Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

Shri Vaishnav Institute of Science

Choice Based Credit System (CBCS) in the light of NEP-2020

M.Sc. Physics

SEMESTER-I

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MSPHC101	Core course	Quantum Mechanics	Max	60	20	20	30	20	3	0	0	3
			Min	24	16		14	9				

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OBJECTIVES:

The student will have ability to:

1. Develop a thorough understanding of the fundamental concepts, principles, and mathematical formulation of quantum mechanics.
2. Apply the Schrödinger equation to analyze and solve quantum mechanical problems involving one-dimensional and central potential systems.
3. Understand the formalism of quantum mechanics, including operators, observables, commutation relations, Dirac notation, and matrix representations.
4. Analyze the quantum behavior of atomic systems, angular momentum, identical particles, and the hydrogen atom using appropriate theoretical methods.
5. Apply approximation techniques such as perturbation and variational methods to obtain approximate solutions for quantum systems that cannot be solved exactly.

COURSE ALIGNMENT WITH UNSDG: The Course aims to fulfill the United Nations Sustainable Development Goals, **SDG 4 (Quality Education)**.

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Board of Studies, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Faculty of Studies, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

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SEMESTER-I

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				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MSPHC101	Core course	Quantum Mechanics	Max	60	20	20	30	20	3	0	0	3
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Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OUTCOMES:

After completion of the course, the student will be able to:

1. Explain the origin of quantum mechanics, interpret the Schrödinger equation, and evaluate the physical significance of wave functions and probability concepts.
2. Solve quantum mechanical problems involving potential barriers, quantum tunneling, square wells, harmonic oscillators, and central force potentials.
3. Apply the mathematical framework of quantum mechanics, including operators, uncertainty principles, eigenvalue problems, and Dirac bra-ket notation, to analyze quantum systems.
4. Analyze the properties of angular momentum, hydrogen atom spectra, and systems of identical particles, and distinguish between bosons and fermions using quantum principles.
5. Employ perturbation and variational methods to obtain approximate solutions for complex quantum systems and interpret their physical significance.

Teaching Pedagogy:

T1	Classroom teaching (white board), Power Point Presentations, Interactive lectures, Inquiry-based teaching
T2	ABL activities, Assignments, Flip Class/ Seminars, Quizzes, Oral Viva-voce examination

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MSPHC101	Core course	Quantum Mechanics	Max	60	20	20	30	20	3	0	0	3
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Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Assessment Tools

AT1-1	Quiz
AT1-2	Activity Based Learning
AT1-3	Midterm Exams
AT1-4	Flip Class
AT1-5	Seminar Presentation
AT1-6	Assignments
AT1-7	Poster
AT1-8	Oral Viva-voce examination
AT1-9	Industrial Visit Report

Prerequisites: HSC Standard knowledge of Classical and Modern Physics

Module	Descriptors/Topics	Hours	Assessment tools
I	Origin of Quantum Mechanics and failure of classical mechanics. Wave-particle duality. Schrödinger equation and its physical interpretation. Continuity equation and probability current density. Ehrenfest theorem. Admissible wave functions and their properties. Stationary states and expectation values.	10	AT1 AT2 AT3 AT6 AT8

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MSPHC101	Core course	Quantum Mechanics	Max	60	20	20	30	20	3	0	0	3
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II	One-dimensional potential problems: Potential step, potential barrier, tunneling effect, finite and infinite square wells. Linear harmonic oscillator: Solution by Schrödinger wave equation and operator method. Energy eigenvalues and eigenfunctions	10	AT1 AT2 AT3 AT6 AT8
III	Heisenberg uncertainty principle and uncertainty relations. States with minimum uncertainty product. General formalism of wave mechanics. Operators and observables. Commutation relations. Representation of states and dynamical variables. Completeness and orthogonality of eigenfunctions. Dirac delta function. Bra-ket notation. Matrix representation of operators. Unitary transformations.	10	AT1 AT2 AT3 AT6 AT8
IV	Angular momentum in Quantum Mechanics. Orbital angular momentum operators and eigenvalue spectrum. Central force problems. Solution of Schrödinger equation for spherically symmetric potentials. Hydrogen atom and its energy spectrum. Identical particles. Symmetric and antisymmetric wave functions. Bosons and Fermions. Pauli exclusion principle and its applications.	10	AT1 AT2 AT3 AT6 AT8

