BHAKTA KAVI NARSINH MEHTA UNIVERSITY

Major/Minor/Multidisciplinary

Syllabus of B.Sc. (Honors) as per NEP-2020

Faculty of Science

Effective from June 2026

Subject: Physics

SEMESTER-VII & VIII

SUMMARY OF THE SYLLABUS

Sem No.	Sr. No.	Category of Course	Course Title	Course Level	Credit	Teaching Hrs.	SEE Marks	CCE Marks	Total Marks	Exam Duration
Sem-7	1	Major-17	MAJPHY717	6.0	4	60	50	50	100	2 hours
	2	Major-18	MAJPHY718	6.0	4	60	50	50	100	2 hours
	3	Major-19	MAJPHY719 (P)	6.0	4	120	50	50	100	4 hours
	4	Minor-7	MINPHY707	6.0	4	60	50	50	100	2 hours
	5	OJT/Research			6				150	
		MDSC (Without OJT)	MDSC (P)	6.0	4	120	50	50	100	4 hours
		MDSC (Without OJT)	Skill Enhancement Course (SEC)	6.0	2	30	25	25	50	2 hours
				Total	**22**					

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SEMESTER-VII & VIII

Course Level	UG	**Internal Marks**	50
Programme	B.Sc. in Physics	**External Marks**	50
Semester	VII	**Practical Internal**	0
Category of Course		**Practical External**	0
Course Credit	4	**Prac.External Exam Duration**	0
Teaching Hours	60	**Total**	100
Course Code	MAJPHY717	**Exam Duration**	2 hours
Course Title	Mathematical Physics & classical Mechanics		

Course Objectives:

After completing this course, students will be able to:

1. Develop a strong foundation in solving ordinary differential equations using analytical methods applicable to physical systems.
2. Apply series solution techniques, including Frobenius' method, to solve differential equations with variable coefficients.
3. Analyze the motion of particles under central force fields and understand orbital dynamics using classical mechanics.
4. Understand the theory of complex variables and apply contour integration and residue theorem to evaluate definite integrals arising in physics.
5. Explain canonical transformations, Poisson brackets, and Hamilton–Jacobi theory as powerful formulations of classical mechanics.
6. Analyze the dynamics of particles in translating and rotating coordinate systems, including the effects of fictitious forces such as the Coriolis force.

Course Learning Outcome:

Upon successful completion of this course, students will be able to:

CLO1: Solve second-order ordinary differential equations with variable coefficients using homogeneous, inhomogeneous, and Frobenius series methods.

CLO2: Analyze central force motion, derive orbital equations, classify planetary and scattering trajectories, and explain concepts such as Bertrand's theorem, Kepler's problem, and Rutherford scattering.

CLO3: Apply the principles of complex analysis to identify analytic functions, evaluate contour integrals, determine Laurent series expansions, calculate residues, and solve definite integrals using the residue theorem.

CLO4: Explain canonical transformations and utilize Poisson brackets to solve problems involving Hamiltonian systems, angular momentum, harmonic oscillators, and the Virial theorem.

CLO5: Formulate and solve problems using Hamilton–Jacobi theory by constructing Hamilton's principal and characteristic functions for dynamical systems.

CLO6: Analyze the motion of particles in non-inertial reference frames by incorporating translational and rotational coordinate transformations, and evaluate the effects of inertial forces including the Coriolis force.

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SEMESTER-VII & VIII

Course Contents: MAJPHY717

Unit No.	Syllabi	Teaching Hours
1	**Ordinary Differential Equations:** Introduction, Solution of Second Order Differential with Variable Coefficients (1) Homogenous Equations (2) Inhomogeneous Equations Series Integration Method of the Solution of Linear Differential Equations (Frobenius' Method) **The Equation of Motion and First Integrals:** Differential Equation for the Orbit, Condition for Closed Orbits, Bertrand's Theorem, Kepler's Problem, Inverse Square Law of Force, Classification of Orbit's, Rutherford Scattering	15
2	**Complex Variables:** Introduction, Analytical Function, Theorems, Illustrative examples, Contour Integral Theorem, Integral Formula Theorem, Illustrative examples, Laurent Series Theorem, Method of finding residues. The Residue Theorem, Evaluation of Definite, Integrals by use of the residue theorem, Examples, Additional illustrative examples.	15
3	**Canonical Transformations:** Equation of Canonical Transformation, Example of Harmonic Oscillator, Poisson Brackets Properties of Poisson Brackets, Angular Momentum Poisson Bracket Relation. Virial Theorem	15
4	**Hamilton – Jacobi Theory:** Hamilton – Jacobi Theory, Hamilton – Jacobi Equation for Hamilton's Principal Function, Harmonic Oscillator Example, Hamilton's Characteristic and Principal Functions. Moving Coordinate System, Coordinate System with Relative Translational Motions, Rotating Coordinate Systems, Coriolis Force, Motion on the Earth	15

