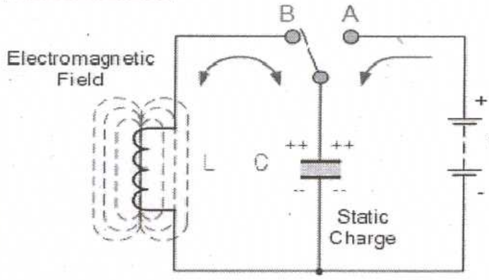
SCHEME OF VALUATION

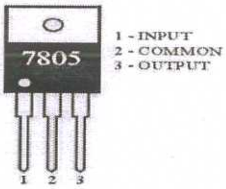
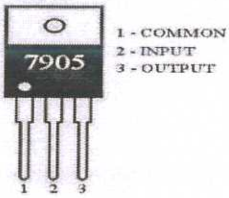
(Schoring Indicators)

REVISION : 15 COURSE CODE :TED(15)-3031

COURSE TITLE: ANALOG DEVICES AND CIRCUITS

VERSION :A

QN NO		SCORING INDICATORS	SPLIT UP SCORE	SUB TOTAL	TOTAL SCORE
I		**PART A**			
	1.	• Passive Components Examples – Resistors, – Inductors – Capacitors. • Active Components Examples o Transistor – Bipolar Junction Transistor – Field Effect Transistor o Silicon Controlled Rectifier o Operational amplifiers *Any two for each*	4 x 0.5	2	
	2.	**Need of filter** To remove the ac component in the rectified output *or* To get a pure dc output instead of pulsating dc *Or similar* *Any one*	1 x 2	2	
	3	**Coupling schemes** • Resistance-Capacitance Coupling • Transformer Coupling • Impedance Coupling • Direct Coupling *Any four*	0.5 x 4	2	
	4	**Tank circuit**  *Or similar*	2 x 1	2	
	5.	**Applications of OP Amps** Integrator Differentiator ZCD Level Detector Precision rectifier Adder *Any four*	0.5 x 4	2	10

<table>
<tr><th colspan="2">QN NO</th><th>SCORING INDICATORS</th><th>SPLIT UP SCORE</th><th>SUB TOTAL</th><th>TOTAL SCORE</th></tr>
<tr><td>II</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td>1.</td><td>
<table>
<tr><th rowspan="3">Sl no</th><th rowspan="3">Parameters</th><th colspan="3">Types of rectifiers</th></tr>
<tr><th rowspan="2">Half Wave</th><th colspan="2">Full Wave</th></tr>
<tr><th>Centre Tapped</th><th>Bridge</th></tr>
<tr><td>1</td><td>Peak Inverse Voltage</td><td>Vm</td><td>2 Vm</td><td>Vm</td></tr>
<tr><td>2</td><td>Ripple Factor</td><td>1.21</td><td>0.482</td><td>0.482</td></tr>
<tr><td>3</td><td>Rectification Efficiency in %</td><td>40.6%</td><td>81.2%</td><td>81.2%</td></tr>
<tr><td>4</td><td>Output frequency</td><td>f</td><td>2f</td><td>2f</td></tr>
</table>
4 parameters</td><td>1.5 x 4</td><td>6</td><td></td></tr>
<tr><td>II</td><td>2.</td><td>**7805**
Positive Voltage Regulator
• Produce a voltage that is positive relative to a common ground
• The number 78 indicates that it is a positive voltage regulator
• The xx in 78 xx indicates the fixed output voltage it is designed to provide (ie +05 V for 7805 IC)
• It regulates a steady output of +5V if the input voltage is in rage of 7.2V to 35V.

Any 3</td><td>1 x 3</td><td></td><td></td></tr>
<tr><td></td><td></td><td>**7905**
Negative Voltage Regulator
• Produce a voltage that is negative relative to a common ground
• The number 79 indicates that it is a negative voltage regulator
• The xx in 79 xx indicates the fixed output voltage it is designed to provide (ie -05 V for 7905 IC)
• It regulates a steady output of -5V if the input voltage is in rage of 7.2V to 35V.

Any 3
(Figure not compulsory)</td><td>1 x 3</td><td>6</td><td></td></tr>
</table>

<table>
<tr><th colspan="2">QN NO</th><th>SCORING INDICATORS</th><th>SPLIT UP SCORE</th><th>SUB TOTAL</th><th>TOTAL SCORE</th></tr>
<tr><td>II</td><td>3</td><td>
<table>
<tr><th>Positive feedback</th><th>Negative feedback</th></tr>
<tr><td>The feedback signal aids the input signal.</td><td>the feedback signal opposes the input</td></tr>
<tr><td>Feedback signal is in phase with input signal</td><td>Feedback signal is out of phase with input signal</td></tr>
<tr><td>Vi= Vs + Vf</td><td>Vi= Vs -Vf</td></tr>
<tr><td>It increases the gain of the amplifier</td><td>It decreases the gain of the amplifier</td></tr>
<tr><td>It is used in oscillator circuits</td><td>It is used in amplifier circuits</td></tr>
<tr><td>gain
$A_V = \frac{A}{(1 - A\beta)}$</td><td>gain
$A_V = \frac{A}{(1 + A\beta)}$</td></tr>
</table>
<i>Any 4</i></td><td>4 x 1.5</td><td>6</td><td></td></tr>
<tr><td>II</td><td>4</td><td>
<table>
<tr><th></th><th>Class A</th><th>Class B</th><th>Class C</th></tr>
<tr><td>Transistor is ON for.......</td><td>one full cycle</td><td>one half cycle</td><td>Less than one half cycle</td></tr>
<tr><td>Transistor Conducts .... of the time</td><td>100%</td><td>50%</td><td>Less than 50%</td></tr>
<tr><td>Conduction angle</td><td>360 degrees</td><td>180 degrees</td><td>Less than 180 degrees</td></tr>
<tr><td>The operating point (Q point)is selected at ....</td><td>midpoint of dc load line</td><td>Cut off region of dc load line</td><td>Below Cut off region of dc load line</td></tr>
</table>
<i>Any 4</i></td><td>1.5 X 4</td><td>6</td><td></td></tr>
<tr><td>II</td><td>5</td><td>B-H Criterion
Or
Barkhausen criterion</td><td>2</td><td></td><td></td></tr>
<tr><td></td><td></td><td>• $|A\beta| = 1$
• $< A\beta = 0^0 \; or \; 360^0$</td><td>2 x2</td><td></td><td></td></tr>
<tr><td></td><td></td><td>In practical cases it is considered that
• $|A\beta| \geq 1$
<i>Optional</i></td><td></td><td>6</td><td></td></tr>
</table>

