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

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) Major - 20 (4 Credits)	Minor Disciplines- MI (Discipline- I & II) Minor- 8 (4 Credits)	Ability Enhancement Courses -AEC AEC -4 (2 Credits)	Skill Enhancement- SEC SEC- 3 (3 Credits)	Summer Internship Int./Proj./ Comm. Ser. -2 (4 Credits)	Multidisciplinary Courses MDC-3 (3 Credits)	Value Added Courses - VAC VAC -2 (4 Credits)	Dissertation/ Project/ Entrepreneurship Dissertation/ Project/ Entp. 2	Total Credit / No. of courses
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

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:

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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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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.

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Delhi.

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