Q2 (a) A RLC circuit has R = 25 Ω , L= 0.04 H and C = 0.01 μF. Calculate the resonance frequency. If 1 V source of the same frequency as the resonance frequency is applied to the circuit, calculate the frequencies at which voltage across L and C are maximum.

Answer

Resonance freq. = fo= 1/ 2π √LC = 7960 Hz
At resonance, current is I = V / R = 1V / 25 Ω = 0.04 A
Freq. at which VL is maximum is fL= 1/ 2π √[LC – ($R^2.C^2$ / 2)] = 8 KHz
Freq. at which Vc is maximum is fc= 1/ 2π √[(1/ LC) – (R^2 / 2 L^2)] = 7.9 KHz

Q2 (b) State and explain with suitable example
(1) Reciprocity Theorem (2) Miller's Theorem

Answer

(1) *Reciprocity Theorem: If we consider two loops A and B of network N and if an ideal voltage source E in loop A produces current I in loop B, then interchanging positions, if an identical source in loop B produces the same current I in loop A, the network is said to be reciprocal. A linear n/w is said to be reciprocal or bilateral if it remains invariant due to the interchange of position of cause and effect in the network.*

(2) *Miller Theorem: Page Number 504 of Textbook*

Q3 (a) Draw and explain with waveforms the full wave centre-tapped rectifier. Show that its maximum efficiency is 81.2 %.

Answer

$$\eta = \frac{p_{dc}}{p_{ac}} \times 100\%$$

For FWR, $p_{dc} = I_{dc}^2.R_L = \left(\frac{2}{\pi}.I_m\right)^2.R_L$

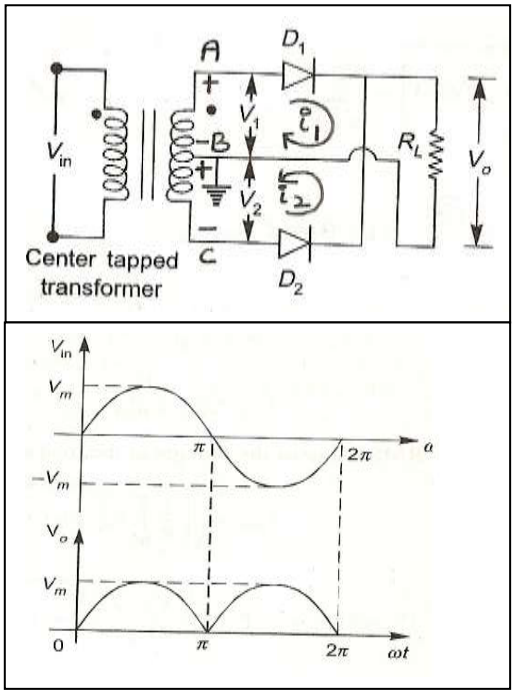
$P_{ac} = I^2_{rms}(R_f + R_S + R_L)$

$$\left(\frac{I_m}{\sqrt{2}}\right)^2 (R_f + R_S + R_L)$$

$$\eta = \frac{\frac{I^2_m 4}{\pi^2}.R_L}{\frac{I^2 m^2}{2}.(R_f + R_s + R_L)}$$

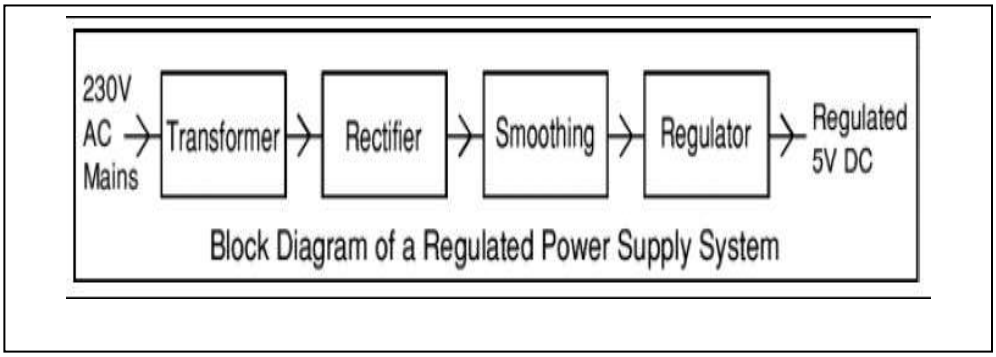
$If\ (R_f + R_S) << R_L$

$$\eta = \frac{4}{\pi^2}.\frac{2}{1} = \frac{8}{\pi^2} = 0.812 = 81.2\%$$



Q3 (b) With neat block diagram, explain DC regulated power supply. Explain the role of each block.

