DEBRA THANA S.K.S. MAHAVIDYALAYA

(Autonomous)

Debra, Paschim Medinipur, West Bengal

Department Of Physics

Proposed Curriculum & Syllabus (draft)

(w.e.f. Academic Year 2024-2025)

Based on

Curriculum & Credit Framework for Undergraduate Programmes (CCFUP), 2024 & NEP, 2020

Selection of Disciplines/Subjects during Admission:

1. 4-YEAR BACHELOR OF SCIENCE (HONOURS) WITH PHYSICS:

i) MAJOR IN PHYSICS:

a) Major- Physics
b) Minor - Any other 2 subjects

ii) MAJOR IN OTHER SUBJECT WITH MINOR IN PHYSICS:

a) Major- Other subject
b) Minor – Physics and another subject

PHYSICS: Minor 1 / Minor 2

2. 3-YEAR BACHELOR OF PHYSICAL SCIENCE WITH PHYSICS (MULTIDISCIPLINARY STUDIES) :

a) Major- 2 subjects (A & B)
b) Minor -1 subject (C)

PHYSICS: A/B/C

ANNEXURE-1

Curriculum & Credit Structure of 4-Year Bachelor Degree Programme B.A./B.Sc./B.Com. (Hons./ Hons. with Research) in Single Major

SEMESTER	Major - MJ (Core Discipline)	Minor Disciplines- MI (Discipline- I & II)	Ability Enhancement Courses -AEC	Skill Enhancement- SEC	Summer Internship	Multidisciplinary Courses	Value Added Courses - VAC	Dissertation/ Project/ Entrepreneurship	Total Credit / No. of courses
	Major - 20 (4 Credits)	Minor- 8 (4 Credits)	AEC -4 (2 Credits)	SEC- 3 (3 Credits)	Int./Proj./ Comm. Ser. -2 (4 Credits)	MDC-3 (3 Credits)	VAC -2 (4 Credits)	Dissertation/ Project/ Entp. 2	
I	Major-1	Minor -1 (Discipline-1)	English Communication-1	SEC-1		MDC-1	VAC-1 (ENVS)		20 /6
II	Major -2	Minor-2 (Discipline-II)	MIL (Bengali/Hindi) -1	SEC-2	Community Service (Add.)	MDC-2	VAC-2		20/ 6
YEAR-1	(2x4) 8	(2x4) 8	(2x2) 4	(3x2) 6	(+4)	(3x2) 6	(2x4) 8	-	40 (+4) 44
Exit option with Undergraduate Certificate (in the Major Discipline) securing 44credits with Community Service (Additional 4 credits)									
III	Major -3 Major -4	Minor-3 (Discipline-1)	English Communication-2	SEC-3		MDC-3			20/ 6
IV	Major 5 Major 6 Major 7	Minor4 (Discipline-1I)	MIL (Bengali/Hindi) -2		Internship / Apprenticeship (Major Disc.)				22/ 6
YEAR-2	(7x4) 28	(4x4) 16	(4x2) 8	(3x3) 9	4 (+4) 8	(3x3) 9	(2x4) 8	-	86
Students on Exit shall be awarded Undergraduate Diploma (in the Major Discipline) securing 86 credits									
V	Major 8, 9, 10 Major (Elect.) -1	Minor- 5 (Discipline-1)							20/ 5
VI	Major -11, 12, 13 Major (Elect.) -2	Minor-6 (Discipline-1I)							20/ 5
YEAR-3	(15x4) 60	(6x4) 24	(4x2) 8	(3x3) 9	4 (+4) 8	(3x3) 9	(2x4) 8	-	126
Students on Exit shall be awarded 3-Year Bachelor Degree (in the Major Discipline) after securing 126 Credits									
VII	Major -14, 15, Major (Elect.) -3*	Minor-7 (Discipline-I)						Project-1 (4 Credit)	20/ 5
VIII	Major -16 Major (Elect.) -4*	Minor-8 (Discipline-1I)						Project-2 (8 Credit)	20/ 4 (5*)
YEAR-4	(20x4) 80	(8x4) 32	(4x2) 8	(3x3) 9	4 (+4)=8	(3x3) 9	(2x4) 8	(4+8) 12	166 /43
Students shall be awarded Bachelor Degree (Hons. with Research) in the Major Discipline securing 166 credits									
**Students not opting Research shall complete Three (03) additional papers (Major Electives-5 in Sem.-VII and Major Electives-6, 7 in Sem.-VIII*									
One (01) Major Discipline & Two (02) Minor Disciplines-(1 & 2) Disciplines to be selected from given Subject bunch/group									

ANNEXURE-2

Curriculum and Credit Structure of 3-Year Bachelor Degree Programme B.A./B.Sc./B.Com. in Multidisciplinary Studies

SEMESTER	Major - MJ (Disciplines- A & B)	Minor Disciplines- MI (Discipline- C)	Ability Enhancement Courses -AEC	Skill Enhancement- SEC	Summer Internship	Multidisciplinary Courses	Value Added Courses - VAC	Dissertation/ Project/ Entrepreneurship	Total Credit / No. of courses
	Major - 15 (4 Credits)	Minor Disc.- 6 (4 Credits)	AEC -4 (2 Credits)	SEC- 3 (3 Credits)	Int./Proj./ Comm. Ser. -2 (4 Credits)	MDC-3 (3 Credits)	VAC -2 (4 Credits)	Dissertation/ Project/ Entp. 2	
I	Major -A1	Minor -C1	English Communication-1	SEC-1		MDC-1	VAC-1 (ENVS)		20 /6
II	Major -B1	Minor-C2	MIL (Bengali/Hindi) -1	SEC-2	Community Service (Add.)	MDC-2	VAC-2		20/ 6
YEAR-1	(2x4) 8	(2x4) 8	(2x2) 4	(3x2) 6	(+4)	(3x2) 6	(2x4) 8	-	40 (+4) 44
Exit option with Undergraduate Certificate (Multidisciplinary field of study) securing 44credits with Community Service (Additional 4 credits)									
III	Major -A2 Major -A3	Minor-C3	English Communication-2	SEC-3		MDC-3			20/ 6
IV	Major -B2 Major -B3 Major (Elect.) -1	Minor-C4	MIL (Bengali/Hindi) -2		Internship / Apprenticeship (any Discipline)				22/ 6
YEAR-2	(7x4) 28	(4x4) 16	(4x2) 8	(3x3) 9	4 (+4) 8	(3x3) 9	(2x4) 8	-	86
Students on Exit shall be awarded Undergraduate Diploma (in Multidisciplinary field of study) securing 86 credits									
V	Major-A4, A5, A6 Major (Elect.) -2	Minor- C5							20/ 5
VI	Major-B4, B5, B6 Major (Elect.) -3	Minor-C6							20/ 5
YEAR-3	(15x4) 60	(6x4) 24	(4x2) 8	(3x3) 9	4 (+4) 8	(3x3) 9	(2x4) 8	-	126
Students shall be awarded Bachelor Degree in Multidisciplinary field of studies securing 126 credits									

