VIDYASAGAR UNIVERSITY

Midnapore, West Bengal

PROPOSED CURRICULUM & SYLLABUS (DRAFT) OF

BACHELOR OF SCIENCE WITH PHYSICS

(MULTIDISCIPLINARY STUDIES)

3-YEAR UNDERGRADUATE PROGRAMME

(w.e.f. Academic Year 2023-2024)

Based on

Curriculum & Credit Framework for Undergraduate Programmes

(CCFUP), 2023 & NEP, 2020

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VIDYASAGAR UNIVERSITY
BACHELOR OF SCIENCE IN PHYSICSL SCIENCES with PHYSICS
(*Under CCFUP, 2023*)

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
								CA	ESE	TOTAL
B.Sc. in Physical Sc. with Physics	2nd	III	**SEMESTER-III**							
			Major-A2	PHSPMJ02	**T: Waves and Optics; P: Practical** *(To be studied by students taken* **Chemistry** *as Discipline- A)*	4	3-0-1	15	60	75
			Major-A3	PHSPMJ03	**T: Thermal Physics; P: Practical** *(To be studied by students taken* **Chemistry** *as Discipline- A)*	4	3-0-1	15	60	75
			SEC	SEC03	*To be taken from SEC-03 of Discipline C.*	3	0-0-3	10	40	50
			AEC	AEC03	Communicative English-2 (***common for all programmes***)	2	2-0-0	10	40	50
			MDC	MDC03	Multidisciplinary Course-3 (***to be chosen from the list***)	3	3-0-0	10	40	50
			Minor-3 (Disc.-C3)	PHSMIN03	**T: Waves & Optics; P: Practical** *(To be studied by students taken Chemistry as Discipline- C)*	4	3-0-1	15	60	75
					Semester-III Total	20				375
		IV	**SEMESTER-IV**							
			Major-B2		*To be decided (Same as MajorA2 for Chemistry taken as Discipline-B)*	4	3-0-1	15	60	75
			Major-B3		*To be decided (Same as Major–A3 for* **Chemistry** *taken as Discipline-B)*	4	3-0-1	15	60	75
			Major (Elective) -1	PHSMJE-01	**T: Advanced Mathematical Methods** *(To be studied by students taken Chemistry as Discipline- A)*	4	3-1-0	15	60	75
			AEC	AEC04	MIL-2 (***common for all programmes***)	2	2-0-0	10	40	50
			Minor -4 (Disc.-C4)	PHSMIN04	**T: Electricity & Magnetism; P: Practical** *(To be studied by students taken Chemistry as Discipline- C)*	4	3-0-1	15	60	75
			Summer Intern.	IA	Internship / Apprenticeship- **activities to be decided by the Colleges following the guidelines to be given later**	4	0-0-4	-	-	50
					Semester-IV Total	22				400
					TOTAL of YEAR-2	42	-	-	-	775

MJP = 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, CA= Continuous Assessment, ESE= End Semester Examination, T = Theory, P= Practical, L-T-P = Lecture-Tutorial-Practical, MIL = Modern Indian Language

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MAJOR (MJ)

MJ A2/B2: **Waves and Optics** **Credits 04**

MJ A2/B2T: **Waves and Optics** **Credits 03 [40L]**

Course contents:

1. Oscillations: Differential equation of simple harmonic oscillations and its solution, Calculation of kinetic energy, potential energy, total energy and their time and space average values, Damped oscillations, Forced oscillations: Transient and steady states; Resonance, amplitude and velocity resonance, sharpness of resonance, power dissipation and Quality Factor. [8L]

2. Superposition of harmonic oscillations: Superposition of two collinear harmonic oscillations having equal frequencies and different frequencies (beats), Superposition of two perpendicular harmonic oscillations, Lissajous figures. [4L]

3. Wave motion: Plane progressive waves, Wave equation for progressive waves, Particle and wave velocities, Speed of transverse vibrations in a stretched string, standing (stationary) waves in a string, Phase and Group velocities, Doppler Effect and Doppler shift. [4L]

4. Geometrical optics: Fermat's principle, Laws of reflection and refraction at a plane surface from Fermat's principle, refraction at a spherical surface, lens formula and lens maker's formula, Combination of thin lenses in contact and in separation, equivalent focal length, Dispersion and dispersive power, Spherical and chromatic aberration. [6L]

5. Interference: Huygens' principle, explanation of the laws of reflection and refraction, Coherent sources, Division of wavefront and division of amplitude, Young's double slit experiment (YDSE), Intensity distribution, conditions of interference, Interference in thin films, Parallel and wedge shaped films: Fringes of equal inclination (Haidinger fringes- Idea only), Fringes of equal thickness (Fizeau fringes- Idea only), Newton's rings: Measurement of wavelength and refractive index. [6L]

