अध्ययन मण्डल बैठक दिनांक -15/07/2025

विषय - भौतिकशास्त्र

राष्ट्रीय शिक्षा नीति 2020 के अनुरूप विश्वविद्यालय के अंतर्गत संचालित M.Sc. Physics मे अध्ययन मण्डल द्वारा तैयार किए गए तृतीय एवं चतुर्थ सेमेस्टर के पाठ्यक्रम को निम्नानुसार लागू करने की अनुशंसा की जाती है:-

M.Sc. Physics Third Semester									
Course Type	**Course Code**	**Course Title**	**Paper**	**Sem**	**Credits**	**Max Marks**	**Min Marks**	**CIA**	**ESE**
DSC	PHSC- 09	Quantum Mechanics - II	T	III	4	100	40	30	70
DSE	PHSE-13T	Solid State Physics - II	T	III	4	100	40	30	70
DSE	PHSE-14T	Nuclear (II) & Particle Physics	T	III	4	100	40	30	70
DSE	PHSE-15T	Laser Physics & Optoelectronic Devices	T	III	3	100	40	30	70
DSE	PHSE-15P	Lab Course	P	III	1	50	20	15	35
OPTIONAL PAPER (CHOOSE ONLY ONE)									
DSE	PHSE-16T	Electronics & Communications	Elective - 1T	III	3	100	40	30	70
DSE	PHSE-16P	Lab Course	Elective - 1P	III	1	50	20	15	35
DSE	PHSE – 17T	Astronomy & Astrophysics	Elective - 2T	III	3	100	40	30	70
DSE	PHSE – 17P	Lab Course	Elective - 2P	III	1	50	20	15	35
DSE	PHSE – 18T	Physics of Nano-material	Elective - 3T	III	3	100	40	30	70
DSE	PHSE – 18P	Lab Course	Elective - 3P	III	1	50	20	15	35
DSE	PHSE – 19T	Space Physics	Elective - 4T	III	3	100	40	30	70
DSE	PHSE – 19P	Lab Course	Elective - 4P	III	1	50	20	15	35
TOTAL					**20**	**600**	**240**	**180**	**420**

Note:- It is mandatory to choose one paper from PHSE 16 to PHSE 19.

15/07/25 3 15/07/25 4 15.07.2025 5 15/7/25 15/7/25

M.Sc. Physics Fourth Semester

Course Type	Course Code	Course Title	Paper	Sem	Credits	Max Marks	Min Marks	CIA	ESE
DSC	PHSC – 10 Research Work & Dissertation								
	PHSC – 10 A	Synopsis Presentation & Research Proposal	R	IV	12	50	20	50	-
	PHSC – 10 B	First Project Progress Report Through Presentation				50	20	50	-
	PHSC – 10 C	Second Project Progress Report Through Presentation				50	20	50	-
	PHSC – 10 D	Training & Experiment Work				75	30	-	75
	PHSC – 10 E	Final Dissertation Report				100	40	-	100
	PHSC – 10 F	Presentation & Viva - Voce				75	30	-	75
	Total					**400**	**160**	**150**	**250**
Discipline Specific Elective (DSE)									
DSE	PHSC- 20T	Quantitative Methods In Physics	T	IV	4	100	40	30	70
	PHSE- 21T	Research Methodology In Physics	T	IV	4	100	40	30	70
	Total					**200**	**80**	**60**	**140**
GRAND TOTAL					**20**	**600**	**240**	**210**	**390**

टीप:- परीक्षा योजना एवं प्रश्न पत्र के प्रारूप को भी यथावत लागू करने की अनुशंसा की जाती है।

आज दिनांक 15/07/2025 को भौतिक शास्त्र अध्ययन मण्डल की बैठक मे निम्नलिखित अध्यक्ष/सदस्य उपस्थित हुए।

Mr. D. K. Dewangan (A.P.) सदस्य 15/07/25

BHAGWAN DAS CHANDAK (A.P.) सदस्य 15/07/25

Dr. Ashok Kumar Jyoti (A.P.) सदस्य 15.07.2025

Lochan Singh Verma (A.P.) सदस्य 15/7/25

Dr H.L Vishwakarma सदस्य 15/7/25

SHAHEED MAHENDRA KARMA VISHWAVIDYALAYA
JAGDALPUR, BASTAR (C.G.)

