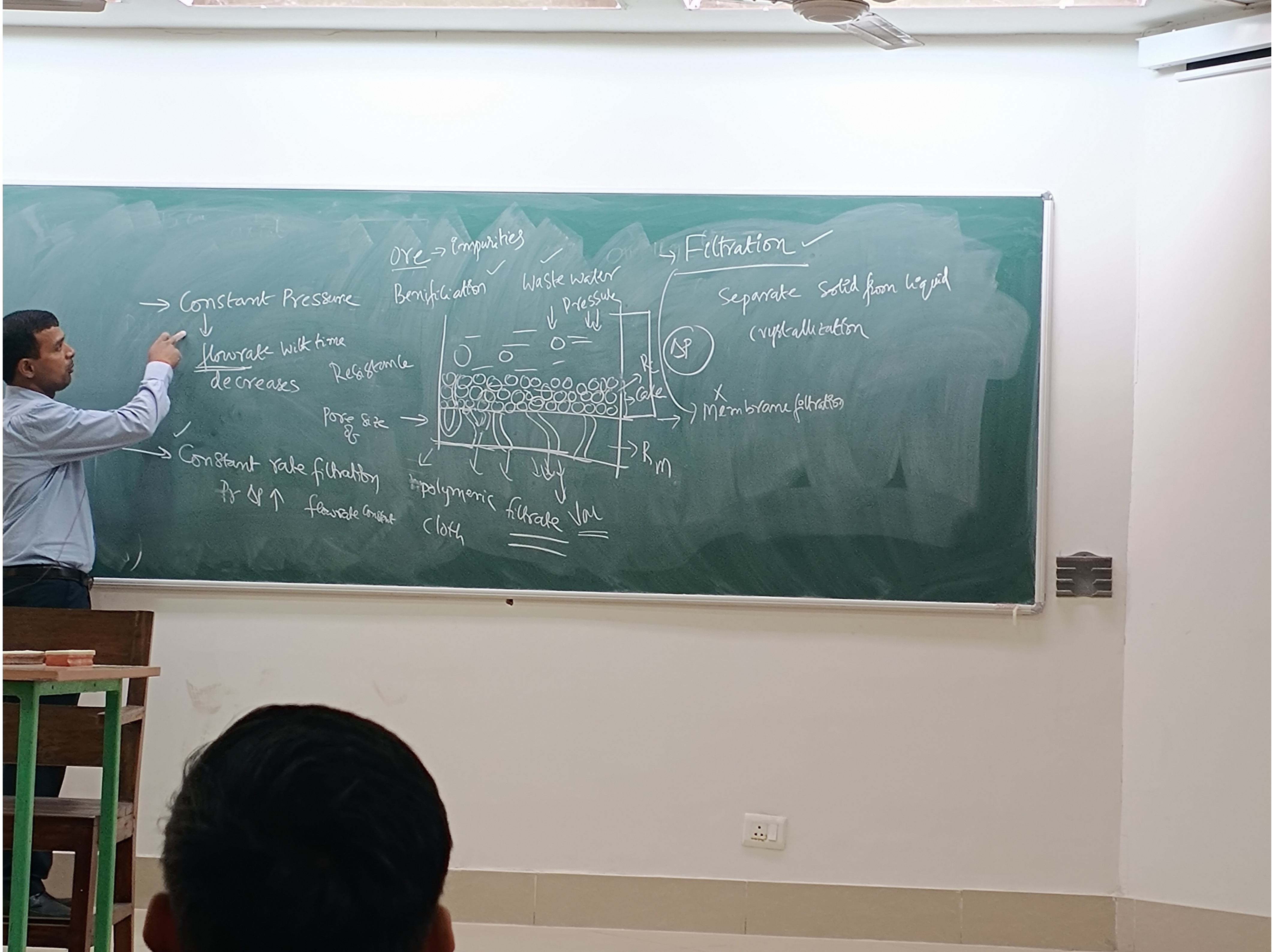
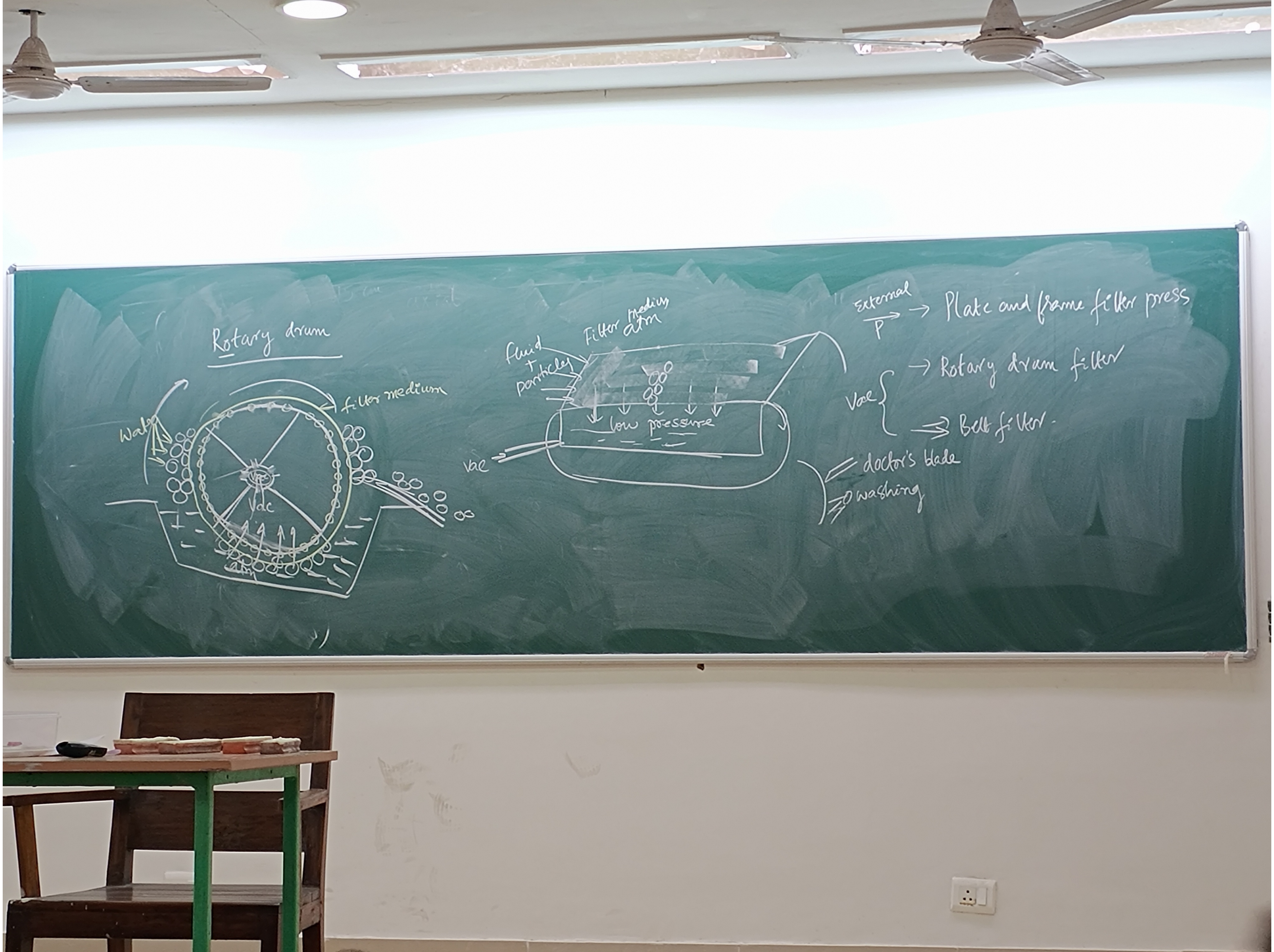


