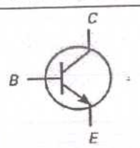
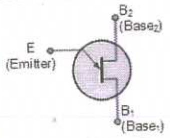
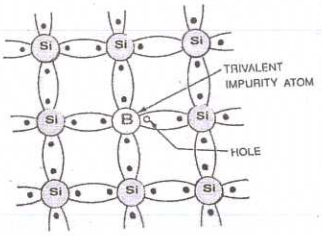
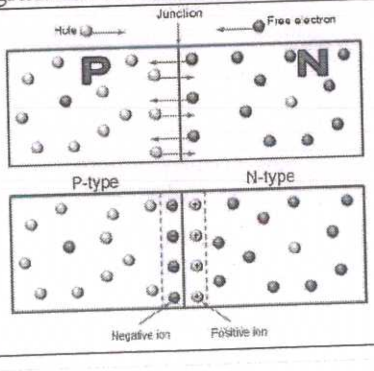
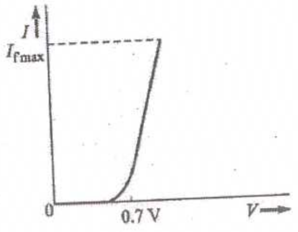
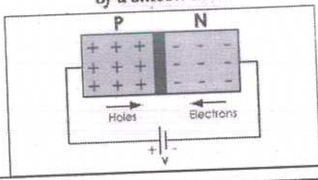
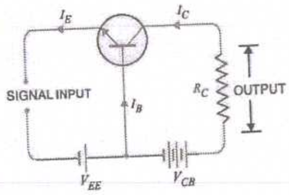
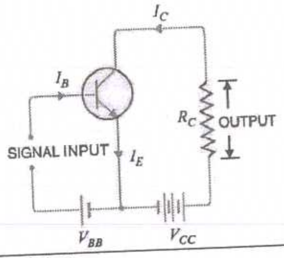
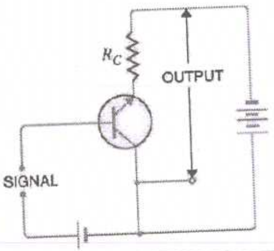
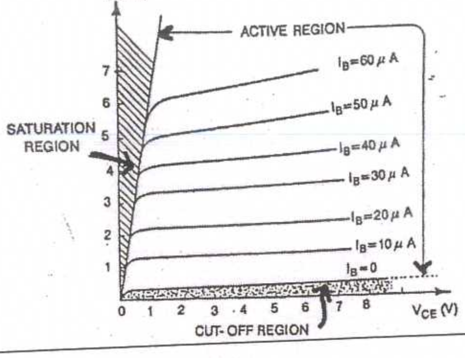
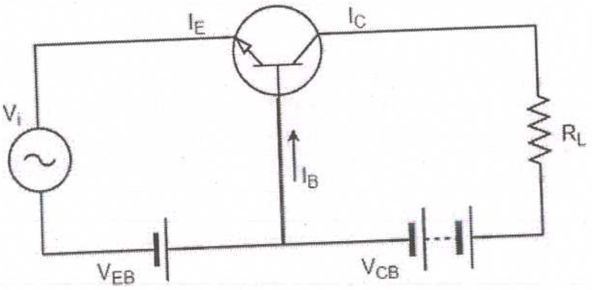
SCORING INDICATORS

	Course Code: 2041 **Course Title : BASIC ELECTRONICS** **Revision : 2021** **QID : 2106220058**	**SET 1**		
Qn. No.	**Scoring Indicator**	**Split score**	**Sub Total**	**Total Score**
	PART A			9
I.1	The process of adding impurities to the semiconductor materials is called doping.	1	1	1
I.2	0.6 V or 0.7 V	1	1	1
I.3		1	1	1
I.4	γ is the ratio of transistor's emitter current to base current.	1	1	1
I.5	Cut off	1	1	1
I.6		1	1	1
I.7	Drain current is controlled by gate voltage.	1	1	1
I.8	Ripples at the output of a rectifier can be removed by filter circuits.	1	1	1
I.9	In order to achieve good differentiation, the time constant RC of the circuit should be much smaller than the time period of the input wave.	1	1	1
	PART B			24
II 1	**Diagram - P type**  When a trivalent impurity is added to silicon (or germanium), impurity atom replaces a silicon atom in its crystalline structure. Boron atom has three valence electrons- These electrons form covalent bonds with the three neighbouring silicon atoms - The fourth neighbouring silicon atom is unable to form a covalent bond - There is a deficiency of an electron around the boron atom	1 2	3	3
II 2	Drift current is due to the motion of charge carriers due to the force exerted on them by an electric field. Diffusion current flows as a result of a gradient of carrier concentration. A gradient of carrier concentration arises near the boundary of a PN-junction	1.5 1.5	3	3
II 3		1.5	3	3

