(225)

CMR
INSTITUTE OF
TECHNOLOGY

USN	1	C	R							

CMR INSTITUTE OF TECHNOLOGY

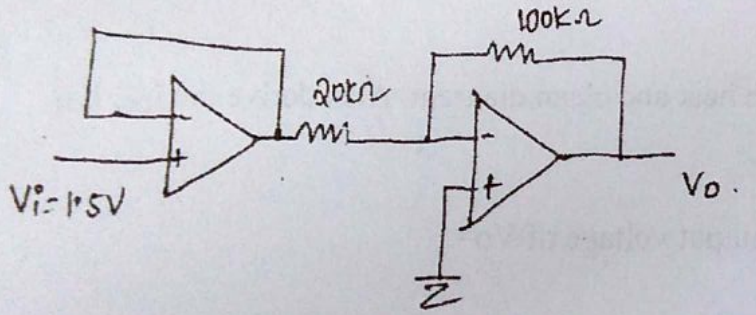
Internal Assesment Test - II

Sub :	Basic Electronics						Code:	18ELN14
Date:	05/12 / 2018	Duration:	90 mins	Max Marks:	50	Sem: I	SEC:	I,J,K,L,M,N,O

Answer Any **FIVE FULL** Questions

No.	Question	Marks	OBE CO	OBE RBT
1	For an op-amp (i) List the characteristics of an ideal op-amp and (ii) Draw the three input inverting summer circuit and derive an expression for its output voltage.	[10]	CO1	L3
2	Explain the operation of Full wave bridge rectifier with neat and clean diagram. Also derive the I_{DC}, I_{RMS} ,P_{AC} ,P_{DC} and Efficiency for this rectifier.	[10]	CO2	L2
3(a)	Design an adder circuit using an op-amp to obtain an output voltage of Vo= -[2V1+3V2+5V3] Given Rf = 10kΩ	[05]	CO1	L3
(b)	With a neat diagram, explain how an op-amp can be used as a differentiator.	[05]	CO1	L2
4(a)	Write a short note on the following: (i) Photo diode (ii) Light emitting diode	[05]	CO1	L1
(b)	A non-inverting amplifier circuit has an input resistance of 10KΩ and feedback resistance 60KΩ,with load resistance of 47KΩ.Draw the circuit. Calculate the output voltage, voltage gain, load current when the input voltage is 1.5V.	[05]	CO1	L3

6 (a)	Design a Zener Voltage Regulator to meet the following specification Output voltage=5V, Load current =10 mA, Zener Wattage=100 mW , input voltage=10V±2V, Iz min =5mA.	[05]	CO 2	L3
(b)	Explain Full wave rectifier with capacitor filter in detail with necessary waveforms	[05]	CO 2	L2
7 (a)	Find the output Vo of following op-amp circuit	[05]	CO 1	L3



(b)	What is Zener diode? With neat circuit diagram, explain load and Line regulation using Zener diode.	[05]	CO2	L2
8(a)	Draw and Explain the working of an inverting op-amp. Derive the expression for its voltage gain.	[05]	CO1	L3
(b)	The input to the basic differentiator circuit is a sinusoidal voltage of peak value of 10mV and frequency 1.5KHz. Find the output if, Rf=100KΩ and C1=1μF.	[05]	CO1	L3

I-sem (I, J, K, L, M, N, O)

Marking scheme & solution Basic Electronics

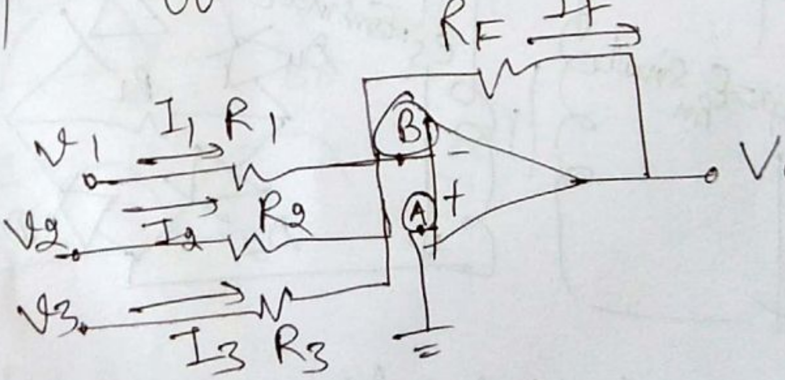
IAT 2

Date - 5/12/2018

Ans-1 (i) Opamp Ideal characteristics :- —— 5 Mark

1. CMRR (common Mode Rejection Ratio)
   Ideally CMRR = ∞
2. A_{OL} (open Loop Gain) → Ideally $A_{OL} = \infty$
3. Input Impedance (Ideally ∞)
4. Output Impedance (Ideally 0)
5. PSRR (Power supply Rejection Ratio) Ideally = 0
6. Bandwidth (Ideally infinite).
7. NO effect of Temperature.
8. Zero Input offset voltage.

