Physics-II (PH211)

Instructor

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SYLLABUS

Electromagnetism

Thermodynamics

Elements of Quantum Mechanics

Solid State Physics

Reference Books

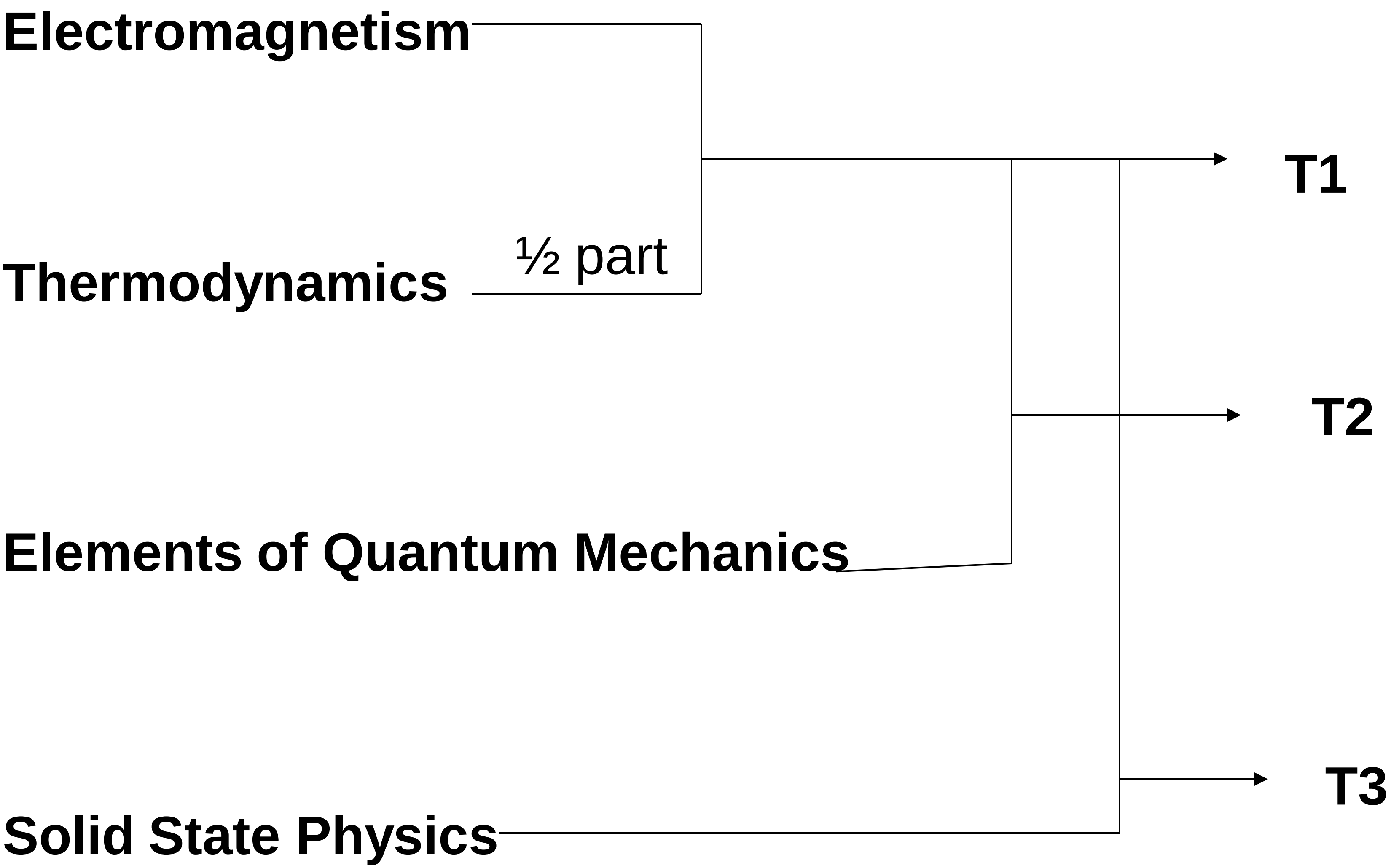
Electromagnetism :- Electromagnetics (Schaum's Outline Series)
By: J. A.Edminister
Pub: Tata McGraw Hill

