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*MODEL ANSWER*
WINTER– 18 EXAMINATION

# Subject Title: Applied Electronics

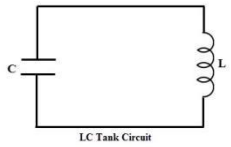
Subject Code: 22329

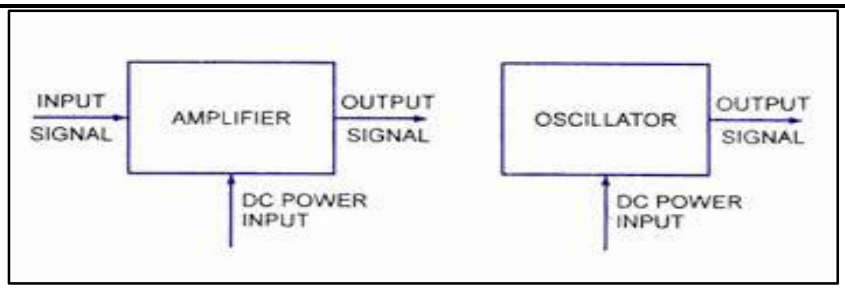
3 Hours / 70 Marks

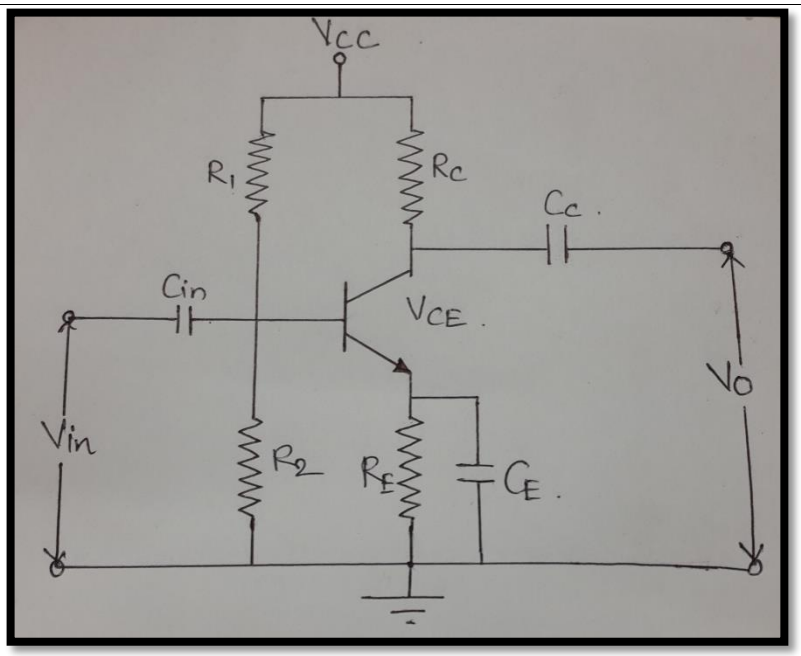
Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for anyequivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

| Q. No. | Sub Q.N. | Answer | Marking Scheme |
|---|---|---|---|
| Q.1 | | Attempt any FIVE of the following : | 10-Total Marks |
| | a) | Define the term related to power amplifier.<br>(i) Efficiency<br>(ii) Voltage gain | 2M |
| | Ans: | (i) Efficiency: Efficiency of the power amplifier is defined as the ratio of maximum a.c. output power to the d.c. input power.<br>Mathematically,<br>$\% \eta = \frac{P_o(\text{ac})}{P_i(\text{dc})} \times 100\%$<br>(ii) Voltage gain: Voltage gain of the power amplifier is defined as the ratio of output voltage to the input voltage.<br>Mathematically,<br>$A_V = \frac{V_{out}}{V_{in}}$ | 1 Mark for each definati on |

| | | |
|---|---|---|
| b) | List any four applications of RC coupled amplifier. | 2M |
| Ans: | Applications of RC coupled amplifier:<br>(i) Widely used as Voltage amplifiers.<br>(ii) They are used in Public Address System.<br>(iii) In Tape recorders.<br>(iv) In stereo amplifiers<br>(v) In T.V. V.C.R. and C.D. Players. | 1 Marks each<br>(Any four) |
| c) | State the role of tuned LC circuit in tuned amplifier. | 2M |
| Ans: | In order to pick up and amplify the desired radio frequency signal, the resistive load in the audio amplifier is replaced by a tuned circuit (also called a parallel resonant circuit)as shown in the figure. The tuned circuit is capable of selecting as particular frequency and rejecting the others.<br>  <br><br>LC Tank Circuit<br>Thus the use of tuned circuit in the transistor amplifier circuit, makes possible the selection and amplification of a particular desired radio frequency. Such an amplifier is called tuned voltage amplifier.<br>Thus an amplifier, which amplifies a specific frequency (or a narrow band frequencies), is called a tuned voltage amplifier or simply tuned amplifier. It serves following two purposes:<br>(i) Selection of desired radio frequency signal.<br>(ii)Amplification of the selected signal to a suitable voltage level. | State 1 ½ Marks and Diagram 1/2 mark |
| d) | List different types of feedback amplifiers. | 2M |
| Ans: | Types of feedback amplifiers:<br>1. Positive feedback amplifiers<br>2. Negative feedback amplifiers<br>(i)voltage series feedback amplifiers<br>(ii)voltage shunt feedback amplifiers<br>(iii)current series feedback amplifiers<br>(iv)current shunt feedback amplifiers | Each type 1 mark |
| e) | List the advantages of negative feedback over positive feedback. | 2M |
| Ans: | Advantages of negative feedback over positive feedback:<br>1. Higher fidelity i.e. more linear operation.<br>2. Highly stabilized gain.<br>3. Increased bandwidth i.e. improved frequency response. | Any four Each 1 mark |

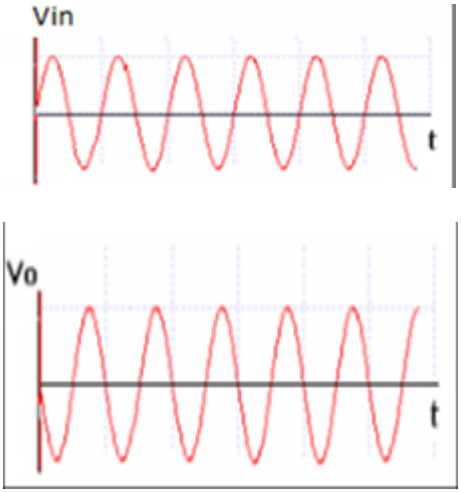
| | | | |
|---|---|---|---|
| | | 4. Less amplitude distortion.<br>5. Reduced noise.<br>6. Less harmonics distortion.<br>7. Less phase distortion.<br>8. Input and output impedance can be modified as desired.<br>9. Less frequency distortion. | |
| | f) | Compare amplifier and oscillator. | 2M |
| | Ans: |  <br>Figure shows a block diagram of an amplifier and an oscillator.<br>An amplifier is a device, which produces an output signal with similar waveform as that of the input. But its power level is generally high. This additional power is supplied by an external D.C. source. Thus an amplifier is essentially an energy convection device I.e. a device, which gets energy from the D.C. source and converts it into an a.c. energy at the same frequency as that of the input signal. The D.C. to A.C.. conversion is controlled by the input signal. It means that if there is no input signal then no energy conversion take place. Thus there is no output signal.<br>An oscillator is a device, which produces an output signal, without any input signal of any desired frequency. It keeps producing an output signal, so long as the D.C. power is supplied. An oscillator does not require any external signal to start or maintain energy conversion process. | Diagram 1 mark and explaination 1 mark |
| | g) | State use of heat sink. | 2M |
| | Ans: | Heat sink is a heat exchanger used to transfer heat generated by a *mechanical or an electronic device* to the surroundings.<br>Heat sinks are either made up of aluminium or copper or any other material which is good conductor of heat. Because conductor helps in conduction of heat from heated surface to the outside air.<br>Heat sinks are commonly used in laptops, computers etc.<br>A heat sink is usually made out of copper and/or aluminum. | State 2 mark |

| Q 2 | | Attempt any THREE of the following : | 12-Total Marks |
|---|---|---|---|
| | a) | Explain with the help of waveforms, the working principle of single stage CE amplifier. | 4M |
| | Ans: |  <br><br>CIRCUIT DESCRIPTION:<br>• The input a.c. signal is applied across the base emitter terminals of the transistor& output is taken across collector emitter terminals of the transistor. $V_{BB}$ supply forward biases the emitter base junction & $V_{CC}$ supply reverse biases the output junction.<br>• The Q point is determined by the $V_{CC}$ supply along with the resistance $R_C$. The resistances $R_1$,$R_2$, $R_E$ form the biasing & stabilization circuit & thus establishes proper operating point.<br>• Input capacitor ($C_{in} \approx 10\mu F$) : It blocks DC voltage to the base,if it is not provided the source resistance comes across $R_2$,so that transistor gets unbiased. It allows A.C. to pass & isolates source resistance from $R_2$.<br>• Emitter capacitance ($C_E \approx 100\mu F$): it is used in parallel with $R_E$ to provide a low reactance path to the amplified a.c. signal. If it is not used then amplified a.c. signal flowing through $R_E$ will cause a voltage drop across it, thus reducing the output voltage.<br>• Coupling capacitor ($C_C \approx 10\mu F$): it couples one stage of amplification to the next stage. If it is not used, $R_C$comes across with the $R_1$ of next stage & biasing of $2^{nd}$ stage gets disturbed. In short it isolates the d.c. of one stage from the next stage but allows the A.C. signal.<br><br>PHASE REVERSAL / WORKING:<br>• Consider above common emitter amplifier circuit. The input a.c. signal is applied across the base emitter terminals of the transistor & output is taken across collector emitter terminals of the transistor. $V_{BB}$ supply forward biases the emitter base junction & $V_{CC}$ supply reverse biases the output junction.<br>• Now apply KVL to collector to emitter loop'<br><br>$V_{CC} - I_C R_C - V_{CE} = 0.$ | Circuit 2 M and explanation 1 M and waveform 1 M |

∴ $V_{CC} - I_C R_C = V_{CE}$ ---------- (1)

- When the input a.c. signal voltage increases, the base current increases as a result collector current increases (as $I_C = \beta I_B$). Hence voltage drop $I_C R_C$ increases. As $V_{CC}$ is constant, from equation 1 output voltage $V_{CE}$ decreases.
- From above in common emitter amplifier when the input increases in the positive, the output voltage decreases. i.e. output is 180° out of phase with input.

Waveform:

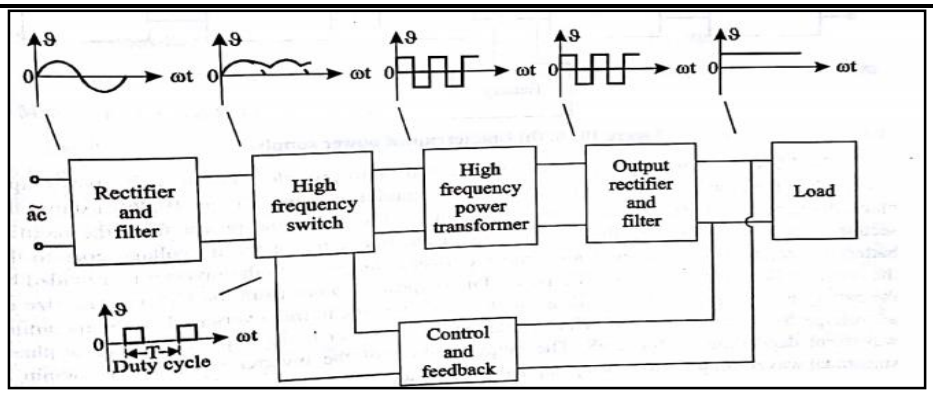


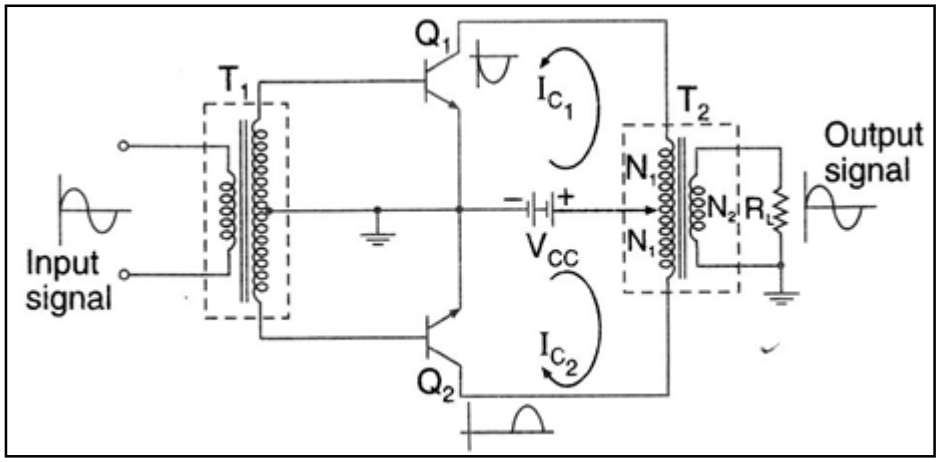

b) Compare positive and negative feedback. — 4M

Ans:

| Sr. No. | Parameter | Positive feedback | Negative feedback |
|---|---|---|---|
| 1 | BW | Increases | Decreases |
| 1 | Feedback signal | In phase with the input signal. | 180 º out of phase with the input signal. |
| 2 | Net input signal | Increases | Decreases |
| 3 | Gain | Increases | Decreases |
| 4 | Noise | Increases | Decreases |
| 5 | Stability | Poor | Improved |
| 6 | Input impedance | decreases | increases |
| 7 | Output impedance | increases | decreases |
| 8 | Uses | Oscillators, Schmitt trigger | Amplifiers, bootstrapping |

Any four points Each point 1 M

| | | |
|---|---|---|
| | | |
| c) | Define oscillator and state the Barkhausen criterion for the generation of sustained oscillations. | 4M |
| Ans: | Oscillator: An oscillator is a device, which produces an output signal, without any input signal of any desired frequency.<br>Barkhausen criterion:<br>The overall voltage gain of a positive feedback amplifier is given by,<br>$A' = \frac{A}{1-\beta A}$ .....(1)<br>Where, A = gain of an amplifier without feedback also called open loop gain<br>β A = product of feedback fraction and open loop gain. It is called loop gain.<br>The Barkhausen criterion for the generation of sustained oscillations.<br>for positive feedback are:<br>1. β A = 1<br>2. ∠ β A = 360° or 0° ie the total phase shift should be 360° or 0°. | Definition 1 M and Barkhausen criterion 3 M |
| d) | Explain the working of SMPS with neat block diagram. | 4M |
| Ans: |  <br>A block diagram of Switch Mode Power Supply is shown in figure. The first block is rectifier and filter that converts the A.C. supply voltage to pulsating D.C. which is then filtered out to reduce the amount of ripple content. This section uses the power diodes in bridge configuration to obtain the pulsating d.c. and the capacitor is used as a filter element. The second block is the high frequency switching section and it uses either MOSFETs or BJTs to convert the D.C. voltage to a high frequency ac\.c. square wave. This high frequency a.c. square waves ranges from 20 KHz to 100 KHz. Since the power transistors are not operated in their active region, their operation results in low power dissipation. Thus it is a two stage conversion i.e. the input a.c. supply voltage is first rectified to d.c. and then the high frequency switching section changes it back to A.C.<br>The next block of SMPS is high frequency power transformer that isolate the circuit and step up or step down the voltage to the desired voltage level. The output of the transformer is the input of the second rectifier section, called the output rectifier section. This rectifier section is different fron the first block of the rectifier in that the frequency of the voltage is very high. Therefore, the bridge configuration of this rectifier uses a high frequency diodes such as schottky diode and the output ripple is naturally filtered becouse of the number of the overlaps between each individual output pulse. Since the ripple is very | Block diagram 2 M And explanation 2 M |

| | | | |
|---|---|---|---|
| | | small in output voltage of the rectifier, a small capacitance is required in the filter section. The last section of the SMPS is the control and feedback block, which contains circuitry that provides Pulse Width Modulation (PWM) output signal. The PWM controller provides duty cycle that varies pulse by pulse to provide an accurate d.c. output voltage. | |
| Q.3 | | Attempt any THREE of the following : | 12-Total Marks |
| | a) | Explain with sketch the working of class B push pull amplifier. | 4M |
| | Ans: | Circuit Diagram:-<br>  <br><br><u>Operation:</u><br>• In class B amplifier transistor conduct only for half cycle of input signal.One conduct in positive half cycle and other conducts in negative half cycle.<br>• Transformer $T_1$ is called as input transformer called phase splitter and produces two signals which are 180 degree out of phase with each other.<br>• Transformer $T_2$ is called as output transformer and is required to couple the a.c signal from the collector to the load.<br>• When there is no input signals both the transistor $Q_1$ and $Q_2$ are cut off hence no current is drawn from Vcc supply. Thus there is no power wasted in stand by the power dissipation in both transistor is practically zero.<br>• During positive half cycle ON $Q_2$ OFF and at the output half cycle is obtained $Q_1$ during negative half OFF and $Q_2$ on hence another half cycle is obtained cycle $Q_1$ at the output.<br>• Then output transformer joins these two halves and produces a full sine wave in the load resistor. | Circuit Diagram 2M & Operation 2M |
| | b) | Compare different types of power amplifier on basis of-<br>(i) Efficiency. | 4M |

(ii) Power dissipation in transistor.
(iii) Conduction angle of collector current
(iv) Position of Q.