(ii)



$V_A = 0$

$V_B = V_A = 0V$ (By Virtual Ground Concept).

Applying KCL at node B,

$$I_1 + I_2 + I_3 = I_F$$

$$\frac{V_1 - V_0}{R_1} + \frac{V_2 - V_0}{R_2} + \frac{V_3 - V_0}{R_3} = \frac{0 - V_0}{R_F}$$

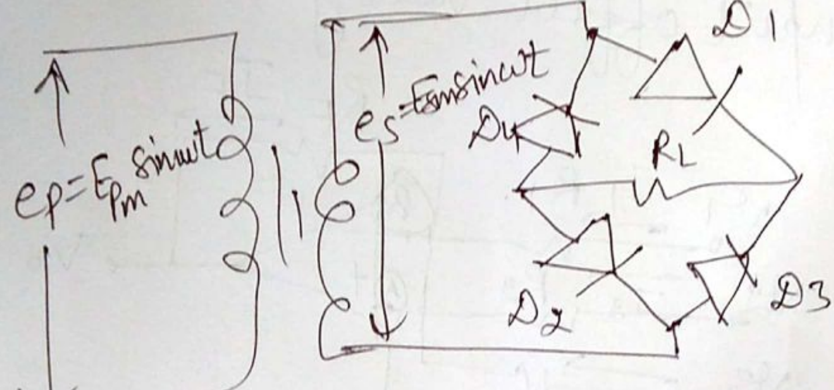
$$\Rightarrow V_0 = -R_F\left(\frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3}\right)$$

$$V_0 = \frac{-R_F}{R_1}V_1 - \frac{R_F}{R_2}V_2 - \frac{R_F}{R_3}V_3$$

when $R_F = R_1 = R_2 = R_3 = R$

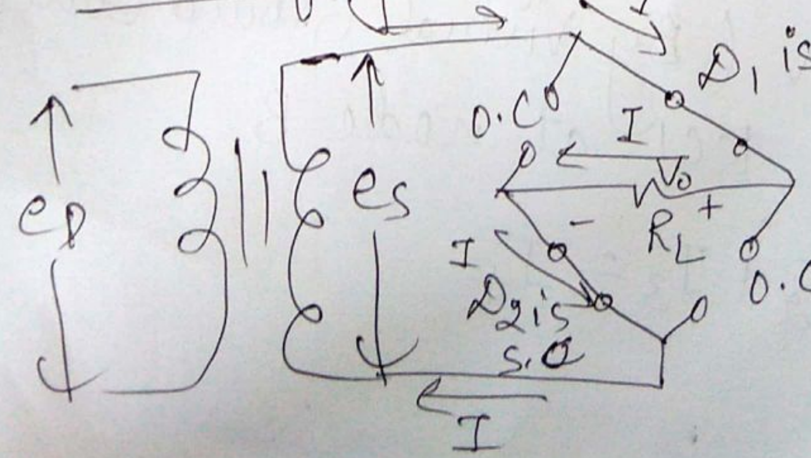
$$\Rightarrow \boxed{V_0 = -(V_1 + V_2 + V_3)} \longrightarrow$$ Adder/ Summer output Voltage.

Ans 2 — (1 Mark) diagram



All D_1, D_2, D_3, D_4 are ideal diodes.

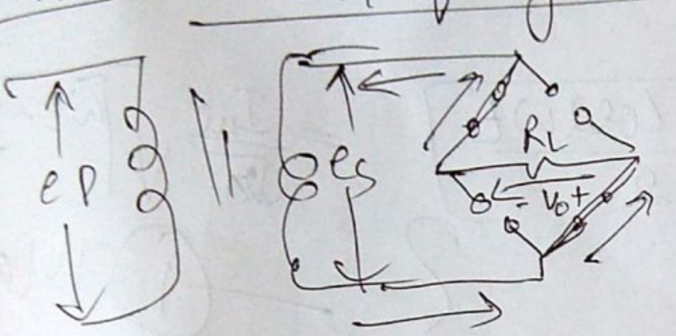
Case-I +ve half cycle



(1) Mark

D_1 and D_2 are forward biased so short circuited. D_3 and D_4 are replaced with open circuit. so, V_o is obtained.

