DR. RAM MANOHAR LOHIA AVADH UNIVERSITY, AYODHYA

Structure of Syllabus for the Program:
M.Sc./BSc-IV Year Subject: Physics

w. e. f. Session 2026-27

Structure of Syllabus Developed by			
Name of BOS Convener/ BOS Member	**Designation**	**Department**	**College/ University**
Prof S. S. Mishra	Dean	Faculty of Science	Dr R.M.L. Avadh University, Ayodhya
Prof. Rajeev Kumar Srivastava	Convener	Physics	Ganpat Sahay P G College, Sultanpur
Dr. Anoop Kumar Pandey	Member	Physics	K.S. Saket P.G. College Ayodhya
Dr. Gaurav Mishra	Member	Physics	K.S. Saket P.G. College Ayodhya
Prof. Prabhakar Singh	External Expert	Physics	I.I.T. BHU Varanasi
Prof. (Smt.) Anchal Srivastva	External Expert	Physics	University of Lucknow
Prof. Lallan Yadav	External Expert	Physics	D.D.U. University Gorakhpur

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Dr. Rammanohar Lohia Avadh University
Ayodhya (U.P.)

Syllabus for FYUP B.Sc. (Hons) Sem VIII/and M.Sc. Sem-II

Course Code		Course Title	Credits	T/P	Evaluation	
					CIE	ETE
A	B	C	D	E	F	G
FYUP B.Sc. (Hons) Sem VIII/and M.Sc. Sem-II						
B010801T	CORE	Advanced Quantum Mechanics	4	T	25	75
B010802T	CORE	Electrodynamics	4	T	25	75
B010803T	CORE	Electronics	4	T	25	75
B010804T	CORE	Lasers, Optical Fibers, and Sensors	4	T	25	75
B010805P	CORE	Physics Lab-2	4	P	50	50
		Total	20			

Abbreviations: FYUP – Four Year Undergraduate Programme, T – Theory, P – Practical, R – Research Project, CIE – Continuous Internal Evaluation, ETE – End term examination.

Note:

1. Research Project can be replaced by Dissertation or Internship or field/Survey work.
2. Research Project will be annually (Sem. III & IV), evaluated half yearly (Sem III) and finally in Sem. IV same will be applicable for Dissertation or Internship or field/Survey work.
3. For FYUP UG. (Hons. with Research), Students will do one annual Research Project in place of last CORE theory papers of semester VII & VIII. Credit and evaluation will be same as Research Project of PG Semester III & IV.

For FYUP Apprenticeship Embedded UG, Students have to do 12 months Apprenticeship of 1200 Hrs from National Apprenticeship Training Scheme (NATS) through NATS 2.0 Portal or from equivalent organisation /Industry/Institute. For this 40 Credit will be earned by the students.

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B010801T: Advanced Quantum Mechanics

Course Outcomes (COs):

After completion of this course, a student will be able to:

- CO1: They will be able to tackle time dependent perturbation theory and its applications.
- CO2: They will be able to understand relativistic quantum mechanics.
- CO3: They will be able to understand Dirac equation and its interpretation.
- CO4: They will be able to understand quantum representation of fields.

Unit-I

Perturbation Theory:

Perturbed oscillator, First order Stark effect, Zeeman effect, Variation method: Basic principles, Applications to: One-dimensional harmonic oscillator, Ground state energy of hydrogen atom, Ground state of helium atom, Time dependent perturbation theory, Emission and absorption of radiation, Spontaneous emission.

Unit-II

Relativistic Quantum Mechanism:

Relativistic formulation of quantum mechanics beginning with the Klein–Gordon equation for a free particle. Charge and current densities and their physical interpretation. Inclusion of electromagnetic interaction through minimal coupling. Dirac's relativistic wave equation, its covariant form, and the adjoint Dirac equation. Derivation of the continuity equation and its significance.

Unit-III

Dirac equation:

Solutions of the Dirac equation for a free particle. Interpretation of negative energy states as proposed by Dirac and further developed in the Feynman picture. Dirac equation in the presence of an electromagnetic field and its non-relativistic reduction. Application of the Dirac equation to a central potential, including spin angular momentum, spin–orbit interaction, and detailed treatment of the hydrogen atom.

