I.K. Gujral Punjab Technical University, Kapurthala

Main Campus

Department of Physical Sciences

Ref No.: IKGPTU/PS/1361 Date: 05/09/2018

Subject: Proceedings of the Board of Studies (BoS), Physical Sciences (Material Science/Nano Science and Technology) meeting held on 30.08.2018.

A meeting of members of Board of Studies (BoS), Physical Sciences (Material Science/Nano Science and Technology) was held on 30.08.2018 in the Department of Physical Sciences, I K Gujral Punjab Technical University, Kapurthala,in reference to the meeting of BoS (Physics and Mathematics) members with the Vice Chancelor, IKGPTU held on 23.08.2018 in the office of Dean Academics (Minutes circulated vide Ref no. IKG-PTU/DA/1741 dated 29.08.2018) and decision to review the difficulty level of newly adopted Engineering Physics syllabus. The agenda of the meeting was discussed in detail and recommendations were made on point. The proceedings of the meetings were recorded in the minutes of the meeting as enclosed as an Annexure-A.

Submitted for necessary action.

Convener- BoS
Dr. Hitesh Sharma

Convener- BoS
Dr. Neetika

Chairman, Board of Studies
Head, Physical Sciences.

I.K.Gujral Punjab Technical University, Kapurthala

Main Campus

Department of Physical Sciences

Ref No.: IKGPTU/PS/ 1364 Date: 05/09/18

Minutes of Meeting

In reference to the meeting of BoS (Physics and Mathematics) members with the Vice Chancellor, IKGPTU held on 23.08.2018 in the office of Dean Academics (Minutes circulated vide Ref no. IKG-PTU/DA/1741 dated 29.08.2018) and decision to review the difficulty level of newly adopted Engineering Physics syllabus, a meeting of Board of Studies (BoS), Physical Sciences (Material Science/Nano Science and Technology) was held on 30.08.2018 in the Department of Physical Sciences, I K Gujral Punjab Technical University, Kapurthala.

The following BOS members were present in the meeting:

1. Dr. Amit Sarin (Chairperson)
2. Dr Rakesh Dogra, Member
3. Dr. Arvind Kumar, Member
4. Dr. Kanchan L. Singh,Member
5. Dr. Hitesh Sharma,Member
6. Dr. Maninder Kaur,Member
7. S. Navdeepak Sandhu, Member
8. Dr.Varinderjit Singh (Special invitee)
9. Dr.Neetika (Special invitee)

The following members could not attend the meeting:

1. Dr. Ravi Kumar, Member
1. Dr. Davinder Mehta,Member
2. Dr. R. K. Bedi,Member
3. Dr. Rajiv Malhotra, Member
4. Dr. Ranjan Kumar, Member
5. Dr. Harpreet Kaur Grewal, Member
6. Dr. B. D. Gupta,Member
7. Dr. P. Arumugam,Member
8. Dr.Harkirat Singh,(Special invitee)

The Board of Studies discussed on the agenda point and following recommendations were made:

Agenda item: To review the difficulty of Engineering Physics Course in B.Tech-1st Year

All BoS members discussed in detail the contents of all Engineering Physics courses in B.Tech-1st Year syllabus and some of difficulties being faced by students. The feedback received from BOS members who could not attend the meeting was also deliberated upon.Accordingly, the updated syllabus for Engineering Physics course for B.Tech-1st Year (All Engineering Branches) is enclosed as an attachment [Annexure-1].

Dr. Amit Sarin
Chairperson- BoS, Physical Sciences

Dean Academics

06/9/18

S.No.	Branch	Related Branches	Course codes	Course title	Credits
1	Civil Engineering	1. Civil Engineering	BTPH101-18	Mechanics of solids	4
		2.Construction Engineering & Management	BTPH111-18	Mechanics of solids Lab	1.5
2	Electrical Engineering	1.Electrical Engineering	BTPH102-18	Optics and Modern Physics	4
		2.Automation & Robotics			
		3.Electrical & Electronics Engineering	BTPH112-18	Optics and Modern Physics Lab	1.5
		4.Electronics & Electrical Engineering			
		5.Electrical Engineering & Industrial Control			
		6.Instrumentation & Control Engineering			
3	Mechanical Engineering	1.Mechanical Engineering	BTPH103-18	Electromagnetism	4
		2.Marine Engineering			
		3.Production Engineering	BTPH113-18	Electromagnetism Lab	1.5
		4.Industrial Engineering			
		5.Tool Engineering			
		6.Automobile Engineering			
		7.Aerospace Engineering			
		8.Aeronautical Engineering			
4	Computer Science Engineering	1.Computer Engineering	BTPH104-18	Semiconductor Physics	4
		2.Computer Science Engineering			
		3.Information Technology	BTPH114-18	Semiconductor	1.5

		4.3D Animation Engineering		Physics Lab	
5	Electronics and communication Engineering	1.Electronics & Communication Engineering	BTPH105-18	Semiconductor and Optoelectronics Physics	4
		2.Electronics & Computer Engineering			
		3.Electronics & Instrumentation Engineering	BTPH115-18	Semiconductor and Optoelectronics Physics Lab	1.5
		4.Electronics & Telecomm Engineering			
		5.Electronics Engineering			
6	Chemical Sciences	1.Chemical Engineering	BTPH106-18	Optics and Electromagnetism	4
		2.Petrochem & Petroleum Refinery Engineering	BTPH116-18	Optics and Electromagnetism Lab	1.5
		3.Textile Engineering			
		4.Food Technology			
7	Bio-Technology	Bio-Technology	BTPH107-18	Introduction to Physics: Biotechnology	4
			BTPH117-18	Physics Lab	1.5

BTPH101-18	Mechanics of Solids	L-3, T-1, P-0	4 Credits

Pre-requisites (if any): High-school education with Physics as one of the subject.

Course Objectives: The aim and objective of the course on **Mechanics of Solids** is to introduce the students of B. Tech. to the formal structure of vector mechanics, harmonic oscillators, and mechanics of solids so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the vector mechanics for a classical system.
CO2	Identify various types of forces in nature, frames of references, and conservation laws.
CO3	Know the simple harmonic, damped, and forced simple harmonic oscillator for a mechanical system.
CO4	Analyze the planar rigid body dynamics for a mechanical system.
CO5	Apply the knowledge obtained in this course to the related problems.

Detailed Syllabus:

PART-A

UNIT I: Vector mechanics *(10 lectures)*

Physical significance of gradient, Divergence and curl. Potential energy function, F = - Grad V, equipotential surfaces, Forces in Nature, Newton's laws and its completeness in describing particle motion, Conservative and non-conservative forces, curl of a force field; Central forces; Conservation of Angular Momentum and Energy, Introduction to Cartesian, spherical and cylindrical coordinate system, Inertial and Non-inertial frames of reference; Rotating coordinate system:- Centripetal and Coriolis accelerations.