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SCHEME OF EXAMINATION
&
SYLLABUS

Of
M.Sc. Physics 3rd and 4th Semester Exam

UNDER

FACULTY OF SCIENCE
Session 2025-26

(Approved by Board of Studies)
Effective from July 2025

M.Sc. Physics Third Semester									
Course Type	**Course Code**	**Course Title**	**Paper**	**Sem**	**Credits**	**Max Marks**	**Min Marks**	**CIA**	**ESE**
DSC	PHSC- 09	Quantum Mechanics - II	T	III	4	100	40	30	70
DSE	PHSE-13T	Solid State Physics - II	T	III	4	100	40	30	70
DSE	PHSE-14T	Nuclear (II) & Particle Physics	T	III	4	100	40	30	70
DSE	PHSE-15T	Laser Physics & Optoelectronic Devices	T	III	3	100	40	30	70
DSE	PHSE-15P	Lab Course	P	III	1	50	20	15	35
OPTIONAL PAPER (CHOOSE ONLY ONE)									
DSE	PHSE-16T	Electronics & Communications	Elective - 1T	III	3	100	40	30	70
DSE	PHSE-16P	Lab Course	Elective - 1P	III	1	50	20	15	35
DSE	PHSE – 17T	Astronomy & Astrophysics	Elective - 2T	III	3	100	40	30	70
DSE	PHSE – 17P	Lab Course	Elective - 2P	III	1	50	20	15	35
DSE	PHSE – 18T	Physics of Nano-material	Elective - 3T	III	3	100	40	30	70
DSE	PHSE – 18P	Lab Course	Elective - 3P	III	1	50	20	15	35
DSE	PHSE – 19T	Space Physics	Elective - 4T	III	3	100	40	30	70
DSE	PHSE – 19P	Lab Course	Elective - 4P	III	1	50	20	15	35
TOTAL					**20**	**600**	**240**	**180**	**420**

Note:- It is mandatory to choose one paper from PHSE 16 to PHSE 19.

Name and Signature of Convener & Members of BOS:

M.Sc. Physics Fourth Semester									
Course Type	**Course Code**	**Course Title**	**Paper**	**Sem**	**Credits**	**Max Marks**	**Min Marks**	**CIA**	**ESE**
DSC	**PHSC – 10 Research Work & Dissertation**								
	PHSC – 10 A	Synopsis Presentation & Research Proposal	P	IV	12	50	20	50	-
	PHSC – 10 B	First Project Progress Report Through Presentation				50	20	50	-
	PHSC – 10 C	Second Project Progress Report Through Presentation				50	20	50	-
	PHSC – 10 D	Training & Experiment Work				75	30	-	75
	PHSC – 10 E	Final Dissertation Report				100	40	-	100
	PHSC – 10 F	Presentation & Viva - Voce				75	30	-	75
	Total					**400**	**160**	**150**	**250**
Discipline Specific Elective (DSE)									
DSE	PHSC- 20T	Quantitative Methods In Physics	T	IV	4	100	40	30	70
	PHSE- 21T	Research Methodology In Physics	T	IV	4	100	40	30	70
	Total					**200**	**80**	**60**	**140**
GRAND TOTAL					**20**	**600**	**240**	**210**	**390**

Name and Signature of Convener & Members of BOS:

ONE YEAR POST – GRADUATE PROGRAM (NEP2020)
PROGRAM: MASTER IN SCIENCE (2025-26)
DISCIPLINE –PHYSICS
SESSION – 2025-26

PART-A: INTRODUCTION				
Program : Master in Science (Physics)			**Semester: III**	**Session:2025-26**
1	**Course Code**	**PHSC-09**		
2	**Course Title**	**Quantum Mechanics-II**		
3	**Course Type**	**Discipline Specific Course**		
4	**Pre-requisite (if any)**	**As per Program**		
5	**Course Learning Outcomes (CLO)**	After going through the course, the student should be able to: • Understand and apply the **variational method** to estimate ground and excited state energies of quantum systems such as the helium atom and harmonic oscillator. • Analyze **quantum scattering phenomena** using tools like the Born approximation, Green's functions, and partial wave analysis for different potentials. • Apply **time-dependent perturbation theory** to problems involving atomic transitions, including absorption, emission, and ionization, using Fermi's Golden Rule. • Describe the behaviour and properties of **identical particles**, and distinguish between symmetric and anti-symmetric wave functions in quantum systems. • Formulate and solve problems in **relativistic quantum mechanics** using the Klein-Gordon and Dirac equations, and interpret associated physical quantities like current and charge densities.		
6	**Credit Value**	**04 Credits**	**1 Credit = 15 Hours for Learning & Observation**	
7	**Total Marks**	**Maximum Marks: 100**	**Minimum Pass Marks: 40**	

