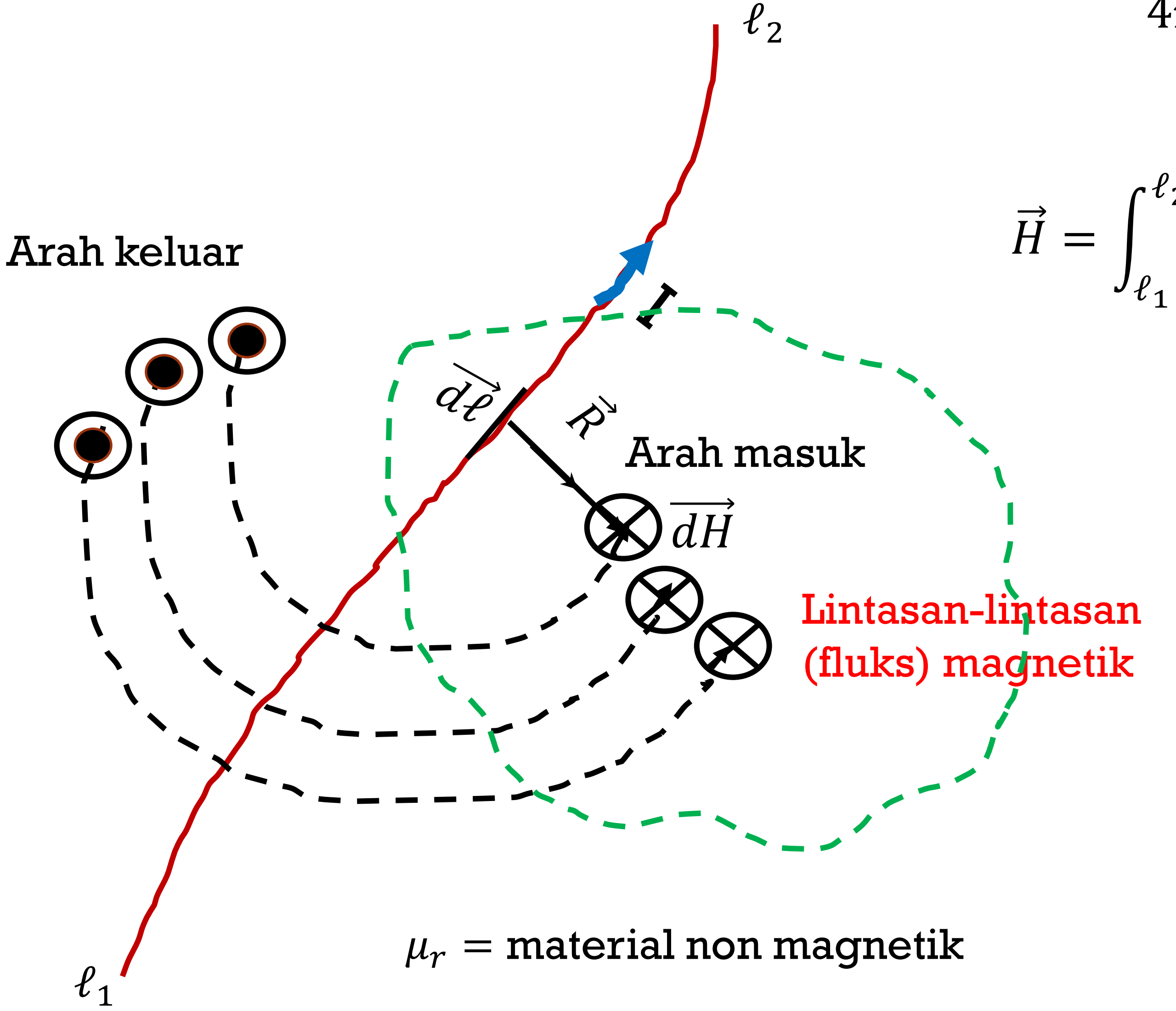
DIFERENSIAL VEKTOR

Tentang Fluks Magnetik



$$\overrightarrow{dH} = \frac{I\overrightarrow{d\ell} \times \vec{a}_R}{4\pi R^2}$$