Ore → impurities
Benificiation
Waste water
Filtration
Separate solid from liquid
Crystallization
ΔP
Membrane filtration
Constant Pressure
flowrate with time decreases
Resistance
Pressure
Rc
Cake
Pore size
Rm
Constant rate filtration
ΔP ↑
flowrate constant
polymeric cloth
filtrate Vol

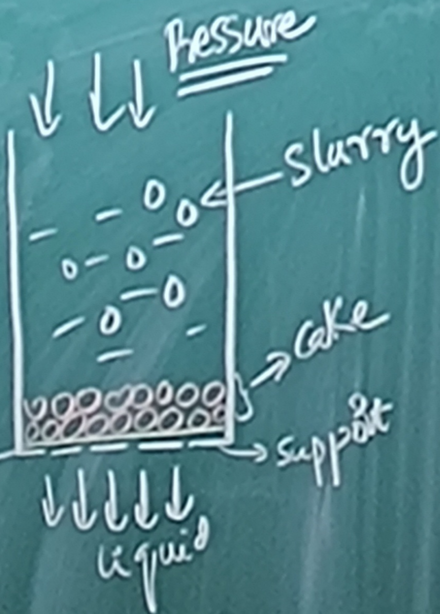

Rotary drum
filter medium
Water
Vac
atm
fluid
+
particles
Filter medium
atm
low pressure
Vac
External
P
→ Plate and frame filter press
Vac
→ Rotary drum filter
→ Belt filter.
doctor's blade
washing