PART-B: CONTENT OF THE COURSE

Total No. of Teaching-learning Periods (01 Hr. per period) - 60 Periods (60 Hours)

Unit	Topics (Course contents)	No. of Periods
I	Variational method, expectation value of energy, application to excited states, ground state of He-atom, Zero point energy of one dimensional harmonic oscillator, Vander-waals interaction, the W.K.B. approximation, approximate solutions, solution near turning point, connection formulae, energy levels of a potential well and quantization rule.	15
II	Theory of scattering: differential and total scattering cross section, wave mechanical picture of scattering & the scattering amplitude, Green's functions and formal expression for scattering amplitude, The Born approximation and its validity, Partial	15

	wave analysis, asymptomatic behaviour of partial waves and phase shifts, scattering by a square well potential, scattering by a hard sphere, scattering by a Coulomb potential.	
III	Time-dependent perturbation theory, first order perturbation, Harmonic perturbation, Fermi's Golden rule, Ionization of a H-atom, absorption and induced emission, Selection rules. Identical particles, symmetric and anti-symmetric wave functions.	**15**
IV	Relativistic quantum mechanics, formulation of relativistic quantum theory, the Klein-Gordon equation; plane wave solutions, charge and current densities, The Dirac equation for a free particle, matrices alpha and beta, Lorentz covariance of the Dirac equation, free particle solutions and the energy spectrum, charge and current densities.	**15**
Keywords :	***Variational Method, WKB Approximation, Quantum Scattering Theory, Time-Dependent Perturbation Theory, Fermi's Golden Rule, Relativistic Quantum Mechanics (Dirac & Klein-Gordon Equations)***	

Name and Signature of Convener & Members of BOS:

PART-C: LEARNING RESOURCES

Text Books, Reference Books Recommended and Others

Text Books &Reference Books Recommended -

1. L.1. Schiff: Quantum Mechanics (McGraw-Hill).
2. S.Gasiorowicz: Quantum Physics (Wiley).
3. Landau and Lifshitz: Quantum Mechanics.
4. B.Craseman and Z.D.Powell: Quantum Mechanics (Addison Wesley)
5. A.P. Messiah: Quantum Mechanics.
6. J.J. Sakurai: Modern Quantum Mechanics.
7. Mathews and Venkatesan: Quantum Mechanics.
8. Bjorken and Drell :Relativstic Quantum Mechanics

Online Resources (e-books/learning portals/ other e-resources)

1. All e-books of physics https://www.e-booksdirectory.com/listing.php?category=2
2. https://www.tcm.phy.cam.ac.uk/~bds10/aqp/lec22-24_compressed.pdf
3. https://juanrojo.com/wp-content/uploads/2021/04/quantummechanics2-lecturenotes-chapter8.pdf
4. https://compphys.quantumtinkerer.tudelft.nl/downloads/aqm.pdf
5. https://web.pa.msu.edu/people/pratts/phy851/lectures/lectures_full.pdf
6. https://www.nikhef.nl/~wouterh/teaching/PP1/LectureNotes.pdf
7. NPTEL Online courses https://nptel.ac.in/courses/115105098; https://archive.nptel.ac.in/courses/115/106/115106123/;

PART-D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Examination (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz (2): **20&20** Assignment/ Seminar (1): **10** Total Marks: **30**	Better marks out of the two Test/Quiz + marks obtained in Assignment shall be considered against **30 Marks**
End Semester Exam (ESE):	**Two section - A & B** Section A: Q1. Objective - **10 x1 = 10 Mark**; Q2. Short answer type - **5x4 = 20 Marks** Section B: Descriptive answer type qts, **1 out of 2** from each unit - **4x10 = 40 Marks**	

Name and Signature of Convener & Members of BOS:

ONE YEAR POST – GRADUATE PROGRAM (NEP2020)
PROGRAM: MASTER IN SCIENCE (2025-26)
DISCIPLINE –PHYSICS
SESSION – 2025-26

PART-A: INTRODUCTION				
Program : Master in Science (Physics)		**Semester: III**	**Session:2025-26**	
1	**Course Code**	**PHSE-13T**		
2	**Course Title**	**Solid State Physics -II**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite (if any)**	**As per Program**		
5	**Course Learning Outcomes (CLO)**	After going through the course, the student should be able to: • Understand dielectric and ferroelectric properties and their phase transitions. • Explain magnetic behaviours using quantum theory and domain structures. • Analyze optical processes and excitonic effects in crystalline materials. • Evaluate crystal defects and their impact on mechanical properties.		
6	**Credit Value**	**04 Credits**	**1 Credit = 15 Hours for Learning & Observation**	
7	**Total Marks**	**Maximum Marks: 100**	**Minimum Pass Marks: 40**	

PART-B: CONTENT OF THE COURSE		
Total No. of Teaching-learning Periods (01 Hr. per period) - 60 Periods (60 Hours)		
Unit	**Topics (Course contents)**	**No. of Periods**
I	**Dielectric and ferroelectrics** Maxwell's equations, polarization, macroscopic electric field, depolarization filed, El;local electric field at an atom, Lorentz filed E2, fields of dipoles inside cavity E3; dielectric constant and polarizability, electronic polarizability; structural phase transition; ferro-electric crystals, classification; displacive transition, soft optical phonons, Landau theory of phase transitions, first and second order transition.	**15**
II	**Magnetism** General ideas of dia- and para- magnetisms, quantum theory of paramagnetism, rare earth ions, iron group ions, crystal field splitting, quenching of orbital angular momentum, spectroscopic splitting factor, van vleck temperature dependent paramagnetism, Cooling by isentropic demagnetization, nuclear demagnetization, paramagnetic Susceptibility of conduction electrons.	**15**

III	**Ferromagnetism and anti-ferromagnetism** Ferromagnetic order, Curie point and exchange integral, temp dependence of saturation magnetization, saturation magnetization at absolute zero; magnons, quantization of spin waves, thermal excitation of magnons; neutron magnetic scattering, Ferrimagnetic order, Curie temp and susceptibility of ferrimagnets, iron garnets. Antiferromagnetic order, antiferromagnetic magnons, ferromagnetic domains.	**15**
IV	**Optical Processes & Excitons and defects** Optical reflectance, excitons, Frenkel and Mott-Wannier excitons, Alkali Halides and Molecular crystals Defects: lattice vacancies, Schottkey and Frenkel point effects, colour centers, F and other centers, Line defect. Shear strength of single crystals, dislocations- edge and screw dislocations, Burger vectors, Stress fields of dislocations, dislocation densities, dislocation multiplication and slip, strength of alloys, dislocations and crystal growth.	**15**
Keywords:	Dielectric Polarization, Ferroelectric Phase Transition, Magnetism (Para-, Ferro-, Antiferro-), Excitons and Optical Properties, Crystal Defects and Dislocations.	

Name and Signature of Convener & Members of BOS:

PART-C: LEARNING RESOURCES

Text Books, Reference Books Recommended and Others

Text Books & Reference Books Recommended -

1. C. Kittel: Introduction to Solid State Physics (Wiley and Sons).
2. J.M. Ziman: Principles of theory of solids (Cambridgeuniv. press).
3. Azaroff: X-ray crystallography.
4. Weertman and weertman: Elementary Dislocation Theory.
5. Verma and Srivastava: Crystallography for Solid State Physics.
6. Azeroff and Buerger: The Power Method.
7. Buerger: Crystal Structure Analysis.
8. Thomas: Transmission Electron Microscopy.
9. Omar: Elementary solid state physics.
10. Aschroft and Mermin: Solid State Physics.
11. Chalking and Lubensky: Principles of Condensed Matter Physics.
12. Madelung: Introduction to solid state theory.
13. Callaway: Quantum theory of solid state physics.
14. Huang: Theoretical Solid State Physics.
15. Kittel: Quantum theory of solids.