$\overrightarrow{dH}$ adalah medan magnet yang dirasakan di titik observator akibat adanya arus I yang melewati potongan panjang $\overrightarrow{d\ell}$

$$\vec{H} = \int_{\ell_1}^{\ell_2} \overrightarrow{dH} = \int_{\ell_1}^{\ell_2} \frac{I\overrightarrow{d\ell} \times \vec{a}_R}{4\pi R^2}$$

$$\vec{B} = \mu\vec{H}$$

$\mu =$ permeabilitas medium (material)

$\mu = \mu_r\mu_0; \mu_0 =$ permeabilitas ruang hampa

$= 4\pi \times 10^{-7}$

$\mu_r =$ permeabilitas relatif medium terhadap permeabilitas ruang hampa

μ_r = material non magnetik

$\mu_r \gg$ material ferromagnetik

DIFERENSIAL VEKTOR

- Merupakan operasi matematika berupa diferensiasi terhadap vektor.
- Tools ini digunakan untuk mencari sumber sumber terkecil dari medan listrik dan medan magnet.
- Terdapat 3 tools (operasi diferensial vector) :
  - Gradien
  - Divergensi
  - Curl

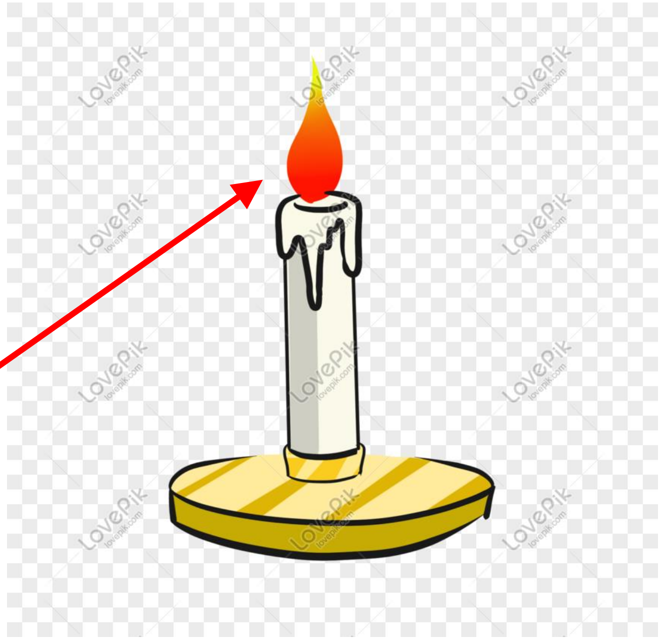
GRADIEN

- Sebuah tools matematik yaitu diferensiasi vektor untuk menentukan posisi maksimum suatu besaran listrik skalar/suatu besaran fisik skalar tertentu dan magnitudo maksimum besaran tersebut;
- Hasil akhir operasi gradien adalah besaran vektor;
- Besaran vektor memiliki arah dan magnitudo;
- Arah menunjukan ke posisi maksimum;
- Magnitudo menunjukan magnitudo maksimum suatu besaran skalar yang diuji

CONTOH GRADIEN

Gradien Suhu

Gradien Suhu : ∇T (symbol)



Grad. (T)

Observator (P)

∇V (simbol untuk Gradien Potensial Listrik)

DEL FACTOR ∇

Merupakan simbol diferensial vector dan bergantung pada sistem koordinat

$$\nabla = \frac{\partial(\ \ )}{\partial x}\vec{a}_x + \frac{\partial(\ \ )}{\partial y}\vec{a}_y + \frac{\partial(\ \ )}{\partial z}\vec{a}_z$$

(kartesian)

$$\nabla = \frac{\partial(\ \ )}{\partial \rho}\vec{a}_\rho + \frac{1}{\rho}\frac{\partial(\ \ )}{\partial \phi}\vec{a}_\phi + \frac{\partial(\ \ )}{\partial z}\vec{a}_z$$