Ans:

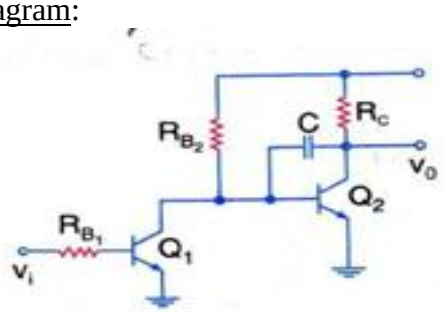
| Parameter | Class A | Class B | Class AB | Class C |
|---|---|---|---|---|
| Position of operating pt. (Q Point) on load line | Q point is at the center of load line. | On X axis | Just above X axis. | Below X axis. |
| Efficiency | lowest efficiency 25% to 50% | Above 78.5% | Between 50 to 78.5% | Above 95% |
| Conduction Angle of collector current | Conducts for ($360^0$) full cycle of input signal | ($180^0$) half cycle of input signal. | Greater than $180^0$ and less than $360^0$ | Less than $180^0$ of input signal. |
| Power dissipation in transistor | Very High | Low | Low | Very Low |

Each difference carry 1M

c) Draw miller sweep generation and give its applications. 4M

Ans:

Diagram:




(a) Miller sweep circuit.

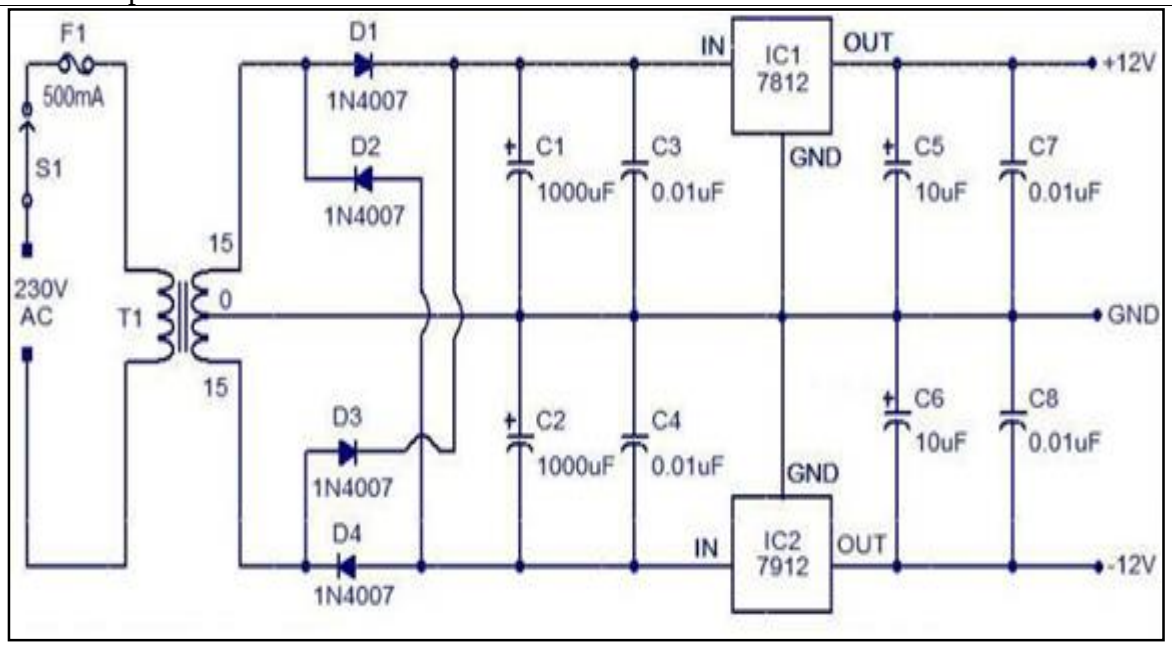
Diagram:2M & Applications (any two) 2M

Applications of Miller Sweep Generator: (any two)

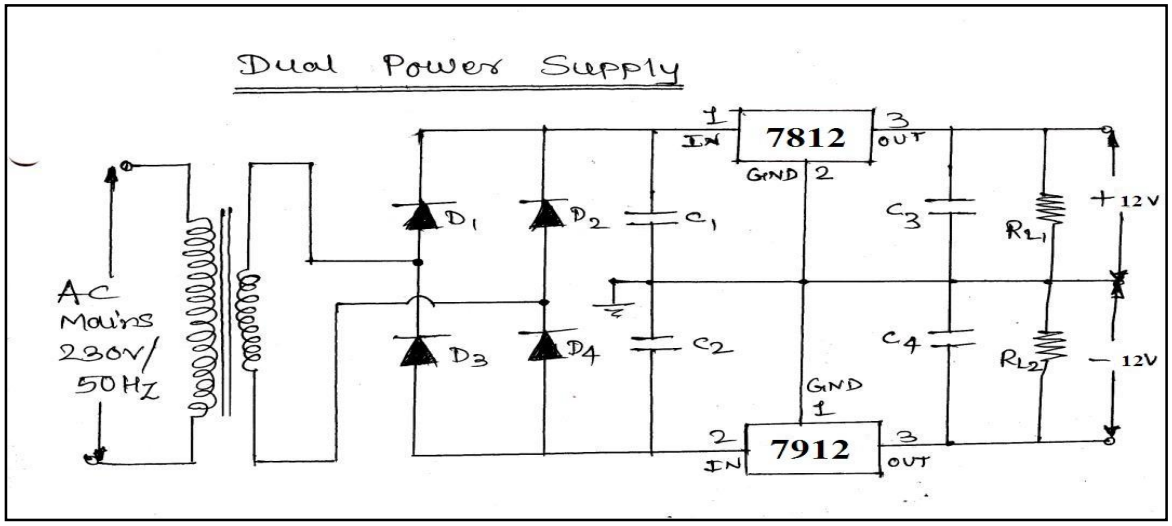
1. Applications where linear output is expected.
2. Television (TV)
3. CRO
4. To convert step waveform into ramp waveform.

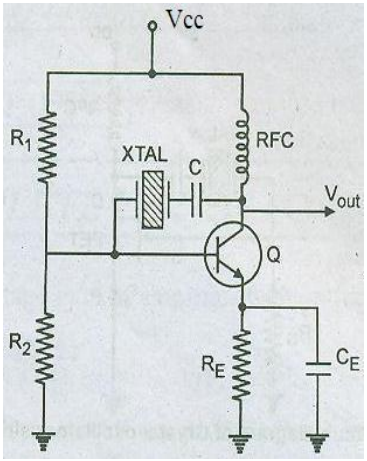
| | | | |
|---|---|---|---|
| | d) | Sketch the circuit diagram for dual voltage regulator using IC 78XX and 79XX to obtain ±12V output. | 4M |

Ans:




OR



| | | | |
|---|---|---|---|
| Q.4 | A) | Attempt any THREE of the following : | 12-Total Marks |
| | a) | State the necessity of regulated power supply. Define load and line regulation. | 4M |
| | Ans: | <u>Necessity of regulated power supply: 2M</u><br><br>The major disadvantage of a power supply is that the output voltage changes with the variations in the input voltage or The D.C output voltage of the rectifier also increase similarly, In many electronic applications, it is desired that the output voltage should remain constant regardless of the variations in the input voltage or load. In order to get ensure this; a voltage stabilizing device called voltage regulator is used.<br><br><u>Load Regulation</u>:1M<br>The load regulation indicates the change in output voltage that will occur per unit change in load current.<br>Mathematically,<br>$\textbf{Load Regulation} = \frac{V_{NL} - V_{FL}}{\Delta I_L}$<br>Where, $V_{FL}$ *is full load voltage*<br>$\Delta I_L$ *is change in laod current*<br>$V_{NL}$ is no load voltage<br><br><u>Line Regulation</u>:1M<br>The change in output voltage with respect to per unit change in input voltage is defined as line regulation. It is mathematically expressed as,<br>Line regulation=$\Delta V_L/\Delta V_S$<br>Where,<br>$\Delta V_L$ = The change in output voltage<br>$\Delta V_S$= The change in input voltage | Necessity 2M ,<br><br>Load Regulation 1M & Line regulation 1M |
| | b) | Explain the working principle of crystal oscillator with diagram. | 4M |
| | Ans: | <u>Circuit Diagram:</u><br><br>  | |

Working Principle of Piezoelectric Crystal:

- A Quartz Crystal has a very peculiar property known as Piezoelectric Effect.
- According to this effect, when an AC voltage is applied across a quartz crystal, it vibrates at a frequency of applied voltage.
- Conversely, if a mechanical force is applied to vibrate a quartz crystal it generates an AC voltage.
- Above fig shows the circuit of crystal oscillator using transistor. In this circuit, the crystal is connected as a series element in the feedback path from collector to the base.
- The resistors $R_1$, $R_2$ and $R_E$ provide voltage divider stabilized d.c. bias circuit. The capacitor $C_E$ provides a.c bypass of emitter resistor and RFC coil provides for d.c bias. The coupling capacitor C has negligible impedance at the circuit operating frequency.
- The circuit frequency of oscillation is set by the series resonant frequency of the crystal and its value is given by the relation

$$fr = \frac{1}{2\pi\sqrt{LC}}$$

Or

Working Principle:

When the D.C. power is switched on, the noise voltage of small amplitude appearing at the base gets amplified and appears at the output. This amplified noise now drives the feedback network consisting of a quartz crystal and capacitor C. Thus the crystal is excited by a fraction of energy feedback from the output to the input. The crystal is made to operate as an inductor L so that the feedback network consists of series resonant LC circuit. This is possible only, if the frequency of oscillations $f_0$ is in between the series resonant frequency $f_s$ and the parallel resonant frequency $f_p$ of an electrical equivalent circuit of a crystal . Thus, the frequency of oscillations is set by the series resonant frequency $f_s$ of the crystal. This produces undamped oscillations of stable frequency $f_0$.

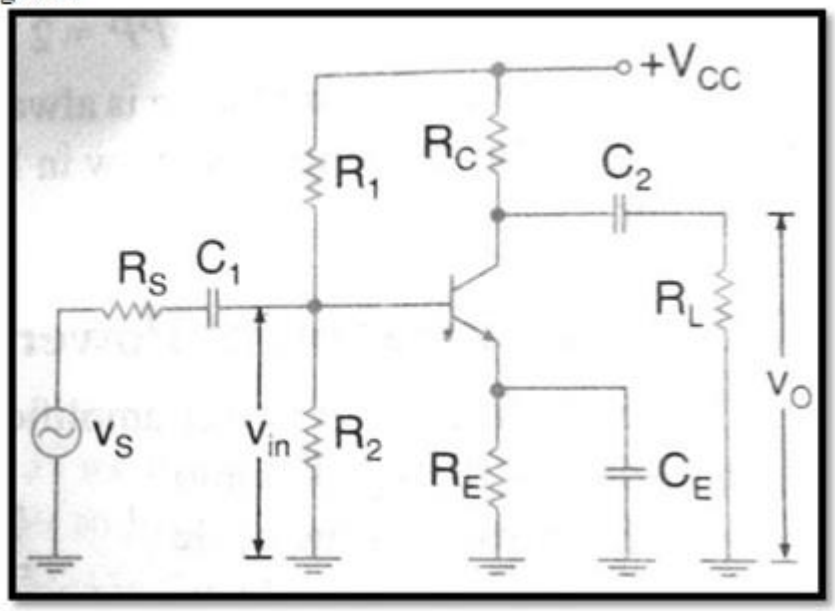
$$fr = \frac{1}{2\pi\sqrt{LC}}$$

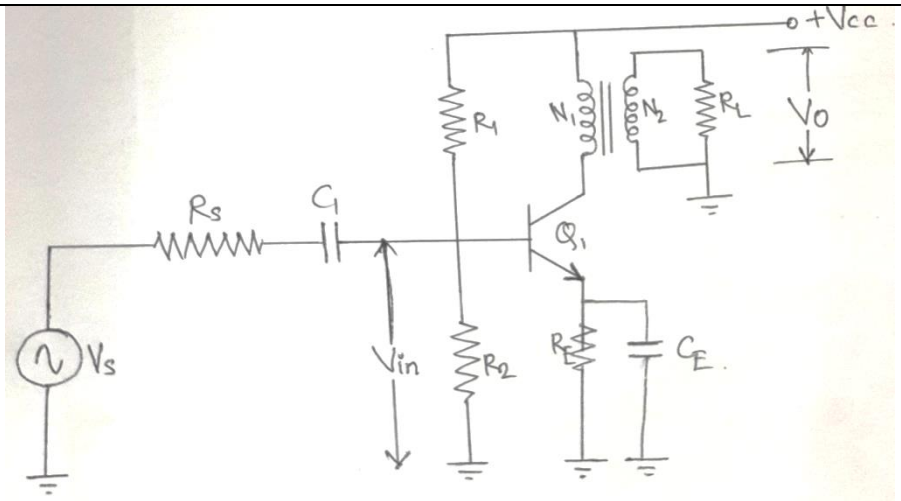
c) Compare the performance of current series and current shunt feedback amplifier. 4M

Ans:

| Sr.No. | Characteristics | Current series feedback amplifier | Current shunt feedback amplifier |
|---|---|---|---|
| 1. | Voltage gain | Decreases | Decreases |
| 2. | Bandwidth | Increases | Increases |
| 3. | Harmonic distortion | Decreases | Decreases |

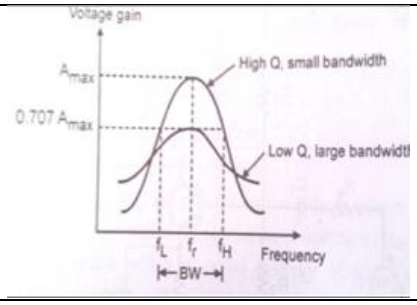
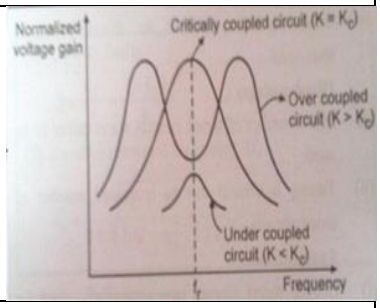
(Any Four) each carry 1M

