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.

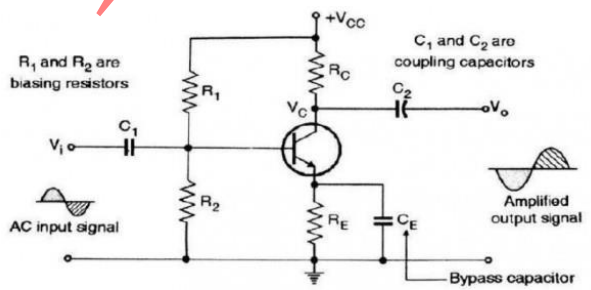
Q. No.	Sub Q.N.	Answer	Marking Scheme
Q.1		**Attempt any Five :**	**10M**
	a)	**State classification of Amplifiers.**	**2M**
	Ans:	CLASSIFICATION OF AMPLIFIERS: A] Based on input signal 1. Small signal amplifiers 2. Large signal amplifiers B] Based on output signal 1. Voltage amplifier 2. Power amplifier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

		3. Transformer coupled amplifier	
	b)	**Define the terms related to tuned amplifiers** **(i) Resonant Frequency(Fr)** **(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. $X_L=X_C$ (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. $Q_O = \frac{X_L}{R} = \frac{\omega_0 L}{R} = \frac{2\pi f_0 L}{R}$ Where , L = value of circuit inductance. R = Value of circuit resistance.	**1M** **1M**
	c)	**State the need of multistage amplifier.**	**2M**
	Ans:	**Need of multistage amplifier:** 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:-** 1. Class A amplifier 2. Class B amplifier 3. Class AB amplifier 4. Class C amplifier	**Each type: 1/2M**
	e)	**List advantages of negative feedback(any four)**	**2M**
	Ans:	**Advantage of negative feedback amplifier:** • Increased stability in gain • Increased bandwidth • Less amplitude and harmonic distortion • Decreased noise • Less frequency distortion • Less non-linear distortion • Input and output resistance can be modified as desired.	**Each point: 1/2M**
	f)	**Define :** **(i) Sweep time** **(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. 78XX can generate positive values of voltages. E.g. 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. State the function of each component.**	**4M**
	Ans:	**Circuit diagram of RC coupled single stage CE amplifier:** **Function of Components:** • 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. • **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. • **Emitter capacitance ($C_E \approx 100\mu F$)**: it is used in parallel with R_E to provide a low	**2M** **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.

- **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 2nd 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:**	**2M**

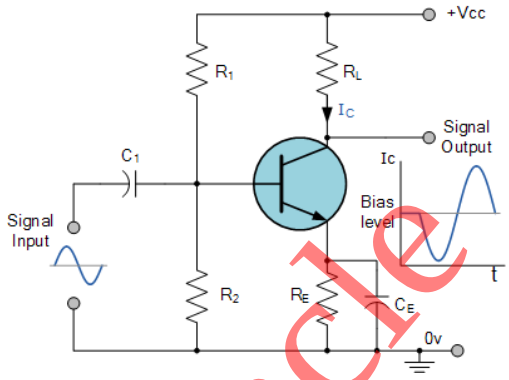


Figure (a)

OR

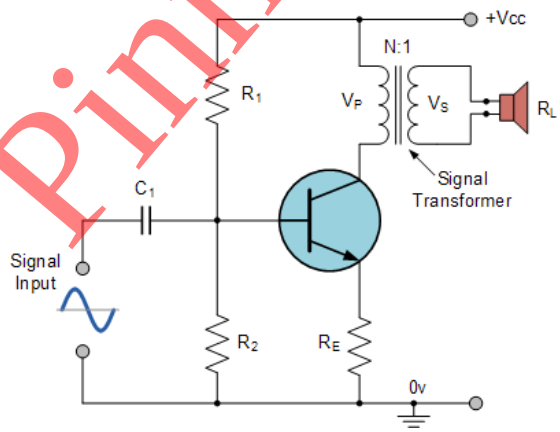


Figure (b)