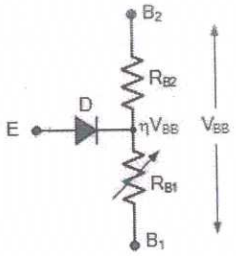
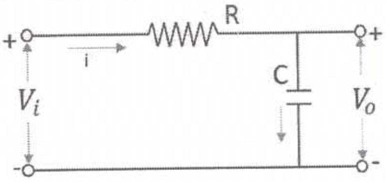
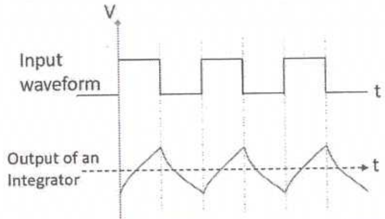
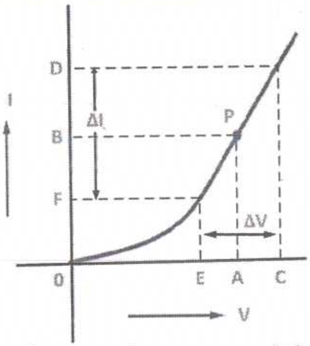
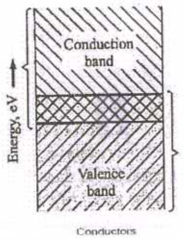
<table>
<tr><td></td><td>Density gradient across the junction results in majority carrier diffusion across the junction. Free electrons in the N region begin to diffuse across the junction into the P region where they combine with holes near the junction. This process creates a layer of two ions creating a voltage barrier.</td><td>1.5</td><td></td><td></td></tr>
<tr><td>II 4</td><td>

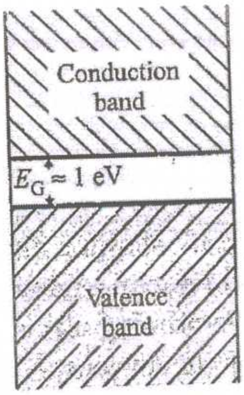
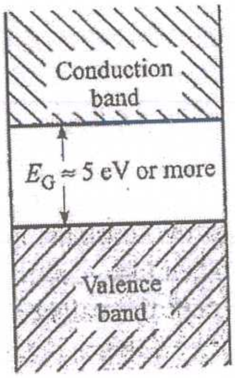
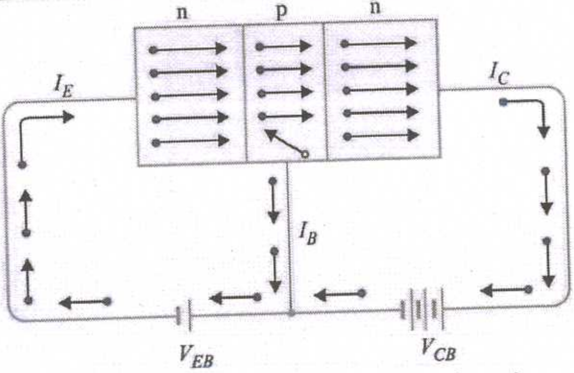
Forward characteristics of a silicon diode

</td><td>1.5
1.5</td><td>3</td><td>3</td></tr>
<tr><td>II 5</td><td><table>
<tr><th>Emitter junction</th><th>Collector junction</th><th>Region of operation</th></tr>
<tr><td>Forward biased</td><td>Reverse biased</td><td>Active</td></tr>
<tr><td>Forward biased</td><td>Forward biased</td><td>Saturation</td></tr>
<tr><td>Reverse biased</td><td>Reverse biased</td><td>Cutoff</td></tr>
</table></td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>II 6</td><td>CB