Suggested Reading:

Text Books:

1. Mathematical Methods for Physicists by G. Arfkenand Weber, Academic Press, 6th Ed (2005).
2. Mathematical Methods in Physical Sciences by M. L. Boas, Second Edition, John Wiley & Sons, (1996).
3. Mathematical Physics by B. S. Rajput, 28th Ed., Pragati Prakashan, Meerut (2015).

4. H. Goldstein, C. P. Poole, J. L. Safko, Classical Mechanics, 3rd Ed., Pearson India, New Delhi (2011).
5. J. C. Upadhyay, Classical Mechanics, Himalaya Publishing House, Mumbai (2016).

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Programme	B.Sc. in Physics	**External Marks**	50
Semester	VII	**Practical Internal**	0
Category of Course		**Practical External**	0
Course Credit	4	**Prac.External Exam Duration**	0
Teaching Hours	60	**Total**	100
Course Code	MAJPHY718	**Exam Duration**	2 hours
Course Title	Electrodynamics & Plasma		

Course Objectives:

The objectives of this course are to:

1. Develop a thorough understanding of scalar and vector potentials, gauge transformations, and electromagnetic field formulations for time-varying charge and current distributions.
2. Explain the fundamental principles of electromagnetic radiation, including dipole radiation, radiation from moving charges, and energy emission mechanisms.
3. Introduce the fundamental concepts of plasma physics, plasma parameters, and the behavior of charged particles in electric and magnetic fields.
4. Analyze plasma as a conducting fluid using fluid equations, dielectric properties, plasma drifts, and plasma instabilities.
5. Understand plasma wave phenomena, plasma oscillations, and magnetohydrodynamic (MHD) waves, along with their applications in laboratory and space plasmas

Course Learning Outcomes:

CO1: Explain the concepts of scalar and vector potentials, gauge transformations, Coulomb and Lorentz gauges, retarded potentials, Jefimenko's equations, Liénard–Wiechert potentials, and determine the electromagnetic fields of moving charges.

CO2: Analyze the mechanism of electromagnetic radiation, derive expressions for electric and magnetic dipole radiation, evaluate radiation from arbitrary sources, and calculate the power radiated by accelerated point charges.

CO3: Describe the fundamental properties of plasma, evaluate plasma parameters and criteria, explain plasma applications, and analyze the motion of charged particles in uniform, non-uniform, and time-varying electric and magnetic fields using adiabatic invariants and plasma fluid concepts.

CO4: Apply plasma fluid equations to explain dielectric behavior, convective derivatives, plasma drifts perpendicular to magnetic fields, and identify the origin and significance of plasma instabilities.

CO5: Explain plasma oscillations, derive the plasma frequency, distinguish between phase and group velocities, and interpret important plasma wave phenomena such as whistler modes, Faraday rotation, hydromagnetic waves, magnetosonic waves, and Alfvén waves.

CO6: Apply the principles of electromagnetic fields, radiation, and plasma physics to analyze and solve theoretical and practical problems encountered in advanced physics, space science, fusion research, and plasma-based technologies.

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SEMESTER-VII & VIII

Course Contents: MAJPHY718

Unit No.	Syllabi	Teaching Hours
1	**Potentials and Fields:** Scalar and Vector Potentials, Gauge Transformation, Coulomb Gauge and Lorentz Gauge, Retarded Potentials, Jenmenko's Equations, Lienard-Wiechert Potentials, The Fields of a Moving Point Charge	15
2	**Radiation:** What is Radiation? Electric Dipole Radiation, Magnetic Dipole Radiation, Radiation from an Arbitrary Source, Power Radiated by a Point Charge	15
3	**Introduction to Plasma-1:** Definition of Plasma, Plasma parameters, criteria for plasma, Applications of Plasma Motion of Charged particle in Uniform B and E fields, non-uniform B and E fields, time varying E field, adiabatic invariants, Dielectric constant of Plasma, Fluid equation of Plasma, convective derivative, fluid drifts perpendicular to B, plasma instabilities	15
4	**Introduction to Plasma-2:** Concept of phase and group velocities, plasma oscillations, expression for ω_p, Experimental consequences – Whistler modes, Faraday rotation, Hydro magnetic waves and Magneto sonic or Alfven waves	15

