

# PHI - 101 [ Electromagnetic Theory + Quantum Physics ].

# Program Name

B Tech.	Biosciences & Bioengineering	}	BE-1	23
BS-MS	Economics		BE-2	22
BS-MS	Physics		HS-1	33
B Tech.	Engineering Physics		BP-1	27
		}	EP-1	25
			EP-2	25

155 Students.# Course Instructors ⇒

- ① Prof. Anjan Kumar Tiwari
- ② Prof. Rajdeep Chatterjee
- ③ Prof. Ajay / Prof. Tashi Nautiyal
- ④ Prof. Davinder Kaur
- ⑤ Prof. Rajesh Kumar
- ⑥ Prof. Vivek Kumar Malika
- ⑦ Prof. Narayan Mohanta
- ⑧ Prof. Dibakar Roychowdhury
- ⑨ Prof. Rajesh Saini tava.

[ Physics Department ].

No. of Students ⇒ 1350.

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Office No 0133228 5772  
[ Physics Department 206 ].

T.A → BE 1 → Arunima  
BE 2 → Hind Parash  
HS 1 → Anmol  
BP 1 → Manjeet  
EP 1 → Nitita Chaudhary  
EP 2 → Kuldeep Sharma.

# Grading →

MTE → 20%

ETE → 40%

PRS → 20%

CWS → 20%

5 Marks

[ Attend. + Interaction ]

15 Marks

Attendance

+

Tutorial Submission

+

Interaction

# MS Team

What's app group.

[ BR (Admins)  
+  
Me.  
Open to all .

**Teaching days for Autumn Semester 2023-24 (w.e.f. 18.07.2023 to 14.11.2023)**

**All Programs (Other than MBA & UG I Yr)**

Days	Months												Less for MTE/ ETE/Thomson	Total Teaching days										
	July			August			September			October														
Mon	-	24	31*		7	14	21	28		4	11	-	25	-	9	16	23	30	6	13	20	1	15-1*=14	
Tue	18	25		1	8	-	22	29		5	12	-	26	3	10	17	-	31	7	14	21	1	15	
Wed	19	26		2	9	16	23	-		6	13		27	4	11	18	25		1	8	-	22	2	14
Thu	20	27		3	10	17	24	31			14	-	-	5	12	19	26		2	9	-	23	2	13+1*=14
Fri	21	-		4	11	18	25		1	8	15	-	29	6	13	20	27		3	10	17	24	4	13+1*=14
Sat	-	-		-	-	-	-	-		-	16	-	30*	-	-	-	-		-	-	18	25	3	-
Total days	09			21			12			19			10			71								

\* Time-Table Rescheduling (for all the classes)

31.07.2023	Monday	Friday Time Table
30.09.2023	Saturday	Thursday Time Table

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**Teaching days for Autumn Semester 2023-24 (w.e.f. 02.08.2023 to 14.11.2023)**

**UG I Year**

Days	Months												Less for MTE/ ETE/Thomson	Total Teaching days								
	August			September			October			November												
Mon		7	14	21	28		4	11	-	25	-	9	16	23	30	6	13	20	1	13+1*=14		
Tue		8	-	22	29		5	12	-	26	3	10	17	-	31	7	14	21	1	12+2*=14		
Wed	2	9	16	23	-		6	13	-	27	4	11	18	25		1	8	-	22	2	12+1*=13	
Thu	3	10	17	24	31		-	14	-	-	5	12	19	26		2	9	-	23	2	11+2*=13	
Fri	4	11	18	25			1	8	15	-	29	6	13	20	27		3	10	17	24	3	12+2*=14
Sat	5	12*	19*	26*			2*	9*	16	-	30*	7*	-	-	28*		-	-	18	25	3	6
Total	20+3*=23			11+3*=14			19+2*=21			10			68									

\* Time-Table Rescheduling (for all the classes)

12.08.2023	Saturday	Monday Time Table	09.09.2023	Saturday	Friday Time Table
19.08.2023	Saturday	Tuesday Time Table	30.09.2023	Saturday	Thursday Time Table
26.08.2023	Saturday	Wednesday Time Table	07.10.2023	Saturday	Friday Time Table
02.09.2023	Saturday	Thursday Time Table	28.10.2023	Saturday	Tuesday Time Table

**Mid Term Examination**

**September 13 - 16, 2023**

**Mid Term Break**

**September 18-22, 2023**

**Thomso 2023**

**October 13-15 2023**

**Last Date of Teaching**

**November 14, 2023**

**End Term Examination**

**November 17 - 25, 2023**

**List of Holidays**

Muharram*	29.07.2023	Saturday
Independence Day	15.08.2023	Tuesday
Raksha Bandhan	30.08.2023	Wednesday
Janamashtami	07.09.2023	Thursday
Ganesh Chaturthi	19.09.2023	Tuesday
Prophet Mohammad's Birthday*	28.09.2023	Thursday
Mahatma Gandhi's Birthday	02.10.2023	Monday
Dussehra	24.10.2023	Tuesday
Diwali	12.11.2023	Sunday
Bhai Duj	15.11.2023	Wednesday
Guru Nanak's Birthday	27.11.2023	Monday
Christmas Day	25.12.2023	Monday

\*Subject to change in the visibility of the moon.

