FYUGP

PHYSICS HONOURS/ RESEARCH

FOR UNDER GRADUATE COURSES UNDER **NILAMBER-PITAMBER UNIVERSITY**

Implemented from

Academic Session 2022-2026

SEMESTER I

I. MAJOR COURSE –MJ 1: (Credits: Theory-04, Practicals-02)

Marks: 15 (5 Attd. + 10 SIE: 1Hr) + 60 (ESE: 3Hrs) = 75	Pass Marks: Th (SIE + ESE) = 30

Instruction to Question Setter for

Instruction to Question Setter for

Semester Internal Examination (SIE 10 marks):

*There will be **two** group of questions. Question No.1 will be **very short answer type in Group A** consisting of five questions of 1 mark each. **Group B will contain descriptive type** two questions of five marks each, out of which any one to answer.*

End Semester Examination (ESE 60 marks):

*There will be **two** group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 & 3 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*

***Note:** There may be subdivisions in each question asked in Theory Examinations.*

BASIC MATHEMATICAL PHYSICS & MECHANICS

Theory: 60 Lectures

The emphasis of course is on applications in solving problems of interest to physicists.The students are to be examined entirely on the basis of problems, seen and unseen.

Differential Equation:

First Order Differential Equations and Integrating Factor. Second Order Differential equations: Homogeneous Equations with constant coefficients. Wronskian and general solution. Particular Integral for typical source terms like polynomials, exponential, sine, cosine, etc.

(8 Lectures)

Vector Calculus:

Vector Differentiation: Directional derivatives and normal derivatives. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities. **(7 Lectures)**

Vector Integration: Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems. **(6 Lectures)**

Orthogonal Curvilinear Coordinates:

Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in orthogonal curvilinear coordinates. **(7 Lectures)**

Dirac's Delta Function and its properties: Definition of Dirac delta function. Representation as limit of a Gaussian function and rectangular function. Properties of Dirac delta function. **(2 Lectures)**

Elasticity: Elastic constants and interrelation between Elastic constants. Twisting torque on a Cylinder or Wire and Twisting couple. **(3 Lectures)**

Flexure of Beam: Bending of beam, Cantilever. **(3 Lectures)**

Surface Tension: Ripples and Gravity waves, Determination of surface tension by Jaeger's and Quinke's methods. Temperature dependance of surface tension. **(6 Lectures)**

Fluid Motion: Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube and corrections. **(2 Lectures)**

Central Force Motion: Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS). **(5 Lectures)**

Oscillations: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor. **(6 Lectures)**

Non-inertial system: Non-inertial frames and fictious forces, Uniformly rotating frame. Law of physics in rotating coordinate system. Centrifugal force, Coriolis force and its application.

(5 Lectures)

Reference Books:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn.,Elsevier.
2. Mathematical Physics, P. K. Chattopadhyaya, 2/e, New Age International Publisher
3. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
4. Differential Equations, George F. Simmons, 2007, McGraw Hill.
5. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
6. Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
7. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones andBartlett Learning
8. Mathematical Physics, Goswami, 1st edition, Cengage Learning
9. Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
10. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
11. Essential Mathematical Methods, K.F.Riley & M.P.Hobson, 2011, Cambridge Univ. Press.
12. Mathematical Physics, H.K. Dass and R. Verma, S. Chand & Company.
13. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
14. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
15. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
16. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning

17. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
18. Undergraduate Mechanics, Arun Kumar, J. P. Agarwal and Nutan Lata, Pragati Prakashan
19. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
20. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

Additional Books for Reference

1. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
2. University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
3. Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A. Serway, 2010,Cengage Learning
4. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.

PHYSICS PRACTICAL- MJ 1 LAB

Marks : Pr (ESE: 3Hrs) =25	Pass Marks: Pr (ESE) = 10

Instruction to Question Setter for
End Semester Examination (ESE):
There will be one Practical Examination of 3Hrs duration. Evaluation of Practical Examination may be as per the following guidelines:

Experiment = 15 marks
Practical record notebook = 05 marks
Viva-voce = 05 marks

PRACTICALS: 60 Lectures

The aim of this Lab is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics.

1. Highlights the use of computational methods to solve physical problems
2. The course will consist of lectures (both theory and practical) in the Lab
3. Evaluation done not on the programming but on the basis of formulating the problem
4. Aim at teaching students to construct the computational problem to be solved
5. Students can use any one operating system Linux or Microsoft Windows

Topics	Description with Applications
Introduction and Overview	Computer architecture and organization, memory and Input/output devices
Basics of scientific computing	Binary and decimal arithmetic, Floating point numbers,algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, underflow &overflow-emphasize the importance of making equations in termsof dimensionless variables, Iterative methods
Review of C & C++ Programming fundamentals	Introduction to Programming, constants, variables anddata types, operators and Expressions, I/O statements,scanf and printf, c in and c out, Manipulators for data formatting, Control statements (decision making and looping statements) (If-statement. If-else Statement. Nested if Structure. Else-if Statement. Ternary Operator. Goto Statement. Switch Statement. Unconditional and Conditional Looping. While Loop. Do-While Loop. FORLoop. Break and Continue Statements. Nested Loops), Arrays (1D & 2D) and strings, user defined functions, Structures and Unions, Idea of classes and objects
Programs:	Sum & average of a list of numbers, largest of a givenlist of numbers and its location in the list, sorting of numbers in ascending descending order, Binary search
Random number generation	Area of circle, area of square, volume of sphere, valueof pi (π)

- Measurements of length (or diameter) using vernier caliper, screw gauge and travelling

microscope.