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			Marks	THEORY			PRACTICAL		L	T	P	CREDITS
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MSPHC101	Core course	Quantum Mechanics	Max	60	20	20	30	20	3	0	0	3
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V	Time-independent (stationary) perturbation theory. Non-degenerate perturbation theory. First-order and second-order energy corrections. Applications of perturbation theory with special reference to the Stark effect. Introduction to degenerate perturbation theory (elementary concepts).	10	AT1 AT2 AT3 AT6 AT8
	Total Hours	50	

Additional Resources

A. Value addition to course content/ Skill enhancement content:

Refer relevant online tutorial/ course available on "Swayam portal".

https://swayam.gov.in/explorer?searchText=quantum%20mechanics

B. Remedial classes for slow learners:

As per the AUMP SOP for slow and fast learners.

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COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME									
			Marks	THEORY			PRACTICAL		L	T	P	CREDITS
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MSPHC101	Core course	Quantum Mechanics	Max	60	20	20	30	20	3	0	0	3
			Min	24	16		14	9				

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Suggested Readings:

Reference Books:

1.**J. J. Sakurai and Jim Napolitano**, *Modern Quantum Mechanics*, **2nd Edition**, Cambridge University Press, Cambridge, 2017.

2. **L. I. Schiff**, *Quantum Mechanics*, **3rd Edition**, McGraw-Hill Book Company, New York, 1968.

3. **Claude Cohen-Tannoudji, Bernard Diu, and Franck Laloë**, *Quantum Mechanics*, **Volume I, Reprint Edition**, Wiley-VCH, Weinheim, 2006.

4. **Satya Prakash, Swati Saluja, and T. S. K. Saxena**, *Quantum Mechanics*, **22nd Revised Edition**, Kedar Nath Ram Nath Publishers, Meerut.

5. **V. K. Thankappan**, *Quantum Mechanics*, **2nd Edition**, New Age International (P) Ltd., New Delhi, 2015.

6.**Nouredine Zettili**, *Quantum Mechanics: Concepts and Applications*, **2nd Edition**, John Wiley & Sons, 2009.

Suggested e- resources (Websites/e-books):

NPTEL https://nptel.ac.in/courses & https://onlinecourses.nptel.ac.in.

The Physics of Quantum Mechanics:

https://www-thphys.physics.ox.ac.uk/people/JamesBinney/qb.pdf

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				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MSPHC101	Core course	Quantum Mechanics	Max	60	20	20	30	20	3	0	0	3
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Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Articulation Matrix (Mapping of COs with POs)

Course Outcomes	Correlation with POs										Correlation with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	-	-	2	2	-	-	-	-	-	**3**	**1**	-
CO2	3	2	-	3	3	-	-	-	-	-	**3**	**3**	**1**
CO3	3	2	-	3	3	-	-	-	-	-	**3**	**2**	-
CO4	3	3	-	2	3	1	-	-	-	-	**3**	**2**	**1**
CO5	3	3	-	3	3	2	1	1	2	2	**3**	**3**	**2**

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M.Sc. Physics

SEMESTER-I

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			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MSPHC102	Core Course-2	Classical Mechanics	Max	60	20	20	30	20	3	0	0	3
			Min	24	16		14	9				

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OBJECTIVES:

The student will have ability to:

1. Develop a comprehensive understanding of Newtonian and analytical mechanics using generalized coordinates, constraints, and variational principles.
2. Apply Lagrangian and Hamiltonian formulations to derive equations of motion and solve advanced problems in classical mechanics.
3. Explain the role of symmetry principles, conservation laws, and canonical transformations in the formulation of physical systems.
4. Analyze the dynamics of particles in inertial and non-inertial frames, central force motion, planetary motion, satellite dynamics, and scattering phenomena.
5. Develop problem-solving and analytical skills through the study of Hamilton–Jacobi theory, Poisson brackets, and the theory of small oscillations and normal modes.

COURSE ALIGNMENT WITH UNSDG: The Course aims to fulfill the United Nations Sustainable Development Goals, **SDG 4 (Quality Education)**.