Suggested Reading:

1. Introduction to Plasma Physics & controlled fusion (IInd edition): Vol. 1: Plasma Physics by F.F. Chen
2. Introduction to electrodynamics, D.J. Griffith (PHI, New Delhi)
3. Plasma Physics by Bittencourt
4. Plasma Physics by Chakraborty

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SEMESTER-VII & VIII

Course Level	UG	**Internal Marks**	0
Programme	B.Sc. in Physics	**External Marks**	0
Semester	VII	**Practical Internal**	50
Category of Course		**Practical External**	50
Course Credit	4	**Prac. External Exam Duration**	2+2=4 hours
Teaching Hours	120	**Total**	100
Course Code	MAJPHY719	**Exam Duration**	
Course Title	Physics Practical		

Course Objectives:

1. To provide practical experience in studying the characteristics and applications of semiconductor, optoelectronic, and electronic devices.
2. To develop skills in designing, constructing, and analyzing analog electronic circuits using transistors and operational amplifiers.
3. To familiarize students with modern experimental techniques in solid-state physics, optics, nuclear physics, and ultrasonics.
4. To enhance experimental, analytical, and data interpretation skills through laboratory investigations.

Course Outcomes:

After successful completion of the course, students will be able to:

- **CO1**: Perform experiments to study the characteristics and applications of semiconductor devices such as SCR, DIAC, TRIAC, JFET, thermistors, and solar cells.
- **CO2**: Design, construct, and analyze analog electronic circuits including UJT oscillators, transistor amplifiers, and operational amplifier-based circuits.
- **CO3**: Apply experimental techniques to determine important physical parameters such as Hall coefficient, semiconductor band gap, laser wavelength, Planck's constant, viscosity, compressibility, and Rydberg's constant.
- **CO4**: Analyze experimental data, estimate errors, and interpret results using appropriate scientific methods and laboratory practices.

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Subject: Physics

SEMESTER-VII & VIII

Course Contents: MAJPHY616 (P)

Unit	Syllabi	Teaching Hours
List of Experiments	**Group A** 1. To Study I-V characteristics of SCR. 2. To Study I-V characteristics of DIAC. 3. To Study I-V characteristics of TRIAC. 4. Construct and study UJT relaxation oscillator. 5. Determination of "Plateau" in G.M. tube characteristics. 6. To study the Energy Band-gap of thermistor. 7. To measure efficiency of solar cell. 8. To Study JFET source follower. 9. To Study JFET common source amplifier. 10. To Study Adder circuit Operational amplifier IC 741. **Group B** 11. To Study Subtractor circuit Operational amplifier IC 741. 12. To study parameters of IC 741. 13. Direct coupled amplifier using transistors. 14. To study frequency response of I.F. tuned amplifier. 15. To Study Hall effect. 16. To determine Energy ban-gap of a semiconductor using four probe method. 17. To determine the wavelength of given LASER beam using diffraction grating. 18. To find the value of Plank radiation constant using intrinsic photoconduction of photovoltaic cell. 19. To determine the viscosity of ultrasound wave in liquid and compressibility of the liquid. 20. To determine the value of Rydberg's constant.	**120**

Suggested Reading:

1. Practical Physics by C.L. Arora (S. Chand)
2. Advanced Practical Physics by Chauhan & Singh. (Pragati Prakashan)
3. B. Saraf et al-Physics through experiments Vol. I & II

4. Electronic Laboratory Primer by Poorna Chandra & Sasikala, (S. Chand)
5. Practical Physics by Chattopadhyay, Rakshit & Saha.

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Subject: Physics

SEMESTER-VII & VIII

Course Level	UG	**Internal Marks**	50
Programme	B.Sc in Physics	**External Marks**	50
Semester	VII	**Practical Internal**	0
Category of Course		**Practical External**	0
Course Credit	4	**Prac.External Exam Duration**	0
Teaching Hours	60	**Total**	100
Course Code	MINPHY707	**Exam Duration**	2 hours
Course Title	Solid State Electronics Devices & Circuits		

Course Objectives:

The objectives of this course are to:

1. To develop a thorough understanding of Field Effect Transistors (JFET and MOSFET), their characteristics, biasing techniques, and amplifier configurations.
2. To introduce the working principles, characteristics, and applications of optoelectronic and special semiconductor devices used in modern electronic systems.
3. To explain the design and analysis of active filters, oscillators, waveform generators, comparators, data converters, and voltage regulation circuits.
4. To enable students to analyze and apply analog electronic circuits in communication, instrumentation, control, and power electronic applications.