<table>
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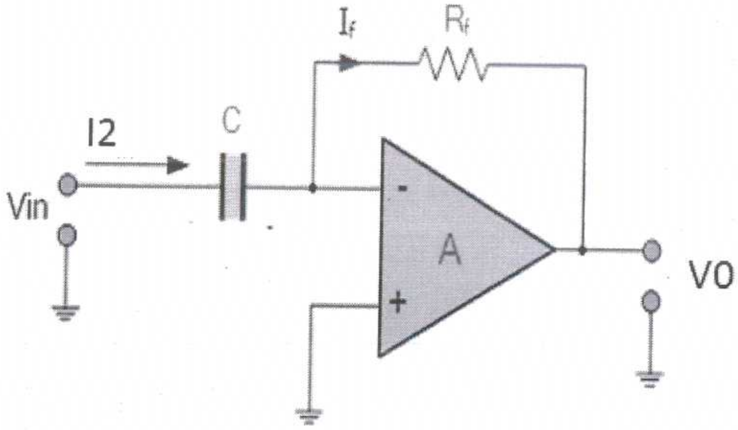
<tr><td>II</td><td>6</td><td>
<table>
<tr><th>Parameters</th><th>Ideal Op amps</th></tr>
<tr><td>Open loop gain</td><td>infinite</td></tr>
<tr><td>Input resistance</td><td>infinite</td></tr>
<tr><td>Bandwidth</td><td>infinite</td></tr>
<tr><td>CMRR</td><td>infinite</td></tr>
<tr><td>Slew Rate</td><td>infinite</td></tr>
<tr><td>Output resistance</td><td>Zero</td></tr>
<tr><td>Input currents</td><td>Zero</td></tr>
<tr><td>Difference voltage</td><td>Zero</td></tr>
</table>
Any 6</td><td>1 x 6</td><td>6</td><td></td></tr>
<tr><td>II</td><td>7</td><td>Differentiator circuit


</td><td>3</td><td></td><td></td></tr>
<tr><td></td><td></td><td>

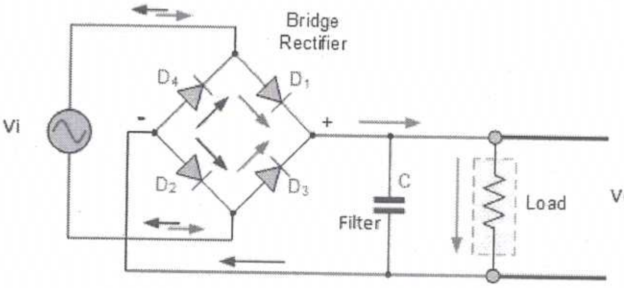
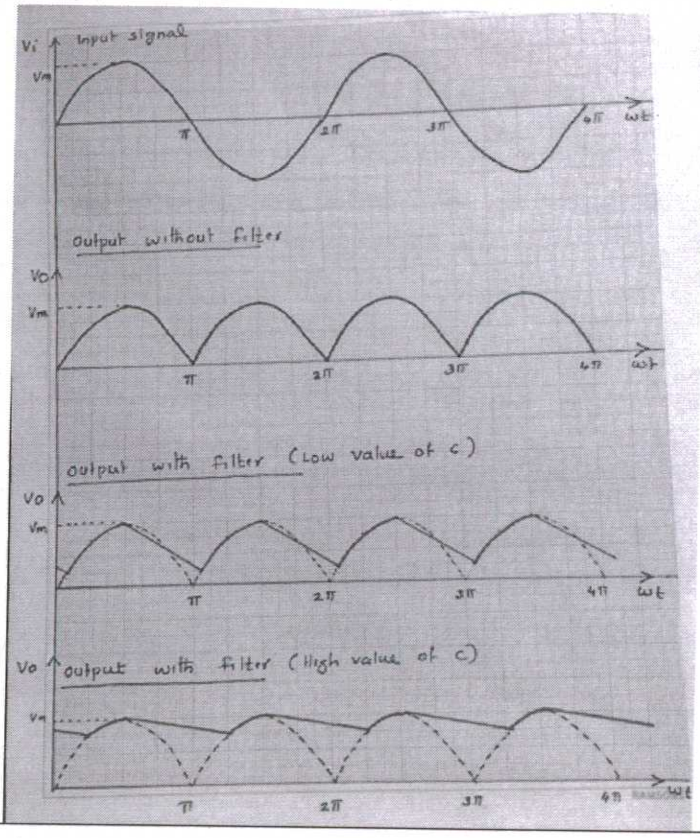
$$I_2 = I_f$$

