Semester - I

Paper (I) - Classical Mechanics

(DSC MPHY 101, Credits Theory 04, Lectures 60)

Duration of EoSE : 3 hrs. **Max. Marks : 70**

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain eight short answer type questions of 14 marks and the candidate is required to attempt any seven questions. Each question will carry two marks for correct answer. (7 x 2 = 14 Marks)

Part B of the paper will consist of four questions, one question from each unit with internal choice. Each question will carry 14 marks. (4 x 14 = 56 Marks)

Semester	Code of The Course	Title of The Course/Paper	NHEQF Level	Credits
I	DSC MPHY 101	Classical Mechanics	8	4
Level of Course	**Type of The Course**	**Delivery Type of The Course**		
Introductory	Core	Lecture, Sixty Lectures including diagnostic and formative assessments during lecture hours.		
Prerequisites	UG level qualification with Physics as a core subject from a UGC recognized college/Univ.			
Objectives of The Course :	The objective of the course is to provide students with a comprehensive understanding of advanced classical mechanics. The course aims to develop their knowledge and skills in analysing and solving problems related to these topics, using appropriate mathematical formalism and physical concepts.			

Unit - I : Holonomic & Non-Holonomic Constraints

D'Alembert's principle & Lagrange's equation, Velocity dependent potentials, Simple applications of Lagrangian formulation, Hamilton principle, Calculus of variations, Derivation of Lagrange's equation from Hamilton's principle, Extension of Hamilton's principle for nonconservative & non-holonomic systems, Method of Lagrange's multipliers, Conservation theorems & Symmetry properties, Noether's theorem, Conservation of energy, linear momentum & angular momentum as a consequence of homogeneity of time & space, Isotropy of space. **(15 Lectures)**

Unit - II : Generalized Momentum, Legendre Transformation & Hamilton's Eqns. of Motion

Simple applications of Hamiltonian formulation, Cyclic coordinates, Hamiltonian formulation of relativistic mechanics, Derivation of Hamilton's canonical equation from Hamilton's variational principle, The Principle of least action. **(15 Lectures)**

Unit - III : Canonical Transformation, Integral Invariant of Poincare

Lagrange's & Poisson brackets as canonical invariants, Equation of motion in Poisson bracket formulation, Infinitesimal contact transformation & Generators of symmetry, Liouvilee's theorem, Hamilton-Jacobi equation & its applications. **(15 Lectures)**

Unit - IV : Action Angle Variable & Adiabatic Invariance of Action Variable

The Keppler problem in action angle variables, Theory of small oscillation in Lagrangian formulation, Normal coordinates and its applications, Orthogonal transformation, Euler's theorem, Eigenvalues of the inertia tensor, Euler equations, Force free motion of a rigid body.

(15 Lectures)

Reference Books/Text Books

1. Classical Mechanics by Goldstein , Pearson Education.
2. Classical Mechanics by Landau and Lifshitz , Reed Educational and Professional Publishing Ltd.
3. Classical Mechanics by A. Raychoudhary , Oxford University Press, USA.
4. Classical Mechanics by J. M. Finn, Laxmi Publications.
5. Classical Mechanics by T. Kibble & F. H. Berkshire, Imperial College Press.

Suggested E-Resources :

1. MIT OpenCourseWare: Classical Mechanics - This resource provides lecture notes, problem sets, and solutions for a complete course on classical mechanics : https://ocw.mit.edu/courses/physics/8-01sc-classical-mechanics-fall-2016/
2. HyperPhysics - This online resource provides concise explanations and interactive simulations for various topics in mechanics : http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html
3. NPTEL/Swayam : https://onlinecourses.nptel.ac.in/noc22_ph28/preview
4. IIT Madras Lectures : https://www.youtube.com/playlist?list=PLtUBquogGkRukyAAWOmq2LmQx8Yf9H_3E

Course Learning Outcomes :

By the end of the course, students should be able to:

1. Understand the concept of Holonomic & non-holonomic constraints.
2. Understanding of theory of Lagrangian formulation, its applications, and Lagrange's multipliers.
3. Understanding of theory of Hamilton's principle and its extensions.
4. Basic theoretical formulation of conservation theorems, conservation of energy, Noether's theorem.
5. Understanding of linear & angular momentum in reference to homogeneity of time & space, isotropy of space.
6. Deep understanding of theories of cyclic coordinates, Hamiltonian formulation of relativistic mechanics.
7. Derivation of Hamilton's canonical equation from Hamilton's variational principle.
8. Theory of principle of least action and applications.
9. Theoretical formulation of Lagrange's and Poisson brackets as canonical invariants.
10. Development of equation of motion in Poisson bracket formulation.
11. Understanding of infinitesimal contact transformation and generators of symmetry & Liouvilee's theorem.
12. Explanation of Hamilton-Jacobi equation and applications.
13. Fundamental knowledge of theory of action angle variable, adiabatic invariance of action variable.
14. Formulation of Keppler problem in action angle variables.
15. Theoretical knowledge of small oscillation in Lagrangian reference.
16. Theory of orthogonal transformation, Euler's theorem.
17. Eigenvalues of inertia tensor, Euler equations.

M.Sc. (Physics)

Semester - I

Paper (II) - Quantum Mechanics

(DSC MPHY 102, Credits Theory 04, Lectures 60)

Duration of EoSE : 3 hrs. **Max. Marks : 70**

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain eight short answer type questions of 14 marks and the candidate is required to attempt any seven questions. Each question will carry two marks for correct answer. (7 x 2 = 14 Marks)

Part B of the paper will consist of four questions, one question from each unit with internal choice. Each question will carry 14 marks. (4 x 14 = 56 Marks)

Semester	Code of The Course	Title of The Course/Paper	NHEQF Level	Credits
I	DSC MPHY 102	Quantum Mechanics	8	4
Level of Course	Type of The Course	Delivery Type of The Course		
Introductory	Core	Lecture, Sixty Lectures including diagnostic and formative assessments during lecture hours.		
Prerequisites	UG level qualification with Physics as a core subject from a UGC recognized college/Univ.			
Objectives of The Course :	The objective of the course is to provide students with a comprehensive understanding of quantum mechanics at a step higher than the UG level. The course aims to develop their knowledge and skills in analysing and solving problems related to these topics, using appropriate mathematical formalism and physical concepts. The course targets development of advanced fundamentals in students for higher level problems of quantum mechanics and to prepare their advanced level fundamentals to enable to study them advanced quantum mechanics in upcoming semesters.			

Unit - I : States, Amplitude and Operators

States of a quantum mechanical system, Representation of quantum mechanical states, Properties of quantum mechanical amplitude, Operators & change of a state, A complete set of basis states, Products of linear operators, Language of quantum mechanics, Postulates, Essential definitions & commutation relations.

