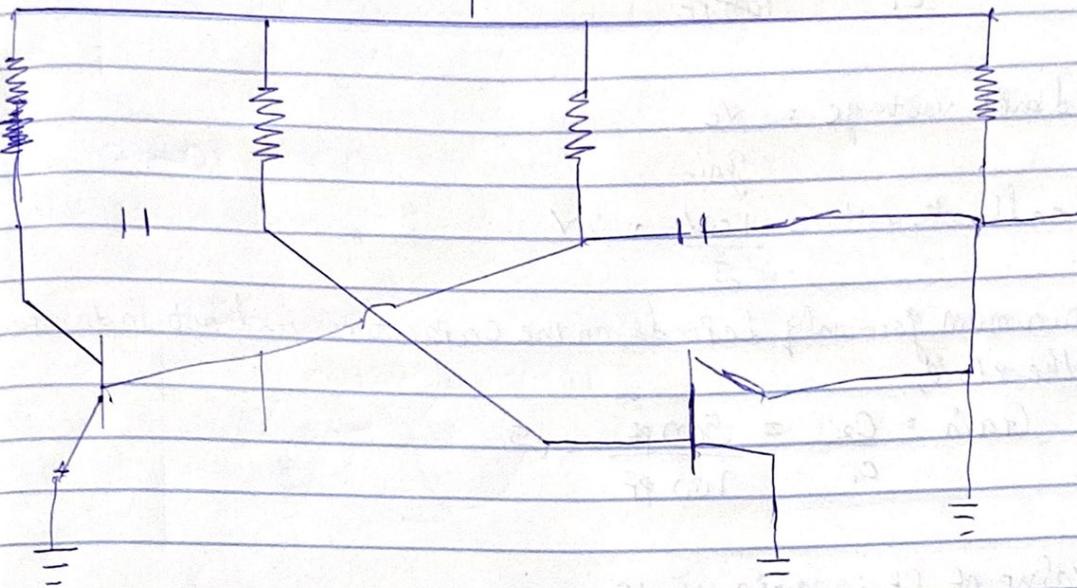
$$C_{\text{eff}} = 4.5455 \times 10^{-11} \text{F}$$

$$f_0 = \frac{1}{2 \times 3.142 \times \sqrt{40 \times 10^{-3} \times 4.5455 \times 10^{-11}}}$$

