I B.Tech Physics Syllabus (June 2018 onwards)
PHIR11- PHYSICS I (Common to all branches)

Objectives

To introduce the notions of light matter interaction, fabrication of lasers, light propagation in waveguides, applications of lasers and optical fibers.

To understand the fundamentals of acoustics, crystal physics and structure determination of crystals.

To learn the fundamentals of magnetic, electrical and superconducting materials.

To introduce the thoughts of special theory of relativity.

Lasers

Introduction to Laser-characteristics of Lasers-Spontaneous and stimulated emissions – Einstein's coefficients – population inversion and lasing action – laser systems: Ruby laser, He-Ne Laser, semiconductor laser-applications-Holography.

Fiber Optics

Fermat's principle and Snell's law-optical fiber – principle and construction – acceptance cone - numerical aperture – V-Number - types of fibers, Fabrication: Double Crucible Technique- fiber optic communication principle – fiber optic sensors.

Acoustics

Introduction -reverberation – reverberation time – Sabine's formula – acoustics of buildings – ultrasonics – production of ultrasonics using piezoelectric method –magnetostriction method- applications.

Crystallography

Seven crystal systems and Bravais lattices– Miller indices – interplanar distance-symmetry operation -Bragg's law of X-ray diffraction –Laue Method- powder crystal method- structure determination for cubic system.

Magnetic materials, conductors and superconductors

Magnetic materials: Definition of terms – classification of magnetic materials and properties – domain theory of ferromagnetism- hard and soft magnetic materials – applications.

Conductors: classical free electron theory (Lorentz –Drude theory) – electrical conductivity

Superconductors: definition – Meissner effect – type I & II superconductors – BCS theory (qualitative) – high temperature superconductors – Josephson effects applications.

Special theory of relativity

Lorentz transformation -Time dilation – length contraction- mass-energy relation.

Outcome

Students will be able to know principle, construction of lasers, light propagation in optical fibers and their applications. Students will understand the acoustics of building, ultrasonics, crystal systems and structure determination. Students will also appreciate various materials properties like electrical, magnetic and superconducting. Students will also establish mass-energy relationship through special theory of relativity.

References

1. Laser Fundamentals, William T. Silfvast, 2nd edn, Cambridge University press, New York (2004)
2. Fundamentals of Physics, 6th Edition, D. Halliday, R. Resnick and J. Walker, John Wiley and Sons, New York (2001).
3. Introduction to solid state physics,7th Edn, Charls Kittel, Wiley, Delhi (2007)
4. *Concepts of Modern Physics. Arthur Beiser, Tata McGraw-Hill, New Delhi (2010).*
5. Fundamentals of Physics, R. Shankar, Yale University Press, New Haven and London (2014).

Laboratory Experiments

1. Torsional pendulum
2. Numerical aperture of an optical fiber
3. Radius of curvature of lens-Newton's Rings
4. Conversion of galvanometer into ammeter and voltmeter
5. Dispersive power of a prism – Spectrometer
6. Temperature measurement - Thermocouple
7. Thickness of a thin wire – Air Wedge
8. Superconductivity- measurement of transition temperature (Demonstration)
9. Kundt's tube experiment

References

1. Physics Laboratory Manual, Department of Physics, National Institute of Technology Tiruchirappalli (2018).
2. Practical Physics, R.K. Shukla, Anchal Srivastava, New age international (2011).
3. *B.Sc. Practical Physics, C.L Arora, S. Chand & Co. (2012).*

PHIR12 PHYSICS II
(Non-Circuit Branches)

Objectives

To introduce the concepts of matter waves, wave functions and its interpretation to understand the matter at atomic scale.

To understand the fundamentals of nuclear forces, models and classification of matter.

To know the basics of advanced materials and their applications.

To introduce the concepts of NDT, vacuum pumps and their applications.

Quantum Mechanics

Inadequacy of classical mechanics-black body radiation, photoelectric effect, Compton effect – wave and particle duality of radiation – de Broglie concept of matter waves – electron diffraction – Heisenberg's uncertainty principle – Schrodinger's wave equation – eigen values and eigen functions – superposition principle – interpretation of wave function – particle confined in one dimensional infinite square well potential.

Nuclear and Particle Physics

Nuclear properties and forces - Nuclear models - Shell model - Nuclear reaction - Radioactivity - types and half-life - Stellar nucleosynthesis. Fundamental forces - Particle physics - classification of matter - quark model - neutrino properties and their detection.

Advanced Materials

Nanomaterials: introduction and properties – synthesis – chemical vapour deposition – ball milling – applications. Carbon nanotubes: structure and properties – synthesis– arc method – pulsed laser deposition- applications.
Liquid Crystals: types – nematic, cholesteric, smectic – modes: dynamic light scattering, twisted nematic – display systems.
Shape memory alloys-one way and two-way memory effect- pseudoelasticity-applications-thermoelectric materials.

Non-Destructive Testing

Liquid penetrant testing – magnetic particle inspection- principle of ultrasonic testing – inspection methods – pulse-echo, through transmission-different types of scans — principle and types of radiography – exposure factor – attenuation of radiation – real time radiography – principle of thermography – thermographic camera – advantages and limitations.

Vacuum Technology

Introduction- Classification of vacuum pumps -rotary vane pump-roots pump-diffusion pump-turbo-molecular pump-measurement of low pressure-pirani gauge-penning guage - applications of vacuum technology - thin film deposition: thermal evaporation.