(silinder)

$$\nabla = \frac{\partial(\ \ )}{\partial r}\vec{a}_r + \frac{1}{r}\frac{\partial(\ \ )}{\partial \theta}\vec{a}_\theta + \frac{1}{r\sin\theta}\frac{\partial(\ \ )}{\partial \theta}\vec{a}_\theta$$

(bola)

CONTOH GRADIEN
GRADIEN POTENSIAL LISTRIK

$$\nabla V = \frac{\partial V}{\partial x}\vec{a}_x + \frac{\partial V}{\partial y}\vec{a}_y + \frac{\partial V}{\partial z}\vec{a}_z$$ (sistem koordinat kartesian)

$$\nabla V = \frac{\partial V}{\partial \rho}\vec{a}_\rho + \frac{1}{\rho}\frac{\partial V}{\partial \phi}\vec{a}_\phi + \frac{\partial V}{\partial z}\vec{a}_z$$ (sistem koordinat silinder)

$$\nabla V = \frac{\partial V}{\partial r}\vec{a}_r + \frac{1}{r}\frac{\partial V}{\partial \theta}\vec{a}_\theta + \frac{1}{r\sin\theta}\frac{\partial V}{\partial \phi}\vec{a}_\phi$$ (sistem koordinat bola)

Contoh :

Diketahui : potensial listrik memenuhi persamaan : $V = 6x^2y^3 + e^z$

Tentukan : Gradien potensial listrik di titik P(2,1,0)

Solusi :

$$\nabla V = \frac{\partial(6x^2y^3+e^z)}{\partial x}\vec{a}_x + \frac{\partial(6x^2y^3+e^z)}{\partial y}\vec{a}_y + \frac{\partial(6x^2y^3+e^z)}{\partial z}\vec{a}_z$$

$$= 12xy^3\vec{a}_x + 18x^2y^2\vec{a}_y + e^z\vec{a}_z$$

Gradien V di titik P(2,1,0) = $24\vec{a}_x + 72\vec{a}_y + \vec{a}_z$

$$|\nabla V| = \sqrt{24^2 + 72^2 + 1^2} = 75{,}9 \text{ (volt/meter)}$$

$$\vec{a}_{\nabla V} = \frac{\nabla V}{|\nabla V|} = \frac{24\vec{a}_x + 72\vec{a}_y + \vec{a}_z}{75{,}9} = 0{,}316\vec{a}_x + 0{,}95\vec{a}_y + 0{,}013\vec{a}_z$$

Contoh :

Potensial listrik memenuhi persamaan : $V = 2\rho z^2 \sin\phi$ (volt)

Tentukan : Gradien potensial listrik di titik P($\rho = 1m, \phi = 45°, z = 2$m)

Solusi :

$$\nabla V = \frac{\partial V}{\partial \rho}\vec{a}_\rho + \frac{1}{\rho}\frac{\partial V}{\partial \phi}\vec{a}_\phi + \frac{\partial V}{\partial z}\vec{a}_z$$

$$\nabla V = \frac{\partial\left(2\rho z^2 \sin\phi\right)}{\partial \rho}\vec{a}_\rho + \frac{1}{\rho}\frac{\partial\left(2\rho z^2 \sin\phi\right)}{\partial \phi}\vec{a}_\phi + \frac{\partial\left(2\rho z^2 \sin\phi\right)}{\partial z}\vec{a}_z$$