A, B & C – Three (03) Disciplines/ Subjects to be selected from Subject bunch/group of respective Multidisciplinary studies

DEBRA THANA S.K.S. MAHAVIDYALAYA

Proposed Syllabus (Draft) of

BACHELOR OF SCIENCE (HONOURS)
MAJOR IN PHYSICS

4-YEAR UNDERGRADUATE PROGRAMME

(w.e.f. Academic Year 2024-2025)

Based on Curriculum & Credit Framework for Undergraduate Programmes (CCFUP), 2024 & NEP, 2020

DEBRA THANA S.K.S. MAHAVIDYALAYA
BACHELOR OF SCIENCE (HONOURS) MAJOR IN PHYSICS
(under CCFUP, 2024)

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
								CA	ESE	TOTAL
B.Sc. (Hons.)	1st	I	**SEMESTER-I**							
			Major-1	**PHSHMJ101**	**T: Foundation of Physics; P: Practical**	**4**	**3-0-1**	**15**	**60**	**75**
			SEC	**PHSSEC01**	**P: Basic Computer and Graph Plotting**	**3**	**0-0-3**	**10**	**40**	**50**
			AEC	**AEC01**	Communicative English -1 (***common for all programmes***)	**2**	**2-0-0**	**10**	**40**	**50**
			MDC	**MDC01**	Multidisciplinary Course -1 (***to be chosen from the list***)	**3**	**3-0-0**	**10**	**40**	**50**
			VAC	**VAC01**	ENVS (***common for all programmes***)	**4**	**2-0-2**	**50**	**50**	**100**
			Minor (Disc.-I)	**PHSMI01**	**T: Mathematical Methods and Mechanics; P: Practical** ***(To be taken by students of other Disciplines)***	**4**	**3-0-1**	**15**	**60**	**75**
					Semester-I Total	**20**				**400**
		II	**SEMESTER-II**							
			Major-2	**PHSHMJ102**	**T: Waves and Optics; P: Practical**	**4**	**3-0-1**	**15**	**60**	**75**
			SEC	**PHSSEC02**	**P: Introduction to Python Programming and Graph plotting**	**3**	**0-0-3**	**10**	**40**	**50**
			AEC	**AEC02**	MIL-1 (***common for all programmes***)	**2**	**2-0-0**	**10**	**40**	**50**
			MDC	**MDC02**	Multi Disciplinary Course-02 (***to be chosen from the list***)	**3**	**3-0-0**	**10**	**40**	**50**
			VAC	**VAC02**	Value Added Course-02 (***to be chosen from the list***)	**4**	**4-0-0**	**10**	**40**	**50**
			Minor (Disc.-II)	**PHSMI01**	**T: Mathematical Methods and Mechanics; P: Practical** ***(To be taken by students of other Disciplines)***	**4**	**3-0-1**	**15**	**60**	**75**
			Summer Intern.	**CS**	Community Service	**4**	**0-0-4**	**-**	**-**	**50**
					Semester-II Total	**24**				**400**
					TOTAL of YEAR-1	**44**				**800**

MJ = Major, MI = Minor Course, SEC = Skill Enhancement Course, AEC = Ability Enhancement Course, MDC = Multidisciplinary Course, VAC = Value Added Course; CA= Continuous Assessment, ESE= End Semester Examination, T = Theory, P= Practical, L-T-P = Lecture-Tutorial-Practical, MIL = Modern Indian Language, ENVS = Environmental Studies

SEMESTER I

BACHELOR OF SCIENCE (HONOURS)

MAJOR IN PHYSICS

PHYSICS

MAJOR 1

MJ-1 : Foundation of Physics

MJ-1T: Foundation of Physics

Unit-I: Mathematical Physics I

Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields. [3L]

Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities, Gradient, divergence, curl and Laplacian in spherical and cylindrical coordinates. [4L]

Vector Integration: Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs). [4L]

First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients. Wronskian and general solution. Statement of existence and Uniqueness Theorem for Initial Value Problems. Particular Integral. [3L]

Matrix: Types of Matrix, Eigen value & Eigen vector of a Matrix. [2L]

Some Special Integrals: Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. [3L]

Unit –II: Newtonian Mechanics

Fundamentals of Dynamics: Reference frames. Inertial frames; Review of Newton's Laws of Motion. Galilean transformations; Galilean invariance. Momentum of variable- mass system: motion of rocket. Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse. [4L]

Non-Inertial Systems: Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems. [4L]

Work and Energy: Work and Kinetic Energy Theorem. Conservative and non- conservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy. [3L]

Rotational Dynamics: Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation. [4L]

Gravitation and Central Force Motion: Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere. Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. [5L]

Elasticity: Relation between Elastic constants. Twisting torque on a Cylinder or Wire. Bending of beams. [3L]

Fluid Motion: Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid. Suggested Readings: [3L]

1. Mathematical Methods in the Physical Sciences, M. L. Boas, 2005, Wiley

2. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier

3. Mathematical Methods for Physics and Engineering: A Comprehensive Guide by K. F. Riley, M. P.Hobson, S. J. Bence, Cambridge Univ. Press, 3rd Eds., 2006

4. Vector Analysis and an introduction to Tensor Analysis, S. Lipschutz, D. Spellman, M. R. Spiegel, Schaum's Outline Series, Tata McGraw Hill Education Private Limited, edition 2009

5. Mathematical Physics, A. K. Ghatak, I. C. Goyal, S. J. Chua, Macmillan India Ltd., 2016

6. Fundamentals of Mathematical Physics, A. B. Gupta, Books and Allied (P) Ltd. 2022

Classical Mechanics:

1. Classical Mechanics, N. C. Rana and P. S. Joag, McGraw-Hill Education

2. Classical Mechanics, A. K. Raychaudhuri, Oxford University Press, 1984

3. Feynman Lectures, Vol. I, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education

4. Classical Mechanics and General Properties of Matter. S. N. Maiti and D. P. Raychaudhuri, New Age International.

5. Introduction to Classical Mechanics, R. G. Takwale and P.S.Puranik, Tata McGraw-Hill

Publishing Company Ltd.

6. Theory and Problems of Theoretical Mechanics, M. R. Spiegel, Mc Grow Hill Education

7. Introduction to Classical Mechanics with problems and solutions, D. Morin, Cambridge University Press

8. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill, Physics

9. Mechanics, Resnick, Halliday and Walker 8/e. 2008, Wiley

10. Mechanics, D. S. Mathur, S. Chand and Company Limited, 2000

11. University Physics. F.W. Sears, M.W.Zemansky, H.D Young 13/e, 1986, Addison Wesley

12. Classical Mechanics, J. C.Upadhyay, Himalaya Publishing.

13. Fundamentals of Classical Mechanics, A. B. Gupta, Books & Allied (P) Ltd.

14. Introduction to Electrodynamics, David J Griffith, Pearson.

MJ 1-P: Practical :

Course Outline:

1. Measurements of length (or diameter) using vernier callipers, screw gauge and travelling microscope.

2. To determine g and velocity for a freely falling body using Video tracker.

3. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g using video tracker

4. To determine g by Bar Pendulum.

5. To determine the Moment of Inertia of a Flywheel.

6. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.

