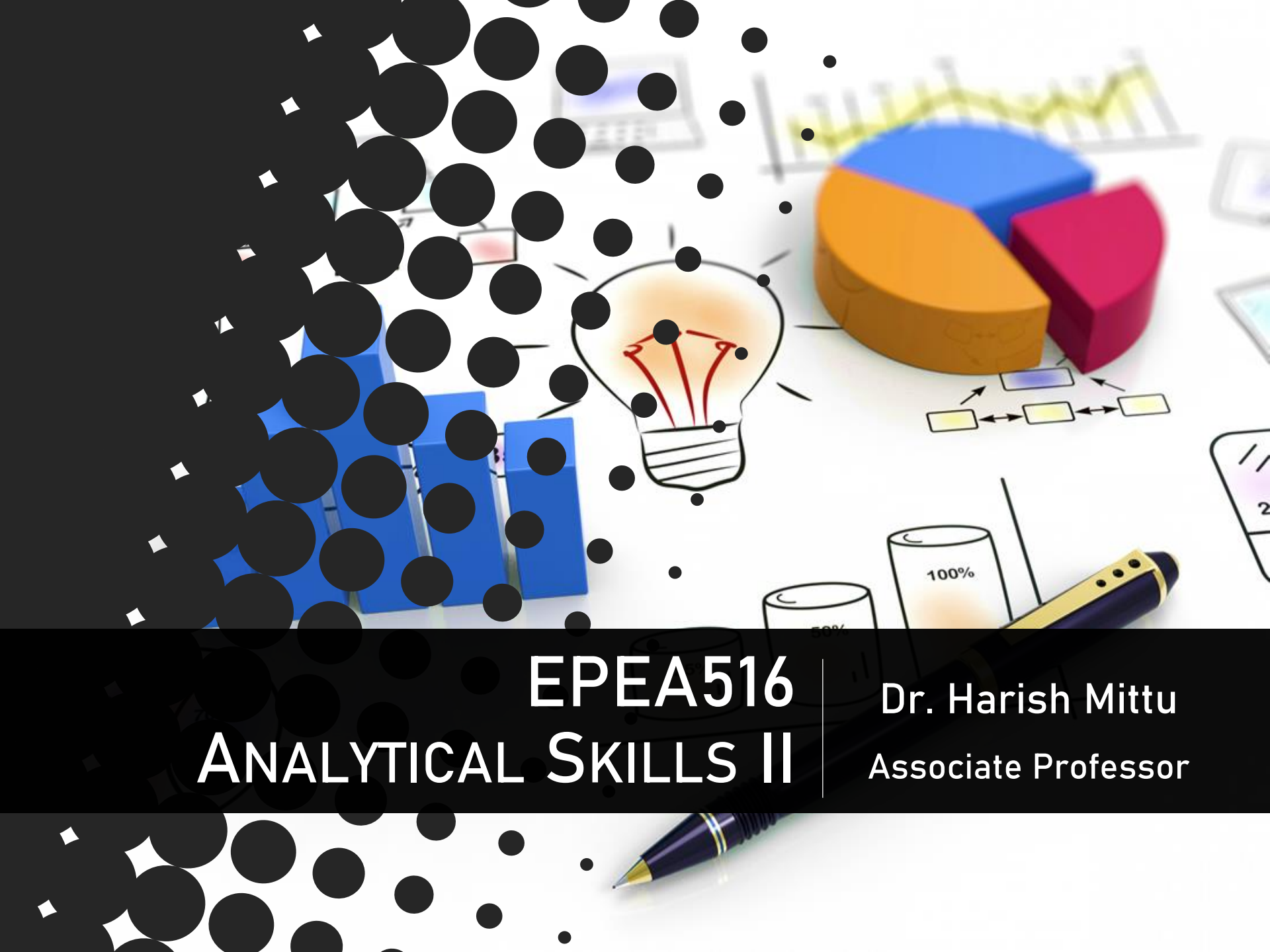

EPEA516
Analytical Skills II

Dr. Harish Mittu
Associate Professor

Learning Outcomes

After this lecture, you will be able to

- solve various problems relating to speed, distance, time, and average speed.