UNIT II: Simple harmonic motion, damped and forced simple harmonic oscillator *(10 lectures)*

Mechanical simple harmonic oscillators, damped oscillations, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical oscillators, resonance.

PART-B

UNIT III: Planar rigid body mechanics *(10 lectures)*

Definition and motion of a rigid body in plane; Rotation in the plane, Angular momentum about a point of a rigid body in planar motion; center of mass, moment of inertia, theorems of moment of inertia, inertia of plane lamina, circular ring, moment of force, couple, Euler's laws of motion.

UNIT IV: Mechanics of solids*(10 lectures)*

Friction: Definitions: Types of friction, Laws of static friction, Limiting friction, Angle of friction, angle of repose; motion on horizontal and inclined planes. Methods of reducing friction, Concept of stress and strain at a point; Concepts of elasticity, plasticity, strain hardening, failure (fracture/yielding), one dimensional stress-strain curve; Generalized Hooke's law. Force analysis — axial force, shear force, bending moment and twisting moment. Bending stress; Shear stress; Concept of strain energy; Yield criteria.

Reference books andsuggested reading:

1. Engineering Mechanics, 2nd ed. - MK Harbola, Cengage Learning India, 2013.
2. Introduction to Mechanics - MK Verma, CRC Press Book, 2009.
3. Mechanics- DS Mathur, S Chand Publishing, 1981.
4. An Introduction to Mechanics - D Kleppner& R Kolenkow, Tata McGraw Hill 2009.
5. Principles of Mechanics - JL Synge & BA Griffiths, Nabu Press, 2011.
6. Mechanics - JP Den Hartog, DoverPublications Inc, 1961.
7. Engineering Mechanics- Dynamics, 7th ed. - JL Meriam, Wiley.
8. Theory of Vibrations with Applications-WT Thomson, Pearson.
9. An Introduction to the Mechanics of Solids, 2nd ed. with SI Units-SH Crandall, NC Dahl & TJ Lardner
10. Classical Mechanics- H. Goldstein, Pearson Education, Asia.
11. Classical mechanics of particles and rigid bodies-K.C Gupta, Wiley eastern, New Delhi.
12. Engineering Physics-Malik and Singh, Tata McGraw Hill.
13. Engineering Mechanics: Statics- 7th ed.-JL Meriam, Wiley, 2011.
14. Analytical Mechanics-Satish K Gupta, Modern Publishers.
15. https://nptel.ac.in/courses/122102004/

BTPH111-18	Mechanics of Solids Lab	L-0, T-0, P-3	1.5 Credits

Pre-requisites (if any): High-school education with Physics lab as one of the subject.

Course Objectives: The aim and objective of the Lab course on **Mechanics of Solids** is to introduce the students of B. Tech to the formal structure of Mechanics of solids so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be

CO1	Able to understand the concepts learned in the mechanics of solids.
CO2	Learning the skills needed to verify some of the concepts of theory courses.
CO3	Trained in carrying out precise measurements and handling sensitive equipment.
CO4	Able to understand the principles of error analysis and develop skills in experimental design.
CO5	Able to document a technical report which communicates scientific information in a clear and concise manner.

Detailed syllabus:

Note: Students are expected to perform about 10-12 experiments from the following list, selecting minimum of 7-8 from the Section-A and 3-4 from the Section-B.

Section -A

1. Measurements of length (or diameter) using vernier caliper, screw gauge, and travelling microscope. Use of Plumb line and Spirit level.
2. To determine the horizontal distance between two points using a Sextant.
3. To determine the vertical distance between two points using a Sextant.
4. To determine the height of an inaccessible object using a Sextant.
5. To determine the angular diameter of the sun using the sextant.
6. To determine the angular acceleration α, torque τ, and Moment of Inertia of flywheel.
7. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of **g** and (c) Modulus of rigidity.
8. To determine the time period of a simple pendulum for different length and acceleration due to gravity.
9. To study the variation of time period with distance between centre of suspension and centre of gravity for a compound pendulum and to determine: (i) Radius of gyration of the bar about an axis through its C.G. and perpendicular to its length. (ii) The value of g in the laboratory.
10. To determine the Young's Modulus of a Wire by Optical Lever Method.
11. To determine the Elastic Constants/Young's Modulus of a Wire by Searle's method.
12. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
13. To determine the Modulus of Rigidity of brass using Searle's method.
14. To find the moment of inertia of an irregular body about an axis through its C.G with the torsional pendulum.
15. To determine **g** by Kater's Pendulum.
16. To determine **g** and velocity for a freely falling body using Digital Timing Technique.
17. To find out the frequency of AC mains using electric-vibrator.

Section-B

Virtual lab:

1. To determine the angular acceleration α and torque τ of flywheel.
2. To determine the moment of inertia of a flywheel.
3. To find the acceleration of the cart in the simulator.
4. To find the distance covered by the cart in the simulator in the given time interval.
5. To verify that energy conservation and momentum conservation can be used with a ballistic pendulum to determine the initial velocity of a projectile, its momentum and kinetic energy.
6. To verify the momentum and kinetic energy conservation using collision balls.
7. To understand the torsional oscillation of pendulum in different liquid. and determine the rigidity modulus of the suspension wire using torsion pendulum.
8. To find the Time of flight, Horizontal range and maximum height of a projectile for different velocity, angle of projection, cannon height and environment.
9. The Elastic and Inelastic collision simulation will help to analyse the collision variations for different situations.
10. Demonstration of collision behaviour for elastic and inelastic type.
11. Variation of collision behavior in elastic and inelastic type.
12. Study of variation of Momentum, Kinetic energy, Velocity of collision of the objects and the Center of Mass with different velocity and mass.
13. Calculation of the Momentum, Kinetic energy, and Velocity after collision.

Reference book and suggested readings:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4thEdition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11^{th}Edn, 2011, Kitab Mahal.
4. Engineering Practical Physics, S. Panigrahi& B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4^{th}Edition, Cambridge University Press.
6. Laboratory Experiments in College Physics, C.H. Bernard and C.D. Epp, John Wiley and Sons, Inc., New York, 1995.
7. Practical Physics, G.L. Squires, Cambridge University Press, Cambridge, 1985.
8. Experiments in Modern Physics, A.C. Melissinos, Academic Press, N.Y., 1966.
9. Practical Physics, C L Arora. S. Chand & Company Ltd.
10. http://www.vlab.co.in
11. http://vlab.amrita.edu/index.php?sub=1

BTPH102-18	Optics and Modern Physics	L-3, T-1, P-0	4 Credits

Pre-requisite (if any):

1. High-school education with physics as one of the subject.
2. Mathematical course on differential equations.

Course Objectives: The aim and objective of the course on **Optics andModern Physics** is to introduce the students of B.Tech. to the subjects of wave optics, Quantum Mechanics, Solids, and Semiconductors so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Identify and illustrate physical concepts and terminology used in optics and other wave phenomena.
CO2	Understand optical phenomenon,such as, interference, diffraction etc. in terms of wave model.
CO3	Understand the importance of wave equation in nature and appreciate the mathematical formulation of the same.
CO4	Appreciate the need for quantum mechanics, wave particle duality, uncertainty principle etc. and their applications.
CO5	Understand some of the basic concepts in the physics of solids and semiconductors.