7. To determine the Elastic Constants of a Wire by Searle's method.

8. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).

9. To determine the height of a building using a Sextant.

10. To determine the Young's Modulus of a Wire by Optical Lever Method.

11. Mapping of 2D scalar field by using image analysis.

Suggested Readings:

1. Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia Publishing House.

2. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.

3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

4. Laboratory Manual of Physics, Madhusudan Jana, Books & Allied (P) Ltd., 2022, Kolkata.

5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press

6. B.Sc. Practical Physics, C.L. Arora, S Chand and Company Limited

7. Physics in Laboratory, Mandal, Chowdhury, Das, Das, Santra Publication

8. Advanced Practical Physics Vol 1, B. Ghosh, K. G. Majumder, Sreedhar Publisher

9. Practical Physics, P.R. Sasi Kumar, PHI Learning Private Limited

10. B.Sc. Practical Physics, Harnem Singh, P.S. Hemne, S Chand and Company Limited.

BACHELOR OF SCIENCE (HONOURS)

MAJOR IN PHYSICS

PHYSICS

SKILL ENHANCEMENT COURSE (SEC)

SEC 1

SEC 1: Basics of Computer and Graph Plotting.

SEC1P: Basics of Computer and Graph Plotting.

Introduction and Overview: Introduction to computer and Basic data types Introduction to computer- Characteristics and Basic Applications of Computer, Components of Computer System, Central Processing Unit (CPU), VDU, Keyboard and Mouse, Other input/output Devices, Memory, concepts of Hardware and Software.

Basic Word Processing: Introduction to Word Processing, Opening Word Processing Package, Opening and closing documents, Using a Document/Help Wizard, Text Creation and Manipulation, Formatting the Text, Handling Multiple Documents, Table Manipulation, Printing, saving documents in different formats.

Spreadsheets and Basic Data Analysis: Spread Sheet, Elements of Electronics Spread Sheet, Application/usage of Electronic Spread Sheet, Manipulation of cells, Formulas and functions; Spread sheets for Small accountings maintaining invoices/budgets, basic practical data analysis works

Basic Presentations: Basics- Difference between presentation and document, Using Power Point, Creation of Presentation, Preparation of Slides, Selection of type of Slides, Importing text from word documents, Providing aesthetics- Slide Designs, Slide Manipulation and Slide Show, Presentation of the Slides.

Introduction to plotting graphs: Basic 2D and 3D graph plotting - plotting functions and data files, fitting data using gnuplot's fit function, polar and parametric plots, modifying the appearance of graphs, Surface and contour plots, exporting plots. Graph plotting using Origin software.

Introduction to Image analysis software: Overview of image analysis software (e.g., ImageJ). Basics of image processing techniques. Projectile Motion Analysis. Frictional Forces and Surface Analysis.

Introduction to Video tracking software: Overview of video tracking and it's application. Introduction to popular video tracking software. Tracking of simple mechanical systems (e.g., pendulum, projectile motion). Analyzing motion trajectories and velocity profiles

Suggested Readings:

1. C.S. French "Data Processing and Information Technology", BPB Publications 1998

2. P.K Sinha, Computer Fundamentals, BPB Publications, 1992

3. Guy Hart-Davis "The ABCs of Microsoft Office 97 Professional edition", BPB Publications, 1998

4. Karl Schwartz, "Microsoft Windows 98 Training Guide", 1998

5. A first course in Numerical Methods, U.M. Ascher & C. Greif, 2012, PHI Learning.

6. Elementary Numerical Analysis, K.E. Atkinson, 3 rd Edn . , 2007, Wiley India Edition.

BACHELOR OF SCIENCE (HONOURS)

MINOR IN PHYSICS

Physics

MINOR 1

Mathematical Methods and Mechanics:

MI-1T: Mathematical Methods and Mechanics:

Course contents:

1. Differential equations: Exact and inexact differential, First order linear differential equations with integrating factor, Second order Linear differential equations with constant coefficients. Particular Integral. [5L]

2. Vector Calculus: Properties of vectors under rotations. Scalar product and its invariance under rotations. Scalar triple product and their interpretation in terms of area and volume, respectively. Scalar and Vector fields. Vector differentiation: Gradient of a scalar field and its geometrical interpretation. Divergence and Curl of a vector field. Gauss' divergence theorem, Green's theorem and Stokes theorem. [8L]

3. Fundamentals of Dynamics: Reference frames. Inertial frames and Non inertial frames. Review of Newton's laws of motion. Dynamics of a system of particles. Centre of mass. Calculation of center of masses of 2d and 3d bodies. [8L]

4. Rotational Dynamics: Perpendicular and parallel axes theorems, radius of gyration, calculation of moment of inertia for rectangular, cylindrical, and spherical bodies, pure rolling of a body on an inclined plane. [7L]

5. Introduction to classical Dynamics:

UNIT I-

Generalised co-ordinates and Velocities, Generalised Force, Principle of virtual work Derivation of Lagranges equation of motion from DAlemberts Principles, Lagrangian and its Application to Simple, Compound and Double Pendulums, Single Particle in Space, Atwoods Machine, Dumb-bell, Linear harmonic oscillator. [7L]

UNIT II-

Hamiltons Principle, Calculus of Variation and derivation of Euler-Lagranges equation, Langranges Equations derived from Hamiltons Principles, Hamiltonian and its applications to Shortest Distance between two points in a plane, Hamiltions equations of motion. [5L]

Suggested Readings:

1. Mathematical Methods in the Physical Sciences, M. L. Boas, 2005, Wiley

2. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier

3. Mathematical Methods for Physics and Engineering: A Comprehensive Guide by K. F. Riley, M. P.Hobson, S. J. Bence, Cambridge Univ. Press, 3rd Eds., 2006

4. Vector Analysis and an introduction to Tensor Analysis, S. Lipschutz, D. Spellman, M. R. Spiegel, Schaum's Outline Series, Tata McGraw Hill Education Private Limited, edition 2009

5. Mathematical Physics, A. K. Ghatak, I. C. Goyal, S. J. Chua, Macmillan India Ltd., 2016

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1. Classical Mechanics, N. C. Rana and P. S. Joag, McGraw-Hill Education

2. Classical Mechanics, A. K. Raychaudhuri, Oxford University Press, 1984

3. Feynman Lectures, Vol. I, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education

4. Classical Mechanics and General Properties of Matter. S. N. Maiti and D. P. Raychaudhuri, New Age International.

5. Introduction to Classical Mechanics, R. G. Takwale and P.S.Puranik, Tata McGraw-Hill

Publishing Company Ltd.