Answer



Block Diagram of a Regulated Power Supply System

Transformer – steps down 230V AC mains to low voltage AC.
Rectifier – converts AC to DC, but the DC output is varying.
Smoothing Filter – smooth the DC from varying greatly to a small ripple.
Regulator – regulates the unregulated DC voltage.

Q4 (a) Distinguish between BJT and JFET. Also state their merits and demerits.

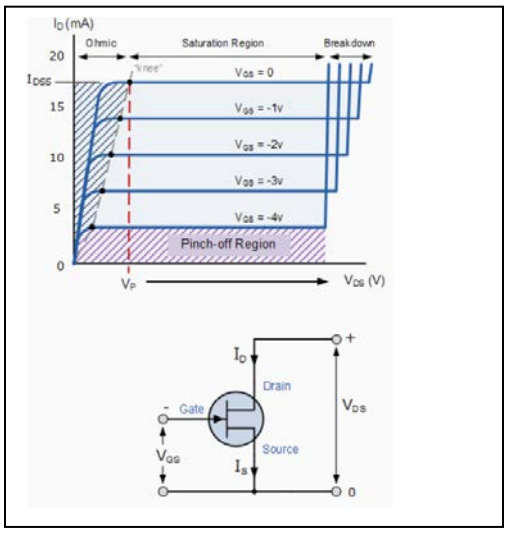
Answer

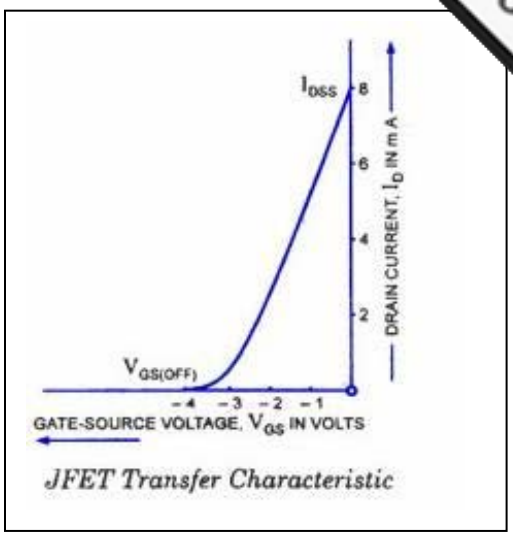
BJT	**FET**
Bipolar device	Uni-polar device
Majority & minority carriers	only majority carriers
Lesser switching speed	higher switching speed
Current controlled device	voltage controlled device
Less i/p impedance	higher i/p impedance
Comparatively more noisy	less noisy
Relatively more affected by radiations	less affected
Lesser thermal stability	more thermal stability
Occupy more space in IC fabrication	occupy very less space

Q4 (b) Draw and explain in brief the V_{DS}-I_D and transfer characteristics of n-channel JFET. Show that μ = rd x gm.

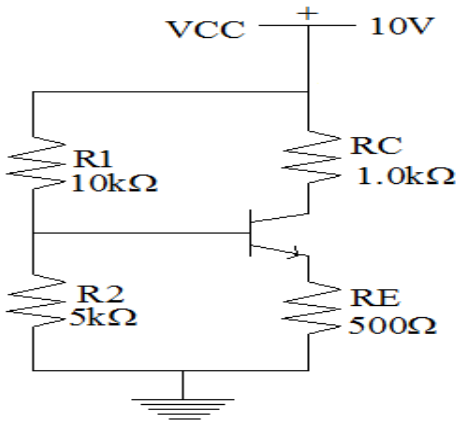
Answer

Drain resistance rd = $\Delta V_{DS} / \Delta I_D$
Tran conductance gm= $\Delta I_D / \Delta V_{GS}$
Amplification factor $\mu = \Delta V_{DS} / \Delta V_{GS} = (\Delta V_{DS} / \Delta I_D) \text{ X } (\Delta I_D / \Delta V_{GS}) = \text{rd X gm}$





Q5 (a) **Assuming Si transistor with β= 100 Calculate V_{CE}, I_C stability factor's.**