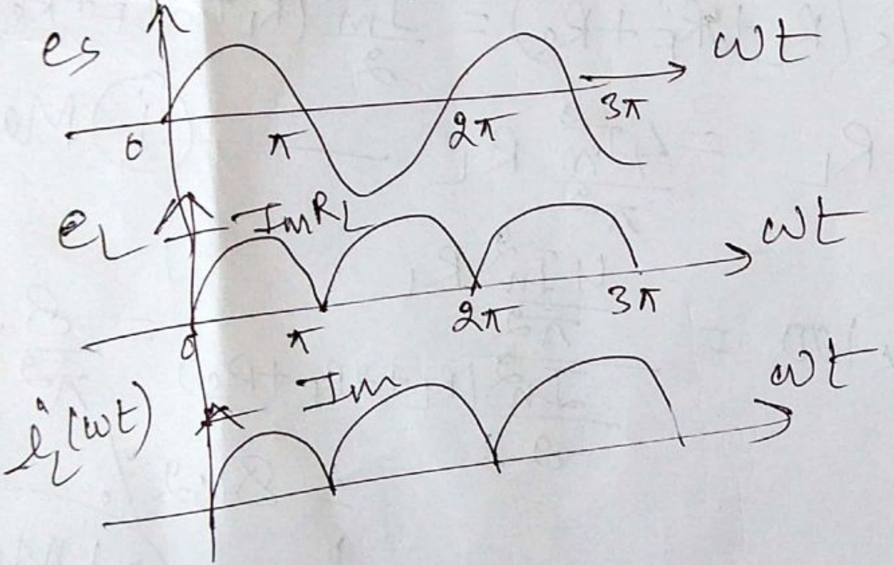
Case II — -ve Half cycle.



$D_1, D_2 \rightarrow$ open circuited
$D_3, D_4 \rightarrow$ short circuited

(1 Mark)

so V_o is obtained across R_L.



(1) Mark Waveform.

Derivations :-

(1) $I_{dc} = \frac{1}{T}\int_0^T i_L(\omega t)\, d\omega t$

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

$= \frac{I_m}{\pi}\left(-\cos\omega t\right)_0^\pi = \frac{I_m}{\pi}\left[-\cos\pi + \cos 0\right] = \frac{2I_m}{\pi}$

(1 Mark)

Scanned by CamScanner

CMR

(2) $I_{rms} = \sqrt{\frac{1}{T}\int_0^T i_L^2(\omega t)\, d(\omega t)}$

$= \sqrt{\frac{1}{\pi}\int_0^\pi I_m^2 \sin^2\omega t\, d(\omega t)}$

$= \frac{I_m}{\sqrt{\pi}}\sqrt{\int_0^\pi \left[\frac{1-\cos 2\omega t}{2}\right]} = \frac{I_m}{\sqrt{2\pi}}\sqrt{\left[\omega t - \frac{\sin 2\omega t}{2}\right]_0^\pi}$

$I_{rms} = \frac{I_m}{\sqrt{2}}$ } — (1) Mark

(3) $P_{ac} = I_{rms}^2(R_L + 2R_F + R_S) = \frac{I_m^2}{2}(R_L + 2R_F + R_S)$ — (1) Mark

$P_{dc} = I_{dc}^2 R_L = \frac{4 I_m^2}{\pi^2} R_L$ — (1) Mark

$\eta\% = \frac{P_{dc}}{P_{ac}} \times 100 = \frac{\frac{4 I_m^2}{\pi^2} R_L}{\frac{I_m^2}{2}(R_L + 2R_F + R_S)} = \frac{8}{\pi^2} \times 100$

$= 81.2\%$ → 1 Mark

Ans-3 (a)

$V_o = -[2v_1 + 3v_2 + 5v_3]$ if $R_F = 10K\Omega$

$V_o = -\frac{R_F}{R_1}v_1 - \frac{R_F}{R_2}v_2 - \frac{R_F}{R_3}v_3$ } — (1) Mark