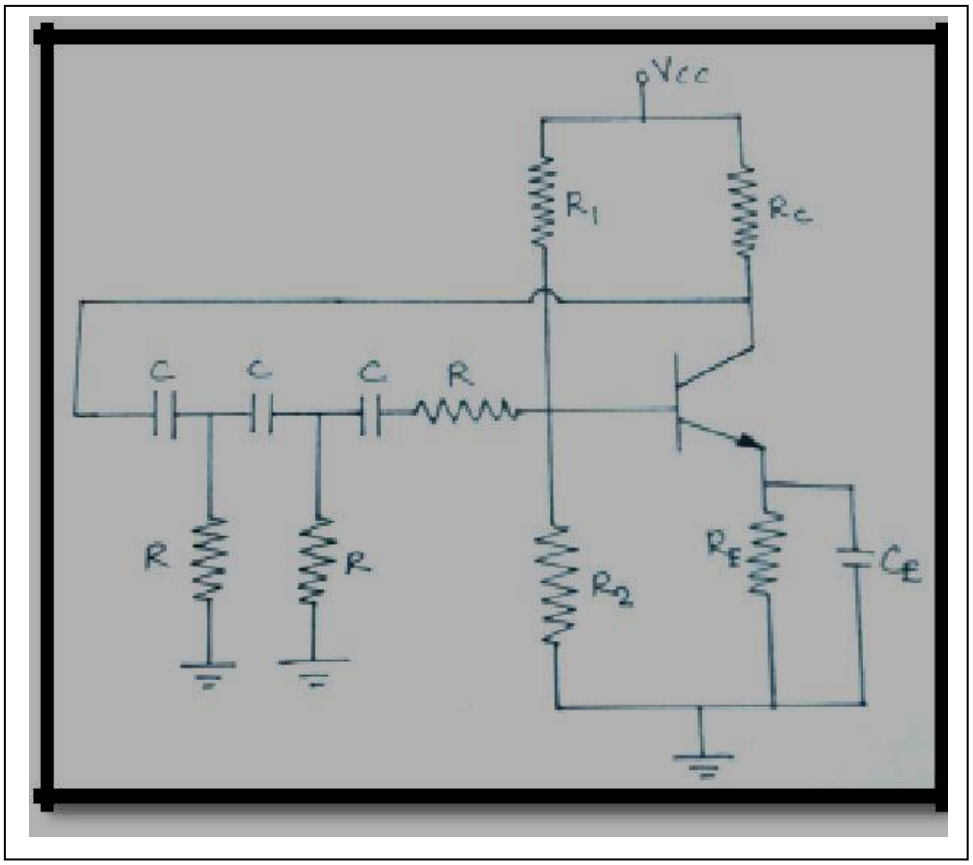
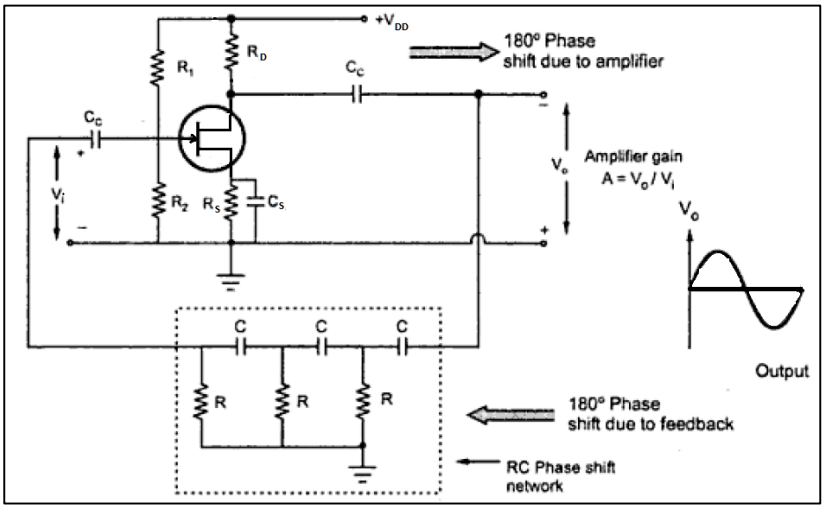
| | | | | | |
|---|---|---|---|---|---|
| | | 4. | Noise | Decreases | Decreases | |
| | | 5. | Input resistance | Increases | Decreases | |
| | | 6. | Output resistance | Increases | Increases | |
| | d) | Describe with help of circuit diagram working of class A power amplifier. | | | 4M |
| | Ans: | **Circuit Diagram:**<br>  <br><br><u>Working:</u><br>The input a.c. signal is applied across the base emitter terminals of the transistor & output is taken across collector emitter terminals of the transistor. $V_{BB}$ supply forward biases the emitter base junction & $V_{CC}$ supply reverse biases the output junction.<br>The Q point is determined by the $V_{CC}$ supply along with the resistance $R_C$. The resistances $R1, R_2, R_E$ form the biasing & stabilization circuit & thus establishes proper operating point.<br>Input capacitor ($C_{in} \approx 10\mu F$) : It blocks DC voltage to the base, if it is not provided the source resistance comes across $R_2$,so that transistor gets unbiased. It allows ac to pass & isolates source resistance from $R_2$.<br>Class A amplifier is basically, a common emitter amplifier. This circuit is called direct coupled class A power amplifier. The only difference between this circuit and small signal version, considered earlier, is that the signals handled by the power amplifier circuit are in the range of volt.<br>Or<br><u>Circuit Diagram:</u> | | Circuit Diagram 2M & Working 2M |



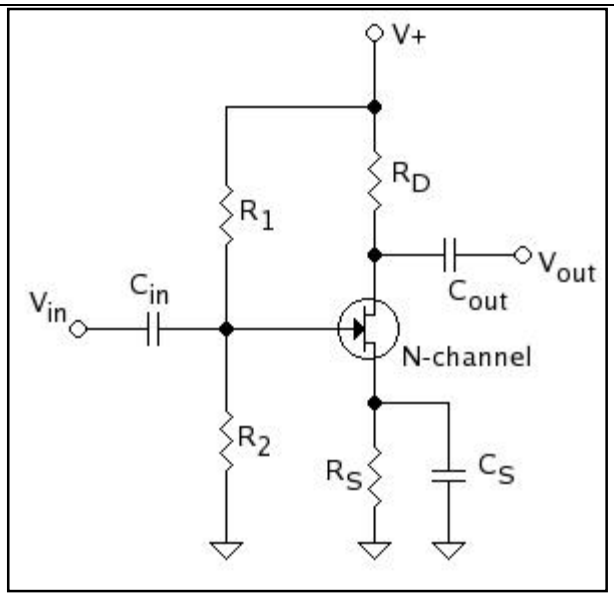

e) Compare single tuned and double tuned amplifier with respect to operating principle, frequency response, efficiency and applications.

Ans:

| Sr.No. | Characteristics | Single tuned amplifier | Double tuned amplifier |
|---|---|---|---|
| 1. | Operating Principle | Parallel Resonance | Parallel Resonance |
| 2. | Frequency response |  |  |
| 3. | Efficiency | High | Low |
| 4. | Application | TRF receiver, TV receiver | IF amplifier in Radio receiver, TV receiver |

| | | | |
|---|---|---|---|
| Q.5 | | Attempt any TWO of the following : | 12- Total Marks |
| | a) | Explain with diagram the working of phase shift oscillator. Also a phase shift oscillator has R = 220 kΩ and C = 500 pf. Calculate the frequency of sine wave generated by the oscillator. | 6M |
| | Ans: | Circuit Diagram of RC PHASE SHIFT OSCILLATOR:   OR   | Circuit Diagram: 2M Working: 2M Calculation for $f_o$ = 2M |

| | | | |
|---|---|---|---|
| | | WORKING:<br>• Common emitter amplifier introduces a $180^0$ phase shift between input & output. & remaining $180^0$ phase shift is produced by three identical basic RC phase shifting networks.<br>• Each RC network is designed to introduce a phase shift of $60^0$.<br>• The phase shift around the loop is $360^0$ only at one precise frequency.<br>• This frequency of oscillation is given by<br>$f_o = \frac{1}{2\,\pi\,RC\,\sqrt{6}}$<br>• The feedback factor $\beta = \frac{1}{29}$<br>• Therefore $A_V$ = 29<br>Calculation For $f_o$:<br>Given:<br>R= 220 $K\Omega$<br>C= $500pF$<br>To Find:<br>Frequency of oscillation $f_o$.<br>Formula Used: $f_o = \frac{1}{2\,\pi\,RC\,\sqrt{6}}$<br>Solution: $f_o = \frac{1}{2\,\pi\,RC\,\sqrt{6}}$<br>$f_o = \frac{1}{2\,\pi * 220K\Omega * 500pF * \sqrt{6}}$<br>$f_o$= 590.67 Hz<br>The frequency of sine wave generated by the oscillator = 590.67 Hz. | |
| | b) | Explain operation of FET common source amplifier with applications. | 6M |
| | Ans: | COMMON SOURCE FET AMPLIFIER:<br>Circuit Diagram: | Circuit Diagram: 2M<br>Operation: 2M<br>Applications (any 2): 2M |




- Above circuit shows CS N-channel FET amplifier.
- Voltage divider biasing circuit is used.
- $C_1$ & $C_2$ are coupling capacitors used to couple input AC signal & output respectively.
- $C_S$ is a bypass capacitor which keeps the source of FET effectively.

OPERATION:

DURING POSITIVE HALF CYCLE:

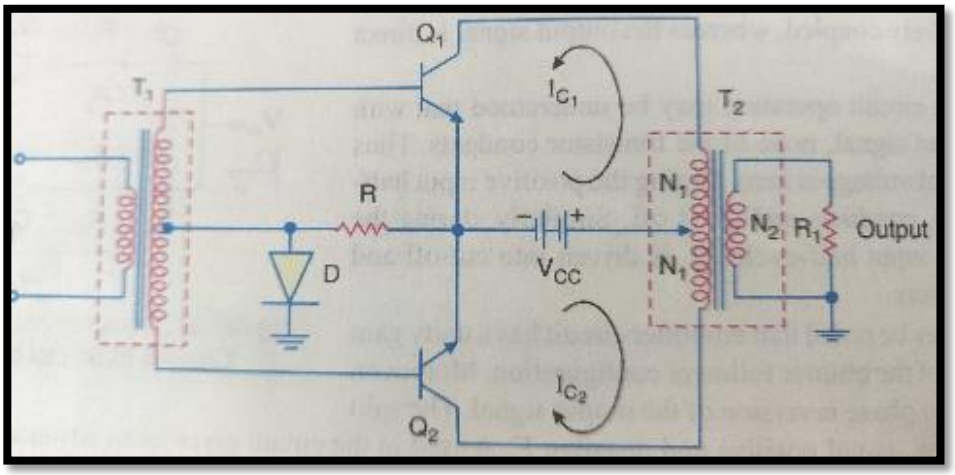
- As the gate to source voltage increases, the drain current also increases.
- As a result of this, the voltage drop across resistor $R_D$ also increases.
- This causes the drain voltage to decrease. As $V_{DS} = V_{DD} - I_D R_D$.
- It means that the positive half cycle of the input produces negative half cycle of the output voltage.
- In other words output voltage is 180 out of phase with the input voltage.

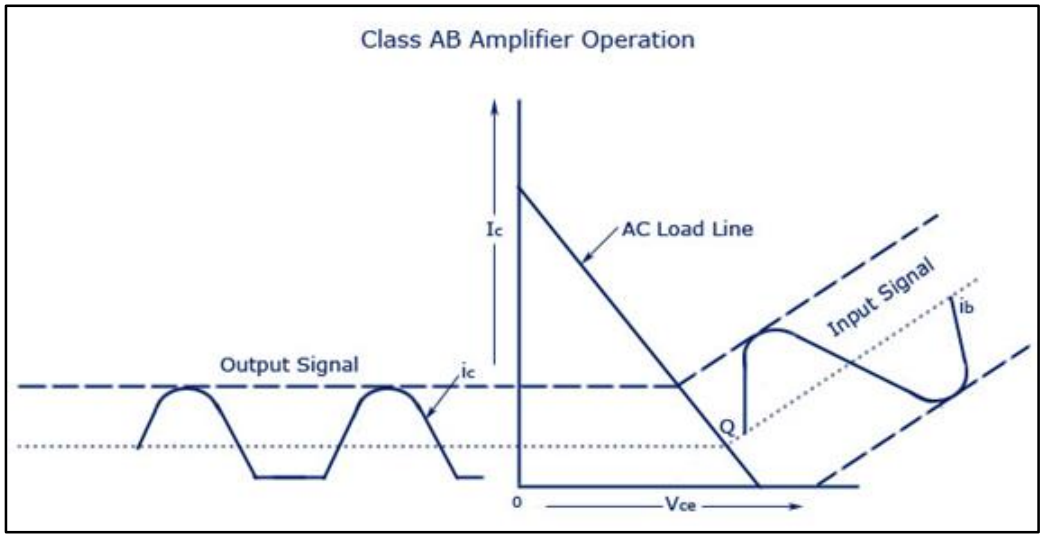
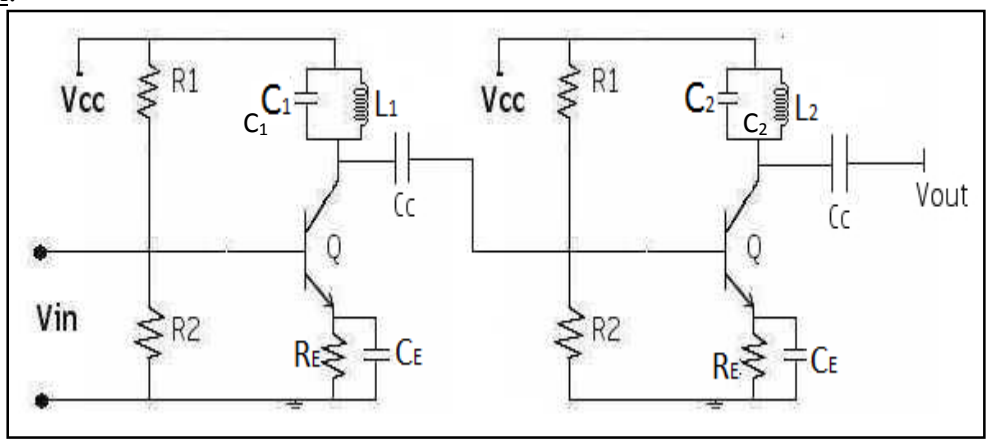
DURING NEGATIVE HALF CYCLE:

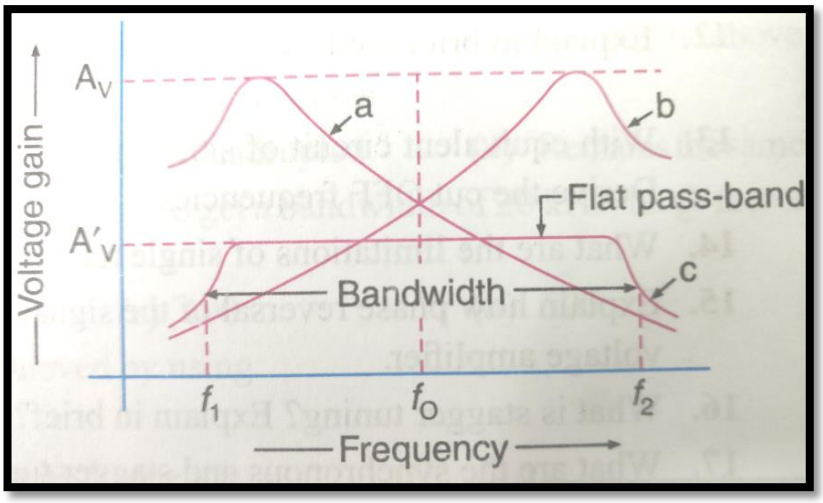
- As the gate to source voltage decreases, the drain current also decreases.
- As a result of this, the voltage drop across resistor $R_D$ also decreases.
- This causes the drain voltage to increase. As $V_{DS} = V_{DD} - I_D R_D$.
- It means that the negative half cycle of the input produces positive half cycle of the output voltage.
- In other words output voltage is 180 out of phase with the input voltage.

APPLICATIONS OF CS-FET AMPLIFIER:

- As a pre-amplifier in audio circuits.
- As a voltage amplifier.
- In the public address system.
- In radio & TV amplifier circuit.

| | | | |
|---|---|---|---|
| | c) | Explain with circuit diagram and waveform the operation of class AB push pull power amplifier | 6M |
| | Ans: | Class AB Push Pull Power Amplifier:<br>Circuit Diagram:<br>  <br><br>Circuit Decription:<br>The circuit consists of two centre-tapped transformers $T_1$ and $T_2$, two identical transistors $Q_1$ and $Q_2$ , Resistor R and diode D. The DC voltage developed across the diode D is connected to the bases of both the transistors through the secondary winding of the input transformer. This voltage acts as DC bias for the transistors because it is equal to cut-in voltage and they will conduct for complete half cycleperiod of the input to eliminate the cross-over distortion.<br><br>WORKING:<br>➢ When there is no a.c. input signal is applied both the transistors $Q_1$& $Q_2$ are cut off. Hence no current is drawn from $V_{CC}$.<br>➢ DURING POSITIVE HALF CYCLE:<br>• The base of the transistor $Q_1$ is positive and that of $Q_2$ is negative.<br>• As a result of this $Q_1$ conducts, while the transistor $Q_2$ is OFF.<br>➢ DURING NEGATIVE HALF CYCLE:<br>• The base of the transistor $Q_2$ is positive and that of $Q_1$ is negative.<br>• As a result of this $Q_2$ conducts, while the transistor $Q_1$ is OFF.<br>➢ Thus at any instant any one transistor in the circuit is conducting.<br>➢ Then the output transformer joins these two halves & produces a full sine wave in the load resistor. | Circuit Diagram: 2M<br>Operation: 2M<br>Waveform: 2M |

| | | | |
|---|---|---|---|
| | | Waveform:<br>  <br> | |
| Q.6 | | Attempt any TWO of the following: | 12- Total Marks |
| | a) | Explain stagger tuned amplifier with the help of waveforms. | 6M |
| | Ans: | Circuit Diagram:<br>  <br><br>Above figure shows two-stage tuned voltage amplifier. The stagger tuning in this circuit, may be achieved by resonating the tuned circuits $L_1C_1$ and $L_2C_2$ to slightly different frequencies.<br><br>Frequency Response: | Circuit Diagram: 2M<br>Waveform (Frequency Response): 2M<br>Explanation:2 M |



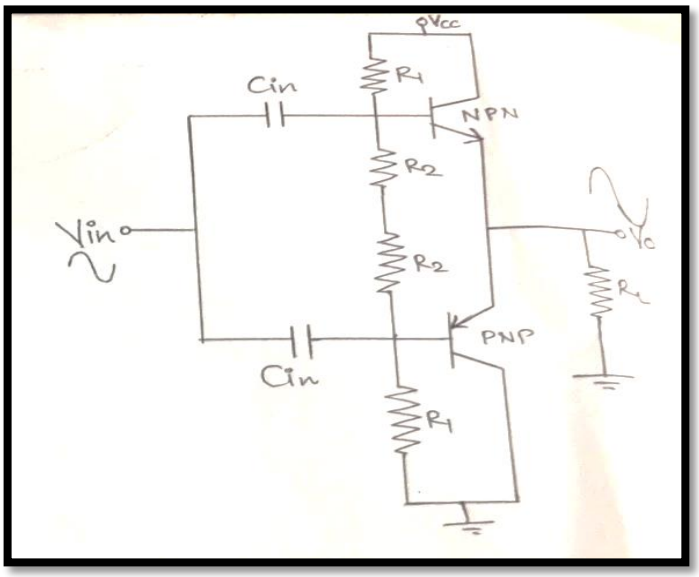

Above figure shows frequency response of a stagger-tuned amplifier. In this figure, curve 'a' shows the gain versus frequency of the $L_1C_1$ tuned circuit. Similarly the curve 'b' shows the response of the $L_2C_2$ tuned circuit. The curve 'c' indicates the combined response of the circuit. It is evident from this curve that the amplifier has a greater bandwidth and flatter pass-band. It has been found that more the number of stages used, flatter will be the pass-band and steeper will be the gain fall-off outside the pass-band. Because of the stagger tuning there is a loss of voltage gain.

b) Draw the circuit of complementary, symmetry push pull amplifier and explain its working. 6M

Ans:

COMPLEMENTRY SYMMETRY CLASS B PUSH PULL AMPLIFIER

Circuit Diagram:




Circuit description:

- Two transistors one NPN & other PNP is used in the circuit so they are complementary to each other.
- Biasing conditions used for both transistors are same so they are symmetrical.
- $R_1$, $R_2$, $V_{CC}$ are used for voltage divider bias of transistors.
- Both transistors conduct for 180°as it is class B amplifier.
- Whenever one transistor is ON other push to be OFF so the name push pull.