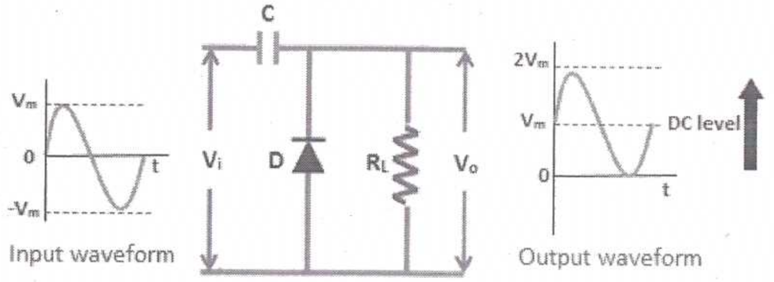
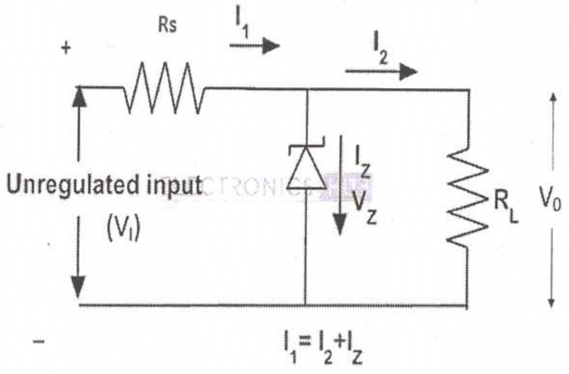
$$C\frac{dV_{in}}{dt} = \frac{-V_0}{R_f}$$

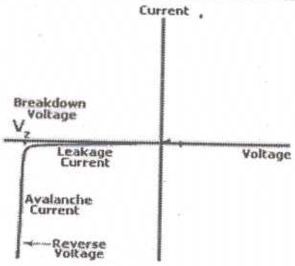
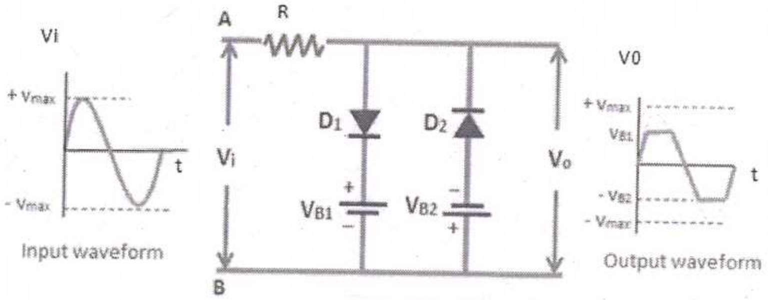
$$V_0 = -R_f C\frac{dV_{in}}{dt}$$

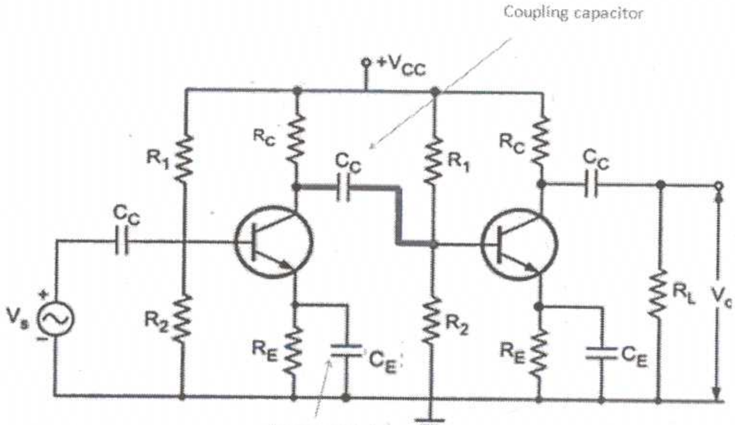
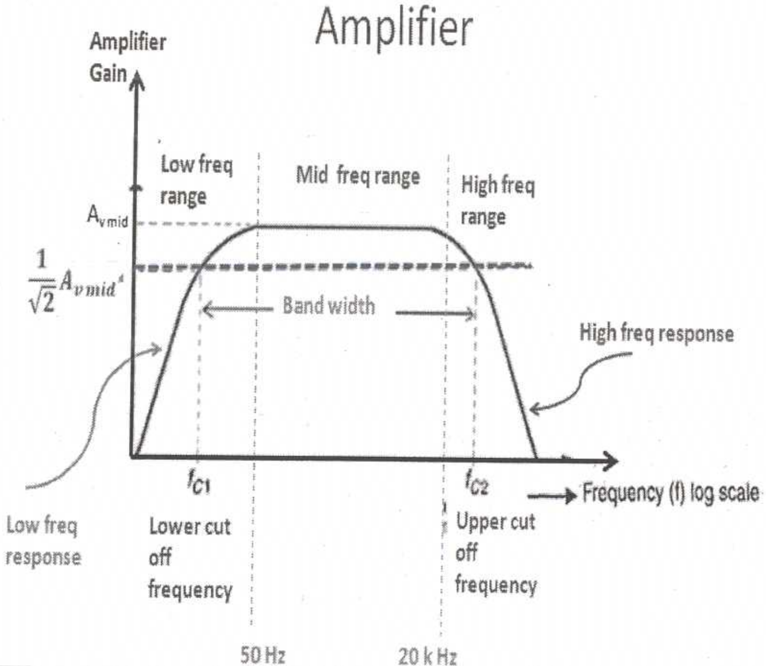
$$V_0 = -R_f C\,(\text{Derivative of input signal})$$