6. Diffraction: Fresnel diffraction: Fresnel's half-period zones for plane waves, Theory of Zone Plate: Multiple foci of Zone Plate, Fraunhoffer diffraction: Single and double slits. Concept of diffraction grating with its diffraction pattern. Rayleigh criterion and idea of grating's resolving power. [6L]

7. Polarization: Description of linear, circular and elliptical polarization, Malus law, Birefringence, Uniaxial crystals, Double refraction and polarization by double refraction, Ordinary and extraordinary refractive indices, Retardation plates (idea only): Quarter-wave and Half-wave plates, Rotatory polarization, Biot's laws for rotatory polarization, Specific rotation. [6L]

Suggested readings:

- Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
- Advanced Acoustics, D. P. Roychowdhury, Promothesh Banerjee and Raghunandan Misra, The New Book Stall.
- Waves and Oscillations, N. K. Bajaj, 2017, Tata McGraw-Hill.
- A textbook of Optics, N. Subramanyam, B. Lal and M. N. Avadhanulu, 2006, S. Chand Publishing.

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- A Text Book on Light, B. Ghosh & K.G. Mazumdar, Shreedhar Publishers.
- স্নাতক পদার্থবিদ্যা (সেমিস্টার IV), দেবনারায়ণ জানা, সুজিত কুমার বেরা, এবং সীতারাম পাল, সাঁতরা পাবলিকেশন।

MJ A2 /B2 P: Practical **Credits 01**

List of Practical:

1. Measurement of focal length of a concave lens by combination method.
2. Familiarization with Schuster`s method and determination of angle of prism.
3. Determination of refractive index of material of a prism using sodium source.
4. Determination of unknown frequency of a tuning fork by Sonometer.
5. Determination of wavelength of sodium light/radius of a plano-convex lens using Newton's Rings.
6. To study the specific rotation of optically active solution using polarimeter.

Recommended Reading:

- Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia Publishing House.
- Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
- Laboratory Manual of Physics, Vol. 1 & 2 Madhusudan Jana, Books & Allied (P) Ltd., 2022, Kolkata.
- Practical Physics, G. L. Squires, 2015, 4th Edition, Cambridge University Press
- B. Sc. Practical Physics, C. L. Arora, S Chand and Company Limited
- Physics in Laboratory, Mandal, Chowdhury, Das, Das, Santra Publication
- Advanced Practical Physics Vol 1 & 2, B. Ghosh, K. G. Majumder, Sreedhar Publisher
- Practical Physics, P.R. Sasi Kumar, PHI Learning Private Limited
- B.Sc. Practical Physics, Harnem Singh, P.S. Hemne, S Chand and Company Limited

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MJ A3/B3: **Thermal Physics** **Credits 04**

MJ A3/B3T: **Thermal Physics** **Credits 03 [35L]**

Course contents:

1. Kinetic Theory of Gases: Derivation of Maxwell's law of distribution of molecular velocities and its experimental verification, Mean free path (zeroth order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Degrees of freedom, Law of equi-partition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases. [6L]

2. Laws of Thermodynamics: Zeroth Law of thermodynamics and concept of temperature, First law of thermodynamics and internal energy, conversion of heat into work, Various thermodynamic processes, Applications of First law: General relation between C_P and C_V, Work done in isothermal and adiabatic processes, compressibility and expansion coefficient, Reversible and irreversible processes, Second law of thermodynamics, concept of entropy, Carnot's cycle and Carnot's theorem, entropy changes in reversible & irreversible processes, entropy-temperature diagrams, Third law of thermodynamics and its implication. [10L]

3. Thermodynamic Potentials: Enthalpy, Gibbs, Helmholtz and internal energy functions, Maxwell's relations and applications, Expression for (C_P - C_V), C_P/C_V, TdS equations and their importance, Joule-Thomson Effect, Adiabatic demagnetisation (idea only), Clausius-Clapeyron Equation. [6L]

4. Theory of Radiation: Blackbody radiation, spectral distribution, concept of energy density, Derivation of Planck's law, Deduction of four laws (Wien's distribution law, Rayleigh - Jeans Law, Stefan Boltzmann Law and Wien's displacement law) from Planck's law. [6L]

5. Statistical Mechanics: Phase space, Macrostate and Microstate, Entropy and Thermodynamic probability, Quantum statistics: Fermi-Dirac distribution, Application to electron gas, Bose-Einstein distribution, Application to photon gas, comparison of three statistics. [7L]

Recommended Reading:

- A Treatise on Heat, Meghnad Saha, and B. N. Srivastava, 1969, Indian Press.
- Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
- Heat and Thermodynamics, M. W. Zemansky and R. Dittman, 1981, McGraw Hill
- Thermodynamics, Kinetic theory & Statistical thermodynamics, F. W. Sears and G. L. Salinger. 1988, Narosa.
- Thermal Physics, A. B. Gupta and H. P. Roy, Books & Allied (P) Ltd.
- Thermal Physics, A. Kumar and S. P. Taneja, 2014, R. Chand Publications.
- স্নাতক পদার্থবিদ্যা (সেমিস্টার III), দেবনারায়ণ জানা, সুজিত কুমার বেরা, এবং সীতারাম পাল, সাঁতরা পাবলিকেশন।

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MJ A3 /B3 P: Practical **Credits 01**

List of Practical:

1. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
2. Verification of Stefan-Boltzmann law using tungsten bulb and to determine Stefan's Constant.
3. To determine the temperature co-efficient of resistance of platinum by platinum resistance thermometer.
4. To study the variation of thermo emf across two junctions of a thermocouple with temperature.
5. Determination of the temperature coefficient of resistance by Carey Foster's method.

Recommended Reading:

- Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia Publishing House.
- Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
- Laboratory Manual of Physics, Vol. 1 & 2 Madhusudan Jana, Books & Allied (P) Ltd., 2022, Kolkata.
- Practical Physics, G. L. Squires, 2015, 4th Edition, Cambridge University Press
- B. Sc. Practical Physics, C. L. Arora, S Chand and Company Limited
- Physics in Laboratory, Mandal, Chowdhury, Das, Das, Santra Publication
- Advanced Practical Physics Vol 1 & 2, B. Ghosh, K. G. Majumder, Sreedhar Publisher
- Practical Physics, P.R. Sasi Kumar, PHI Learning Private Limited
- B.Sc. Practical Physics, Harnem Singh, P.S. Hemne, S Chand and Company Limited

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Major Elective -1 (MDP)

MJ (Elective)-1: Advanced Mathematical Methods Credits 04
MJ (Elective)-1T: Advanced Mathematical Methods Credits 03 [45L]

1. Matrices
(a) Addition and multiplication of matrices. Null matrices. Diagonal, scalar and unit matrices. Transpose of a matrix. Symmetric and skew-symmetric matrices. Conjugate of a matrix. Hermitian and skew-Hermitian matrices. Singular and non-singular matrices. Orthogonal and unitary matrices. Trace of a matrix. (b) Eigenvalues and eigenvectors (non-degenerate). Properties of Hermitian matrices. Cayley-Hamilton theorem. **[18L]**

2. Partial Differential Equations
Solutions to Laplace's equation using separation of variables for cartesian coordinates, Wave equation and its solution for vibrational modes of a stretched string. Simple problems. **[4L]**

3. Basics of Probability
Random experiments, sample space, events. Definitions of Probability. Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Bayes' theorem and its applications. **[5L]**

4. Some special integrals
Beta and Gamma functions and relation between them. Expression of integrals in terms of Gamma functions. Error function (probability integral). **[4L]**

5. Fourier Series
Periodic functions. Orthogonality of sine and cosine functions, Dirichlet conditions (statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Simple problems. **[7L]**

6. Fourier Transforms
Fourier integral theorem. Fourier Transform. Examples. Fourier transform of box and gaussian functions. **[7L]**

MJ (Elect. A/B)-1Tu: Advanced Mathematical Methods Credits 1

Tutorial
Students must be given at least Two assignments with list of relevant problems. On the basis of regularity of submission and evaluation of assignment by the respective teacher, credits should be awarded to the students.

Recommended reading:

- Introduction to Mathematical Physics, Charlie Harper, 1978, PHI Learning Pvt. Ltd.
- Mathematical methods in the Physical Sciences, M. L. Boas, 2005, Wiley.
- Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press.
- Mathematical Physics, P.K. Chattopadhyay, 2014, New Academic Science.
- Mathematical Physics, H. K. Dass & Rama Verma, 2014, S Chand.
- Fundamentals of Mathematical Physics, A B Gupta, 2024, Books & Allied.

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MINOR (MI)

MI-3/C3: Same as Minor-3 (PHSMIN03) of Physics (Hons) programme **Credits 04**
Full Marks: 75

MI-4/C4: Same as Minor-4 (PHSMIN04) of Physics (Hons) programme **Credits 04**
Full Marks: 75

SKILL ENHANCEMENT COURSE (SEC)

(To be studied by students taken Physics as Discipline- C)

SEC-03 P: Same as SEC-03 (PHSSEC03) of Physics (Hons) programme **Credits 03**
Full Marks: 50

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