Circuit diagram: 2m
Circuit description: 1m
Working: 2m
Waveform: 1m

| | | | |
|---|---|---|---|
| | | Working:<br>➢ Input signal $V_{in}$ is applied to both the transistor through input capacitor.<br>➢ During positive half cycle of input:<br>• The base of the transistors NPN & PNP is positive.<br>• As a result of this NPN conducts & PNP remains OFF.<br>• So we get half cycle in the output.<br>➢ During negative half cycle of input:<br>• The base of the transistors NPN & PNP is negative.<br>• As a result of this PNP conducts & NPN remains OFF.<br>• So we get remaining half cycle in the output. | |
| | c) | In voltage amplifier output voltage without negative feedback is 10V. If 25% of output voltage its feedback in series with input voltage. Find Feedback voltage, also give value of the feedback factor. | 6M |
| | Ans: | Given Data:<br>$V_{OUT}$ = 10V<br>25% of output voltage its feedback in series with input voltage.<br><br>To find:<br>1. Feedback voltage $V_F$<br>2. Feedback factor β<br><br>**Solution:**<br>1. Feedback voltage $V_F$:<br><br>25% of output voltage its feedback in series with input voltage.<br>i.e. $V_F$ = 25% of $V_{OUT}$<br>$V_F$ = 25% of 10V<br>$V_F$ = 2.5V<br><br>2. Feedback factor β:<br><br>$\beta = \frac{V_F}{V_{OUT}}$<br><br>$\therefore \beta = \frac{2.5V}{10V}$<br><br>$\therefore \beta = 0.25$<br><br>1. Feedback voltage $V_F$ = 2.5V<br>2. Feedback factor β = 0.25 | Caculation of feedback voltage: 3m<br>Caculation of feedback factor:3 m |

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***MODEL ANSWER***

**SUMMER– 19 EXAMINATION**

# Subject Title:Applied ElectronicsSubject Code: 22329

**Important Instructions to examiners:**

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for anyequivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

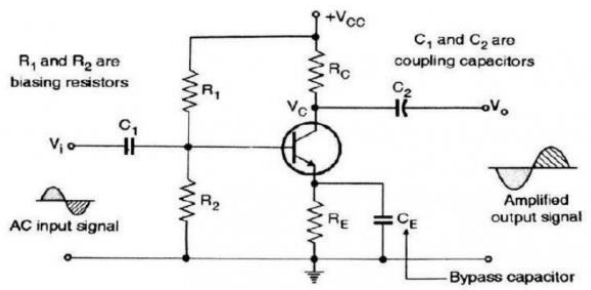
| Q. No. | Sub Q.N. | Answer | Marking Scheme |
|---|---|---|---|
| **Q.1** | | **Attempt any Five :** | **10M** |
| | **a)** | **State classification of Amplifiers.** | **2M** |
| | **Ans:** | CLASSIFICATION OF AMPLIFIERS:<br>A] Based on input signal<br>1. Small signal amplifiers<br>2. Large signal amplifiers<br>B] Based on output signal<br>1. Voltage amplifier<br>2. Power amplifier<br>C] Based on biasing conditions<br>1. Class A amplifier<br>2. Class B amplifier<br>3. Class AB amplifier<br>4. Class C amplifier<br>D] Based on frequency response<br>1. Audio frequency amplifier<br>2. Radio frequency amplifier<br>E] Based on coupling<br>1. Direct coupled amplifiers<br>2. R-C Coupled amplifier | **2M** |

| | | | |
|---|---|---|---|
| | | 3. Transformer coupled amplifier | |
| | **b)** | **Define the terms related to tuned amplifiers**<br>**(i) Resonant Frequency(Fr)**<br>**(ii) Q Factor** | **2M** |
| | **Ans:** | (i) **Resonant Frequency(Fr):** It is a frequency at which the inductive reactance is equal to the capacitive reactance i.e. $X_L=X_C$<br>(ii) **Q Factor:** The quality factor or Q factor is a measure of the performance of a coil, capacitor inductor in terms of its losses and resonator bandwidth.<br>$Q_O = \frac{X_L}{R} = \frac{\omega_0 L}{R} = \frac{2\pi f_0 L}{R}$<br>Where , L = value of circuit inductance.<br>R = Value of circuit resistance. | **1M**<br>**1M** |
| | **c)** | **State the need of multistage amplifier.** | **2M** |
| | **Ans:** | **Need of multistage amplifier:**<br>The voltage (or power) gain, obtained from a single stage small signal amplifier, is limited. Therefore, it is not sufficient for all practical applications. Therefore, in order to obtain greater voltage and power gain, we have to use more than one stage of amplification. Such an amplifier is called a 'MULTISTAGE AMPLIFIER'. | **2M** |
| | **d)** | **List the types of power amplifiers.** | **2M** |
| | **Ans:** | **Types of power amplifiers:-**<br>1. Class A amplifier<br>2. Class B amplifier<br>3. Class AB amplifier<br>4. Class C amplifier | **Each type: 1/2M** |
| | **e)** | **List advantages of negative feedback(any four)** | **2M** |
| | **Ans:** | **Advantage of negative feedback amplifier:**<br>• Increased stability in gain<br>• Increased bandwidth<br>• Less amplitude and harmonic distortion<br>• Decreased noise<br>• Less frequency distortion<br>• Less non-linear distortion<br>• Input and output resistance can be modified as desired. | **Each point: 1/2M** |
| | **f)** | **Define :**<br>**(i) Sweep time**<br>**(ii) Retrace time** | **2M** |
| | **Ans:** | **(i) Sweep time:** It is defined as time interval taken by time based signal generator to increase from minimum to maximum voltage. | **1M** |

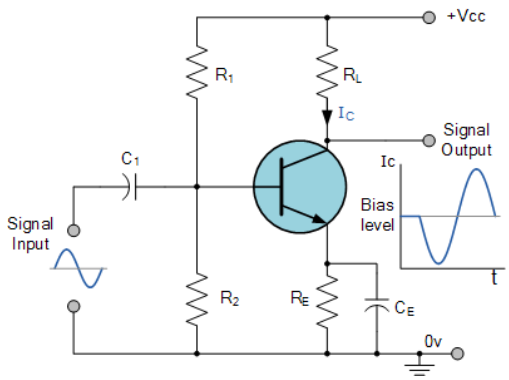
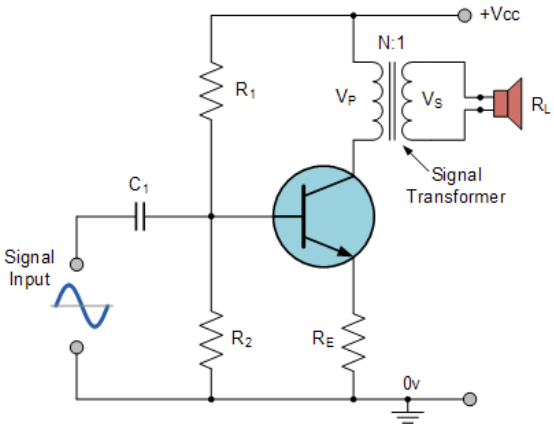
| | | | |
|---|---|---|---|
| | | **(ii) Retrace time:** It is defined as time taken by time based signal generator to decrease from maximum to minimum voltage. | **1M** |
| | **g)** | **State fixed voltage regulator IC'S.** | **2M** |
| | **Ans:** | Fixed voltage regulator IC's can provide fixed amount of voltage either in positive or in negative.<br>78XX can generate positive values of voltages.<br>E.g.<br><br>79XX can generate negative values of voltages. | **Any two IC's from 78XX & 79XX series ½ M each** |
| **Q 2** | | **Attempt any Three of the following :** | **12M** |
| | **a)** | **Sketch circuit diagram of RC coupled single stage CE amplifier.<br>State the function of each component.** | **4M** |
| | **Ans:** | **Circuit diagram of RC coupled single stage CE amplifier:**<br><br>**Function of Components:**<br>• The Q point is determined by the $V_{CC}$ supply along with the resistance $R_C$. The resistances **$R_1$, $R_2$, $R_E$** form the biasing & stabilization circuit. Thus establishes proper operating point.<br>• **Input capacitor ($C_{in} \approx 10\mu F$)**: It blocks DC voltage to the base,if it is not provided the source resistance comes across $R_2$,so that transistor gets unbiased. It allows a.c. to pass & isolates source resistance from $R_2$.<br>• **Emitter capacitance ($C_E \approx 100\mu F$)**: it is used in parallel with $R_E$ to provide a low | **2M**<br><br>**Each component function: 1/2 M** |

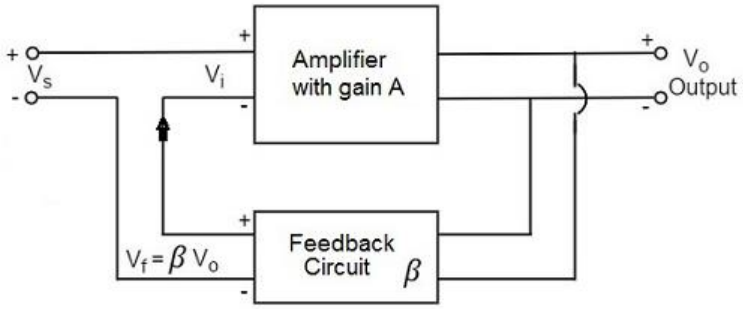
| IC NUMBER | OUTPUT VOLTAGE |
|---|---|
| 7805 | +5.0 V |
| 7806 | +6.0 V |
| 7808 | +8.0 V |
| 7809 | +9.0 V |
| 7812 | +12.0 V |
| 7815 | +15.0 V |
| 7818 | +18.0 V |
| 7824 | +24.0 V |

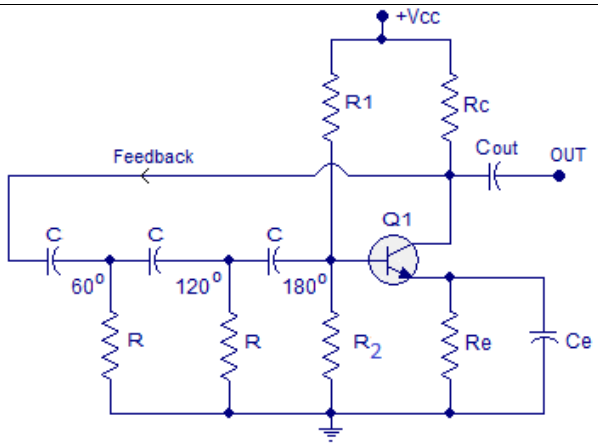
| IC NUMBER | OUTPUT VOLTAGE |
|---|---|
| 7905 | -5.0 V |
| 7906f | -6.0 V |
| 7908 | -8.0 V |
| 7909 | -9.0 V |
| 7912 | -12.0 V |
| 7915 | 15.0 V |
| 7918 | -18.0 V |
| 7924 | -24.0 V |




**Single stage RC coupled CE amplifier**

| | | |
|---|---|---|
| | reactance path to the amplified a.c. signal. If it is not used then amplified a.c. signal flowing through $R_E$ will cause a voltage drop across it, thus reducing the output voltage.<br>• **Coupling capacitor ($C_C \approx 10\mu F$)**: it couples one stage of amplification to the next stage. If it is not used, $R_C$ comes across with the $R_1$ of next stage & biasing of $2^{nd}$ stage gets disturbed. In short it isolates the d.c. of one stage from the next stage but allows the a.c. signal. | |
| **b)** | **Describe the working of single stage class A amplifier with circuit diagram** | **4M** |
| **Ans:** | **Circuit diagram of single stage class A amplifier:**<br>  <br><br>**Figure (a)**<br>**OR**<br>  <br><br>**Figure (b)**<br>**Working:-**<br>**For figure (a):-**<br>• This is the simplest type of Class A power amplifier circuit.<br>• It uses a single-ended transistor for its output stage with the resistive load connected directly to the Collector terminal. When the transistor switches "ON" it sinks the output current through the Collector resulting in an inevitable voltage drop across the Emitter resistance thereby limiting the negative output capability.<br>• The efficiency of this type of circuit is very low (less than 30%) and delivers small power outputs for a large drain on the DC power supply.<br>• A Class A amplifier stage passes the same load current even when no input signal is | **2M**<br><br>**2M** |

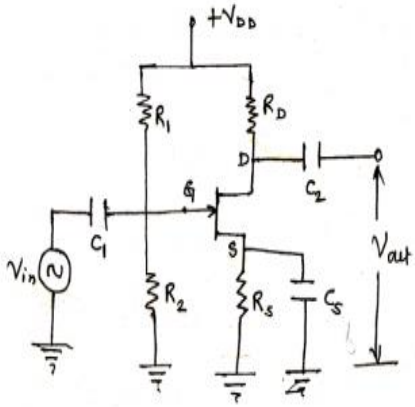
| | | |
|---|---|---|
| | applied so large heat sinks are needed for the output transistors.<br>**For Figure (b):-**<br>An output transformer improves the efficiency of the amplifier by matching the impedance of the load with that of the amplifiers output impedance.<br>By using an output or signal transformer with a suitable turns ratio, class-A amplifier efficiencies reaching 40% are possible. | |
| **c)** | **Explain principle of feedback amplifier.** | **4M** |
| **Ans:** | **Block diagram of feedback amplifier:-**<br>  <br><br>**Explanation:-**<br>• "Feedback" is a process of injecting some energy from the output and then it back to the input. The amplifier which use the feedback principle are called feedback amplifier".<br>• Depending upon whether the feedback signal increases or decreases the input signal, there are 2 basic types of feedback: Positive feedback and Negative feedback.<br>From the above figure, the gain of the amplifier is represented as A. the gain of the amplifier is the ratio of output voltage $V_o$ to the input voltage $V_i$. The feedback network extracts a voltage $V_f = \beta V_o$ from the output $V_o$ of the amplifier.<br>This voltage is added for positive feedback and subtracted for negative feedback, from the signal voltage $V_s$. Now,<br>$V_i = V_s + Vf$<br>$= V_s + \beta V_o$ ……..for Positive feedback<br>$V_i = V_s - Vf$<br>$= V_s - \beta V_o$ ……..for Negative feedback<br>The quantity $\beta = V_f / V_o$ is called as feedback ratio or feedback fraction. | **2M**<br>**2M** |
| **d)** | **Draw circuit dagram of RC phase shift oscillator and state its working.** | **4M** |
| **Ans:** | **Circuit diagram of RC phase shift oscillator:** | **2M** |

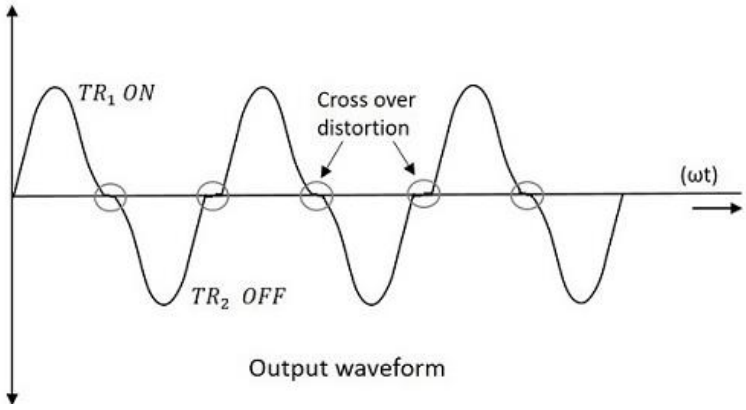



**WORKING**:

- Circuit consists of a single stage amplifier in common emitter configuration & RC phase shifting network.
- $R_1$, $R_2$, $R_E$ provides biasing & $C_E$ is bypass capacitor.
- Common emitter amplifier introduces a $180^0$ phase shift between input & output. & remaining $180^0$ phase shift is produced by three identical basic RC phase shifting networks.
- Each RC network is designed to introduce a phase shift of $60^0$.
- The phase shift around the loop is $360^0$ only at one precise frequency.
    - This frequency of oscillations is equal to $\frac{1}{2\pi RC\sqrt{6}}$
    - The feedback factor $\beta = \frac{1}{29}$
      Therefore $A_v$ =29.

