DATE

期中 30%
期末 30%
平时 40% （10次小考） ← Griffiths

office hour : Wesday 14:00?

Book: ① David J Griffiths, 3rd
Introduction to Electrodynamics

② Rai L Chow, Electromagnetic theory, 2006

③ Halliday / Resnick - Physics

④ J. Jackson : Classical Electrodynamics 3rd

⑤ L. Landau / E Lifschitz :
The classical Theory of fields.

9/19 考·ch1

NO

DATE 9/12, 2007

Quantum Mechanism + Planck ← Schrödinger eq ← Electricity & Magnetism ⟷ Force Motion Law

Electric circuit

Voltage law

Current law

Ohm's law

Circuit elements

Resister

capacitor

Inductor

electric charges → columbs law / Gauss law → electric field → Work, Energy, Voltage

⊖ ⟵ ⊕

vector

In matter

Dielectiv $\epsilon$

isotropic ≡ constant scalar vector

anisotropic ≤ tensor $\begin{bmatrix} \epsilon_1 & \epsilon_2 & \epsilon_3 \\ \vdots & \vdots & \vdots \end{bmatrix}$

7.5mm×28行

NO.

DATE 9/12

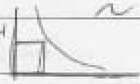
## ch 1

1781 Columb law → 扭力天平

↓

平方反比

↓

$1/r^2$ $e^{-1}$  $\sim e^{-r/c}$ $\frac{e^{-r/c}}{r}$ ⇒ 弱作用力

↓

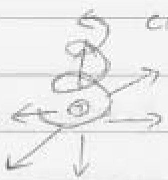
scalor →

⇕

异种电荷 $\xrightarrow{\text{推論}}$ Vector + field →

Gradent:

curl



at ∞, E=0

Electric field

电荷 → 电場 → ΔE → ?

温度 + 压力 → 高温 ↓ 低温 ΔT → devergency + Gradent

?

磁場 → ΔB → ?

curl

DATE 9/12

① 驗證場的存在？ Maxwell's eq + Hertz's

② 場的疊加？ Yes ⇒ 分離變數法、拉普拉斯 $\vec{E}(r)$

③ 电荷的分割 → electric elements → Point charge → electric charge.


who to do? (20 世紀)

⇒ 湯川介子，強弱作用場 (21 世紀)

④ 純量 → 微分 → 向量

$V: \varphi$ scalar $\quad V^+ \cdot V^- \Rightarrow -\nabla\varphi = \vec{E}$

⑤ 向量場 → 微分 → 純量

DATE 9/12 (三)

① The Gradient $\nabla$, $\vec{\nabla}$ (del)

$\vec{\nabla} f$ : $f$ : scalar / function

$= \left[\hat{x}\frac{\partial}{\partial x} + \hat{y}\frac{\partial}{\partial y} + \hat{z}\frac{\partial}{\partial z}\right] f \rightarrow$ Vector

② $\vec{\nabla}\cdot(\vec{\nabla} f) = \nabla^2 f$ Laplacian

$= 0$

$$\nabla^2 f = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2} + \frac{\partial^2 f}{\partial z^2}$$ rectangular

$$\nabla^2 f = \frac{\partial^2 f}{\partial r^2} + \frac{1}{r}\frac{\partial f}{\partial r} + \frac{1}{r^2}\frac{\partial^2 f}{\partial \theta^2} + \frac{\partial^2 f}{\partial z^2}$$ cylindrical.

$$\nabla^2 f = \frac{\partial^2 f}{\partial r^2} + \frac{1}{r^2}\frac{\partial^2 f}{\partial \theta^2} + \frac{1}{r^2\sin^2\theta}\frac{\partial^2 f}{\partial \phi^2} + \frac{2}{r}\frac{\partial f}{\partial r} + \frac{\cot\theta}{r^2}\frac{\partial f}{\partial \theta}$$ spherical