Observables & description of quantum system : Process of measurement, Expectation values, Time dependence of quantum mechanical amplitude, Observable with no classical analogue, Spin dependence of quantum mechanical amplitude on position, The wave function, Superposition of amplitudes, Identical particles. **(15 Lectures)**

Unit - II : Hamiltonian Matrix & Time Evolution of Quantum Mechanical States

Hermiticity of the Hamiltonian matrix, Time-independent perturbation of an arbitrary system, Simple matrix examples of time-independent perturbation, Energy eigenstates of a two-state system, Diagonalizing of energy matrix, Time-independent perturbation of two state system, The perturbative solution : Weak field & Strong field cases, General description of two state system, Pauli matrices, Ammonia molecule as an example of two state system. **(15 Lectures)**

Unit - III : Transition Between Stationary States

Transitions in a two-state system, Time-dependent perturbations - The Golden Rule, Phase space, Emission & absorption of radiation, Induced dipole transition & Spontaneous emission of radiation energy width of a quasi-stationary state.

The co-ordinate Representation : Compatible observables, Quantum conditions & uncertainty relation, Coordinate representation of operators, position, momentum & angular momentum, Time-dependence of expectation values, Ehrenfest's Theorem, The time evolution of wave function, Schrödinger's equation, Energy quantization, Periodic potential as an example.

(15 Lectures)

Unit - IV : Symmetries & Angular Momentum

Compatible observables & constants of motion, Symmetry transformation & conservation laws, Invariance under space & time translations, space rotation, Conservation of momentum, energy & angular momentum.

Angular momentum operators & their Eigenvalues, Matrix representations of the angular momentum operators & their eigenstates, Coordinate representations of the orbital angular momentum operators & their eigen state (spherical harmonics), Composition of angular momenta, Clebsch-Gordon coefficients tensor operators & Wigner-Eckart theorem, Commutation relations, of J_x, J_y, J_z with reduced tensor operator, Matrix elements of vector operators, Time reversal invariance & vanishing of static electric dipole moment of stationary state. **(15 Lectures)**

Reference Books/Text Books

1. Quantum Mechanics - A Modern Approach by Ashok Das and A.C. Melissinos, Gordon and Breach Science Publishers.
2. Quantum Mechanics by P.A.M. Dirac, Oxford University Press.
3. Quantum Mechanics by E. Merzbacher, Second Edition, John Wiley & Sons.
4. Quantum Mechanics - Relativistic Theory by L.P. Landau and E.M. Lifshitz, Pergamon Press.
5. Quantum Mechanics - Theory and Applications by A. Ghatak and S. Lokanathan, Third Edition, Mac. Millan, India Ltd.

Suggested E-Resources :

1. MIT OpenCourseWare : Introductory Quantum Mechanics - This resource offers lecture notes, assignments, and exams for a complete course on introductory quantum mechanics : https://ocw.mit.edu/search/?q=introductory%20quantum%20mechanics%20
2. HyperPhysics - This online resource provides concise explanations and interactive simulations for various topics in introductory quantum mechanics : http://hyperphysics.phy-astr.gsu.edu/hbase/quacon.html#quacon
3. IIT Madras Lectures : https://www.youtube.com/watch?v=vJR94oyY-as
4. Cosmo Learning : https://cosmolearning.org/courses/quantum-mechanics-lessons-from-drphysicsa/
5. Documentaries on Quantum Mechanics : https://cosmolearning.org/physics/documentaries?topic=18&sort=za

Course Learning Outcomes :

By the end of the course, students should be able to :

1. Understand the concept of Holonomic & non-holonomic constraints.

2. Understanding of theory of Lagrangian formulation, its applications, and Lagrange's multipliers.
3. Understanding of theory of Hamilton's principle and its extensions.
4. Basic theoretical formulation of conservation theorems, conservation of energy, Noether's theorem.
5. Understanding of linear & angular momentum in reference to homogeneity of time & space, isotropy of space.
6. Deep understanding of theories of cyclic coordinates, Hamiltonian formulation of relativistic mechanics.
7. Derivation of Hamilton's canonical equation from Hamilton's variational principle.
8. Theory of principle of least action and applications.
9. Theoretical formulation of Lagrange's and Poisson brackets as canonical invariants.
10. Development of equation of motion in Poisson bracket formulation.
11. Understanding of infinitesimal contact transformation and generators of symmetry & Liouvilee's theorem.
12. Explanation of Hamilton-Jacobi equation and applications.
13. Fundamental knowledge of theory of action angle variable, adiabatic invariance of action variable.
14. Formulation of Keppler problem in action angle variables.
15. Theoretical knowledge of small oscillation in Lagrangian reference.
16. Theory of orthogonal transformation, Euler's theorem.
17. Eigenvalues of inertia tensor, Euler equations.

M.Sc. (Physics)

Semester - I

Paper (III) - Classical Electrodynamics (I)

(DSC MPHY 103, Credits Theory 04, Lectures 60)

Duration of EoSE : 3 hrs. **Max. Marks : 70**

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain eight short answer type questions and the candidate is required to attempt any seven questions. Each question will carry two marks for correct answer. **(2 x 7 = 14 Marks)**

Part B of the paper will consist of four questions, one question from each unit with internal choice. Each question will carry 14 marks. **(4 x 14 = 56 Marks)**

Semester	Code of The Course	Title of The Course/Paper	NHEQF Level	Credits
I	DSC MPHY 103	Classical Electrodynamics (I)	8	4
Level of Course	**Type of The Course**	**Delivery Type of The Course**		
Introductory	Core	Lecture, Sixty Lectures including diagnostic and formative assessments during lecture hours.		
Prerequisites	UG level qualification with Physics as a core subject from a UGC recognized college/Univ.			
Objectives of The Course :	The objective of the first course in classical electrodynamics is to provide students with a comprehensive understanding of classical electrodynamics at a step higher than the UG level. The course aims to develop their knowledge and skills in analysing and solving problems related to these topics, using appropriate mathematical formalism and physical concepts. The course targets development of advanced fundamentals in students for higher level problems of classical electrodynamics, and to prepare their advanced level fundamentals to enable them solving advanced problems in classical electrodynamics in upcoming semesters.			

Unit - I : Electrostatics

Electric field, Gauss Law, Differential form of Gaussian law, Another equation of electrostatics & scalar potential, Surface distribution of charges, dipoles & discontinuities in the electric field and potential, Poisson & Laplace equations, Green's theorem, Uniqueness of the solution with the Dirichlet or Neumann boundary Conditions, Formal solutions of electrostatics, Boundary value problem with Green's function, Electrostatic potential energy and energy density, capacitance.
Boundary Value Problems in Electrostatics : Methods of images, Point charge in the presence of a grounded conducting sphere, Point charge in the presence of a charged insulated conducting sphere, Point charge near a conducting sphere at a fixed potential, Conducting sphere in a uniform electric field by method of images, Green function for the sphere, General solution for the

potential, Conducting sphere with hemispheres at different potentials, Orthogonal functions & expansion. **(15 Lectures)**

Unit - II : Multipoles, Electrostatics of Macroscopic Media, Dielectrics

Multipoles, Electrostatics of Macroscopic Media : Multipole expansion, Multipole expansion of the energy of a charge distribution in an external field, Elementary treatment of electrostatics with permeable media.

