FEBRUARY 2018 / IN-SEM(T1)

F. Y. B. TECH. (COMMON) (SEMESTER - II)

COURSE NAME: Basic Electronics Engineering

(2017 PATTERN)

Q.NO	Sub Q.NO	Marking Scheme	Marks	Difficulty Level	Cognitive level	CO Mapped
Q1	a)	Avg. output voltage=20.66V:2M PIV=-31.74V:2M Output voltage waveform:2M	[6]	M	Comprehension	CO1
	b)	IL min=0A:2M I_{Lmax}=24.5mA:2M $R_{L\ min}$=490 ohm	[6]	M	Comprehension	CO1
	c)	Operation of photo diode: 2 M Dark current explanation: 2 M	[4]	L	Knowledge	CO1
OR						
Q2	a)	Circuit diagram: 2M Explanation:2M Derivation : 2M	[6]	M	Knowledge	CO1
	b)	V_{DC}=25.8V:2M V_{rpp}=8.33V:2M r=32.3%:2M	[6]	H	Comprehension/Application	CO1
	c)	i) % load regulation= 4% :2M ii) % line regulation=4% :2M	[4]	M	Comprehension/Application	CO1
Q3	a)	$I_{C\ sat}$=32.3 mA:2M $I_{B\ min}$=646 uA:2M Vin=4.96 V:2M	[6]	H	Comprehension	CO1
	b)	I_B=-85.2 uA :1M Ic=-10.7 mA :1M V_{CE}=-3.83 V :1M V_{CB}=3.13V:1M	[4]	M	Comprehension	CO1
	c)	Circuit diagram: 2M Working : 2M	[4]	L	Knowledge	CO1
OR						

February 2018 / In - sem (T_1)

F.Y B.Tech (common) sem. II

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Model Answers

Q1 a) $V_m = (0.2) \times 120 \times \sqrt{2} = 33.84$ $\therefore V_m = 33.84 - 1.4$

$$\boxed{V_m = 32.44\ V}$$

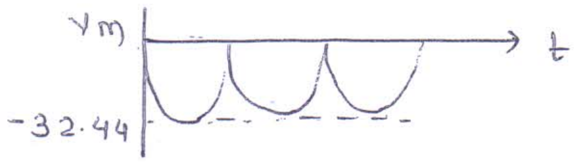
$\therefore$ Average output voltage $= \frac{2V_m}{\pi}$

$= \frac{2 \times 32.44}{\pi}$

$$\therefore \boxed{\text{Avg. output voltage} = 20.66\ V}$$

$$\boxed{PIV = -32.44 + 0.7 = 31.74\ V}$$

o/p vtg. waveform :-



b) When $I_L = 0A$ ($R_L = \infty$), I_Z is maximum and equal to the total circuit current I_T

$$I_{Z\,max} = I_T = \frac{V_{IN} - V_Z}{R} = \frac{24 - 12}{470\ \Omega} = 25.5\ mA$$

Since $I_{Z\,max}$ is less than I_{ZM}, 0 A is an acceptable minimum value for I_L becoz the Zener can handle all of the 25.5 mA.

If R_L is removed from circuit, the load current is 0 A.

$$I_{L\,min} = 0\,A$$

The maximum value of I_L occurs when I_Z is minimum ($I_Z = I_{ZK}$), so

$$I_{L(max)} = I_T - I_{ZK}$$

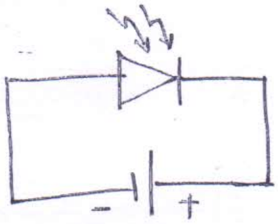
$$= 25.5\,mA - 1\,mA$$

$$I_{L\,max} = 24.5\,mA$$

The minimum value of R_L is

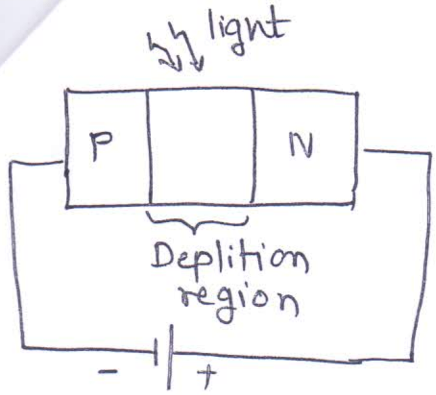
$$R_{L(min)} = \frac{V_Z}{I_{L\,max}} = \frac{12V}{24.5\,mA} = 490\,\Omega$$