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				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*					
MSPHC102	Core Course-2	Classical Mechanics	Max	60	20	20	30	20		3	0	0	3
			Min	24	16		14	9					

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OUTCOMES:

After completion of the course, the student will be able to:

1. Formulate and solve mechanical problems using Newton's laws, D'Alembert's principle, and Lagrange's equations of motion.
2. Apply conservation laws, symmetry principles, and generalized coordinates to analyze the dynamics of physical systems.
3. Evaluate the motion of particles in rotating frames and solve problems involving central force motion, Keplerian orbits, artificial satellites, and Rutherford scattering.
4. Derive and apply Hamilton's equations, Hamilton–Jacobi equation, canonical transformations, and Poisson brackets in analytical mechanics.
5. Analyze coupled oscillatory systems using normal coordinates and normal modes, and demonstrate advanced analytical and mathematical skills for solving classical mechanics problems.

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				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
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Teaching Pedagogy:

T1	Classroom teaching (white board), Power Point Presentations, Interactive lectures, Inquiry-based teaching
T2	ABL activities, Assignments, Flip Class/ Seminars, Quizzes, Oral Viva-voce examination

Assessment Tools

AT1-1	Quiz
AT1-2	Activity Based Learning
AT1-3	Midterm Exams
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Prerequisites: Undergraduate level knowledge of Mechanics.

Module	Descriptors/Topics	Hours	Assessment tools
I	Newton's laws of motion and equations of motion. Constraints and generalized coordinates. D'Alembert's principle and virtual work. Derivation of Lagrange's equations of motion. Applications of Lagrange's equations to simple mechanical systems. Gauge invariance in Lagrangian mechanics.	10	AT1 AT2 AT3 AT6 AT8
II	Generalized coordinates and generalized momenta. Cyclic coordinates and integrals of motion. Conservation of linear momentum, angular momentum and energy. Symmetries of space and time and their relation to conservation laws. Noether's theorem (introductory treatment) and its physical applications.	10	AT1 AT2 AT3 AT6 AT8
III	Rotating frames; Inertial forces; Terrestrial and astronomical applications of Coriolis force. Central force: Definition and characteristics, Two-body problem; Kepler's laws and equations. Artificial satellites; Rutherford scattering.	10	AT1 AT2 AT3 AT6 AT8

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Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

IV	Principle of least action and variational methods. Derivation of equations of motion from Hamilton's principle. Variation with fixed end points. Hamilton's characteristic functions. Legendre transformation and Hamilton's equations of motion. Hamilton–Jacobi equation and its applications.	10	AT1 AT2 AT3 AT6 AT8
V	Canonical transformations and generating functions. Poisson brackets and their properties. Poisson's theorems and applications. Theory of small oscillations. Normal coordinates and normal modes. Coupled oscillations and physical applications.	10	AT1 AT2 AT3 AT6 AT8
		50	

Additional Resources

A. Value addition to course content/ Skill enhancement content:

Refer relevant online tutorial/ course available on "Swayam portal".

https://swayam.gov.in/explorer?

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B. Remedial classes for slow learners:

As per the AUMP SOP for slow and fast learners.

Suggested Readings:

Reference Books:

1.L. D. Landau and E. M. Lifshitz, *Mechanics (Course of Theoretical Physics, Volume 1)*, 3rd Edition, Butterworth-Heinemann, 1976.

2. Herbert Goldstein, Charles P. Poole, and John L. Safko, *Classical Mechanics*, 3rd Edition, Pearson Education, 2002. *(Can also be used as a reference text for advanced topics.)*

3. V. I. Arnold, *Mathematical Methods of Classical Mechanics*, 2nd Edition, Springer, 1989.

4. J. C. Upadhyaya, *Classical Mechanics*, 2nd Edition, Himalaya Publishing House, Mumbai, 2017.

5. N. C. Rana and P. S. Joag, *Classical Mechanics*, 1st Edition (Reprint Edition), Tata McGraw-Hill Education, New Delhi, 1991 (reprinted in subsequent years).