6. Theory and Problems of Theoretical Mechanics, M. R. Spiegel, Mc Grow Hill Education

7. Introduction to Classical Mechanics with problems and solutions, D. Morin, Cambridge University Press

8. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill, Physics

9. Mechanics, Resnick, Halliday and Walker 8/e. 2008, Wiley

10. Mechanics, D. S. Mathur, S. Chand and Company Limited, 2000

11. University Physics. F.W. Sears, M.W.Zemansky, H.D Young 13/e, 1986, Addison Wesley

12. Classical Mechanics, J. C.Upadhyay, Himalaya Publishing.

13. Fundamentals of Classical Mechanics, A. B. Gupta, Books & Allied (P) Ltd.

MI-1P: Practical :

Course Outline:

1. Measurements of length (or diameter) using vernier callipers, screw gauge and travelling microscope.

2. To determine g and velocity for a freely falling body using Digital Timing Technique.

3. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g.

4. To determine g by Bar Pendulum.

5. To determine the Moment of Inertia of a Flywheel.

6. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.

7. To determine the Elastic Constants of a Wire by Searle's method.

8. To determine the height of a building using a Sextant.

9. To determine the Young's Modulus of a Wire by Optical Lever Method.

Suggested Readings:

1. Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia Publishing House.

2. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.

3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New

Delhi.

4. Laboratory Manual of Physics, Madhusudan Jana, Books & Allied (P) Ltd., 2022, Kolkata.

5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press

6. B.Sc. Practical Physics, C.L. Arora, S Chand and Company Limited

7. Physics in Laboratory, Mandal, Chowdhury, Das, Das, Santra Publication

8. Advanced Practical Physics Vol 1, B. Ghosh, K. G. Majumder, Sreedhar Publisher

9. Practical Physics, P.R. Sasi Kumar, PHI Learning Private Limited

10. B.Sc. Practical Physics, Harnem Singh, P.S. Hemne, S Chand and Company Limited.

SEMESTER II

BACHELOR OF SCIENCE (HONOURS)

MAJOR IN PHYSICS

PHYSICS

MAJOR 2

MJ-2: Waves and Optics

MJ-2T: Waves and Optics

Oscillations: SHM: 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 **. [5L]**

Superposition of Collinear Harmonic oscillations Linearity and Superposition Principle: Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences. [4L]

Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses. [2L]

Wave Motion: Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves. [5L]

Velocity of Waves: Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction. [3L]

Superposition of Two Harmonic Waves: Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Plucked and Struck Strings. Melde's Experiment. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves. [6L]

Wave Optics: Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence. [2L]

Interference: Division of amplitude and wavefront. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes

of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index. [4L]

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

Diffraction and Holography: Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integral formula. (Qualitative discussion only) Fraunhofer diffraction: Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating. Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire. Holography: Principle of Holography. Recording and Reconstruction Method. Theory of Holography as Interference between two Plane Waves. Point source holograms. [10L]

Reference Books:

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

• Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill

• Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.

• Optics, Ajoy Ghatak, 2008, Tata McGraw Hill

• The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.

• The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.

• Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications.

• The Physics of waves, Howard Georgi, Pearson.

• Optics, Eugene Hecht, Pearson.

List of Practical:

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify $\lambda 2$ law.

2. To study Lissajous Figures by using Oscilloscope.

3. Familiarization with: Schuster`s focusing; determination of angle of prism.

4. To determine refractive index of the Material of a prism using sodium source.

5. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.

6. To determine wavelength of sodium light using Fresnel Biprism.

7. To determine wavelength of sodium light using Newton's Rings.

8. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.

9. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.

10. To determine dispersive power and resolving power of a plane diffraction grating.

11. Study of diffraction with piece of cloth and LASER by using image analysis.

Suggested Readings:

1. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
2. Laboratory Manual of Physics, Madhusudan Jana, Books & Allied (P) Ltd., 2022, Kolkata.
3. B.Sc. Practical Physics, C.L. Arora, S Chand and Company Limited
4. Physics in Laboratory, Mandal, Chowdhury, Das, Das, Santra Publication
5. Advanced Practical Physics Vol 1, B. Ghosh, K. G. Majumder, Sreedhar Publisher
6. Practical Physics, P.R. Sasi Kumar, PHI Learning Private Limited10. B.Sc. Practical Physics, Harnem Singh, P.S. Hemne, S Chand and Company Limited.

BACHELOR OF SCIENCE (HONOURS)

MAJOR IN PHYSICS

PHYSICS

SKILL ENHANCEMENT COURSE (SEC)

SEC 2

SEC 2: Introduction to Python programming and Graph Plotting

SEC2P: Introduction to Python programming and Graph Plotting

Course Outline:

1. Introduction to programming in python(Version-3):

(a) Introduction

1. Python interpreter as a calculator

2. Variable and data types (int, float, complex, list, tuple, set, string),the type()function)

3. Basic mathematical operations

4. Compound statements in python

Logical Conditions (if, elif, else)

Loops (for, while)

User defined functions def: (return statement, default values for arguments, key word arguments), lambda function.

5. Importing modules with math, c math, random as examples

6. Using help and dir command to use the inbuilt manual

7. Basic idea of name spaces-local and global

8. Python scripts, I/O operations (including opening and writing to files)

(b) The python data types

1. List: defining lists, reading and changing elements from lists, slicing, concatenation, list comprehension. 2D list as matrix

2. built in functions involving lists: range(), len(), sum(), min(), max() – list methods:

append(),extend(),count(), index(), sort(), insert(), pop(),remove(), reverse()

3. Tuples: Contrast and compare with lists, packing/unpacking using tuples (including a,b=b,a to swap variables)

4. Sets: set methods: update(), pop(), remove(), Set Theoretic operations: union, intersection, difference and symmetric difference of two sets.

5. Strings: Defining strings, the use of single, double or triple quotes as string delimiters, len(), indexing, slicing, string concatenation, some string methods: strip(), split(), join(), find(), count(), replace(), string for matting in python (using the % operator)

6. Dictionary: Make a dictionary, Built-in functions on dict and dictionary methods

2. Problems and Applications

1. Find odd, even numbers

2. Finding factors of an integer

3. Generate list of various random numbers. Find mean, var., std. dev.

4. Roots of a quadratic equation

5. Area of triangle by Heron's formula

6. Check strong number, Armstrong number

7. Determining whether an integer is prime or not. Define a python function and use this to find out

all prime numbers within a given range. Finding out prime number greater than or lesser than a given value.

8. Sorting of lists (algorithm and code) using Bubble, insertion or Selection sort

9. Sum of series correct upto given decimal places (Sine, Cosine, Exponential etc.)

10. Motion of a particle under a given force F(x, t, v) with given initial condition and plotting (x,t), (x, v),(t, v). (Matplotlib to be used to plot graphs), using Euler's method only. [Examples: Nuclear Decay equation, projectile motion, damped harmonic motion etc.]

11. Matrix Addition, Multiplication and Transpose directly and using List Comprehension.

12. Curve fitting, Least square fit, Goodness of fit, standard deviation.

13. Plot a polynomial (or any transcendental) function. Indentify the real roots by plotting. Write a

Python code to fine tune a possible root.