...tion Equation

Cake filtration

↓

Concentrated Slurry



Porous ← filter medium

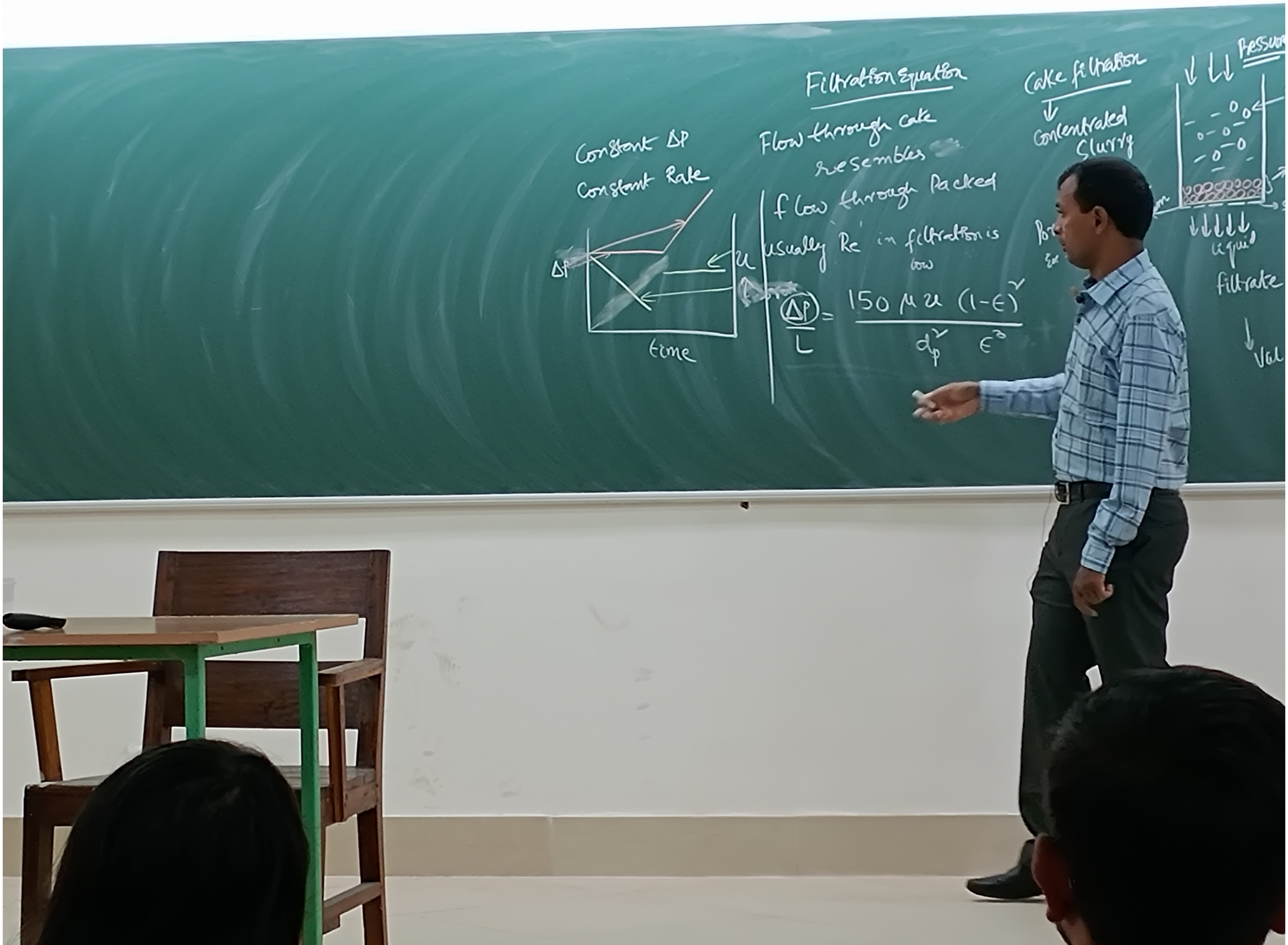
Ex - polymeric cloths

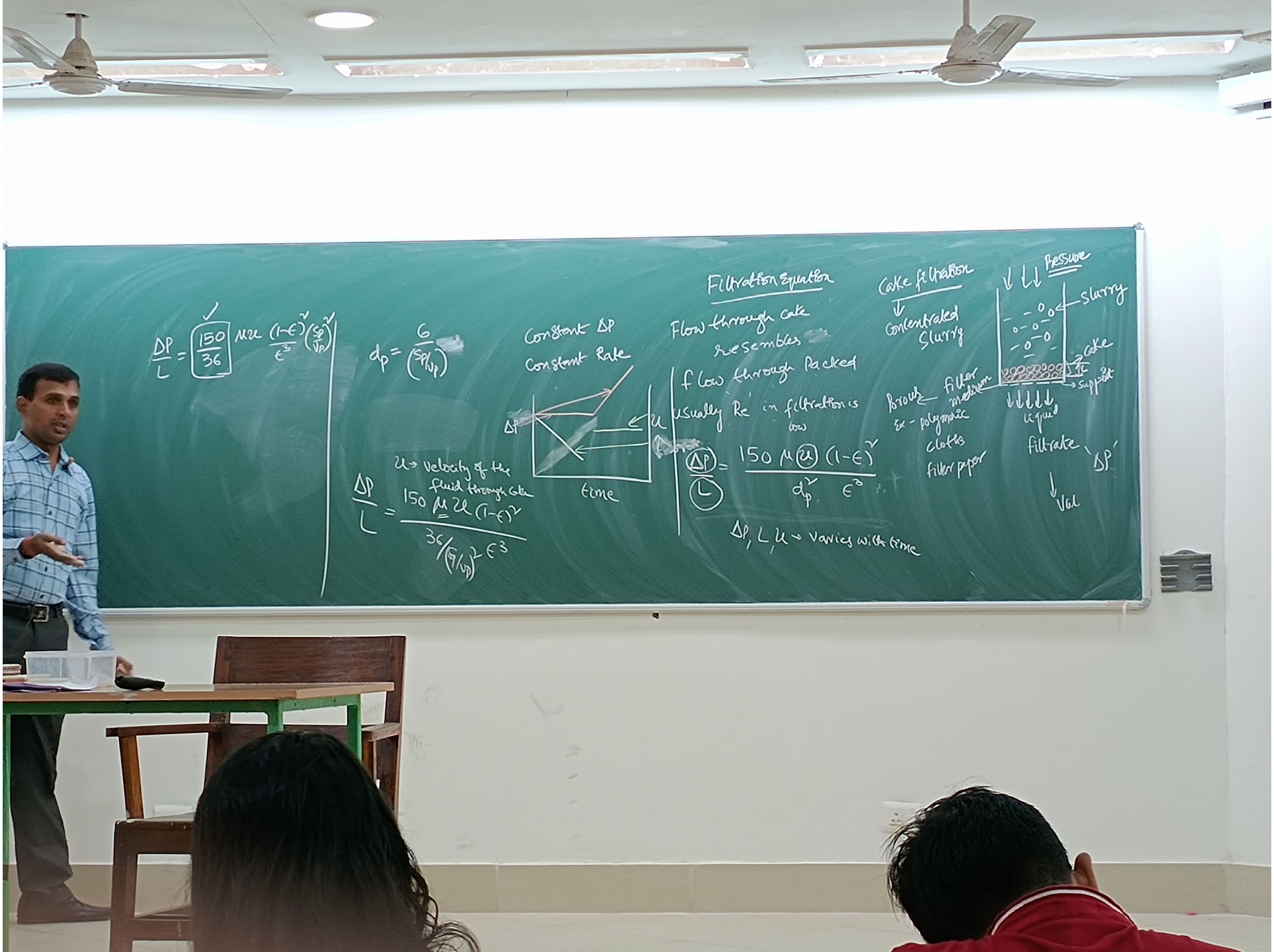
filter paper

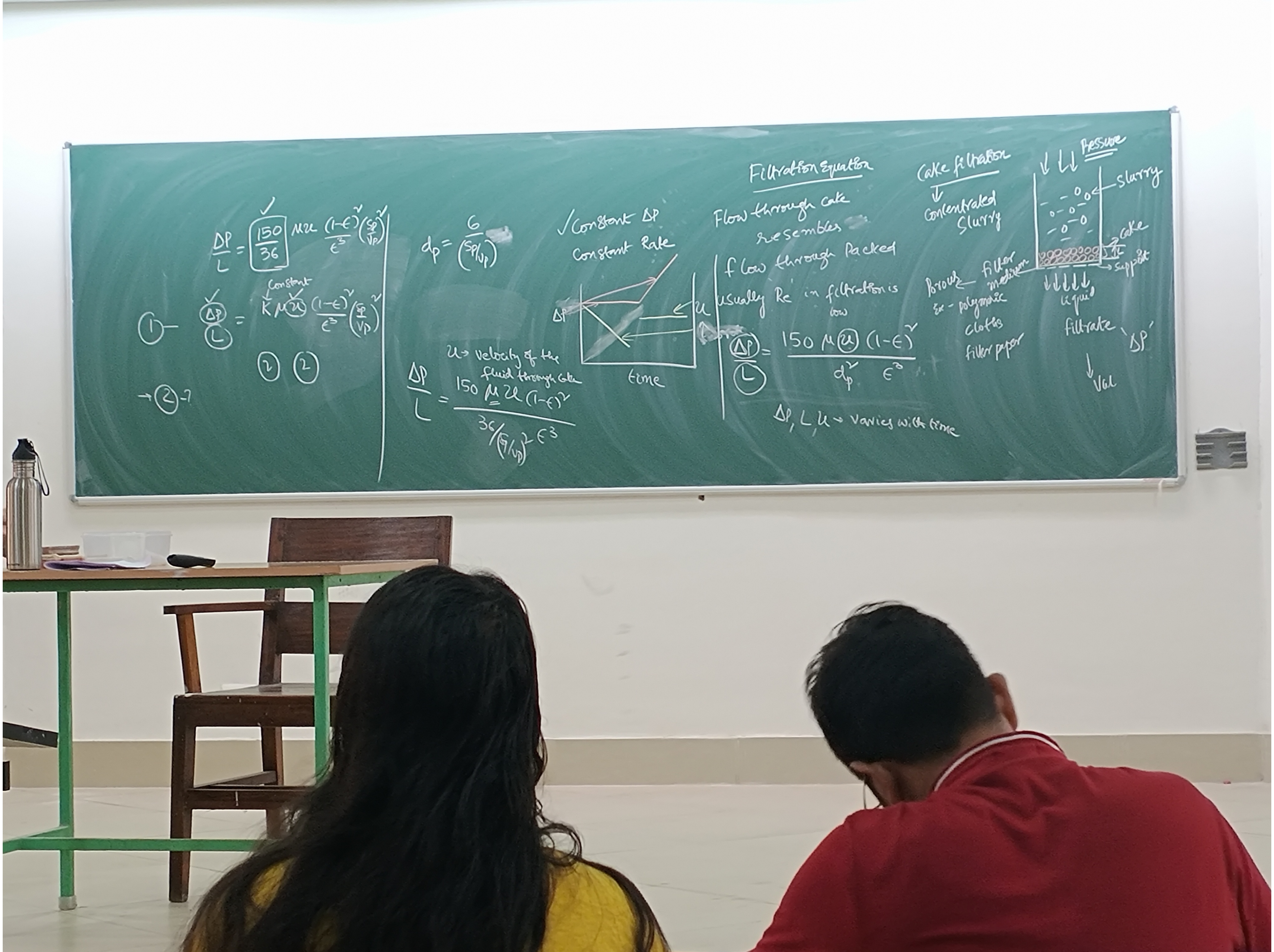
filtrate 'ΔP'

↓

Vol


Filtration Equation
Cake filtration
Concentrated Slurry
Constant ΔP
Constant Rate
ΔP
u
time
Flow through cake resembles flow through Packed
usually Re in filtration is low
$\frac{\Delta P}{L} = \frac{150 \mu u (1-\epsilon)^2}{d_p^2 \epsilon^3}$
liquid
filtrate


ΔP/L = 150/36 μu (1-ε)²/ε³ (Sp/Vp)²
dp = 6/(Sp/Vp)
u → velocity of the fluid through cake
ΔP/L = 150 μ u (1-ε)² / 36/(Sp/Vp)² ε³
Constant ΔP
Constant Rate
ΔP
u
time
Filtration Equation
Flow through cake resembles
flow through Packed
usually Re in filtration is low
ΔP/L = 150 μ u (1-ε)² / dp² ε³
ΔP, L, u → varies with time
Cake filtration
Concentrated Slurry
Pressure
Slurry
cake
support
Porous filter medium
Ex - polymeric cloths
filter paper
liquid
filtrate
ΔP
Vol



Filtration Equation
Cake filtration
Concentrated Slurry
Pressure
Slurry
cake
support
filter medium
Porous
ex - polymeric cloths
filter paper
liquid
filtrate
'ΔP'
Vol
Flow through cake resembles flow through Packed
usually Re in filtration is low
ΔP, L, u → Varies with time
Constant ΔP
Constant Rate
time
u → velocity of the fluid through cake
ΔP/L = 150/36 μu (1-ε)²/ε³ (Sp/Vp)²
ΔP/L = K μ u (1-ε)²/ε³ (Sp/Vp)²
constant
dp = 6/(Sp/Vp)
ΔP/L = 150 μ u (1-ε)² / 36/(Sp/Vp)² ε³
ΔP/L = 150 μ u (1-ε)² / dp² ε³