Suggested e- resources (Websites/e-books):

NPTEL https://nptel.ac.in/courses & https://onlinecourses.nptel.ac.in

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			Marks	THEORY			PRACTICAL		L	T	P	CREDITS
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Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Articulation Matrix (Mapping of COs with POs)

Course Outcomes	Correlation with POs										Correlation with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2		3	3	-	-	-	-	-	3	2	-
CO2	3	3		3	3	1	-	-	-	-	3	3	1
CO3	3	2		3	3	2	1	-	-	-	3	2	1
CO4	3	2		2	3	2	-	-	-	-	3	2	1
CO5	3	3		3	3	2	1	1	2	2	3	3	2

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Board of Studies, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Faculty of Studies, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

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Shri Vaishnav Institute of Science

Choice Based Credit System (CBCS) in the light of NEP-2020

MSc Physics

SEMESTER-I

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MSPHC103	Core Course	Applied Electronics	Max	60	20	20	30	20	3	0	0	3
			Min	24	16		14	9				

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OBJECTIVES:

The student will have ability to:

1. **Understand** the principles of analog network theory, transient analysis, resonance phenomena, and network theorems for analyzing electrical circuits.
2. **Develop** a comprehensive understanding of advanced semiconductor physics, including carrier transport, recombination mechanisms, semiconductor statistics, and transport phenomena.
3. **Analyze** the operation, characteristics, and applications of semiconductor devices such as BJTs, FETs, CMOS devices, and optoelectronic devices.
4. **Design and evaluate** analog electronic circuits involving amplifiers, feedback networks, oscillators, and power amplifiers for signal processing applications.
5. **Apply** operational amplifiers and analog integrated circuits in scientific instrumentation, sensor interfacing, and modern electronic measurement systems.

COURSE ALIGNMENT WITH UNSDG: The Course aims to fulfill the United Nations Sustainable Development Goals, **SDG 4 (Quality Education)**.

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Shri Vaishnav Institute of Science

Choice Based Credit System (CBCS) in the light of NEP-2020

MSc Physics

SEMESTER-I

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MSPHC103	Core Course	Applied Electronics	Max	60	20	20	30	20	3	0	0	3
			Min	24	16		14	9				

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OUTCOMES:

After completion of the course, the student will be able to:

1. Analyze AC networks, transient responses, resonance characteristics, and apply network theorems to solve analog circuit problems.
2. Explain carrier transport mechanisms, semiconductor statistics, and physical processes governing the operation of semiconductor materials and devices.
3. Evaluate the characteristics and performance of BJTs, FETs, CMOS technology, and specialized semiconductor devices for analog electronic applications.
4. Design and analyze amplifier circuits, feedback systems, oscillators, and power amplifiers while assessing their frequency response and performance.
5. .Design and implement operational amplifier-based analog circuits for signal conditioning, sensor interfacing, and scientific instrumentation relevant to experimental physics.

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Choice Based Credit System (CBCS) in the light of NEP-2020

MSc Physics

SEMESTER-I

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MSPHC103	Core Course	Applied Electronics	Max	60	20	20	30	20	3	0	0	3
			Min	24	16		14	9				

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Teaching Pedagogy:

T1	Classroom teaching (white board), Power Point Presentations, Interactive lectures, Inquiry-based teaching
T2	ABL activities, Assignments, Flip Class/ Seminars, Quizzes, Oral Viva-voce examination

Assessment Tools

AT1-1	Quiz
AT1-2	Activity Based Learning
AT1-3	Midterm Exams
AT1-4	Flip Class
AT1-5	Seminar Presentation
AT1-6	Assignments
AT1-7	Poster
AT1-8	Oral Viva-voce examination
AT1-9	Industrial Visit Report

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Shri Vaishnav Institute of Science

Choice Based Credit System (CBCS) in the light of NEP-2020

MSc Physics

SEMESTER-I

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MSPHC103	Core Course	Applied Electronics	Max	60	20	20	30	20	3	0	0	3
			Min	24	16		14	9				

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Prerequisites: HSC Standard knowledge of Classical and Modern Physics