3. Introduction of graph plotting:

Matplotlib as a plotting Module: Basics of XY-plotting of function (i) power laws and exponential functions, (ii) trigonometric functions, (iii) Hyperbolic functions. (iv) Define a Python function and

plot in a domain. Bar chart plots, histograms, polar plots, pie plots, Plot from data file, saving the figures, subplots, multiple plots.

4.Introduction to Adruino:

Understand the fundamentals of Arduino hardware and software. Basic programming using Adruino.

Suggested Readings:

1. Scientific Computing in Python. Abhijit Kar Gupta, Techno World

2. Computational Physics, Mark Newman, Amazon Digital.

3. Introduction to Numerical Analysis, S.S. Sastry, 5thEdn. , 2012, PHI Learning Pvt. Ltd

4. Numerical Methods, Arun Kr Jalan, Utpal Sarkar, University Press

5. Numerical Mathematical Analysis, J. B. Scarborough, OXFORD and IBH Co. Pvt. Ltd.

6. Elementary Numerical Analysis, K.E. Atkinson, 3rdEdn., 2007, Wiley India Edition

7. Python Programming, Satyanarayana, Radhika Mani, Jagdesh, University Press

8. Python 2.1 Bible Dave Brueck, Stephen Tanner, Hungry Minds Inc, New York

9. Learning with Python-how to think like a computer scientist, J.Elkner, C.Meyer, and A Downey, 2015, Dreamtech Press.

10. Introduction to computation and programming using Python, J.Guttag, 2013, Prentice Hall India.

11. Effective Computation in Physics-Field guide to research with Python, A. Scopatz and K.D.Huff,2015, O'Rielly

12. An Introduction to Computational Physics, T. Pang, 2nd Edn., 2006, Cambridge Univ. Press

Computational Physics, DarrenWalker,1stEdn.,2015, Scientific International Pvt.Ltd.

BACHELOR OF SCIENCE (HONOURS)

MINOR IN PHYSICS

Physics

MINOR 2

Mathematical Methods and Mechanics:

MI-2T: Mathematical Methods and Mechanics:

Course contents:

1.Differential equations: Exact and inexact differential, First order linear differential equations with integrating factor, Second order Linear differential equations with constant coefficients. Particular Integral. [5L]

2.Vector Calculus: Properties of vectors under rotations. Scalar product and its invariance under rotations. Scalar triple product and their interpretation in terms of area and volume, respectively. Scalar and Vector fields. Vector differentiation: Gradient of a scalar field and its geometrical interpretation. Divergence and Curl of a vector field. Gauss' divergence theorem, Green's theorem and Stokes theorem. [8L]

3.Fundamentals of Dynamics: Reference frames. Inertial frames and Non inertial frames. Review of Newton's laws of motion. Dynamics of a system of particles. Centre of mass. Calculation of center of masses of 2d and 3d bodies. [8L]

4.Rotational Dynamics: Perpendicular and parallel axes theorems, radius of gyration, calculationof moment of inertia for rectangular, cylindrical, and spherical bodies, pure rolling of a body on an inclined plane. [7L]

5.Introduction to classical Dynamics:

UNIT I-

Generalised co-ordinates and Velocities, Generalised Force, Principle of virtual work Derivation of Lagranges equation of motion from DAlemberts Principles, Lagrangian and its Application to Simple, Compound and Double Pendulums, Single Particle in Space, Atwoods Machine, Dumb-bell, Linear harmonic oscillator. [7L]

UNIT II-

Hamiltons Principle, Calculus of Variation and derivation of Euler-Lagranges equation, Langranges Equations derived from Hamiltons Principles, Hamiltonian and its applications to Shortest Distance between two points in a plane, Hamiltions equations of motion. [5L]

Suggested Readings:

1. Mathematical Methods in the Physical Sciences, M. L. Boas, 2005, Wiley

2. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier

3. Mathematical Methods for Physics and Engineering: A Comprehensive Guide by K. F. Riley, M. P.Hobson, S. J. Bence, Cambridge Univ. Press, 3rd Eds., 2006

4. Vector Analysis and an introduction to Tensor Analysis, S. Lipschutz, D. Spellman, M. R. Spiegel, Schaum's Outline Series, Tata McGraw Hill Education Private Limited, edition 2009

5. Mathematical Physics, A. K. Ghatak, I. C. Goyal, S. J. Chua, Macmillan India Ltd., 2016

6. Fundamentals of Mathematical Physics, A. B. Gupta, Books and Allied (P) Ltd. 2022

Classical Mechanics:

1. Classical Mechanics, N. C. Rana and P. S. Joag, McGraw-Hill Education

2. Classical Mechanics, A. K. Raychaudhuri, Oxford University Press, 1984

3. Feynman Lectures, Vol. I, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education

4. Classical Mechanics and General Properties of Matter. S. N. Maiti and D. P. Raychaudhuri, New Age International.

5. Introduction to Classical Mechanics, R. G. Takwale and P.S.Puranik, Tata McGraw-Hill

Publishing Company Ltd.

6. Theory and Problems of Theoretical Mechanics, M. R. Spiegel, Mc Grow Hill Education

7. Introduction to Classical Mechanics with problems and solutions, D. Morin, Cambridge University Press

8. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill, Physics

9. Mechanics, Resnick, Halliday and Walker 8/e. 2008, Wiley

10. Mechanics, D. S. Mathur, S. Chand and Company Limited, 2000

11. University Physics. F.W. Sears, M.W.Zemansky, H.D Young 13/e, 1986, Addison Wesley

12. Classical Mechanics, J. C.Upadhyay, Himalaya Publishing house.

MI-2P: Practical :

Course Outline:

1. Measurements of length (or diameter) using vernier callipers, screw gauge and travelling microscope.

2. To determine g and velocity for a freely falling body using Digital Timing Technique.

3. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g.

4. To determine g by Bar Pendulum.

5. To determine the Moment of Inertia of a Flywheel.

6. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.

7. To determine the Elastic Constants of a Wire by Searle's method.

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2. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.