Expected Outcome

Students will be able to experience the behaviour of matter at atomic scale, role of nuclear and particle physics in applications like radioactivity and nuclear reactions. Students will also get an exposure to nanomaterial synthesis, liquid crystal display and shape memory alloys. Students will also familiarize various NDT methods, vacuum pumps and their applications.

References

1.*Concepts of Modern Physics. Arthur Beiser, Tata McGraw-Hill, New Delhi (2010).*

2.Fundamentals of Physics II, R. Shankar, Yale University Press, New Haven and London (2016).

3.Hand Book of Non-destructive evaluation, C.J. Hellier, McGraw-Hill, New York (2001).

4.Vacuum Science and Technology, V.V. Rao, T.B. Ghosh, K.L. Chopra, Allied Publishers, New Delhi (2008).

5.Introduction to Nanotechnology, C.P. Poole and F.J. Owens, Wiley, New Delhi (2007).

6. Introduction to Liquid Crystals Chemistry and Physics, 2nd Ed, *Peter J. Collings, Princeton University Press, New Jersey, (2002).*

7. Shape memory alloys - modeling and engineering applications, Ed. D. C. Lagoudas, Springer, New York (2008).

PHIR13-PHYSICS II
(Circuit Branches)

Objectives

To introduce the concepts of matter waves, wave functions and its interpretation to understand the matter at atomic scale.

To understand the fundamentals of nuclear forces, models and classification of matter.

To know the basics of advanced materials and their applications.

To familiarize the laws of electricity and magnetism, Maxwell’s equation and electromagnetic wave propagation.

To impart the fundamentals and classification of semiconductors.

Quantum Mechanics

Inadequacy of classical mechanics-black body radiation, photoelectric effect, Compton effect – wave and particle duality of radiation – de Broglie concept of matter waves – electron diffraction – Heisenberg's uncertainty principle – Schrodinger's wave equation – eigen values and eigen functions – superposition principle – interpretation of wave function – particle confined in one dimensional infinite square well potential.

Nuclear and Particle Physics

Nuclear properties and forces - Nuclear models - Shell model - Nuclear reaction - Radioactivity - types and half-life - Stellar nucleosynthesis. Fundamental forces - Particle physics - classification of matter - quark model - neutrino properties and their detection.

Advanced Materials

Nanomaterials: introduction and properties – synthesis – chemical vapour deposition – ball milling – applications. Carbon nanotubes: structure and properties – synthesis– arc method – pulsed laser deposition- applications.

Liquid Crystals: types – nematic, cholesteric, smectic – modes: dynamic light scattering, twisted nematic – display systems.

Shape memory alloys-one way and two-way memory effect- pseudoelasticity-applications-thermoelectric materials.

Semiconductor Physics

Introduction-Direct and indirect band gap semiconductors - Intrinsic semiconductor at 0 K-Intrinsic semiconductor at room temperature-Intrinsic carriers- Electron and Hole concentrations-doping-n-type – p-type-temperature variation of carrier concentration in extrinsic semiconductor-Extrinsic conductivity-Law of Mass action-Charge neutrality-Fermi level in extrinsic semiconductors-Electrical conduction in extrinsic semiconductors.

Electrodynamics

Electrostatics: Coulomb's law - Gauss's law – proof of Gauss's law- Electrostatic field in matter: dielectric polarization, polarizability and susceptibility - types of polarization – internal field and Claussius-Mosotti equation. Magetostatics: Lorentz force -Steady current and equation of continuity - Biot-Savart law – Ampere's law –Magnetostatic field in matter: torques and forces on magnetic dipoles-Magnetization-Faraday's law of induction – Maxwell's equations: generalization of Ampere's law – propagation of EM waves in free space.

Expected Out come

Students will be able to experience the behaviour of matter at atomic scale, role of nuclear and particle physics in applications like radioactivity and nuclear reactions. Students will get an exposure to nanomaterial synthesis, liquid crystal display and shape memory alloys. Students will also apprise electrical conduction in semiconductors, significance of Maxwell's equation.

References

1. Concepts of Modern Physics. Arthur Beiser, Tata McGraw-Hill, New Delhi (2010).
2. Fundamentals of Physics II, R. Shankar, Yale University Press, New Haven and London (2016).
3. Semiconductor Physics and Devices:Basic principle, Donald A. Neamen 4th ed,, McGraw-Hill, New York (2012).
4. Introduction to Elecrodynamics, David J. Griffiths, 3rd ed, Printice Hall of India, NewDelhi (2012).
5. Introduction to Nanotechnology, C.P. Poole and F.J. Owens, Wiley, New Delhi (2007).
6. Introduction to Liquid Crystals Chemistry and Physics, 2nd ed, *Peter J. Collings, Princeton University Press, New Jersey, (2002).*
7. Shape memory alloys-modeling and engineering applications, Ed. D. C. Lagoudas, Springer, New York (2008).

LABORATORY EXPERIMENTS

1. Specific rotation of a liquid – Half Shade Polarimeter
2. Wavelength of white light – Spectrometer
3. Wavelength of laser using diffraction grating
4. Calibration of Voltmeter – Potentiometer
5. Field along the axis of a Circular coil
6. Thermal conductivity –Lee's Disc
7. Non-destructive testing by ultrasonic flaw detector
8. Liquid penetrant testing
9. GM counter experiment
10. Photoelectric effect – Planck's constant

References

1. Physics Laboratory Manual, Department of Physics, National Institute of Technology Tiruchirappalli (2018).
2. Practical Physics, R.K. Shukla, Anchal Srivastava, New age international (2011).
3. *B.Sc. Practical Physics, C.L Arora, S. Chand & Co. (2012).*