Thermodynamics :- Basic & Applied Thermodynamics
By: P.K. Nag
Pub: Tata McGraw Hill

Elements of Quantum Mechanics:- Perspectives of Modern Physics
By: A. Beiser,
Pub: Mc Graw Hill International

Solid State Physics:- Solid State Physics
By: S. O. Pillai
Pub: New Age International Publishers

Test details



Electromagnetism

Lecture 1

Scalars and Vectors

Scalar

- Require only the magnitude for their specification.
- Examples: mass, volume, energy, time, length, speed temperature, charge, current ect.

Vector

- Require both the magnitude and the direction for their specification.
- Examples: Displacement, velocity, acceleration, electric field, momentum, force ect.

Vector Notation

Vectors are denoted as a symbol with an arrow over the Top and Bold font

$$\vec{A}$$

It is also written as $\vec{A} = A\hat{a}$

Where A is $|A|$ which is the magnitude and $\hat{a}$ is unit vector

$$\vec{A} = A_x \hat{a}_x + A_y \hat{a}_y + A_z \hat{a}_z$$

Where

A_x – Magnitude of Ā in x direction

A_y – Magnitude of Ā in y direction

A_z – Magnitude of Ā in z direction

Modulus or Magnitude of Ā is given by

$$|\vec{A}| = \sqrt{(A_x^2 + A_y^2 + A_z^2)}$$

UNIT VECTORS

- A unit vector along A is defined as a vector whose magnitude is unity(i.e 1) and its direction is along A

- It can be written as $\hat{a}$ or a_A

$$\hat{a}_A = \frac{\vec{A}}{\left|\vec{A}\right|}$$

$$\text{thus A} = \vec{A}\,\hat{a}_A$$

For All unit vectors

$$\vec{a}_A = \frac{A_x \hat{a}_x + A_y \hat{a}_y + A_z \hat{a}_z}{\sqrt{A_x^2 + A_y^2 + A_z^2}}$$