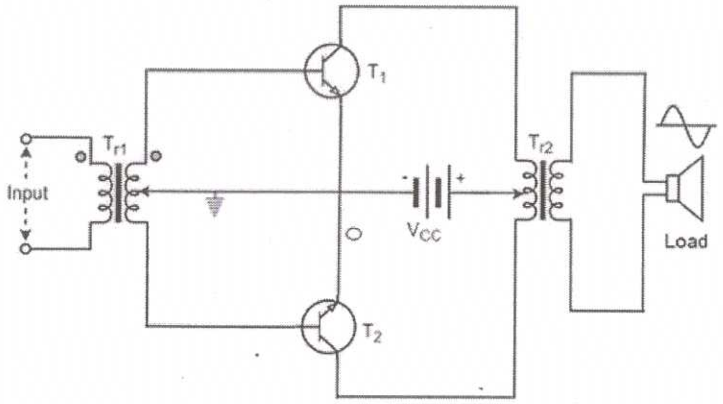
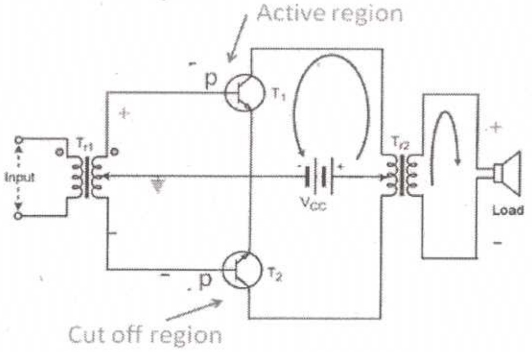
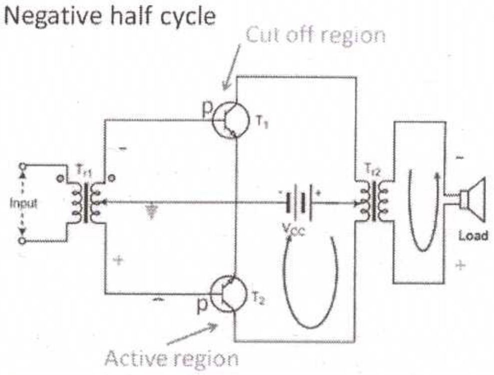
</td><td>3</td><td></td><td></td></tr>
<tr><td></td><td></td><td>*Non inverting configuration can also be accepted*</td><td></td><td>6</td><td>30</td></tr>
</table>

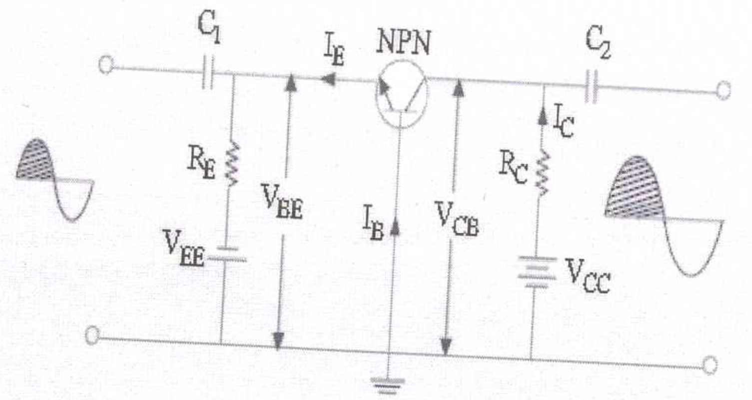
QN NO		SCORING INDICATORS	SPLIT UP SCORE	SUB TOTAL	TOTAL SCORE
		PART C MODULE 1			
III	a	**FWBR** *Circuit diagram-2 marks* *Wave form(with x-y axis parameters marked)* *Output-without filter-2 marks* *Output-with filter (low value of C)-2 marks* *Output-without filter(High value of C)-2 marks* *Proportionate mark has to be reduced if x and y axis parameters are not marked on the waveform*			
		 *Or similar circuit with step down transformer at input side*	2		
			2 x 3	8	

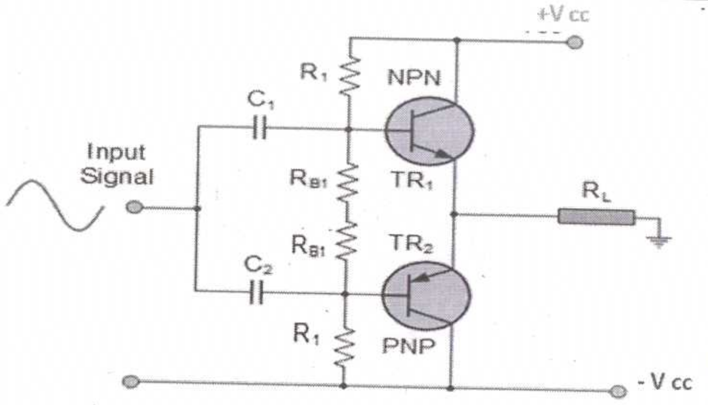
QN NO		SCORING INDICATORS	SPLIT UP SCORE	SUB TOTAL	TOTAL SCORE
III	b	**Positive Clamper** *Circuit diagram-2 marks* *Wave form(with x-y axis parameters marked)* *input-1 mark* *Output -2 marks* *Explanation- 2 marks* *Proportionate mark has to be reduced if x and y axis parameters are not marked on the waveform*			
		 Positive clamper	2 + 1 +1		
		Negative half cycle : Diode is forward biased & Capacitor charges towards peak value V_m Positive half cycle : Diode is reverse biased & $V_0 = V_i + V_m$	2	7	15
IV	a	**Zener Voltage Regulator** *Circuit diagram-3 marks* *Zener diode reverse characteristics(mention / sketch)-2 marks* *working-3 marks*			
			3		