**2M**

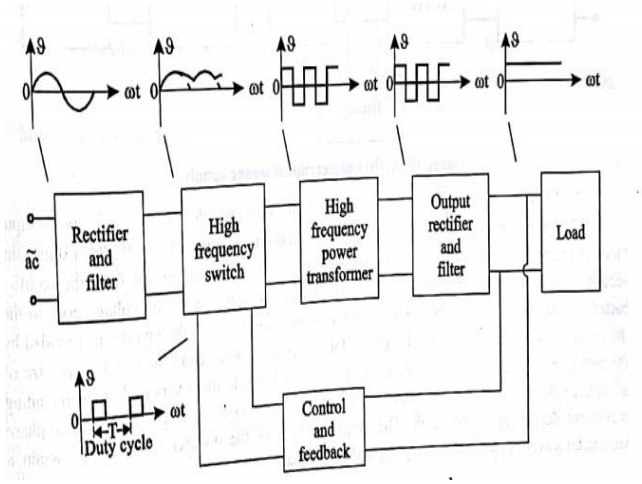
| | | | |
|---|---|---|---|
| **Q.3** | | **Attempt any three:** | **12- Total Marks** |
| | **a)** | **Sketch circuit diagram of common source FET Amplifier. State working principle of it.** | **4M** |
| | **Ans:** |   Common Source FET amplifier | **2M** |
| | | **Working**: - <br>• When small a.c. signal is applied to the gate, it produces variation in | **2M** |

| | | | |
|---|---|---|---|
| | | the gate to source voltage. This produces variation in the drain current. As the gate to source voltage increases, the drain current also increases. As the result of this voltage drop across $R_D$ also increases. This causes the drain voltage to decreases.<br>• As the input voltage rises, gate to source voltage becomes less negative, it will increase the channel width and increase the level of drain current $I_D$.<br>• As the input voltage falls, it will decrease the channel width and decrease the level of drain current $I_D$.<br>• Thus $I_D$ varies sinusoidally above its Q point value.<br>• The drain to source voltage $V_{DS}$ is given by<br>• $V_{DS} = V_{DD} – I_DR_D$<br>• Therefore as $I_D$ increases the voltage drop $I_DR_D$ will also increase and voltage $V_{DS}$ will decrease.<br>• If $\Delta I_D$ is large for a small value of $\Delta V_{GS}$; the $\Delta V_{DS}$ will also be large and we get amplification. Thus the AC output voltage $V_{DS}$ is 180º out of phase with AC input voltage. | |
| **b)** | **Explain the term crossover distortion. State methods to overcome it.** | | **4M** |
| **Ans:** | **Explanation:-**<br>• Cross over distortion occurs in Class B push pull Amplifier.<br>• In the push-pull configuration, the two identical transistors get into conduction, one after the other and the output produced will be the combination of both.<br>• When the signal changes or crosses over from one transistor to the other at the zero voltage point, it produces an amount of distortion to the output wave shape. For a transistor in order to conduct, the base emitter junction should cross 0.7v, the cut off voltage. The time taken for a transistor to get ON from OFF or to get OFF from ON state is called the **transition period**.<br>• At the zero voltage point, the transition period of switching over the transistors from one to the other, has its effect which leads to the instances where both the transistors are OFF at a time. Such instances can be called as **Flat spot** or **Dead band** on the output wave shape.<br>**Waveform:-**<br>  <br><br>Output waveform<br>**Method to overcome :**<br>This cross over distortion can be eliminated if the conduction of the amplifier is more than | **2M**<br>**1M**<br>**1M** |

| | | |
|---|---|---|
| | one half cycle, so that both the transistors won't be OFF at the same time. The remedy is to use Class AB amplifier. | |
| **c)** | **Compare positive feedback and negative feedback on the basis of:**<br>**(i) Gain**<br>**(ii) Bandwidth**<br>**(iii) Phase shift**<br>**(iv) Stability** | **4M** |
| **Ans:** | | **Each point 1M** |

| Sr. no. | Parameter | Positive feedback | Negative feedback |
|---|---|---|---|
| 1 | Gain | Increases | Decreases |
| 2 | Bandwidth | Decreases | Increases |
| 3 | Phase shift | 0 or 360 degree | 180 degree |
| 4 | Stability | Poor | Improved |

| | | |
|---|---|---|
| **d)** | **Draw block diagram of SMPS. State its working principle.** | **4M** |
| **Ans:** | **Block diagram of SMPS:-** | **2M** |




**Working principle:-** **2M**

A switched-mode power supply is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently.

An SMPS transfers power from a DC or AC source (often mains power) to DC loads, such as a personal computer, while converting voltage and current characteristics. Unlike a linear power supply, the pass transistor of a switching-mode supply continually switches between low-dissipation, full-on and full-off states, and spends very little time in the high dissipation transitions, which minimizes wasted energy.

Ideally, a switched-mode power supply dissipates no power.

Voltage regulation is achieved by varying the ratio of on-to-off time.

Switching regulators are used as replacements for linear regulators when higher efficiency, smaller size or lighter weights are required.

**OR**

**Working :-**

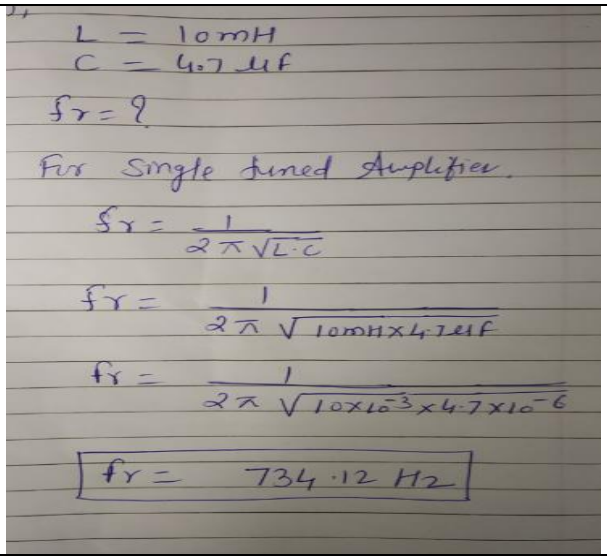
**Rectifier and filter** :- It converts the ac supply voltage to a pulsating dc, which is then filtered out to reduce the amount of ripple content. It uses the power diodes in a bridge configuration to obtain the pulsating dc and the capacitor is used as a filter element.

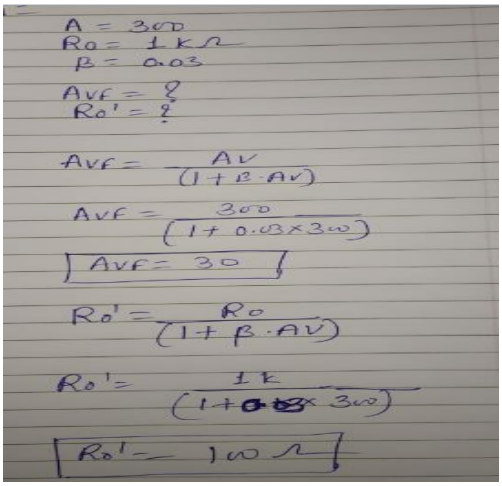
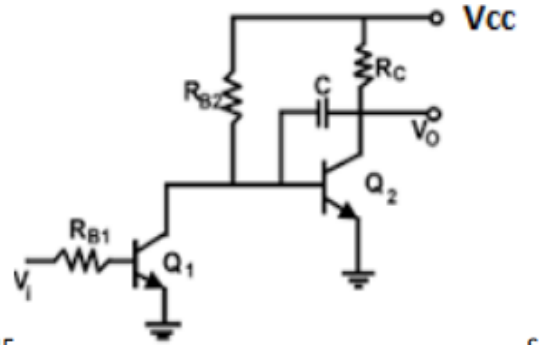
**High-frequency switching**:- It uses either MOSFETs or BJTs to convert the dc voltage to high frequency ac square wave. This high-frequncy ac square wave ranges from 20 kHz to 100 kHz. Since the power transistors are not operated in their active region, their operation results in low power dissipation. Thus, it is a two stage conversion. i.e. the input ac supply voltage is first rectified to dc and then the high- frequency switching section changes it back to ac.

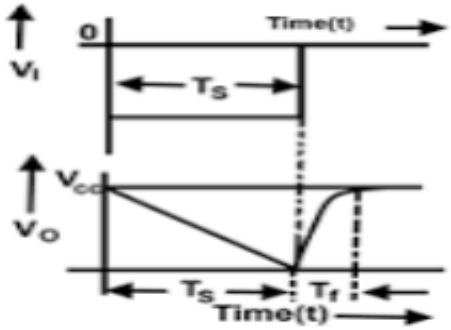
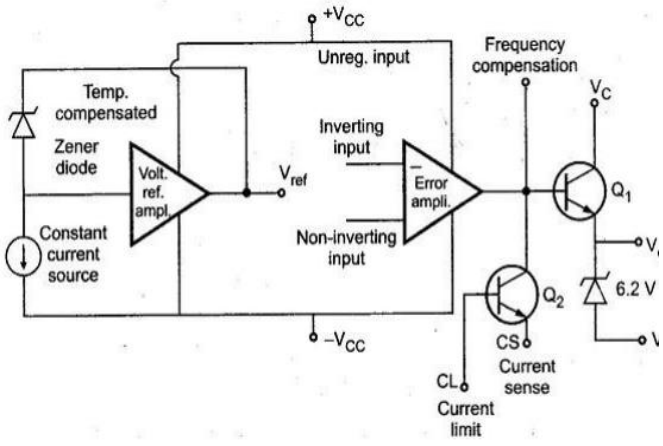
**High frequency power transformer**:-It isolates the circuit and steps-up or steps-down the voltage to the desired voltage level. The output of the transformer is the input of the second rectifier section, called the output rectifier section.

**Output rectifier** :- This rectifier section is different from the first block of the rectifier in that the frequency of the voltage is very high. Therefore, the bridge configuration of this rectifier uses a high frequency diode such as a Schottky diode and the output ripple is naturally filtered because of the number of overlaps between each individual output pulse. Since the ripple is very small in the output voltage of the rectifier, a small capacitance value is required in the filter section.

**Control and feedback**:- It provides a pulse width modulation(PWM) output signal. The PWM controller provides a duty-cycle that varies pulse by pulse to provide an accurate dc output voltage.

| | | | |
|---|---|---|---|
| **Q.4** | **A)** | **Attempt any THREE of the following :** | **12- Total Marks** |
| | **a)** | **Calculate Resonant frequency of single tuned amplifier, if inductor L = 10mH and Capacitor C = 4.7 µf of tank circuit.** | **4M** |
| | **Ans:** |  | **Formula & unit 1M**<br>**each Correct ans 2M** |

| | | | |
|---|---|---|---|
| | | | |
| | **b)** | **An amplifier has gain 'A' of 300 without feedback, output impedance is 1KΩ . If negative feedback with feedback factor 0.03 is introduced in the circuit then calculate the gain with feedback and output impedance of this feedback amplifier.** | **4M** |
| | **Ans:** |  | **gain with feedback- 2M, output impedance- 2M** |
| | **c)** | **Describe miller sweep generator circuit with neat input output waveforms** | **4M** |
| | **Ans:** | **Circuit diagram:-**<br>  <br>**Working**:<br>• Figure shows the circuit of a Miller integrator or a sweep circuit.<br>• Transistor $Q_1$ acts as a switch and transistor $Q_2$ is a common - emitter amplifier. i.e. a high gain amplifier.<br>• Consider the case when $Q_1$ is ON and $Q_2$ is OFF. At this condition, the voltage across the capacitor C and the output voltage Vo is equal to $V_{cc}$.<br>• When a negative pulse is applied to the base of $Q_1$, the emitter - base junction of $Q_1$ is reverse biased and hence $Q_1$ is turned OFF. | **1M**<br><br>**2M** |

| | | | |
|---|---|---|---|
| | | • Thus, the collector voltage (Vc1) of $Q_1$ increases which increases the bias to Q2 and as a result $Q_2$ is turned ON. Since $Q_2$ conducts, Vo begins to decrease. Because the capacitor is coupled to the base of transistor $Q_2$, the rate of decrease of output voltage is controlled by rate of discharge of capacitor. The time constant of the discharge is given by td = $R_{B2}$*C.<br>• As the value of time constant is very large, the discharge current practically remains constant. Hence, the rundown of the collector voltage is linear. When the input pulse is removed, $Q_1$ turns ON and $Q_2$ turns OFF. The capacitor charges quickly to $+V_{cc}$ through $R_c$ with the time constant t =$R_C$*C<br>**Waveform:**<br>  <br> | **1M** |
| **d)** | **Describe block diagram of IC 723 regulator. State the working principle of IC723.** | | **4M** |
| **Ans:** | | | **2M** |
| | | **Block diagram of IC 723 regulator:-**<br>  <br> | **2M** |
| | | **Working principle:-**<br>• It consists of a voltage reference source, an error amplifier, a series pass transistor and a current limiting transistor.<br>• The device can provide voltage with an output voltage ranging from 2 V to 37 V, and output current levels up to 150 m A. | **2M** |

- The working can be explained by dividing it into two blocks, the reference voltage generator and the error amplifier.
- In the reference voltage generator, a Zenger diode is being compelled to operate at fixed point (so that sneer output voltage is a fixed voltage) by a constant current Source which comes along with an amplifier to generate a constant voltage of 7.15V at the Verve pin of the IC.
- As for the error amplifier section, it consists of an error amplifier, a series pass transistor Q1 and a current limiting transistor.
- The error amplifier can be used to compare the output voltage applied at Inverting input terminal through a feedback to the reference voltage Verve applied at the Non-Inverting input terminal. This connection is not provided internally and so has to be externally provided in accordance with the required output voltage.
- The conduction of the transistor Q1 is controlled by the error signal. It is this transistor that controls the output voltage.

**Q.5** **Solve any TWO :** **12M**

**a)** **6M**

**Compare RC coupled, transformer coupled, direct Coupled amplifier on the basis of:**

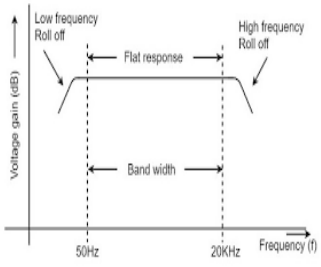
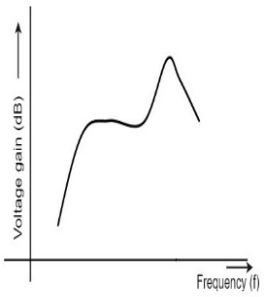
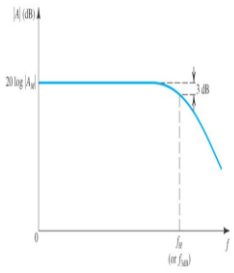
**(i) Type of coupling**