DIVERGENSI

Divergensi Kerapatan Fluks Listrik :

$$\nabla \cdot \vec{D} = \frac{\partial D_x}{\partial x} + \frac{\partial D_y}{\partial y} + \frac{\partial D_z}{\partial z}$$ (Sistem Koordinat Kartesian)

$$\nabla \cdot \vec{D} = \frac{1}{\rho}\frac{\partial(\rho D_\rho)}{\partial \rho} + \frac{1}{\rho}\frac{\partial D_\phi}{\partial \phi} + \frac{\partial D_z}{\partial z}$$ (Sistem Koordinat Silinder)

$$\nabla \cdot \vec{D} = \frac{1}{r^2}\frac{\partial(r^2 D_r)}{\partial r} + \frac{1}{r \sin\theta}\frac{\partial(\sin\theta D_\theta)}{\partial \theta} + \frac{1}{r \sin\theta}\frac{\partial D_\phi}{\partial \phi}$$ (Sistem Koordinat Bola)

CURL

Curl dari Medan Magnet

$$\nabla \times \vec{H} = \left[\frac{\partial H_z}{\partial y} - \frac{\partial H_y}{\partial z}\right]\vec{a}_x + \left[\frac{\partial H_x}{\partial z} - \frac{\partial H_z}{\partial x}\right]\vec{a}_y + \left[\frac{\partial H_y}{\partial x} - \frac{\partial H_x}{\partial y}\right]\vec{a}_z$$

