FACULTY OF SCIENCES

SYLLABUS

of

Physics

For

Bachelor of Science

(Non-Medical & Computer Science)

(Semester III -IV)

(Under Credit Based Continuous Evaluation Grading System)

(12+3 System of Education)

Session: 2024-25

The Heritage Institution
KANYA MAHA VIDYALAYA
JALANDHAR

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULUM OF EXAMINATIONS OF THREE YEAR DEGREE PROGRAMME

Bachelor of Science (Non-Medical & Computer Science)

Session-2024-25

Semester -III										
Course Name	**Program Name**	**Course Code**	**Course Type**	**Total Marks**	**Marks**					
					Paper	**Credits**	**Ext.**		**CA**	**EXAM TIME**
						L-T-P	**L**	**P**		**In Hrs**
Physics	Bachelor of Science (Non-Medical) / Bachelor of Science (Computer Science)	BSNM-3395(I) / BCSM-3395(I)	C	**75**	Statistical Physics and Thermodynamics	**3-0-0**	**60**		**15**	**3**
		BSNM-3395(II) / BCSM-3395(II)		**50**	Optics and Laser	**2-0-0**	**40**		**10**	**3**
		BSNM-3395(P) / BCSM-3395(P)		**50**	Physics Lab	**0-0-2**		**40**	**10**	**3**
				175		**5-0-2**			**35**	

Semester -IV										
Course Name	**Program Name**	**Course Code**	**Course Type**	**Total Marks**	**Marks**					
					Paper	**Credits**	**Ext.**		**CA**	**EXAM TIME**
						L-T-P	**L**	**P**		**In Hrs**
Physics	Bachelor of Science (Non-Medical) / Bachelor of Science (Computer Science)	BSNM-4395(I) / BCSM-4395(I)	C	**75**	Quantum Mechanics	**3-0-0**	**60**		**15**	**3**
		BSNM-4395(II) / BCSM-4395(II)		**50**	Atomic and Molecular Spectra	**2-0-0**	**40**		**10**	**3**
		BSNM-4395(P) / BCSM-4395(P)		**50**	Physics Lab	**0-0-2**		**40**	**10**	**3**
				175		**5-0-2**			**35**	

Bachelor of Science (Semester System) (12+3 System of Education)

SEMESTER-III

(Session-2024-25)

PHYSICS (STATISTICAL PHYSICS AND THERMODYNAMICS)

Course code: BSNM-3395 (I) for Bachelor of Science (Non Medical)
BCSM-3395 (I) for Bachelor of Science (Computer Science)

COURSE OUTCOMES:

After passing this course, students will be able to:

CO1: Understand the basic ideas and scope of probability as well as distribution of n particles in different compartments.

CO2: Concept of different types of Statistics and the need for Quantum Statistics.

CO3: Understand the concept of entropy, Laws of Thermodynamics and applications to thermoelectric effect.

CO4: Understand the Maxwell Thermodynamics relations, Change of state and Clapeyron equation.

Bachelor of Science (Semester System) (12+3 System of Education)

SEMESTER-III

(Session-2024-25)

PHYSICS (STATISTICAL PHYSICS AND THERMODYNAMICS)

Course code: BSNM-3395 (I) for Bachelor of Science (Non Medical)
BCSM-3395 (I) for Bachelor of Science (Computer Science)

Time: 3 Hours	**Max Marks: 75**	**Ext Marks: 60**
Credits: 3-0-0	**CA: 15**	**Pass Mark: 21**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 12 marks.

Note: Students can use Non-Scientific calculators or logarithmic tables.

UNIT–I

Basic ideas of Statistical Physics, Scope of Statistical Physics, Basic ideas about probability, Distribution of four distinguishable particles into compartments of equal size. Concept of macro states, microstates, Thermodynamic Probability, Effects of constraints on the system. Distribution of n particles in two compartments, Deviation from the state of maximum probability. Equilibrium state of dynamic system, Distribution of distinguishable n particles in k compartments of unequal sizes.

UNIT–II

Phase space and division into elementary cells. Three kinds of statistics. The basic approach in three statistics. Maxwell Boltzmann (MB) statistics applied to an ideal gas in equilibrium. Experimental verification of the law of distribution of molecular speeds. Need for Quantum Statistics – B.E. Statement of Planck's law of Radiation Wien's Displacement and Stefan's law. Fermi Dirac (FD) statistics. Comparison of M.B, B.E and F.D statistics.

