ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY

Guwahati

Course Structure and Syllabus

B.Sc. PHYSICS (HONOURS)

(From Academic Session 2018-19 onwards)

2nd Semester

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B.Sc. Physics (HONOURS)

2nd Semester: Course Structure

Theory/ Practical	Sl. No	Sub Code	Subject	Hours Per week			Credits C
				L	T	P	
CORE (For Physics Honours)							
Theory	1	BPH181C201	Electricity and Magnetism	4	0	0	4
	2	BPH181C202	Waves and Optics	4	0	0	4
Practical	1	BPH181C211	Electricity and Magnetism Lab	0	0	4	2
	2	BPH181C212	Waves and Optics Lab	0	0	4	2
AECC-2							
Theory	1	BAECC181204	Environmental Science	2	0	0	2
Generic Elective-2 (Physics: For other Discipline)							
Theory	1	BGENP181203	Basic Electricity and Magnetism	4	0	0	4
Practical	1	BGENP181213	Basic Electricity and Magnetism Lab	0	0	4	2
Total				14	0	12	**20**
Total contact hours per week: 26 **Total Credit : 20**							

Course Code	Course Title	Hours per week L-T-P	Credit C
BPH181C201	**Electricity and Magnetism**	**4-0-0**	**4**

MODULE 1: Electric Field and Electric Potential

Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry. **(5 Lectures)**

Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force and Torque on a dipole. **(5 Lectures)**

Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor. Method of Images and its application to: (1) Plane Infinite Sheet and (2) Sphere. **(7 Lectures)**

MODULE 2:

Dielectric Properties of Matter: Electric Field in matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector **D**. Relations between **E**, **P** and **D**. Gauss' Law in dielectrics. **(6 Lectures)**

MODULE 3:

Magnetic Field: Magnetic force between current elements and definition of Magnetic Field **B**. Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of **B**: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field. **(7 Lectures)**

MODULE 4:

Magnetic Properties of Matter: Magnetization vector (**M).** Magnetic Intensity(**H).** Magnetic Susceptibility and permeability. Relation between **B, H, M**. Ferromagnetism. B-H curve and hysteresis. **(3 Lectures)**

MODULE 5:

Electromagnetic Induction: Faraday's Law. Lenz's Law. Self-Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current. **(5 Lectures)**

MODULE 6:

Electrical Circuits: AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit. **(5 Lectures)**

MODULE 7:

Ballistic Galvanometer: Torque on a current Loop. Ballistic Galvanometer: Current and Charge Sensitivity. Electromagnetic damping. Logarithmic damping. **(5 Lectures)**

Reference Books:

1. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
2. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
3. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
4. Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
5. Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
6. Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press.

Course Code	Course Title	Hours per week L-T-P	Credit C
BPH181C202	**Waves and Optics**	**4-0-0**	**4**

MODULE 1:

Superposition of Collinear Harmonic Oscillations:

Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N Collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences. **(5 Lectures)**

MODULE 2:

Superposition of two perpendicular Harmonic Oscillations:

Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses. **(2 Lectures)**

MODULE 3:

Wave Motion:

Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. **(3 Lectures)**

MODULE 4:

Velocity of Waves:

Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction. **(5 Lectures)**

MODULE 5:

Superposition of Two Harmonic Waves:

Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Plucked and Struck Strings. Melde's Experiment. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves. **(7 Lectures)**

MODULE 6:

Geometrical Optics:

Aberrations: chromatic aberration, spherical aberration, methods of minimizing the defects of monochromatic images. **(3 Lectures)**

MODULE 7:

Wave Optics:

Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence. **(3 Lectures)**

MODULE 8:
Interference:
Division of amplitude and wavefront. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index. **(7 Lectures)**

MODULE 9:
Interferometer:
Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer. **(3 Lectures)**

MODULE 10:
Diffraction: Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integral formula. (Qualitative discussion only) (**2 Lectures)**

MODULE 11:
Fraunhofer diffraction:
Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating.