Solid, liquids

Volume of the cake $= AL_c$

↓

Solids + liquid

Solids in the feed slurry = Solids deposited on the filter medium

$C_f \rightarrow \frac{\text{mass}}{\text{Volume of Slurry}}$

$\frac{q \times t}{\text{Volume of Slurry}}$

$C_f \boxed{q \times t} = A L_c (1-\epsilon) \rho_s$

density

$\frac{\text{mass}}{\text{Vol}} \times \frac{\text{Vol}}{\text{time}} \times t$

Length of the cake at any time t

Liquid volume in the cake $= AL_c\epsilon$

Solids volume in the cake $= AL_c(1-\epsilon)$

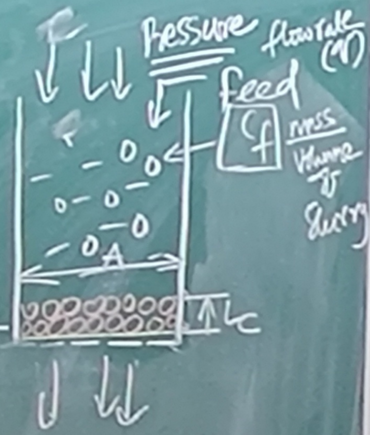
Void fraction in the cake ϵ

filtrate V

$C_f \rightarrow \frac{\text{mass of solids}}{\text{Volume of liquid}}$

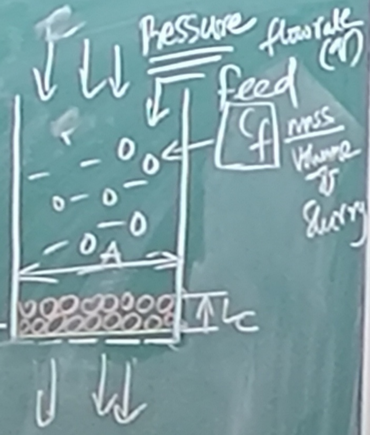
$C_f \times V_f$

Volume of liquid in the feed at any time t



Solid, liquids

Volume of the cake = AL_c
↓
Solids + liquid



Solids in the feed slurry = Solids deposited on the filter medium

$C_f \rightarrow \frac{\text{mass}}{\text{Volume of Slurry}}$

$\frac{q \times t}{\text{Volume of slurry}}$

$C_f \boxed{q \times t} = A L_c (1-\epsilon) \rho_s$

ρ_s: density

$\frac{\text{mass}}{\text{Vol}}$, $\frac{\text{Vol}}{\text{time}} \times t$

L_c: length of the cake at any time t

Liquid volume in the cake $= AL_c\epsilon$

Solids volume in the cake $= AL_c(1-\epsilon)$

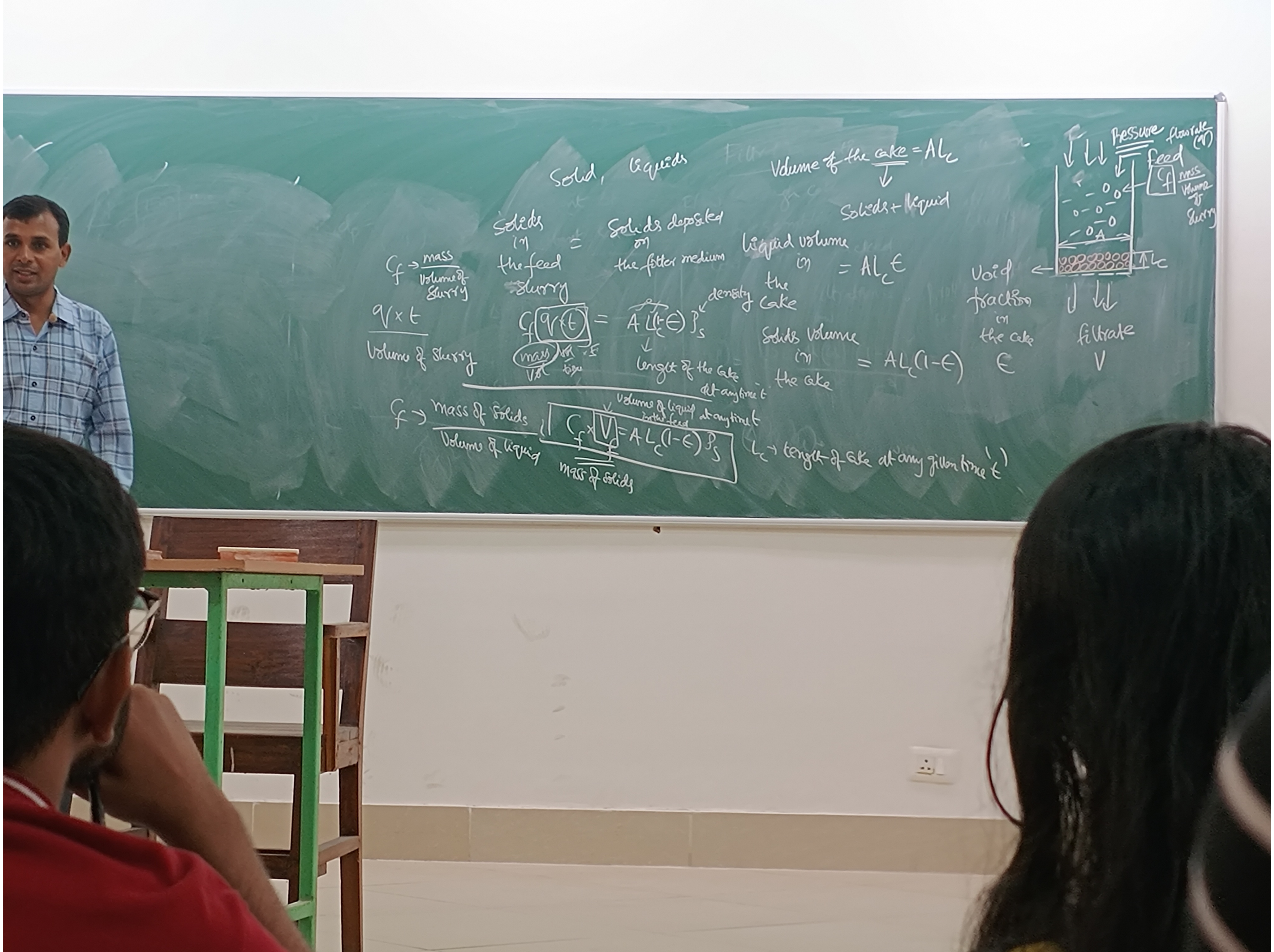
Void fraction in the cake ϵ

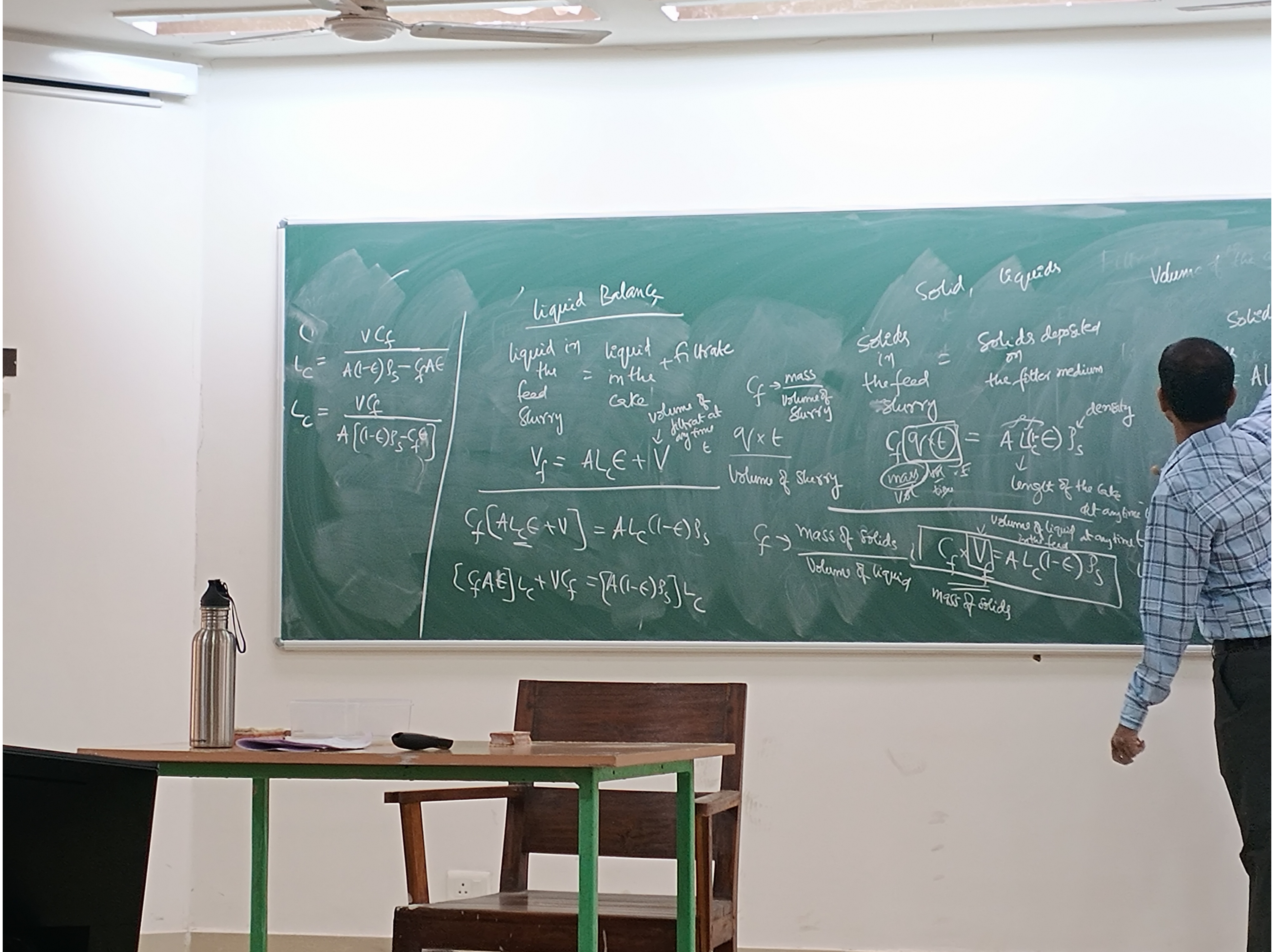
filtrate V

$C_f \rightarrow \frac{\text{mass of solids}}{\text{Volume of liquid}}$

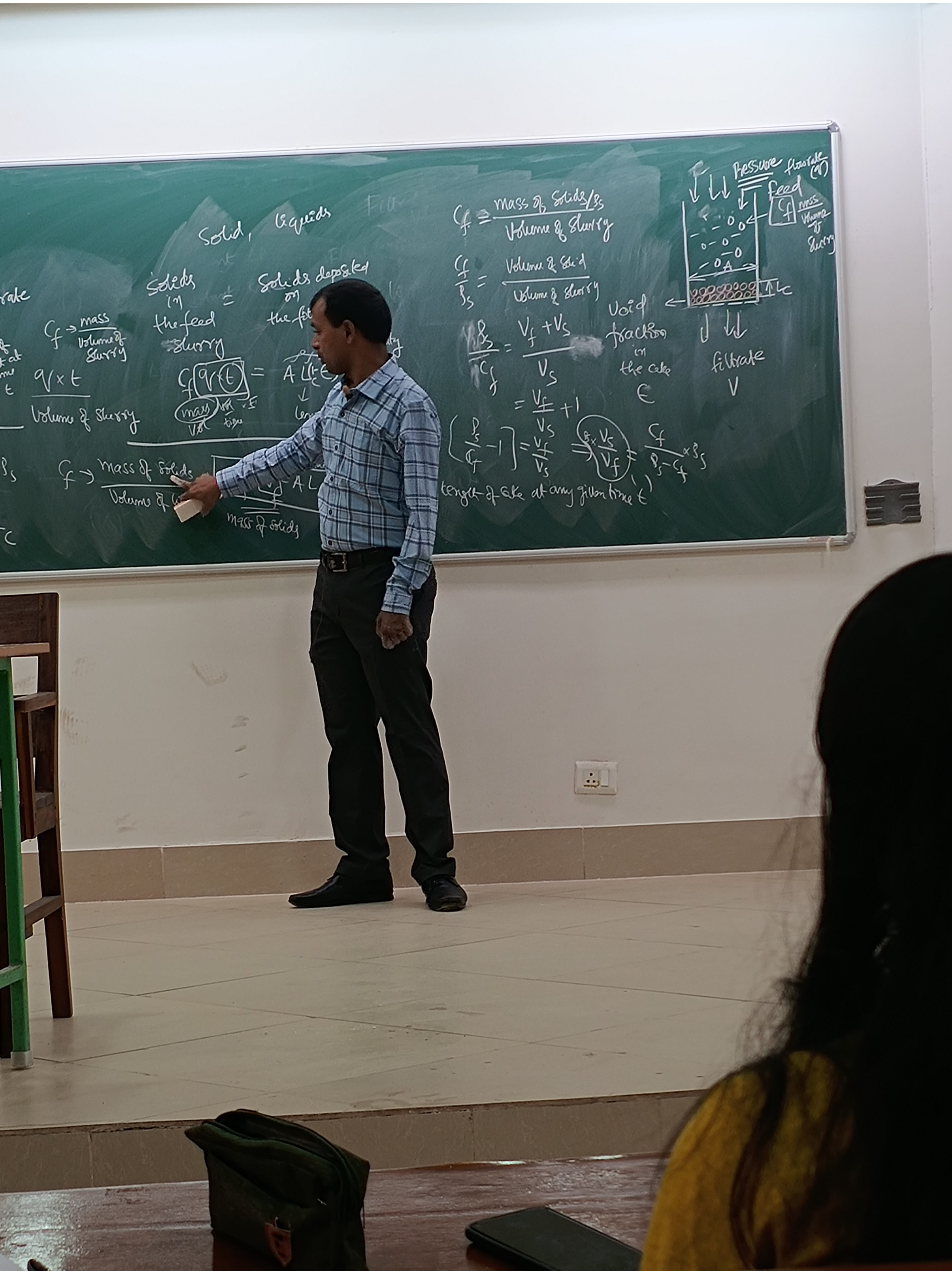