Online Resources (e-books/learning portals/ other e-resources)

1. All e-books of physics https://www.e-booksdirectory.com/listing.php?category=2
2. **Ferroelectrics – Physical Effects**
   https://www.issp.ac.ru/ebooks/books/open/Ferroelectrics_-_Physical_Effects.pdf
3. **Ferroelectrics – Material Aspects**
   https://www.issp.ac.ru/ebooks/books/open/Ferroelectrics_-_Material_Aspects.pdf
4. **Fundamentals of Ferroelectric Materials (Sample Chapter)**
   https://application.wiley-vch.de/books/sample/3527342710_c01.pdf
5. **Antiferroelectrics – History, Fundamentals, Applications**
   https://www.mri.psu.edu/sites/default/files/stm/publications/Antiferroelectrics-%20History%2C%20Fundamentals%2C%20Crystal%20Chemistry%2C%20Crystal%20Structures%2C%20Size%20Effects%2C%20and%20Applications-JACerS-2021.pdf
6. NPTEL Online courses https://nptel.ac.in/courses/115105098;
7. https://archive.nptel.ac.in/courses/115/106/115106123/;

PART-D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Examination (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): **(By course teacher)**	Internal Test/ Quiz (2): **20&20** Assignment/ Seminar (1): **10** Total Marks: **30**	Better marks out of the two Test/Quiz + marks obtained in Assignment shall be considered against **30 Marks**

End Semester Exam (ESE):	**Two section - A & B** Section A: Q1. Objective - **10 x1 = 10 Mark**; Q2. Short answer type - **5x4 = 20 Marks** Section B: Descriptive answer type qts, **1 out of 2** from each unit - **4x10 = 40 Marks**

Name and Signature of Convener & Members of BOS:

ONE YEAR POST – GRADUATE PROGRAM (NEP2020)
PROGRAM: MASTER IN SCIENCE (2025-26)
DISCIPLINE –PHYSICS
SESSION – 2025-26

PART-A: INTRODUCTION				
Program : Master in Science (Physics)		**Semester: III**	**Session:2025-26**	
1	**Course Code**	**PHSE-14T**		
2	**Course Title**	**Nuclear (II) & Particle Physics**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite (if any)**	**As per Program**		
5	**Course Learning Outcomes (CLO)**	After going through the course, the student should be able to: • **Understand** the characteristics of nuclear forces, including nucleon-nucleon interactions, spin dependence, isospin formalism, and charge symmetry. • **Analyze** nuclear reactions using concepts like Q-value, threshold energy, cross-sections, and partial wave analysis. • **Explain** the principles of nuclear decay processes such as beta and gamma decay, Fermi's theory, selection rules, and the role of neutrinos. • **Apply** nuclear models—liquid drop, shell, and collective models—and describe key concepts of elementary particle physics, including the quark model and the Standard Model.		
6	**Credit Value**	**04 Credits**	**1 Credit = 15 Hours for Learning & Observation**	
7	**Total Marks**	**Maximum Marks: 100**	**Minimum Pass Marks: 40**	

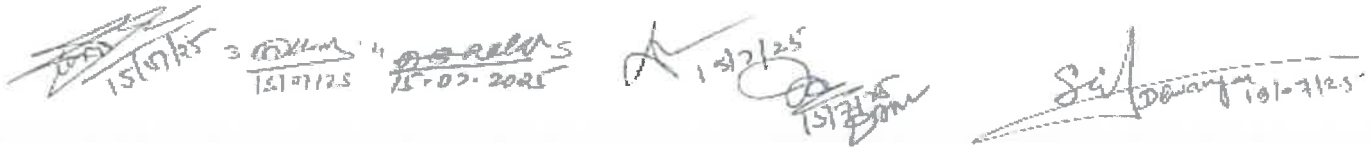
PART-B: CONTENT OF THE COURSE

Total No. of Teaching-learning Periods (01 Hr. per period) - 60 Periods (60 Hours)

Unit	Topics (Course contents)	No. of Periods
I	**Nuclear Interactions**: Nucleon-nucleon interaction, Nucleon-nucleon scattering at low energy, Scattering length, Effective range theory, Spin dependence of nuclear forces, Charge independence and charge symmetry of nuclear forces, Iso-spin formalism, Exchange forces. **Nuclear Reactions**: Reaction energetics: Q-equation and threshold energies, Reactions cross sections, Direct and compound nuclear reactions, Formal reaction theory: Partial wave approach and phase shifts.	15
II	**Nuclear Decay**: Beta decay, Femi's theory of beta decay, Shape of the beta spectrum, Total decay rate, Angular momentum and parity selection rules, Allowed and forbidden transitions, Selection rules, Parity violation, Detection and properties of neutrino, Gamma decay, Angular momentum and Parity selection rules.	15