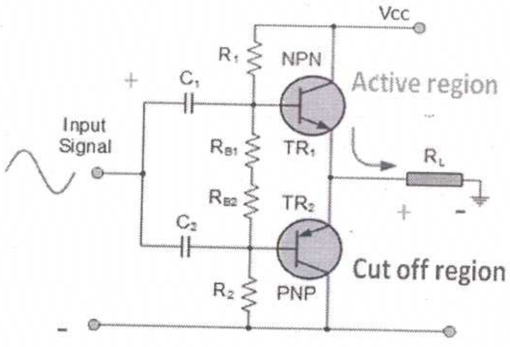
QN NO		SCORING INDICATORS	SPLIT UP SCORE	SUB TOTAL	TOTAL SCORE
			2		
		Zener diode is connected in reverse biased condition it is operating in its breakdown condition **Load regulation** Maintain a constant output voltage even if the supply voltage is changed If supply voltage is increased Supply current also increases $I_S = I_Z + I_L$ $I_1 = I_Z + I_2$ This increased current will flow through Zener diode Thus makes constant load current and hence constant load voltage ***Or*** ***Explain about Line regulation***	3	8	
IV	b	***Double ended clipper*** *Circuit diagram-2 marks* *Wave form(with x-y axis parameters marked)* *input-1 marks* *Output -2 marks* *Explanation- 2 marks* *Proportionate mark has to be reduced if x and y axis parameters are not marked on the waveform*			
		 *Various schemes can be adopted*	5		
		Positive half cycle : Diode D1 is forward biased Hence V0 = VB1(= + ve) Negative half cycle : Diode D2 is forward biased Hence V0 = VB2(= -ve)	2	7	15

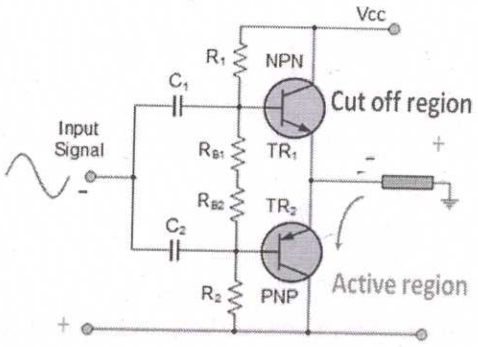
QN NO		SCORING INDICATORS	SPLIT UP SCORE	SUB TOTAL	TOTAL SCORE
V	a	**RC coupled amplifier** *circuit diagram –3marks* *frequency response diagram (with x-y axis parameters marked)-2marks* *6 parameters- 0.5 marks each = 3 marks*			
			3		
		FREQUENCY RESPONSE of RC coupled Amplifier 	2 + (0.5 x 6)= 5	8	

QN NO		SCORING INDICATORS	SPLIT UP SCORE	SUB TOTAL	TOTAL SCORE
V	b	**Push Pull Amplifier** *circuit diagram – 3 marks* *operation(explanation/ indication on diagram)for + ve and _ve half cycle -4 mark*			
			3		
		Positive half cycle  T1- active region T2- cut off region T1 –conducts Collector current flows as shown in fig *Diagram or explanation - any one is sufficient*	2		
		T1- cut off region T2- active region T2 –conducts Collector current flows as shown in fig Negative half cycle  *Diagram or explanation any one needed*	2	7	15

QN NO		SCORING INDICATORS	SPLIT UP SCORE	SUB TOTAL	TOTAL SCORE
VI	a	**CB transistor Amplifier** circuit diagram –3 marks wave form- 2marks explanation-3 marks			
			3+ 2		
		Positive Half cycle • Forward biasing decreases • Base current and emitter current and collector current decreases • Voltage drop IC RC decreases • Output voltage Vcc-IcRc increases • This corresponds to Positive half cycle	1.5		
		Negative Half cycle • Forward biasing increases • Base current and emitter current and collector current increases • Voltage drop IC RC increases • Output voltage Vcc-IcRc decreses • This corresponds to Negative half cycle	1.5		
		Variations in circuit diagram can be accepted *Can be explained with PNP transistor also*		8	

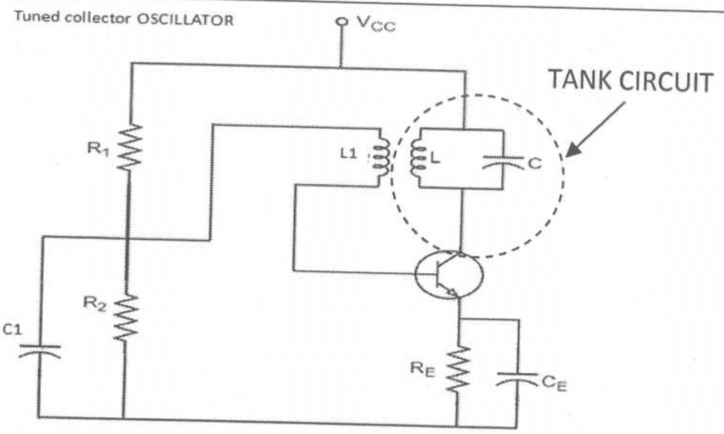
<table>
<tr><th colspan="2">QN NO</th><th>SCORING INDICATORS</th><th>SPLIT UP SCORE</th><th>SUB TOTAL</th><th>TOTAL SCORE</th></tr>
<tr><td>VI</td><td>b</td><td>Complimentary symmetry push pull amplifier
<i>circuit diagram – 3 marks</i>
<i>operation(explanation/ indication on diagram) for + ve and _ve half cycle -4 mark</i></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>
</td><td>3</td><td></td><td></td></tr>
<tr><td></td><td></td><td>T1- active region
T2- cut off region
T1 –conducts
Collector current flows as shown in fig