Module	Descriptors/Topics	Hours	Assessment tools
I	Network Theory: AC circuit analysis, Complex impedance, Phasor algebra, RC Networks: First-order systems, Time constant, Integrator, Differentiator, Pulse response RL Networks: Transient analysis, Time constant, Switching response, RLC Networks: Differential equation of RLC circuit, Natural response, Forced response, Resonance, Resonant frequency, Bandwidth, Quality factor, Selectivity, Frequency response, Network theorems (brief review): Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem	10	AT1 AT2 AT3 AT6 AT8
II	Carrier transport equations, Drift-diffusion equation, Einstein relation, Recombination-generation mechanisms, Hall effect, Carrier lifetime, Diffusion length, Continuity equation, Semiconductor statistics, Density of states, Fermi-Dirac distribution	10	AT1 AT2 AT3 AT6 AT8

Chairperson
Board of Studies, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

Chairperson
Faculty of Studies, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

Controller of Examination
Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

Registrar
Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

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Shri Vaishnav Institute of Science

Choice Based Credit System (CBCS) in the light of NEP-2020

MSc Physics

SEMESTER-I

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
				THEORY			PRACTICAL					
			Marks	END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MSPHC103	Core Course	Applied Electronics	Max	60	20	20	30	20	3	0	0	3
			Min	24	16		14	9				

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

III	BJT: Ebers-Moll model, Early effect, High-frequency response, Hybrid-π model, Switching characteristics; FET Devices: JFET analysis, MOSFET physics, Short-channel effects, CMOS technology; Special Devices: Gunn diode, IMPATT diode, PIN diode, Avalanche photodiode, Phototransistor	10	AT1 AT2 AT3 AT6 AT8
IV	RC coupled amplifier, Transformer coupled amplifier, Direct coupled amplifier, Frequency response, Gain-bandwidth concept; Multistage amplifiers: Feedback, Positive feedback, Negative feedback; Oscillators: Barkhausen criterion, RC Phase shift oscillator, Wien bridge oscillator, Hartley oscillator: Power amplifier: Class A, Class B, Class AB, Class C, Efficiency calculations.	10	AT1 AT2 AT3 AT6 AT8
V	Operational Amplifier: Internal architecture, Offset voltage, Bias current, Slew rate, CMRR, PSRR, Frequency compensation, Stability; OP-AMP Applications: Inverting amplifier, Non-inverting amplifier, Voltage follower, Summing amplifier, Integrator, Differentiator, Comparator, Signal conditioning, Temperature measurement, Light detection, Sensor interfacing	10	AT1 AT2 AT3 AT6 AT8
	Total Hours	50	

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Shri Vaishnav Institute of Science

Choice Based Credit System (CBCS) in the light of NEP-2020

MSc Physics

SEMESTER-I

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME									
			Marks	THEORY			PRACTICAL		L	T	P	CREDITS
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MSPHC103	Core Course	Applied Electronics	Max	60	20	20	30	20	3	0	0	3
			Min	24	16		14	9				

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Additional Resources

A. **Value addition to course content/ Skill enhancement content:**

Refer relevant online tutorial/ course available on "Swayam portal".

B. **Remedial classes for slow learners:**

As per the AUMP SOP for slow and fast learners.

Suggested Readings:

Reference Books:

1. Microelectronic Circuits, 8th Edition, Oxford University Press.
2. Electronic Devices and Circuit Theory, 11th Edition, Pearson Education.
3. Solid State Electronic Devices, 7th Edition, Pearson Education.
4. Semiconductor Device Fundamentals, Pearson Education.
5. Integrated Electronics: Analog and Digital Circuits and Systems, McGraw-Hill Education.
6. Electronic Principles, McGraw-Hill Education.

Suggested e- resources (Websites/e-books):

NPTEL https://nptel.ac.in/courses & https://onlinecourses.nptel.ac.in.