III	**Nuclear models**: Liquid drop model, Bohr-Wheeler theory of fission, Shell Model, Experimental evidence for shell effects, Single particle shell model, Spin-orbit interaction and magic numbers, Analysis of shell model predictions, Magnetic moments and Schmidt lines, Collective model of Bohr and Mottelson.	**15**
IV	**Elementary particle Physics:** The fundamental interactions, Classification of elementary particles, Leptons and Hadrons, Symmetries, groups and conservation laws, Quark model, Properties of Quarks, the standard model.	**15**
Keywords:	***Nucleon-Nucleon Interaction, Nuclear Reactions, Beta and Gamma Decay, Nuclear Models (Shell Model, Liquid Drop Model), Elementary Particle Physics and Standard Model.***	

Name and Signature of Convener & Members of BOS:



PART-C: LEARNING RESOURCES

Text Books, Reference Books Recommended and Others

Text Books & Reference Books Recommended -

1. A. Bohr and B.R. Mottelson, Nuclear structure, vol. 1 (1969) and vol.2, Benjamin, Reading, A, 1975.
2. Kenneth S. Kiane, Introductory Nuclear Physics, Wiley, New York, 1988.
3. Ghoshal, Atomic and Nuclear Physicsvol.2.
4. P.H. Perking, Introduction to high energy physics, Addison-Wesley, London, 1982
5. Shriokov Yudin, Nuclear Physics vol.1 & 2, Mir Publications, Moscow 1982
6. D. Griffiths, introduction to elementary particles, harper and row, New York, 1987.
7. H.A. Enov, introduction to Nuclear Physics, Addison – Wesley, 1973
8. G.E. Brown and A.D. Jackson, Nucleon – Nucleon interaction North – hall and Amsterdam, 1976
9. S.D. Bendetti, Nuclear Interaction, John Willey and sons, New York 1964
10. M.K. Pal, Theory of Nuclear structure, affiliated East West, Madras, 1982
11. Y.R. Waghmare, introductory nuclear physics, Oxford, IBH, Bombay, 1981.
12. J.M. Longo, elementary particles, McGraw Hill, New York, 1971.
13. R.R. Roy and B.P. Nigam, Nuclear Physics, Wiley- Easterm Ltd. 1983.

Online Resources (e-books/learning portals/ other e-resources)

1. All e-books of physics https://www.e-booksdirectory.com/listing.php?category=2
2. https://www.researchgate.net/publication/238671907_The_nucleon-nucleon_interaction
3. https://ocw.mit.edu/courses/22-02-introduction-to-applied-nuclear-physics-spring-2012/5ac279a77468f9041a4d213442c3cb6a_MIT22_02S12_lec_ch5.pdf
4. https://inpp.ohio.edu/~meisel/PHYS7501/file/Lecture11_NNInteraction_PHYS7501_F2021_ZM.pdf
5. https://ocw.mit.edu/courses/22-02-introduction-to-applied-nuclear-physics-spring-2012/d0d046f78c917f107d925f11ac862ae4_MIT22_02S12_lec_ch1.pdf

PART-D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Examination (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz (2): **20&20** Assignment/ Seminar (1): **10** Total Marks: **30**	Better marks out of the two Test/Quiz + marks obtained in Assignment shall be considered against **30 Marks**
End Semester Exam (ESE):	**Two section - A & B** Section A: Q1. Objective - **10 x1 = 10 Mark**; Q2. Short answer type - **5x4 = 20 Marks** Section B: Descriptive answer type qts, **1 out of 2** from each unit - **4x10 = 40 Marks**	

Name and Signature of Convener & Members of BOS:

ONE YEAR POST – GRADUATE PROGRAM (NEP2020)
PROGRAM: MASTER IN SCIENCE (2025-26)
DISCIPLINE –PHYSICS
SESSION – 2025-26

PART-A: INTRODUCTION				
Program : Master in Science (Physics)			Semester: III	Session:2025-26
1	Course Code	PHSE-15T		
2	Course Title	Laser Physics & Optoelectronic Device		
3	Course Type	Discipline Specific Elective		
4	Pre-requisite (if any)	As per Program		
5	Course Learning Outcomes (CLO)	After going through the course, the student should be able to: • Understand the principles and characteristics of lasers, including emission processes and resonator dynamics. • Analyze different types of laser systems and techniques like Q-switching and mode-locking. • Explore laser applications in communication, fiber optics, and nonlinear optical processes. • Describe the structure, operation, and characteristics of special bipolar, unipolar, and photonic semiconductor devices.		
6	Credit Value	03 Credits	1 Credit = 15 Hours for Learning & Observation	
7	Total Marks	Maximum Marks: 100	Minimum Pass Marks: 40	