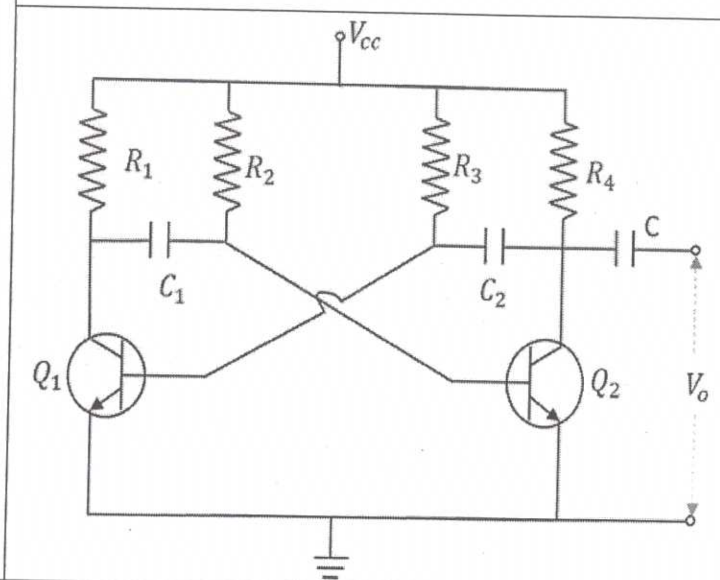
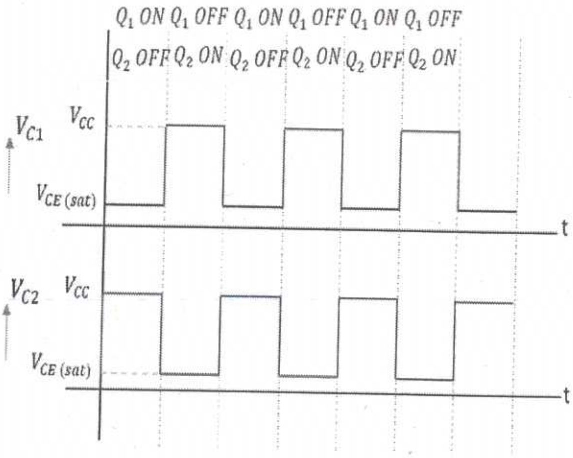
Positive Half cycle


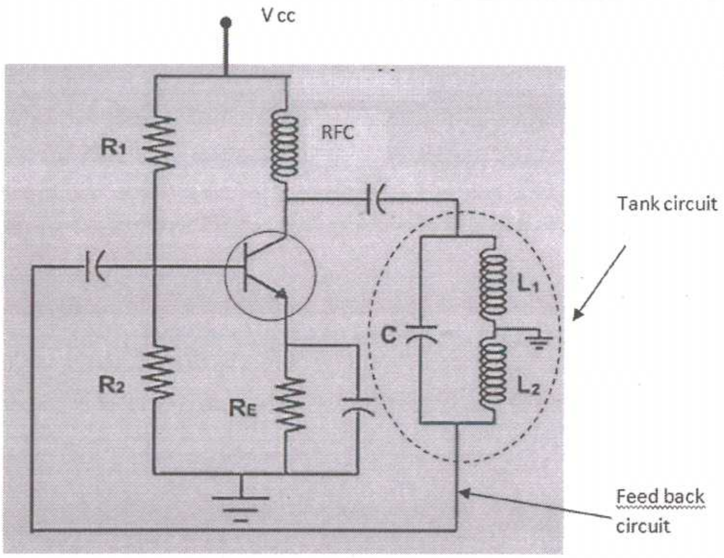
<i>Diagram or explanation any one needed</i></td><td>2</td><td></td><td></td></tr>
<tr><td></td><td></td><td>Negative Half cycle


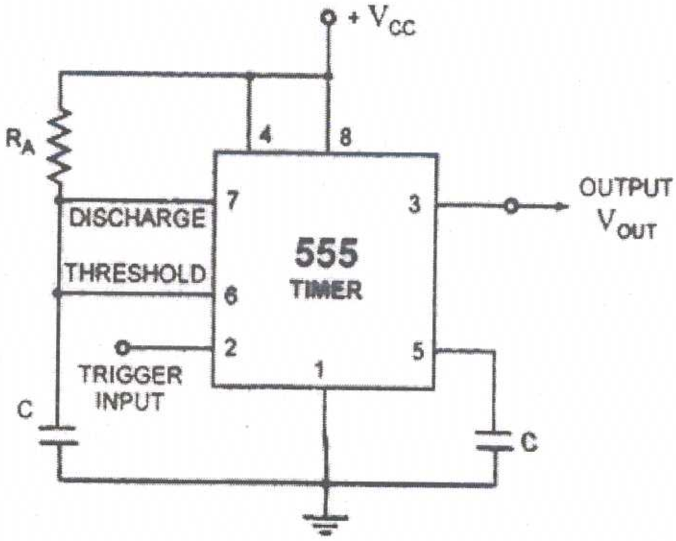
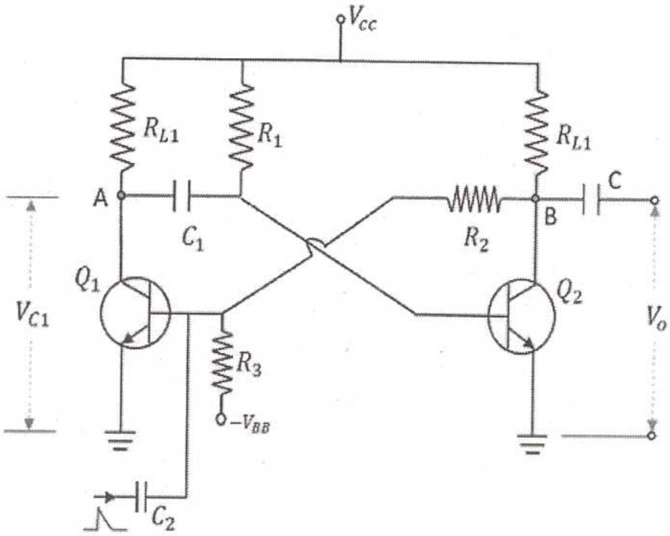
T1- cut off region
T2- active region
T2 –conducts
Collector current flows as shown in fig

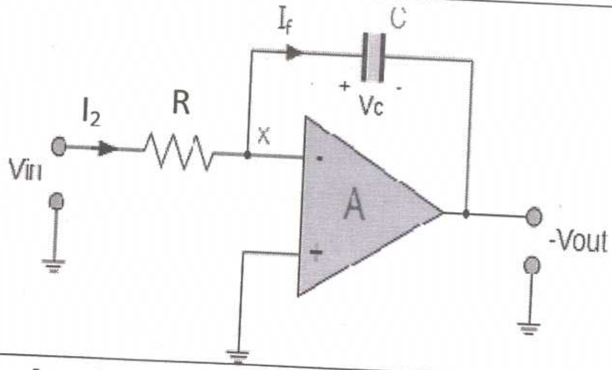
<i>Diagram or explanation any one needed</i></td><td>2</td><td>7</td><td>15</td></tr>
</table>