Detailed Syllabus:

PART-A

UNIT I: Waves and Oscillations*(10 lectures)*

Mechanicalsimple harmonic oscillators, damped harmonic oscillator, forced mechanical oscillators, impedance, steady state motion of forced damped harmonic oscillator, Transverse wave on a string, wave equation on a string, reflection and transmission of waves at a boundary, impedance matching, standing waves, longitudinal waves and their wave equation, reflection and transmission of waves at a boundary.

UNIT II: Optics and LASERS *(10lectures)*

Optics: Light as an electromagnetic wave, reflectance and transmittance, Fresnel equations (Qualitative idea), Brewster's angle, total internal reflection: Interference: Huygens' principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting; Young's double slit experiment,Michelson interferometer. Diffraction: Farunhofer diffraction from a single slit and a circular aperture,Diffraction gratings and their resolving power; LASERS:Spontaneous and stimulated emission, Einstein's theory of matter radiation interaction and A and B coefficients; population inversion, pumping, various modes, properties of laser beams, types of lasers: gas lasers (He-Ne), solid-state lasers (ruby), and its applications.

PART-B

UNIT III: Introduction to Quantum Mechanics *(10 lectures)*

Wave nature of Particles, Free-particle wave function and wave-packets, probability densities, Expectation values, Uncertainty principle, Time-dependent and time-independent Schrodinger equation for wave function, Born interpretation, Solution of stationary-state Schrodinger equation for one dimensional problems: particle in a box,linear harmonic oscillator.

UNIT IV: Introduction to Solids and Semiconductors *(10 lectures)*

Free electron theory of metals, Fermi level, density of states in 1, 2 and 3 dimensions, Bloch's theorem for particles in a periodic potential, Origin of energy bands (Qualitative idea); Types of electronic materials: metals, semiconductors, and insulators, Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction.

Reference books andsuggested reading:

1. I. G. Main, "Vibrations and waves in physics", Cambridge University Press, 1993.
2. H. J. Pain, "The physics of vibrations and waves", Wiley, 2006.
3. E. Hecht, "Optics", Pearson Education, 2008.
4. A. Ghatak, "Optics", McGraw Hill Education, 2012.
5. O. Svelto, "Principles of Lasers", Springer Science & Business Media, 2010.
6. D. J. Griffiths, "Quantum mechanics", Pearson Education, 2014.
7. R. Robinett, "Quantum Mechanics", OUP Oxford, 2006.
8. D.A. Neamen, "Semiconductor Physics and Devices", Times Mirror High Education Group, Chicago, 1997.
9. E.S. Yang, "Microelectronic Devices", McGraw Hill, Singapore, 1988.
10. B.G. Streetman, "Solid State Electronic Devices", Prentice Hall of India, 1995.
11. HK Malik and AK Singh, Engineering Physics, 2nd ed., Tata McGraw Hill, 2018.
12. S. Sharma and J. Sharma, Engineering Physics, Pearson, 2018.
13. https://nptel.ac.in/courses/117108037/3
14. https://nptel.ac.in/courses/115102023/

BTPH112-18	Optics and Modern Physics Lab	L-0, T-0, P-3	1.5 Credits

Pre-requisite (If any): High-school education with physics as one of the subject.

Course Objectives: The aim and objective of the lab on **Optic andModern Physics** is to introduce the students of B.Tech. class to the formal structure of wave and optics, Quantum Mechanics and semiconductor physics so that they can use these in Engineering branch as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Verify some of the theoretical concepts learnt in the theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	Introduced to the methods used for estimating and dealing with experimental uncertainties and systematic errors.
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Write a technical report which communicates scientific information in a clear and concise manner.

Detailed Syllabus:

Note: Students are expected to perform about 10-12 experiments from the following list, selecting minimum of 7-8 from the Section-A and 3-4 from the Section-B.

Section-A

1. To study the laser beam characteristics like; wave length using diffraction grating aperture & divergence.
2. Study of diffraction using laser beam and thus to determine the grating element.
3. To study laser interference using Michelson's Interferometer.
4. To determine the numerical aperture of a given optic fibre and hence to find its acceptance angle.
5. To determine attenuation & propagation losses in optical fibres.
6. To determine the grain size of a material using optical microscope.
7. To find the refractive index of a material/glass using spectrometer.
8. To find the refractive index of a liquid using spectrometer.
9. To find the velocity of ultrasound in liquid.
10. To determine the specific rotation of sugar using Laurent's half-shade polarimeter.
11. To study the characteristic of different p-n junction diode - Ge and Si.
12. To analyze the suitability of a given Zener diode as voltage regulator.
13. To find out the intensity response of a solar cell/Photo diode.
14. To find out the intensity response of a LED.
15. To find out the frequency of AC mains using electric-vibrator.

Section-B

Virtual lab:

1. To find the resolving power of the prism.
2. To determine the angle of the given prism.
3. To determine the refractive index of the material of a prism
4. To determine the numerical aperture of a given optic fibre and hence to find its acceptance angle.
5. To calculate the beam divergence and spot size of the given laser beam.
6. To determine the wavelength of a laser using the Michelson interferometer.
7. To revise the concept of interference of light waves in general and thin-film interference in particular.
8. To set up and observe Newton's rings.
9. To determine the wavelength of the given source.
10. To understand the phenomenon Photoelectric effect.
11. To draw kinetic energy of photoelectrons as a function of frequency of incident radiation.
12. To determine the Planck's constant from kinetic energy versus frequency graph.
13. To plot a graph connecting photocurrent and applied potential.
14. To determine the stopping potential from the photocurrent versus applied potential graph.

Reference books andsuggested reading:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11thEdn, 2011, Kitab Mahal.
4. Engineering Practical Physics, S. Panigrahi& B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4thEdition, Cambridge University Press.
6. Laboratory Experiments in College Physics, C.H. Bernard and C.D. Epp, John Wiley and Sons, Inc., New York, 1995.
7. Practical Physics, G.L. Squires, Cambridge University Press, Cambridge, 1985.
8. Experiments in Modern Physics, A.C. Melissinos, Academic Press, N.Y., 1966.
9. Practical Physics, C L Arora. S. Chand & Company Ltd.
10. http://www.vlab.co.in
11. http://vlab.amrita.edu/index.php?sub=1

BTPH103-18	Electromagnetism	L-3, T-1, P-0	4 Credits

Pre-requisites(if any):

1. High-school education with physics as one of the subject.
2. Mathematical course on vector calculus.

Course Objectives: The aim and objective of the course is to expose the students to the formal structure of electromagnetism so that they can use these inEngineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Specify the constitutive relationships for fields and understand their important.
CO2	Describe the static and dynamic electric and magnetic fields for technologically important structures.
CO3	Measure the voltage induced by time varying magnetic flux.
CO4	acquire the knowledge of Maxwell equation and electromagnetic field theory and propagation and reception of electro-magnetic wave systems.
CO5	have a solid foundation in engineering fundamentals required to solve problems and also to pursue higher studies.