Regulation is maintain for any value of R_L between $490\,\Omega$ & infinity.

c) 

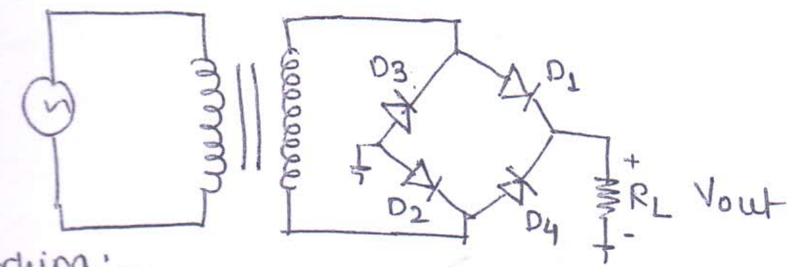
The output current flowing through photo diode must be proportional to the light falling on it. If the photo diode operated in forward bias mode then the current flowing through diode is proportional to the biasing voltage. But we want the operation of photo-diode only when light is falling on it. Means out put current of diode must be function of intensity of light.

That's why photo diode is operated in reverse bias mode.



OR

Q.2 a) . <u>circuit diagram</u>



<u>working</u>:-

Bridge rectifier uses Four diodes connected in fig. when i/p cycle is positive, diodes D_1 & D_2 are forward biased. A voltage is developed across R_L that looks like positive half of i/p cycle. During this time diode D_3 & D_4 are reverse biased.

When i/p cycle is negative, D_3 & D_4 are forward bias & conducts current in the same direction thr' R_L. During -ve half cycle D_1 & D_2 are reverse biased.

<u>Bridge output voltage</u>:- $V_{p\,out} = V_{p\,sec}$.

By neglecting diode drops, the secondary voltage appears across Load resistor.

$$V_{p\,out} = V_{p\,sec}$$

Two diodes are always in series with R_L. IF these diode drops are taken then output voltage is

$$V_{p\,out} = V_{p\,sec} - 1.4\,V$$

$$PIV = V_{p\,out} + 0.7$$

Expression for DC output voltage

$V_{Ldc} = I_{Ldc} \times R_L$

$V_{Ldc} = \frac{2I_m}{\pi} \times R_L$

~~VLdc~~ Average load current (I_{Ldc})

$I_{Ldc} = \frac{1}{\pi} \int_0^{\pi} I_m \sin\omega t \, d\omega t$

$$\boxed{I_{Ldc} = \frac{2I_m}{\pi}}$$

Avg. load voltage $V_{Ldc} = I_{Ldc} \times R_L$

$V_{Ldc} = \frac{2I_m}{\pi} \times R_L$

$$\boxed{V_{Ldc} = \frac{2V_m}{\pi}}$$

b) $V_p = 30\,V$ $\quad C = 50\,\mu F$

$V_{rpp} = \frac{V_{p\,in}}{f \cdot R_L C} = \frac{30}{(2 \times 60\,Hz) \times 600 \times 50\,\mu F}$

$$\boxed{V_{rpp} = 8.33\,V}$$

$V_{DC} = \left[1 - \frac{1}{2f \cdot R_L C}\right] V_{p\,in}$

$= \left[1 - \frac{1}{240 \times 600 \times 50\,\mu F}\right] \times 30$

$$\boxed{V_{DC} = 25.8\,V}$$

% ripple factor $= \frac{V_{rpp}}{V_{DC}} \times 100 = \frac{8.33}{25.8}$

$$\boxed{r = 32.3\,\%}$$

/ Given data :- $V_{CC} = 9V$, $V_{CE(sat)} = 0.3V$ $R_C = 220\Omega$
$R_B = 3.3\,k\Omega$, $\beta_{dc} = 50$ $V_{LED} = 1.6V$
calculate magnitude of square wave.