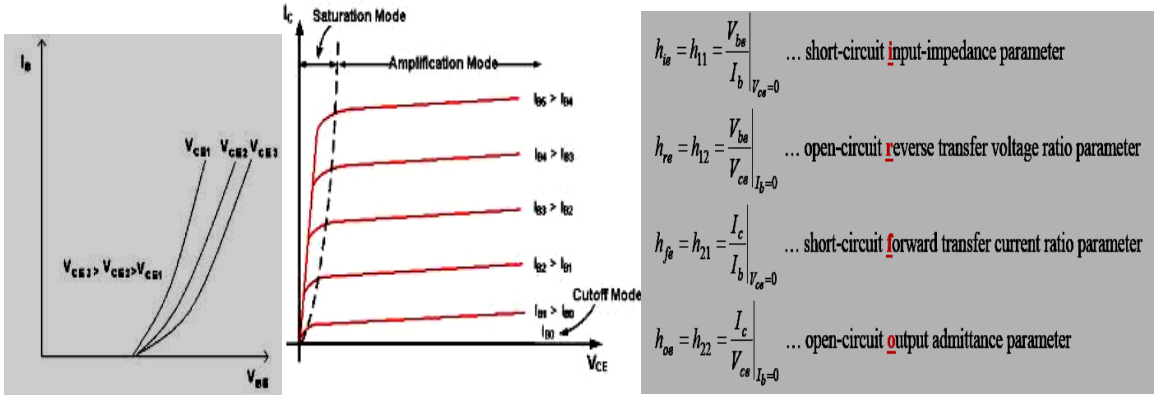
Answer

VB = [R2 / R1 + R2] x Vcc=3.33V
VE= VB – VBE= 3.3 - 0.7 = 2.63 V
IE= VE / RE = 2.63/ 500 = 5.26 mA
IB= IE / (1+ β) = 5.26 mA / 101 =52.08 μA
IC= β. IB = 100 X 52.08 μA **= 5.208 mA**

KVL to collector:
VCC – IC.RC – VCE – IE.RE =0
VCE = VCC – IC.RC — IE.RE
VCE = 2.162 V

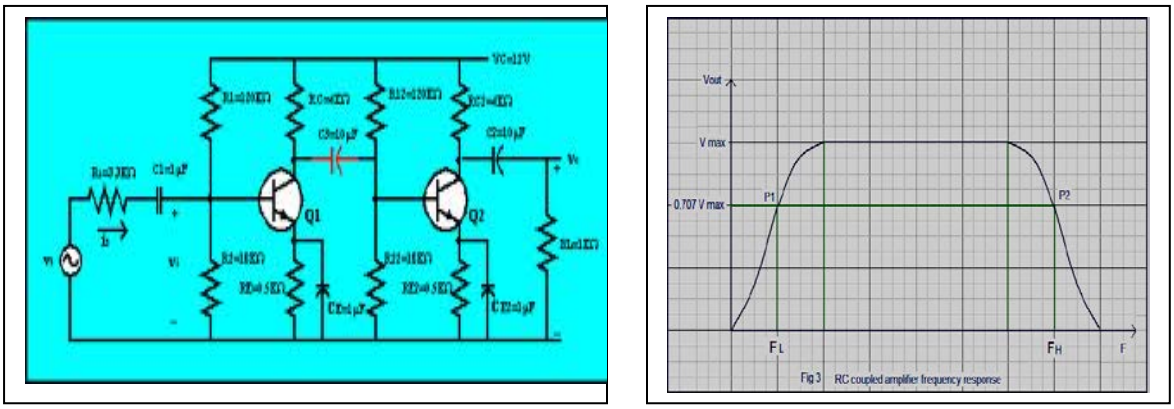
Q5 (b) What are hybrid parameters of BJT in CE mode? Explain how it can be determined graphically from CE characteristics?

Answer



Q6 (a) with neat circuit diagram and frequency response, explain two stage RC coupled amplifier. What are its advantages and applications?

Answer



Working Principle: When a.c. signal is applied to the base of the first transistor, it is amplified and developed across the out of the 1st stage. This amplified voltage is applied to the base of next stage through the coupling capacitor Cc where it is further amplified and reappears across the out put of the second stage. Thus the successive stages amplify the signal and the overall gain is raised to the desired level. Much higher gains can be obtained by connecting a number of amplifier stages in succession (one after the other). Resistance-Capacitance (RC) coupling is most widely used to connect the output of first stage to the input (base) of the second stage and so on. It is the most popular type of coupling because it is cheap and provides a constant amplification over a wide range of frequencies. Fig. shows the circuit arrangement of a two stage RC coupled CE mode transistor amplifier where resistor R is used as a load and the capacitor C is used as a coupling element between the two stages of the amplifier.