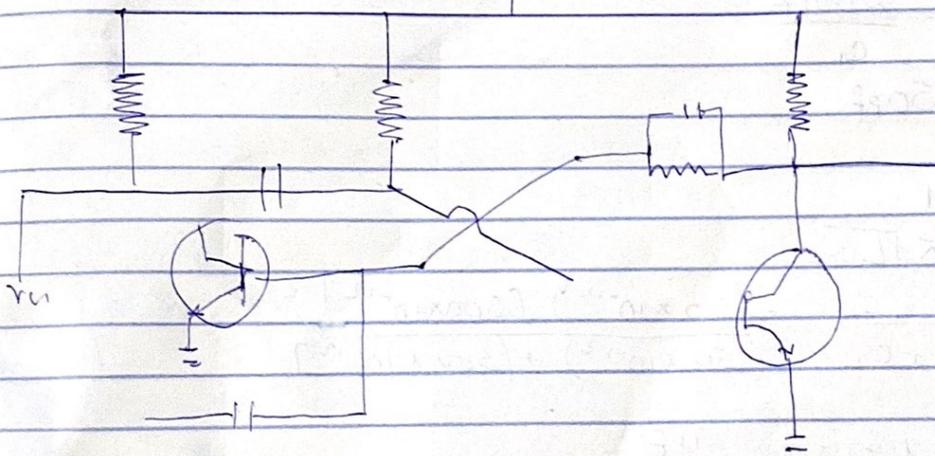
$$f_0 = 118016.6 \text{ Hz}$$

$$f_0 = 118.02 \text{ kHz}$$

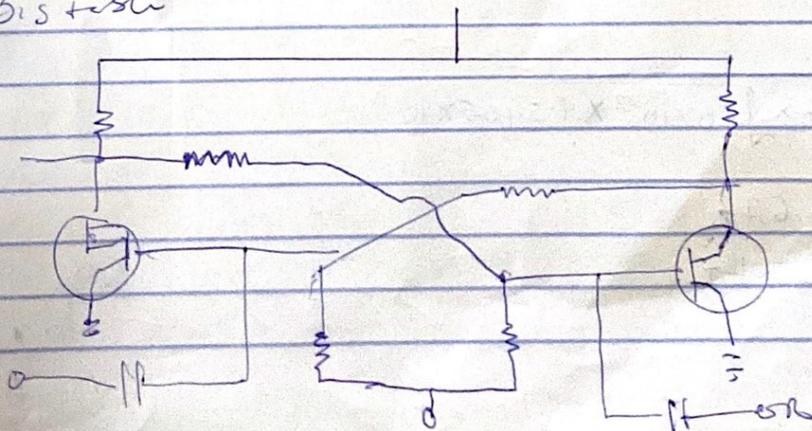
(a) Astable multivibrator



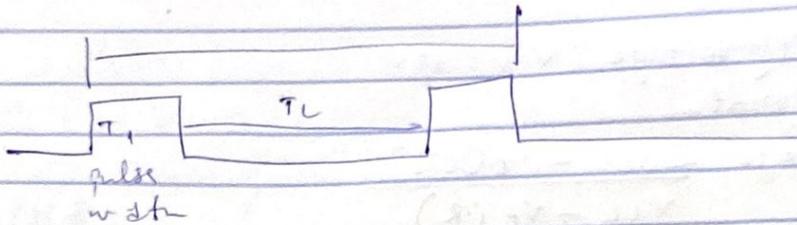
(b) Monostable multivibrator



(c) Bistable



2b)



Let  $C_1$  = value of the capacitor required to provide the desired pulse width find.

$C_2$  = value of the capacitor required to provide the desired repetition

Recall frequency of oscillation =  $1/T$

$$100 \times 10^{-3} = \frac{1}{T} ; T = 10 \times 10^{-6} \text{ sec.}$$

Pulse width  $T_1 = 0.69 R_1 C_1$

$$1 \times 10^{-6} = 0.69 R_1 C_1$$

$$C_1 = \frac{1 \times 10^{-6}}{0.69 \times 10 \times 10^{-3}}$$

$$C_1 = 145 \times 10^{-12} \text{ F}$$

$$C_1 = 145 \text{ pF}$$

Total period  $T = T_1 + T_2$

$$10 \times 10^{-6} = T_1 + T_2$$

$$T_2 = 10 \times 10^{-6} - 1 \times 10^{-6}$$

$$T_2 = 9 \times 10^{-6} \text{ sec.}$$

Period  $T_2 = 0.69 R_2 C_2$

$$C_2 = \frac{9 \times 10^{-6}}{0.69 \times (10 \times 10^3)}$$

$$C_2 = 1304 \times 10^{-12} \text{ F}$$

$$C_2 = 1304 \text{ pF}$$

Collector supply voltage;  $V_{CC} = 12V$   
Inputs pulse width

$$T = R_B \left[ \rho_{yo} \frac{2V_{CC} - V_{BC}(C_{ic})}{V_{CC} - V_p(CR)} \right]$$

$$= 20 \times 10^3 \times 0.1 \times 10^{-6} \log_e \frac{2 \times 12 - 0.8}{12 - 0.8}$$

$$T = 1.4565 \text{ ms}$$

Saturation collector current

$$I_{c \text{ sat}} = \frac{V_{CC} - V_{CE}(\text{sat})}{R_c} = \frac{12 - 0.2}{2 \times 10^{-3}}$$

$$= 5.9 \text{ mA}$$

Minimum base current required to keep the transistor can be determined by using  $h_{fe}$ .