*** Magnitude is Unity**

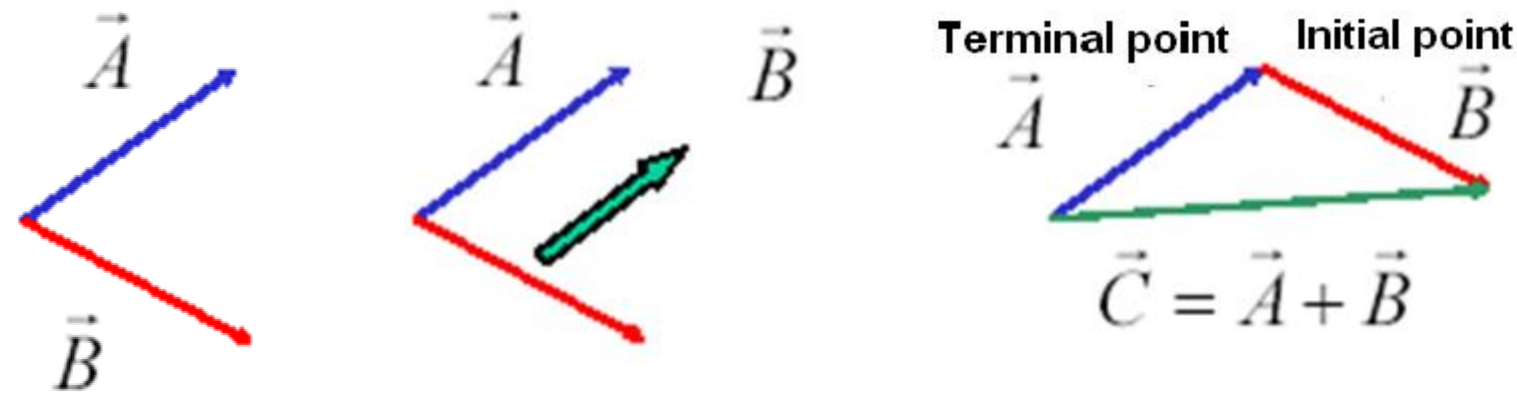
*** Provide only Direction**

VECTOR ALGEBRA

- VECTOR ADDITION
- VECTOR SUBSTRACTION
- VECTOR MULTIPLICATION

VECTOR ADDITION

- The sum of two vectors for example vector A and B can be obtain by moving one of them so that its terminal points (tip) coincide with the initial point (tail) of the other



Arrange the vectors in a head to tail fashion.

The resultant is drawn from the tail of the first to the head of the last vector.

VECTOR SUBSTRACTION

- Vector subtraction is carried out by

Flip one vector.

Then proceed to add the vectors

$$\vec{C} = \vec{A} - \vec{B} = \vec{A} + \left(-\vec{B}\right)$$

The resultant is drawn from the tail of the first to the head of the last vector.

VECTOR MULTIPLICATION

•Vector multiplied by a scalar yielding a vector output

•Scalar (dot) product (A.B) [*Vector multiplied by a vector yielding a scalar output (Dot product)]*

• Vector (cross) product (A x B) [*Vector multiplied by a vector yielding a vector output (Cross product)]*

Multiplication of a vector by a scalar

- Let vector A is multiplied by scalar quantity k

- Then the magnitude becomes k times of the A and the direction will remains same if k = +ve and reverse if k = -ve

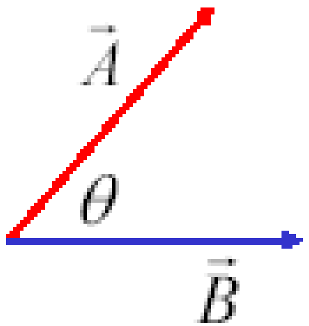
$$\vec{B} = k\vec{A}$$

$k > 0$	+ ve same direction
$k < 0$	-ve opposite direction
$1 < k$	Magnitude increases
$0 < k < 1$	Magnitude decreases

SCALAR PRODUCT

- The dot product of two vectors A and B, written as A•B and is defined as the magnitude A and B, and the projection of A onto B (or vise versa).
- Thus

$$A \bullet B = |A||B|\cos\theta$$



Where θ is an acute angle between the A and B

- If $\theta = 0$ then dot product

$$\vec{A} \cdot \vec{B} = AB$$

- If $\theta = 90^0$ then dot product

$$\vec{A} \cdot \vec{B} = \mathbf{0}$$

Properties

$\mathbf{a}_x \bullet \mathbf{a}_y = 0$ $\quad$ $\mathbf{a}_x \bullet \mathbf{a}_x = 1$

$\mathbf{a}_y \bullet \mathbf{a}_z = 0$ $\quad$ $\mathbf{a}_y \bullet \mathbf{a}_y = 1$

$\mathbf{a}_z \bullet \mathbf{a}_a = 0$ $\quad$ $\mathbf{a}_z \bullet \mathbf{a}_z = 1$

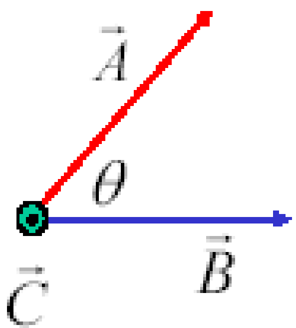
The result of a dot product of two vectors is a *scalar*!