Dielectrics : Boundary value problems with dielectrics, Molar polarizability & electric susceptibility, Models for molecular polarizability, Electrostatic energy in dielectric media. **(15 Lectures)**

Unit - III : Magnetostatics

Introduction & definition, Biot & Savart Law, The differential equations of magnetostatics & Ampere's law, Vector potential & Magnetic induction for a current loop, Magnetic fields of a localized current distribution, Magnetic moment, Force, torque & energy of a localized current distribution in an external induction, Macroscopic equations, Boundary conditions on B and H, Methods of solving Boundary value problems in magnetostatics, Uniformly magnetized sphere, Magnetized sphere in an external field, Permanent magnets, Magnetic shielding, Spherical shell of permeable material in an uniform field. **(15 Lectures)**

Unit - IV : Time Varying Fields, Maxwell's Equations, Conservation Laws

Energy in a magnetic field, Vector & Scalar potentials, Gauge transformations, Lorentz gauge, Coulomb's gauge, Green function for the wave equation, Derivation of the equations of macroscopic electromagnetism, Poynting's theorem & conservation of energy and momentum for a system of charged particles & EM fields, Conservation laws for macroscopic media, Electromagnetic field tensor, Transformation of four potentials & four currents, Tensor dissipation of Maxwell's equations. **(15 Lectures)**

Reference Books/Text Books

1. Classical Electrodynamics by J.D. Jackson, Wiley Student Ed.
2. Classical Electrodynamics & Magnetism by Panofsky & Phillip, Dover Publications.
3. Introduction to Electrodynamics by Griffith, Cambridge University Press.
4. Classical Theory of Electrodynamics by Landau &Lifshitz, Elsevier.
5. Electrodynamics of Continuous Media by Landau &Lifshitz, Elsevier.

Suggested E-Resources :

1. MIT OpenCourseWare: Electricity and Magnetism - This resource offers lecture notes, assignments, and exams for a complete course on electricity and magnetism: https://ocw.mit.edu/courses/physics/8-02sc-physics-ii-electricity-and-magnetism-spring-2011/
2. HyperPhysics - This online resource provides concise explanations and interactive simulations for various topics in electromagnetism : http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html
3. NPTEL/Swayam Platform : https://onlinecourses.nptel.ac.in/noc21_ph05/preview
4. Physics Stack Exchange : https://physics.stackexchange.com/questions/9449/video-lectures-on-graduate-level-classical-electrodynamics
5. Cosmo Learning : https://cosmolearning.org/courses/special-relativity-and-electrodynamics-578/video-lectures/
6. IIT Madras Lectures : https://www.youtube.com/playlist?list=PLtUBquogGkRv5CME__m2oudBqW3_ffv33

Course Learning Outcomes :

By the end of the course, students should be able to :

1. Understand the concept of advanced electrostatics in the framework of Poisson & Laplace equations, Green's theorem, Dirichlet or Neumann boundary conditions.
2. Understand the concept of boundary value problems in electrostatics.
3. Grasping the concept of electrostatics to develop capability to solve problems.
4. Understand the concept of multipoles, electrostatics of macroscopic media & dielectrics.
5. Understand the concept of boundary value problems in dielectrics.
6. Understand the concept of advanced magnetostatics in detail.
7. Understand the concept of boundary value problems in magnetostatics.
8. Understand the concept of time varying fields, Maxwell's equations, conservation laws of macroscopic media.

M.Sc. (Physics)
Semester - I
Paper (IV) - Mathematical Methods In Physics
(DSC MPHY 104, Credits Theory 04, Lectures 60)

Duration of EoSE : 3 hrs. Max. Marks : 70

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain eight short answer type questions and the candidate is required to attempt any seven questions. Each question will carry two marks for correct answer. (2 x 7 = 14 Marks)

Part B of the paper will consist of four questions, one question from each unit with internal choice. Each question will carry 14 marks. (4 x 14 = 56 Marks)

Semester	Code of The Course	Title of the Course/Paper	NHEQF Level	Credits
I	DSC MPHY 104	Mathematical Methods In Physics	8	4
Level of Course	**Type of The Course**	**Delivery Type of The Course**		
Introductory	Core	Lecture, Sixty Lectures including diagnostic and formative assessments during lecture hours.		
Prerequisites	UG level qualification with Physics as a core subject from a UGC recognized college/Univ.			
Objectives of The Course :	The objective of the first course in mathematical methods in physics is to provide students with a comprehensive understanding of mathematical methods at the beginning stage of PG level. This is certainly steps higher than the mathematical physics studied at the UG level. The course aims to develop their knowledge and skills in analysing and solving problems related to these topics, using appropriate mathematical formalism and physical concepts. The course targets development of advanced fundamentals in students to enable them to cope-up with higher level complexities in mathematical theories in physics. It will prepare students with advanced level fundamentals to enable them understanding complex physical theories that possess the essential components of mathematics, and also to solve complex numericals in all branches of physics.			

Unit - I : Coordinates Transformation in *N*-Dimensional Space

Contravariant & covariant tensor, Jacobian, Relative tensor, Pseudo tensors (Example : charge density, angular momentum), Algebra of tensors, Metric tensor, Associated tensors, Riemann space (Example: Euclidean space and 4D Minkowski space), Christoffel symbols, Transformation of Christoffel symbols, Covariant differentiation, Ricci's theorem, Divergence, Curl & Laplacian tensor form, Stress & strain tensors, Hook's law in tensor form, Lorentz covariance of Maxwell equation, Klein Gordon & Dirac Equation, Test of covariance of Schrödinger equation.

(15 Lectures)

Unit - II : Group of Transformation : (Example : Symmetry Transformation Of Square)

Generators of a finite group, Normal subgroup, Direct product of groups, Isomorphism & Homomorphism, Representation theorem of finite groups, Invariants subspace & Reducible representations, Irreducible representation, Crystallographic point groups, Irreducible representation of C4V, Translation group & Reciprocal lattice. **(15 Lectures)**

Unit - III : Fourier Transforms

Development of Fourier integral from Fourier Series, Fourier & inverse Fourier transform, Simple Applications : Finite wave train, Wave train with Gaussian amplitude, Fourier transform of derivatives, Solution of wave equation as an application, Convolution theorem, Intensity in terms of spectral density for quasi monochromic EM waves, Momentum representation, Application of Fourier transform to diffraction theory : Diffraction pattern of one and two slits. **(15 Lectures)**

Unit - IV : Laplace Transforms & Applications

Laplace transformation of derivatives & integrals, Derivatives & integral of Laplace transformation, Convolution theorem, Impulsive function, Application of Laplace transform in solving linear differential equations with constant coefficient & with variable coefficient and linear partial differential equation. **(15 Lectures)**

Reference Books/Text Books

1. Mathematical Methods for Physicists by George Arfken, Academic Press.
2. Applied Mathematics for Engineers and Physicists by L. A. Pipe, McGraw Hill.
3. Mathematical Methods by Potter and Goldberg, Prentice Hall of India.
4. Elements of Group Theory for Physicists by A.W. Joshi, Wiley Eastern Ltd.
5. Vector Analysis (Schaum Series), McGraw Hill.