Detailed Syllabus:

PART-A

UNIT I: Electrostatics in vacuum and linear dielectric medium*(10 lectures)*

Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential; Uniqueness theorem (Definition); examples: Faraday's cage; Boundary conditions of electric field;Energy of a charge distribution and its expression in terms of electric field.Electrostatic field and potential of a dipole. Bound charges due to electric polarization in Dielectrics; Electric displacement; Solving simple electrostatics problems in presence of dielectrics – Point charge at the centre of a dielectric sphere, charge in front of a dielectric slab.

UNIT II: Magnetostaticsin linear magnetic medium*(10 lectures)*

Bio-Savart law, Divergence and curl of static magnetic field; Concept of vector potential,Magnetization and associated bound currents; auxiliary magnetic field $\vec{H}$; Boundary conditions on $\vec{B}$and$\vec{H}$. Solving for magnetic field due to bar magnet; magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials; magnetic domains, hysteresis and B-H curve.

PART-B

UNIT III: Faraday's law and Maxwell's equations *(10 lectures)*

Faraday's law; equivalence of Faraday's law and motional EMF; Lenz's law; Electromagnetic breakingand its applications; Differential form of Faraday's law; energy stored in a magnetic field.Continuityequation for current densities; Modifying equation for the curl of magnetic field to satisfy continuityequation; displacement current and magnetic field arising from time-dependent electric field;Maxwell's equation in vacuum and non-conducting medium; Flow of energy and Poynting vector andPoynting theorem.

UNIT IV: Electromagnetic waves *(10 lectures)*

Wave equation for electromagnetic waves in free space and conducting medium, Uniform plane waves and general solution of uniform plane waves, relation between electric and magnetic fields of an electromagnetic wave their transverse nature.; Linear, circular and elliptical polarization, Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

Text and Reference Books:

1. D. Griffiths, Introduction to Electrodynamics, Pearson Education India; 4thed. (2015).
2. J D Jackson, Classical Electrodynamics, John Wiley and Sons (1999).
3. Halliday and Resnick, Fundamentals of Physics, Wiley (2011).
4. W. Saslow, Electricity, Magnetism and Light, Academic Press (2002).
5. HK Malik and AK Singh, Engineering Physics, 2nd ed., Tata McGraw Hill (2018).

BTPH113-18	Electromagnetism Lab	L-0, T-0, P-3	1.5 Credits

Pre-requisite (If any): High-school education

Course Objectives: The aim and objective of the lab course on **Electromagnetism** is to introduce the students of B. Tech. class to the formal structure of electromagnetism so that they can use these in various branches of engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Able to verify some of the theoretical concepts learnt in the theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	understand the methods used for estimating and dealing with experimental uncertainties and systematic "errors."
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Write a technical report which communicates scientific information in a clear and concise manner.

Detailed Syllabus:

Note: Students are expected to perform about 10-12 experiments from the following list, selecting minimum of 7-8 from the Section-A and 3-4 from the Section-B.

Section-A

1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses.
2. To study the magnetic field of a circular coil carrying current.
3. To study B-H curve for a ferromagnetic material using CRO.
4. To find out the frequency of AC mains using electric-vibrator.
5. To find out polarizability of a dielectric substance.
6. Determine a high resistance by leakage method using Ballistic Galvanometer.
7. To study the characteristics of a Series RC Circuit.
8. To study the series LCR circuit and determine its (a) Resonant Frequency, (b) Quality.
9. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency (b) Quality factor Q.
10. To determine the value of self-inductance by Maxwell Inductance Bridge.
11. To determine the value of self-inductance by Maxwell Inductance Capacitance Bridge.
12. To determine the mutual inductance of two coils by Absolute method.
13. To study the induced emf as a function of the velocity of magnet and to study the phenomenon of electromagnetic damping.
14. To determine unknown capacitance by flashing and quenching method.
15. To study the field pattern of various modes inside a rectangular waveguide.
16. To determine charge to mass ratio (e/m) of an electron by helical method.
17. To determine charge to mass ratio (e/m) of an electron by Thomson method.
18. To find out the horizontal component of earth's magnetic field (B_h).

Section-B

Virtual lab:

1. To find out the horizontal component of earth's magnetic field (B_h).
2. An experiment to study the variation of magnetic field with distance along the axis of a circular coil carrying current.
3. Aim is to find the horizontal intensity of earth's magnetic field at a place and moment of the bar magnet.
4. To determine the self-inductance of the coil (L) using Anderson's bridge.
5. To calculate the value of inductive reactance (X_L) of the coil at a particular frequency.
6. The temperature coefficient of resistor simulation will help the user to easily identify the change in resistivity of the resistor according to the change in temperature.

Reference books andsuggested reading:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11thEdn, 2011, Kitab Mahal.
4. Engineering Practical Physics, S. Panigrahi& B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4thEdition, Cambridge University Press.
6. Laboratory Experiments in College Physics, C.H. Bernard and C.D. Epp, John Wiley and Sons, Inc., New York, 1995.
7. Practical Physics, G.L. Squires, Cambridge University Press, Cambridge, 1985.
8. Experiments in Modern Physics, A.C. Melissinos, Academic Press, N.Y., 1966.
9. Practical Physics, C L Arora, S. Chand & Company Ltd.
10. http://www.vlab.co.in
11. http://vlab.amrita.edu/index.php?sub=1

BTPH104-18	Semiconductor Physics	L-3, T-1, P-0	4 Credits

Prerequisite(if any): Introduction to Quantum Mechanicsdesirable

Course Objectives: The aim and objective of the course on **Semiconductor Physics** is to introduce the students of B. Tech. class to the formal structure of semiconductor physics so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand and explain the fundamental principles and properties of electronic materials and semiconductors
CO2	Understand and describe the interaction of light with semiconductors in terms of fermi golden rule.
CO3	Understand and describe the impact of solid-state device capabilities and limitations on electronic circuit performance.
CO4	Understand the design, fabrication, and characterization techniques ofEngineered semiconductor materials.
CO5	Develop the basic tools with which they can study and test the newly developed devices and other semiconductor applications.

Detailed Syllabus:

PART-A

UNIT 1: Electronic materials*(10 lectures)*

Free electron theory of metals, Density of states in 1D, 2D, and 3D, Bloch's theorem for particles in a periodic potential, Energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, E-k diagram, Direct and indirect bandgaps, Types of electronic materials: metals, semiconductors, and insulators, Occupation probability, Fermi level, Effective mass.

