TECHNO INDIA UNIVERSITY
WESTBENGAL

EM 4, Sector V, Salt Lake, Kolkata-700091, West Bengal, India
Phone: +91 9836544416/17/18/19, Fax: +91 33 2357 1097

2-Year Master of Science (M.Sc.) Curriculum and Syllabus for Physics

First Semester

Course Code	Course Title	Credit
TIU-PPH-S101	Career Advancement Skill Development-I	3
TIU-PPH-T101	Electronics	3
TIU-PPH-T103	Classical Mechanics	3
TIU-PPH-T105	Mathematical Methods of Physics I	3
TIU-PPH-T107	Quantum Mechanics-I	3
TIU-PPH-T109	Solid State Physics I	3
TIU-PPH-L101	Electronics Lab	3
TIU-PPH-L111	Computer Programming Lab (through C/C++)	2
TIU-PES-S199	Entrepreneurship Skill Development	2
	Total	**25**

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SEMESTER I

TIU-PPH-T101: ELECTRONICS [L-T-P-C: 3-1-0-3]

Review: Semiconductor devices, structure and characteristics and applications

Modulation and Detection: Amplitude modulation, Frequency modulation, Phase modulation, AM and FM spectrum, Channel bandwidth and signal bandwidth , Side band frequencies, Principle of Detection, Principle of generation of AM and FM waves with necessary circuits. Detector circuits, A.V.C. frequency changing, Superheterodyne receiver, Block diagram level.

Op Amps and Optoelectronic Devices: Op amps and their applications, Solar cells, Photodetectors, LED – basic principles, characteristics, spectrum, structures, applications. Lasser diodes- basic principles, characteristics, spectrum, structures applications.

Optical detectors: Photo-conductors, Photo-diodes, (PIN, Avalanche)

Review: Digital Electronics, Counters, Registers. ROM, PROM, EPROM, RAM, D/A and A/D converter, comparator.

Microprocessors: Basics of Microprocessors and Microcontrollers.

Texts:

1. A. S. Sedra and K. C. Smith, Electronics Circuits, (6th Edn), Oxford University Press (2009).
2. R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory (10th Edn), Prentice Hall (2008).

References:

3. D. P. Leach, A. P. Malvino and G. Saha, Digital Principles and Applications (6th Edn), Tata McGraw Hill (2007).
4. R. Gaekwad, Op-Amps and Linear Integrated Circuits, Prentice Hall of India (1995).
5. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085, Penram India (1999).

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TIU-PPH-T103: CLASSICAL MECHANICS [L-T-P-C: 3-1-0-3]

Review: Generalized coordinates, principle of virtual work, D'Alembert's principle, Lagrange equation and Hamilton's principle, Lagrange equation from Hamilton's principle, Extension to non-Holonomic systems, Lagrange multipliers, symmetry and conservation laws

Review: Central force including Two body problem in central force, Equations of motion, effective potential energy, Virial theorem, Kepler's problem, condition for closure of orbits, scattering in a central force field, centre of mass and laboratory frame

Review: Rigid body motion

Hamiltonian formulation: Legendre transformations, Hamilton's equations, symmetries and conservation laws in Hamiltonian picture, Hamilton's principle, canonical transformations, Poisson brackets, Lagrange Brackets, Hamilton-Jacobi theory, action-angle variables.

Small-oscillations: Eigen value problem, frequencies of free vibrations and normal modes, forced vibrations, dissipation.

Classical field theory: Lagrangian and Hamiltonian formulation of continuous system.

Special Theory of Relativity: Lorentz Transform, Relativistic Kinematics and Mass-Energy Relationship.

Texts

1. H. Goldstein, C. P. Poole and J. Safko, *Classical Mechanics,* 3rd Edition, Pearson (2012).

References

1. N. C. Rana and P. S. Joag, *Classical Mechanics*, Tata Mcgraw Hill (2001).
2. L. Landau and E. Lifshitz, *Mechanics,* Oxford (1981).
3. S. N. Biswas, *Classical Mechanics*, Books and Allied (P) Ltd., Kolkata (2004).
4. F. Scheck, *Mechanics,* Springer (1994).

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TIU-PPH-T105: MATHEMATICAL METHODS OF PHYSICS I [L-T- P-C: 3 -1 - 0 -3]

Complex Variable: Analytic functions, Cauchy-Riemann equation; Cauchy's integral formula; Taylor's expansion, Laurent's expansion; singularities and zeros; Residue formulae.

Differential Equations: The hyper geometric equation and functions; Confluent hyper geometric equation and functions; Representation of Legendre, Bessel and Hermite functions in terms of hyper geometric functions. Properties of Legendre, Bessel, Hermite and Laguerre functions, Green's Functions.

Linear space and operators: Vector space, inner product space, Schmidt's orthogonalisation method, Schwartz inequality. Linear operators- matrix representation of operators. Special operators-conjugate operators, adjoint and self adjoint operators, unitary operators, othogonality.

Texts:

1. G. B. Arfken, H. J. Weber and F. E. Harris, *Mathematical Methods for Physicists*, Seventh Edition, Academic Press (2012).
2. S. Andrilli & D. Hecker, *Elementary Linear Algebra*, Academic Press (2006).
3. A.W. Joshi, *Elements of Group Theory*, New Age Int. (2008).