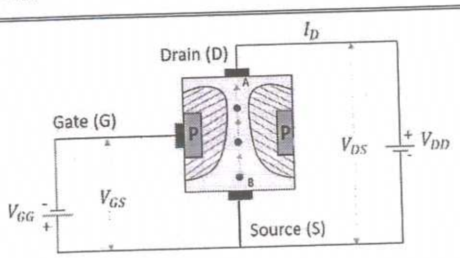
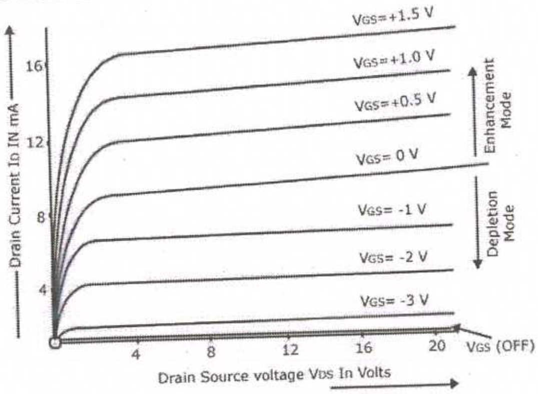
CE


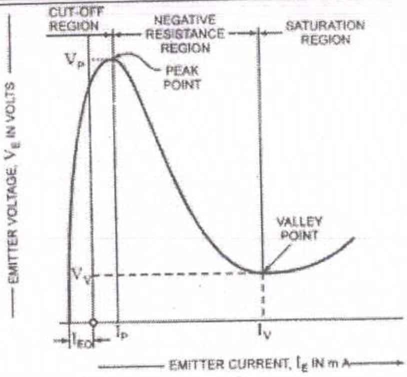
CC

</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>II 7</td><td>
</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>II 8</td><td>

Low resistance in input circuit, lets any small change in input signal to result in an appreciable change in the output. The emitter current caused by the input signal contributes the collector current, which when flows through the load resistor R_L, results in a large voltage drop across it.
[CE configuration can also be used for explanation]</td><td>2
1</td><td>3</td><td>3</td></tr>
</table>

II 9	Equivalent circuit  	2	3	3
	The resistive ratio of RB1 to RB1+RB2 is called the intrinsic stand-off ratio	1		
II 10	 	2	3	3
	 	1		
	PART C			42
III 1.	 	3	7	7
	Static or DC Forward Resistance is measured by taking the ratio of DC voltage across the diode to the DC current flowing through it $R_F = \frac{OA}{OB}$	2		
	Dynamic or AC Forward Resistance is measured by a ratio of change in voltage across the diode to the resulting change in current through it $r_f = \frac{CE}{DF} = \frac{\Delta V}{\Delta I}$	2		
III 2.	Conductor  	1	7	7
	There is no forbidden energy gap between the valence and conduction bands - The two bands overlap - The valence band energies are the same as the conduction band energies - very easy for a valence electron to become a conduction (free) electron - Without supplying any additional energy such as heat or light, a metal already contains a large number of free electrons.	1		

	Semiconductor  Semiconductors The forbidden energy gap is not wide. The energy provided by heat at room temperature is sufficient to lift electrons from the valence band to the conduction band. Some electrons jump the gap and go to the conduction band. At room temperature, semiconductors are capable of conducting some electric current. At absolute zero temperature semiconductor acts like a perfect insulator. Insulator  Insulators Very wide forbidden energy gap (5 eV or more) - Valance electrons are bound tightly - practically impossible for an electron in the valence band to jump the gap to reach the conduction band - Only at very high temperatures or under very stressed (electrically) conditions, an electron can jump the gap - At room temperature, an insulator does not conduct because there are no conduction electrons in it	1 2 1 1		
III 3.	 EB junction is forward biased while CB junction is reverse biased - electrons in the emitter are pushed towards the base constituting I_E - these electrons enter the p-type material, tend to combine with holes - only a few electrons combine with holes to constitute base current I_B - remaining electrons diffuse across the base region and reach the collector and are collected by the collector - This constitutes collector current I_C $I_E=I_B+I_C$	3 4	7	7