$C_f \times V_f$

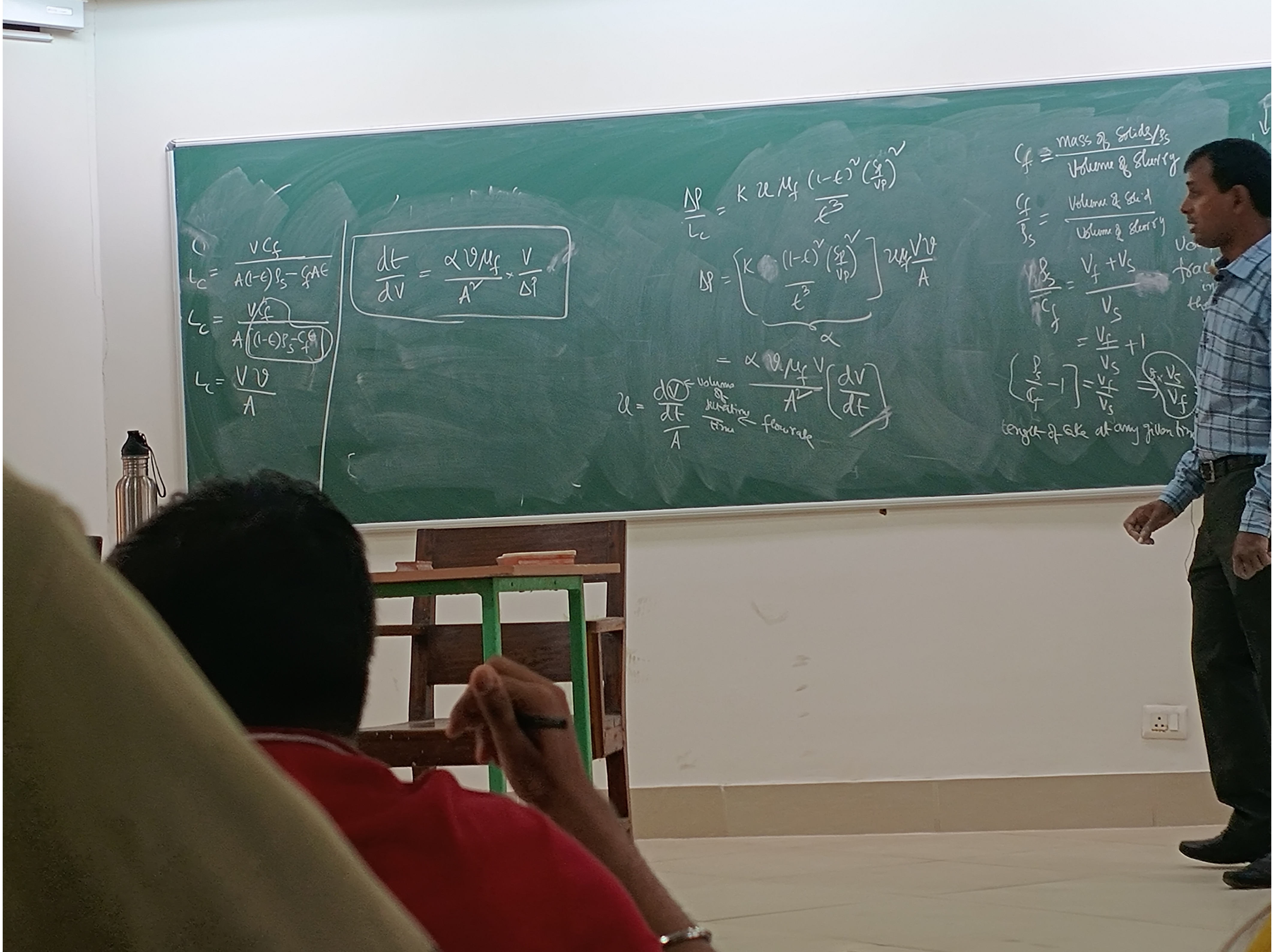
V_f: Volume of liquid in the feed at any time t


Solid, liquids
Volume of the cake = AL_c
Solids + liquid
Solids in the feed slurry = Solids deposited on the filter medium
C_f → mass / Volume of slurry
q × t / Volume of slurry
C_f (q × t) = A L_c (1 − ε) ρ_s
density
length of the cake at any time t
Liquid volume in the cake = A L_c ε
Solids volume in the cake = A L_c (1 − ε)
Void fraction in the cake ε
C_f → Mass of solids / Volume of liquid
C_f × V = A L_c (1 − ε) ρ_s
Volume of liquid in the feed at any time t
mass of solids
L_c → length of cake at any given time 't'
Pressure
flowrate (q)
feed
C_f
mass / Volume of slurry
A
L_c
filtrate
V



$L_c = \frac{VC_f}{A(1-\epsilon)\rho_s - C_f A\epsilon}$
$L_c = \frac{VC_f}{A[(1-\epsilon)\rho_s - C_f\epsilon]}$
liquid Balance
liquid in the feed slurry = liquid in the cake + filtrate
volume of filtrat at any time t
$V_f = AL_c\epsilon + V$
$C_f[AL_c\epsilon + V] = AL_c(1-\epsilon)\rho_s$
$[C_f A\epsilon]L_c + VC_f = [A(1-\epsilon)\rho_s]L_c$
$C_f \rightarrow \frac{mass}{Volume\ of\ slurry}$
$\frac{q \times t}{Volume\ of\ slurry}$
Solid, liquids
Solids in the feed slurry = Solids deposited on the filter medium
$C_f \boxed{q \times t} = AL_c(1-\epsilon)\rho_s$
density
mass
time
length of the cake at any time
Volume
$C_f \rightarrow \frac{mass\ of\ solids}{Volume\ of\ liquid}$
Volume of liquid in the feed at any time t
$\boxed{C_f \times \boxed{V_f} = AL_c(1-\epsilon)\rho_s}$
mass of solids
Solids