Problem 1

- Calculate the speed of a bus which covers a distance of 120 Km in 5 hours.
- D = 120 Km
- T = 5 hours
- S = ?

$$S = \frac{D}{T}$$

$$S = \frac{\overset{24}{\cancel{120}}}{\cancel{5}}$$

$$S = 24 \text{ Km/h}$$

Problem 2

- In how much time a bike, running at the rate of 36 Km/h, crosses a 150 m long bridge?
- D = 150 m
- S = 36 Km/h = $\cancel{36}^{2} \times \frac{5}{\cancel{18}}$ m/s = 10 m/s
- T = ?

$$T = \frac{D}{S}$$

$$T = \frac{\cancel{150}^{15}}{\cancel{10}}$$

T = 15 seconds

Problem 3

- A car running at a speed of 72 Km/h passes a bridge in 15 seconds. Find the length of the bridge.
- S = 72 Km/h = $\cancel{72}^{4} \times \cancel{\frac{5}{18}}$ m/s = 20 m/s
- T = 15 seconds
- D = ?

$$D = S \times T$$

$$D = 20 \times 15$$

$$D = 300 \text{ m} = 0.3 \text{ Km}$$

Problem 4

- A truck runs to a city at the speed of 20 Km/h, and back at the speed of 25 Km/h. What is the average speed of the truck for the whole journey?

- Average Speed $= \frac{2ab}{(a + b)}$ Km/h
- a = 20 Km/h and b = 25 Km/h
- Average Speed $= \frac{2 \times 20 \times 25}{(20 + 25)}$ Km/h
- Average Speed $= \frac{2 \times 20 \times \cancel{25}^{5}}{\cancel{45}^{9}}$

$= \frac{200}{9}$ Km/h or 22.22 Km/h

Problem 5

- A bus covers a distance of 30 Km at 20 Km/h, and 50 Km at 25 Km/h. What is the average speed of the bus for the whole journey?
- Average Speed $= \frac{ab(x + y)}{(ay + bx)}$ Km/h
- x = 30 Km, y = 50 Km, a = 20 Km/h and b = 25 Km/h
- Average Speed $= \frac{20 \times 25\ (30 + 50)}{(20 \times 50 + 25 \times 30)}$ Km/h
- Average Speed $= \frac{20 \times \cancel{25} \times \cancel{80}^{8}}{\cancel{1750}_{\cancel{70}_{7}}}$

$= \frac{160}{7}$ Km/h or 22.86 Km/h

Problem 6

- A bus goes to school at the speed of 15 Km/h and returns with a speed of 10 Km/h. If it takes 2 hours in all, find out the distance in Km.
- Distance = x

$$= \text{Total time taken} \times \frac{\text{Product of Two Speeds}}{\text{Sum of Two Speeds}}$$

$$x = \frac{T(ab)}{(a + b)} \text{ hours}$$

- a = 15 Km/h, b = 10 Km/h, and T = 2 hours

Problem 6

- Distance, $x = \frac{T(ab)}{(a + b)}$ hours
- a = 15 Km/h, b = 10 Km/h, and T = 2 hours

$$x = \frac{2 \times (15 \times 10)}{(15 + 10)}$$

$$x = \frac{2 \times \overset{6}{\cancel{(150)}}}{\cancel{(25)}}$$

$$x = 12 \text{ Km}$$

Problem 7

- Ananditta starts her journey from city A to B and simultaneously Dhruvika starts from city B to A. After crossing each other, they finish their remaining journey in 16 hours and 25 hours respectively. What is Dhruvika's speed if Ananditta's speed is 50 Km/h?

- $\frac{\text{a (i.e., Speed of Ananditta)}}{\text{b(i.e., Speed of Dhruvika)}} = \frac{\sqrt{T_2}}{\sqrt{T_1}}$

- a = 50 Km/h, T_1 = 16 hours, T_2 = 25 hours, and b = ?

Problem 7

- $\frac{\text{a (i.e., Speed of Ananditta)}}{\text{b(i.e., Speed of Dhruvika)}} = \frac{\sqrt{T_2}}{\sqrt{T_1}}$
- a = 50 Km/h, T_1 = 16 hours, T_2 = 25 hours, and b = ?

$$\frac{50}{b} = \frac{\sqrt{25}}{\sqrt{16}}$$

$$^{5}\ \frac{\cancel{50}}{b} = \frac{\cancel{5}}{4}$$

$$b = 5 \times 4 = 20\text{Km/h}$$

Speed of Dhruvika = 20Km/h

Problem 8

- A car, during its journey, travels 20 minutes at a speed of 15 m/s, another 25 minutes at a speed of 30 m/s and 30 minutes at a speed of 15 m/s. Find out average speed of the car.
- Average Speed = $\frac{a_1t_1 + a_2t_2 + a_3t_3 + \ldots + a_nt_n}{t_1 + t_2 + t_3 + \ldots + t_n}$
- a_1 = 15 m/s, a_2 = 30 m/s, a_3 = 15m/s, t_1 = 20 min. = 1200 s,
- t_2 = 25 min. = 1500 s, and t_3 = 30 min. = 1800s
- Average Speed = $\frac{a_1t_1 + a_2t_2 + a_3t_3}{t_1 + t_2 + t_3}$

Problem 8

- Average Speed = $\frac{15 \times 1200 + 30 \times 1500 + 15 \times 1800}{1200 + 1500 + 1800}$
- Average Speed = $\frac{18000 + 45000 + 27000}{3500}$
- Average Speed = $\frac{90000}{3500}$ (25.71)
- Average Speed = 25.71 m/s

Problem 9

- A car, during its journey, covers 30 Km in 2 hours, another 120 Km in 4 hours and 45 Km in 3 hours. Find out average speed of the car.
- Average Speed = $\frac{x_1 + x_2 + x_3 + \ldots + x_n}{t_1 + t_2 + t_3 + \ldots + t_n}$
- x_1 = 30 Km, x_2 = 120 Km, x_3 = 45 Km
- t_1 = 2 hours, t_2 = 4 hours, and t_3 = 3 hours
- Average Speed = $\frac{x_1 + x_2 + x_3}{t_1 + t_2 + t_3}$

Problem 9

- Average Speed = $\frac{x_1 + x_2 + x_3}{t_1 + t_2 + t_3}$
- Average Speed = $\frac{30 + 120 + 45}{2 + 4 + 3}$
- Average Speed = $\frac{195}{9}$ 21.67
- Average Speed = 21.67 Km/h

Problem 10

- By walking at $\frac{5}{6}$ of his usual speed, Rohit is 9 minutes late to his office. Find out his usual time to cover the distance.
- Change in Time = $(\frac{n}{m} - 1)$ × Original Time
- Original Time = $\frac{\text{Change in Time}}{(\frac{n}{m} - 1)}$
- $\frac{m}{n} = \frac{5}{6}$ or $\frac{n}{m} = \frac{6}{5}$, Change in Time = 9 min., Original Time = ?
- Original Time = $\frac{9}{(\frac{6}{5} - 1)}$

Problem 10

- Original Time = $\dfrac{9}{(\frac{6}{5} - 1)}$
- Original Time = $\dfrac{9}{(\frac{6 - 5}{5})}$
- Original Time = $\dfrac{9 \times 5}{1}$
- Original Time = 45 minutes

Problem 11

- Two motorcyclists do the same journey by travelling 18 Km and 20 Km/h. Find out the length of the journey when one takes 30 minutes longer than the other.
- $\frac{\text{Product of Speed}}{x} = \frac{\text{Difference of Speed}}{\text{Difference of Time}}$
- Difference of Time = 30 minutes = $\frac{30}{60}$ h
- Difference of Speed = (20 -18) = 2 Km/h
- Product of Speed = (20 x 18) = 360 $(\text{Km/h})^2$
- $\frac{360}{x} = \frac{2 \times 60}{30}$

Problem 11

- $\frac{360}{x} = \frac{2 \times 60}{30}$
- $\frac{360}{x} = \frac{2 \times 60}{30}$
- $x = \frac{\overset{6}{\cancel{360}} \times \overset{15}{\cancel{30}}}{\cancel{2} \times \cancel{60}}$
- x = 90 Km

Problem 12

- A bus runs at a speed of 25 Km/h from point X to Y and returns from point Y to X with a speed of 40 Km/h. Find out the ratio of the time taken by the bus from point X to Y to that from point Y to X?

- Ratio of Speeds $= \cancel{25}^{5} : \cancel{40}^{8}$

$= 5 : 8$

- Ratio of Times $= \frac{1}{5} : \frac{1}{8}$

$= 8 : 5$

Conclusion

- $\text{Speed} = \frac{\text{Distance Travelled}}{\text{Time Taken}}$
- Speed x Time = Distance
- $\text{Time} = \frac{\text{Distance}}{\text{Speed}}$
- $1\ \text{Km/h} = \frac{5}{18}\ \text{m/s}$ & $1\ \text{m/s} = \frac{18}{5}\ \text{Km/h}$
- $\text{Average Speed} = \frac{\text{Total Distance Covered}}{\text{Total Time Taken}}$

Conclusion

- If A covers a distance x Km at a Km/h and, then y Km at b Km/h, then the average speed during the whole journey is $\frac{ab(x + y)}{(ay + bx)}$ Km/h

- If a person goes from point 'A' to point 'B' at 'a' Km/h and comes back from point 'B' to point 'A' at 'b' Km/h, then the average speed during the whole journey is given by $\frac{2ab}{(a + b)}$ Km/h

Conclusion

- A person goes certain distance point ‘A’ to point ‘B’ at a speed of x Km/h and returns back point ‘B’ to point ‘A’ at a speed of y Km/h. If s/he takes T hours in all, then the distance between points ‘A’ and ‘B’ is

$$T\left(\frac{xy}{x+y}\right) \text{ hours}$$

or

$$\text{Total Time Taken} \times \frac{\text{Product of Two Speeds}}{\text{Sum of Two Speeds}}$$

Conclusion

- If two persons, A and B, start at the same time from two points P and Q towards each other, and after crossing they take T_1 and T_2 hours in reaching Q and P respectively, then

$$\frac{\text{a (i.e., Speed of A)}}{\text{b(i.e., Speed of B)}} = \frac{\sqrt{T_2}}{\sqrt{T_1}}$$

- If the new speed is $\frac{m}{n}$ of the original speed, then the change in time taken to cover the same distance is given by

$$\left(\frac{n}{m} - 1\right) \times \text{Original Time}$$

Conclusion

- If a body travels $x_1, x_2, x_3, \dots, x_n$ metres with different speeds $a_1, a_2, a_3, \dots, a_n$ m/s in time $t_1, t_2, t_3, \dots, t_n$ seconds respectively, then the average speed of the body throughout the journey is given by

$$\frac{x_1 + x_2 + x_3 + \dots + x_n}{t_1 + t_2 + t_3 + \dots + t_n} \text{ or } \frac{a_1t_1 + a_2t_2 + a_3t_3 + \dots + a_nt_n}{t_1 + t_2 + t_3 + \dots + t_n}$$

- A body covers a distance 'x' in time 't_1' with speed 'a', but when it travels with speed 'b' covers the same distance in time 't_2'.

$$\frac{\text{Product of speed}}{\text{Distance}} = \frac{a}{t_2} = \frac{b}{t_1} = \frac{\text{Difference of Speed}}{\text{Difference of Time}}$$

Summary

- Problems
  - Speed
  - Distance
  - Time
  - Average Speed

That’s all for now…