UNIT–III

Statistical definition of entropy, Change of entropy of system, additive nature of entropy, Law of increase of entropy, Reversible and irreversible processes, and their examples, work done in reversible process, examples of increase in entropy in natural processes, entropy and disorder, Brief review of Terms, Laws of Thermodynamics, Carnot Cycle, Entropy changes in Carnot cycle, Absolute thermodynamics or Kelvin Scale of Temperature, Applications of thermodynamics to thermoelectric effect, Peltier Effect, Thomson Effect, change of entropy along reversible path in P-V diagram. Heat death of universe.

UNIT–IV

Derivation of Maxwell Thermodynamics relations, Cooling produced by adiabatic stretching, A diabetic Compression, change of internal energy with volume, Specific heat and constant pressure and constant volume. Expression for C_P-C_V, Change of state and Clapeyron equation, Joule-Thomson effect.

Text Reference Books:

1. Statistical Physics and Thermodynamics by V.S. Bhatia (Sohan Lal Nagin Chand), Jal.
2. A Treatise on Heat by M.N. Saha & B.N. Srivastava (The Indian Press Pvt. Ltd., Allahabad),1965.
3. Statistical Mechanics: An Introductory Text by Bhattacharjee, J.K. (Allied Pub., Delhi), 2000.
4. Statistical Physics by Bhattacharjee, J.K. (Allied Pub., Delhi) 2000.
5. Statistical Mechanics by B.B. Laud, (Macmillan India Ltd.) 1981.

Bachelor of Science (Semester System) (12+3 System of Education)

SEMESTER-III

(Session-2024-25)

Course code: BSNM-3395 (II) for Bachelor of Science (Non Medical)
BCSM-3395 (II) for Bachelor of Science (Computer Science)

PHYSICS (OPTICS AND LASER)

COURSE OUTCOMES:

After passing this course, students will be able to:

CO1: understand the concept of interference of waves by division of wave front and by division of Amplitude, its different methods and interferometers.

CO2: understand the Huygens Fresnel theory and diffraction, Fraunhofer diffraction due to single slit, double slit and n slits, the concept of resolving power.

CO3: understand the concept of the polarization of light and types of polarisers.

CO4: understand the fundamentals of lasers and its processes. The knowledge of different components and types of lasers and its applications

Bachelor of Science (Semester System) (12+3 System of Education)

SEMESTER-III

(Session-2024-25)

Course code: BSNM-3395 (II) for Bachelor of Science (Non Medical)
BCSM-3395 (II) for Bachelor of Science (Computer Science)

PHYSICS (OPTICS AND LASER)

Time: 3 Hours	**Max Marks: 50**	**Ext Marks: 40**
Credits: 2-0-0	**CA: 10**	**Pass Mark: 14**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 8 marks.

Note: Students can use Non-Scientific calculators or logarithmic tables.

UNIT–I

Interference of Light:

Superposition of light waves and interference, Young's double slit experiment, Conditions for sustained interference pattern, Coherent sources of light, Interference pattern by division of wave front, Fresnel Biprism, Displacement of fringes, Change of phase on reflection, Interference in thin films due to reflected and transmitted light, non reflecting films, Newton's Rings. Michelson Interferometer.

UNIT–II

Diffraction:

Huygen's Fresnel theory, half-period zones, Zone plate, Distinction between Fresnel and Fraunhoffer diffraction. Fraunhoffer diffraction due to single slit, rectangular and circular apertures, Effect of diffraction in optical imaging, Resolving power of telescope in diffraction grating, its use as a spectroscopic element and its resolving power, Resolving power of microscope

UNIT–III

Polarization:

Plane Polarized light, Elliptically polarized light, wire grid polarizer, Sheet polarizer, Mauls' Law, Brewester Law, Polarization by reflection and scattering, Double reflection, Nicol prism, Retardation plates, Production and Analysis of polarized light, Quarter and half wave plates.

UNIT–IV

Laser Fundamentals:

Derivation of Einstein relations, Concept of stimulated emission and population inversion, broadening of spectral lines, three level and four level laser schemes, Threshold and Schawlow Townes condition, Components of laser devices, types of lasers, Ruby and Nd:YAG lasers, He-Ne and CO2 lasers construction, mode of creating population inversion and output characteristics, application of lasers –a general outline.