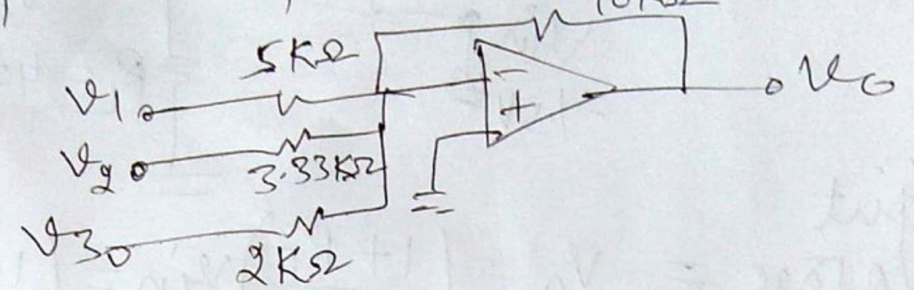
$\Rightarrow \frac{R_F}{R_1} = 2, \quad \frac{R_F}{R_2} = 3, \quad \frac{R_F}{R_3} = 5$ } (1) Mark

Scanned by CamScanner

Calculations - 2 Mark

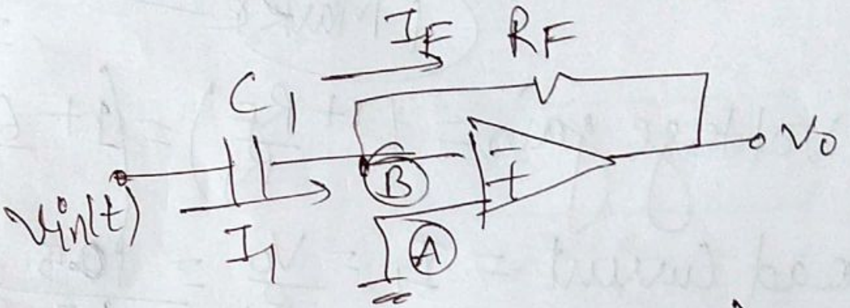
$R_F = 10K\Omega$

$\Rightarrow R_1 = 5K\Omega$, $R_2 = \frac{10}{3} = 3.33K\Omega$, $R_3 = 2K\Omega$



1 Mark

Ans 3 (b)



2 Mark

$V_A = 0V$

$V_B = V_A = 0V$ (Virtual Ground)

KCL at node B,

$I_1 = I_F$

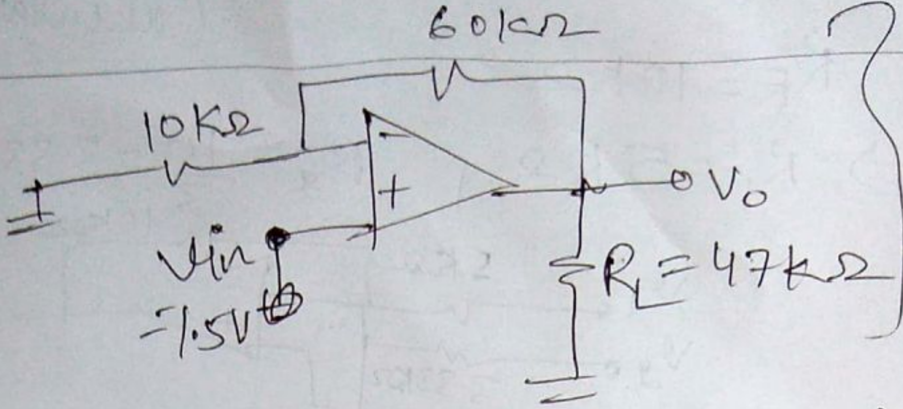
$$C_1 \frac{d\,v_{in}(t)}{dt} = \frac{0 - v_o}{R_F}$$

$$\Rightarrow \boxed{v_o = -C_1 R_F \frac{d\,v_{in}(t)}{dt}}$$

5 Mark

So when vin(t) is applied v_o is differentiation of input signal.