$\boxed{\text{Vector field}}$ : Divergency $\vec{\nabla}\cdot\vec{E}$ / Curl

$\vec{A}$ : Vector field

$\vec{\nabla}\cdot\vec{B} = 0$




$$\vec{\nabla}\cdot\vec{A}_r = \frac{\partial A_x}{\partial x} + \frac{\partial A_y}{\partial y} + \frac{\partial A_z}{\partial z}$$

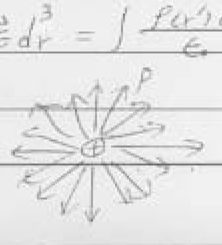
$$\vec{\nabla}\cdot\vec{A}_c = \frac{\partial A_r}{\partial r} + \frac{A_r}{r} + \frac{1}{r}\frac{\partial A_\theta}{\partial \theta} + \frac{\partial A_z}{\partial z}$$

$$\vec{\nabla}\cdot\vec{A}_s = \frac{1}{r^2}\frac{\partial}{\partial r}(r^2 A_r) + \frac{1}{r\sin\theta}\frac{\partial A_\phi}{\partial \phi} + \frac{1}{r^2\sin\theta}\frac{\partial}{\partial \theta}(A_\theta \sin\theta)$$

$\rightarrow \vec{\nabla}\cdot\vec{E} = \rho/\epsilon_0$

$\Downarrow$

$$\int \vec{\nabla}\cdot\vec{E}\, d^3r = \int \frac{\rho(r')\, d^3r}{\epsilon_0} = \frac{Q}{\epsilon_0}$$



The Curl: $\vec{\nabla}$ (Del)

$$\vec{\nabla}\times\vec{E} = \begin{vmatrix} \hat{x} & \hat{y} & \hat{z} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ E_x & E_y & E_z \end{vmatrix} = \left(\frac{\partial E_z}{\partial y} - \frac{\partial E_y}{\partial z}\right)\hat{x} + \left(\frac{\partial E_x}{\partial z} - \frac{\partial E_z}{\partial x}\right)\hat{y} + \left(\frac{\partial E_y}{\partial x} - \frac{\partial E_x}{\partial y}\right)\hat{z}$$

Cylindrical

$$\vec{\nabla}\times\vec{E} = \begin{vmatrix} \frac{\hat{r}}{r} & \hat{\theta} & \frac{\hat{z}}{r} \\ \frac{\partial}{\partial r} & \frac{\partial}{\partial \theta} & \frac{\partial}{\partial z} \\ E_r & rE_\theta & E_z \end{vmatrix}$$

Spherical

$$\vec{\nabla}\times\vec{E} = \begin{vmatrix} \frac{\hat{r}}{r^2\sin\theta} & \frac{\hat{\theta}}{r\sin\theta} & \frac{\hat{\phi}}{r} \\ \frac{\partial}{\partial r} & \frac{\partial}{\partial \theta} & \frac{\partial}{\partial \phi} \\ E_r & rE_\theta & r\sin\theta\, E_\phi \end{vmatrix}$$

① $\vec{\nabla}\times\vec{\nabla}\times\vec{A} = \ldots\ldots$

② $\vec{\nabla}\cdot(\vec{\nabla}\times\vec{A}) = \ldots\ldots$

Note: $\underset{\text{(Del)}}{\nabla} \rightarrow \Delta$ (Delta), $\underline{\Delta U} \rightarrow \begin{matrix} + & >0 \\ - & <0 \end{matrix}$


$\boxed{\text{Scalar field}}$ $-\Delta U$,

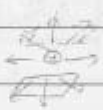
$\hookrightarrow \underline{-\nabla U} \Rightarrow$ 向量 $\rightarrow$ $\begin{matrix}\text{in} \\ \text{out}\end{matrix}$ $\rightarrow$ $\boxed{\text{closed } \frac{\text{space}}{\begin{matrix}\text{line} \\ \text{Area.}\end{matrix}}}$ $\rightarrow$ flux 流量

$\overset{\shortparallel}{0} \rightarrow$ open

$\underset{0}{\nparallel}$ $\quad \overset{\shortparallel}{0}$, $\rho = 0$.

$\int \vec{E}\cdot d\vec{r}$

$\phi = \underline{\text{flux}}$



差值(flux)