Text Reference Books:

1.Fundamentals of Optics: F.A. Jenkins and Harvey E White, (Megraw Hill) 4th Edition, 2001.
2. Optics: Ajoy Ghatak, (McMillan India) 2nd Edition, 7th Reprint, 1997
3. Optics: Born and Wolf, (Pergamon Press) 3rd Edition, 1965.
4. Laser Fundamentals: W.T. Silfvast (Foundation Books), New Delhi, 1996.
5. Laser and Nonlinear Optics: B.B. Laud (New Age Pub.) 2002
6. Laser: Svelto, Plenum Press) 3rd Edition, New York

Bachelor of Science (Semester System) (12+3 System of Education)

SEMESTER-III

(Session-2024-25)

Course code: BSNM-3395(P) for Bachelor of Science (Non Medical)
BCSM-3395(P) for Bachelor of Science (Computer Science)

PHYSICS (PRACTICAL)

COURSE OUTCOMES:

After passing this course, students will be able to:

CO1: use a spectrometer to determine the refractive index of different transparent materials, dispersive power and resolving power of different transparent prisms and liquids using a spectrometer.

CO2: use diffraction grating and apply it to determine dispersive power, resolving power, the wavelengths of Hg source and the Cauchy's constants.

CO3: to measure an accessible (Horizontal and vertical) and inaccessible heights using sextant.

CO4: set up Newton's rings to determine the wavelength of sodium light.

CO5: demonstrate the verification of laws of probability distribution.

Bachelor of Science (Semester System) (12+3 System of Education)

SEMESTER-III

PHYSICS (PRACTICAL)

(Session-2024-25)

Course code: BSNM-3395(P) for Bachelor of Science (Non Medical)
BCSM-3395(P) for Bachelor of Science (Computer Science)

Time: 3 Hours	**Max Marks: 50**	**Ext Marks: 40**
Credits: 0-0-2	**CA: 10**	**Pass Mark: 14**

Instructions to Practical Examiner

Question paper is to be set on the spot jointly by the external and internal examiners. Two copies of the same to be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar

General Guidelines for Practical Examination

I. The distribution of marks is as follows: **Marks: 40**
i) One experiment **20 Marks**
ii) Brief Theory **5 Marks**
iii) Viva–Voce **10 Marks**
iv) Record (Practical file) **5 Marks**
II. There will be one session of 3 hours duration. The paper will have one session.
Paper will consist of 8 experiments out of which an examinee will mark 6 experiments and one of these is to be allotted by the external examiner.
III. Number of candidates in a group for practical examination should not exceed 12.
IV. In a single group no experiment is to be allotted to more than three examinees in any group.

List of Experiments

1. To determine the refractive index of glass/ liquid using a spectrometer.
2. To determine the Cauchy's constants.
3. To study the refractive index of a doubly refracting prism.
4. To set up Newton's rings to determine wavelength of sodium light.
5. To determine the wavelength by using plane diffraction grating (Use Hg source)
6. To determine dispersive power of plane diffraction grating.
7. To determine resolving power of a telescope.
8. To measure an accessible (Horizontal and vertical) height using sextant.
9. To measure inaccessible height by using sextant.
10. Verify laws of probability distribution by throwing similar coins.
11. To determine the wavelength of given laser source using Young's double slit experiment

Bachelor of Science (Semester System) (12+3 System of Education)

SEMESTER-IV

PHYSICS (QUANTUM MECHANICS)

(Session-2024-25)

Course code: BSNM-4395 (I) for Bachelor of Science (Non Medical)
BCSM-4395 (I) for Bachelor of Science (Computer Science)

COURSE OUTCOMES:

After passing this course, students will be able to:

CO1: Students will be familiar with the main aspects of the historical development of quantum mechanics

CO2: Students will understand the central concepts and principles in quantum mechanics

CO3: Students will be able to find the solution of Schrödinger wave equation for simple systems in one dimension and for Hydrogen atoms.

CO4: Students will be able to find the solution of Schrödinger wave equation for simple systems in three dimensions and for Hydrogen atoms in spherical coordinates.

Bachelor of Science (Semester System) (12+3 System of Education)

SEMESTER–IV

(Session-2024-25)

PHYSICS (QUANTUM MECHANICS)

Course code: BSNM-4395 (I) for Bachelor of Science (Non Medical)
BCSM-4395 (I) for Bachelor of Science (Computer Science)

Time: 3 Hours	**Max Marks: 75**	**Ext Marks: 60**
Credits: 3-0-0	**CA: 15**	**Pass Mark: 21**

Instructions for the Paper Setters:
Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 12 marks.
Note: Students can use Non-Scientific calculators or logarithmic tables.