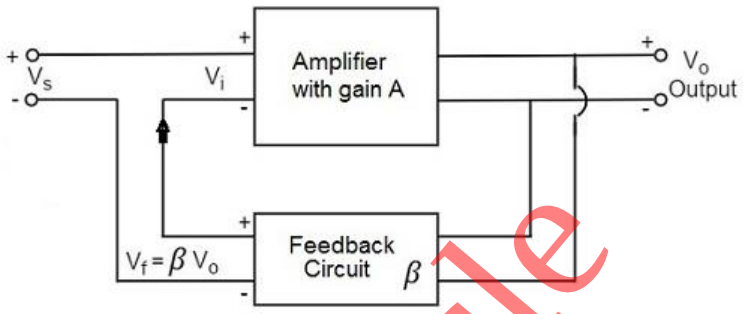
2M

Working:-

For figure (a):-

- This is the simplest type of Class A power amplifier circuit.
- 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.
- 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.
- A Class A amplifier stage passes the same load current even when no input signal is

	applied so large heat sinks are needed for the output transistors. **For Figure (b):-** An output transformer improves the efficiency of the amplifier by matching the impedance of the load with that of the amplifiers output impedance. 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:-**	**2M**



Explanation:-

- "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".
- Depending upon whether the feedback signal increases or decreases the input signal, there are 2 basic types of feedback: Positive feedback and Negative feedback.

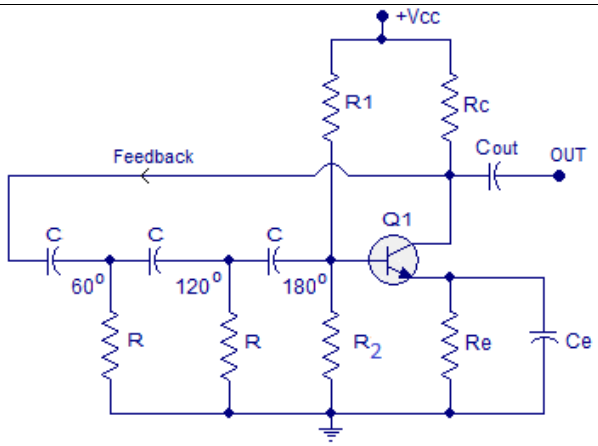
From the above figure, the gain of the amplifier is represented as A. the gain of the amplifier is the ratio of output voltage V_o to the input voltage V_i. The feedback network extracts a voltage $V_f = \beta V_o$ from the output V_o of the amplifier. **2M**

This voltage is added for positive feedback and subtracted for negative feedback, from the signal voltage V_s. Now,

$$V_i = V_s + Vf$$
$$= V_s + \beta V_o \text{ .....for Positive feedback}$$
$$V_i = V_s - Vf$$
$$= V_s - \beta V_o \text{ .....for Negative feedback}$$

The quantity $\beta = V_f / V_o$ is called as feedback ratio or feedback fraction.

d)	**Draw circuit dagram of RC phase shift oscillator and state its working.**	**4M**
Ans:	**Circuit diagram of RC phase shift oscillator:**	**2M**

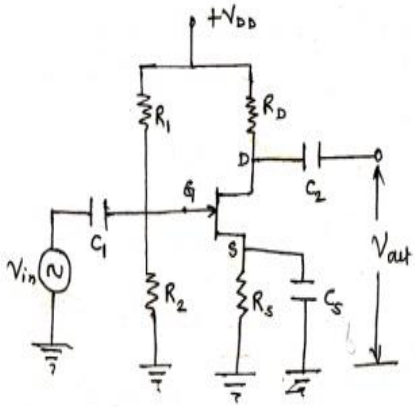


WORKING:

- 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: - • 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.

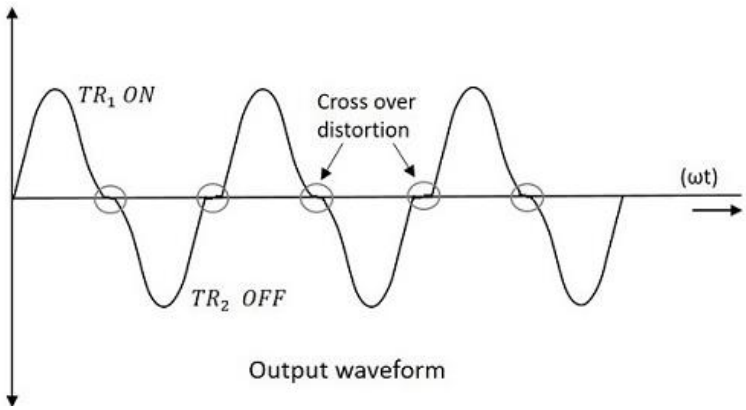
- As the input voltage rises, gate to source voltage becomes less negative, it will increase the channel width and increase the level of drain current I_D.
- As the input voltage falls, it will decrease the channel width and decrease the level of drain current I_D.
- Thus I_D varies sinusoidally above its Q point value.
- The drain to source voltage V_{DS} is given by
- $V_{DS} = V_{DD} - I_D R_D$
- Therefore as I_D increases the voltage drop $I_D R_D$ will also increase and voltage V_{DS} will decrease.
- If ΔI_D is large for a small value of ΔV_{GS}; the ΔV_{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:-** **2M**

- Cross over distortion occurs in Class B push pull Amplifier.
- 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.
- 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**.
- 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.