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7. Physics in Laboratory, Mandal, Chowdhury, Das, Das, Santra Publication

8. Advanced Practical Physics Vol 1, B. Ghosh, K. G. Majumder, Sreedhar Publisher

9. Practical Physics, P.R. Sasi Kumar, PHI Learning Private Limited

10. B.Sc. Practical Physics, Harnem Singh, P.S. Hemne, S Chand and Company Limited.

DEBRA THANA S.K.S. MAHAVIDYALAYA

Proposed Syllabus (Draft) of

BACHELOR OF SCIENCE WITH PHYSICS (MULTIDISCIPLINARY STUDIES)

3-YEAR UNDERGRADUATE PROGRAMME

(w.e.f. Academic Year 2024-2025)

Based on Curriculum & Credit Framework for Undergraduate Programmes (CCFUP), 2024 & NEP, 2020

DEBRA THANA S.K.S. MAHAVIDYALAYA

BACHELOR OF SCIENCE IN PHYSICAL SCIENCES with PHYSICS

(*under CCFUP, 2024*)

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
								CA	ESE	TOTAL
B.Sc. in Physical Sc. with Physics	1st	I	**SEMESTER-I**							
			Major (Disc.-A1)	PHSPMJ101	**T: Mathematical Methods and Mechanics (including STR) P: Practical** ***(To be studied by the students taken Physics as Discipline-A)***	4	3-0-1	15	60	75
			SEC	SEC01	***To be chosen from SEC-01 of Discipline A/B/C of their Hons. prog.*** **P: Basics of Computer and Graph Plotting**	3	0-0-3	10	40	50
			AEC	AEC01	Communicative English-1 (***common for all programmes***)	2	2-0-0	10	40	50
			MDC	MDC01	Multidisciplinary Course-1 (***to be chosen from the list***)	3	3-0-0	10	40	50
			VAC	VAC01	VAC-01: ENVS (***common for all programmes***)	4	2-0-2	50	50	100
			Minor (Disc.-C1)	PHSMI 01/C1	**T: Mathematical Physics and Mechanics; P: Practical** ***(To be studied by the students taken Physics as Discipline-C)***	4	3-0-1	15	60	75
			Semester-I Total			20				400
		II	**SEMESTER-II**							
			Major (Disc.-B1)		**T: Mathematical Methods and Mechanics (including STR) P: Practical** ***(Same as like A1 for students taken Physics as Discipline-B)***	4	3-0-1	15	60	75
			SEC	SEC02	***To be chosen from SEC-02 of Discipline A/B/C of their Hons. prog.*** **P:Introduction to Python Programming and Graph Plotting.**	3	0-0-3	10	40	50
			AEC	AEC02	MIL-1 (***common for all programmes***)	2	2-0-0	10	40	50
			MDC	MDC02	Multi Disciplinary Course-02 (***to be chosen from the list***)	3	3-0-0	10	40	50
			VAC	VAC02	VAC-02 (***to be chosen from the list***)	4	4-0-0	10	40	50
			Minor (Disc.-C2)	PHSMI 02/C2	**T:Electricity and Magnetism; P: Practical** ***(To be studied by the students taken Physics as Discipline-C)***	4	3-0-1	15	60	75
			Summer Intern.	CS	Community Service	4	0-0-4	-	-	50
			Semester-II Total			24				400
			TOTAL of YEAR-1			44	-	-	-	800

P MJ= Major Programme (Multidisciplinary), MI = Minor, A/B = Choice of Major Discipline; C= Choice of Minor Discipline; SEC = Skill Enhancement Course, AEC = Ability Enhancement Course, MDC = Multidisciplinary Course, VAC = Value Added Course; CA= Continuous Assessment, ESE= End Semester Examination, T = Theory, P= Practical, L-T-P = Lecture-Tutorial-Practical, MIL = Modern Indian Language, ENVS = Environmental Studies

SEMESTER I

BACHELOR OF SCIENCE WITH PHYSICS

(MULTIDISCIPLINARY STUDIES)

Physics

Major A1

Mathematical Methods and Mechanics:

MJ A1-T: Mathematical Methods and Mechanics:

Course contents:

1. Differential equations: Exact and inexact differential, First order linear differential equations with integrating factor, Second order Linear differential equations with constant coefficients. Particular Integral. [4L]

2. Vector Calculus: Properties of vectors under rotations. Scalar product and its invariance under rotations. Scalar triple product and their interpretation in terms of area and volume, respectively. Scalar and Vector fields. Vector differentiation: Gradient of a scalar field and its geometrical interpretation. Divergence and Curl of a vector field. Only statements of Gauss' divergence theorem, Green's theorem and Stokes theorem. [6L]

3. Fundamentals of Dynamics: Reference frames. Inertial frames. Galilean transformations. Galilean invariance. Review of Newton's laws of motion. Dynamics of a system of particles. Centre of mass. Concept of Centre of mass frame. Non-inertial frames and fictitious forces. [5L]

4. Gravitation and central force motion: Gravitational potential Energy. Potential and field due to a spherical shell and solid sphere. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). [5L]

5. Rotational Dynamics: Perpendicular and parallel axes theorems, radius of gyration, calculation of moment of inertia for rectangular, cylindrical, and spherical bodies, pure rolling of a body on an inclined plane. [5L]

6. Motion under central forces: Two-body problem, reduction to one-body problem, reduced mass; definition and nature (conservative nature, spherically symmetric potential) of central force, features of motion under central force field, differential equation of orbit; energy expression, simple derivations of nature of force from equation of orbit and vice versa. [6L]

7. General properties of matter: Relation between Elastic constants, Torsion of a cylinder or wire, surface tension and surface energy, angle of contact, capillarity and Juris's law, excess pressure and application to soap bubble, molecular theory of surface tension, ripple method, Viscosity, Reynold's number, Poiseuille's Equation for flow of a liquid through a Capillary Tube, Stroke's law in a high viscous liquid. [6L]

8. Special Theory of Relativity: Constancy of speed of light, postulates of special theory of relativity, Lorentz transformations, length contraction, time dilation, relativistic addition of velocities – illustrations with simple problems. [5L]

Suggested Readings:

1. Mathematical Methods in the Physical Sciences, M. L. Boas, 2005, Wiley

2. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier

3. Mathematical Methods for Physics and Engineering: A Comprehensive Guide by K. F. Riley, M. P.Hobson, S. J. Bence, Cambridge Univ. Press, 3rd Eds., 2006

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13. Fundamentals of Classical Mechanics, A. B. Gupta, Books & Allied (P) Ltd.

MJ A1-P: Practical :

Course Outline:

1. Measurements of length (or diameter) using vernier callipers, screw gauge and travelling microscope.

2. To determine g and velocity for a freely falling body using Digital Timing Technique.

3. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g.

4. To determine g by Bar Pendulum.

5. To determine the Moment of Inertia of a Flywheel.

6. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.

7. To determine the Elastic Constants of a Wire by Searle's method.

8. To determine the height of a building using a Sextant.

9. To determine the Young's Modulus of a Wire by Optical Lever Method.

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2. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.

3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New

Delhi.

4. Laboratory Manual of Physics, Madhusudan Jana, Books & Allied (P) Ltd., 2022, Kolkata.

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8. Advanced Practical Physics Vol 1, B. Ghosh, K. G. Majumder, Sreedhar Publisher

9. Practical Physics, P.R. Sasi Kumar, PHI Learning Private Limited

10. B.Sc. Practical Physics, Harnem Singh, P.S. Hemne, S Chand and Company Limited.

BACHELOR OF SCIENCE WITH PHYSICS

(MULTIDISCIPLINARY STUDIES)

Physics

SKILL ENHANCEMENT COURSE (SEC)

SEC 1

SEC 1: Basics of Computer and Graph Plotting.