UNIT–I

Formalism of Wave Mechanics:
Brief introduction to need and development of quantum mechanics, photoelectric effect, Compton effect, Wave particle duality, De broglie hypothesis, Wave packet, Group velocity, Uncertainty principle, Fundamental postulates of wave mechanics, Time dependent and time independent Schrodinger wave equation for a free particle and equation of a particle subject to forces. Stationary states, Superposition principle.

UNIT–II

Normalization and probability interpretation of wave function, Gaussian wave packet. Admissibility conditions of wave function, Eigen function and Eigen value, Expectation value, Operator and commutator formalism, Hermitian operator, orthogonal system, Probability current and conservation of probability, Ehrenfest theorem,.

UNIT–III

Application of Schrodinger wave equation to one dimensional problems:
Application of Schrodinger Equation for solving one dimensional Particle in a box, One dimensional step potential for $E>V_0$, one dimensional step potential for $0<E<V0$,
one dimensional potential barrier of finite height and width, Quantum mechanical tunnelling effect, one dimensional square well of finite depth

UNIT–IV

Application of Schrodinger equation to three dimensional problems:
Free particle in three dimensional rectangular box, Eigen wave function, Eigenvalues of momentum, energy and degeneracy, three dimensional harmonic oscillator (Cartesian coordinates) wave function, energy levels, degeneracy, Schrodinger's wave equation in spherical polar coordinates, Schrodinger wave equation for spherically symmetric potential for hydrogen atom, wave function of H atom, ⟩(√),⌊ (∪solution of R(r), equations.

Text Reference Books:

1. A Text book of Quantum Mechanics by P.M. Mathews and K. Venkatesan,(Tata McGraw Hill Pub. Co. Delhi) 2002.
2. Quantum Mechanics by J.L. Powell and B. Craseman (Narosa Pub. House, New Delhi) 1997.

3. Concepts of Modern Physics by Arthur Beiser (McGraw Hill Pub. Co., New Delhi, 9th Ed.)
4. 1995.
5. Elements of Modern Physics by S.H. Patil (McGraw Hill), 1998.
6. Quantum Mechanics by E. Merzbacher (John Wiley, 2nd Edition)
7. Fundamentals of Molecular Spectroscopy by C.N. Banwell (Tata McGraw Hill Pub. Co.Delhi), 2001.
8. Atomic Spectra by H.G. Kuhn (Longmans), 2nd Ed., 1969.
9. Introduction to Quantum Mechanics by L. Pauling and E.B. Wilson (Tata McGraw Hill Pub. Co., Delhi), 2002.
10. Quantum Mechanics by W. Greiner (Springer Verlag), 1994.
11. Fundamentals of Molecular Spectroscopy by C.B. Banwell-Tata McGraw Hill, 1986.
12. Molecular Spectroscopy: Jeanne L McHale.

Bachelor of Science (Semester System) (12+3 System of Education)

SEMESTER–IV

(Session-2024-25)

PHYSICS (ATOMIC AND MOLECULAR SPECTRA)

Course code: BSNM-4395 (II) for Bachelor of Science (Non Medical)
BCSM-4395 (II) for Bachelor of Science (Computer Science)

COURSE OUTCOMES:

After passing this course, students will be able to:

CO1: understand fine and hyperfine spectrum of hydrogen atom and the concept of spin and magnetic moment of an electron

CO2: understand spectra of alkali atoms and Zeeman effect

CO3: demonstrate understanding of exchange symmetry of wave function, different coupling schemes and spectra of atoms with more than one electron.

CO4: Students will understand concept of X rays spectra and molecular spectra including rotational, vibrational and Raman Spectra

Bachelor of Science (Semester System) (12+3 System of Education)

SEMESTER–IV

(Session-2024-25)

PHYSICS (ATOMIC AND MOLECULAR SPECTRA)

Course code: BSNM-4395 (II) for Bachelor of Science (Non Medical)
BCSM-4395 (II) for Bachelor of Science (Computer Science)

Time: 3 Hours	**Max Marks: 50**	**Ext Marks: 40**
Credits: 2-0-0	**CA: 10**	**Pass Mark: 14**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 8 marks.

Note: Students can use Non-Scientific calculators or logarithmic tables.