Waveform:- **1M**



Output waveform **1M**

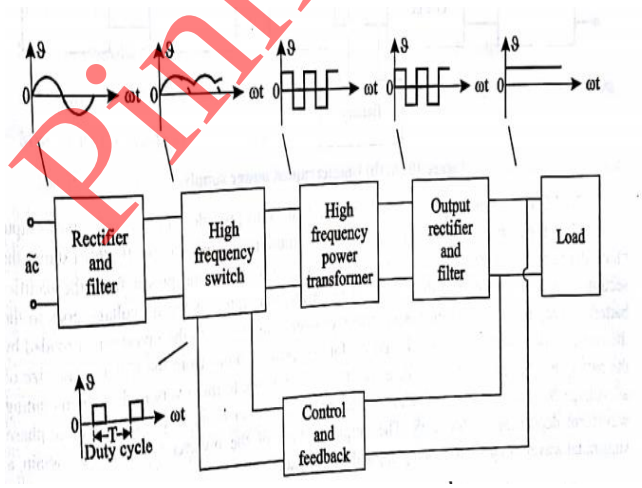
Method to overcome :

This cross over distortion can be eliminated if the conduction of the amplifier is more than

	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:** **(i) Gain** **(ii) Bandwidth** **(iii) Phase shift** **(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 :-

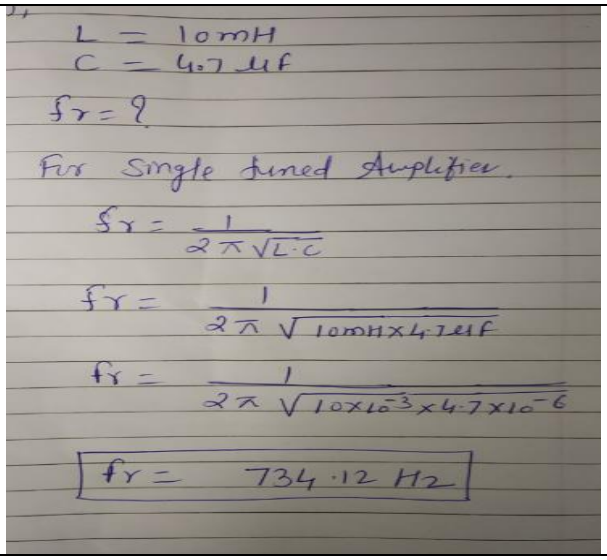
Rectifier and filter :- It converts the ac supply voltage to a pulsating dc, which is then filtered out to reduce the amount of ripple content. It uses the power diodes in a bridge configuration to obtain the pulsating dc and the capacitor is used as a filter element.

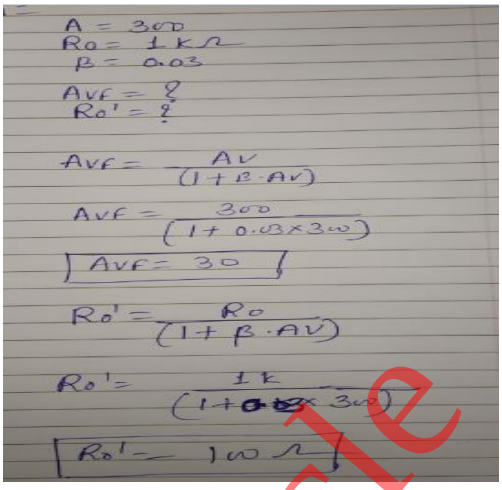
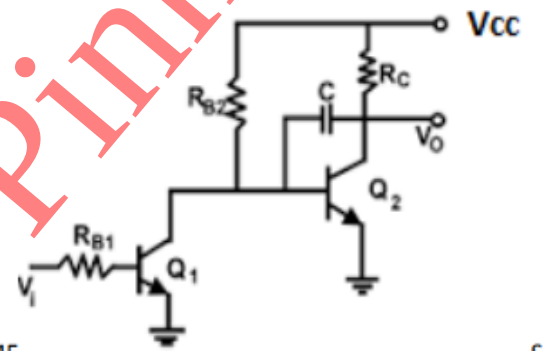
High-frequency switching:- It uses either MOSFETs or BJTs to convert the dc voltage to high frequency ac square wave. This high-frequncy ac square wave ranges from 20 kHz to 100 kHz. Since the power transistors are not operated in their active region, their operation results in low power dissipation. 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.