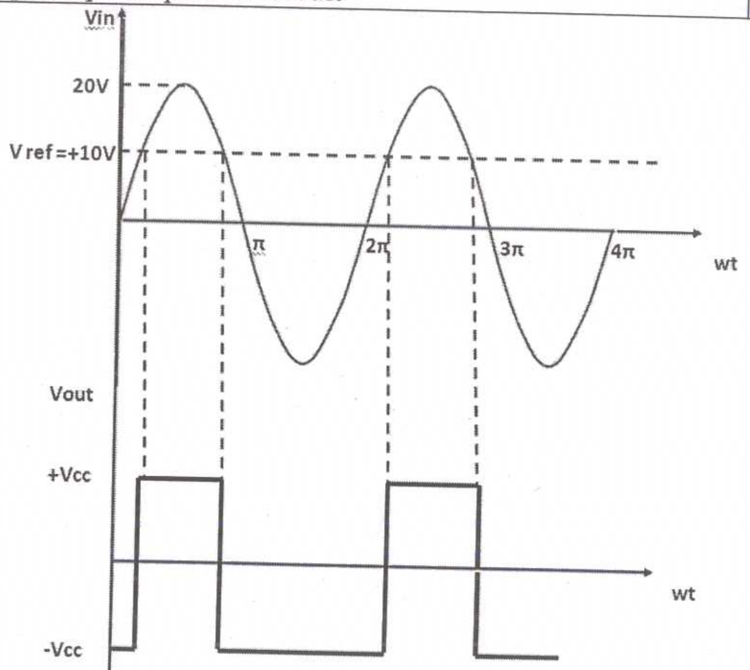
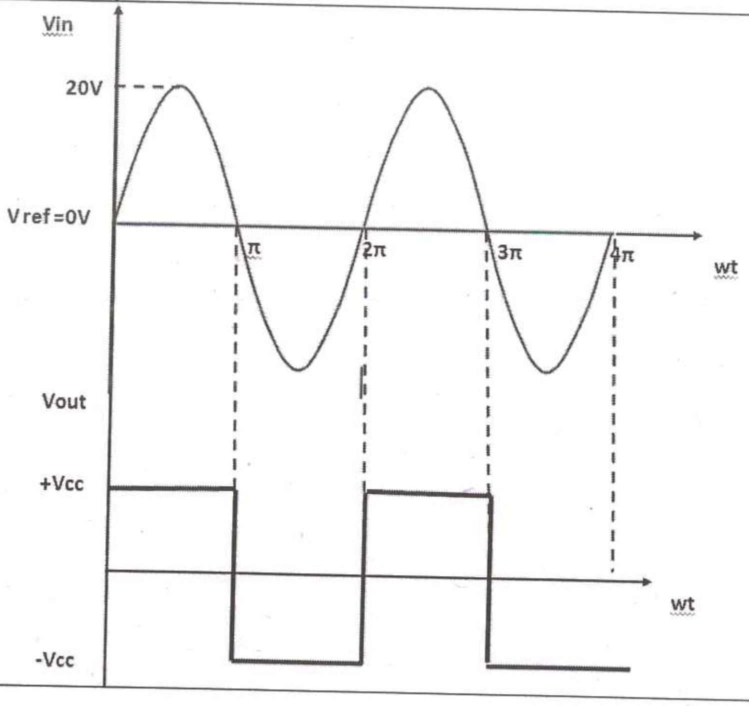
QN NO		SCORING INDICATORS	SPLIT UP SCORE	SUB TOTAL	TOTAL SCORE
V II	a	**Tuned collector oscillator** *Circuit diagram- 3 marks* *Tank circuit Labelling -1mark* *Mentioning B-H criterion & phase shift - 2marks* *Operation= 2marks*			
			3 +1		
		Conditions for sustained Oscillations 1.There should be Positive feed back **2.B-H criterion** should be satisfied · $\|A\beta\| = 1$ · $< A\beta = 0^0 \text{ or } 360^0$ **Phase shift of feedback** At transistor phase shift = 180^0 At transformer phase shift =180^0 Total phase shift = 360^0 Positive feedback	2		
		Operation - When supply (Vcc) is given the transistor turns on . - Now the collector current starts to flow - This current charges the capacitor - When the capacitor is fully charged **L-C circuit acts like a tank circuit** - As a result oscillations are produced - Frequency of oscillations is given by $f = \frac{1}{2\pi\sqrt{LC}}$	2	8	

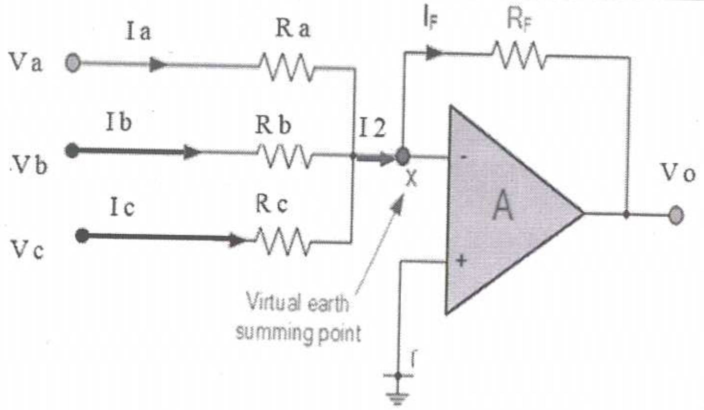
QN NO		SCORING INDICATORS	SPLIT UP SCORE	SUB TOTAL	TOTAL SCORE
V II	b	**Astable multivibrator** *Fig – 4 marks* *Waveform = 2 marks* *Explanation= 1 mark*			
			4		
		 *Or* *Similar waveforms* *Shape of the waveform can be changed according to which transistor turns on first*	3	7	15