Suggested E-Resources :

1. Britannica : Mathematical Physics - This resource offers lecture notes, assignments, and exams for a complete course on mathematical physics : https://www.britannica.com/science/fractal
2. Study.com- This online resource provides concise explanations and interactive simulations for various topics in mathematical physics : https://study.com/academy/lesson/mathematical-physics-overview-application-concepts.html
3. NPTEL/Swayam Platform : https://onlinecourses.nptel.ac.in/noc22_ph36/preview
4. Online Lectures : https://www.youtube.com/playlist?list=PLDIWMHnDwyljd4tfGXbAft6fYCo0NksQw
5. Cosmo Learning : https://cosmolearning.org/courses/numerical-methods-and-programing/video-lectures/
6. Cosmo Learning : https://cosmolearning.org/topics/computational-physics/
7. IIT Madras Lectures : https://www.youtube.com/playlist?list=PLtUBquogGkRuZH23UO-8AWR4dzcu-La8_

Course Learning Outcomes :

By the end of the course, students should be able to :

1. Understand the concept of coordinate transformation in *N*-dimensional space.
2. Understand the concept of group transformation.
3. Understand the concept of Fourier transforms with special reference to applications in physical theories.
4. Understand the concept of Laplace transforms.
5. Understand the concept of associated properties of Laplace transformation.
6. Understand the concept of Laplace transformation with special reference to applications in physical theories.

M.Sc. (Physics)

Semester - I

Physics Practical Lab I(A) - Electronics/Advanced Optics/General Laboratory

(DSCP MPHY 111, Credits Practical 06, Practical Hours 180)

Note: Out of following experiments, 6 experiments must be done by the students in each semester.

(9 hrs. per week)

External Exam Duration : 4 hrs. — **Max. Marks : 60**

Internal Exam Duration : 2 hrs. — **Max. Marks : 40**

Semester	Code of The Course	Title of The Course/Paper	NHEQF Level	Credits
I	DSCP MPHY 111	Physics Practical Lab I(A) (Electronics/Advanced Optics/General Lab)	8	6
Level of Course	**Type of The Course**	**Delivery Type of The Course**		
Introductory	Core	Practical Hours, One Hundred & Eighty hours of postgraduate level experiments including diagnostic and formative assessments.		
Prerequisites	UG level qualification with Physics as a core subject from a UGC recognized college/Univ.			
Objectives of The Course :	The objective of the first course in practical physics is to provide students with a comprehensive understanding of practical physics. The course aims to develop their knowledge and skills in developing experimental skills at the postgraduate level and to endow them with a zeal for experimental physics. This will help nurture their interests in experimental domain to enable them to take-up research in physics as well in addition to preparing their experimental attitude for future careers in physics, such as, teaching at the school & UG, PG level.			

DSCP MPHY 111 : Physics Practical Lab I(A)

The inclusion of new experiments should be intimated and approved by the Convenor, Board of Studies before the start of the academic session. It is binding to have an experimental set-up of at least ten experiments listed below. In case the number of experiments performed by the student is less than eight, his marks shall be scaled down in the final examination on a pro-rata basis. Laboratory examination paper will be set by the external examiner out of eight or more experiments available at the center.

List of Experiments : Semester - I

1. To study transistor bias stability for determination of Q-point, leakage current and stability factor.

2. To study the non-inverting, inverting, unity buffer, adder & subtractor properties of an operational amplifier.
3. To study the integration and differentiation applications of an operational amplifier using CRO.
4. To design a single stage amplifier of a given voltage gain and lower cut of frequencies.
5. To design a RC coupled two stage amplifier of a given gain and the cutoff frequencies.
6. To determine Planck's constant using solar cell.
7. To determine Planck's constant and work function by a photocell.
8. To study regulated power supply using (a) Zener diode only, (b) Zener diode with a series transistor, (c) Zener diode with a shunt transistor.
9. To determine angle of minimum deviation and verify Fresnel's formula.
10. To study the percentage regulation and variation of ripple factor with load for a full wave rectifier.
11. To study analog to digital and digital to analog conversion.
12. To study a driven mechanical oscillator.
13. To verify Hartmann's formula using constant deviation spectrograph.
14. To find e/m of electron using Zeeman effect.
15. To design and study of pass filters in half-wave and full-wave rectifiers.
16. To align Michelson's Interferometer using He-Ne laser to observe concentric circular fringes.
17. To determine the wavelength of He-Ne laser using circular fringes with the help of Michelson's Interferometer.
18. To determine the wavelength of Na lamp and difference between the wavelengths of two sodium D-lines with the help of Michelson's Interferometer.
19. To study fringes of equal inclination and equal thickness using Na lamp in Michelson's Interferometer.
20. To align and determine the wavelength of He-Ne laser using Fabry-Perot Interferometer.
21. To determine the velocity of ultrasonic waves using ultrasonic interferometer.
22. To study elliptically polarized light using Babinet compensator.
23. To verify the Cauchy's dispersion relation of a given prism.
24. To study the DC gate control characteristics and anode current characteristics of SCR.
25. To determine wavelength of the laser monochromatic radiation by diffraction grating.
26. To determine numerical aperture, beam divergence and bending losses of in optical fiber.
27. To determine wavelength of the laser monochromatic radiation by slit method.
28. To study the characteristics of a UJT and use it to design a relaxation oscillator and measure its frequency.
29. To design a multivibrator of given frequency and study its wave shape.
30. To study the current-voltage characteristics of an FET.
31. To study the frequency-response of Hartley oscillator.
32. To determine Lo. Co. and RF of a given coil and to study the variations of RF with frequency.
33. Any other experiment compatible with the postgraduate level physics theory.

Course Learning Outcomes :

Through these experiments, students will develop practical skills in experimental techniques, data collection, analysis, and interpretation. They will also enhance their understanding of fundamental concepts and principles in advanced electronics & optics. The lab experiences will foster critical thinking, problem-solving abilities, and the application of theoretical knowledge to real-world scenarios.

M.Sc. (Physics)

Semester - I

Physics Practical Lab I(B) - Seminar (I)/Lab Project Work

(DSEP MPHY 131, Credits Practical 06, Practical Hours 180)

Note: Out of Seminar or presentation or Lab Project Work, student needs to select a practical work.