SEC1P: Basics of Computer and Graph Plotting.

Introduction and Overview: Introduction to computer and Basic data types Introduction to computer- Characteristics and Basic Applications of Computer, Components of Computer System, Central Processing Unit (CPU), VDU, Keyboard and Mouse, Other input/output Devices, Memory, concepts of Hardware and Software.

Basic Word Processing: Introduction to Word Processing, Opening Word Processing Package, Opening and closing documents, Using a Document/Help Wizard, Text Creation and Manipulation, Formatting the Text, Handling Multiple Documents, Table Manipulation, Printing, saving documents in different formats.

Spreadsheets and Basic Data Analysis: Spread Sheet, Elements of Electronics Spread Sheet, Application/usage of Electronic Spread Sheet, Manipulation of cells, Formulas and functions; Spread sheets for Small accountings maintaining invoices/budgets, basic practical data analysis works

Basic Presentations: Basics- Difference between presentation and document, Using Power Point, Creation of Presentation, Preparation of Slides, Selection of type of Slides, Importing text from word documents, Providing aesthetics- Slide Designs, Slide Manipulation and Slide Show, Presentation of the Slides.

Introduction to plotting graphs: Basic 2D and 3D graph plotting - plotting functions and data files, fitting data using gnuplot's fit function, polar and parametric plots, modifying the appearance of graphs, Surface and contour plots, exporting plots.

Suggested Readings:

1. C.S. French "Data Processing and Information Technology", BPB Publications 1998

2. P.K Sinha, Computer Fundamentals, BPB Publications, 1992

3. Guy Hart-Davis "The ABCs of Microsoft Office 97 Professional edition", BPB Publications, 1998

4. Karl Schwartz, "Microsoft Windows 98 Training Guide", 1998

5. A first course in Numerical Methods, U.M. Ascher & C. Greif, 2012, PHI Learning.

6. Elementary Numerical Analysis, K.E. Atkinson, 3 rd Edn . , 2007, Wiley India Edition.

BACHELOR OF SCIENCE WITH PHYSICS

(MULTIDISCIPLINARY STUDIES)

Physics

Minor C1

MI – C1: Mathematical Physics and Mechanics:

MI –C1T: Mathematical Physics and Mechanics

Course contents:

1. Differential equations: Exact and inexact differential, First order linear differential equations with integrating factor, Second order Linear differential equations with constant coefficients, Particular Integral. [5L]

2. Vector Calculus: Properties of vectors under rotations. scalar product and its invariance under rotations, Scalar triple product and their interpretation in terms of area and volume, respectively, Scalar and Vector fields, Vector differentiation: Gradient of a scalar field and its geometrical interpretation. Divergence and Curl of a vector field. Only statements of Gauss' divergence theorem, Green's theorem and Stokes theorem. [6L]

3. Fundamentals of Dynamics: Reference frames, inertial frames. Galilean transformations. Galilean, invariance, review of Newton's laws of motion, dynamics of a system of particles, centre of mass, concept of centre of mass frame, Non-inertial frames and fictitious forces. [6L]

4. Gravitation and central force motion: Gravitational potential Energy, potential and field due to a spherical shell and solid sphere, Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). [5L]

5. Rotational Dynamics: Perpendicular and parallel axes theorems, radius of gyration, calculation of moment of inertia for rectangular, cylindrical, and spherical bodies, pure rolling of a body on an inclined plane. [6L]

6.Motion under central forces: Two-body problem, reduction to one-body problem, reduced mass; definition and nature (conservative nature, spherically symmetric potential) of central force, features of motion under central force field, differential equation of orbit; energy expression, simple derivations of nature of force from equation of orbit and vice versa. [7L]

7. General properties of matter: Relation between Elastic constants, Torsion of a cylinder or wire, surface tension and surface energy, angle of contact, capillarity and Jurin's law, excess pressure and application to soap bubble, molecular theory of surface tension, ripple method, Viscosity, Reynold's number, Poiseuille's Equation for flow of a liquid through a Capillary Tube, Stoke's law in a high viscous liquid. [7L]

Suggested Readings:

Math. Methods:

1. Mathematical Methods in the Physical Sciences, M. L. Boas, 2005, Wiley.

2. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.

3. Mathematical Methods for Physics and Engineering: A Comprehensive Guide by K. F. Riley, M. P. Hobson, S. J. Bence, Cambridge Univ. Press, 3rd Eds., 2006.

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Spiegel, Schaum's Outline Series, Tata McGraw Hill Education Private Limited, edition 2009.

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3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

4. Laboratory Manual of Physics, Madhusudan Jana, Books & Allied (P) Ltd., 2022, Kolkata.

5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press

6. B.Sc. Practical Physics, C.L. Arora, S Chand and Company Limited

7. Physics in Laboratory, Mandal, Chowdhury, Das, Das, Santra Publication

8. Advanced Practical Physics Vol 1, B. Ghosh, K. G. Majumder, Sreedhar Publisher

9. Practical Physics, P.R. Sasi Kumar, PHI Learning Private Limited

10. B.Sc. Practical Physics, Harnem Singh, P.S. Hemne, S Chand and Company Limited.

SEMESTER II

BACHELOR OF SCIENCE WITH PHYSICS

(MULTIDISCIPLINARY STUDIES)

Physics

Major B1

Mathematical Methods and Mechanics:

MJ B1-T: Mathematical Methods and Mechanics:

Course contents:

1. Differential equations: Exact and inexact differential, First order linear differential equations with integrating factor, Second order Linear differential equations with constant coefficients. Particular Integral. [4L]

2. Vector Calculus: Properties of vectors under rotations. Scalar product and its invariance under rotations. Scalar triple product and their interpretation in terms of area and volume, respectively. Scalar and Vector fields. Vector differentiation: Gradient of a scalar field and its geometrical interpretation. Divergence and Curl of a vector field. Only statements of Gauss' divergence theorem, Green's theorem and Stokes theorem. [6L]

3. Fundamentals of Dynamics: Reference frames. Inertial frames. Galilean transformations. Galilean invariance. Review of Newton's laws of motion. Dynamics of a system of particles. Centre of mass. Concept of Centre of mass frame. Non-inertial frames and fictitious forces. [5L]

4. Gravitation and central force motion: Gravitational potential Energy. Potential and field due to a spherical shell and solid sphere. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). [5L]

5. Rotational Dynamics: Perpendicular and parallel axes theorems, radius of gyration, calculation of moment of inertia for rectangular, cylindrical, and spherical bodies, pure rolling of a body on an inclined plane. [5L]

6. Motion under central forces: Two-body problem, reduction to one-body problem, reduced mass; definition and nature (conservative nature, spherically symmetric potential) of central force, features of motion under central force field, differential equation of orbit; energy expression, simple derivations of nature of force from equation of orbit and vice versa. [6L]