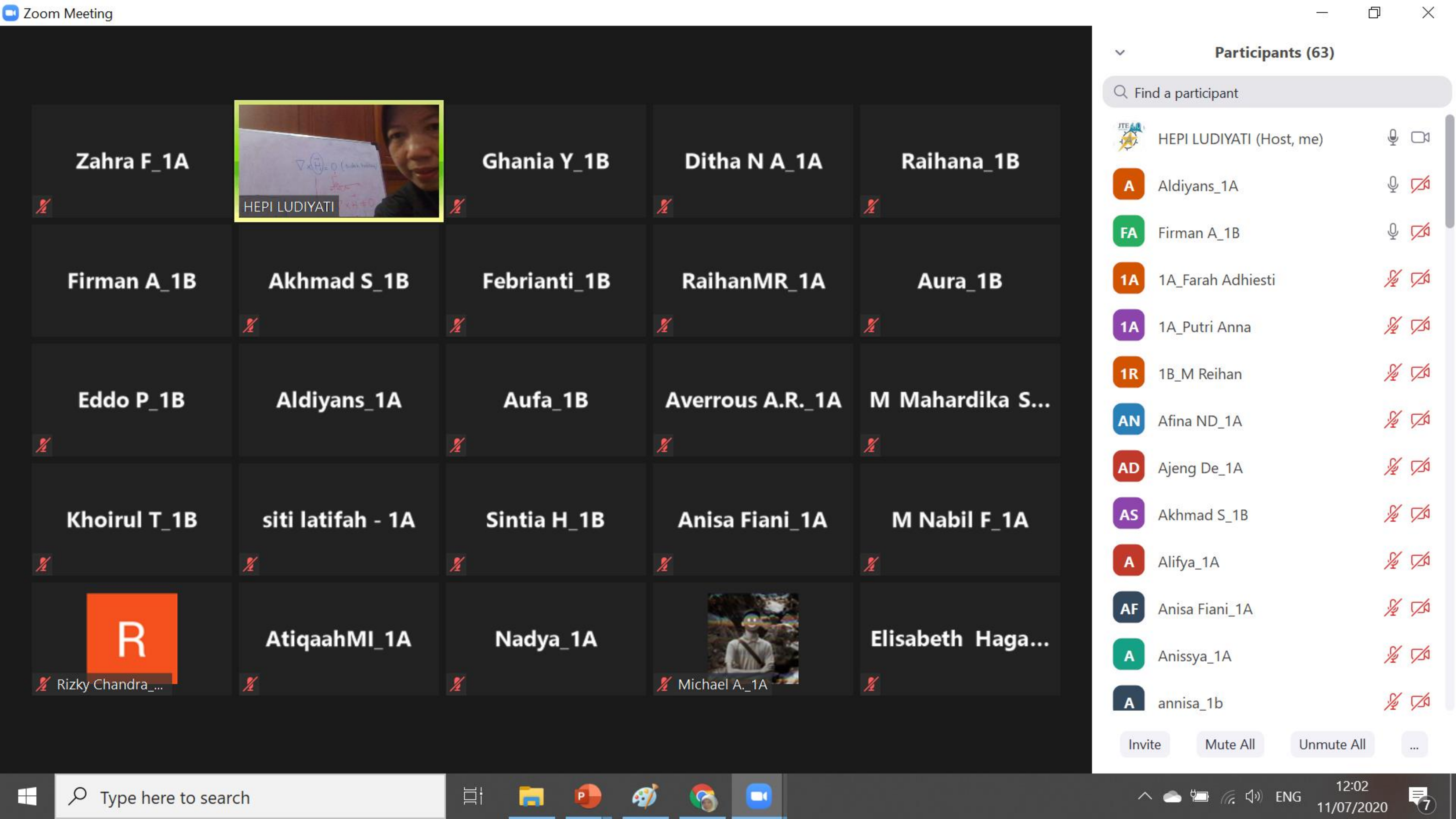
Kartesian

$$\nabla \times \vec{H} = \left[\frac{1}{\rho}\frac{\partial H_z}{\partial \phi} - \frac{\partial H_y}{\partial z}\right]\vec{a}_\rho + \left[\frac{\partial H_\rho}{\partial z} - \frac{\partial H_z}{\partial \rho}\right]\vec{a}_\phi + \left[\frac{1}{\rho}\frac{\partial}{\partial \rho}(\rho H_\phi) - \frac{1}{\rho}\frac{\partial H_\rho}{\partial \phi}\right]\vec{a}_z$$

Silinder

$$\nabla \times \vec{H} = \frac{1}{r\sin\theta}\left[\frac{\partial}{\partial \theta}(\sin\theta\, H_\phi) - \frac{\partial H_\theta}{\partial \phi}\right]\vec{a}_r + \frac{1}{r}\left[\frac{1}{\sin\theta}\frac{\partial H_r}{\partial \phi} - \frac{\partial}{\partial r}(rH_\phi)\right]\vec{a}_\theta + \frac{1}{r}\left[\frac{\partial}{\partial r}(rH_\theta) - \frac{\partial H_r}{\partial \theta}\right]\vec{a}_\phi$$