UNIT II: Semiconductors*(10 lectures)*

Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, Metal-semiconductor junction (Ohmic and Schottky), Semiconductor materials of interest for optoelectronic devices.

PART-B

UNIT III: Light-semiconductor interaction*(10 lectures)*

Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission; Einstein coefficients, Population inversion, application in semiconductor Lasers; Joint density of states, Density of states for phonons, Transition rates (Fermi's golden rule), Optical loss and gain; Photovoltaic effect, Exciton, Drude model.

UNIT IV:Measurement Techniques*(10 lectures)*

Measurement for divergence and wavelength using a semiconductor laser, Measurements for carrier density, resistivity, hallmobility using Four-point probe and van der Pauwmethod, Hot-point probe measurement, capacitance-voltage measurements, parameterextraction from diode I-V characteristics.

Reference books andsuggested reading:

1. J. Singh: Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995).
2. B. E. A. Saleh and M. C. Teich: Fundamentals of Photonics, John Wiley & Sons, Inc., (2007).
3. S. M. Sze: Semiconductor Devices: Physics and Technology, Wiley (2008).
4. A. Yariv and P. Yeh, Photonics: Optical Electronics in Modern Communications, Oxford University Press, New York (2007).
5. P. Bhattacharya: Semiconductor Optoelectronic Devices, Prentice Hall of India (1997).
6. Ben G. Streetman: Solid State Electronics Devices, Pearson Prentice Hall.
7. D.A. Neamen, "Semiconductor Physics and Devices", Times Mirror High Education Group, Chicago, 1997.
8. E.S. Yang, "Microelectronic Devices", McGraw Hill, Singapore, 1988.
9. Online course: "Semiconductor Optoelectronics" by M R Shenoy on NPTEL.
10. Online course: "Optoelectronic Materials and Devices" by Monica Katiyar and Deepak Gupta on NPTEL.

BTPH114-18	Semiconductor Physics Lab	L-0, T-0, P-3	1.5 Credits

Pre-requisite(if any): (i) High-school education

Course Objectives: The aim and objective of the Lab course on **Semiconductor Physics** is to introduce the students of B.Tech. class to the formal structure of semiconductor physics so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Able to verify some of the theoretical concepts learnt in the theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	Introduced to the methods used for estimating and dealing with experimental uncertainties and systematic "errors."
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Write a technical report which communicates scientific information in a clear and concise manner.

Detailed Syllabus:

Note: Students are expected to perform about 10-12 experiments from the following list, selecting minimum of 7-8 from the Section-A and 3-4 from the Section-B.

Section-A

1. To study the characteristic of different PN junction diode-Ge and Si.
2. To analyze the suitability of a given Zener diode as a power regulator.
3. To find out the intensity response of a solar cell/Photo diode.
4. To find out the intensity response of a LED.
5. To determine the band gap of a semiconductor.
6. To determine the resistivity of a semiconductor by four probe method.
7. To confirm the de Broglie equation for electrons.
8. To study voltage regulation and ripple factor for a half-wave and a full-wave rectifier without and with different filters.
9. To study the magnetic field of a circular coil carrying current.
10. To find out polarizability of a dielectric substance.
11. To study B-H curve of a ferro-magnetic material using CRO.
12. To find out the frequency of AC mains using electric-vibrator.
13. To find the velocity of ultrasound in liquid.
14. To study the Hall effect for the determination of charge current densities.
15. Distinguish between Diamagnetic material, Paramagnetic and ferromagnetic material.
16. Measurement of susceptibility of a liquid or a solution by Quincke's method.
17. To study the sample with the nano-scale objects and measure surface topography with different scales, width and height of nano objects, and force-distance curves using AFM.
18. To study the temperature coefficient of Resistance of copper.
19. To determine the ratio k/e Using a transistor.
20. To compare various capacitance and verify the law of addition of capacitance.
21. To determine dipole moment of an organic molecule acetone.
22. To measure the temperature dependence of a ceramic capacitor.

23. Verification of the curie Weiss law for the electrical susceptibility of a ferromagnetic material.
24. To study the laser beam characteristics like; wave length using diffraction grating aperture & divergence.
25. To study laser interference using Michelson's Interferometer.
26. Study of diffraction using laser beam and thus to determine the grating element.

Section-B

Virtuallab:

1. To draw the static current-voltage (I-V) characteristics of a junction diode.
2. To plot the characteristics of thermistor and hence find the temperature coefficient of resistance.
3. To determine the resistivity of semiconductors by Four Probe Method.
4. To study Zener diode voltage as regulator and measure its line and load regulation.
5. To study the B-H Curve for a ferromagnetic material.
6. To study the Hall effect experiment to determine the charge carrier density.
7. To determine the magnetic susceptibilities of paramagnetic liquids by Quincke's Method.
8. To study the phenomena of magnetic hysteresis and calculate the retentivity, coercivity and saturation magnetization of a material using a hysteresis loop tracer.
9. Verification and design of combinational logic using AND, OR, NOT, NAND and XOR gates.

Reference books and suggested reading:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11thEdn, 2011, Kitab Mahal.
4. Engineering Practical Physics, S. Panigrahi& B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4thEdition, Cambridge University Press.
6. Laboratory Experiments in College Physics, C.H. Bernard and C.D. Epp, John Wiley and Sons, Inc., New York, 1995.
7. Practical Physics, G.L. Squires, Cambridge University Press, Cambridge, 1985.
8. Experiments in Modern Physics, A.C. Melissinos, Academic Press, N.Y., 1966.
9. Practical Physics, C L Arora, S. Chand & Company Ltd.
10. http://www.vlab.co.in
11. http://vlab.amrita.edu/index.php?sub=1

BTPH105-18	Semiconductor and Optoelectronics Physics	L-3, T-1, P-0	4 Credits

Prerequisite(if any): "Introduction to Quantum Mechanics" Desirable

Course Objectives: The aim and objective of the course on **Semiconductor and Optoelectronics Physics** is to introduce the students of B. Tech. class to the formal structure of semiconductor physics and Optoelectronics so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand and explain the fundamental principles and properties of electronic materials and semiconductors.
CO2	Understand and describe the interaction of light with semiconductors in terms of fermi golden rule.
CO3	Understand and describe the impact of solid-state device capabilities and limitations on electronic circuit performance.
CO4	Understand the design, fabrication, characterization techniques, and measurements ofEngineered semiconductor materials.
CO5	Learn the basics of the optoelectronic devices, LEDs, semiconductor lasers, and photo detectors.

Detailed Syllabus:

PART-A

UNIT -I: Electronic materials*(10 lectures)*

Free electron theory of metals, Density of states in 1D, 2D, and 3D,Bloch's theorem for particles in a periodic potential, energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, E-k diagram, Direct and indirect band gaps, Types of electronic materials: metals, semiconductors and insulators, Occupation probability, Fermi level, Effective mass of electron and hole.

UNIT -II: Semiconductors*(10 lectures)*

Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, Metal-semiconductor junction (Ohmic and Schottky).

PART-B

UNIT -III: Optoelectronic devices*(10 lectures)*

Radiative and non-radiative recombination mechanisms in semiconductors, Semiconductor materials of interest for optoelectronic devices; Semiconductor light emitting diodes (LEDs): light emitting materials, device structure, characteristics; Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission, Semiconductor laser: population inversion at a junction, structure, materials, device characteristics, Photovoltaics:Types of semiconductor photo detectors-p-n junction, PIN, and Avalanche-and their structure, materials, working principle, and characteristics, Noise limits on performance.

UNIT-IV: Measurement techniques*(10lectures)*

Measurement for divergence and wavelength using a semiconductor laser, Measurements for carrier density, resistivity, and hallmobility using Four-point probe and van der Pauw method, Hot-point probe measurement, capacitance-voltage measurements, parameterextraction from diode I-V characteristics.

Reference books andsuggested reading:

1. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995).
2. B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc. (2007).
3. S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley (2008).
4. A. Yariv and P. Yeh, Photonics: Optical Electronics in Modern Communications, Oxford University Press, New York (2007).
5. P. Bhattacharya: Semiconductor Optoelectronic Devices, Prentice Hall of India (1997).
6. Solid state electronics devices: Ben. G. Streetman Pearson Prentice Hall.
7. D.A. Neamen: "Semiconductor Physics and Devices", Times Mirror High Education Group, Chicago, 1997.
8. E.S. Yang: "Microelectronic Devices", McGraw Hill, Singapore, 1988.
9. Online course: "Semiconductor Optoelectronics" by M R Shenoy on NPTEL.
10. Online course: "Optoelectronic Materials and Devices" by Monica Katiyar and Deepak Gupta on NPTEL.

BTPH115-18	Semiconductor and Optoelectronics Physics Lab	L-0, T-0, P-3	1.5 Credits

Pre-requisite(if any): High-school education

Course Objectives: The aim and objective of the Lab course on **Semiconductor and Optoelectronics Physics** is to introduce the students of B.Tech. class to the formal lab structure of semiconductor physics so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Able to verify some of the theoretical concepts learnt in the theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	Introduced to the methods used for estimating and dealing with experimental uncertainties and systematic "errors."
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Write a technical report which communicates scientific information in a clear and concise manner.

Detailed Syllabus:

Note: Students are expected to perform about 10-12 experiments from the following list, selecting minimum of 7-8 from the Section-A and 3-4 from the Section-B.

Section-A

1. To study the characteristic of different PN junction diode-Ge and Si.
2. To analyze the suitability of a given Zener diode as a power regulator.
3. To find out the intensity response of a solar cell/Photo diode.
4. To find out the intensity response of a LED.
5. To determine the band gap of a semiconductor.
6. To determine the resistivity of a semiconductor by four probe method.
7. To confirm the de Broglie equation for electrons.
8. To study voltage regulation and ripple factor for a half-wave and a full-wave rectifier without and with different filters.
9. To study the magnetic field of a circular coil carrying current.
10. To find out polarizability of a dielectric substance.
11. To study B-H curve of a ferro-magnetic material using CRO.
12. To find out the frequency of AC mains using electric-vibrator.
13. To find the velocity of ultrasound in liquid.
14. To study the Hall effect for the determination of charge current densities.
15. Distinguish between diamagnetic material, paramagnetic and ferromagnetic material.
16. Measurement of susceptibility of a liquid or a solution by Quincke's method.
17. To study the sample with the nano-scale objects and measure surface topography with different scales, width and height of nano objects, and force-distance curves using AFM.
18. To study the temperature coefficient of Resistance of copper.
19. To determine the ratio k/e using a transistor.
20. To compare various capacitance and verify the law of addition of capacitance.

21. To measure the temperature dependence of a ceramic capacitor.
22. Verification of the curie Weiss law for the electrical susceptibility of a ferromagnetic material.
23. To study the laser beam characteristics like; wave length using diffraction grating aperture & divergence.
24. To study laser interference using Michelson's Interferometer.
25. Study of diffraction using laser beam and thus to determine the grating element.

Section-B

Virtuallab:

1. To draw the static current-voltage (I-V) characteristics of a junction diode.
2. To plot the characteristics of thermistor and hence find the temperature coefficient of resistance.
3. To determine the resistivity of semiconductors by Four Probe Method.
4. To study Zener diode voltage as regulator and measure its line and load regulation.
5. To study the B-H Curve for a ferromagnetic material.
6. To study the Hall effect experiment to determine the charge carrier density.
7. To determine the magnetic susceptibilities of paramagnetic liquids by Quincke's Method.
8. To study the phenomena of magnetic hysteresis and calculate the retentivity, coercivity and saturation magnetization of a material using a hysteresis loop tracer.
9. Verification and design of combinational logic using AND, OR, NOT, NAND and XOR gates.

Reference books and suggested reading:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11thEdn, 2011, Kitab Mahal.
4. Engineering Practical Physics, S. Panigrahi& B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4thEdition, Cambridge University Press.
6. Laboratory Experiments in College Physics, C.H. Bernard and C.D. Epp, John Wiley and Sons, Inc., New York, 1995.
7. Practical Physics, G.L. Squires, Cambridge University Press, Cambridge, 1985.
8. Experiments in Modern Physics, A.C. Melissinos, Academic Press, N.Y., 1966.
9. Practical Physics, C L Arora, S. Chand & Company LTD.
10. http://www.vlab.co.in
11. http://vlab.amrita.edu/index.php?sub=1

BTPH106-18	Optics and Electromagnetism	L-3, T-1, P-0	4 Credits

Prerequisite(if any): Introduction to Quantum Mechanics desirable

Course Objectives: The aim and objective of the course on **Optics and Electromagnetism** is to introduce the students of B.Tech. class to the basic concepts of optics and its applications, electricity and magnetism, and quantum physics, so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to understand

CO1	Identify and illustrate physical concepts and terminology used in optics and other wave phenomena.
CO2	Understand optical phenomena such as polarization, birefringence, interference, and diffraction in terms of the wave model.
CO3	Understand the importance of wave equation in nature and appreciate the mathematical formulation of the same
CO4	Acquire knowledge about the Maxwell equation and magnetic properties of materials.
CO5	Appreciate the need for quantum mechanics, wave particle duality, uncertainty principle etc.

Detailed syllabus:

PART-A

Unit I: Wave Optics (*8 lectures*)

Diffraction:Introduction to interference and example; concept of diffraction, Fraunhoferand Fresnel diffraction, Fraunhofer diffraction at single slit, double slit, and multiple slits;diffraction grating, characteristics of diffraction grating and its applications; Polarization:Introduction to polarization, polarisation by reflection,polarisation by double refraction,scattering of light, circular and elliptical polarisation, optical activity.

UNIT-II: Fibre Optics and LASERS(*12 lectures*)

Fibre Optics: Introduction, optical fibre as a dielectric wave guide: total internal reflection, numerical aperture and various fibre parameters, losses associated with optical fibres, step and graded index fibres, application of optical fibres;LASERS: Spontaneous and stimulated emission, Einstein's theory of matter radiation interaction and A and B coefficients; population inversion, pumping, various modes, properties of laser beams, types of lasers: gas lasers (He-Ne), solid-state lasers (ruby), applications.

PART-B

UNIT-III: Electromagnetism and Magnetic Properties of Materials*(10 lectures)*

Laws of electrostatics: Coulomb and Gauss Law, electric current and the continuity equation, laws of magnetism: Ampere's and Faraday's laws. Maxwell's equations (derivation and physical significance), Dielectric polarisation, permeability and dielectric constant, polar and non-polar dielectrics, internal fields in a solid, Clausius-Mossotti equation, applications of dielectrics; Magnetisation,permeability and susceptibility, classification of magnetic materials, ferromagnetism, magnetic domains and hysteresis, applications.

Unit IV: Quantum Mechanics *(10 lectures)*

Introduction to quantum physics, black body radiation, explanation using the photon concept, photoelectric effect, Compton effect, de Broglie hypothesis, wave-particle duality, Born's interpretation of the wave function, Davisson and Germer experiment: verification of matter waves, uncertainty principle, Schrodinger wave equation: particle in1-dimensional box.

Reference books andsuggested reading:

1. "Fundamentals of Physics", 6th Ed., D. Halliday, R. Resnick and J. Walker, John Wiley and Sons, Inc., New York, 2001.
2. "Physics", M. Alonso and E.J. Finn, Addison Wesley, .1992.
3. "Fundamentals of Optics", 4th Ed., F.A. Jenkins and H.E. White, McGraw-Hill Book Co., 1981.
4. "Optics", A Ghatak, Tata-McGraw Hill, New Delhi, 1992.
5. "Vibration and Waves", A.P. French, Arnold-Heinemann, New Delhi, 1972.
6. "Vibrations and waves in physics", I. G. Main, Cambridge University Press, 1993.
7. "The physics of vibrations and waves", H. J. Pain, Wiley, 2006.
8. "Optics", E. Hecht, Pearson Education, 2008.
9. "Optics", A. Ghatak, McGraw Hill Education, 2012.
10. "Principles of Lasers", O. Svelto, Springer Science & Business Media, 2010.
11. "Quantum mechanics", D. J. Griffiths, Pearson Education, 2014.
12. "Quantum Mechanics", R. Robinett, OUP Oxford, 2006.
13. "Semiconductor Physics and Devices", D.A. Neamen, Times Mirror High Education Group, Chicago, 1997.
14. "Microelectronic Devices", E.S. Yang, McGraw Hill, Singapore, 1988.
15. "Solid State Electronic Devices", B.G. Streetman, Prentice Hall of India, 1995.
16. HK Malik and AK Singh, Engineering Physics, 2nd ed., Tata McGraw Hill (2018).
17. https://nptel.ac.in/courses/117108037/3
18. https://nptel.ac.in/courses/115102023/

BTPH116-18	Optics and Electromagnetism Lab	L-0, T-0, P-3	1.5 Credits
Pre-requisite (if any): High-school education			
Course Objectives: The aim and objective of the lab on Optics and Electromagnetism is to provide students the firsthand experience of verifying various theoretical concepts learnt in theory courses so that they can use these in their branch of Engineering as per their requirement.			
Laboratory Outcomes: At the end of the course, students will be			

CO1	Able to verify some of the theoretical concepts learnt in the theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	Introduced to the methods used for estimating and dealing with experimental uncertainties and systematic "errors."
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Write a technical report which communicates scientific information in a clear and concise manner.

Detailed Syllabus:

Note: Students are expected to perform about 10-12 experiments from the following list, selecting minimum of 7-8 from the Section-A and 3-4 from the Section-B.

Section-A

1. To study the magnetic field of a circular coil carrying current.
2. To find out polarizability of a dielectric substance.
3. To study the laser beam characteristics like; wave length using diffraction grating aperture & divergence.
4. To study laser interference using Michelson's Interferometer.
5. Study of diffraction using laser beam and thus to determine the grating element.
6. To determine numerical aperture of an optical fibre.
7. To determine attenuation & propagation losses in optical fibres.
8. To find out the frequency of AC mains using electric-vibrator.
9. To find the refractive index of a material using spectrometer.
10. To find the refractive index of a liquid using spectrometer.
11. To study B-H curve for a ferromagnetic material using CRO.
12. To find the velocity of ultrasound in liquid.
13. To determine the grain size of a material using optical microscope.
14. To study the characteristics of solar cell.
15. To study the Characteristics of Light Emitting Diode (LED).
16. To determine the energy gap of a given semi-conductor.
17. To determine the specific rotation of sugar using Laurent's half-shade polarimeter.

Section-B

Virtual lab:

1. To find the resolving power of the prism.
2. To determine the angle of the given prism.
3. To determine the refractive index of the material of a prism.
4. To find the numerical aperture of a given optic fibre and hence to find its acceptance angle.
5. To calculate the beam divergence and spot size of the given laser beam.
6. To determine the wavelength of a laser using the Michelson interferometer.
7. To revise the concept of interference of light waves in general and thin-film interference in particular.
8. To set up and observe Newton's rings.
9. To determine the wavelength of the given source.
10. To understand the phenomenon Photoelectric effect as a whole.
11. To draw kinetic energy of photoelectrons as a function of frequency of incident radiation.
12. To determine the Planck's constant from kinetic energy versus frequency graph.
13. To plot a graph connecting photocurrent and applied potential
14. To determine the stopping potential from the photocurrent versus applied potential graph.

Reference books andsuggested reading:

1. "Fundamentals of Physics", 6th Ed., D. Halliday, R. Resnick and J. Walker, John Wiley and Sons, Inc., New York, 2001.
2. "Physics", M. Alonso and E.J. Finn, Addison Wesley, .1992.
3. "Fundamentals of Optics", 4th Ed., F.A. Jenkins and H.E. White, McGraw-Hill Book Co., 1981.
4. "Optics", A Ghatak, Tata-McGraw Hill, New Delhi, 1992
5. "Vibration and Waves", A.P. French, Arnold-Heinemann, New Delhi, 1972.
6. "Students Reference Manual for Electronic Instrumentation Laboratories",
7. "Laboratory Experiments in College Physics", C.H. Bernard and C.D. Epp, John Wiley and Sons, Inc., New York, 1995.
8. "Practical Physics", G.L. Squires, Cambridge University Press, Cambridge, 1985.
9. "Experiments in Modern Physics", A.C. Melissinos, Academic Press, N.Y., 1966.
10. "Practical Physics", C L Arora. S. Chand & Company LTD.
11. http://www.vlab.co.in
12. http://vlab.amrita.edu/index.php?sub=1

Hlath

BTPH107-18	Introduction to Physics in Biotechnology	L-3, T-1, P-0	4 Credits

Prerequisite(if any): High School knowledge

Course Objectives: The aim and objective of the course on Introduction to Physics in Biotechnology is to introduce the students of B. Tech. class to the basic concepts and applications of Lasers, fibre optics, X-rays, magnetic material, superconductivity and a brief introduction to quantum physics, so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Identify and illustrate physical concepts and terminology used in Lasers, fibre optics and other wave phenomena.
CO2	Understand the X-Rays and their applications to the ultrasounds.
CO3	Understand the importance of wave equation in nature and appreciate the mathematical formulation of the same
CO4	Appreciate the need for quantum mechanics, wave particle duality, uncertainty principle etc.
CO5	Understand the properties of magnetic materials and superconductivity.

Detailed Syllabus:

PART-A

UNIT I: LASERS and Fibre Optics*(10 lectures)*

Principles and working oflaser: population inversion, pumping, threshold population inversion,types of laser: solid state (Ruby), gas (He-Ne); application of lasers (Medical/Industrial Applications); Fibre Optics:Introduction, optical fibre as a dielectric wave guide, total internal reflection, step and graded index fibres, numerical aperture and various fibre parameters, losses associated with optical fibres, application of optical fibres.

UNIT II: Magnetic Materials and Superconductivity*(10 lectures)*

Origin of magnetism, Basic idea of Diamagnetic, Paramagnetic, Ferromagnetic, Ferrimagnetic and Ferrite materials, Soft and Hard Magnetic materials, magnetostriction, magnetic anisotropy, applications of magnetic materials; Superconductivity, properties of superconducting state, Meissner Effect, Type-I and Type-II superconductors,Introduction to BCS theory (Qualitative idea), applications in medical industry.

PART-B

UNIT III: X-rays and Ultrasounds*(10 lectures)*

X-rays, Production of X-rays, Continuous and Characteristic X-Rays, Absorption of X-rays, Bragg's law, Adverse effects of X-rays, X-ray radiography; Ultrasounds:Ultra sound generators, properties of ultrasound-waves and its propagation in biological tissues, Pulse echo techniques, Doppler principle, involvement in design of medical instruments, Adverse effects of ultrasound waves.

UNIT IV: Quantum Theory and Nano-Materials (*(10 lectures)*

Photoelectric effect, Compton effect and de-Broglie waves; Wave-particle duality, concept of Electron microscopy; Nano-materials,surface to volume ratio, electron confinement (qualitative description), top-down and bottom-up method of synthesis, qualitative idea of quantum well, quantum wire and quantum dot. Carbon nanotubes: types, properties and applications.

Text and Reference Books:

1. Engineering Physics, Malik; HK, Singh; AK, Tata McGraw Hill.
2. Concepts of Modern Physics, Beiser; A., Tata McGraw Hill.
3. Introduction to Solids, Azaroff LV, Tata Mc Graw Hill.
4. Engineering Physics, D.K. Bhattacharya, Poonam Tondon, Oxford University Press.
5. Optical Fibre system, Technology, Design & Applications, Kao; CK, McGraw Hill.
6. Laser Theory & Applications, Thygrajan; K, Ghatak; AK, Mc Millan India Ltd.

BTPH117-18	Physics lab	L-0, T-0, P-3	1.5 Credits

Pre-requisite (if any): High-school education

Course Objectives: The aim and objective of the Physics lab is to provide students the firsthand experience of verifying various theoretical concepts learnt in theory courses so that they can use these in Engineering as per their requirement.

Laboratory Outcomes: At the end of the course, students will be

CO1	Able to verify some of the theoretical concepts learnt in the theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	Introduced to the methods used for estimating and dealing with experimental uncertainties and systematic errors.
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Write a technical report which communicates scientific information in a clear and concise manner.

Detailed Syllabus:

Note: Students are expected to perform about 10-12 experiments from the following list, selecting minimum of 7-8 from the Section-A and 3-4 from the Section-B.

Section-A

1. To study the magnetic field of a circular coil carrying current.
2. To find out polarizability of a dielectric substance.
3. To study the laser beam characteristics like; wave length using diffraction grating aperture & divergence.
4. To study laser interference using Michelson's Interferometer.
5. Study of diffraction using laser beam and thus to determine the grating element.
6. To determine numerical aperture of an optical fibre.
7. To determine attenuation & propagation losses in optical fibres.
8. To find out the frequency of AC mains using electric-vibrator.
9. To determine the energy gap of a given semi-conductor.
10. To study B-H curve of a ferromagnetic material using CRO.
11. To find the velocity of ultrasound in liquid.
12. To determine the grain size of a material using optical microscope.
13. To study the characteristics of solar cell.
14. To study the Characteristics of Light Emitting Diode (LED).
15. To determine the specific rotation of sugar using Laurent's half-shade polarimeter.

Section-B

Virtual lab:

1. To find the numerical aperture of a given optic fibre and hence to find its acceptance angle.
2. To calculate the beam divergence and spot size of the given laser beam.
3. To determine the wavelength of a laser using the Michelson interferometer.
4. To revise the concept of interference of light waves in general and thin-film interference in particular.
5. To set up and observe Newton's rings.
6. To determine the wavelength of the given source.
7. To understand the phenomenon Photoelectric effect.
8. To draw kinetic energy of photoelectrons as a function of frequency of incident radiation.
9. To determine the Planck's constant from kinetic energy versus frequency graph.
10. To plot a graph connecting photocurrent and applied potential
11. To determine the stopping potential from the photocurrent versus applied potential graph.

Reference books andsuggested reading:

1. "Fundamentals of Physics", 6th Ed., D. Halliday, R. Resnick and J. Walker, John Wiley and Sons, Inc., New York, 2001.
2. "Physics", M. Alonso and E.J. Finn, Addison Wesley, 1992.
3. "Fundamentals of Optics", 4th Ed., F.A. Jenkins and H.E. White, McGraw-Hill Book Co., 1981.
4. "Optics", A Ghatak, Tata-McGraw Hill, New Delhi, 1992
5. "Vibration and Waves", A.P. French, Arnold-Heinemann, New Delhi, 1972.
6. "Students Reference Manual for Electronic Instrumentation Laboratories",
7. "Laboratory Experiments in College Physics", C.H. Bernard and C.D. Epp, John Wiley and Sons, Inc., New York, 1995.
8. "Practical Physics", G.L. Squires, Cambridge University Press, Cambridge, 1985.
9. "Experiments in Modern Physics", A.C. Melissinos, Academic Press, N.Y., 1966.
10. "Practical Physics", C L Arora. S. Chand & Company LTD.
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