(9 hrs. per week)

External Exam Duration : 1 hrs. **Max. Marks : 60**

Internal Exam Duration : 1 hrs. **Max. Marks : 40**

Semester	Code of The Course	Title of The Course/Paper	NHEQF Level	Credits
I	DSEP MPHY 131	Physics Practical Lab I(B) (Electronics/Advanced Optics/General Lab)	8	6
Level of Course	**Type of The Course**	**Delivery Type of The Course**		
Introductory	Core	Practical Hours, One Hundred & Eighty hours of postgraduate level experiments including diagnostic and formative assessments.		
Prerequisites	UG level qualification with Physics as a core subject from a UGC recognized college/Univ.			
Objectives of The Course :	The objective of the first course in practical physics is to provide students with a comprehensive understanding of practical physics. The course aims to develop their knowledge and skills in developing experimental skills at the postgraduate level and to endow them with a zeal for experimental physics. This will help nurture their interests in experimental domain to enable them to take-up research in physics as well in addition to preparing their experimental attitude for future careers in physics, such as, teaching at the school & UG, PG level.			

DSCP MPHY 131 : Physics Practical Lab I(B)

The inclusion of new experiments should be intimated and approved by the Convenor, Board of Studies before the start of the academic session. It is binding to have an experimental set-up of at least ten experiments listed below. In case the number of experiments performed by the student is less than eight, his marks shall be scaled down in the final examination on a pro-rata basis. Laboratory examination paper will be set by the external examiner out of eight or more experiments available at the center.

M.Sc. (Physics)

Semester - II

Paper (V) - Electronics

(DSC MPHY 201, Credits Theory 04, Lectures 60)

Duration of EoSE : 3 hrs. **Max. Marks : 70**
Note: There will be two parts in end semester theory paper.
Part A of the paper shall contain eight short answer type questions and the candidate is required to attempt any seven questions. Each question will carry two marks for correct answer. **(2 x 7 = 14 Marks)**
Part B of the paper will consist of four questions, one question from each unit with internal choice.
Each question will carry 14 marks. **(4 x 14 = 56 Marks)**

Semester	Code of The Course	Title of The Course/Paper	NHEQF Level	Credits
II	DSC MPHY 201	Electronics	8	4
Level of Course	**Type of The Course**	**Delivery Type of The Course**		
Introductory	Core	**Lecture, Sixty Lectures including diagnostic and formative assessments during lecture hours.**		
Prerequisites	UG level qualification with Physics as a core subject from a UGC recognized college/University.			
Objectives of The Course :	The objective of the course in electronics in physics is to provide students with a comprehensive understanding of electronics at the initial postgraduate level. The course aims to develop their knowledge and skills in analysing and solving problems related to these topics, using appropriate mathematical formalism and physical concepts. The course targets development of advanced fundamentals in students to enable them to cope-up with higher level complexities in electronics theories in physics. It will prepare students with advanced level fundamentals in electronics to enable them understanding complex circuit theories and learn their applications in solving circuits.			

Unit - I : Operational Amplifiers
Differential amplifier - circuit configurations - dual input, balanced output differential amplifier, DC analysis, inverting and non-inverting inputs, CMRR-constant current bias level translator, Block diagram of typical OP-Amp analysis, Open-loop configuration, Inverting & Non-Inverting amplifiers, Op-Amp with negative feedback, Voltage series feedback, Effect of feedback on closed loop gain, Input resistance, Bandwidth & Output offset voltage, Voltage follower, Practical Op-Amp, Input offset voltage-input bias current-input offset current, Total output offset voltage, CMRR frequency response, DC & AC amplifier, Integrator & Differentiator. **(15 Lectures)**

Unit - II : Oscillators & Wave Shaping Circuits

Oscillator principle, Frequency stability response, The phase shift oscillator, Wein bridge oscillator, LC tunable oscillators, Multivibrators - Monostable, astable (free running) & bistable, Comparators, Square wave & Triangle wave generation, Clamping & Clipping circuits.

(15 Lectures)

Unit - III : Digital Electronics

Combinational logic : Standard representations for logic functions, Karnaugh map representation of logical functions, Simplification of logical functions using K-Map, Minimization of logical functions specified in Minterms/Maxterms or truth table, Don't care conditions, Adder (half & full), Subtractor (half & full), Comparator, Multiplexers and their uses, Demultiplexer/Decoders and their uses, BCD arithmetic, Parity generators/ Checkers, Code converters, Priority encoders, Decoder /Drivers for display devices, Seven segment display device, ROM, Programmable logic array, Basic concepts about fabrication & characteristics of integrated circuits. **(15 Lectures)**

Unit - IV : Sequential Logic

Flip-Flops : One-bit memory, RS, JK, JK master slave, T & D type flip flops, Shift resisters - Synchronous & Asynchronous counters, Cascade counters, Binary counter, Decade counter, A/D & D/A conversion- Basic principles, circuitry & simple applications, Voltage regulators - Fixed regulators, Adjustable voltage regulators, Switching regulators, Basic idea of IC 555 & its applications as Multivibrator & Square Wave Generator, Opto-electronic Devices : Photo diode, Phototransistor, Light Emitting Diode (LED) & applications. **(15 Lectures)**

Reference Books/Text Books

1. "Electronic Devices and Circuit Theory" by Robert Boylested and Louis Nashdsky, PHI, New Delhi - 110001, 1991.
2. "OP-AMP and Linear Integrated Circuits" by Ramakanth, A. Gayakwad, PHI, Second Edition 1991.
3. "Digital Principle and Applications" by A.P. Malvino and Donald P. Leach, TataMcGraw Hill Company, New Delhi, 1993.

Suggested E-Resources :

1. MIT OpenCourseWare : Electronics - This resource offers lecture notes, assignments, and exams for a complete course on electronics : https://ocw.mit.edu/search/?q=electronics
2. HyperPhysics - This online resource provides concise explanations and interactive simulations for various topics in electronics : http://hyperphysics.phy-astr.gsu.edu/hbase/Electronic/etroncon.html#c1
3. NPTEL/Swayam Platform : https://nptel.ac.in/courses/122106025
4. NPTEL/Swayam Platform : https://onlinecourses.nptel.ac.in/noc22_ee55/preview
5. Cosmo Learning : https://cosmolearning.org/courses/circuits-and-electronics-457/video-lectures/

Course Learning Outcomes :

By the end of the course, students should be able to :

1. Understand the concept of operational amplifiers.
2. Understand the concept of characteristics of operational amplifiers.
3. Understand the concept of applications of operational amplifiers.
4. Understand the concept of oscillators & wave-shaping circuits.
5. Understand the concept of characteristics of digital electronics of combinatorial circuits.
6. Understand the concept of sequential logic.
7. Understand the concept of optoelectronic devices & sequential logic.