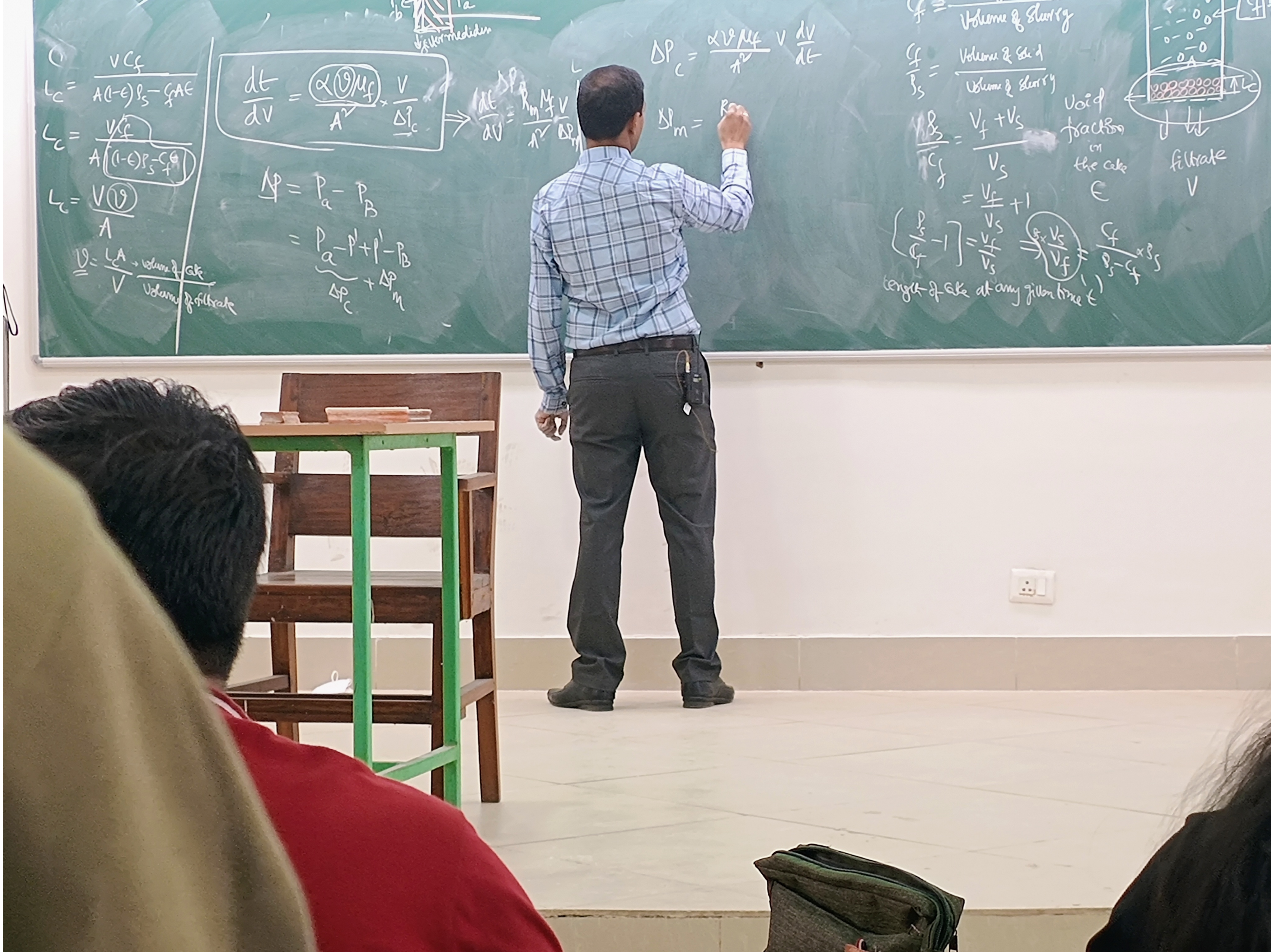

Solid, liquids
Solids in the feed slurry
Solids deposited on the
mass of solids
Volume of slurry
Volume of solid
Volume of slurry
mass
Volume of slurry
Volume of slurry
mass of solids
Pressure
flowrate (q)
feed
mass
Volume of slurry
filtrate
V
Void fraction in the cake
ε
length of cake at any given time t
mass of solids



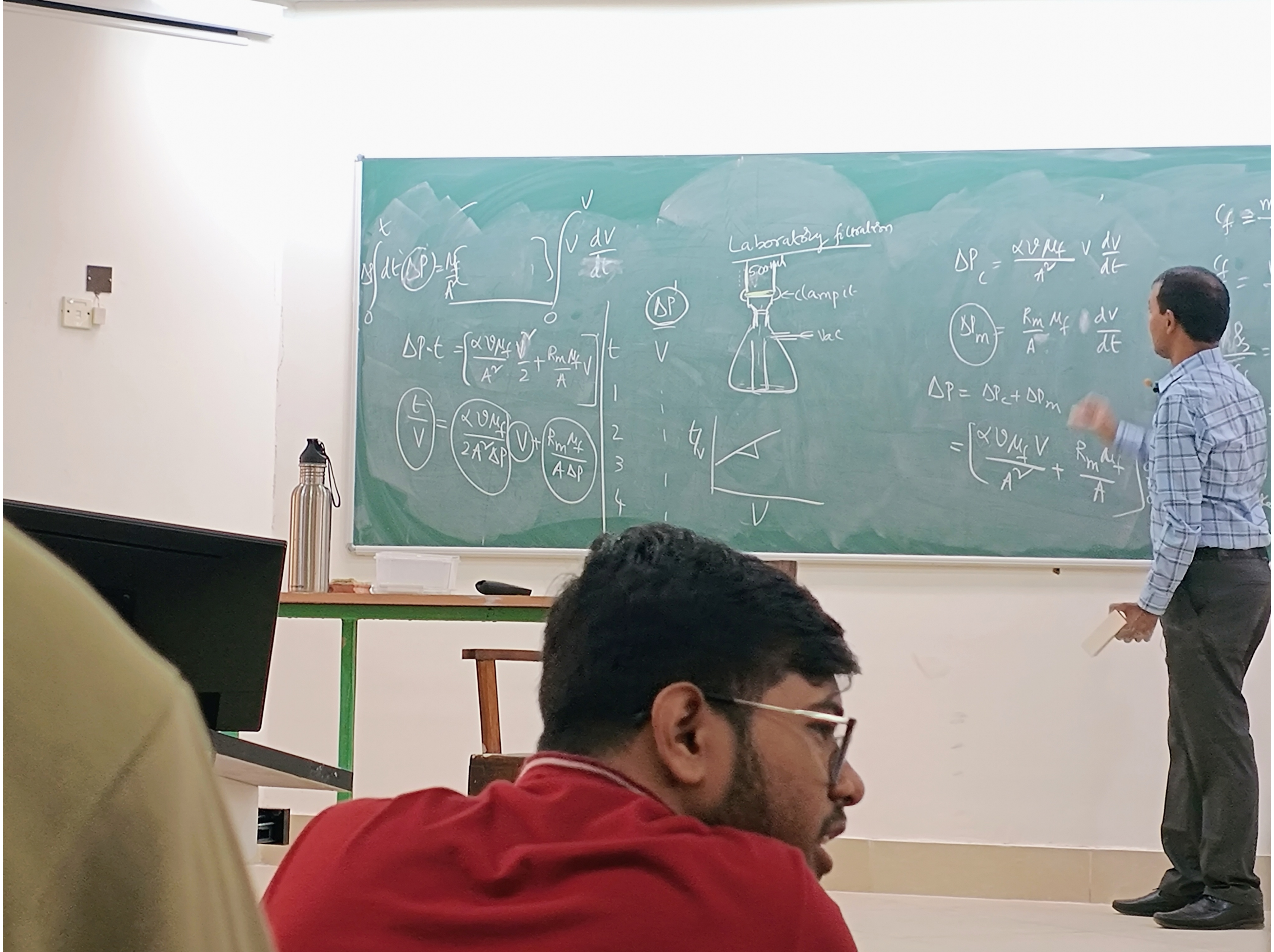
Mass of Solids/ρs
Volume of Slurry
Volume of Solid
Volume of Slurry
flowrate
Length of cake at any given time


