

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.	Electromagnetic Theory: 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.	Quantum Physics: 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
Total		42

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 th edition.	2021
2.	David J. Griffiths, Introduction to Electrodynamics, Prentice Hall of India, 4 th edition.	2015
3.	Arthur Beiser, "Concepts of Modern Physics", Tata McGraw Hill, 6 th edition.	2003
4.	Robert Eisberg, Robert Resnick, "Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles", Wiley, 2 nd 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.

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NAME OF DEPARTMENT/CENTRE: Mathematics

1. **Subject Code:** MAI-101 **Course Title:** Mathematics I
2. **Contact Hours:** **L:** 3 **T:** 1 **P:** 0
3. **Examination Duration (Hrs.):** **Theory:** 3 **Practical:** 0
4. **Relative Weightage:** **CWS:** 20-35 **PRS:** 0 **MTE:** 20-30 **ETE:** 40-50 **PRE:** 0
5. **Credits:** 4 **6. Semester:** Autumn **7. Subject Area:** BSC
8. **Prerequisite:** NIL
9. **Objective:** To provide the essential knowledge of basic tools of Differential Calculus, Integral Calculus, Vector Calculus and Matrix Algebra.

10. Details of the Course

S. No.	Contents	Contact Hours
1.	Matrix Algebra: Elementary operations and their use in getting the rank, inverse of a matrix and solution of linear simultaneous equations. Orthogonal, symmetric, skew-symmetric, Hermitian, skew-Hermitian, normal and unitary matrices and their elementary properties. Eigenvalues and Eigenvectors of a matrix, Cayley-Hamilton theorem, Diagonalization of a matrix.	8
2.	Differential Calculus: Limit, continuity and differentiability of functions of two variables, Euler's theorem for homogeneous equations, Tangent plane and normal. Change of variables, chain rule, Jacobians, Taylor's Theorem for two variables, Error approximations. Extrema of functions of two or more variables, Lagrange's method of undetermined multipliers	12
3.	Integral Calculus: Review of curve tracing and quadric surfaces, Double and Triple integrals, Change of order of integration. Change of variables. Gamma and Beta functions. Dirichlet's integral. Applications of Multiple integrals such as surface area, volumes, centre of gravity and moment of inertia..	12
4.	Vector Calculus: Differentiation of vectors, gradient, divergence, curl and their physical meaning. Identities involving gradient, divergence and curl. Line and surface integrals. Green's, Gauss and Stoke's theorem and their applications.	10
Total		42

11. Suggested Books:

S.No.	Name of Authors/Book/Publisher	Year of Publication / Reprint
1.	Kreyszig, E., "Advanced Engineering Mathematics", 10 th Ed., Wiley India Pvt. Ltd	2015
2.	Jain, R. K. and Iyenger, S. R. K., "Advanced Engineering Mathematics", 5 th Ed., Narosa Publishing House.	2017
3.	Thomas, G. B., Hass, J., Heil, C. and Weir M. D., "Thomas' Calculus", 14 th Ed., Pearson Education	2018

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NAME OF DEPARTMENT/CENTRE: Mathematics

1. **Subject Code:** MAI-102 **Course Title:** Mathematics II
2. **Contact Hours:** **L:** 3 **T:** 1 **P:** 0
3. **Examination Duration (Hrs.):** **Theory:** 3 **Practical:** 0
4. **Relative Weightage:** **CWS:** 20-35 **PRS:** 0 **MTE:** 20-30 **ETE:** 40-50 **PRE:** 0
5. **Credits:** 4 **6. Semester:** Spring **7. Subject Area:** BSC
8. **Prerequisite:** NIL
9. **Objective:** To introduce the basic concepts of linear algebra, probability and statistics.

10. Details of the Course

S. No.	Contents	Contact Hours
1.	Vector Spaces: Vector spaces (over the field of real numbers), subspaces, spanning set, linear independence, basis and dimension. Linear transformations, range and null space, rank-nullity theorem, matrix of a linear transformation.	8
2.	Inner Product Spaces: Inner-product spaces, Gram-Schmidt process, orthonormal basis; spectral theorem for real symmetric matrices, singular value decomposition; low-rank approximation.	6
3.	Probability and distributions: Concept of probability, random variables and their probability distributions, expectation, moments and moment generating functions, Chebyshev's inequality.	6
4.	Special distributions: (Discrete): Binomial, Poisson, Negative binomial, and Geometric distributions. (Continuous): Uniform, Exponential, Gamma, and Normal distributions.	5
5.	Bivariate random variables: Joint, marginal, and conditional distributions, statistical independence. Distributions of functions of random variables. Correlation and regression.	6
6.	Sampling Distributions: Random sampling and sampling distributions, law of large numbers, central limit theorem.	3
7.	Estimation: Point estimation, unbiased estimators, maximum likelihood estimation. Interval estimation, interval estimation of mean, variance and proportion for normal populations.	4
8.	Testing of Hypothesis: Simple and composite hypothesis, Type I and Type II errors, power of a test. Hypothesis testing for mean, variance and proportion for normal populations.	4
Total		42

11. Suggested Books:

S.No.	Name of Authors/Book/Publisher	Year of Publication / Reprint
1.	Axler, S., "Linear Algebra Done Right", 3 rd Ed., Springer Nature.	2015
2.	Strang, G., "Linear Algebra and Its Applications" 4 th Ed., Cengage India Private Limited.	2005
3.	Hogg, R. V., Mckean, J. and Craig, A. T., "Introduction to Mathematical Statistics", 8 th Ed., Pearson Education India	2021
4.	Rohatgi, V. K. and Saleh, A. K. Md. E., "An Introduction to Probability and Statistics" 2 nd Ed., Wiley India	2008
5.	Miller, I. and Miller, M., "John E. Freund's Mathematical Statistics with Applications", 8 th Ed., Pearson Education India	2013