$$I_B(\text{min}) = \frac{I_c(\text{sat})}{h_{fe}} = \frac{5.9 \text{ mA}}{50} = 0.118 \text{ mA}$$

Basic current can be calculated as,

$$I_B = \frac{V_{in} - V_{R_B}(\text{sat})}{R_B}$$

$$I_B = \frac{12 - 0.8}{20 \times 10^3} = 0.56 \text{ mA}$$

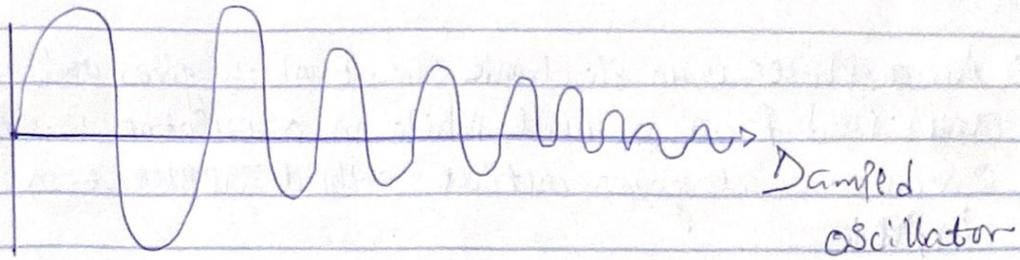
Hence  $I_B > I_B(\text{min})$  which ensures the transfer in saturation

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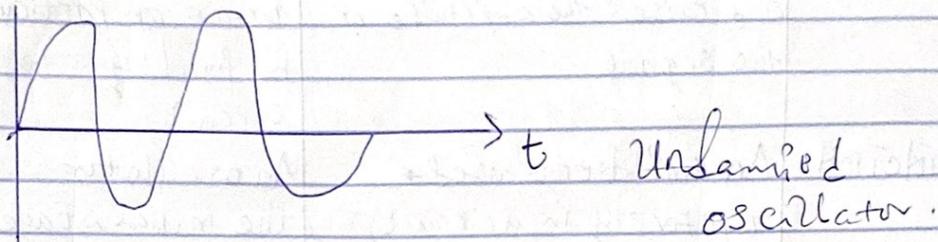
3a) An amplifier is an electronic circuit which gives output as an amplified form of input. While an oscillator is an electronic circuit which gives output without application of external input.

Parameter	Amplifier	Oscillator.
▷ Definition.	An amplifier is a circuit which amplifies the work signal and raises the amplitude of the signal.	An oscillator is a circuit which generates the AC waves forms of particular frequency for providing to an electronic circuit.
i) FUNCTION	An amplifier is used repeatedly in a circuit, because the signal loses its intensity after traveling to a long distance.	An oscillator is used only in the initial stage when the circuit required signal source.
ii) feedback	It uses negative feedback.	It uses positive feedback.
iv) REQUIREMENT of Input	The input is required for its operation it cannot operate without input.	It do not require any input to perform operation.
v) Type of signal generated	The signal can be periodic or non periodic.	The signal generated by it will be always periodic in nature.