Frequency response curve

The curve representing the variation of gain of an amplifier with frequency is known as frequency response curve. It is shown in **figure.** The voltage gain of the amplifier increases with the frequency, f and attains a maximum value. The maximum value of the gain remains

constant over a certain frequency range and afterwards the gain starts decreasing with th increase of the frequency. It may be seen to be divided into three regions. 1) Low frequency range (<50 Hz) 2) Mid frequency range (50 Hz to 20 KHz) and 3) High frequency range (> 20 kHz).

Advantages-

1. Requires no bulky or expensive components and no adjustment.
2. Small, light and inexpensive.
3. Overall amplification is higher than other couplings.
4. Wide frequency response. 5. Less frequency distortion.

Q6 (b) Draw ideal and the actual response of tuned amplifier. Compare single tuned and double tuned amplifier.

Answer Page Number 493 and Page 515 of Electronic Devices and Circuits- third edition by S. Salivahanan and N. Suresh Kumar

Q7 (a) Explain briefly with suitable diagrams, how power amplifiers are classified with reference to operating point?

Answer

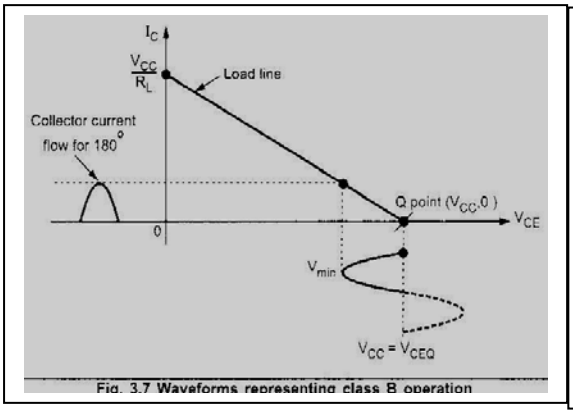


Fig. 3.7 Waveforms representing class B operation

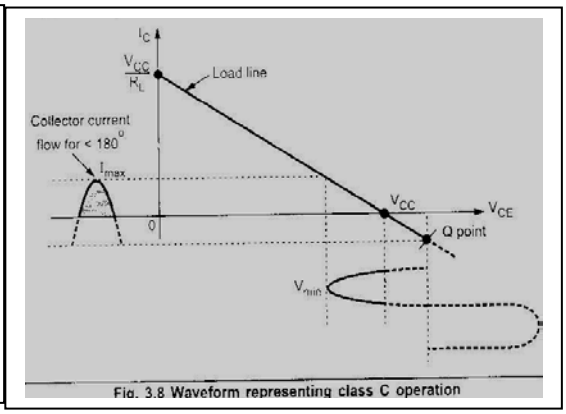


Fig. 3.8 Waveform representing class C operation

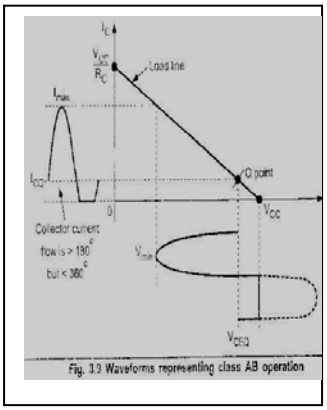


Fig. 3.9 Waveforms representing class AB operation

Class	A	B	C	AB
Operating Cycle	360°	180°	Less than 180°	180° to 360°
Position of Q point	Centre of load line	On X axis	Below X axis	Above X-axis but below the centre of load line
Efficiency	Poor, 25% to 50%	Better, 78.5%	High	Higher than A but less than B 50% to 78.5%

Q7 (b) Show that the maximum efficiency of class A direct coupled power amplifier is 25 %.