**(ii) Frequency response**

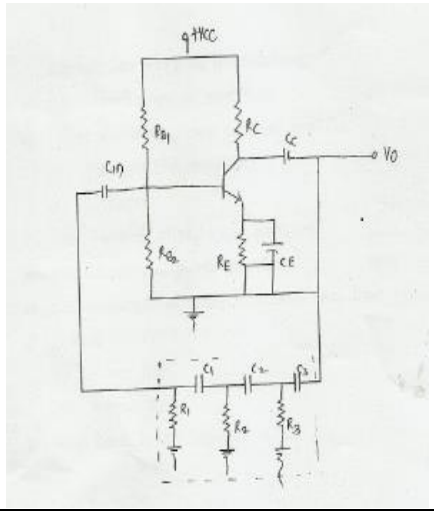
**(iii) Gain**

**(iv) Application**

**Ans:** **1 ½ M each point**

| Sr. no | Parameter | RC coupling | Transformer coupling | Direct coupling |
|---|---|---|---|---|
| 1 | **Types of coupling** | RC coupling-Resistor, Capacitor are used as a coupling network | Transformer is used as a coupling network | No coupling network is u |
| 2 | **Frequency Response** |   |   |  |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | **3** | **Gain** | Overall gain is less due to loading effect | It provides high voltage gain than RC coupled | Uniform gain up to certain frequency ,gain rolls off at high frequency | |
| | | **4** | **Application** | Voltage amplification | Power amplification | Low frequency amplification | |
| | **b)** | **A complementary symmetrypushpullamplifierisoperatedusing±10voltand deliverpowertoload $R_L$=50.Calculate.**<br>**i) Maximum power output**<br>**ii) Power rating of transistor**<br>**iii) D.C input at maximum power output.** | | | | | **6M** |
| | **Ans:** | Given : $V_{cc} = \pm 10V$ $R_L = 50\Omega$.<br>i) Maximum Power output.<br>$P_{o(max)} = \frac{V_{cc}^2}{2 \cdot R_L} = \frac{(10)^2}{2 \times 50} = \frac{100}{100} = 1W.$<br>ii) Power rating of transistor<br>$V_m = \frac{2V_{cc}}{\pi} = \frac{2}{\pi} \times 10 = 6.36V.$<br>Total collector power rating in two transistor<br>$P_{c(dc)} = P_{in(dc)} - P_{o(ac)}$<br>$= V_{cc}\left(\frac{2V_m}{\pi \cdot R_L}\right) - \left(\frac{V_m^2}{2R_L}\right)$<br>$= 10\left(\frac{2 \times 6.36}{\pi \times 50}\right) - \frac{(6.36)^2}{2 \times 50}$<br>$= 0.8097 - 0.4044$<br>$= 0.4053\ W.$<br>Power rating of each transistor<br>$= \frac{P_{c(dc)}}{2} = \frac{0.4053}{2} = 0.2026W.$<br>iii) D.C i/p at maximum power output<br>$P_{in(dc)max} = V_{cc} \times \frac{2V_{cc}}{\pi R_L}$<br>$= 10 \times \frac{2 \times 10}{\pi \times 50}$<br>$= 1.273W.$ | | | | | **2M each point** |

| | | | |
|---|---|---|---|
| | **c)** | **IdentifythecircuitgiveninFigureNo.1.Calculateoutputfrequencyof the given circuit if $R_1=R_2=R_3=2K\Omega$ and G = $C_2=C_3=0.1\mu f$.**   | **6M** |
| | **Ans:** | **The given circuit diagram is RC phase shift Ocillator**<br>Given $R_1=R_2=R_3=2K\Omega$<br>$C_1=C_2=C_3=0.1\mu F.$<br>$freq = \frac{1}{2\pi\sqrt{6}RC}$<br>$= \frac{1}{2\pi\sqrt{6}\times 2\times10^{3}\times0.1\times10^{-6}}$<br>$= 324.87\ Hz.$ | **2M**<br>**2M Formula**<br>**2M** |
| **Q.6** | | **Attempt any TWO of the following:** | **12- Total Marks** |
| | **a)** | **CompareClassA ,ClassB,ClassCandclassABpoweramplifiersonthebasis of:**<br>**i)Angle of conduction**<br>**ii)Efficiency**<br>**iii)Position of operating pointing power dissipation**<br>**iv)Distortion** | **6M** |

**v)Application**

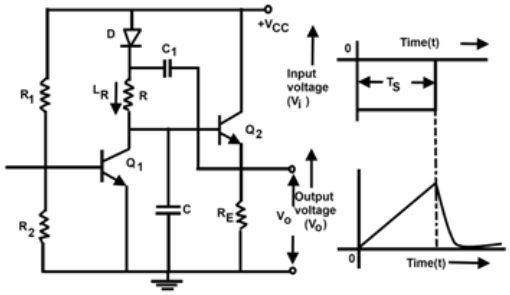
**Ans:**

| Sr. No | Parameter | Class A | Class B | Class C | Class AB |
|---|---|---|---|---|---|
| 1 | Angle of conduction | $360^0$ | $180^0$ | Less than $180^0$ | More than $180^0$ less than $360^0$ |
| 2 | Efficiency | 25% can increase to 50% | 78.5% | 95% | 78.5% |
| 3 | Position of operating point in power dissipation | At the center of load line | On X-axis | Below X-axis | Just above X-axis |
| 4 | Distortion | No distortion | Distortion more than A and AB but less than C | Maximum distortion | Less than B and C but more than A |
| 5 | Application | Outdoor musical system | Audio power amplifiers | Audio power amplifier | RF amplifier |

**Efficiency point 2M & others points 1M each**

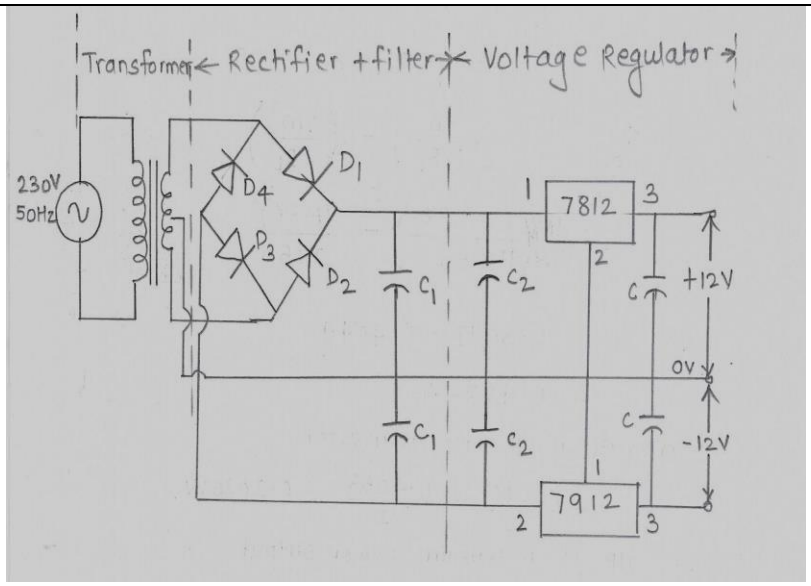
**b) DrawBootstrapsweepgeneratorcircuit.CompareMillerIntegratorandbootstrapsweepgeneratorwithrespecttothetechniqueused.** **6M**

**Ans:** **Circuit diagram of bootstrap sweep generator:** **2M**




| Sr. No | Miller Integrator | Bootstrap sweep generator |
|---|---|---|
| 1 | It is an integrator used to convert input step waveform into ramp waveform. | In Bootstrap time base generator a constant current is obtained by maintaining nearly constant voltage across fixed resistor in series with capacitor |
| 2 | In Miller sweep polarity of sweep voltage is negative. | In Bootstrap polarity of sweep voltage is positive |
| 3 | The inverting amplifier is used in this circuit | The non-inverting amplifier is used in this circuit |

**Any 4 points 1M each**

| | | | | |
|---|---|---|---|---|
| | | 4 | Open circuit gain of the amplifier is infinity | Open circuit gain of the amplifier is unity |
| | | 5 | The Linearity of sweep voltage is better than Bootstrap sweep circuit | The linearity of sweep voltage is poor than Miller integrator |
| | **c)** | **Build the circuit diagram of dual voltageregulatortoget+12Vdeand-12Vdc using IC 7812and IC 7912 along with rectifier.** | | **6M** |
| | **Ans:** |  | | **Labeling 2M & correct diagram 4M** |

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**WINTER – 19EXAMINATION**

**Subject Name:Applied Electronics** **Model Answer**Subject Code: 22329

**Important Instructions to examiners:**

1) The answers should be examined by key words and not as word-to-word as given in themodel answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may tryto assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given moreImportance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in thefigure. The figures drawn by candidate and model answer may vary. The examiner may give credit for anyequivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constantvalues may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

| Q. No. | Sub Q. N. | Answer | Marking Scheme |
|---|---|---|---|
| **Q.1** | | **Attempt any FIVE of the following:** | **10-Total Marks** |
| | **a)** | **List the types of coupling used in BJT amplifier.** | **2M** |
| | **Ans:** | Types of coupling used in BJT amplifier:<br>i. Resistance capacitance (RC)coupling<br>ii. Impedance coupling<br>iii. Transformer coupling<br>iv. Direct coupling | **Each ½ M** |
| | **b)** | **Compare small signal amplifier with power amplifier(any four)** | **2M** |
| | **Ans:** | | **Any four points: each ½ M** |

| Sr.No | Parameters | Small signal Amplifiers | Power Amplifiers |
|---|---|---|---|
| 1 | Amplification quantity | It increases voltage into high resistance load. Hence small signal amplifiers are also called as voltage amplifiers. | It increases power into low resistance load. Hence these amplifiers are also called as large signal amplifiers. |
| 2 | Current Gain(β) | High(typically 100) | Low(5 to 20) |
| 3 | Input Resistance($R_i$) | Quite low | Very large |
| 4 | Output | High | low |

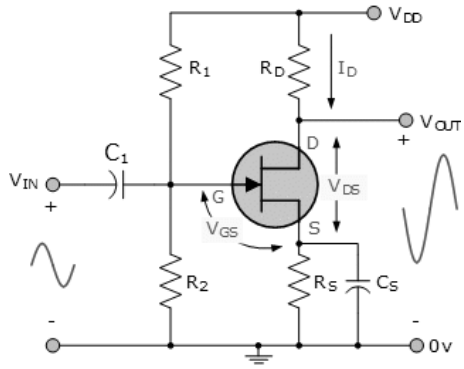
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | Impedance($R_o$) | | | |
| | | | 5 | Physical size | Small | Large in size | |
| | | | 6 | Coupling | R-C coupling | Transformer coupling | |
| | | | 7 | Power output | low | High | |
| | **c)** | **State four advantages of negative feedback used in feedback amplifier.** | | | | | **2M** |
| | **Ans:** | **Advantages of negative feedback: (Any Four)**<br>i. Distortion decreases<br>ii. Noise in output decreases<br>iii. Stability of gain of amplifier improves<br>iv. It is used as an amplifier.<br>v. Operating point is stabilized.<br>vi. Input resistance increases in certain configuration and output resistance decreases in certain configurations.<br>vii. Bandwidth is increased | | | | | **Each ½ M** |
| | **d)** | **State Barkhausen criteria of oscillation.** | | | | | **2M** |
| | **Ans:** | Where, $A_V$ = gain of an amplifier without feedback also called open loop gain<br>$\beta A_V$ = product of feedback fraction and open loop gain. It is called loop gain.<br>The Barkhausen criterion for the generation of sustained oscillations. for positive feedback are:<br>1. $\beta A = 1$<br>2. Total phase shift should be 360° or 0° | | | | | **1M**<br><br>**1M** |
| | **e)** | **Differentiate positive feedback and negative feedback (four points)** | | | | | **2M** |

**Ans:**

| Sr. No. | Parameter | Positive feedback | Negative feedback |
|---|---|---|---|
| 1 | Feedback signal | In phase with the input signal. | 180 º out of phase with the input signal. |
| 2 | Net input signal | Increases | Decreases |
| 3 | Gain | Increases | Decreases |
| 4 | Noise Increases | Increases | Decreases |
| 5 | Stability | Poor | Improved |
| 6 | Input impedance | decreases | increases |
| 7 | Output impedance | increases | decreases |
| 8 | Uses | Oscillators, Schmitt trigger | Amplifiers, bootstrapping |

**Any Four points Each ½ M**

| | | | |
|---|---|---|---|
| | **f)** | **State the need of tuned amplifier in electronic circuits.(four points)** | **2M** |
| | **Ans:** | **(Note:Any two points can be given full marks)**<br>**Need of tuned amplifier:**<br>i. Selects the desired radio frequency signal.<br>ii. Amplifies the selected high or radiosignal to a suitable voltage level.<br>iii. As a filter. | **2M** |
| | **g)** | **List the uses of heat sink (four points)** | **2M** |
| | **Ans:** | **Uses of heat sink:**<br>i. It is used to avoid thermal runaway in electronic circuits.<br>ii. Use to transfer heat generated by a mechanical or an electronic device to the surroundings.<br>iii. Use to optimize the heat exchange between component and surrounding by maximizing the contact surface between heat sink and air.<br>iv. Used to dissipate the amount of heat generated. | **Each point ½ M** |

| | | | |
|---|---|---|---|
| **Q.2** | | **Attempt any THREE of the following:** | **12-Total Marks** |
| | **a)** | **Explain the working principle of FET amplifier and list its two applications.** | **4M** |
| | **Ans:** | **Circuit diagram:**<br>  <br><br>**Explanation:**<br>i. When small a.c. signal is applied to the gate, it produces variation in the gate to source voltage. This produces variation in the drain current. As the gate to source voltage increases, the drain current also increases. As the result of this voltage drop across $R_D$ also increases. This causes the drain voltage to decreases.<br>ii. As the input voltage rises, gate to source voltage becomes less negative, it will increase the channel width and increase the level of drain current $I_D$.<br>iii. As the input voltage falls, it will decrease the channel width and decrease the level of drain current $I_D$.Thus $I_D$ varies sinusoidally above its Q point value.<br>iv. The drain to source voltage $V_{DS}$ is given by $V_{DS} = V_{DD} – I_DR_D$<br>v. Therefore as $I_D$ increases the voltage drop $I_DR_D$ will also increase and voltage $V_{DS}$ will decrease.<br>vi. If $\Delta I_D$ is large for a small value of $\Delta V_{GS}$; the $\Delta V_{DS}$ will also be large and we get amplification. Thus the AC output voltage $V_{DS}$ is 180º out of phase with AC | **Circuit diagram: 1 ½M**<br>**1 ½M** |

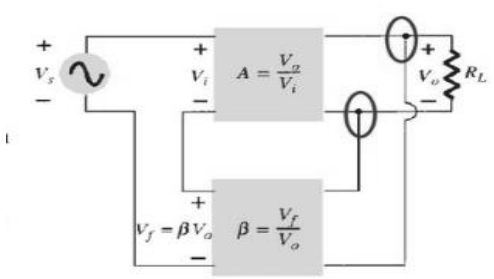
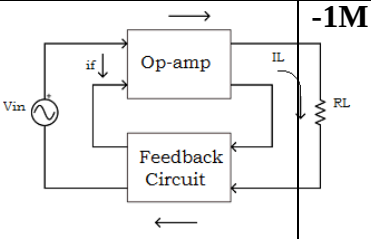
input voltage.

**Applications: (Any 2)** **1M (1/2 M each)**

i. Low noise amplifier
ii. Buffer amplifier
iii. Cascade amplifier
iv. Analog switch
v. Multiplexer
vi. Chopper
vii. Current limiter

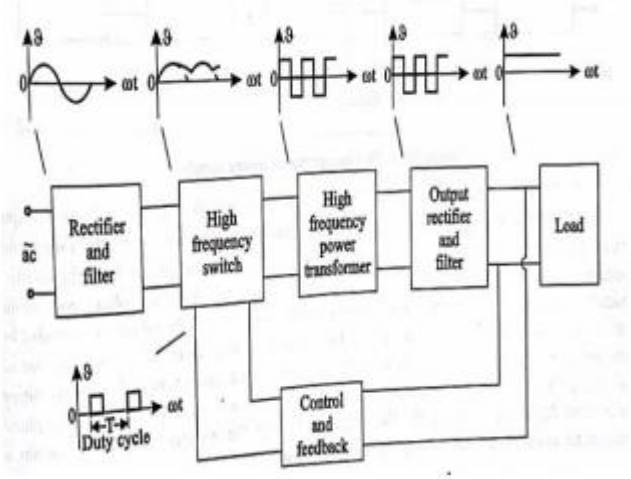
**b) Compare the performance of voltage series and current series type of negative feedback amplifiers.(four points)** **4M**

**Ans:** **Any four point Each point -1M**

| Sr.No | Parameters | voltage series negative feedback amplifiers | current series type of negative feedback amplifiers |
|---|---|---|---|
| 1 | **Block diagram** |  |  |
| 2 | **Gain** | Decreases | Decreases |
| 3 | **Output resistance** | Decrease $Z_{if}=\frac{ZI}{1+\beta A}$ | Increase $Z_{if}=Z_i(1+\beta A)$ |
| 4 | **Input resistance** | Increases $Z_{if}=Z_i(1+\beta A)$ | Increase $Z_{if}=Z_i(1+\beta A)$ |
| 5 | **Disortion** | Decrease | Decrease |

**c) Draw the block diagram of SMPS and state its working principle.** **4M**

**Ans:** **Diagram:** **2M**




**Working principle:-** **2M**

**Rectifier and filter**:- It converts the ac supply voltage to a pulsating dc, which is then filtered out to reduce the amount of ripple content. It uses the power diodes in a bridge configuration to obtain the pulsating dc and the capacitor is used as a filter element.

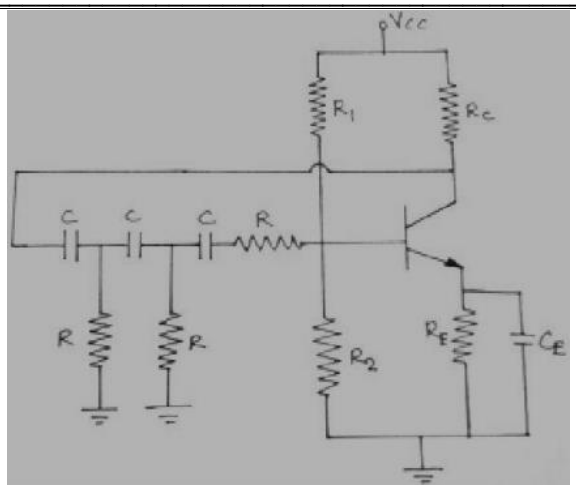
**High-frequency switching:-** It uses either MOSFETs or BJTs to convert the dc voltage to high frequency ac square wave. This high-frequency ac square wave ranges from 20 kHz to 100 kHz. Since the power transistors are not operated in their active region, their operation results in low power dissipation. Thus, it is a two stage conversion. i.e. the input ac supply voltage is first rectified to dc and then the high-frequency switching section changes it back to ac.