(6 Lectures)

MODULE 12:
Fresnel Diffraction:
Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire. **(7 Lectures)**

Reference Books

1. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.

2. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
3. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
4. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
5. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
6. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
7. Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications.

Course Code	Course Title	Hours per week L-T-P	Credit C
BPH181C211	**Electricity and Magnetism Lab**	**0-0-4**	**2**

At least 75% of the experiments listed below are required to be performed by each student during the course

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 characteristics of a series RC Circuit.
3. To determine an unknown Low Resistance using Potentiometer.
4. To determine an unknown Low Resistance using Carey Foster's Bridge.
5. To compare capacitances using De'Sauty's bridge.
6. Measurement of field strength B and its variation in a solenoid (determine dB/dx)

7. To determine self-inductance of a coil by Anderson's bridge.

8. To study response curve of a Series LCR circuit and determine its
   (a) Resonant frequency,
   (b) Impedance at resonance,
   (c) Quality factor Q, and
   (d) Band width.

9. To study the response curve of a parallel LCR circuit and determine its
   (a) Anti-resonant frequency and
   (b) Quality factor Q.

10. To determine self-inductance of a coil by Rayleigh's method.
11. To determine the mutual inductance of two coils by Absolute method.

Reference Books

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. Engineering Practical Physics, S.Panigrahi and B.Mallick, 2015, Cengage Learning.
5. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub

Course Code	Course Title	Hours per week L-T-P	Credit C
BPH181C212	**Waves and Optics Lab**	**0-0-4**	**2**

At least 75% of the experiments listed below are required to be performed by each student during the course

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^2 –T law.
2. To investigate the motion of coupled oscillators.
3. To study Lissajous Figures.
4. Familiarization with: Schuster`s focusing; determination of angle of prism.
5. To determine refractive index of the Material of a prism using sodium lamp.
6. To determine the dispersive power and Cauchy constants of the material of a prism using mercury lamp.
7. To determine the wavelength of sodium light using Michelson's interferometer.
8. To determine wavelength of sodium light using Fresnel Biprism.
9. To determine wavelength of sodium light using Newton's Rings.
10. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
11. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
12. To determine dispersive power and resolving power of a plane diffraction grating.

Reference Books

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

Course Code	Course Title	Hours per week L-T-P	Credit C
BAECC181204	**Environmental Science**	**2-0-0**	**2**

MODULE 1: (2 Lectures)

Introduction to environmental studies

a. Multidisciplinary nature of environmental studies;
b. Scope and importance; Concept of sustainability and sustainable development.

MODULE 2: (6 Lectures)

Ecosystems

What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems:

a. Forest ecosystem
b. Grassland ecosystem
c. Desert ecosystem
d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

MODULE 3: (8 Lectures)

Natural Resources: Renewable and Non-renewable Resources

a. Land resources and land use change; Land degradation, soil erosion and desertification.
b. Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
c. Water: Use and over – exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state).
d. Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

MODULE 4: (8 Lectures)

Biodiversity and Conservation

a. Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots
b. India as a mega- biodiversity nation; Endangered and endemic species of India
c. Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity :In-situ and Ex-situ conservation of biodiversity.
d. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

MODULE 5: (8 Lectures)

Environmental Pollution

a. Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution
b. Nuclear hazards and human health risks
c. Solid waste management: Control measures of urban and industrial waste.
d. Pollution case studies.

MODULE 6: (7 Lectures)
Environmental Policies & Practices

a. Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
b. Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
c. Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

MODULE 7: (6 Lectures)
Human Communities and the Environment

a. Human population growth: Impacts on environment, human health and welfare.
b. Resettlement and rehabilitation of project affected persons; case studies.
c. Disaster management: floods, earthquake, cyclones and landslides.
d. Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan.
e. Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
f. Environmental communication and public awareness, case studies (e.g.,CNG vehicles in Delhi).