Unit-IV

Quantization of Fields:

Concept of single-particle and many-particle Hilbert spaces and introduction to Fock space. Fundamentals of second quantization and occupation number representation. Creation and annihilation operators and their properties, with emphasis on bosonic systems. Representation of operators including change of basis and field operators. Representation of one-body and two-body operators and applications of second quantization in quantum systems.

References:

1. Quantum Mechanics by L.I. Schiff, Tata Mcgraw Hill Education Private Limited (2010).
2. Introduction To Quantum Mechanics by David J. Griffiths, Pearson (2005).
3. Advanced Quantum Mechanics by J. J Sakurai, Pearson (2005).
4. Quantum Mechanics: Theory And Applications by A. Ghatak, Macmillan India Limited (2004).
5. Relativistic Quantum Fields by James D. Bjorken, Sidney D. Drell, Dover publications (2012).
6. A First Book o f Quantum Field Theory by A Lahiri, Narosa Book Distributors Pvt. Ltd. (2005).

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B010802T: Electrodynamics Courses

Course Outcomes (COs):

At the end of this course, students will be able to

CO1: Students will be able to understand Poisson and Laplace equations.

CO2: They will learn different representations used in Electrodynamics and their physical significance.

CO3: They will learn the importance of EM Fields and their correlations with Maxwell's equations.

CO4: They will be able to understand the dynamics of charged particles in E.M. fields and various concepts of Plasma Physics.

UNIT I

Electrostatics Differential equation for electric field, Poisson and Laplace equations, Boundary value problems, Solutions of Laplace equation in cylindrical and spherical coordinates by orthogonal functions, dielectrics, polarization of a medium, electrostatic energy.

UNIT II

Maxwell's Equations Displacement current, vector and scalar potentials, gauge symmetry, Coulomb and Lorentz gauges, electromagnetic energy and momentum, conservation laws, inhomogeneous wave equation and Green's function solution. Electromagnetic Waves Plane waves in a dielectric medium, reflection and refraction at dielectric interfaces, frequency dispersion in dielectrics and metals, dielectric constant and anomalous dispersion, wave propagation in one dimension, group velocity, metallic wave guides, boundary conditions at metallic surfaces, propagation modes in wave guides, resonant modes in cavities.

UNIT III

Radiation Field of a localized oscillating source, fields and radiation in dipole and quadrupole approximations, antenna, radiation by moving charges, Lienard-Wiechert potentials, total power radiated by an accelerated charge, Lorentz formula.

UNIT IV

Concepts of Plasma Physics Formation of plasma, Debye theory of screening, plasma oscillations, motion of charges in electromagnetic fields, magneto-plasma, plasma confinement, hydromagnetic waves.

References:

1. J.D. Jackson, Classical Electrodynamics.
2. D.J. Griffiths, Introduction to Electrodynamics.
3. J.R. Reitz, F.J. Milford and R.W. Christy, Foundations of Electromagnetic Theory.
4. W.K.H. Panofsky and M. Phillips, Classical Electricity and Magnetism.
5. F.F. Chen, Introduction to Plasma Physics and Controlled Fusion.

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B010803T: Electronics

Course Outcomes (COs):
After completion of this course, a student will be able to: CO1: Thorough understanding of operational amplifiers. CO2: Design circuits using operational amplifiers for various applications. CO3: Explain the working and applications of Power Devices and Regulator Circuits. CO4: Design Oscillators and active filters using Op-Amps.

Unit-I

Operational Amplifier: Introduction to OP-Amp, Basic parameters, Applicability of OP-Amp in analog computation, OP-Amp as voltage follower, Adder, Subtractors, Integrator, Differentiator, Log amplifier, Anti-log Amplifier, Analog multiplier & divider circuit. OP-Amp as Low pass filter, High Pass, Band pass filter and Band elimination filter.