Cake
filter medium
volume of cake
Volume of filtrate

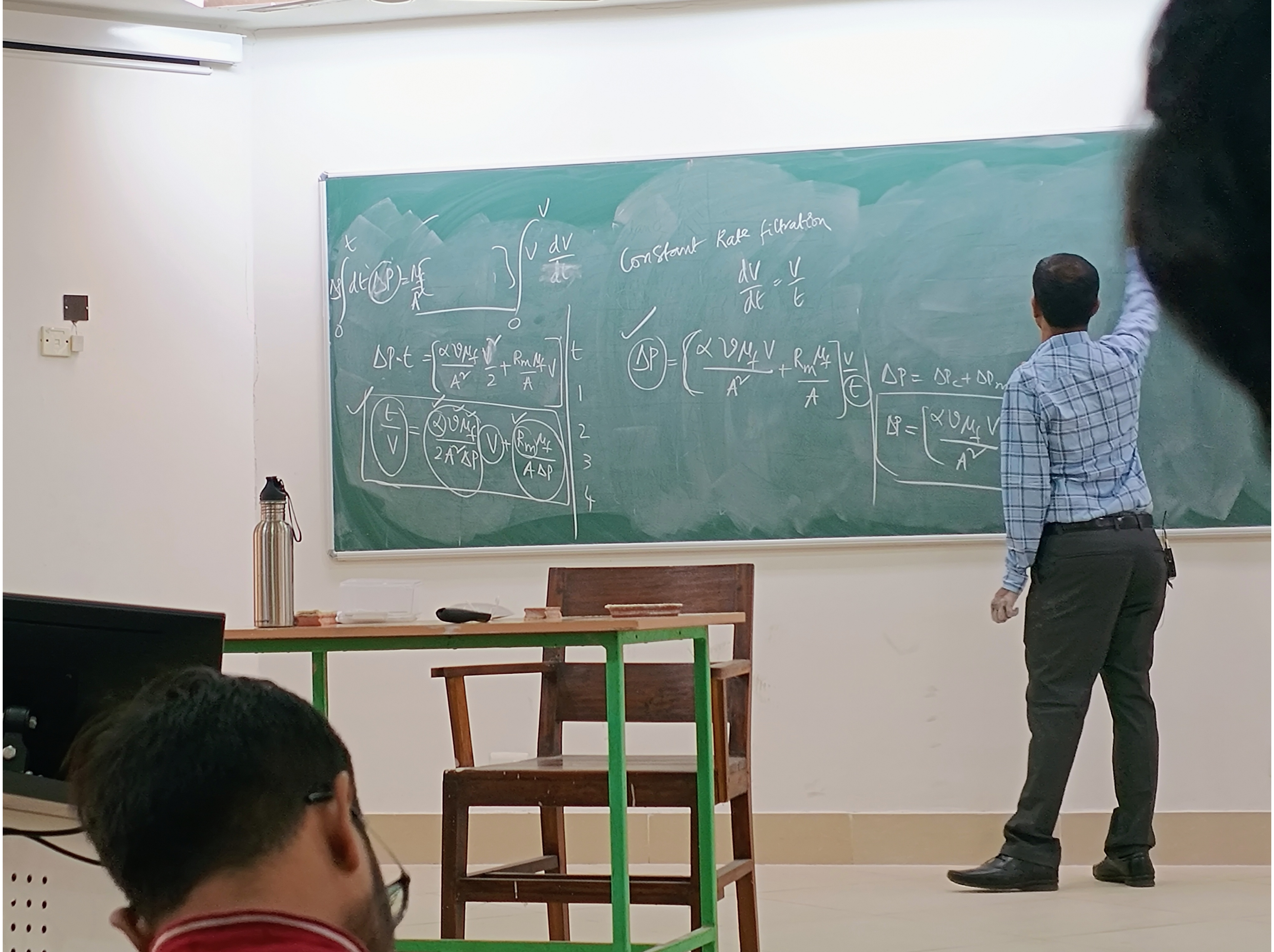
Δp = pa − pB
= pa − p' + p' − pB


Volume of slurry
Volume of solid
Volume of slurry
Void fraction in the cake
filtrate
volume of cake
Volume of filtrate
Length of cake at any given time t

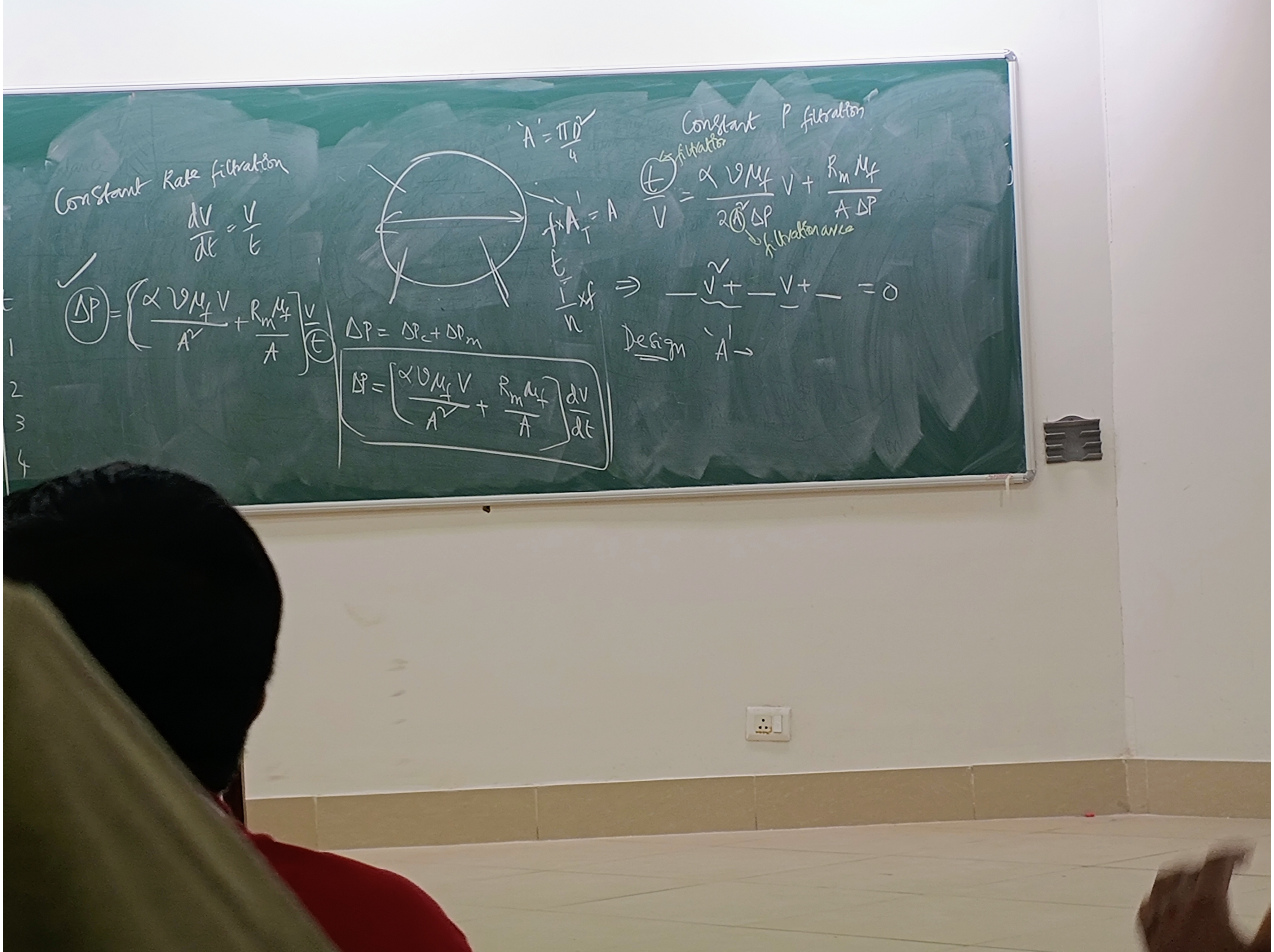

Volume of slurry
ΔPc = αvμf/A² V dV/dt
Cf/ρs = Volume of solid / Volume of slurry
ΔPm = Rm μf/A² V dV/dt
Void fraction in the cake
ε
filtrate
V
ΔP = ΔPc + ΔPm
= αv + Rm
Length of cake at any given time t



Laboratory filtration
500ml
clamp it
Vac
ΔP = ΔPc + ΔPm



Constant Rate filtration
dV/dt = V/t
ΔP = ΔPc + ΔPm


Constant Rate filtration
dV/dt = V/t
ΔP = [α υ μf V / A² + Rm μf / A] V/t
ΔP = ΔPc + ΔPm
ΔP = [α υ μf V / A² + Rm μf / A] dV/dt
'A' = πD²/4
f × A'T = A
Constant P filtration
filtration
t/V = α υ μf / 2A² ΔP V + Rm μf / A ΔP
filtration area
⇒ __V² + __V + __ = 0
Design 'A' →