Course Outcomes (COs)

After successful completion of the course, students will be able to:

- **CO1**: Explain the construction, characteristics, biasing methods, and applications of JFETs and MOSFETs, and analyze FET-based amplifier circuits.
- **CO2**: Describe the operating principles, characteristics, and applications of optoelectronic and special semiconductor devices, including LEDs, photodiodes, solar cells, SCRs, TRIACs, DIACs, UJTs, and thermistors.
- **CO3**: Design and analyze active filters, oscillators, waveform generators, and comparator circuits for analog signal processing.
- **CO4**: Explain the operation and applications of ADCs, DACs, sample-and-hold circuits, IC 555 timers, phase-locked loops, and fixed, variable, and switching voltage regulators.

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SEMESTER-VII & VIII

Course Contents: MINPHY707

Unit No.	Syllabi	Teaching Hours
1	**Field Effect Transistors:** Junction Field Effect Transistors (JFET): Comparison with BJT, construction, polarity conventions and characteristics. JFET parameters, biasing methods, Common Source amplifier and Source Follower. MOSFETs: DE-MOSFET and E-MOSFET: construction and characteristics.	15
2	**Optoelectronic and Special Semiconductor Devices:** Photometry and Radiometry units; Classification of optoelectronic devices; Radiative and non-radiative transitions; LDR; Photodiode; PIN Photodiode; Phototransistor; LED: Physics and materials; LCD. Zener diode and voltage regulation; SCR; TRIAC; DIAC; UJT and relaxation oscillator; Thermistors; Solar Cells	15
3	**Filters:** Introduction of filters, first and second order low pass, high pass, band pass and band reject filters, all pass filter, Oscillators – phase shift, Wein bridge and quadrature oscillators, square, triangle and sawtooth generators, voltage-controlled oscillators, Non-sinusoidal oscillators.	15
4	**Comparators:** Basic, zero crossing and Schmitt trigger comparators, characteristics and limitations, Analog-to-digital and digital-to-analog converters, sample and hold circuit. IC 555 and its applications, Phase-locked-loops and its applications, Voltage regulators – fixed, variable and switching regulators.	15

Suggested Reading:

1. Electronic Circuits: Discrete and Integrated, Donald Schilling & Charles Belove, MaGraw Hill International
2. Electronic devices and circuit theory, Robert Boylestad & Louis Nahselsky, PHI
3. Solid State Devices and integrated circuits, W.D. Cooper Weisbecker, Reston Pub (USA)
4. Solid state Devices & applications, Frederick Driscoll & Robert Coughlin, Prantice Hall

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SEMESTER-VII & VIII

Course Level	UG	**Internal Marks**	0
Programme	B.Sc. in Physics	**External Marks**	0
Semester	VII	**Practical Internal**	50
Category of Course		**Practical External**	50
Course Credit	4	**Prac. External Exam Duration**	2+2=4 hours
Teaching Hours	120	**Total**	100
Course Code	MDSC	**Exam Duration**	
Course Title	Physics Practical		

Course Objectives:

- To develop practical skills in constructing and analyzing basic electronic circuits and semiconductor devices.
- To understand the operation of analog electronic circuits, operational amplifiers, and network theorems through experiments.
- To familiarize students with material characterization techniques and basic C programming concepts.

Course Outcomes:

After successful completion of the course, students will be able to:

- **CO1:** Construct and analyze the characteristics of semiconductor devices and electronic circuits.
- **CO2:** Design and test basic analog circuits, regulated power supplies, amplifiers, and RC circuits.
- **CO3:** Apply network theorems, operational amplifiers, and material characterization techniques in laboratory experiments.
- **CO4:** Develop simple C programs to solve basic programming problems and generate required output patterns

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SEMESTER-VII & VIII

Course Contents: MDSC (P)

Unit	Syllabi	Teaching Hours
List of Experiments	**Group A** 1. Construct the circuit to obtain and study I-V characteristics of PN junction diode. 2. Construct the circuit to obtain and study I-V characteristics of Zener diode. 3. Construct the circuit to obtain and study I-V characteristics of Uni-Junction Transistor. 4. Construct the circuit to obtain and study I-V characteristics of JFET. 5. Design & Construct Regulated Power Supply. 6. Design & Construct Regulated Power Supply. 7. Design Common emitter amplifier and study its frequency response. 8. Design simple series RC circuit for a given time constant and to study the charging characteristics of it. 9. Design simple series RC circuit for a given time constant and to study the discharging characteristics of it. 10. To study characteristics of LDR. **Group B** 11. Verification of network theorems. 12. To Verify Maximum power transfer theorem. 13. To study characteristics of photodiode and phototransistor. 14. To determine the lattice parameters and structure for a given X–Ray Diffraction (XRD) pattern of sample–1. 15. To determine the lattice parameters and structure for a given X–Ray Diffraction (XRD) pattern of sample–2. 16. Study of OP-AMP using IC 741. (inverter and non-inverter). 17. Comparator as Zero-crossing detector using Operational amplifier IC 741.	**120**

