

# HindPhotostat



## Hind Photostat & Book Store

Best Quality Classroom Topper Hand Written Notes to Crack GATE, IES, PSU's & Other Government Competitive/ Entrance Exams

### MADE EASY

ELECTRICAL ENGINEERING

E.M.T

By-Himadri Shekhar Sir

- Theory
- Explanation
- Derivation
- Example
- Shortcuts
- Previous Years Question With Solution

Visit us:-[www.hindphotostat.com](http://www.hindphotostat.com)

Courier Facility All Over India  
(DTDC & INDIA POST)  
Mob-9311989030



# HindPhotostat



**MADE EASY , IES MASTER , ACE ACADEMY , KREATRYX**

**ESE , GATE, PSU BEST QUALITY TOPPER HAND WRITTEN NOTES  
MINIMUM PRICE AVAILABLE @ OUR WEBSITE**

- |                                |                           |
|--------------------------------|---------------------------|
| 1. ELECTRONICS ENGINEERING     | 2. ELECTRICAL ENGINEERING |
| 3. MECHANICAL ENGINEERING      | 4. CIVIL ENGINEERING      |
| 5. INSTRUMENTATION ENGINEERING | 6. COMPUTER SCIENCE       |

**IES , GATE , PSU TEST SERIES AVAILABLE @ OUR WEBSITE**

❖ IES –PRELIMS & MAINS

❖ GATE

➤ **NOTE;- ALL ENGINEERING BRANCHS**

➤ **ALL PSUs PREVIOUS YEAR QUESTION PAPER @ OUR WEBSITE**

## **PUBLICATIONS BOOKS -**

**MADE EASY , IES MASTER , ACE ACADEMY , KREATRYX , GATE ACADEMY , ARIHANT , GK  
RAKESH YADAV , KD CAMPUS , FOUNDATION , MC –GRAW HILL (TMH) , PEARSON...OTHERS**

**HEAVY DISCOUNTS BOOKS AVAILABLE @ OUR WEBSITE**

<b>F230, Lado Sarai New Delhi-110030 Phone: 9311 989 030</b>	<b>Shop No: 46 100 Futa M.G. Rd Near Made Easy Ghitorni, New Delhi-30 Phone:9711475393</b>	<b>F518 Near Kali Maa Mandir Lado Sarai New Delhi-110030 Phone: 9560 163 471</b>	<b>Shop No.7/8 Saidulajab Market Neb Sarai More, Saket, New Delhi-30</b>
--	--	--	--

**Website: [www.hindPhotostat.com](http://www.hindPhotostat.com)**

**Contact Us: 9311 989 030**

**Courier Facility All Over India**

**(DTDC & INDIA POST)**

# EMT

- Syllabus (GATE/ESE)

- i) Vector Analysis

- Co-ordinate system
- vector calculus

- ii) Electrostatics

- iii) Magneto statics

- iv) Time Varying field [Maxwell Eqns]

- Average Weightage

Gate : ~ 4 Marks

ESE : 30 Marks

- Reference Book (Optional)  
Sadiku

- Question Practice

Gate PYQ [10-15 Y]

ESE PYQ [10-15 Y]

- Test Series

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65  
66  
67  
68  
69  
70  
71  
72  
73  
74  
75  
76  
77  
78  
79  
80  
81  
82  
83  
84  
85  
86  
87  
88  
89  
90  
91  
92  
93  
94  
95  
96  
97  
98  
99  
100

## CHAPTER-01 : VECTOR ANALYSIS

### 01. Co-ordinate Systems:

These are 3 types of coordinate systems

i) Cartesian Co-ordinate System  $\{x, y, z\}$

ii) Cylindrical Co-ordinate System  $\{\rho, \phi, z\}$

iii) Spherical Co-ordinate System  $\{r, \theta, \phi\}$

These 3-co-ordinate system obeys following rules

#### i) Orthogonality:

a) The dot product of two similar unit vectors of same Co-ordinate system results to 1.