**High frequency power transformer**:-It isolates the circuit and steps-up or steps-down the voltage to the desired voltage level. The output of the transformer is the input of the second rectifier section, called the output rectifier section.

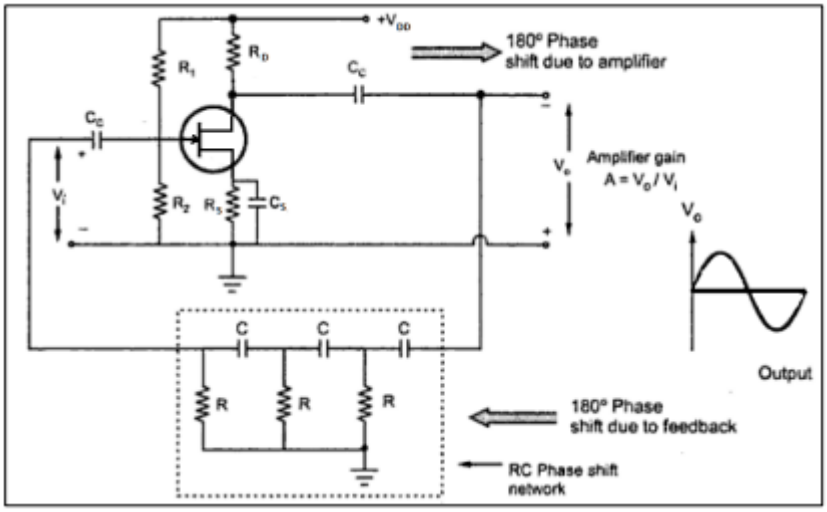
**Output rectifier**: - This rectifier section is different from the first block of the rectifier in that the frequency of the voltage is very high. Therefore, the bridge configuration of this rectifier uses a high frequency diode such as a Schottky diode and the output ripple is naturally filtered because of the number of overlaps between each individual output pulse. Since the ripple is very small in the output voltage of the rectifier, a small capacitance value is required in the filter section.

**Control and feedback**:- It provides a pulse width modulation(PWM) output signal. The PWM controller provides a duty-cycle that varies pulse by pulse to provide an accurate dc output voltage.

| | | |
|---|---|---|
| **d)** | **Design a RC phase shift oscillator to generate the frequency of 500KHz.Assume suitable values for $R_1=R_2=R_3=R$ and $C_1=C_2=C_3=C$ .Justifyyour answer.** | **4M** |
| **Ans:** | **RC Phase shift oscillator:** | **Circuit diagram 1M** |




**OR**

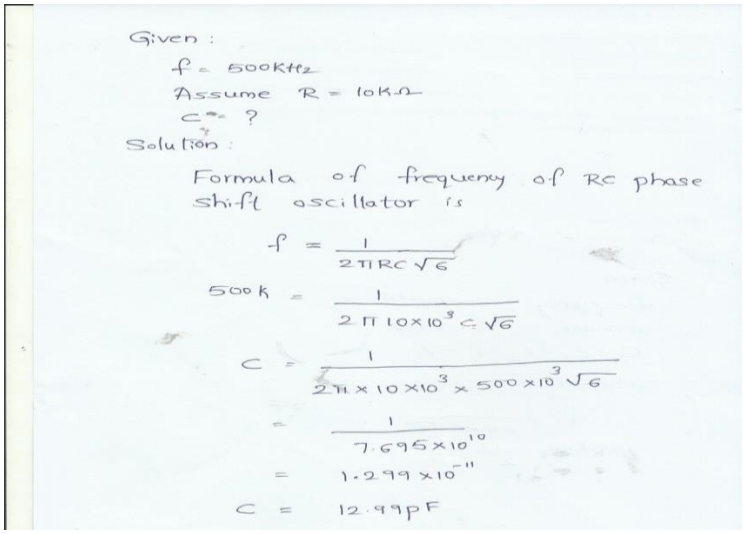



**Assume the values of R and C:**

**(NOTE:STUDENT CAN ASSUME ANY VALUES OF R AND CALCULATE "C"ORASSUME ANY VALUES "C " AND CALCULATE " R")**

Assume

R1=R2=R3=R=10KΩ

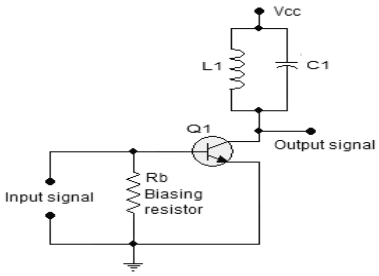


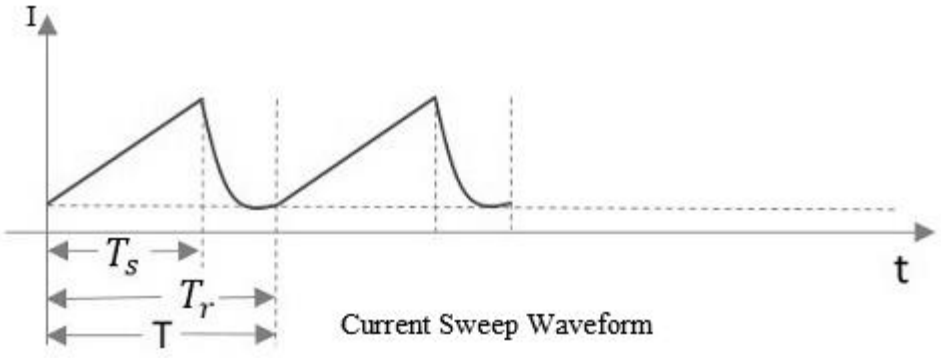
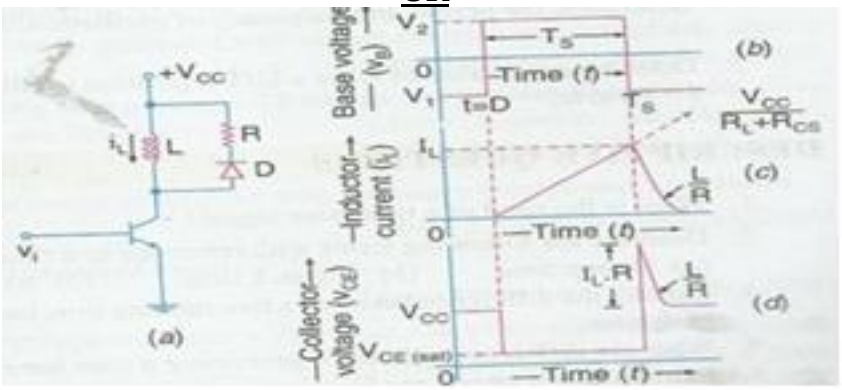

**Similarly students can calculate R assuming C**

This oscillator is used to generate low frequency signal.

**Calculation 2M**

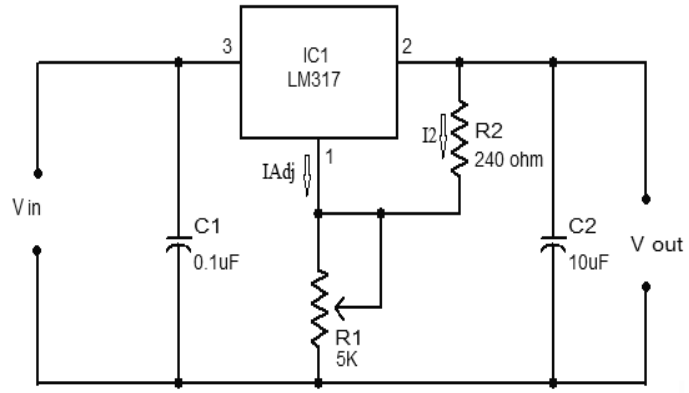
**Justification 1M**

| Q.3 | | Attempt any THREE of the following: | 12-Total Marks |
|---|---|---|---|
| | a) | **Classify the power amplifiers on the basis of operation and input/output waveforms.** | 4M |
| | Ans: | Depending upon the operation and input/output waveforms power amplifiers are classified into following type.<br>1) Class A amplifier.<br>2) Class B amplifier.<br>3) Class C amplifier.<br>4) Class AB amplifier.<br>5) Class D amplifier. | Any 4 types 1M each |
| | b) | **Describe the operation of class-C type of power amplifier with the help of neat sketch.** | 4M |
| | Ans: | **Circuit diagram:**<br>  <br><br>**Operation:**<br>• Class C power amplifier is a type of amplifier where the transistor conducts for less than one half cycle of the input signal. Less than one half cycles means the conduction angle is less than 180° and its typical value is 80° to 120°.<br>• Biasing resistor $R_b$ pulls the base of $Q_1$ further downwards and the Q-point will be set below the cut-off point in the DC load line. As a result the transistor will start conducting only after the input signal amplitude has risen above the base emitter voltage (Vbe~0.7V) plus the downward bias voltage caused by $R_b$. That is the reason why the major portion of the input signal is absent in the output signal.<br>• Inductor $L_1$ and capacitor $C_1$ forms a tank circuit which is used in the extraction of the required signal from the pulsed output of the transistor.<br>• Values of L1 and $C_1$ are so selected that the resonant circuit oscillates in the frequency of the input signal. Since the resonant circuit oscillates in one frequency (generally the carrier frequency) all other frequencies are attenuated. | 2M<br>2M |
| | c) | **Justify the need of current time base generator to obtain the specified sawtooth waveform with one example.** | 4M |
| | Ans: | **Justification:-**<br>• Current Time base generator is a circuit where the output current is a linear function of time over a specified time interval.<br>• Time base circuits are used by radar systems to determine range to a target, by comparing the current location along the time base to the time of arrival of radio | Justification 2M,<br>Waveform |

| | | | |
|---|---|---|---|
| | | echoes.<br>• Current Time base generators produce very high frequency sawtooth waves specifically designed to deflect the beam in cathode ray tube (CRT) smoothly across the face of the tube and then return it to its starting position.<br>• To display the variations of a signal with respect to time on an oscilloscope, a voltage/current that varies linearly with time, has to be applied to the deflection plates. This makes the signal to sweep the beam horizontally<br>**Waveform:**<br>  <br><br>Current Sweep Waveform<br>**Example:**<br>• A cathode ray tube (CRT) consists of three primary parts, the electron gun that provides a stream of accelerated electrons, the phosphor-covered screen that lights up when the electrons hit it, and the deflection plates that use magnetic or electric fields to deflect the electrons in-flight and allows them to be directed around the screen.<br>• It is the ability for the electron stream to be rapidly moved using the deflection plates that allow the CRT to be used to display very rapid signals.<br>• To display such a signal on an oscilloscope for examination, it is desirable to have the electron beam sweep across the screen so that the electron beam cycles at the same frequency as the carrier, or some multiple of that base frequency.<br>• This is the purpose of the current time base generator, which is attached to one of the set of deflection plates, normally the X axis, while the amplified output of the radio signal is sent to the other axis, normally Y. The result is a visual re-creation of the original waveform.<br>**OR**<br>  <br><br>**Fig: A current time base circuit.** | **1M,**<br>**Example 1M** |

- Above Fig. shows a simple circuit of a current time base generator.
- Here an inductor (L) in series with a transistor is connected across the $V_{CC}$ supply.
- The transistor operates as a switch in the circuit.
- The gating waveform at the base operates between two levels. $V_1$and $V_2$ as shown.
- The lower level ($V_1$) keeps the transistor in cut-off, while the upper level drives the transistor into saturation.
- When the transistor switch is turned ON, then neglecting the effect of small saturation resistance ($R_{cs}$), the current through and inductor ($i_L$) increases linearly with the time.
- The diode D does not conduct during the sweep, because it is reverse biased.

| | | | |
|---|---|---|---|
| | **d)** | **Design a voltage regulator using IC LM317, draw the circuit diagram and state the output voltage equation.** | **4M** |
| | **Ans:** | **Circuit diagram:-** | **2M** |




- IC LM317 is adjustable three terminal positive voltage regulator, available with output voltage of 1.2v to 37v and output current from 0.1A to 18.12 A.
- Three terminals of adjustable voltage regulators are $V_{in}$, $V_{out}$, and adjustment, above fig shows connection diagram of LM 317 regulator. It requires only two external resistors to set the output voltage.
- LM 317 develops a nominal 1.25v referred to as the reference voltage. $V_{ref}$ between output and adjustment terminals. This voltage is impressed across $R_2$, since the voltage is constant; the current $I_2$ is also constant for given value of $R_2$. In addition to $I_2$, current $I_{Adj}$ from the adjustment terminal also flows through the output resistor $R_1$.
- LM317 is designed such as $I_{ADJ}$-100$\mu A$-

The output voltage Vo is $V_0=R_2.I_2 +R_1(I_{ADJ} + I_2)$---(1) **Design-1M**

$$I2 = \frac{Vref}{R2}$$

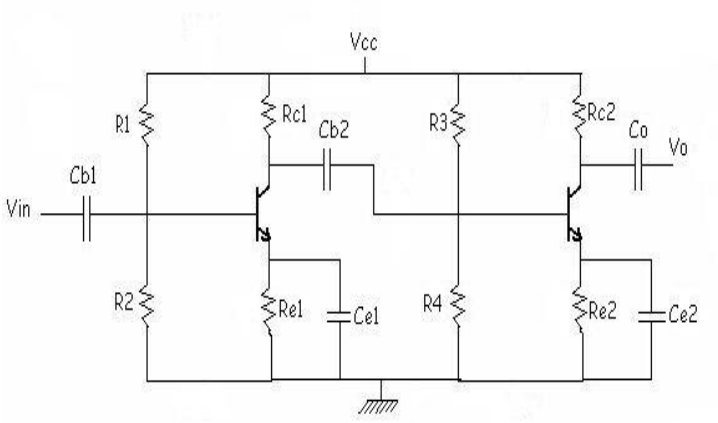
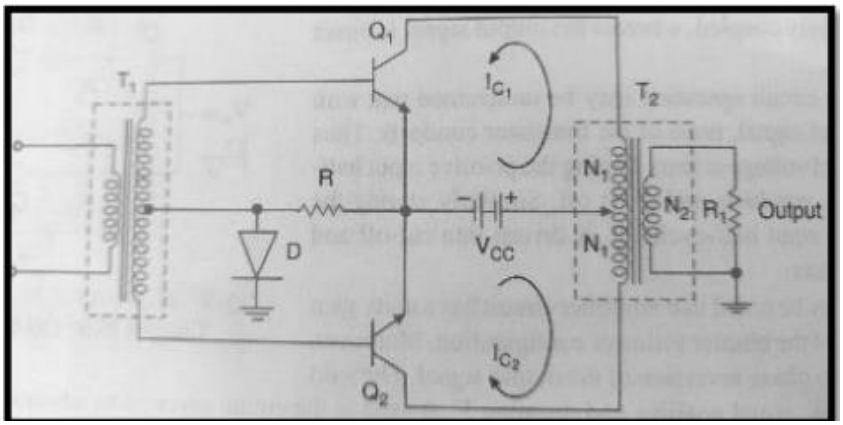
Substitute I2 in equation (1)

$V_0=R_2. \frac{Vref}{R2}+R_1(I_{ADJ} + \frac{Vref}{R2})$

$V_0=R_2. \frac{Vref}{R2}+R_1.I_{ADJ} +R1. \frac{Vref}{R2})$

$V_0=V_{ref}(1+\frac{R1}{R2})+R_1.I_{ADJ}$

Where $V_{ref}$=1.25v.

| | | | |
|---|---|---|---|
| | | However the current IADJ is very small and constant. Therefore the voltage drop across R2 due to IADJ is also very small and can be neglected.<br>Therefore<br>$V_0=1.25.(1+\frac{R1}{R2})$<br>The output is a function of $R_1$ for a given value of $R_2$ and can be varied by adjusting the value of $R_1$. The resistor $R_2$ usually is 240 ohm. Normally no capacitor is needed unless the LM317 is situated far from the power supply filter capacitor. | **Output equation- 1M** |
| **Q.4** | | **Attempt any THREE of the following :** | **12-Total Marks** |
| | **a)** | **Draw the two stage BJT amplifier. State the formula for overall gain of this amplifier.** | **4M** |
| | **Ans:** | **Diagram:**<br>  <br><br>Let $Av_1$-Voltage gain of first amplifier<br>$Av_2$-voltage gain of second amplifier<br>**Overall voltage gain, $Av = Av_1 * Av_2$** | **3M**<br>**Formula 1M** |
| | **b)** | **Draw the circuit diagram of class AB power amplifier and describe its working.** | **4M** |
| | **Ans:** | **Circuit diagram:**<br>  <br><br>**Circuit Description**:<br>The circuit consists of two center-tapped transformers $T_1$ and $T_2$, two identical transistors $Q_1$ and $Q_2$ , Resistor R and diode D. The DC voltage developed across the diode D is connected to the bases of both the transistors through the secondary winding | **2M** |

of the input transformer. This voltage acts as DC bias for the transistors because it is equal to cut-in voltage and they will conduct for complete half cycleperiod of the input to eliminate the cross-over distortion.