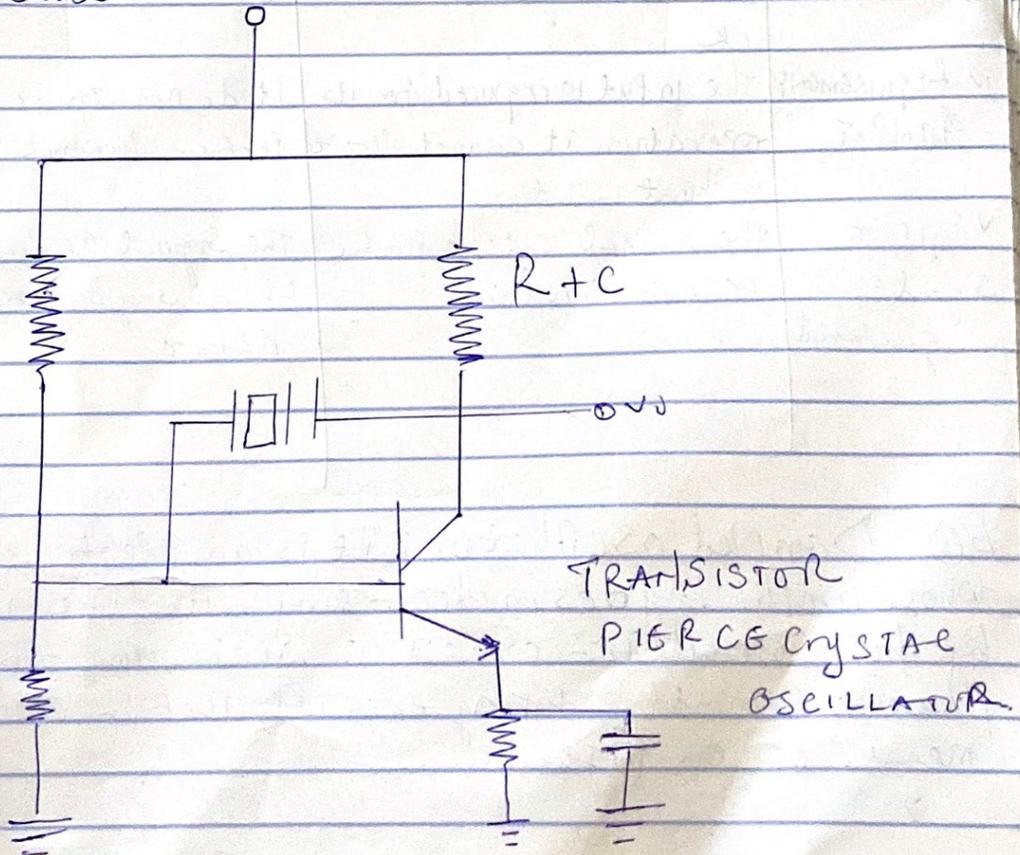
6a) Damped oscillator: It is an electrical oscillator whose amplitude goes on decreasing with time if it is produced by those oscillator circuit in which power losses take place continuously during each oscillation without any means of compensation.



(ii) Undamped oscillator: it is an electrical oscillator whose amplitude remains constant with time.



② In the transistor Pierce crystal oscillator is connected as a series element in the feedback path from collector to base.



3)

$$f_s = \frac{1}{2\pi \sqrt{LC_{eq}}}$$

$$= \frac{1}{2 \times 3142 \times \sqrt{0.5 \times C_{eq}}}$$

$$C_{eq} = \frac{[0.06 \times 10^{-12}] \times [9 \times 10^{-12}]}{[0.06 \times 10^{-12}] + [9 \times 10^{-12}]}$$

$$f_s = \frac{1}{2 \times 3.142 \times \sqrt{0.5 \times 0.051 \times 10^{-12}}}$$

$$f_s = 542.8 \text{ kHz}$$

Q Factor of the crystal.