$$\hat{a}_x \cdot \hat{a}_x = 1 \quad ; \quad \text{Ca. Co. sys}$$

$$\hat{a}_y \cdot \hat{a}_y = 1 \quad ; \quad \text{Cy. Co. sys}$$

$$\hat{a}_z \cdot \hat{a}_z = 1 \quad ; \quad \text{Sp. Co. sys}$$

b) The dot product of two different unit vectors of Same Co-ordinate system results to 0.

$$\hat{a}_x \cdot \hat{a}_y = 0 \quad \left\{ |\hat{a}_x| |\hat{a}_y| \cos \begin{matrix} \hat{a}_x \\ \hat{a}_y \end{matrix} \right. = 1 * 1 * \cos 90 = 0$$

$$\hat{a}_y \cdot \hat{a}_z = 0$$

$$\hat{a}_z \cdot \hat{a}_x = 0$$

## 02. Orthogonality:

a) The cross product of two similar unit vectors of same co-ordinate system results to 0.

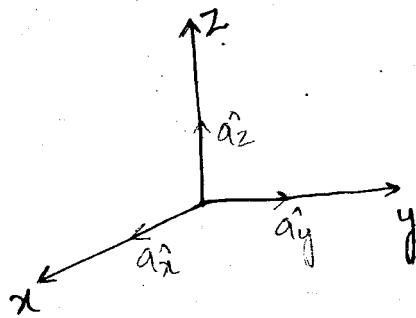
$$\cdot \hat{a}_x \times \hat{a}_x = 0$$

$$\cdot \hat{a}_y \times \hat{a}_y = 0$$

$$\cdot \hat{a}_z \times \hat{a}_z = 0$$

b) The cross product of two different unit vectors of the same co-ordinate system results to third unit vector which is mutually perpendicular to the initial vectors.

$$\cdot \hat{a}_x \times \hat{a}_y = \hat{a}_z$$

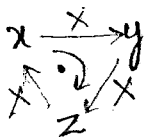


$$\cdot \hat{a}_y \times \hat{a}_z = \hat{a}_x$$

$$\cdot \hat{a}_z \times \hat{a}_x = \hat{a}_y$$

c) The direction of third unit vectors can be found using

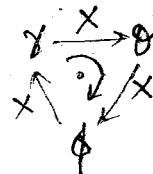
Right hand curl Rule



Ca Co Sys

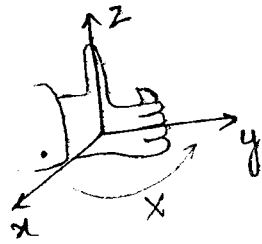


Cy Co Sys



Sp Co Sys

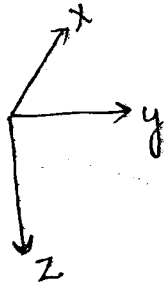
# Right Hand Curl Rule:



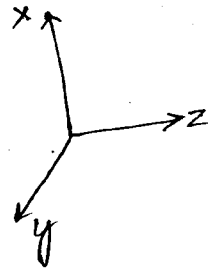
RH curl thumb

$$X \rightarrow Y \equiv Z$$

EX 1:



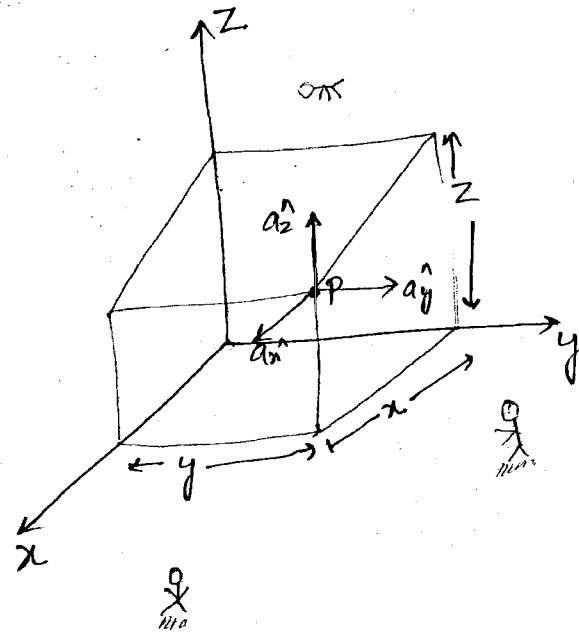
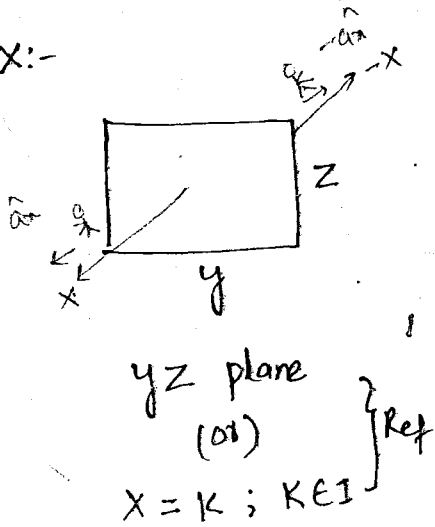
EX 2:



## I) Cartesian Coordinate System $\{x, y, z\}$

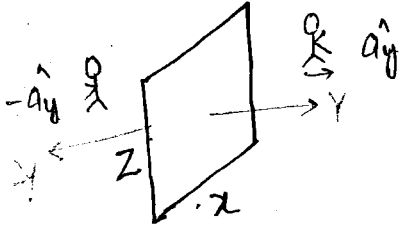
$$A_p = A_x \hat{a}_x + A_y \hat{a}_y + A_z \hat{a}_z$$

X:-



- Perpendicular distance from yz plane is  $x$
- Range of  $x$ ,  $(-\infty, \infty)$
- Unit normal vector from yz plane i.e.  $x = K$ ,  $K \in \mathbb{R}$  is  $\pm \hat{a}_x$

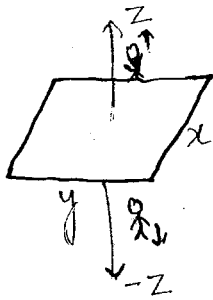
Y:-



$xz$  plane  $Y=K$   $K \in I$  (ref)

- Perpendicular distance from  $xz$  plane is  $Y$
- Range of  $Y$ :  $(-\infty, \infty)$
- Unit Normal vector from  $xz$  plane  
ie  $Y=K$   $K \in I$  is  $\pm \hat{a}_y$

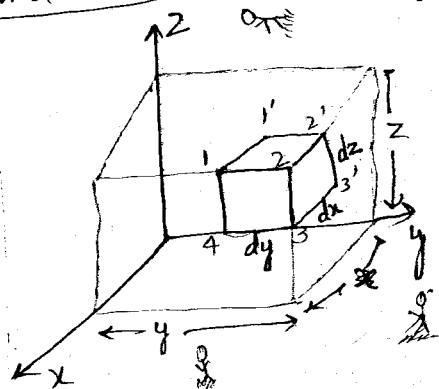
Z:-



$xy$  plane (or)  $Z=K$ ,  $K \in I$  (Ref)

- Perpendicular distance from  $xy$  plane is  $Z$
- Range of  $Z$ :  $(-\infty, \infty)$
- Unit normal vector from  $xy$  plane ie  
 $Z=K$   $K \in I$  is  $\pm \hat{a}_z$

Concept of differential length, Area and Volume  
(Graphical Approach)