**WORKING**:

**i.** When there is no a.c. input signal is applied both the transistors $Q_1$& $Q_2$ are cut off. Hence no current is drawn from VCC.

**ii.** DURING POSITIVE HALF CYCLE:

- The base of the transistor $Q_1$ is positive and that of $Q_2$ is negative.

**iii.** As a result of this $Q_1$ conducts, while the transistor $Q_2$ is OFF. ¬ DURING DURING NEGATIVE HALF CYCLE:

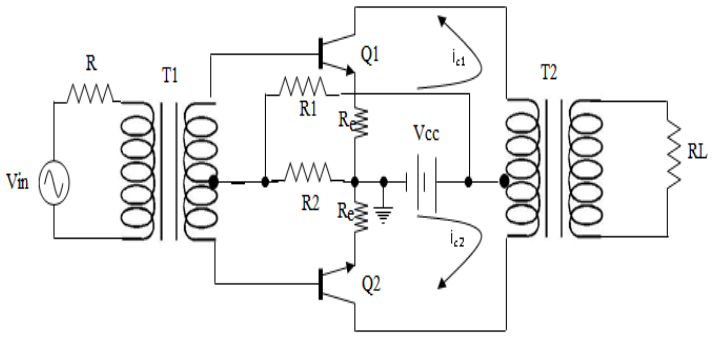
- The base of the transistor $Q_2$ is positive and that of $Q_1$ is negative.
- As a result of this $Q_2$ conducts, while the transistor $Q_1$ is OFF.

**iv.** Thus at any instant any one transistor in the circuit is conducting. Then the output transformer joins these two halves & produces a full sine wave in the load resistor.

**2M**

**OR**

**Circuit diagram:-**




**Circuit operation:-**

- Resistor $R_1$, $R_2$ are chosen to provide biasing to the transistors $Q_1$, $Q_2$, input transformer $T_1$ provides phase splitting function in which two voltages are out of phase with each other. $V_{CC}$ is tied to the transistor collectors through the centre tapped output transformer $T_2$. $R_e$ is stabilized resistor.
- When positive half cycle of the input signal is applied, the base of $Q_1$ becomes positive and base of $Q_2$ negative. Therefore $Q_1$ is ON and $Q_2$ is OFF. As transistors $Q_1$ and $Q_2$ are biased just above cut off. Therefore as positive input cross zero, collector current $ic_1$ starts flowing through $Q_1$, through transformer $T_2$ as shown and $ic_2 = 0$. A positive sinusoidal voltage will appear across load.
- When negative half cycle is applied across input the base of $Q_1$ becomes negative while the base of $Q_2$ is positive. Therefore $Q_1$ is off and $Q_2$ conduct, as soon as input cross zero, negative sinusoidal voltage will appear across load.

| | | | |
|---|---|---|---|
| | **c)** | **With the help of neat circuit diagram, explain the operation of voltage shunt type feedback amplifier.** | **4M** |
| | **Ans:** | **Diagram:** | **2M** |

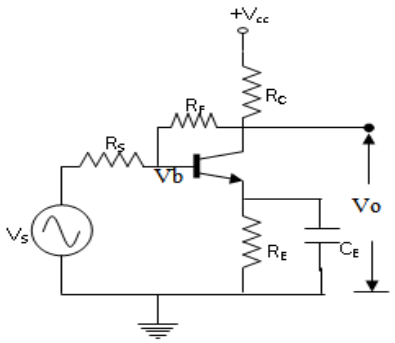



Fig. shows common emitter transistor amplifier with a feedback resistor $R_F$ connected between its output and input terminals. This is collector to base biasing when the input signal is applied to the input then amplified output $V_O$ is produced with $180^0$ phase shift (out of phase with input) with the input.

Hence the feedback current is given by –

$$I_F = \frac{V_b - V_o}{R_F}$$

$\because V_b << V_o$

$$\therefore I_f = - \frac{V_O}{R_F}$$

Thus if we reduce the output voltage to zero then feedback voltage will reduce to zero, therefore it is voltage feedback. As $I_S = I_f + I_i$ it is shunt type therefore it voltage shunt negative feedback amplifier.

**Explanation 2M**

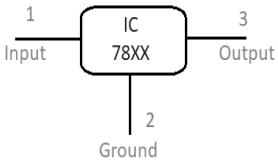
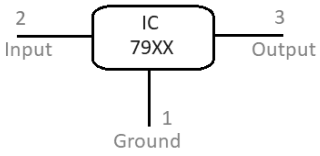
**d) Compare between RC phase shift oscillator and crystal oscillator.** **4M**

**Ans:** **(Note: Any other relevant point also can be considered.)** **Any 4 points 1M each point**

| Sr. No. | RC phase shift oscillator | Crystal oscillator |
|---|---|---|
| 1 | This oscillator is used for low frequency range. | Quartz crystal is mainly used in radio-frequency (RF) oscillators |
| 2 | Used resistor and capacitor network to decide frequency of oscillator. | Crystal decides the frequency of oscillator. |
| 3 | RC phase shift oscillators are comparatively less stable. | crystal oscillators are highly stable |
| **4** | RC network is used as feedback network. | Crystal is connected in feedback. |

**e) Compare the fixed voltage regulators using 78XX and 79XX.(any four points)** **4M**

**Ans:** **(Note: Any other relevant point also can be considered.)** **1M each**

| Sr. No. | 78xx | 79xx |
|---|---|---|
| 1 | It produces positive fixed DC voltage values, | It produces negative fixed DC voltage values |
| 2 | IC 78xx (7805, 7806, 7808, 7812, 7815, 7818,7824)- Positive Voltage Regulator. | IC 79xx (7905, 7906,7908,7912, 7915) - Negative Voltage Regulator |
| 3 | Output current is 1A | Output current is 1.5A |
| 4 |   OR 1-Input 2-Ground 3-Output |   OR 1-Ground 2-Input 3-Output |

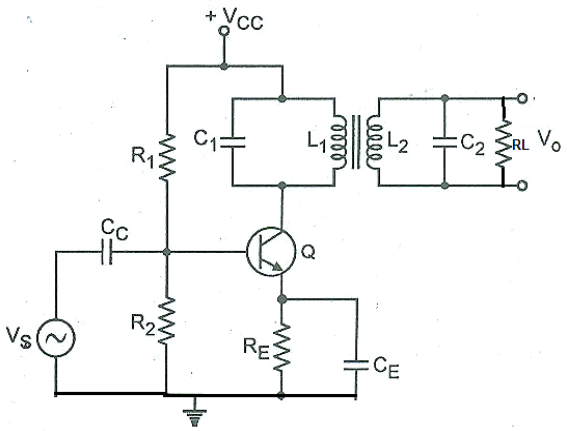
**point**

**Q.5** **Attempt any TWO of the following** **12 Total Marks**

**(a)** **Describe the operation of double tuned amplifier with the help of neat circuit diagram and mention its applications.** **6M**

**Ans:**

**Circuit diagram:** **2M**

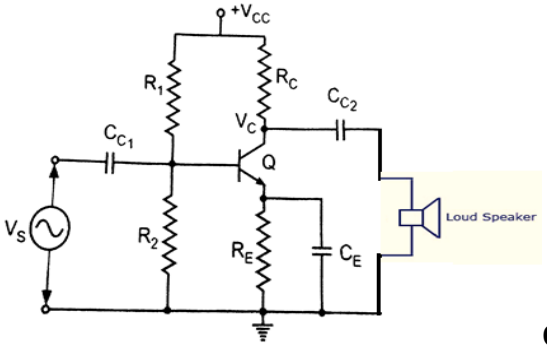
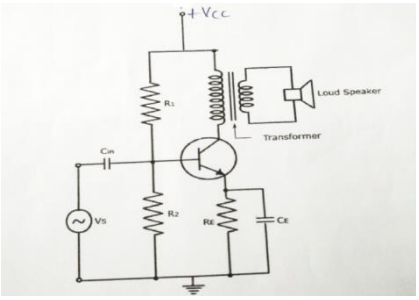
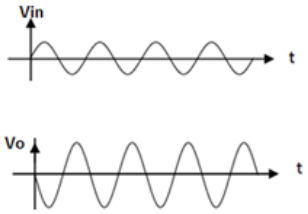
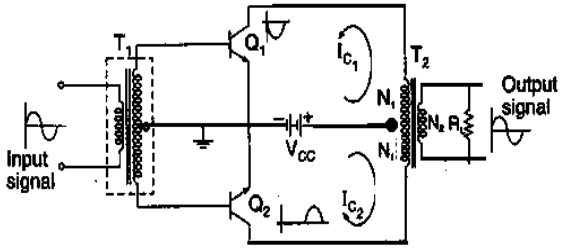
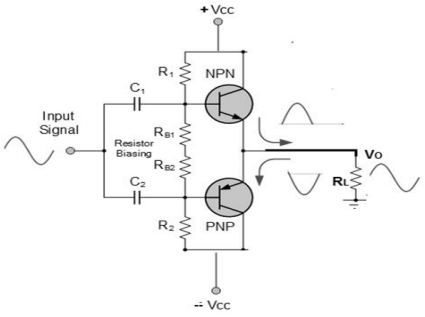
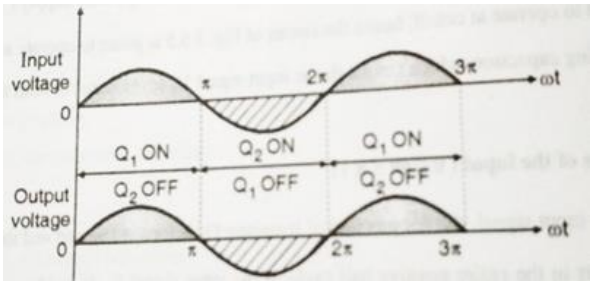


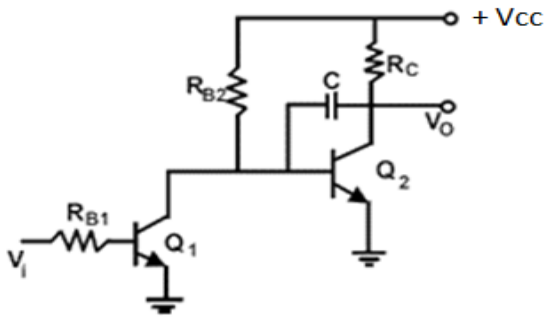
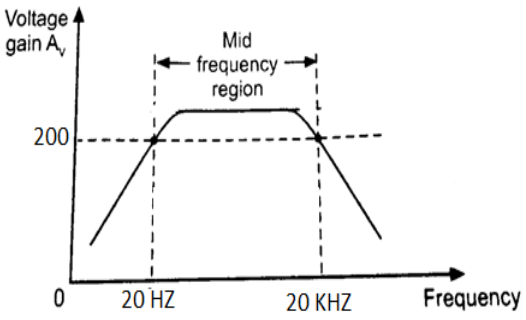

**Operation:**

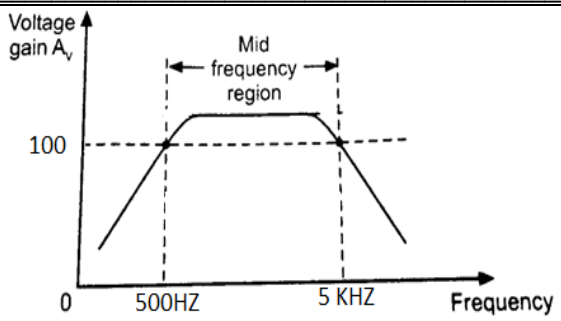
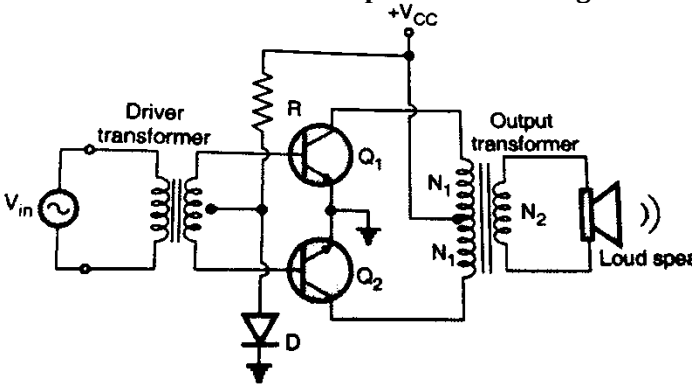
- The signal to be amplified is applied at the input terminal through the coupling capacitor $C_C$ **2M**
- The resonant frequency of the tuned circuit $L_1$ $C_1$ is made equal to that of tuned circuit $L_2$ $C_2$
- Under these conditions the tuned circuit offers avery high impedance to the input signal. As a result of this, a large output appears across the tuned circuit $L_1C_1$which is inductively coupled to the $L_2C_2$ tuned circuit.

**Applications:( any two)** **1M each**

(i) Radio and T .V broadcasting as tuning circuit.

| | | | |
|---|---|---|---|
| | | (ii) Wireless communication system. | |
| | **(b)** | **Sketch the labeled diagram of class A and class B types of power amplifier. Also draw the input and output waveforms. State one application of each.** | **6M** |
| | **Ans:** | **CLASS A POWER AMPLIFIER CIRCUIT DIAGRAM:**<br>  <br>  <br>**OR**<br>**CLASS A POWER AMPLIFIER I/P &O/P WAVEFORMS:**<br>  <br>**CLASS A POWER AMPLIFIER APPLICATION:**<br>1. High gain voltage amplifiers<br>2. RF& IF amplifiers in Radio & T.V.<br>3. Audio amplifiers<br>**CLASS B POWER AMPLIFIER CIRCUITRAM:**<br>  <br>  <br>**class B push pull power amplifiercomplementary symmetry class B push pull power amplifier**<br>**CLASS B POWER AMPLIFIER I/P & O/P WAVEFORMS:**<br>  <br>**CLASS B POWER AMPLIFIER APPLICATION(Any 2):**<br>1. Final stages of the amplifier circuits. | **Diagram**<br>**1 ½ M**<br><br>**Waveform**<br>**1M**<br><br>**Diagram**<br>**1 ½ M**<br><br>**Waveform**<br>**1M**<br><br>**½ M** |

| | | | |
|---|---|---|---|
| | | 2. In public address systems (PA system)<br>3. In tape recorders and music system<br>4. In T.V receivers | |
| | **(c)** | **Draw the neat labelled diagram of miller sweep generator and mention its two applications.** | **6M** |
| | **Ans:** | **Circuit Diagram:**<br>  <br><br>**Applications (Any Two):**<br>• In Television (TV)<br>• In CRO<br>• To convert step waveform into ramp waveform. | **4M**<br><br>**1M each** |
| **Q.6** | | **Attempt any TWO of the following:** | **12Total Marks** |
| | **(a)** | **For a BJT ac amplifier, with a midband voltage gain of 200, if the cutoff frequencies are $f_1$=20Hz and $f_2$=20KHz.Draw the frequency response for amplifier. Draw the frequency response in case of mid gain of 100 and $f_1$=500Hz to $f_2$=5KHz.** | **6M** |
| | **Ans:** | **(i) Frequency response for amplifier with mid-band voltage gain of 200, if the cutoff frequencies are $f_1$=20Hz and $f_2$= 20KHz.**<br>  <br><br>**(ii) Frequency response for amplifier with mid-band voltage gain of 100, if the cutoff frequencies are $f_1$=500Hz and $f_2$= 5KHz.** | **3M**<br><br>**3M** |

| | | | |
|---|---|---|---|
| | |  | |
| | **(b)** | **Draw a class AB push pull amplifier and comment on its usefulness in the output stage as compared to other power amplifiers and the relationship between maximum transistor power dissipation w.r.t the supply voltage.** | **6M** |
| | **Ans:** | **CLASS AB Push – Pull Amplifier circuit diagram:**<br>  <br>**Usefulness as compared to other power amplifiers:**<br>1. Efficiency more than Class A power amplifier<br>**2.** Cross over distortion is eliminated as compared to Class B power amplifier.<br>**Relationship between maximum transistor power dissipation w.r.t the supply voltage:**<br>$P_D = Pi_{(DC)} - Po_{(A.C.)}$<br>$= \frac{2VCC*Im}{\pi} - \frac{Vm*Im}{2}$ | **3M**<br><br>**2M**<br><br>**1M** |
| | **(c)** | **Comment on the effect of negative feedback on the gain, input and output resistance of the feedback amplifiers.Describe the gain bandwidth product term used in this context and its importance.** | **6M** |
| | **Ans:** | **Effect of negative feedback:**<br>1. Gain decreases with negative feedback.<br>2. Input resistance increases with negative feedback.<br>3. Output resistance decreases with negative feedback.<br>**Explanation of significance of Gain bandwidth product**<br>• Bandwidth measure at 3db voltage gain. As Gain and bandwidth product is always constant, and it is unity gain bandwidth.<br>• The gain decreases with negative feedback bandwidth increases which means it is stable output on more range of frequency. | **3M**<br><br>**Explanation**<br>**3M** |