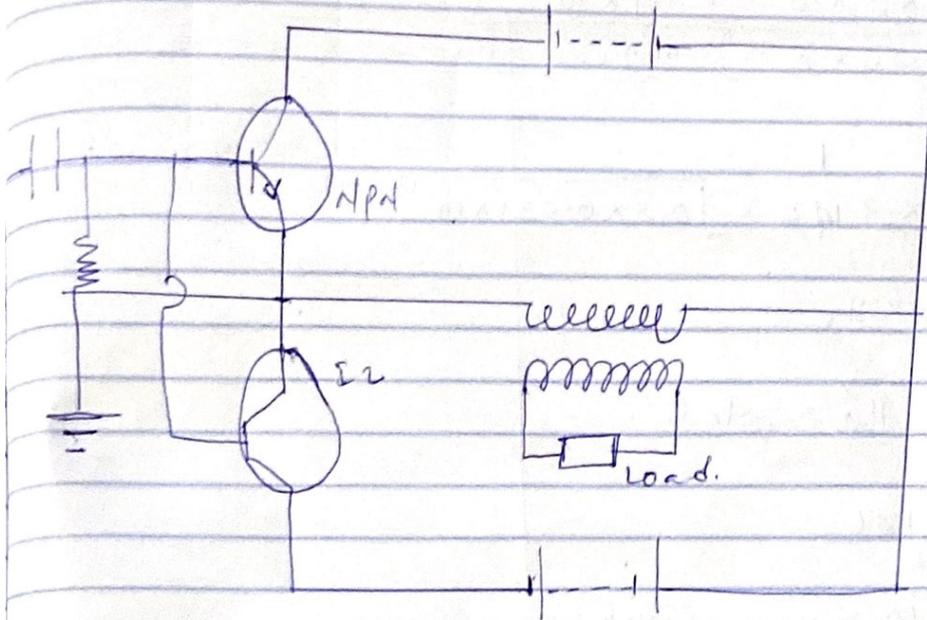
$$Q = \frac{2\pi f_s L}{R}$$

$$= \frac{2 \times 3.142 \times [920.43 \times 10^6] \times 0.05}{5 \times 10^3}$$

$$Q = 579.39$$

Q

45) The push pull amplifier improves the efficiency but the usage of center-tapped transformers makes the circuit bulky, heavy and costly. To make the circuit simple and to improve the efficiency, the transistors used can be complemented as shown below.



46)  $V_i$  [input voltage] = 20V

$$V_{B1} = 10V$$

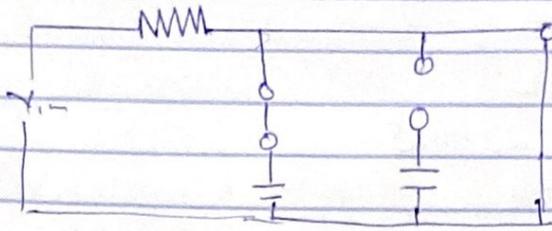
$$V_{B2} = 2.5V$$

Voltage across  $R_{20}$

Diode  $D_1$  is forward biased to  $V_{B1}$

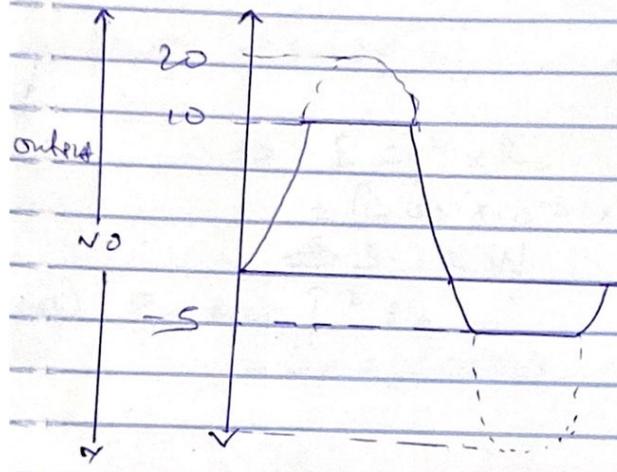
Diode  $D_2$  is reverse biased to  $V_{B2}$

During the positive half cycle terminal A is positive and terminal B; the diode  $D_1$  is forward biased and  $D_2$  reverse biased