III 4.	Current amplification factor (α) in CB ◉ It is the ratio of output current to input current in CB configuration $\alpha = \frac{I_C}{I_E}$ Base current amplification factor (β) in CE ◉ It is the ratio of output current to input current in CE configuration $\beta = \frac{I_C}{I_B}$ Relation between α and β $\beta_{ac} = \frac{\Delta I_C}{\Delta I_B}$ ………. (1) $\alpha_{ac} = \frac{\Delta I_C}{\Delta I_E}$ ……….(2) ⊙ $I_E=I_B+I_C$ ....(3) ⊙ $\Delta I_E= \Delta I_B+ \Delta I_C$ .....(4) ⊙ Dividing eqn 4 by ΔI_C ⊙ $(\Delta I_E / \Delta I_C)=(\Delta I_B/ \Delta I_C)+ (\Delta I_C/ \Delta I_C)$ ⊙ (1/α ac)=(1/βac)+1 ⊙ Rearranging the equations, we get $\alpha ac = \frac{\beta ac}{1+\beta ac}$ ⊙ and $\beta ac=\frac{\alpha_{ac}}{1-\alpha_{ac}}$ ⊙ Similarly $\alpha_{dc}=\frac{\beta_{dc}}{1+\beta_{dc}}$ and $\beta dc=\frac{\alpha_{dc}}{1-\alpha_{dc}}$	1 1 4 1 [eqn]	7	7
III 5.	 When a voltage V_{DS} is applied between drain and source terminals and voltage on the gate is zero, the two pn junctions at the sides of the bar establish depletion layers. The electrons will flow from source to drain through a channel between the depletion layers. When a reverse voltage V_{GS} is applied, the width of the depletion layers is increased. This reduces the width of conducting channel, thereby increasing the resistance of n-type bar. Consequently, the current from source to drain is decreased.	4 3	7	7
III 6.	 Upper curves are for positive V_{GS} and the lower curves are for negative V_{GS}. The bottom drain curve is for $V_{GS} = V_{GS}$(OFF). For a specified V_{DS}, V_{GS} (OFF) is the gate-source voltage at which drain current reduces to a certain specified negligibly small value. For V_{GS} between V_{GS} (OFF) and zero, the device operates in depletion-mode while for V_{GS} exceeding zero the device operates in enhancement mode. These drain curves display an ohmic region, a constant-current source region and a cut-off region	4 3	7	7

<table>
<tr>
<td>III 7.</td>
<td>
<table>
<tr><th>BJT</th><th>FET</th></tr>
<tr><td>Bipolar</td><td>Unipolar</td></tr>
<tr><td>Operation depends on both majority charge carriers and minority charge carriers.</td><td>Operation depends on majority charge carriers</td></tr>
<tr><td>Input impedance very less</td><td>Input impedance is very large.</td></tr>
<tr><td>Current control device.</td><td>Voltage-controlled device.</td></tr>
<tr><td>Noisy</td><td>Less noisy.</td></tr>
<tr><td>Less temperature stability</td><td>Better temperature stability.</td></tr>
<tr><td>Cheaper.</td><td>costlier than BJT</td></tr>
<tr><td>It has more gain.</td><td>It has less gain.</td></tr>
<tr><td>Bigger in size</td><td>Smaller in size</td></tr>
<tr><td>Its switching time is medium.</td><td>Its switching time is fast.</td></tr>
<tr><td>It consumes more power.</td><td>It consumes less power</td></tr>
</table>
</td>
<td>7
[any 7]</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>III 8.</td>
<td>