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Board of Studies, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Faculty of Studies, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

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Shri Vaishnav Institute of Science

Choice Based Credit System (CBCS) in the light of NEP-2020

MSc Physics

SEMESTER-I

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME									
			Marks	THEORY			PRACTICAL		L	T	P	CREDITS
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MSPHC103	Core Course	Applied Electronics	Max	60	20	20	30	20	3	0	0	3
			Min	24	16		14	9				

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Articulation Matrix (Mapping of COs with POs)

Course Outcomes	Correlation with POs										Correlation with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	2	-	-	-	-	3	3	1
CO2	3	2	2	3	3	2	-	-	-	-	3	3	1
CO3	3	3	3	2	3	3	-	1	2	-	3	3	2
CO4	3	3	3	2	3	3	1	2	3	2	3	3	2
CO5	3	3	3	3	3	3	1	2	3	2	3	3	3

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Board of Studies, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Faculty of Studies, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

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Shri Vaishnav Institute of Science

Choice Based Credit System (CBCS) in the light of NEP-2020

M.Sc. Physics

SEMESTER-I

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MSPHC104	Core Course-4	Mathematical Physics	Max	60	20	20	30	20	3	0	0	3
			Min	24	16		14	9				

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OBJECTIVES:

The student will have ability to:

1. Develop a strong foundation in vector spaces, matrix algebra, linear transformations, and eigenvalue problems required for advanced studies in physics.
2. Understand and apply ordinary differential equations and special functions to solve mathematical problems arising in physical sciences.
3. Acquire proficiency in complex variable theory, contour integration, and residue calculus for solving problems in theoretical physics.
4. Apply Laplace and Fourier transforms to analyze and solve differential equations and time-dependent physical systems.
5. Develop analytical and mathematical skills to model and solve problems in quantum mechanics, electrodynamics, and other branches of physics using advanced mathematical techniques.

COURSE ALIGNMENT WITH UNSDG: The Course aims to fulfill the United Nations Sustainable Development Goals, **SDG 4 (Quality Education)**.

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Board of Studies, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Faculty of Studies, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

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Shri Vaishnav Institute of Science

Choice Based Credit System (CBCS) in the light of NEP-2020

M.Sc. Physics

SEMESTER-I

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MSPHC104	Core Course-4	Mathematical Physics	Max	60	20	20	30	20	3	0	0	3
			Min	24	16		14	9				

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OUTCOMES:

After completion of the course, the student will be able to:

1. Apply vector space concepts, matrix methods, and eigenvalue techniques to solve mathematical problems encountered in physics.
2. Solve ordinary differential equations using series methods and employ special functions .such as Legendre, Bessel, Hermite, and Laguerre polynomials in physical applications.
3. Analyze complex functions and evaluate contour integrals using Cauchy's theorems, Laurent series, and residue calculus.
4. Employ Laplace and Fourier transforms to solve initial value problems and analyze periodic and non-periodic physical phenomena.
5. Apply advanced mathematical methods to solve problems in quantum mechanics, harmonic oscillators, hydrogen atom, and other areas of theoretical physics.

Teaching Pedagogy:

T1	Classroom teaching (white board), Power Point Presentations, Interactive lectures, Inquiry-based teaching
T2	ABL activities, Assignments, Flip Class/ Seminars, Quizzes, Oral Viva-voce examination

Chairperson	Chairperson	Controller of Examination	Registrar
Board of Studies, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Faculty of Studies, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

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Shri Vaishnav Institute of Science

Choice Based Credit System (CBCS) in the light of NEP-2020

M.Sc. Physics

SEMESTER-I

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MSPHC104	Core Course-4	Mathematical Physics	Max	60	20	20	30	20	3	0	0	3
			Min	24	16		14	9				

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Assessment Tools

AT1-1	Quiz
AT1-2	Activity Based Learning
AT1-3	Midterm Exams
AT1-4	Flip Class
AT1-5	Seminar Presentation
AT1-6	Assignments
AT1-7	Poster
AT1-8	Oral Viva-voce examination
AT1-9	Industrial Visit Report

Prerequisites: HSC Standard knowledge of Classical and Modern Physics

Module	Descriptors/Topics	Hours	Assessment tools
I	Vector Spaces, Basis and Dimension, Inner Product Spaces, Linear Transformations, Matrices, Inverse Matrices, Orthogonal and Unitary Matrices, Independent Elements of a Matrix, Eigenvalues and Eigenvectors, Diagonalization of Matrices, Complete Orthogonal Sets of Functions.	10	AT1 AT2 AT3 AT6 AT8

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Choice Based Credit System (CBCS) in the light of NEP-2020

M.Sc. Physics

SEMESTER-I

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MSPHC104	Core Course-4	Mathematical Physics	Max	60	20	20	30	20	3	0	0	3
			Min	24	16		14	9				