- To study the random error in observations of simple pendulum oscillations.
- To study the Motion of Spring and calculate (a) Spring constant, (b) **g** and (c) Modulus of rigidity.
- To determine **g** and velocity for a freely falling body using Digital Timing Technique
- To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille'smethod).
- To determine the Young's Modulus of a Wire by Optical Lever Method.
- To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
- To determine the elastic Constants of a wire by Searle's method.
- To determine the value of g using Bar Pendulum.
- To determine the value of g using Kater's Pendulum.

Reference Books:

1. Schaum's Outline of Programming with C++. J. Hubbard, 2000, McGraw-Hill Pub.
2. Numerical Recipes in C: The Art of Scientific Computing, W.H. Pressetal, 3rdEdn. , 2007, Cambridge University Press.
3. A first course in Numerical Methods, U.M. Ascher & C. Greif, 2012, PHI Learning.
4. Elementary Numerical Analysis, K.E. Atkinson, 3rd Edn. , 2007, Wiley India Edition.
5. Numerical Methods for Scientists & Engineers, R.W. Hamming, 1973, Courier Dover Pub.
6. An Introduction to computational Physics, T.Pang, 2nd Edn. , 2006,Cambridge Univ. Press
7. Computational Physics, Darren Walker, 1st Edn., 2015, Scientific International Pvt. Ltd.
8. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia PublishingHouse
9. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted1985, Heinemann Educational Publishers
10. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal
11. Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt.Ltd.
12. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.

SEMESTER II

I. MAJOR COURSE- MJ 2: (Credits: Theory-04, Practicals-02)

Marks: 15 (5 Attd. + 10 SIE: 1Hr) + 60 (ESE: 3Hrs) = 75	Pass Marks: Th (SIE + ESE) = 30

Instruction to Question Setter for

Semester Internal Examination (SIE 10 marks):

*There will be **two** group of questions. Question No.1 will be **very short answer type in Group A** consisting of five questions of 1 mark each. **Group B will contain descriptive type** two questions of five marks each, out of which any one to answer.*

End Semester Examination (ESE 60 marks):

*There will be **two** group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 & 3 will be short answer type** of 5 marks. **Group B will contain descriptive type** five questions of fifteen marks each, out of which any three are to answer.*

***Note:** There may be subdivisions in each question asked in Theory Examinations.*

ELECTRICITY & MAGNETISM Theory: 60 Lectures

Electric Field & Electric Potential: Recapitulation of Electrostatic Field (its conservative nature) & Electrostatic Potential. Laplace's and Poisson equations. The Uniqueness Theorem. Dipole : Potential and Electric Field due to dipole, Force and its turning effect(torque) on a dipole. Electrostatic energy of system of charges. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of an isolated conductors. Parallel-plate capacitor. Method of Images and its application to: (i) Plane Infinite Sheet and (ii) Sphere **(12 Lectures)**

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. **(10 Lectures)**

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. **(6 Lectures)**

Electrical 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. Anderson's bridge, De Sauty's Bridge and Owen's bridge & their vector diagram representation. Three phase electrical power supply, delta and star connections. **(12 Lectures)**

Transients: Growth and Decay of currents in LR, CR, LC and LCR circuits. **(6 Lectures)**

Network theorems: Ideal Constant-voltage and Constant-current Sources. Network Theorems: Thevenin theorem, Norton theorem, Maximum Power Transfer theorem and Superposition Theorem.

(8 Lectures)

Physics of Ballistic Galvanometer: Torque on a current Loop. Ballistic Galvanometer: Current and Charge Sensitivity. Electromagnetic damping. Logarithmic damping. CDR. **(6 Lectures)**

Reference Books:

1. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, TataMcGraw
2. Electricity and Magnetism, P. K. Chakraborty, New Age International Pvt. Ltd.
3. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
4. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
5. Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
6. Concepts of Electromagnetic Theory, K. Mamta, Raj Kumar Singh and J. N. Prasad, 1st Edn
    a. 2021, Wiley/I. K. International Publishing House, New Delhi
7. Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
8. Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press.
9. Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
10. Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning
11. Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGraw Hill
12. Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning
13. Engineering Electromagnetic, Willian H. Hayt, 8th Edition, 2012, McGraw Hill.
14. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer

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PHYSICS PRACTICAL- MJ 2 LAB:

Marks : Pr (ESE: 3Hrs) =25	**Pass Marks: Pr (ESE) = 10**

Instruction to Question Setter for

End Semester Examination (ESE):

There will be one Practical Examination of 3Hrs duration. Evaluation of Practical Examination may be as per the following guidelines:

Experiment = 15 marks
Practical record notebook = 05 marks
Viva-voce = 05 marks

PRACTICALS: 60 Lectures

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. To verify the Thevenin and Norton theorems.
7. To verify the Superposition, and Maximum power transfer theorems.
8. To determine self- inductance of a coil by Anderson's bridge.
9. 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.
10. To study the response curve of a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q.
11. Measurement of charge and current sensitivity and CDR of Ballistic Galvanometer

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia PublishingHouse
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, reprinted1985, 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.
6. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia PublishingHouse.
7. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted1985, Heinemann Educational Publishers
8. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
9. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer

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COURSES OF STUDY FOR **INTRODUCTORY/ MINOR ELECTIVE** FYUGP IN **"PHYSICS"**

SEMESTER I/ II/ III INTRODUCTORY REGULAR COURSE 1 Paper

I. INTRODUCTORY REGULAR COURSE (IRC)

(Credits: Theory-03)

- All Four Introductory & Minor Papers of Physics to be studied by the Students of **Other than Physics Honours.**
- Students of **Physics Honours** must Refer Content from the **Syllabus of Opted Introductory & Minor Elective Subject**.

Marks: 100 (ESE: 3Hrs) = 100	**Pass Marks: Th (ESE) = 40**

Instruction to Question Setter for

End Semester Examination (ESE 100 marks):

*There will be **two** group of questions. **Group A is compulsory** which will contain three questions. **Question No.1 will be very short answer type** consisting of ten questions of 1 mark each. **Question No.2 & 3 will be short answer type** of 5 marks. **Group B will contain descriptive type** six questions of twenty marks each, out of which any four are to answer.*

***Note:** There may be subdivisions in each question asked in Theory Examinations.*

INTRODUCTORY PHYSICS **Theory: 45 Lectures**

Mathematical Physics: Scalar and Vector fields. Concept of Gradient, Curl and Divergence. Del and Laplacian operators. Gauss's divergence theorem, Green's and Stokes Theorems and their applications. First order differential equation, Homogeneous Linear differential equation with constant coefficients – Finding its complete solution. **(8 lectures)**

Newtonian Mechanics & General Properties of Matter : Newton's Laws of Motion. Validity of Newton's Laws of motion, Conservation Principle (conservation of momentum and angular momentum, conservation of energy).

Elasticity, Stress-strain relationship, Hooke's law, Young's modulus, bulk modulus, shear modulus of rigidity (qualitative idea only), Poisson's ratio. Viscosity, Stokes' law, terminal velocity, streamline and turbulent flow, critical velocity. **(6 lectures)**

Special Theory of relativity: Einstein's postulates of STR, Lorentz transformation equations, Length contraction, time-dilation, variation of mass with velocity, mass-energy relation. **(5 Lectures)**

Wave Optics:

Plane progressive wave and stationary wave – equation. Interference of light, Division of amplitude and wavefront. Young's double slit experiment. Diffraction of light, Fresnel and Fraunhofer diffraction. **(8 lectures)**

Thermal Physics: Basics concepts of Thermodynamics: Thermodynamic processes (reversible & irreversible process, reversible process – an ideal process. Isochoric, Isobaric, Isothermal and Adiabatic Process), Zeroth law of thermodynamics and the concept of temperature, First law of thermodynamics, Second law of thermodynamics: Carnot Cycle. **(8 Lectures)**

Modern Physics: Photoelectric effect, Einstein's Photoelectric equation, Particle nature of light, Matter waves, de Broglie relation. Rutherford and Bohr's Model of an atom, Nuclei composition and size of nucleus, Nuclear fission and Nuclear fusion.

Intrinsic and extrinsic semiconductors- p and n type, p-n junction Semiconductor diode - I-V characteristics in forward and reverse bias. Half wave and Full wave rectifier. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion. Octal and Hexadecimal numbers. AND, OR and NOT Gates. **(10 lectures)**

Reference Books;

1. Mathematical Physics, B. D. Gupta.
2. Mathematical Physics, B. S. Rajput.
3. Mathematical Physics, H. K. Dass.
4. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
5. Undergraduate Mechanics, Arun Kumar, J. P. Agarwal and Nutan Lata, Pragati Prakashan
6. Concepts of Electromagnetic Theory, K. Mamta, Raj Kumar Singh and J. N. Prasad, 1/e, 2021, Wiley/I. K. International Publishing House, New Delhi
7. Waves and Acoustics, P. K. Chakraborty and Satyabrata Chowdhury.
8. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
9. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
10. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
11. Electricity and Magnetism, P. K. Chakraborty, New Age International Pvt. Ltd.
12. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
13. A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press
14. Digital Electronics, Floyd.
15. Digital Computer Electronics, Malvino
16. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
17. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India
18. A First Course in Electronics, Khan and Dey, PHI, 2006
19. Basic Electronics, Arun Kumar, Bharati Bhawan, 2007
20. Digital Systems and Applications, Nutan Lata, Pragati Prakashan, 1/e, 2019
21. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