Static Emitter-Characteristic For a UJT

Emitter firing potential is given by $V_P = \eta V_{BB} + V_B$
When V_E becomes equal to ηV_{BB}, neither reverse nor forward current will flow. When $V_E = V_P$, emitter current I_E starts to flow through R_{B1} to ground, that is B1. This is the minimum current that is required to trigger the UJT. This is called the peak-point emitter current and denoted by I_P. when the emitter diode starts conducting, charge carriers are injected into the R_{B1} region of the bar. Resistance of region R_{B1} decreases rapidly due to additional charge carriers. With this decrease in resistance, the voltage drop across R_{B1} also decrease, causing the emitter diode to be more heavily forward biased, in turn, results in larger forward current and consequently more charge carriers are injected causing still further reduction in the resistance of the R_{B1} region. Thus the emitter current goes on increasing. Since V_A decreases with the increase in emitter current, the UJT is said to have negative resistance characteristic.
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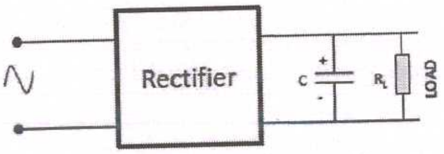
<td>3
4</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>III 9.</td>
<td>


AC components in the rectifier output find a low reactance path through capacitor - C gets charged when the diode (in the rectifier) is conducting - C gets discharged through R_L when the diode is not conducting - The stored energy in the capacitor maintains the output voltage at a high value for a long period - So the ripple voltage is minimized
</td>
<td>3
2</td>
<td>7</td>
<td>7</td>
</tr>
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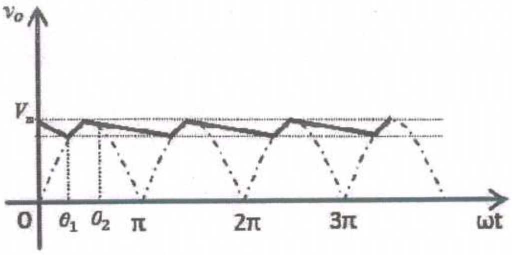
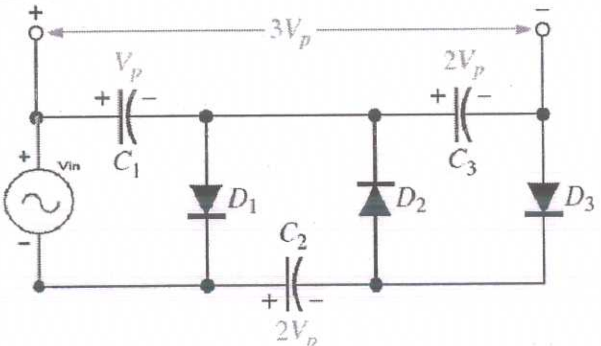
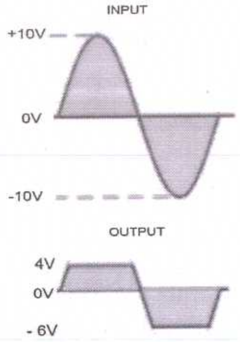
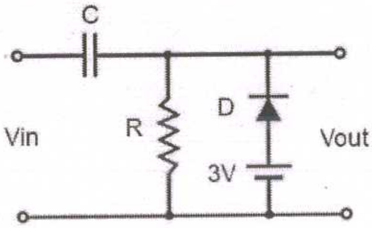
		2		
III 10.	 During the first positive half cycle of the input C1 charges to the peak value of the input voltage Vp - During the negative half cycle, D2 is forward biased diodes D1 and D3 are reverse biased - C2 is charged to twice the peak voltage of the input signal (2Vp) - During the second positive half cycle, the D3 is forward biased, diodes D1 and D2 are reverse biased - C3 is charged to 2Vm - Output voltage is taken across capacitors C1 and C3	4 3	7	7
III 11.	 - When the input voltage is greater than 4V, D1 is forward biased and D2 is reversed biased - limits the output voltage at 4V - When the input voltage is less than –6V, D2 is forward biased and D1 is reversed biased - limits the output voltage at –6V - When the input voltage is between 4V and –6V, both the diodes are reversed biased - During this time, output=input	4 3	7	7
III 12.	 During negative cycle of input, C charges through diode and dc source till (V1+3) volts with positive polarity of the capacitor at right. Charging is limited to (V1+3). Capacitor acts as a dc source in series with the input. Then output = (V1+3) + input	4 3	7	7