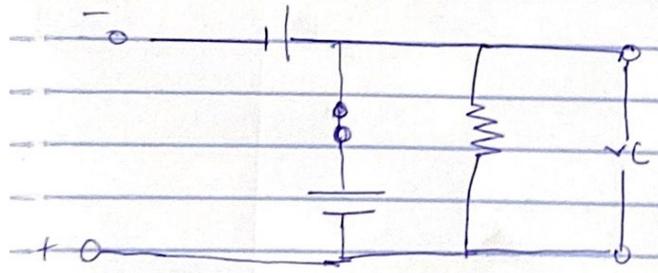


By applying KVL to the loop  
 $10 \cdot V_0 = 0$   
 $V_0 = 10V$

Output wave for m



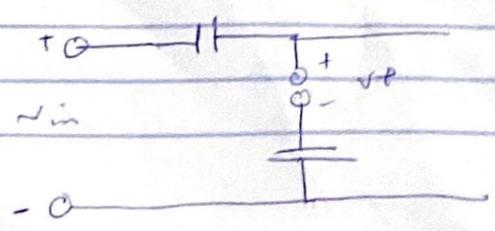
4(c) During the negative half cycle with terminal A being negative with respect to terminal B the diode D is forward biased and the circuit becomes as under.



By KVL with loop I  
 $-20 - V_C + 5 = 0$   
 $V_C = -15V$

By KVL with the loop,  $V_0 = -5V$ .

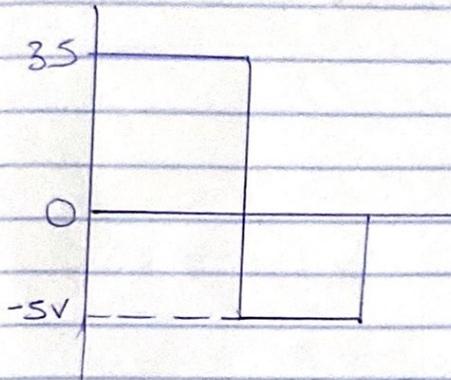
then during the positive half cycle, the diode D is reversed biased and the diode as



$$-20 - (-15) - V_0 = 0$$

$$V_0 = 35V$$

i.e the output signal is as thus.



(5)

$$V_{CC} = 200V \quad V_{CEQ} = 10V \quad I_{in} = 6.00 \times 10^{-3} A \quad R_{LA} = 10 \Omega$$
$$I_f = 300 \times 10^{-9} A$$

$$\text{(i) } P_{in} = V_{CC} \times I_{in}$$
$$= 20 \times 600 \times 10^{-3}$$
$$= 12W$$

ii) Power consumed by load resistance ( $P_{ac\ dc}$ ) =

$$\Rightarrow I_{CQ}^2 \times R_L$$
$$= (6.00 \times 10^{-3})^2 \times 16$$
$$\Rightarrow 5.76W$$

$$\text{iii) } P_{out} = I_c^2 R_L$$
$$= I_p = 300mA$$

$$I_c = \frac{I_p}{\sqrt{2}} = \frac{300 \times 10^{-3}}{\sqrt{2}} = 0.212A$$

$$P_{out} = (0.212)^2 \times 16$$

$$P_{out} = 0.719W$$

$$\text{(iv) } P_{\text{develop}} = P_{\text{supplied}} - P_{\text{consumed}}$$
$$= (12 - 5.76)$$
$$= 6.24W$$

$$\text{v) } DC \text{ Power wasted} = DC \text{ Power developed} - AC \text{ Power developed}$$
$$= (6.24 - 0.719)W$$
$$= 5.52W$$

$$\text{vi) } \text{Overall efficiency} = \frac{P_{out\ dc}}{P_{in\ dc}} \times 100$$

$$\text{vi) Over all efficiency} = \frac{0.719}{12} \times 100\%$$

$$= 5.99\% \approx 6\%$$

vii) Collector Efficiency =

$$\frac{P_{\text{out (dc)}}}{P_{\text{dc power developed}}} \times 100\%$$

$$= \frac{0.719}{6.024} \times 100\%$$

$$= 11.5\%$$