$$I_{C\,sat} = \frac{V_{CC} - V_{LED} - V_{CE\,sat}}{R_C}$$

$$= \frac{9 - 1.6 - 0.3}{220\,\Omega}$$

$$\boxed{I_{C\,sat} = 32.3\ mA}$$

$$I_{B\,min} = \frac{I_{C\,sat}}{\beta_{dc}} = \frac{32.3\ mA}{50}$$

$$\boxed{I_{B\,min} = 646\ \mu A}$$

I_B is two times of minimum base current.

$$\therefore \boxed{I_B = 2 \times 646\ \mu A \simeq 1.3\ mA}$$

$$\therefore I_B = \frac{V_{in} - V_{BE}}{R_B}$$

$$\therefore V_{in} = I_B R_B + V_{BE}$$

$$= 1.3 \times 3.3 + 0.7$$

$$\boxed{V_{in} = 4.96V}$$ Apply 5V of i/p.

b) Let $V_{BE} = -0.7V$

- $I_B = \frac{-3 + 0.7}{27k} = -85.2\ \mu A$
- $I_C = \beta I_B = 125 \times -85.2\ \mu A = -10.7\ mA$

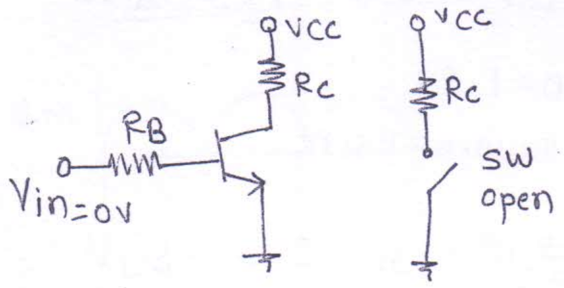
$$V_{CE} = -8V + (10.7\ mA \times 390\,\Omega)$$

- $\boxed{V_{CE} = -3.83\ V}$

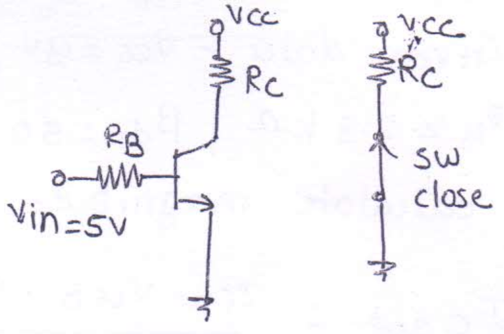
$$V_{CB} = V_{CE} - V_{BE} = -3.83 + 0.7$$

- $\boxed{V_{CB} = 3.13\ V}$

c) Transistor as a switch



cut off operation



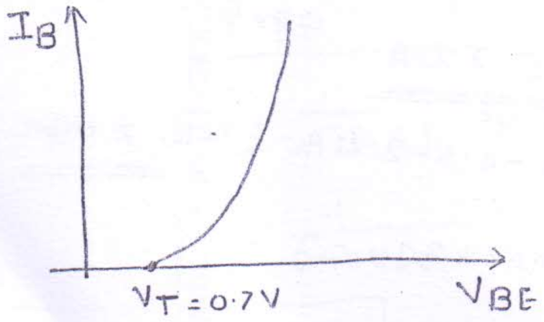
saturation operation

<u>Operation</u> :- Transistor act as switch in saturation and cut-off region. It act as ON switch in saturation region and OFF switch in cut off region.