References:

1. M. L. Boas, *Mathematical Methods in Physical Sciences*, John Wiley & Sons (2005).
2. S. Lang, *Introduction to Linear Algebra*, Second Edition, Springer (2012).
3. E. A. Coddington, *Introduction to Ordinary Differential Equations,* Prentice Hall of India (1989).
4. I. Sneddon, *Elements of Partial Differential Equations*, McGraw Hill
5. T. Lawson, *Linear Algebra*, John Wiley & Sons (1996).
6. P. Dennery & A. Krzywicki, *Mathematics for Physicists*, Dover Publications (1996).

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TIU-PPH-T107: QUANTUM MECHANICS I [L-T- P- C: 3 -1 - 0 -3]

Review based on: Postulates of Quantum Mechanics and Schrödinger equation

Overview of linear vector spaces: Inner product space, operators, expectation values of physical variables, bases, Dirac notation, eigen values and eigen vectors, commutation relations, Hilbert space.

Angular momentum: Commutation relations, spin angular momentum, Pauli matrices, raising and lowering operators, L-S coupling, Total angular momentum, addition of angular momentum, Clebsch-Gordon coefficients.

Three dimensional problems: spherical harmonics, free particle in a spherical cavity, central potential, Three dimensional harmonic oscillator, degeneracy, Hydrogen atom;

Perturbation Theory: Non-degenerate and Degenerate cases, Zeeman and Stark effects, induced electric dipole moment of Hydrogen; Real Hydrogen Atom: relativistic correction, spin-orbit coupling, hyperfine interaction, Helium atom, Pauli's exclusion principle, exchange interaction;

Texts:

1. R. Shankar, Principles of Quantum Mechanics, Springer (India) (2008).

References:

1. J. J. Sakurai, Modern Quantum Mechanics, Pearson Education (2002).
2. K. Gottfried and T-M Yan, Quantum Mechanics: Fundamentals,2nd Ed., Springer (2003).
3. D. J. Griffiths, Introduction to Quantum Mechanics, Pearson Education (2005).
4. P. W. Mathews and K. Venkatesan, A Textbook of Quantum Mechanics, Tata McGraw Hill(1995).
5. F. Schwabl, Quantum Mechanics, Narosa (1998).
6. L. Schiff, Quantum Mechanics, Mcgraw-Hill (1968).
7. E. Merzbacher, Quantum Mechanics, John Wiley (Asia) (1999).
8. B. H. Bransden and C. J. Joachain, Quantum Mechanics, Pearson Education 2nd Ed. (2004).

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TIU-PPH-T109: SOLID STATE PHYSICS – I [L-T- P- C: 3 -1 - 0 -3]

Review based: on Crystal Structure & Classification of Solids

Lattice Vibration and Thermal Properties: Vibration of linear monatomic and diatomic Lattices, excitation of optical branch in ionic crystals- the infrared absorption, Localized vibrations, Quantization of Lattice vibrations, Experimental determination of the dispersion relations, inelastic scattering of neutrons, inelastic scattering of X-rays, Specific heat- lattice heat capacity, Einstein theory, Debye theory, Born's modification of the Debye theory, Heat capacity of diatomic lattices. Lattice thermal conductivity, phonon mean free path, Umklapp processes, Geometrical scattering, Gruneisen relation.

Elastic Constants of Crystals: Analysis of stress and strain, Dilation, elastic compliance and stiffness constants, elastic energy density, Elastic stiffness constant of cubic crystals, Elastic waves in cubic crystals.

Text:

1. Introduction to Solid State Physics, C. Kittel, 8th ed; John Wiley & Sons (2005).
2. Solid State Physics, J. D. Patterson and B.C. Bailey; Springer (2007).
3. Solid State Physics, A. J. Dekker; Prentice Hall

References:

1. Solid State Physics, N. W. Ashcroft and N. D. Mermin; Harcourt Asia Pte. Ltd. (2001).
2. Solid State Physics, M. S. Rogalski and S. B. Palmer; Gordon and Breach Science Publishers (2001).

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TIU-PPH-L101: ELECTRONICS LABORATORY [L-T- P- C: 0 - 0 - 6 - 3]

Typical experiments:

Half-wave and full-wave rectifiers; voltage regulation using Zener diode and IC 78xx; Regulated dual voltage power supply using IC 78xx and IC79xx; I/O characteristics of BJT in CB and CE configuration;

Single stage amplifier using a FET; OP-AMP Circuits: Adder, subtractor, differentiator, integrator and active filters;

Colpitts and Wien bridge oscillators; monostable and astable multivibrator using NE555; Universality of NOR/NAND gates; Verification of De Morgan's theorem, half-adder, full adder, multiplexers and de-multiplexers; comparators; JK flip-flop, mod-counters;

Assembly language programming exercises with INTEL 8085 microprocessor kit; Simple interfacing experiments with 8155/8255.

References:

1. P. B. Zbar and A. P. Malvino, Basic Electronics: a text-lab manual, Tata McGraw Hill (1983).
2. D. P. Leach, Experiments in Digital Principles, McGraw Hill (1986).
3. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085, Penram India (1999).