MODULE 8: (5 Lectures)
Field work

a. Visit to an area to document environmental assets: river/ forest/ flora/ fauna, etc.
b. Visit to a local polluted site-Urban/ Rural/ Industrial/ Agricultural.
c. Study of common plants, insects, birds and basic principles of identification.
d. Study of simple ecosystems-pond, river, Delhi Ridge, etc.

Recommended Books:

1. Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R. 1993. *This Fissured Land: An Ecological History of India*. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999.*Global Ethics and Environment*, London, Routledge.
4. Gleick, P. H. 1993. *Water in Crisis*. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll.*Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. *Science*, 339: 36--37.
7. McCully, P. 1996. *Rivers no more: the environmental effects of dams*(pp. 29--64). Zed Books.
8. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.

9. Odum, E.P., Odum, H.T. & Andrews, J. 1971.*Fundamentals of Ecology*. Philadelphia: Saunders.
10. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
11. Rao, M.N. & Datta, A.K. 1987. *Waste Water Treatment*. Oxford and IBH Publishing Co. Pvt. Ltd.
12. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012.*Environment*. 8th edition. John Wiley & Sons.
13. Rosencranz, A., Divan, S., & Noble, M. L. 2001. *Environmental law and policy in India*. *Tripathi 1992*. 14. Sengupta, R. 2003. *Ecology and economics*: An approach to sustainable development. OUP.
14. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi.
15. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. *Conservation Biology*: *Voices from the Tropics*. John Wiley & Sons.
16. Thapar, V. 1998. *Land of the Tiger*: *A Natural History of the Indian Subcontinent*.
17. Warren, C. E. 1971. *Biology and Water Pollution Control*. WB Saunders.
18. Wilson, E. O. 2006. *The Creation: An appeal to save life on earth*. New York: Norton.
19. World Commission on Environment and Development. 1987. *Our Common Future*. Oxford University Press.

Course Code	Course Title	Hours per weel L-T-P	Credit C
BGENP181203	**Basic Electricity and Magnetism**	**4-0-0**	**4**

MODULE 1: Vector Analysis:
Review of vector algebra (Scalar and Vector product), gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only)

(10 Lectures)

MODULE 2: Electrostatics:
Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line ofcharge, uniformly charged spherical shell and solid sphere, plane charged sheet,charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.

(22 Lectures)

MODULE 3: Magnetism:
Magnetostatics: Biot-Savart's law and its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law. Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para-and ferromagnetic materials. **(7 Lectures)**

MODULE 4: Electromagnetic Induction:
Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field.

(6 Lectures)

MODULE 5: Maxwell`s equations and Electromagnetic wave propagation:
Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.

(7 Lectures)

Reference Books:

1. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education
2. Electricity & Magnetism, J.H. Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press
3. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
4. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
5. D.J.Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin Cummings.

Course Code	Course Title	Hours per week L-T-P	Credit C
BGENP181213	**Basic Electricity and Magnetism Lab**	**0-0-4**	**2**

1. To use a Multimeter for measuring
   a. Resistances,
   b. AC and DC Voltages,
   c. DC Current, and
   d. checking electrical fuses.

2. Ballistic Galvanometer:
   a. Measurement of charge and current sensitivity
   b. Measurement of CDR
   c. Determine a high resistance by Leakage Method
   d. To determine Self Inductance of a Coil by Rayleigh's Method.

3. To compare capacitances using De'Sauty's bridge.
4. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx)
5. To study the Characteristics of a Series RC Circuit.
6. To study a series LCR circuit LCR circuit and determine its (a) Resonant frequency, (b) Quality factor

7. To study a parallel LCR circuit and determine its
   a. Anti-resonant frequency and
   b. Quality factor Q
8. To determine a Low Resistance by Carey Foster's Bridge.
9. To verify the Thevenin and Norton theorems
10. To verify the Superposition, and Maximum Power Transfer Theorems

Reference Books

1. Advanced Practical Physics for students, B.L.Flint & 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, 11th Ed.2011, Kitab Mahal
4. Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.

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