UNIT–I

Introduction to Atomic Spectra:

Observation of spectra, Types of spectra, Spectral analysis, Units in spectroscopy, Bohr's Theory and Hydrogen spectrum, Spectral series, Bohr's correspondence Principle, quantum numbers, The Spinning electron and the vector model, Stern Gerlach Experiment, Total Quantum number, Term values, Magnetic moment(Orbital, Spin and Total)

UNIT–II

One Electron Atomic Spectra:

Electron Spin orbit interaction, Fine and Hyperfine structure of Hydrogen atom, Energy level and different series of alkali spectra, Doublet structure in alkali Spectra (Fine Structure), Selection rules for doublets, Zeeman Effect and its experimental setup, Classical theory of Normal Zeeman effect, Quantum theory of Normal and anomalous Zeeman effect

UNIT–III

Many Electron System Spectra:

Exchange symmetry of wave function, Pauli's Exclusion principle, Electronic configuration and atomic states, shells, subshells in atoms, Two valence electron atoms: LS and JJ coupling schemes and resulting spectral terms, optical spectra for one and many electron system (Helium), spectra of alkaline earth atoms.

UNIT–IV

X Ray and Molecular Spectra:

Production of X-rays and Types of X-ray spectra, Mosley law, Molecular bonding, Molecular spectra, selection rules, symmetric structure, Rotational Vibrational, electronic level and spectra of molecules, Raman spectra. Introduction to Raman spectra.

Text Reference Books:

1. Introduction to Atomic Spectra by: H.E. White-Auckland McGraw Hill, 1934.
2. Spectroscopy Vol. I, II & III by Walker & Straughen
3. Introduction to Molecular Spectroscopy by G.M. Barrow-Tokyo McGraw Hill, 1962.
4. Spectra of Diatomic Molecules by Herzberg-New York, 1944
5. Introduction to Atomic Spectra by H.E. White (Mcgraw Hill, Book Co., Inc., New York)

Bachelor of Science (Semester System) (12+3 System of Education)

SEMESTER–IV

(Session-2024-25)

Course Title: PHYSICS (PRACTICAL)

Course code: BSNM-4395(P) for Bachelor of Science (Non Medical)
BCSM-4395(P) for Bachelor of Science (Computer Science)

COURSE OUTCOMES:

After passing this course, students will be able to:

CO1: The exercises included in this laboratory course are aimed at training the students to handle different type of equipment for verification of some of the laws and concepts studied in theory like concepts of thermodynamics, photoelectric effect and for carrying out precise measurements

CO2: use later the sophisticated instruments in their respective fields.

CO3: use spectrometers and hence will be able to study absorption spectra of iodine.

CO4: prepare cane sugar solution and hence will be able to find its specific rotation by using a polarimeter.

S Bachelor of Science (Semester System) (12+3 System of Education)

SEMESTER–IV

(Session-2024-25)

PHYSICS (PRACTICAL)

Course code: BSNM-4395 (P) for Bachelor of Science (Non Medical)
BCSM-4395 (P) for Bachelor of Science (Computer Science)

Time: 3 Hours	**Max Marks: 50**	**Ext Marks: 40**
Credits: 0-0-2 (4 Hours/week)	**CA: 10**	**Pass Mark: 14**

Instructions to Practical Examiner

Question paper is to be set on the spot jointly by the external and internal examiners. Two copies of the same to be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar

General Guidelines for Practical Examination

I. The distribution of marks is as follows: **Marks: 40**
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iv) Record (Practical file) **5 Marks**
II. There will be one session of 3 hours duration. The paper will have one session.
Paper will consist of 8 experiments out of which an examinee will mark 6 experiments and one of these is to be allotted by the external examiner.
III. Number of candidates in a group for practical examination should not exceed 12.
IV. In a single group no experiment is to be allotted to more than three examinees in any group.

List of Experiments

1. To study adiabatic expansion of gas and hence to calculate the value of V.
2. To find the coefficient of Thermal Conductivity of a bad conductor by Lee's method.
3. To plot a calibration curve of a given thermocouple (copper constantan).
4. To study the photoelectric effect and determine the value of Planck's constant.
5. To determine the ionization potential of mercury.
6. Study of variation of light intensity with distance using photovoltaic cell
(Inverse Square Law)
7. To determine the heating efficiency of an electric kettle with varying voltage.
8. To study the absorption spectra of iodine vapours.
9. To study the rotation of the plane of polarization by using a polarimeter.
10. To determine the specific rotation of sugar using Laurent's half shade polarimeter
11. To study the characterizations of Photovoltaic cells.