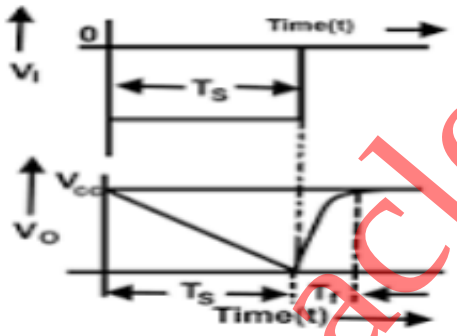
Q.4	**A)**	**Attempt any THREE of the following :**	**12- Total Marks**
	a)	**Calculate Resonant frequency of single tuned amplifier, if inductor L = 10mH and Capacitor C = 4.7 µf of tank circuit.**	**4M**
	Ans:		**Formula & unit 1M** **each Correct ans 2M**

	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:-**  **Working**: • Figure shows the circuit of a Miller integrator or a sweep circuit. • Transistor Q_1 acts as a switch and transistor Q_2 is a common - emitter amplifier. i.e. a high gain amplifier. • 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}. • 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** **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.
- 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

1M

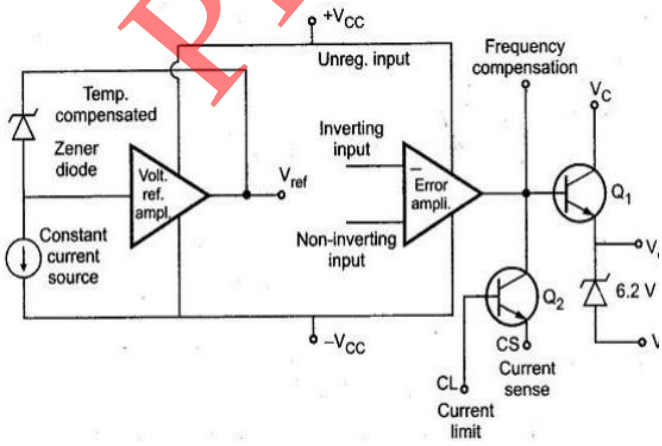
Waveform:



d) Describe block diagram of IC 723 regulator. State the working principle of IC723. **4M**

Ans: **2M**

Block diagram of IC 723 regulator:-



Working principle:- **2M**

- It consists of a voltage reference source, an error amplifier, a series pass transistor and a current limiting transistor.
- 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.

- 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:

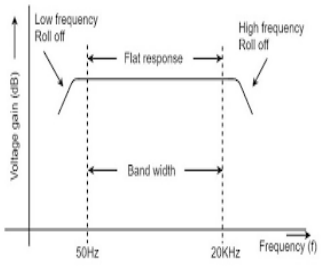
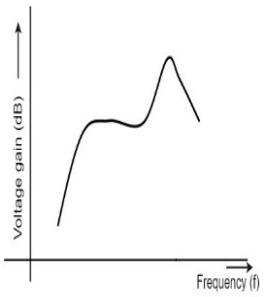
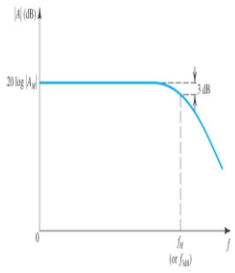
(i) Type of coupling