Bola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Zahra F_1A
HEPI LUDIYATI
Ghania Y_1B
Ditha N A_1A
Raihana_1B
Firman A_1B
Akhmad S_1B
Febrianti_1B
RaihanMR_1A
Aura_1B
Eddo P_1B
Aldiyans_1A
Aufa_1B
Averrous A.R._1A
M Mahardika S...
Khoirul T_1B
siti latifah - 1A
Sintia H_1B
Anisa Fiani_1A
M Nabil F_1A
R
Rizky Chandra_...
AtiqaahMI_1A
Nadya_1A
Michael A._1A
Elisabeth Haga...
Participants (63)
Find a participant
HEPI LUDIYATI (Host, me)
Aldiyans_1A
Firman A_1B
1A_Farah Adhiesti
1A_Putri Anna
1B_M Reihan
Afina ND_1A
Ajeng De_1A
Akhmad S_1B
Alifya_1A
Anisa Fiani_1A
Anissya_1A
annisa_1b
Invite
Mute All
Unmute All
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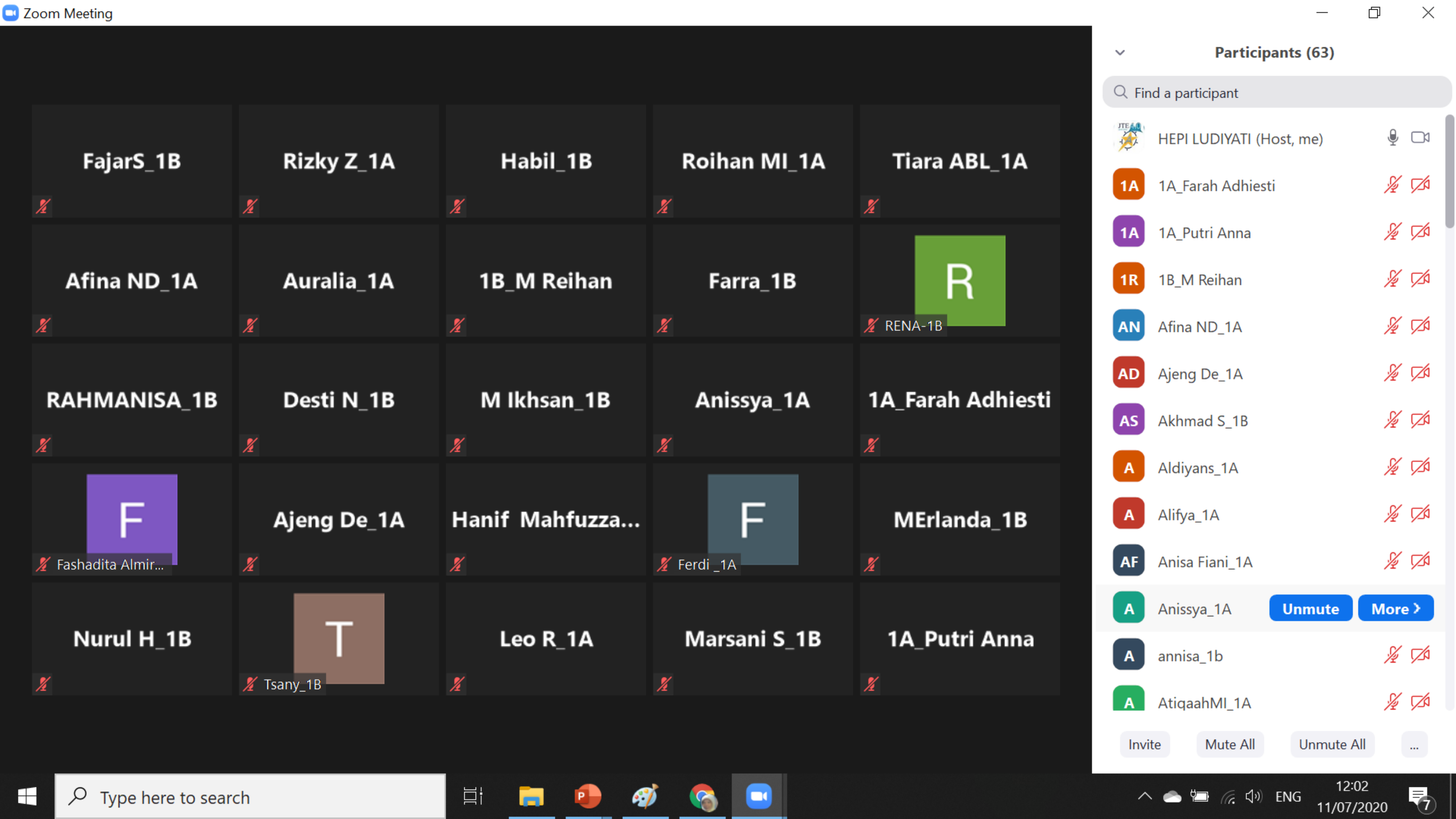
11/07/2020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Rizky Z_1A
Habil_1B
Roihan MI_1A
Tiara ABL_1A
Afina ND_1A
Auralia_1A
1B_M Reihan
Farra_1B
R
RENA-1B
RAHMANISA_1B
Desti N_1B
M Ikhsan_1B
Anissya_1A
1A_Farah Adhiesti
F
Fashadita Almir...
Ajeng De_1A
Hanif Mahfuzza...
F
Ferdi _1A
MErlanda_1B
Nurul H_1B
T