M.Sc. (Physics)

Semester - II

Paper (VI) - Atomic & Molecular Physics

(DSC MPHY 202, Credits Theory 04, Lectures 60)

Duration of EoSE : 3 hrs. **Max. Marks : 70**
Note: There will be two parts in end semester theory paper.
Part A of the paper shall contain eight short answer type questions and the candidate is required to attempt any seven questions. Each question will carry two marks for correct answer. (2 x 7 = 14 Marks)
Part B of the paper will consist of four questions, one question from each unit with internal choice.
Each question will carry 14 marks. (4 x 14 = 56 Marks)

Semester	Code of The Course	Title of the Course/Paper	NHEQF Level	Credits
II	DSC MPHY 202	Atomic & Molecular Physics	8	4
Level of Course	**Type of the Course**	**Delivery Type of The Course**		
Introductory	Core	**Lecture, Sixty Lectures including diagnostic and formative assessments during lecture hours.**		
Prerequisites	UG level qualification with Physics as a core subject from a UGC recognized college/University.			
Objectives of The Course :	The objective of the course in atomic & molecular physics is to provide students with a comprehensive understanding of atomic & molecular physics. The course aims to develop their knowledge and skills in analysing and solving problems related to these topics, using appropriate mathematical formalism and physical concepts. The course targets development of basic and advanced fundamentals in students to enable them to cope-up with higher level complexities in atomic and molecular theories in physics. It will prepare students with advanced level fundamentals in atomic & molecular physics to enable them understanding complex theories of atoms and molecules inculcating quantum mechanics as well.			

Unit - I : Gross Structure of Energy Spectrum of Hydrogen Atom

Interaction with external fields : Non-degenerate first order perturbation method, Relativistic correction to energy levels of an atom, Atom in a weak uniform external electric field - first & second order Stark effect, Calculation of polarizability of the ground state of hydrogen atom & of an isotropic harmonic oscillator, Degenerate stationary state perturbation theory, Linear Stark effect for hydrogen atom levels, Inclusion of spin-orbit interaction & weak magnetic field, Zeeman effect, Effect of strong magnetic field, Magnetic dipole interaction, Hyperfine structure & Lamb shift (only qualitative description). **(15 Lectures)**

Unit - II : Systems With Identical Particles

Indistinguishability & Exchange symmetry, Many particle wave functions & Pauli's exclusion principle, Spectroscopic terms for atoms, Helium atom, Variational method and its use in calculation of ground state energy, Hydrogen molecule, Heitler London method for hydrogen molecule, WKB method for 1D-problem, Application to bound states (Bohr Sommerfeld quantization) and the barrier penetration. **(15 Lectures)**

Unit - III : Spectroscopy (Qualitative)

General features of the spectra of one and two electron systems - singlet, doublet and triplet characters of emission spectra, General features of alkali spectra, Rotation & Vibration band spectrum of a molecule, P,Q & R branches, Raman spectra for rotational & vibrational transitions, Comparison with infrared spectra - Application to learning about molecular symmetry, General features of electronic spectra, Frank-Condon's principle. **(15 Lectures)**

Unit - IV : Laser Cooling & Trapping of Atoms

Scattering force, Slowing an atomic beam, Chirp cooling, Optical molasses technique, Doppler cooling limit, Magneto-optical trap, Introduction to dipole force, Theory of dipole force, Optical lattice, Sisyphus cooling technique – description and its limit, Atomic fountain, Magnetic trap (only qualitative description) for confining low temperature atoms produced by laser cooling, Bose-Einstein condensation in trapped atomic vapors, Scattering length, Bose-Einstein condensate, Coherence of a Bose- Einstein Condensate, Atomic Laser. **(15 Lectures)**

Reference Books/Text Books

1. Atomic Spectra by White, McGraw Hill (CBS).
2. Molecular Spectra by Herzberg, Read Books.
3. Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles by Eisberg & Resnik, Wiley & Sons.
4. Atomic & Molecular Spectra by Rajkumar, LASER, KNRN Publishers.

Suggested E-Resources :

1. NPTEL : Atomic & Molecular Physics - This resource offers lecture notes, assignments, and exams for a complete course on atomic & molecular physics : https://onlinecourses.nptel.ac.in/noc23_ph16/preview
2. Study.com- This online resource provides concise explanations and interactive simulations for various topics in atomic & molecular physics : https://study.com/search/text/academy.html?q=Atomic+%26+Molecular+Physics+&pageType=lesson#/topresults/Atomic%20%26%20Molecular%20Physics
3. Cosmo Learning : https://cosmolearning.org/physics/courses?topic=19

Course Learning Outcomes :

By the end of the course, students should be able to:

1. Understanding of energy spectrum of hydrogen atom.
2. Understanding of effects of atoms in an electric field and a magnetic field.
3. Understanding of Stark effect & Zeeman effect.
4. Understanding of systems with identical particles.
5. Understanding of Hydrogen molecule, Heitler London method for hydrogen molecule.
6. Understanding of WKB method for 1D-problem, application to bound states (Bohr Sommerfeld quantization) and the barrier penetration.
7. Understanding of qualitative features of spectroscopy
8. Understanding of rotational & vibrational spectra in Raman spectroscopy & physics involved.
9. Understanding of Laser Cooling And Trapping of Atoms.
10. Understanding of magneto-optical trap.
11. Understand the concept of magnetic trap for atoms cooled by laser cooling technique.
12. Understand the concept of Bose-Einstein condensation in trapped atomic vapors & the concépt of atomic lasers.

M.Sc. (Physics)

Semester - II

Paper (VII) - Classical Electrodynamics (II)

(DSC MPHY 203, Credits Theory 04, Lectures 60)

Duration of EoSE : 3 hrs. **Max. Marks : 70**

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain eight short answer type questions and the candidate is required to attempt any seven questions. Each question will carry two marks for correct answer. **(2 x 7 = 14 Marks)**

Part B of the paper will consist of four questions, one question from each unit with internal choice. Each question will carry 14 marks. **(4 x 14 = 56 Marks)**

Semester	Code of The Course	Title of The Course/Paper	NHEQF Level	Credits
II	DSC MPHY 203	Classical Electrodynamics (II)	8	4
Level of Course	**Type of The Course**	**Delivery Type of The Course**		
Introductory	Core	**Lecture, Sixty Lectures including diagnostic and formative assessments during lecture hours.**		
Prerequisites	UG level qualification with Physics as a core subject from a UGC recognized college/University.			
Objectives of The Course :	The objective of the second course in classical electrodynamics is to provide students with a comprehensive understanding of advanced classical electrodynamics. The course aims to develop their knowledge and skills in analysing and solving problems related to these topics, using appropriate mathematical formalism and physical concepts. The course targets development of advanced fundamentals in students for higher level problems of classical electrodynamics, and to prepare their advanced level fundamentals to enable them solving advanced problems in classical electrodynamics.			

Unit - I : Plane Electromagnetic Waves & Wave Equation

Plane wave in a nonconducting medium, Frequency dispersion characteristics of dielectrics, Conductors & plasma, Waves in a conducting dissipative medium, Superposition of waves in one dimension, Group velocity, Casualty connection between D & E, Kramer's-Kroning relation.