Ans-4 (b)



(1) Mark

(1) output Voltage = $V_0 = \left(1+\frac{R_F}{R_1}\right)V_{in} = \left(1+\frac{60}{10}\right)1.5$ (1 Mark)

$= 7 \times 1.5 = 10.5V$

(2) Voltage gain $= \left(1+\frac{R_F}{R_1}\right) = \left(1+\frac{60}{10}\right) = 7$ (1) Mark

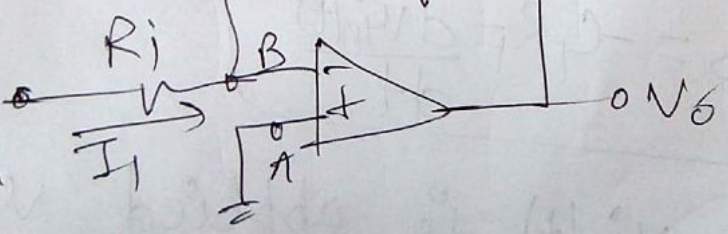
(3) Load Current $= I_L = \frac{V_0}{R_L} = \frac{10.5}{47\times10^3} = 0.223mA$

(2 Mark)

Ans-4 (a) Note on LED and Photodiode

(2.5 Mark) (2.5 Mark)

Ans-8 (a)



(1) Mark

$V_A = 0V$

$V_B = V_A = 0V$ (Virtual Grount)

KCL at node B

$I_1 = I_F$

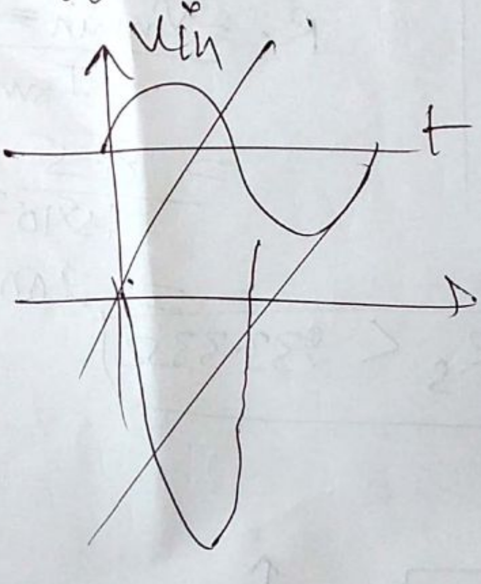
$$\frac{v_{in} - 0}{R_1} = \frac{0 - v_o}{R_F}$$

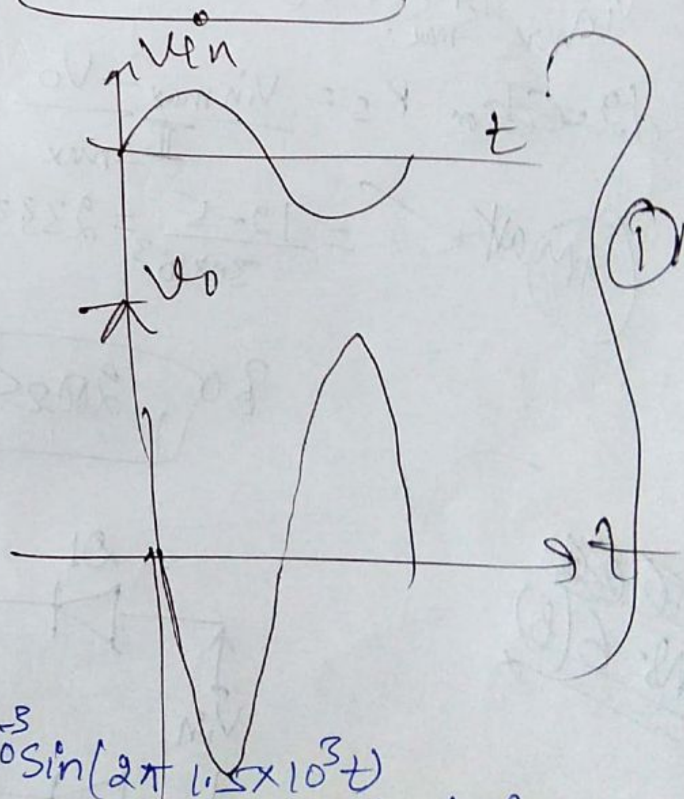
$$\Rightarrow V_o = -\frac{R_F}{R_1} v_{in}$$

3 Mark

$$\text{Gain} = \frac{R_F}{R_1}$$

When $R_F = R_1$ $\quad v_o = -v_{in}$





1 Mark

Ans. 8(b)