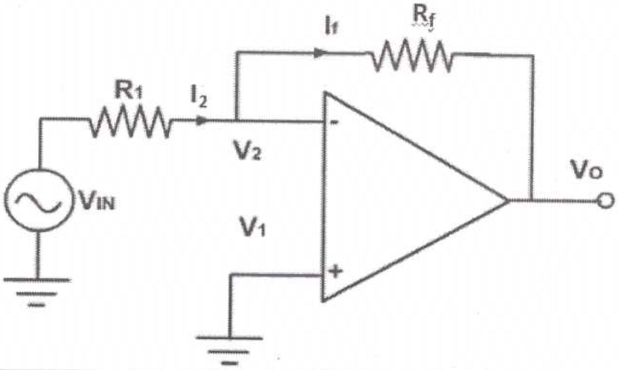
QN NO		SCORING INDICATORS	SPLIT UP SCORE	SUB TOTAL	TOTAL SCORE
VIII	a	**Hartely Oscillator** *Circuit diagram- 3 marks* *Tank circuit Labelling -1mark* *Conditions satisfied for oscillation -2marks* *Operation= 2marks*			
			3 +1		
		Conditions for sustained Oscillations 1.There should be Positive feed back **2.B-H criterion** should be satisfied • $\lvert A\beta\rvert = 1$ • $< A\beta = 0^0 \; or \; 360^0$ **Phase shift of feedback** At transistor phase shift = 180^0 At transformer phase shift =180^0 Total phase shift = 360^0 Positive feedback	2		
		When supply (Vcc) is given the transistor turns on . Now the collector current starts to flow This current charges the capacitor When the capacitor is fully charged L1-L2—C circuit acts like a tank circuit As a result oscillations are produced Frequency of oscillations is given by $$f = \frac{1}{2\pi\sqrt{LC}}$$ $$L = L1 + L2 + 2M$$ M=Mutual inductance	2	8	

QN NO		SCORING INDICATORS	SPLIT UP SCORE	SUB TOTAL	TOTAL SCORE
VIII	b	**MONOSTABLE MULTIVIBRATOR** *Short note= 2 marks* *Circuit diagram using BJT – 3 marks* *Circuit diagram using 555 timer – 2 marks*			
		- Also known as **univibrator or one shot** - non-sinusoidal oscillators - **ONE** stable states + ONE unstable state - Oscillating continously between these two states - produce a constant square wave output waveform with an external pulse	2		
		 *Circuit of The Timer 555* *as a Monostable Multivibrator*	2		
			3	7	15

QN NO		SCORING INDICATORS	SPLIT UP SCORE	SUB TOTAL	TOTAL SCORE
IX	a	**Integrator** *Circuit diagram- 4 marks* *Operation/ Derivation - 4marks*			
			4		
		$I_2 = I_f$ $\frac{V_{in}}{R} = -C\frac{dV_0}{dt}$ $\frac{dV_0}{dt} = \frac{-V_{in}}{RC}$ INTEGRATING BOTH SIDES $\int \frac{dV_0}{dt} = \int \frac{-V_{in}}{RC}$ $V_0 = -\frac{1}{RC}\int V_{in}$ $V_0 = -\frac{1}{RC}$(Integral of input signal)	4		
		Can be explained with non inverting configuration also		8	

QN NO		SCORING INDICATORS	SPLIT UP SCORE	SUB TOTAL	TOTAL SCORE
IX	b	Naming – 1 mark Wave form- 2 marks each		7	15
		Op-Amp comparator circuit	1		
			3		
			3		

QN NO		SCORING INDICATORS	SPLIT UP SCORE	SUB TOTAL	TOTAL SCORE
X	a	**Adder** Circuit daigram-3 Operation/ derivation-3marks Averaging circuit- 2 marks			
			3		
		$I_2 = I_a+ I_b+I_c$ $= \frac{V_a}{R_a}+\frac{V_b}{R_b}+\frac{V_c}{R_c}$ $I_2 = I_f$ $\frac{V_a}{R_a}+\frac{V_b}{R_b}+\frac{V_c}{R_c} = \frac{-V_0}{R_f}$ $V_0 = -R_f\left[\frac{V_a}{R_a}+\frac{V_b}{R_b}+\frac{V_c}{R_c}\right]$ If $R_a = R_b = R_c = R$ $V_0 = -R_f\left[\frac{V_a}{R}+\frac{V_b}{R}+\frac{V_c}{R}\right]$ $= -\frac{R_f}{R}[V_a + V_b + V_c]$ • This is called adder circuit	3		
		If $\frac{R_f}{R} = \frac{1}{3}$ $V_0 = -\frac{1}{3}[V_a + V_b + V_c]$ This is called averaging circuit	2	8	

QN NO		SCORING INDICATORS	SPLIT UP SCORE	SUB TOTAL	TOTAL SCORE
X	b	**Inverting amplifier** Circuit diagram- 3 marks Derivation- 4 marks			
			3		
		- For an op amp Input current = 0 Hence ib1 = ib2 = 0 V1 =0 V2 = 0 (by virtual ground) $i_f = \frac{V_2 - V_0}{R_f}$ $i_f = \frac{0 - V_0}{R_f}$ $i_f = \frac{-V_0}{R_f}$ $I_2 = I_f$ $\frac{V_{in}}{R_1} = \frac{-V_0}{R_f}$ $V_0 = -\frac{R_f}{R_1} V_{in}$ $V_0 = -A\,V_{in}$ Where A is called the gain of the amplifier $A = \frac{R_f}{R_1}$	4	7	15