Tsany_1B
Leo R_1A
Marsani S_1B
1A_Putri Anna
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A AtiqaahMI_1A
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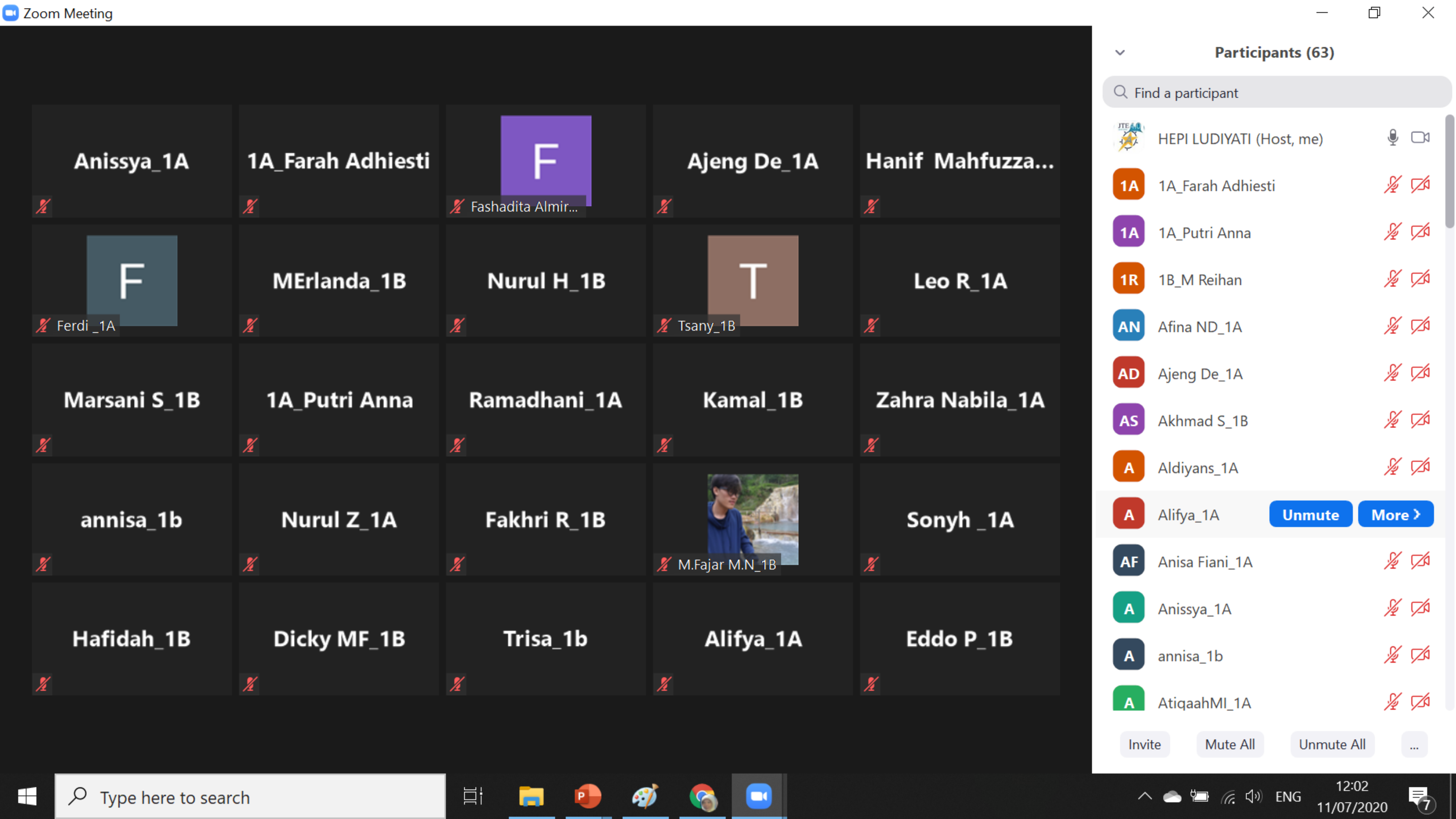
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Kamal_1B
Zahra Nabila_1A
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M.Fajar M.N_1B
Sonyh _1A
Hafidah_1B
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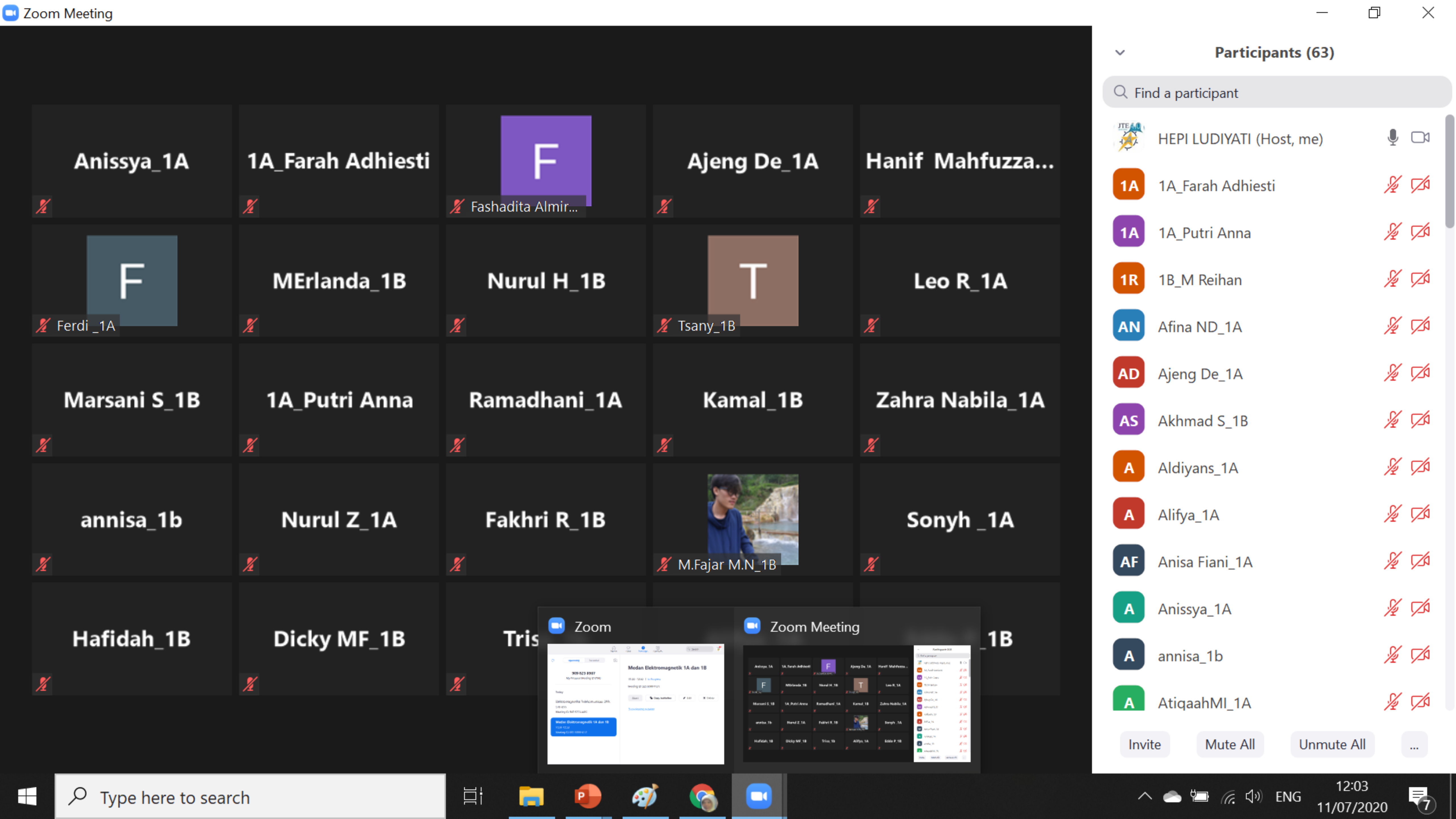
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