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

II	Second-Order Linear Ordinary Differential Equations with Variable Coefficients, Solution by Series Expansion, Legendre Equation and Legendre Polynomials, Bessel Equation and Bessel Functions, Hermite Equation and Hermite Polynomials, Laguerre Equation and Laguerre Polynomials, Generating Functions and Recursion Relations.	10	AT1 AT2 AT3 AT6 AT8
III	Complex Functions, Analytic Functions, Cauchy-Riemann Equations, Harmonic Functions, Complex Integration, Cauchy Integral Theorem, Cauchy Integral Formula, Taylor and Laurent Series, Singularities, Residues and Residue Theorem, Evaluation of Definite Integrals.	10	AT1 AT2 AT3 AT6 AT8
IV	Laplace Transform, Inverse Laplace Transform by Partial Fractions, Solution of Initial Value Problems by Laplace Transform. Fourier Series, Fourier Series of Arbitrary Period, Half-Range Expansions, Partial Sums, Fourier Integrals, Fourier Transforms, Fourier Transform of Delta Function.	10	AT1 AT2 AT3 AT6 AT8

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Choice Based Credit System (CBCS) in the light of NEP-2020

M.Sc. Physics

SEMESTER-I

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MSPHC104	Core Course-4	Mathematical Physics	Max	60	20	20	30	20	3	0	0	3
			Min	24	16		14	9				

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

V	Applications of Special Functions in Physics, Solution of One-Dimensional Harmonic Oscillator, Schrödinger Equation and Hydrogen Atom, Associated Laguerre Equation in Quantum Mechanics, Applications of Laplace and Fourier Transforms to Time-Dependent Physical Problems.	10	AT1 AT2 AT3 AT6 AT8
	Total Hours	50	

Additional Resources

A. Value addition to course content/ Skill enhancement content:

Refer relevant online tutorial/ course available on "Swayam portal".
https://swayam.gov.in/explorer?

B. Remedial classes for slow learners:

As per the AUMP SOP for slow and fast learners.

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M.Sc. Physics

SEMESTER-I

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MSPHC104	Core Course-4	Mathematical Physics	Max	60	20	20	30	20	3	0	0	3
			Min	24	16		14	9				

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Suggested Readings:

Reference Books:

1. **George B. Arfken, Hans J. Weber, and Frank E. Harris**, *Mathematical Methods for Physicists: A Comprehensive Guide*, **7th Edition**, Academic Press (Elsevier), 2013.
2. **P. K. Chattopadhyay**, *Mathematical Physics*, **2nd Edition**, New Age International (P) Ltd., New Delhi, 2017.
3. **B. D. Gupta**, *Mathematical Physics*, **4th Revised Edition**, Vikas Publishing House Pvt. Ltd., New Delhi, 2010
4. **4. Mary L. Boas**, *Mathematical Methods in the Physical Sciences*, **3rd Edition**, John Wiley & Sons, 2006.
5. **5.K. F. Riley, M. P. Hobson, and S. J. Bence**, *Mathematical Methods for Physics and Engineering*, **3rd Edition**, Cambridge University Press, 2006.
6. **A. W. Joshi**, *Matrices and Tensors in Physics*, **3rd Edition**, New Age International (P) Ltd., New Delhi, 1995.

Suggested e- resources (Websites/e-books):

NPTEL https://nptel.ac.in/courses & https://onlinecourses.nptel.ac.in.

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Board of Studies, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Faculty of Studies, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

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M.Sc. Physics

SEMESTER-I

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME									
			Marks	THEORY			PRACTICAL		L	T	P	CREDITS
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MSPHC104	Core Course-4	Mathematical Physics	Max	60	20	20	30	20	3	0	0	3
			Min	24	16		14	9				

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Articulation Matrix (Mapping of COs with POs)

Course Outcomes	Correlation with POs									Correlation with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	-	3	3	**1**	-	-	-	-	3	**2**	-
CO2	3	3	-	3	3	**2**	-	-	-	**1**	3	3	**1**
CO3	3	3	-	3	3	**2**	-	-	-	**1**	3	3	**2**
CO4	3	3	-	3	3	2	-	-	1	2	3	3	**2**
CO5	3	3	-	3	3	3	1	1	2	2	3	3	**2**