Unit-II

Transistor Oscillators: Oscillator as positive feedback amplifier, Condition of sustained oscillations, Phase shift and Wein bridge Oscillator, Hartley & Colpits circuit, Negative resistance oscillator, Frequency stability & distortion in oscillators, Miller circuit.

Unit-III

Non Sinusoidal Generators : Multi vibrators, Bistable, Monostable and Astable Multivibrators, Saw tooth wave generators, Pulse generator, Clipping and Clamping circuits.

Unit-IV

Power Electronics:

Power Devices: SCR- basic structure, I-V characteristics and two transistor model, DIAC and TRIAC, Basic structure, Operation timer and equivalent I-V characteristics, TRIAC as high power switch, DIAC as triggering device of TRIAC, UJT in over voltage protection, Saw tooth wave generation using UJT.

Regulator Circuits: Load and Line regulation, Stabilization ratio, Internal impedance and temperature coefficient of voltage regulation, Linear voltage regulation circuit.

Text and Reference Books:

1. Principle of electronics – V K Mehta
2. Switch model power conversion basic theory & design – K. Kit Sum (CRC Press, New York)
3. Power Electronics- P. C. Sen (Tata McGraw Hill)
4. Electronic Devices & Circuits- Millman & Halkias
5. Functional Electronics- Raja Raman

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B010804T : Lasers, Optical Fibers and Sensors

Course Outcomes (COs):

At the end of this course, students will be able to

1. Understand fundamental properties of LASERS and their operational principles.
2. Understand the operating principles and characteristics of Fiber Optics.
3. Understand and compare operating principles, characteristics of different Optical Fibers.
4. Understand fundamental theories, basic principles and components of optical fiber communication system.
5. Understand fundamental theories, basic principles and components of different types of Sensors.

UNIT- I

LASERS, Concept of Population Inversion, Laser Pumping, Resonators, Ruby laser, Helium Neon laser, Semiconductor lasers, Liquid laser, Dye laser and Chemical laser, Properties of lasers, Lasers in Chemistry, Communication by Laser, Laser in Atmospheric Optics, Laser in Astronomy, Laser in Biology, Laser in Medicine, Laser in Industry.

UNIT- II

Demands of Information Age, The promise of Optical information processing, Evolution of Fiber Optics, Optical fiber Communication System, Block diagram of Optical fiber Communication System, Light propagation through medium, Total internal reflection, Numerical Aperture, Acceptance Angle.

UNIT- III

The optical fiber, Structure and types of fiber, Single mode fiber, Multimode Fiber, Step-index fiber, Graded-index fiber, Attenuation loss, Fiber materials, Fabrication of Optical fibers, Mechanical Misalignment, Fiber joints and Couples, Fiber Splicing, Demonstration of fiber optic communication.

UNIT- IV

Optical Sensors, Advantages of optical Sensors, Properties of Sensors, Sensors types, Biomedical Sensors, Chemical Sensors, Electrical and Magnetic Sensors, Rotation Sensors, Fiber-Optic Gyroscope, Sensors for structural health monitoring, Miscellaneous Sensors.

Reference Books:

1. Optical Fiber Communication Principle and Practice: John M Senior, Pearson Education.
2. Optical Communication System: John Gower, Prentice Hall of India
3. Fiber Optics Communication: Palais, University Press
4. Introduction to Optical Fibers and its Applications: Rajesh Shukla LAP LAMBERT Academic Publishing
5. Nonlinear Fiber Optics: G.P. Agarwal, Academic Press, San Diego California.
6. Laser: Eberly
7. Principles of Laser: Orazio Svelto, Springer
8. Introduction to Optics: Anchal Srivastava etc, New Age International Publishers, New Delhi
9. Laser, theory and Applications: K. Thyagarajan

B010806P : Physics Lab-II

A. List of Experiments

1. To determine laser beam parameter
2. Characteristics of Solar cell
3. Study of Hall's effect in a given semiconductor.
4. Study of Op-amp - Basic operational circuits.
5. Astable and mono stable multivibrators using IC 555.

B. Industrial Training / Field visit .

**Marks distribution:*

ETE: One practical – 50

CTE: Practical record (20) + Field Visit (30) = 50

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