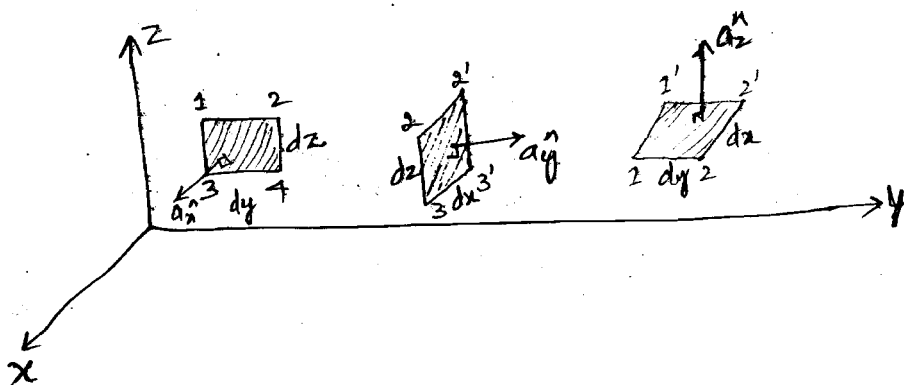




i) Differential length:  $dl = dx \hat{a}_x + dy \hat{a}_y + dz \hat{a}_z$

ii) Differential Surface area

$$\begin{aligned} ds &= dy dz \hat{a}_x \\ &= dx dz \hat{a}_y \\ &= dx dy \hat{a}_z \end{aligned}$$



iii) Differential volume

$$dv = dx dy dz$$

Analytical Approach

$$\begin{aligned} dl &= dx \hat{a}_x + dy \hat{a}_y + dz \hat{a}_z \\ &= 1 \cdot dx \hat{a}_x + 1 \cdot dy \hat{a}_y + 1 \cdot dz \hat{a}_z \\ &= h_1 \cdot dx \hat{a}_x + h_2 \cdot dy \hat{a}_y + h_3 \cdot dz \hat{a}_z \\ &= h_1 du \hat{a}_u + h_2 dv \hat{a}_v + h_3 dw \hat{a}_w \end{aligned}$$

$h_1, h_2, h_3 =$  Scaling factor

$u, v, w$  parameters

Parameters			Scaling factor		
u	v	w	$h_1$	$h_2$	$h_3$
x	y	z	1	1	1

Ca Co Sep

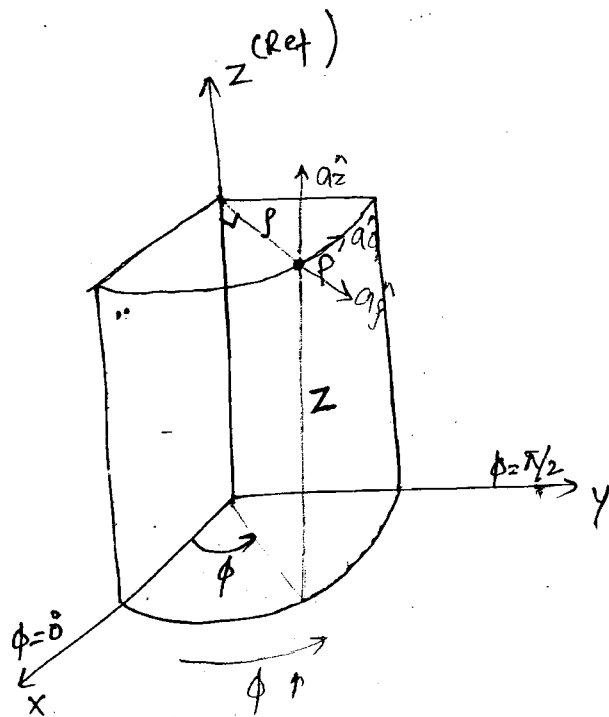
Area کے 'z' کی direction میں  
 لگائے گا تو 'x' کو freeze  
 کرے گا باقی دونوں کو multiply  
 کرے گا  $dy dz \hat{a}_x$

## II Cylindrical coordinate system

$$\vec{A}_p = A_\rho \hat{a}_\rho + A_\phi \hat{a}_\phi + A_z \hat{a}_z$$

$\rho$ :-

- Radial or perpendicular distance of point from a reference axis (z-axis)
- Range of  $\rho$ :  $[0 \rightarrow \infty]$



Physical significance of perpendicular distance in  $\rho$ :

Ex 1:

Axis is along x axis

$f(1,1,1)$

$i(?)$

provided the final point from initial point is perpendicular to x axis.