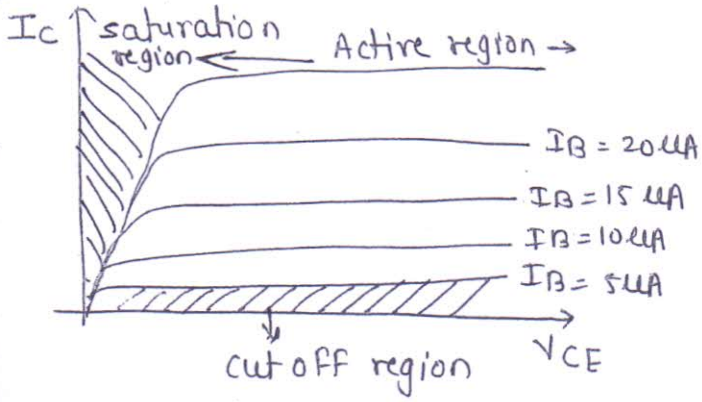
<u>OFF switch</u> :- when Vin = 0V is applied, emitter to base junction becomes rererse bias. so $I_B = 0$. so as base current is zero, as $I_C = \beta I_B$ so I_c is also zero. As collector current is zero means transistor act as off switch.

<u>ON switch</u> :- When Vin = 5V is applied the emitter to base junction is forward bias. so base current is flowing cause collector is also flowing through transistor. Thus transistor act as ON switch. As it is operated in saturation region.

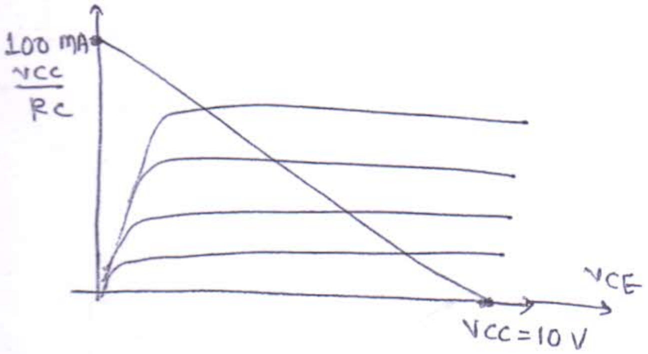
Q4. a) Input characteristic of Transistor in CE



output characteristics of CE

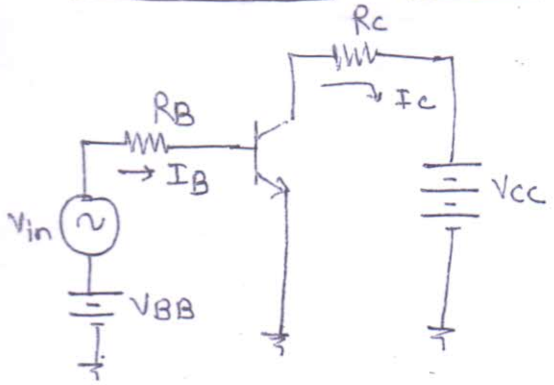


DC load line



$$I_C = \frac{V_{CC}}{R_C} = \frac{10}{100\,\Omega} = 100\,mA$$

b) CE amplifier circuit diagram:



* Expression for voltage gain (A_V)

$$I_e \simeq I_c = \frac{V_b}{r_e'}$$

The AC collector voltage V_c

$V_c = I_c R_c$ As $I_c \simeq I_e$

$\therefore V_c = I_e \cdot R_c$

V_b = Transistor ac i/p voltage

$V_b = V_{in} - I_b R_B$

$$\text{As } A_V = \frac{V_c}{V_b} = \frac{I_e R_c}{I_e r_e'}$$

$$\therefore \boxed{A_V = \frac{R_c}{r_e'}}$$

where r_e' = emitter terminal resistance.

c) Given data :- $V_{CC} = 5V$, $\beta = 150$, $R_B = 1\,M\Omega$ $R_C = 10\,k\Omega$

$V_{CE\,sat} = 0V$

$$I_{C\,sat} = \frac{V_{CC} - V_{CE}}{R_C} = \frac{5-0}{10k} = 0.5\,mA$$

$$\boxed{I_{C\,sat} = 0.5\,mA}$$

$$I_{B\,min} = \frac{I_{C\,sat}}{\beta} = \frac{0.5\,mA}{150} = 3.33\,\mu A$$

$$\boxed{I_{B\,min} = 3.33\,\mu A}$$

$$V_{in} = I_B R_B + V_{BE}$$

$$= (3.33\,\mu A \times 1\,M\Omega) + 0.7$$

$$\boxed{V_{in} = 4.03V}$$