Chapter-3 Date: . .

Q1. Total absarphon in an empty hall of volume 1200 m^3 is 120 OWU. calculate the reverberation time when 100 person sit in the hall. (the coefficient of absorphon for each person is 4.7)

⇒ Total absorphon in the empty hall

$\Sigma a_i s_i$ = 120 OWU

volume of the hall (V) = 1200 m^3

coefficient of absorphon for each person = 4.7 OWU

coeff. of absorp. for 100 person = 100 × 4.7

= 470 OWU

∴ total absorhon with 100 person

= 120 OWU + 470 OWU

= 590 OWU

then, reverberation time

$$T = \frac{0.167V}{\Sigma a.s}$$

$$T = \frac{0.167}{590}$$

$$\Rightarrow T = 0.3396 \text{ sec}$$

Q2. What should be the total absorption in a hall of volume 10000 m^3 if it is required to have a reverberation time of 1.4 sec.

⇒ volume of the hall, $V = 10000\ m^3$

reverberation time $T = 1.4$ sec

Total absorption in hall $\varepsilon as = ?$

we have, $T = \frac{0.167V}{\varepsilon as}$

$\Rightarrow \varepsilon as = \frac{0.167V}{T}$

$\Rightarrow \varepsilon as = \frac{0.167 \times 10000}{1.4}$

$\Rightarrow \varepsilon as = 1192.6$ OWU

Q3. A class room has dimensions $20 \times 15 \times 5\ m^3$. The reverberation time is 3.5 sec. calculate the total absorption of its surfaces and the average absorption coefficient.

⇒ we have reverberation time

$$T = \frac{0.161V}{Ea}$$

$$\Rightarrow Ea = \frac{0.161V}{T}$$

$$\Rightarrow Ea = \frac{0.161 \times (20 \times 15 \times 15)}{3.5}$$

$$\Rightarrow Ea = 69 \checkmark 71.57$$

The surface area of the walls, ceiling and floor of the room

$$= 2(20 \times 15 + 15 \times 15 + 15 \times 20)\ m^2$$

$$\therefore \bar{a} = \frac{a_1 s_1 + a_2 s_2 + \cdots}{\text{total surface } (s_1 + s_2 + \cdots)}$$

$$\Rightarrow \bar{a} = \frac{Ea}{S}$$

$$\Rightarrow \bar{a} = \frac{69}{2(20 \times 15 + 15 \times 15 + 15 \times 20)}$$

$$\Rightarrow \bar{a} = 0.07$$

Q4. For an empty assembly hall of size $20 \times 15 \times 10\ m^3$ the reverberation time is 3.5 sec. calculate the average absorption coefficient of the hall. What area of the wall should be covered by the curtain so as to reduced the reverberation time to 2.5 sec. Given the absorption coefficient of curtain cloth is 0.5

$\Rightarrow$ Total absorption of the empty hall

$$\Sigma as = \frac{0.161V}{T_1}$$

$$\Rightarrow \Sigma as = \frac{0.161 (20 \times 15 \times 10)}{3.5}$$

$$\Rightarrow \Sigma as = 138.$$

Average absorption coeff

$$\bar{a} = \frac{\Sigma as}{S}$$

$$\Rightarrow \bar{a} = \frac{138}{2(20 \times 15 + 20 \times 10 + 10 \times 15)}$$

$$\Rightarrow \bar{a} = 0.106$$

When the walls are covered with curtain cloth of surface area S_1, the reverberation time T_2 becomes

$$T_2 = \frac{0.161V}{\varepsilon a s + a_m S_1}$$

where a_m = absorption coefficient of curtain cloth = 0.5

and S_1 = surface area of curtain cloth.

and $\therefore T_2 = 2.5$

$$\therefore \quad 2.5 = \frac{0.161V}{138 + 0.5 \times S_1}$$

$$\Rightarrow \quad 2.5 = \frac{0.161 \times 20 \times 15 \times 10}{138 + 0.5 \times S_1}$$

$$\Rightarrow \quad 138 + 0.5 S_1 = \frac{483}{2.5}$$

$$\Rightarrow \quad 138 + 0.5 S_1 = 193.2$$

$$\Rightarrow \quad S_1 = \frac{193.2 - 138}{0.5} = 110 m^2$$

Q5. The time of reverberation of an empty hall without and with 500 audience is 1.5 and 1.4 sec resp. Find the reverberation time with 800 audiences in that hall.

⇒ Let T_1 be the reverberation time in empty hall.

and T_2 and T_3 be the reverberation time with 500 and 800.

Then,

$$T_1 = \frac{0.161V}{\varepsilon a s} \quad \text{---} (1)$$

$$T_2 = \frac{0.161V}{\varepsilon a s + 500 \times a_1} \quad \text{---} (2)$$

$$T_3 = \frac{0.161V}{\varepsilon a s + 800 \times a_1} \quad \text{---} (3)$$

now, we have $T_1 = 1.5$

$T_2 = 1.4$

$T_3 = ?$

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Solving eq^n ①, ② and ③
we get: $T_3 = 1.3$ sec

Q6. Given that the velocity of ultra sound in sea water is equal to 1490 m/s. Find the depth of submerged submarine if an ultrasonic pulse reflected from the surface is received 0.33 sec after sending out the ultrasonic waves.

⇒ velocity of ultrasonic wave in sea water ⇒ $v = 1490$ m/s

Time elapsed bet^n the emission ~~of ultrasound~~ and reception of ultrasound

$t = 0.33$ sec

total distance travelled $= vt$

$= 1490 \times 0.33$

$= 480$ m

The distance travelled by ultrasound in going from source to the submarine and back after reflection is equal to twice the depth of submarine

∴ depth of the submarine

$$= \frac{480}{2}$$

$$= 240 \text{ m}$$