$i/p \rightarrow V_{in}(t) = 10 \times 10^{-3} \sin(2\pi\, 1.5 \times 10^3 t)$

$$v_o = -R_F C_1 \frac{dv_{in}(t)}{dt} = -100 \times 10^3 \times 1 \times 10^{-6} \frac{d}{dt}(10^{-2} \sin(3\pi \times 10^3 t))$$

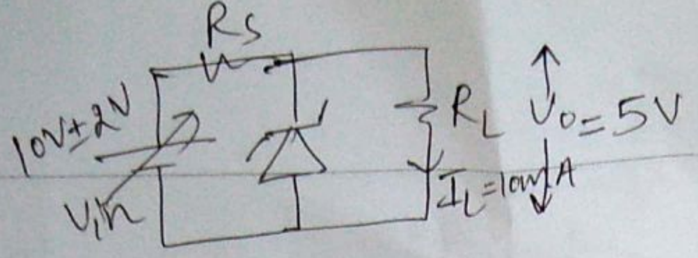
$$= -10^{-3} \cos(3\pi \times 10^3 t)\, 3\pi \times 10^3$$

$$v_o = -3\pi \cos(3\pi \times 10^3 t)$$

$$v_o = -3\pi \cos(3\pi \times 10^3 t)$$ Ans

CMR

Ans-6 (a)



$I_L = 10mA$

$I_{zmin} = 5mA$

$I_{zmax} = ?$

$P_Z = 100mW = I_{zmax} V_Z$

$I_{zmax} = \frac{100\times10^{-3}}{5} = 20mA$ — (1) Mark

$R_L = \frac{V_o}{I_L} = \frac{5}{10\times10^{-3}} = 500\Omega$ — (1) Mark

$I_{Smin} = I_{zmin} + I_L$

$I_{Smin} = 5+10 = 15mA$

$V_{in_{max}} = I_{S_{max}} R_S + V_o$

$R_S = \frac{V_{inmax} - V_o}{I_{Smax}}$

$= \frac{12-5}{30\times10^{-3}} = 233.3\Omega$ — (1) Mark

$I_{Smax} = I_{zmax} + I_L$

$I_{Smax} = 20mA + 10 = 30mA$ — (1) Mark

$V_{inmin} = I_{Smin} R_S + V_o$

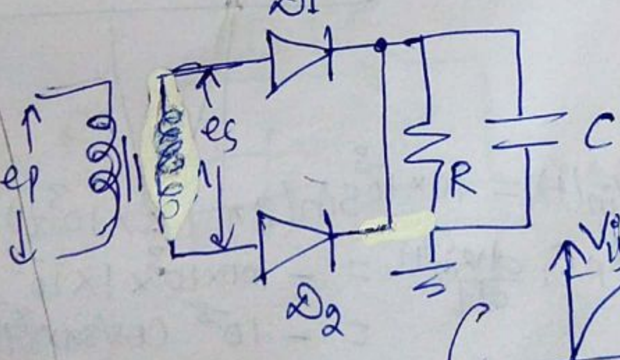
$R_S = \frac{V_{inmin} - V_o}{I_{Smin}}$

$= \frac{8-5}{15\times10^{-3}} = \frac{3}{15\times10^{-3}}$

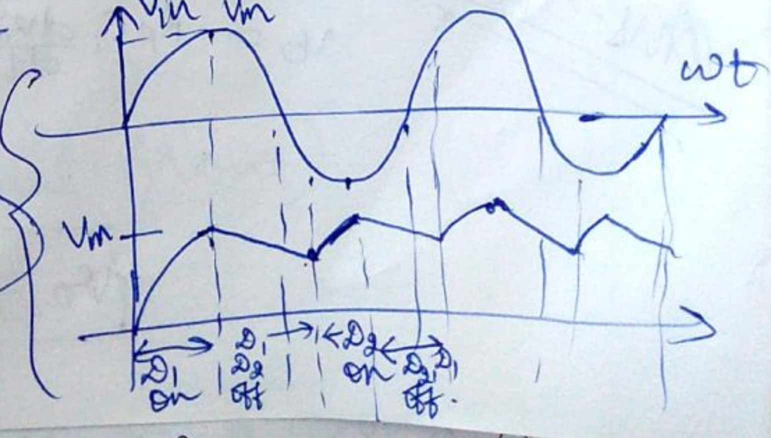
$= 200\Omega$ — 1 Mark

So $200\Omega < R_S < 233.33\Omega$

Ans-6 (B)



(1) Mark



2 Mark

explanation — 2 Mark