Chairperson	Chairperson	Controller of Examination	Registrar
Board of Studies, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Faculty of Studies, Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore	Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

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Shri Vaishnav Institute of Science

Choice Based Credit System (CBCS) in the light of NEP-2020

M.Sc. Physics

SEMESTER-I

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME							L	T	P	CREDITS
				THEORY			PRACTICAL						
			Marks	END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*					
MSPHL105	Lab	Physics Lab-I	Max				30	20			0	8	4
			Min				14	9					

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COURSE OBJECTIVES:

The student will have ability to:

To provide hands-on experience in designing, constructing, testing, and analyzing analog electronic circuits using transistors, FETs, and operational amplifiers, while developing practical skills in electronic instrumentation, circuit analysis, troubleshooting, and data interpretation.

COURSE ALIGNMENT WITH UNSDG:

The Course aims to fulfill the United Nations Sustainable Development Goals, **SDG 4 (Quality Education)**.

COURSE OUTCOMES:

After completion of the course, the student will be able to:

Demonstrate proficiency in designing, assembling, testing, and analyzing analog electronic circuits using transistors, FETs, and operational amplifiers, and interpret experimental results using appropriate electronic instruments and analytical techniques.

TEACHING PEDAGOGY:

T1 Classroom teaching (white board), Power Point Presentations, Interactive lectures, Inquiry-based teaching

T2 ABL activities, Assignments, Flip Class/ Seminars, Quizzes, Oral Viva-voce examination

ASSESSMENT TOOLS:

ATL1 Quiz

ATL2 Activity Based Learning

ATL3 Midterm Exams

ATL4 Flip Class

ATL5 Seminar Presentation

ATL6 Assignments

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SEMESTER-I

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				THEORY			PRACTICAL						
			Marks	END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*					
MSPHL105	Lab	Physics Lab-I	Max				30	20			0	8	4
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ATL7 Poster

ATL8 Oral Viva-voce examination

ATL9 Industrial Visit Report

PREREQUISITES:

Students should have a basic understanding of semiconductor devices, analog electronic circuits, operational amplifiers, transistor characteristics, electronic measuring instruments, and circuit analysis techniques.

SYLLABUS:

List of Experiments	1. Regulated Power Supply. (Transistorized) 2. R.C. coupled amplifier-frequency response. 3. Emitter follower. 4. FET characteristics and calibration of FET Input voltmeter 5. R.C. phase shifts Oscillator. 6. Measurement of Hybrid parameters of transistor. 7.Inverting and noninverting amplifier using OPAMP 8. Operational amplifier (OP Amp) as adder&subtractor 9. Operational amplifier (OP Amp) as integrator &differentiator. 10.Perform mathematical operations using OPAM as Divider, Multiplicator

ADDITIONAL RESOURCES

A. **Value addition to course content/ Skill enhancement content:**

https://www.youtube.com/playlist?list=PLUl4u3cNGP60_JNv2MmK3wkOt9syvfQWY(MIT OCW)

B. **Remedial classes for slow learners:** As per the AUMP SOP for slow and fast learners.

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Choice Based Credit System (CBCS) in the light of NEP-2020

M.Sc. Physics

SEMESTER-I

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME							L	T	P	CREDITS
			Marks	THEORY			PRACTICAL						
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*					
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SUGGESTED READINGS:

Reference Books

1.Malvino, A. P., *Electronic Principles*, McGraw-Hill.

2. Sedra, A. S. & Smith, K. C., *Microelectronic Circuits*, Oxford University Press.

3. Millman, J. & Halkias, C. C., *Integrated Electronics*, McGraw-Hill.

4. Ramakant A. Gayakwad, *Op-Amps and Linear Integrated Circuits*, Pearson.

5.Boylestad, R. L. &Nashelsky, L., *Electronic Devices and Circuit Theory*, Pearson.

Suggestede- resources (Websites/e-books)

1. https://nptel.ac.in

COURSE ARTICULATION MATRIX (MAPPING OF COs WITH POs)

Course Outcomes	Correlation with POs										Correlation with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	2	2	3	3	2	3	3	3

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