**INDIAN INSTITUTE OF TECHNOLOGY ROORKEE**

**NAME OF DEPARTMENT / CENTRE:** Department of Physics

- 1. Subject Code:** PHI-101                    **Course Title:** Physics-I

**2. Contact Hours/Week:** L: 3                T: 1                P: 2/2

**3. Exam Duration (Hrs.):** Theory: 3                    Practical: 0

**4. Relative Weightage:** CWS: 15-30    PRS: 20    MTE: 15-25    ETE: 30-40    PRE: 0

**5. Credits:** 4                                    **6. Semester:** Autumn                            **7. Subject Area:** BSC

**8. Pre-requisite:** Nil

**9. Objective:** To provide basic knowledge and applications of Electromagnetic Theory and Quantum Mechanics.

#### **10. Details of the Course:**

S.No.	Contents	Contact Hours
1.	<b>Electromagnetic Theory:</b> Vector algebra and vector calculus, electrostatics and related Maxwell equations in differential form, magnetostatics and related Maxwell equations in differential form, boundary conditions, time-dependent fields and Maxwell's equations, wave equation, EM waves in free space and lossless dielectric, reflection and transmission at the interface (normal incidence)	21
2.	<b>Quantum Physics:</b> Black body radiation, Planck's radiation law, Compton effect, Frank-Hertz experiment, Davisson-Germer experiment, wave-particle duality, basic postulates of Quantum mechanics, Schrödinger wave equation, 1D problems (1-D box, linear harmonic oscillator, potential step, potential barrier)	21
<b>Total</b>		<b>42</b>

### **11. Suggested Books:**

S.No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
1.	Matthew N. O. Sadiku, "Elements of Electromagnetics", Oxford University Press, 7 <sup>th</sup> edition.	2021
2.	David J. Griffiths, Introduction to Electrodynamics, Prentice Hall of India, 4 <sup>th</sup> edition.	2015
3.	Arthur Beiser, "Concepts of Modern Physics", Tata McGraw Hill, 6 <sup>th</sup> edition.	2003
4.	Robert Eisberg, Robert Resnick, "Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles", Wiley, 2 <sup>nd</sup> edition	1985

### **List of Experiments:**

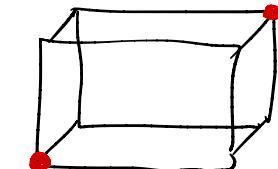
1. To study the variation of a magnetic field of paired coils in Helmholtz arrangement and verify the principle of superposition of magnetic field.
2. Determination of reverse saturation current  $I_0$  and material constant of PN junction also determine the energy band gap.
3. To determine the resistivity of a semiconductor as a function of temperature and to estimate its band gap using the four-probe method.
4. Measure the surface tension using the ‘break-away’ method and determine the density of the material of the ring.
5. To determine the first excitation potential of a gas by the Frank-Hertz Experiment.
6. To determine Planck’s Constant and work function using the photoelectric effect.
7. To study the single slit diffraction by laser light and determine slit width.
8. To determine the wavelength of sodium light by Newton’s Ring.

## # Vector Algebra →

Scalar  $\Rightarrow$  A scalar is a quantity that has only magnitude.  
Ex  $\Rightarrow$  Time, mass, distance, temp.

Vector  $\Rightarrow$  A vector quantity has both magnitude & direction.  
Ex: Velocity, force, displacement.

Field  $\Rightarrow$  A 'field' is any physical quantity which takes on different values at different point in space.



## heating

- |                      |   |
|----------------------|---|
| (i) $T(x, y, z)$     | Temperature field.  |
| $T(x, y, z, t)$      | Scalar field.   |
| (ii)                 | <br>Velocity field.<br>Vector field. |
| (iii) Electric field | Vector field  |
| (iv) Magnetic field  |   |

## # vector operation ↴

$$* \text{ Addition} \Rightarrow \bar{A} + \bar{B} = \bar{B} + \bar{A} \quad (\text{commutative})$$

## \* Multiplication by a scalar

$$a(\bar{A} + \bar{B}) = a\bar{A} + a\bar{B} \quad (\text{distributive})$$

\* Dot product of two vectors:

$$\overline{A} \cdot \overline{B} = AB \cos \theta.$$

$\bar{A} \cdot \bar{B}$  is the product of  $\bar{A}$  with the projection of  $\bar{B}$  along  $\bar{A}$ .

\* Cross product of two vectors  $\Rightarrow$

$$\boxed{\bar{A} \times \bar{B} = AB \sin\theta \hat{n}}$$

$\hat{n}$  is unit vector pointing  $\perp$  to the plane of  $\bar{A} + \bar{B}$ .

$$\bar{A} \times \bar{B} = \begin{vmatrix} \hat{x} & \hat{y} & \hat{z} \\ Ax & Ay & Az \\ Bx & By & Bz \end{vmatrix}$$

Direction  $\rightarrow$  Right-handed screw rule.

\* Triple product  $\Rightarrow$

(a)  $\Rightarrow$  Scalar Triple Product  $\Rightarrow$

$$\bar{A} \cdot (\bar{B} \times \bar{C}) = \begin{vmatrix} Ax & Ay & Az \\ Bx & By & Bz \\ Cx & Cy & Cz \end{vmatrix}$$

$\Rightarrow$  Volume of the parallelepiped generated by  $\bar{A}, \bar{B}, \text{ and } \bar{C}$

(b)  $\Rightarrow$  Vector Triple Product  $\Rightarrow$

$$\boxed{\bar{A} \times (\bar{B} \times \bar{C}) = (\bar{A} \cdot \bar{C}) \bar{B} - (\bar{A} \cdot \bar{B}) \bar{C}}$$