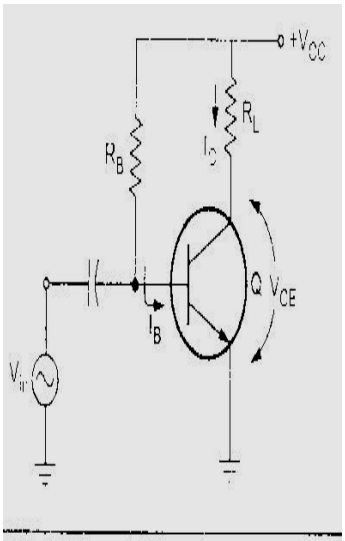


Fig. 3.10 Large signal class A amplifier

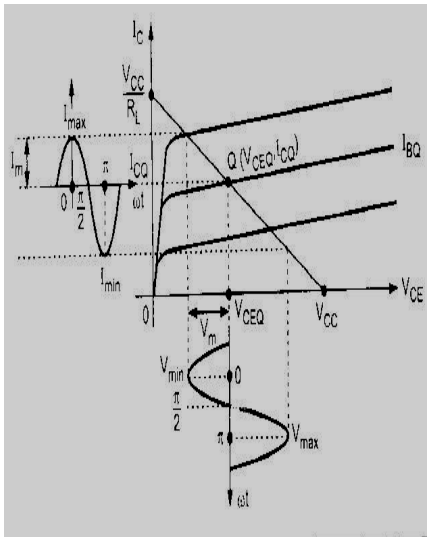


Fig. 3.11 Graphical representation of class A amplifier

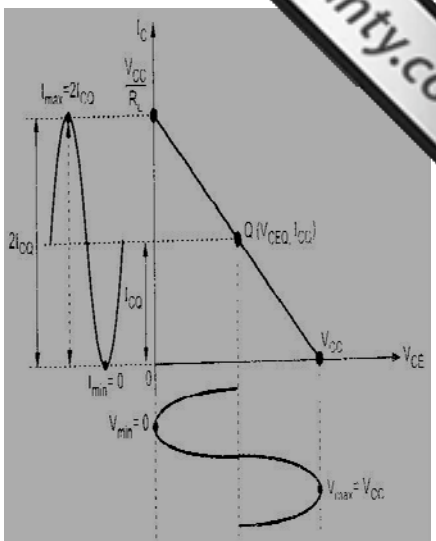


Fig. 3.12 Maximum voltage and current swings

% efficiency = % η = (Pac / Pdc) x 100 %
= [(Vmax – Vmin) (Imax – Imin)] / 8 VCC. I_{CQ} _____ (1)
from fig. 3.12, Vmax= VCC, Vmin= 0, Imax = 2 I_{CQ} and Imin = 0
put in equation 1, **% η = 25 %.**

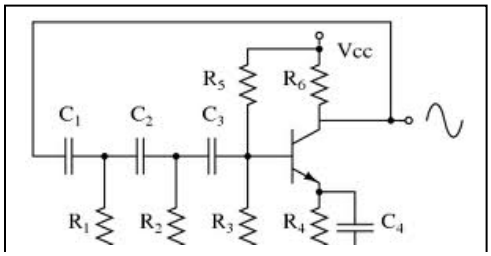
Q8 (a) What are the advantages and disadvantages of negative feedback in amplifier?

Answer
Advantages:
1. Increased stability
2. Increased bandwidth
3. Less amplitude and harmonic distortion
4. Decreased noise
5. Less frequency distortion
6. Less phase distortion.
7. Input and output resistance can be modified as per requirement.

Disadvantage: Reduction in gain of amplifier

Q8 (b) With neat circuit diagram, explain RC phase shift oscillator.

Answer
Each RC n/w produces phase shift of 60^o.
Total phase shift by 3 RC networks will be
$60^o + 60^o + 60^o = 180^o$
Remaining 180^o phase shift is given by
BJT CE amplifier.



Hence total phase shift around the loop
will be 360^o or 0^o.

Q9 (a) What do you mean by Integrated Circuits? What are the advantages of ICs as compared to standard printed circuits?

Answer
Integrated Circuit is just a packaged electronic circuit.

ADVANTAGES:
1. Extremely small physical size.
2. Very less weight.
3. Reduced cost.
4. Extremely high reliability.
5. Increased speed.
6. Low power consumption.
7. Easy replacement.
8. Higher scale of production.

Q9 (b) Explain in brief, the various steps involved in fabrication of ICs.

Answer
Refer page- 785 onwards of Electronic Devices and Circuits- third edition by S. Salivahanan and N. Suresh Kumar

The various steps involved in fabrication of ICs are-

Explanation in brief about:

Silicon wafer preparation, epitaxial growth, Oxidation, photolithography, etching, diffusion, ion implantation, metallization, interconnection, circuit probing, scribing and separating into chips, mounting and packaging and encapsulation

Text Book

Electronic Devices and Circuits, I. J. Nagrath, PHI (2007).