VECTOR PRODUCT

- The cross product of two vectors A and B, written as

$$A \text{ x } B = |A||B|\sin\theta \ a$$

Where a is an unit vector perpendicular to the plane that contains the two vectors. The direction of a is taken as the direction of the right thumb (using right hand rule)



$$\vec{A} \times \vec{B} = \begin{vmatrix} \hat{a}_x & \hat{a}_y & \hat{a}_z \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix}$$

Properties

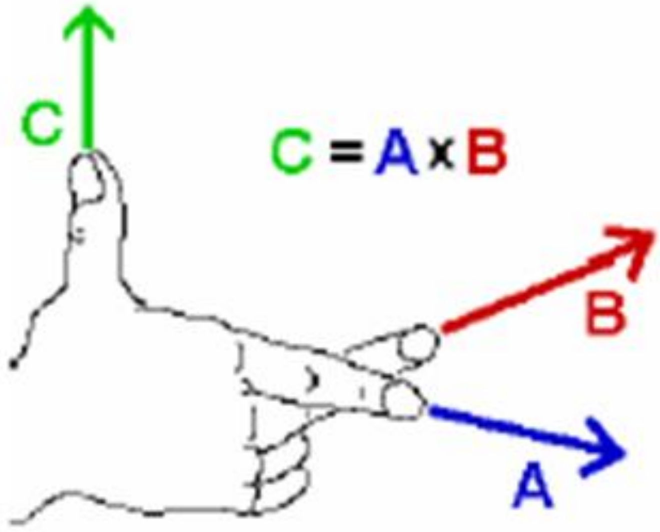
$$\mathbf{a}_x \times \mathbf{a}_y = \mathbf{a}_z \qquad \mathbf{a}_x \times \mathbf{a}_x = 0$$

$$\mathbf{a}_y \times \mathbf{a}_z = \mathbf{a}_x \qquad \mathbf{a}_y \times \mathbf{a}_y = 0$$

$$\mathbf{a}_z \times \mathbf{a}_a = \mathbf{a}_y \qquad \mathbf{a}_z \times \mathbf{a}_z = 0$$

The result of a cross product of two vectors is a new *vector*!

Vector Multiplication : Right Hand Rule



Index finger in the direction of the first vector.

Middle finger in the direction of the second vector

Thumb points in the direction of the cross product.

WARNING: Make sure you are using your right hand!!!

COMPONENTS OF A VECTOR

- A direct application of vector product is in determining the projection (or component) of a vector in a given direction. The projection can be scalar or vector.

- Given a vector **A**, we define the *scalar component* AB of **A** along vector **B** as

$$A_B = A.a_B = \frac{A.B}{|B|}$$

DOT PRODUCT

If $\vec{A} = (A_x, A_y, A_z)$ and $\vec{B} = (B_x, B_y, B_z)$ then

$$\vec{A} \bullet \vec{B} = A_x B_x + A_y B_y + A_z B_z$$

which is obtained by multiplying A and B component by component.

- It follows that modulus of a vector is

$$|\vec{A}| = \sqrt{\vec{A} \bullet \vec{A}} = \sqrt{A_x{}^2 + A_y{}^2 + A_z{}^2}$$

CROSS PRODUCT

- If **A**=(A_x, A_y, A_z), **B**=(B_x, B_y, B_z) then

$$\vec{A} \times \vec{B} = \begin{vmatrix} a_x & a_y & a_z \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix}$$

$$= \begin{vmatrix} A_y & A_z \\ B_y & B_z \end{vmatrix} a_x + \begin{vmatrix} A_z & A_x \\ B_z & B_x \end{vmatrix} a_y + \begin{vmatrix} A_x & A_y \\ B_x & B_y \end{vmatrix} a_z$$

$$=(A_yB_z - A_zB_y)a_x + (A_zB_x - A_xB_z)a_y + (A_xB_y - A_yB_x)a_z$$

CROSS PRODUCT

- Cross product of the unit vectors yield:

$$\mathbf{a}_{\mathbf{x}} \times \mathbf{a}_{\mathbf{y}} = \mathbf{a}_{\mathbf{z}}$$

$$\mathbf{a}_{\mathbf{y}} \times \mathbf{a}_{\mathbf{z}} = \mathbf{a}_{\mathbf{x}}$$

$$\mathbf{a}_{\mathbf{z}} \times \mathbf{a}_{\mathbf{a}} = \mathbf{a}_{\mathbf{y}}$$