(15 Lectures)

Unit - II : Magnetohydrodynamics & Plasma Physics

Introduction & definitions, MHD equations, Magnetic diffusion, Viscosity & Pressure, Pinch effect, Instabilities in pinched plasma column, Magnetohydrodynamics waves, Plasma oscillations, Short wave length limit of plasma oscillations & Debye shielding distance.

(15 Lectures)

Unit - III : Covariant Form of Electrodynamic Equations
Mathematical properties of the space- time special relativity, Invariance of electric charge covariance of electrodynamics, Transformation of electromagnetic field, Radiation by moving charges : Lienard-Wiechert Potential for a point charge, Total power radiated by an accelerated charge : Larmour's formula & its relativistic generalization, Angular distribution of radiation emitted by an accelerated charge, Radiation emitted by a charge in arbitrary extremely relativistic motion, Distribution in frequency & angle of energy radiated by accelerated charges, Thomson scattering & radiation, Scattering by quasi-free charges, Coherent & incoherent scattering, Cherenkov radiation. **(15 Lectures)**

Unit - IV : Radiation Damping, Self-Fields of A Particle, Scattering & Absorption of Radiation by A Bound System
Introductory considerations, Radiative reaction force from conservation of energy, Abraham-Lorentz evaluation of the self-force, Difficulties with Abraham-Lorentz model, Integro-differential equation of motion including radiation damping, Line breadth & level shift of an oscillator, Scattering & absorption of radiation by an oscillator, Energy transfer to a harmonically bound charge. **(15 Lectures)**

Reference Books/Text Books

1. Classical Electrodynamics by J.D. Jackson, Wiley Student Ed.
2. Classical Electrodynamics & Magnetism by Panofsky & Phillip, Dover Publications.
3. Introduction to Electrodynamics by Griffith, Cambridge University Press.
4. Classical Theory of Electrodynamics by Landau &Lifshitz, Elsevier.
5. Electrodynamics of Continuous Media by Landau &Lifshitz, Elsevier.

Suggested E-Resources :

1. MIT OpenCourseWare: Electricity and Magnetism - This resource offers lecture notes, assignments, and exams for a complete course on electricity and magnetism: https://ocw.mit.edu/courses/physics/8-02sc-physics-ii-electricity-and-magnetism-spring-2011/
2. HyperPhysics - This online resource provides concise explanations and interactive simulations for various topics in electromagnetism : http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html
3. NPTEL/Swayam Platform : https://onlinecourses.nptel.ac.in/noc21_ph05/preview
4. Electrodynamics Lectures : https://www.youtube.com/playlist?list=PLtUBquogGkRv5CME__m2oudBqW3_ffv33

Course Learning Outcomes :

By the end of the course, students should be able to :

1. Understand the concept of plane electromagnetic wave & development of wave equations.
2. Understand the concept of magnetohydrodynamics & plasma physics.
3. Understand the concept of covariant form of electrodynamic equations.
4. Understand the concept of Thomson scattering, radiation & Cherenkov radiation.
5. Understand the concept of Radiation Damping, Self-Fields of A Particle, Scattering & Absorption of Radiation by a bound system.
6. Understanding of these advanced concepts with the ability to solve correlated problems.

M.Sc. (Physics)

Semester - II

Paper (VIII) - Numerical Methods

(DSC MPHY 204, Credits Theory 04, Lectures 60)

Duration of EoSE : 3 hrs. **Max. Marks : 70**

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain eight short answer type questions and the candidate is required to attempt any seven questions. Each question will carry two marks for correct answer. **(2 x 7 = 14 Marks)**

Part B of the paper will consist of four questions, one question from each unit with internal choice. Each question will carry 14 marks. **(4 x 14 = 56 Marks)**

Semester	Code of The Course	Title of the Course/Paper	NHEQF Level	Credits
II	DSC MPHY 204	Numerical Methods	8	4
Level of Course	**Type of the Course**	**Delivery Type of the Course**		
Introductory	Core	Lecture, Sixty Lectures including diagnostic and formative assessments during lecture hours.		
Prerequisites	UG level qualification with Physics as a core subject from a UGC recognized college/University.			
Objectives of The Course :	The objective of the course in numerical methods in physics is to provide students with a comprehensive understanding of numerical methods. The course aims to develop their knowledge and skills in analysing and solving problems related to these topics, using appropriate mathematical formalism and physical concepts. The course targets development of advanced fundamentals in students to enable them to cope-up with higher level complexities in mathematical theories in physics. It will prepare students with advanced level fundamentals to enable them understanding complex physical theories that possess the essential components of numerical methods, and also to solve complex numericals in all branches of physics.			

Unit - I : Errors in Numerical Analysis

Source of Errors, Round-off error, Computer arithmetic, Error analysis, Condition & stability, Approximation, Functional & Error analysis, Method of undetermined coefficients, Use of interpolation formula, Iterated interpolation, Inverse interpolation, Hermite interpolation & Spline interpolation, Solution of Linear equations : Direct and Iterative methods, Calculation of eigen values and eigen vectors for symmetric matrices.

(15 Lectures)

Unit - II : Solution of Nonlinear Equation

Bisection method, Newton's method, Modified Newton's method, Method of Iteration, Newton's method & method of iteration for a system of causation Newtons' method for the case of complex roots, Integration of a function, Trapezoidal & Simpson's rules, Gaussian quadrature formula, Singular integrals, Double integration. **(15 Lectures)**

Unit - III : Integration of Ordinary Differential Equation

Predictor-corrector methods, Runga-Kutta method, Simultaneous & Higher order equations. Numerical Integration & Differentiation of Data, Least-Squares Approximations, Fast Fourier Transform (FFT). **(15 Lectures)**

Unit - IV

Elementary probability theory, Random variables, Binomial, Poisson & Normal distributions. **(15 Lectures)**

Reference Books/Text Books

1. A First Course in Numerical Analysis by A. Relston and P. Rabinowitz, McGraw Hill (1985).
2. Introductory Methods of Numerical Analysis by S. S. Sastry, Prentice-Hall of India (1979).
3. Numerical Methods by P. Kandasamy& et al., S. Chand & Company.
4. Numerical Methods in Engineering & Science With Programs in C, C++ & Matlab by B. S. Grewal, Khanna Publishers.
5. A Text Book of Numerical Analysis by Dr. C. P. Awasthi, Prakashn Kendra Lucknow.
6. Numerical Analysis by Faires J., Cengage Learning, Inc.

Suggested E-Resources :

1. NPTEL/Swayam Platform : https://onlinecourses.nptel.ac.in/noc23_ma44/preview
2. NPTEL/Swayam Platform : https://onlinecourses.swayam2.ac.in/cec22_ma13/preview
3. Online Lectures : https://www.youtube.com/playlist?list=PLDlWMHnDwyljd4tfGXbAft6fYCo0NksQw
4. Cosmo Learning : https://cosmolearning.org/courses/numerical-methods-and-programing/video-lectures/
5. Cosmo Learning : https://cosmolearning.org/topics/computational-physics/
6. IIT Madras Lectures : https://www.youtube.com/playlist?list=PLtUBquogGkRuZH23UO-8AWR4dzcu-La8_

Course Learning Outcomes :

By the end of the course, students should be able to :

1. Understand the concept of errors in numerical analysis.
2. Understand the concept of nonlinear equations and solution methodology in special reference to Newton's method.
3. Understand the concept of integration of ordinary differential equation.
4. Understand the concept of Runga-Kutta method.
5. Understand the concept of probability theory, Poisson & normal distribution.
6. Understand the concepts of numerical analysis in physical theories.