(ii) Frequency response

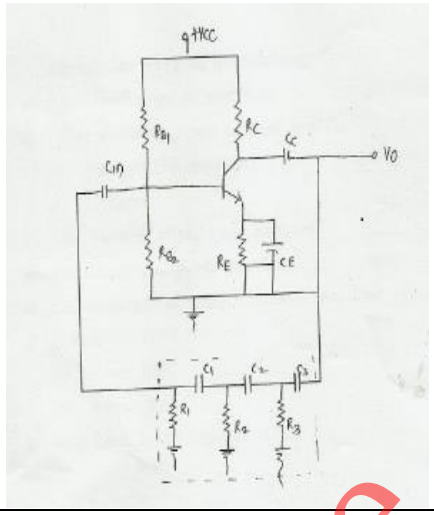
(iii) Gain

(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.** **i) Maximum power output** **ii) Power rating of transistor** **iii) D.C input at maximum power output.**					**6M**
	Ans:	Given : $V_{cc} = \pm 10V$ $R_L = 50\Omega$ i) Maximum Power output $P_{o(max)} = \frac{V_{cc}^2}{2 \cdot R_L} = \frac{(10)^2}{2 \times 50} = \frac{100}{100} = 1W.$ ii) Power rating of transistor $V_m = \frac{2V_{cc}}{\pi} = \frac{2}{\pi} \times 10 = 6.36V.$ Total collector power rating in two transistor $P_{c(dc)} = P_{in(dc)} - P_{o(ac)}$ $= V_{cc}\left(\frac{2V_m}{\pi \cdot R_L}\right) - \left(\frac{V_m^2}{2R_L}\right)$ $= 10\left(\frac{2 \times 6.36}{\pi \times 50}\right) - \frac{(6.36)^2}{2 \times 50}$ $= 0.8097 - 0.4044$ $= 0.4053 W.$ Power rating of each transistor $= \frac{P_{c(dc)}}{2} = \frac{0.4053}{2} = 0.2026W.$ iii) D.C i/p at maximum power output $P_{in(dc)max} = V_{cc} \times \frac{2V_{cc}}{\pi R_L}$ $= 10 \times \frac{2 \times 10}{\pi \times 50}$ $= 1.273W.$					**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** Given $R_1=R_2=R_3=2K\Omega$ $C_1=C_2=C_3=0.1\mu F$. $freq = \frac{1}{2\pi\sqrt{6}RC}$ $= \frac{1}{2\pi\sqrt{6}\times 2\times10^{3}\times0.1\times10^{-6}}$ $= 324.87\ Hz$.	**2M** **2M Formula** **2M**
Q.6		**Attempt any TWO of the following:**	**12- Total Marks**
	a)	**CompareClassA ,ClassB,ClassCandclassABpoweramplifiersonthebasis of:** **i)Angle of conduction** **ii)Efficiency** **iii)Position of operating pointing power dissipation** **iv)Distortion**	**6M**

v)Application

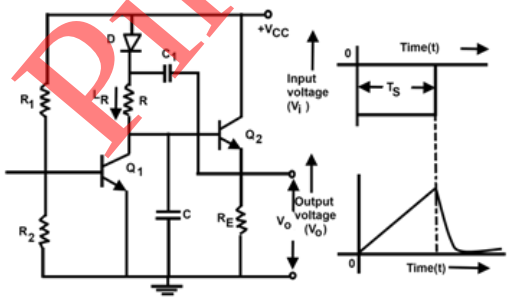
Ans:

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

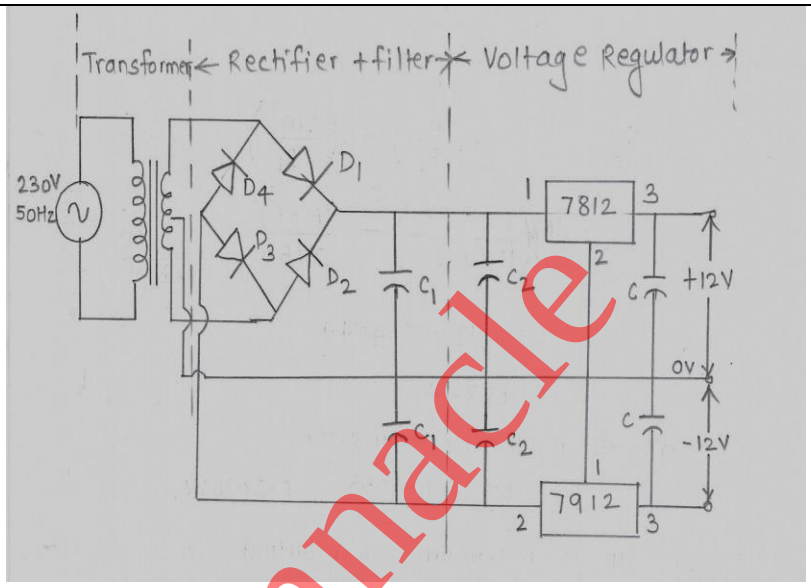
b) DrawBootstrapsweepgeneratorcircuit.CompareMillerIntegratorandbootstrapsweepgeneratorwithrespecttothetechniqueused. **6M**

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**