	18. To write a 'C' program to print the following: 1 1 1 1 1 1 19. To write a 'C' program to print the following: 0 0 0 0 0 0 20. To write a 'C' program to print the following: Δ Δ Δ Δ Δ Δ	

Suggested Reading:

1. Practical Physics by C.L. Arora (S. Chand)
2. Advanced Practical Physics by Chauhan & Singh. (Pragati Prakashan)
3. B. Saraf et al-Physics through experiments Vol. I & II
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Course Level	UG	**Internal Marks**	25
Programme	B.Sc in Physics	**External Marks**	25
Semester	VII	**Practical Internal**	0
Category of Course		**Practical External**	0
Course Credit	2	**Prac.External Exam Duration**	0
Teaching Hours	30	**Total**	50
Course Code	MDSC	**Exam Duration**	2 hours
Course Title	Skill Enhancement Course (SEC)		

Course Objectives:

1. To introduce the fundamentals of computer programming and the C programming language.
2. To develop problem-solving skills using flowcharts, algorithms, and structured programming techniques.
3. To provide knowledge of data types, operators, control statements, arrays, and strings in C.
4. To enable students to write, compile, debug, and execute C programs for solving basic computational problems.

Course Outcomes:

After successful completion of the course, students will be able to:

- **CO1**: Explain the fundamentals of computers, programming concepts, and the structure of C programs.
- **CO2**: Develop C programs using variables, data types, operators, decision-making, and looping constructs.
- **CO3**: Implement one-dimensional, two-dimensional, and multidimensional arrays to solve programming problems.
- **CO4**: Perform string operations using built-in library functions and user-defined functions in C.

Course Contents: **Fundamental of C Language**

Unit No.	Syllabi	Teaching Hours
1	**Introduction to C language:** Introduction to computer and programming language, Evolution of C, Advantages of C, Compiling, Linking & Debugging C programs, Flowchart, Character set, Constants, variables and data types, expressions, evaluation of expressions, standard I/O operations, decision making, branching and looping structures	15
2	**Manipulation of String**: Arrays and string handling, defining one, two and multidimensional arrays, manipulating arrays, declaring and initializing strings, string manipulations, use of string handling functions, Operations of Strings (String handling through built-in & UDF: Length, Compare Concatenate, Reverse, Copy, Character Search using array).	15

Suggested Reading:

1. Programming in C - by E. Balaguruswami (TMH)
2. Computer programming in C - by V. Rajaraman (PHI)
3. The C programming language - by Richi & Karninghan (PHI)

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INTERNAL EVALUATION SCHEME		
NO	**Particulars**	**Marks**
1	**Mid Semester Exam (Mandatory)**	**25**
2	Class Test	05
3	Open book exam/test	05
4	Open note exam/test	05
5	Self-test/ Online test	05
6	Essay/Article writing	05
7	Quizzes/Objective test	05
8	Class assignment	05
9	Home assignment	05
10	Reports Writing	05
11	Research/Dissertation	05
12	Case Studies	05
13	Viva/Oral exam	05
14	Group Discussion	05
15	Role Play	05
16	Paper presentation/Seminar	05
17	Language Lab work	05
18	Interview	05
19	Craftwork	05
20	Co-curricular work	05
21	Field Assignment	05
22	Poster Presentation	05
23	Attendance	05
24	Project Work	05
	Total	**50**

Note: Sr.No.1 is mandatory. Select any five from Sr.No.2 to 24. Each Contains five marks. Students should secure 18 Marks for passing in internal Exam.

Paper Style

Ques. No.	Particulars	From which Unit	Marks
1	Answer any 2 out of 3 of the following questions.	1	10
2	Answer any 2 out of 3 of the following questions.	2	10
3	Answer any 2 out of 3 of the following questions.	3	10
4	Answer any 2 out of 3 of the following questions.	4	10
5	Answer any 5 out of 8 of the following questions.	From Each Unit	10
		Total Marks	50

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