M.Sc. (Physics)

Semester - II

Physics Practical Lab II(A) - Electronics/Advanced Optics/Gen. Laboratory

(DSCP MPHY 211, Credits Practical 06, Practical Hours 180)

Note: Out of following experiments, 6 experiments must be done by the students in each semester.

(9 hrs. per week)

External Exam Duration : 4 hrs. **Max. Marks : 60**
Internal Exam Duration : 2 hrs. **Max. Marks : 40**

Semester	Code of The Course	Title of The Course/Paper	NHEQF Level	Credits
II	DSCP MPHY 211	Physics Practical Lab II(A) (Electronics/Advanced Optics/General Lab)	8	6
Level of Course	Type of The Course	Delivery Type of The Course		
Introductory	Core	Practical Hours, One Hundred & Eighty hours of postgraduate level experiments including diagnostic and formative assessments.		
Prerequisites	UG level qualification with Physics as a core subject from a UGC recognized college/Univ.			
Objectives of The Course :	The objective of the second course in practical physics is to provide students with a comprehensive fundamental understanding of practical physics. The course aims to develop their knowledge and skills in developing experimental skills at the postgraduate level and to endow them with a zeal for experimental physics. This will help nurture their interests in experimental domain to enable them to take-up research in physics as well in addition to preparing their experimental attitude for future careers in physics, such as, teaching at the school & UG, PG level.			

DSCP MPHY 211 : Physics Practical Lab II(A)

The inclusion of new experiments should be intimated and approved by the Convenor, Board of Studies before the start of the academic session. It is binding to have an experimental set-up of at least ten experiments listed below. In case the number of experiments performed by the student is less than eight, his marks shall be scaled down in the final examination on a pro-rata basis. Laboratory examination paper will be set by the external examiner out of eight or more experiments available at the center.

List of Experiments : Semester - II

1. To study transistor bias stability for determination of Q-point, leakage current and stability factor.

2. To study the non-inverting, inverting, unity buffer, adder & subtractor properties of an operational amplifier.
3. To study the integration and differentiation applications of an operational amplifier using CRO.
4. To design a single stage amplifier of a given voltage gain and lower cut of frequencies.
5. To design a RC coupled two stage amplifier of a given gain and the cutoff frequencies.
6. To determine Planck's constant using solar cell.
7. To determine Planck's constant and work function by a photocell.
8. To study regulated power supply using (a) Zener diode only, (b) Zener diode with a series transistor, (c) Zener diode with a shunt transistor.
9. To determine angle of minimum deviation and verify Fresnel's formula.
10. To study the percentage regulation and variation of ripple factor with load for a full wave rectifier.
11. To study analog to digital and digital to analog conversion.
12. To study a driven mechanical oscillator.
13. To verify Hartmann's formula using constant deviation spectrograph.
14. To find e/m of electron using Zeeman effect.
15. To design and study of pass filters in half-wave and full-wave rectifiers.
16. To align Michelson's Interferometer using He-Ne laser to observe concentric circular fringes.
17. To determine the wavelength of He-Ne laser using circular fringes with the help of Michelson's Interferometer.
18. To determine the wavelength of Na lamp and difference between the wavelengths of two sodium D-lines with the help of Michelson's Interferometer.
19. To study fringes of equal inclination and equal thickness using Na lamp in Michelson's Interferometer.
20. To align and determine the wavelength of He-Ne laser using Fabry-Perot Interferometer.
21. To determine the velocity of ultrasonic waves using ultrasonic interferometer.
22. To study elliptically polarized light using Babinet compensator.
23. To verify the Cauchy's dispersion relation of a given prism.
24. To study the DC gate control characteristics and anode current characteristics of SCR.
25. To determine wavelength of the laser monochromatic radiation by diffraction grating.
26. To determine numerical aperture, beam divergence and bending losses of in optical fiber.
27. To determine wavelength of the laser monochromatic radiation by slit method.
28. To study the characteristics of a UJT and use it to design a relaxation oscillator and measure its frequency.
29. To design a multivibrator of given frequency and study its wave shape.
30. To study the current-voltage characteristics of an FET.
31. To study the frequency-response of Hartley oscillator.
32. To determine Lo. Co. and RF of a given coil and to study the variations of RF with frequency.
33. Any other experiment compatible with the postgraduate level physics theory.

Course Learning Outcomes:

Through these experiments, students will develop practical skills in experimental techniques, data collection, analysis, and interpretation. They will also enhance their understanding of fundamental concepts and principles in advanced electronics & optics. The lab experiences will foster critical thinking, problem-solving abilities, and the application of theoretical knowledge to real-world scenarios.

M.Sc. (Physics)

Semester - I

Physics Practical Lab II(B) – Seminar (II)/Lab Project Work

(DSEP MPHY 231, Credits Practical 06, Practical Hours 180)

Note: Out of Seminar or presentation or Lab Project Work, student needs to select a practical work.

(9 hrs. per week)

External Exam Duration : 1 hrs. **Max. Marks : 60**

Internal Exam Duration : 1 hrs. **Max. Marks : 40**

Semester	Code of The Course	Title of The Course/Paper	NHEQF Level	Credits
I	DSEP MPHY 231	Physics Practical Lab II(B) (Electronics/Advanced Optics/General Lab)	8	6
Level of Course	**Type of The Course**	**Delivery Type of The Course**		
Introductory	Core	Practical Hours, One Hundred & Eighty hours of postgraduate level experiments including diagnostic and formative assessments.		
Prerequisites	UG level qualification with Physics as a core subject from a UGC recognized college/Univ.			
Objectives of The Course :	The objective of the first course in practical physics is to provide students with a comprehensive understanding of practical physics. The course aims to develop their knowledge and skills in developing experimental skills at the postgraduate level and to endow them with a zeal for experimental physics. This will help nurture their interests in experimental domain to enable them to take-up research in physics as well in addition to preparing their experimental attitude for future careers in physics, such as, teaching at the school & UG, PG level.			

DSCP MPHY 231 : Physics Practical Lab II(B)

The inclusion of new experiments should be intimated and approved by the Convenor, Board of Studies before the start of the academic session. It is binding to have an experimental set-up of at least ten experiments listed below. In case the number of experiments performed by the student is less than eight, his marks shall be scaled down in the final examination on a pro-rata basis. Laboratory examination paper will be set by the external examiner out of eight or more experiments available at the center.