7. General properties of matter: Relation between Elastic constants, Torsion of a cylinder or wire, surface tension and surface energy, angle of contact, capillarity and Juris's law, excess pressure and application to soap bubble, molecular theory of surface tension, ripple method, Viscosity, Reynold's number, Poiseuille's Equation for flow of a liquid through a Capillary Tube, Stroke's law in a high viscous liquid. [6L]

8. Special Theory of Relativity: Constancy of speed of light, postulates of special theory of relativity, Lorentz transformations, length contraction, time dilation, relativistic addition of velocities – illustrations with simple problems. [5L]

Suggested Readings:

1. Mathematical Methods in the Physical Sciences, M. L. Boas, 2005, Wiley

2. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier

3. Mathematical Methods for Physics and Engineering: A Comprehensive Guide by K. F. Riley, M. P.Hobson, S. J. Bence, Cambridge Univ. Press, 3rd Eds., 2006

4. Vector Analysis and an introduction to Tensor Analysis, S. Lipschutz, D. Spellman, M. R. Spiegel, Schaum's Outline Series, Tata McGraw Hill Education Private Limited, edition 2009

5. Mathematical Physics, A. K. Ghatak, I. C. Goyal, S. J. Chua, Macmillan India Ltd., 2016

6. Fundamentals of Mathematical Physics, A. B. Gupta, Books and Allied (P) Ltd. 2022

Classical Mechanics:

1. Classical Mechanics, N. C. Rana and P. S. Joag, McGraw-Hill Education

2. Classical Mechanics, A. K. Raychaudhuri, Oxford University Press, 1984

3. Feynman Lectures, Vol. I, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education

4. Classical Mechanics and General Properties of Matter. S. N. Maiti and D. P. Raychaudhuri, New Age International.

5. Introduction to Classical Mechanics, R. G. Takwale and P.S.Puranik, Tata McGraw-Hill

Publishing Company Ltd.

6. Theory and Problems of Theoretical Mechanics, M. R. Spiegel, Mc Grow Hill Education

7. Introduction to Classical Mechanics with problems and solutions, D. Morin, Cambridge University Press

8. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill, Physics

9. Mechanics, Resnick, Halliday and Walker 8/e. 2008, Wiley

10. Mechanics, D. S. Mathur, S. Chand and Company Limited, 2000

11. University Physics. F.W. Sears, M.W.Zemansky, H.D Young 13/e, 1986, Addison Wesley

12. Classical Mechanics, J. C.Upadhyay, Himalaya Publishing.

13. Fundamentals of Classical Mechanics, A. B. Gupta, Books & Allied (P) Ltd.

MJ B1-P: Practical :

Course Outline:

1. Measurements of length (or diameter) using vernier callipers, screw gauge and travelling microscope.

2. To determine g and velocity for a freely falling body using Digital Timing Technique.

3. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g.

4. To determine g by Bar Pendulum.

5. To determine the Moment of Inertia of a Flywheel.

6. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.

7. To determine the Elastic Constants of a Wire by Searle's method.

8. To determine the height of a building using a Sextant.

9. To determine the Young's Modulus of a Wire by Optical Lever Method.

Suggested Readings:

1. Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia Publishing House.

2. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.

3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New

Delhi.

4. Laboratory Manual of Physics, Madhusudan Jana, Books & Allied (P) Ltd., 2022, Kolkata.

5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press

6. B.Sc. Practical Physics, C.L. Arora, S Chand and Company Limited

7. Physics in Laboratory, Mandal, Chowdhury, Das, Das, Santra Publication

8. Advanced Practical Physics Vol 1, B. Ghosh, K. G. Majumder, Sreedhar Publisher

9. Practical Physics, P.R. Sasi Kumar, PHI Learning Private Limited

10. B.Sc. Practical Physics, Harnem Singh, P.S. Hemne, S Chand and Company Limited.

BACHELOR OF SCIENCE WITH PHYSICS

(MULTIDISCIPLINARY STUDIES)

Physics

SKILL ENHANCEMENT COURSE (SEC)

SEC 2

SEC 2: Basics of Computer and Graph Plotting.

SEC2P: Basics of Computer and Graph Plotting.

Introduction and Overview: Introduction to computer and Basic data types Introduction to computer- Characteristics and Basic Applications of Computer, Components of Computer System, Central Processing Unit (CPU), VDU, Keyboard and Mouse, Other input/output Devices, Memory, concepts of Hardware and Software.

Basic Word Processing: Introduction to Word Processing, Opening Word Processing Package, Opening and closing documents, Using a Document/Help Wizard, Text Creation and Manipulation, Formatting the Text, Handling Multiple Documents, Table Manipulation, Printing, saving documents in different formats.

Spreadsheets and Basic Data Analysis: Spread Sheet, Elements of Electronics Spread Sheet, Application/usage of Electronic Spread Sheet, Manipulation of cells, Formulas and functions; Spread sheets for Small accountings maintaining invoices/budgets, basic practical data analysis works

Basic Presentations: Basics- Difference between presentation and document, Using Power Point, Creation of Presentation, Preparation of Slides, Selection of type of Slides, Importing text from word documents, Providing aesthetics- Slide Designs, Slide Manipulation and Slide Show, Presentation of the Slides.

Introduction to plotting graphs: Basic 2D and 3D graph plotting - plotting functions and data files, fitting data using gnuplot's fit function, polar and parametric plots, modifying the appearance of graphs, Surface and contour plots, exporting plots.

Suggested Readings:

1. C.S. French "Data Processing and Information Technology", BPB Publications 1998

2. P.K Sinha, Computer Fundamentals, BPB Publications, 1992

3. Guy Hart-Davis "The ABCs of Microsoft Office 97 Professional edition", BPB Publications, 1998

4. Karl Schwartz, "Microsoft Windows 98 Training Guide", 1998

5. A first course in Numerical Methods, U.M. Ascher & C. Greif, 2012, PHI Learning.

6. Elementary Numerical Analysis, K.E. Atkinson, 3 rd Edn . , 2007, Wiley India Edition.

BACHELOR OF SCIENCE WITH PHYSICS

(MULTIDISCIPLINARY STUDIES)

Physics

Minor C2

MI – C2: Electricity and Magnetism:

MI –C2T: Electricity and Magnetism:

Electrostatics: Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem - Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric. [16L]

Magnetism:

Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law. Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para and ferro-magnetic materials. [14L]

Electromagnetic Induction: Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field. [5L]

Maxwell`s equations and Electromagnetic wave propagation: Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic electric medium, transverse nature of EM waves, polarization. [6L]

Suggested Readings:

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

Minor C2 P: Electricity and Magnetism :

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

2. To determine the self- inductance of a coil by Anderson's Bridge.

3. To determine an unknown low resistance using Potentiometer.

4. To study the Characteristics of a Series RC Circuit.

5. To study a series LCR circuit and determine its (a) Resonant Frequency, (b) Quality Factor.

6. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q.

7. To determine a Low Resistance by Carey Foster's Bridge.

8. To verify the Thevenin and Norton theorem.

9. To verify the Superposition, and Maximum Power Transfer Theorem

Suggested Readings:

- Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
- Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers