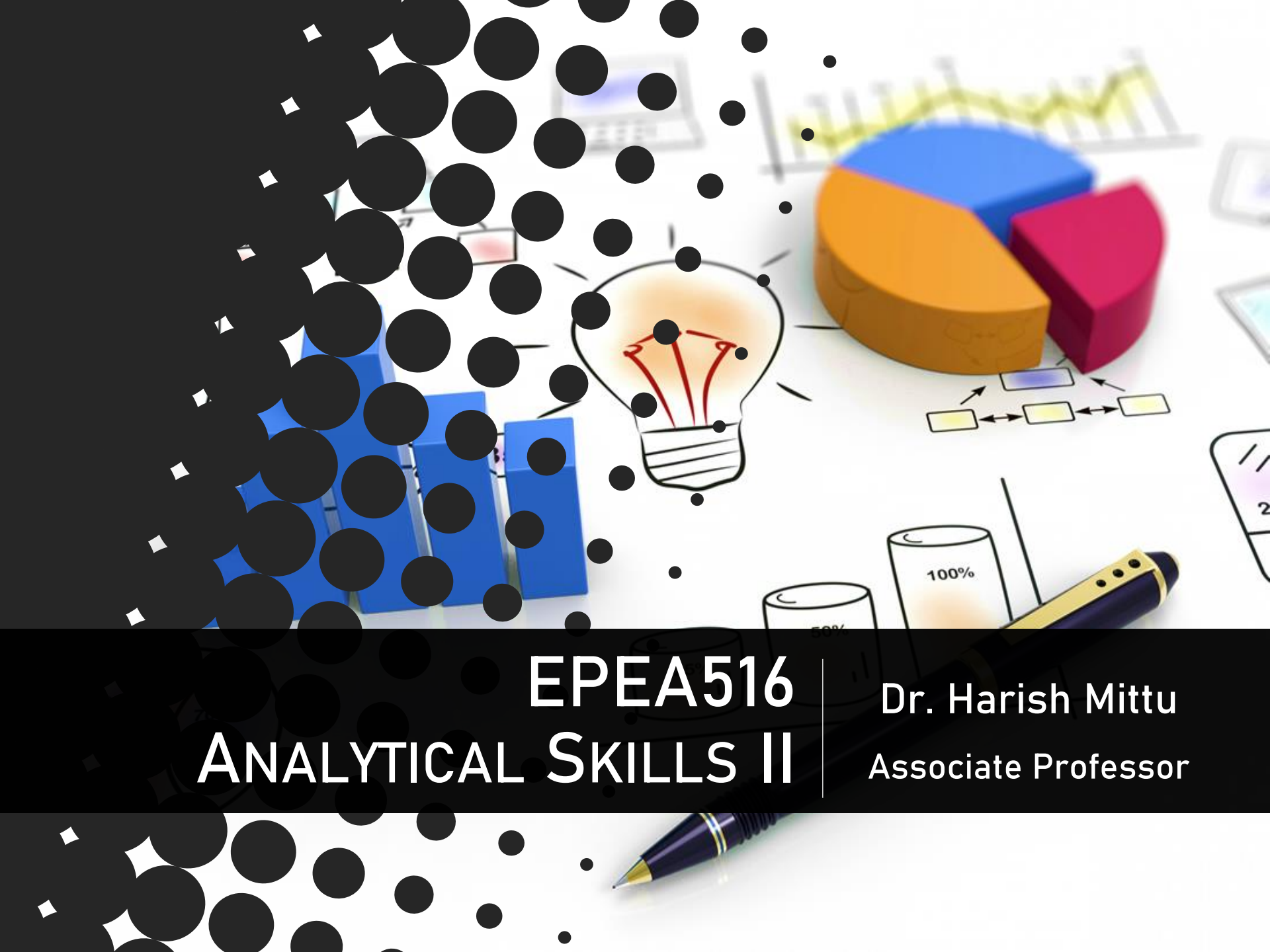

EPEA516
Analytical Skills II

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Learning Outcomes

After this lecture, you will be able to

- solve various problems relating to boats and streams.

Problem 1

- The speed of a boat in still water is 30 Km/h. If the speed of the stream be 5 Km/h, then find out downstream and upstream speeds of boat.
- Downstream Speed of Boat, x = (a + b) Km/h
- Upstream Speed of Boat, y = (a - b) Km/h
- Speed of Boat, a = 30 Km/h & Speed of Stream, b = 5 Km/h
- Downstream Speed of Boat, x = (30 + 5) Km/h = 35 Km/h
- Upstream Speed of Boat, y = (30 - 5) Km/h = 25 Km/h

Problem 2

- A boat is rowed down a river 60 Km in 12 h and up a river 32 Km in 8 h. Compute speed of the boat and river.

- Speed of Boat = $\left(\frac{x + y}{2}\right)$ Km/h

- Speed of River = $\left(\frac{x - y}{2}\right)$ Km/h

- Downstream Speed of Boat, $x = \frac{60}{12}$ Km/h $= 5$ Km/h

- Upstream Speed of Boat, $y = \frac{32}{8}$ Km/h $= 4$ Km/h

Problem 2

- Downstream Speed of Boat, x = 5 Km/h
- Upstream Speed of Boat, y = 4 Km/h
- Speed of Boat $= \left(\frac{x + y}{2}\right)$ Km/h

$= \left(\frac{5 + 4}{2}\right)$ Km/h $= \frac{9}{2}$ Km/h $= 4.5$ Km/h

- Speed of River $= \left(\frac{x - y}{2}\right)$ Km/h

$= \left(\frac{5 - 4}{2}\right)$ Km/h $= \frac{1}{2}$ Km/h $= 0.5$ Km/h

Problem 3

- A man rows at a speed of 12 Km/h in still water to a certain distance upstream and back to the starting point in a river which flows at 6 Km/h. Calculate the average speed of man for whole journey.
- Average Speed = $\frac{(a + b)(a - b)}{a}$ Km/h
- a = 12 Km/h and b = 6 Km/h
- Average Speed of Man for whole Journey

$$= \frac{(12 + 6)\ (12 - 6)}{12} \text{ Km/h} = \frac{\overset{9}{\cancel{(18)}}\ \cancel{(6)}}{\cancel{12}_{2}} \text{ Km/h}$$

$$= 9 \text{ Km/h}$$

Problem 4

- A man can row 12 Km/h in still water. If the river is running at 4 Km/h and it takes 10 hours more in upstream than to go downstream for the same distance. Calculate the distance.

- Distance $= \frac{(a^2 - b^2)(T)}{2b}$ Km

- a = 12 Km/h

- b = 4 Km/h

- T = 10 h

Problem 4

- a = 12 Km/h, b = 4 Km/h, T = 10 h
- Distance = $\frac{(a^2 - b^2)(T)}{2b}$ Km
- Distance = $\frac{((12)^2 - (4)^2)(10)}{2(4)}$ Km
- Distance = $\frac{(144 - 16)(10)}{8}$ Km
- Distance = $\frac{(128)(10)}{8}$ Km
- Distance = 160 Km

Problem 5

- A boat covers a certain distance downstream in 15 hours and covers same distance upstream in 20 hours. If the speed of the stream be 8 Km/h, find out the speed of the boat in still water.

- Speed of Boat in still water, $a = \frac{(b)(t_2 + t_1)}{(t_2 - t_1)}$
- a = ?
- b = 8 Km/h
- t_1 = 15 h
- t_2 = 20 h

Problem 5

- a = ?, b = 8 Km/h, t_1 = 15 h, and t_2 = 20 h

- Speed of Boat in still water, $a = \frac{(b)(t_2 + t_1)}{(t_2 - t_1)}$

$$= \frac{(8)(20 + 15)}{(20 - 15)}$$

$$= \frac{(8)(\cancel{35}^{7})}{\cancel{(5)}}$$

$$= 56 \text{ Km/h}$$

Problem 6

- A man can row a boat in still water at 20 Km/h. In a stream flowing at 8 Km/h if it takes him 5 hours to row to a place and come back, then find distance between the two places.

- Distance between the two places = $\frac{(a^2 - b^2)(T)}{2a}$ Km

- a = 20 Km/h

- b = 8 Km/h

- T = 5 h

Problem 6

- a = 20 Km/h, b = 8 Km/h, and T = 5 h
- Distance between the two places $= \frac{(a^2 - b^2)(T)}{2a}$ Km

$$= \frac{((20)^2 - (8)^2)(5)}{2(20)} \text{ Km}$$

$$= \frac{(400 - 64)(5)}{40} \text{ Km}$$

$$= \frac{(336)(5)}{40} \text{ Km} = \frac{\cancel{1680}^{42}}{\cancel{40}} \text{ Km}$$

$$= 42 \text{ Km}$$

Problem 7

- A boat takes 5 times as long to row upstream as to row downstream the river. If the speed of boat be 12 Km/h, compute speed of stream.
- Speed of Stream i.e., $b = \frac{a(n-1)}{(n+1)}$
- $a = 12$ Km/h and $n = 5$
- Speed of Stream i.e., $b = \frac{12(5-1)}{(5+1)}$
- Speed of Stream i.e., $b = \frac{\overset{2}{\cancel{12}}(4)}{\cancel{(6)}}$
- Speed of Stream i.e., $b = 8$ Km/h

Problem 8

- A boat takes 4 times as long to row upstream as to row downstream the river. If the speed of stream be 10 Km/h, compute speed of boat.
- Speed of Boat i.e., $a = \frac{b(n+1)}{(n-1)}$
- $b = 10$ Km/h and $n = 4$
- Speed of Stream i.e., $a = \frac{10(4-1)}{(4+1)}$
- Speed of Stream i.e., $a = \frac{\overset{2}{\cancel{10}}(3)}{\cancel{(5)}}$
- Speed of Stream i.e., $a = 6$ Km/h

Problem 9

- A man can swim directly across a stream of width 5 Km in 4 h when there is no current and in 5 h when there is a current. Compute the rate of the current.
- Rate of Current = $\sqrt{\frac{1}{(t_1)^2} - \frac{1}{(t_2)^2}}$ Km/h
- t_1 = 4 h and t_2 = 5 h
- Rate of Current = $\sqrt{\frac{1}{(4)^2} - \frac{1}{(5)^2}}$

  = $\sqrt{\frac{1}{16} - \frac{1}{25}}$

Problem 9

- Rate of Current $= \sqrt{\frac{1}{16} - \frac{1}{25}}$

$$= \sqrt{\frac{25 - 16}{(16)(25)}} = \sqrt{\frac{9}{(16)(25)}}$$

$$= \frac{3}{(4)(5)}$$

$$= \frac{3}{(20)}$$

$$= 0.15 \text{ Km/h}$$

Problem 10

- If a man can row distance of 30 Km upstream and 44 Km downstream in 10 hours. Also, he can row distance of 40 Km upstream and 55 Km downstream in 13 hours. Calculate speed of man in still water and speed of stream.

- Upstream Speed of man = $\frac{(d_1 d_4 - d_2 d_3)}{(d_4 t_2 - d_2 t_1)}$

- Downstream Speed of man = $\frac{(d_1 d_4 - d_2 d_3)}{(d_1 t_2 - d_3 t_1)}$

- d_1 = 30 Km, d_2 = 44 Km, d_3 = 40 Km, and d_4 = 55 Km

- t_1 = 10 h and t_2 = 13 h

Problem 10

- d_1 = 30 Km, d_2 = 44 Km, d_3 = 40 Km, and d_4 = 55 Km, t_1 = 10 h and t_2 = 13 h

- Upstream Speed of man $= \frac{(d_1 d_4 - d_2 d_3)}{(d_4 t_1 - d_2 t_2)}$

$$= \frac{(30 \times 55 - 40 \times 44)}{(55 \times 10 - 44 \times 13)}$$

$$= \frac{(1650 - 1760)}{(550 - 5720)}$$

$$= \frac{(-110)}{(-22)}$$

$$= 5 \text{ Km/h}$$

Problem 10

- d_1 = 30 Km, d_2 = 44 Km, d_3 = 40 Km, and d_4 = 55 Km
- t_1 = 10 h and t_2 = 13 h
- Downstream Speed of man = $\frac{(d_1 d_4 - d_2 d_3)}{(d_1 t_2 - d_3 t_1)}$

$$= \frac{(30 \times 35 - 40 \times 44)}{(30 \times 13 - 40 \times 10)}$$

$$= \frac{(600 - 1200)}{(390 - 400)}$$

$$= \frac{(-110)}{(-10)} \quad 11$$

= 11 Km/h

Problem 10

- Speed of Man = $\frac{\text{Downstream Speed + Upstream Speed}}{2}$

$$= \frac{11+5}{2} = \frac{\cancel{16}^{8}}{\cancel{2}}$$

$$= 8 \text{ Km/h}$$

- Speed of Stream = $\frac{\text{Downstream Speed} - \text{Upstream Speed}}{2}$

$$= \frac{11-5}{2} = \frac{\cancel{6}^{3}}{\cancel{2}}$$

$$= 3 \text{ Km/h}$$

Conclusion

- Downstream Speed of Boat = (a + b) Km/h
- Upstream Speed of Boat = (a - b) Km/h
- Speed of Boat

$$= \frac{\text{Downstream Speed + Upstream Speed}}{2}$$

- Speed of Stream

$$= \frac{\text{Downstream Speed} - \text{Upstream Speed}}{2}$$

Conclusion

- Average Speed of Man throughout Journey is

$$\frac{(\text{Downstream Speed of Man})(\text{Uptream Speed of Man})}{\text{Speed of Man in Still Water}}$$

- When rowing speed of man in still water ('a' Km/h), speed of stream ('b' = Km/h), and distance (up and down = 'd' Km).

- Distance between the two places $= \frac{(a^2 - b^2)(T)}{2b}$ Km

- Where 'a' Km/h = Speed of boat in still water, 'b' Km/h = Speed of stream, and 'T' hours = More time taken by boat in upstream than to go downstream for the same distance.

Conclusion

- Speed of the man in still water i.e., $a = \frac{(b)(t_2 + t_1)}{(t_2 - t_1)}$ Km/h
- Where 'b' Km/h = Speed of the stream and t_1 & t_2 hours = Time taken to row the boat (same distance) downstream and upstream.
- Distance between the two places $= \frac{(a^2 - b^2)(T)}{2a}$ Km
- Where 'a' Km/h = Speed of boat in still water, 'b' Km/h = speed of stream, and 'T' hours = Time taken by boat to row to a place and come back.

Conclusion

- Speed of boat & stream $a = \frac{b(n+1)}{(n-1)}$ & $b = \frac{a(n-1)}{(n+1)}$
- Where ‘a’ Km/h = Speed of boat, ‘b’ Km/h = Speed of stream, and boat takes n times as long to row upstream as to row downstream the river.
- Rate of Current = $\sqrt{\frac{1}{(t_1)^2} - \frac{1}{(t_2)^2}}$ Km/h
- Where ‘d’ Km = Width of stream, ‘t_1’ hours and ‘t_2’ hours = time taken to swim the river when there is no current and current respectively.

Conclusion

- Upstream Speed of man = $\frac{(d_1 d_4 - d_2 d_3)}{(d_4 t_2 - d_2 t_1)}$
- Downstream Speed of man = $\frac{(d_1 d_4 - d_2 d_3)}{(d_1 t_2 - d_3 t_1)}$
- Where 'd_1' Km & 'd_2' Km are upstream & downstream distance respectively covered in 't_1' hours and 'd_3' Km & 'd_4' Km are upstream & downstream distance respectively covered in 't_2' hours.

Summary

- Problems
  - Boats & Streams

That’s all for now…