PART-B: CONTENT OF THE COURSE		
Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)		
Unit	**Topics (Course contents)**	**No. of Periods**
I	**Laser Characteristics**: Spontaneous and stimulated emission, Einstein's quantum theory of radiation, theory of some optical processes, coherence and monochromacity, kinetics of optical absorption, line broadening mechanism, Basic principle of lasers, population inversion, laser pumping, two & three level laser systems, resonator, Q-factor, losses in cavity, threshold condition. **Laser Systems**: Solid state lasers the ruby laser, Nd: YAG laser, ND: Glass laser, semiconductor lasers features of semiconductor lasers, Gas laser -neutral atom gas laser, He-Ne laser, molecular gas lasers, CO2 laser.	12
II	**Advances in laser**: Physics Production of giant pulse, Q-switching, mode locking, Non-linear optics, Harmonic generation, second harmonic generation, Phase matching, third harmonic generation, optical mixing, parametric generation and self-focusing of light. **Communication by lasers:** ranging, fiber Optics Communication, Optical fiber, numerical aperture, propagation of light in a medium with variable index,	11

	pulse dispersion.	
III	**Special Bipolar devices:** Thyristors- the four-layer diodes and their basic characteristics, Schottky diode, three terminal thyristor, Diac & Triac, SCR, UJT, Field controlled Thyristors. **Unipolar Devices:** JFET, MESFET and MOSFET, basic structure, working and device 1-V characteristics, small signal equivalent circuit for Microwave performance Introduction to MIS and MOS diodes, charge coupled devices (CCDs), basic structure and working principle, MOSFET-basic device characteristics, types of MOSFET.	**11**
IV	**Photonic Devices:** Radiative transitions, LEDs, Visible and infrared SC lasers; Photo detectors; Photo conductor, & Photodiode, Solar cells, Solar radiation 12 and ideal conversion efficiency, p-n junction solar cells, Hetero junction. Interface thin film solar cells.	**11**
Keywords :	***Laser Emission and Resonators, Q-switching and Mode-locking, Fiber Optic Communication, Semiconductor Devices (JFET, MOSFET, SCR), Photonic Devices (LEDs, Photodiodes, Solar Cells)***	

Name and Signature of Convener & Members of BOS:

PART-C: LEARNING RESOURCES

Text Books, Reference Books Recommended and Others

Text Books &Reference Books Recommended -

1. Laud, B.B.: Lasers and nonlinear optics, (New AgeInt.Pub. 1996).
2. Thyagarajan, K and Ghatak, A.K. :Lasers theory and applications (Plenum press, 1981).
3. Ghatak, A.K. and Thyagarajan, K: Optical electronics (Cambridge Univ. Press 1999).
4. Seigman, A.E. : Laser (Oxford Univ. Press 1986)
5. Maitland, A. and Dunn, M.H. : Laser Physics (N.H. Amsterdam, 1969).
6. Hecht, J. The laser Guide book (McGraw Hill, NY, 1986).
7. Demtroder, W.: Laser Spectroscopy (Springe series in Chemical physics vol.5, Springeverlag, Berlin, 1981).
8. Harper, P.G. and Wherrett B.S. (Ed.): Non-Linear-optics (Acad.press,1977).
9. Semiconductor Devices - Physics and Technology, by SM Sze, Wiley (1985)
10. Introduction to semiconductor device, M.S. Tyasi, John Wiley andsons
11. Measurement, Instrumentation and experimental design in physics and engineering by M.Sayer and A.Mansingh, Prentice Hall India2000
12. Optical electronics by Ajay Ghatak and K.Thyagarajah, Cam. Univ.Press.
13. Opto electronics An introduction: J.Wilson and JFB Hawkes (Eastern Economy Edition).
14. Optical Communications: J.H. Franz and V.K. Jain (Narosa)

Online Resources (e-books/learning portals/ other e-resources)

1. All e-books of physics https://www.e-booksdirectory.com/listing.php?category=2
2. **Download PDF:** https://uomustansiriyah.edu.iq/media/lectures/6/6_2018_03_27%2111_07_39_PM.pdfwww2.mvcc.edu+8ia601608.us.archive.org+8tzin.bgu.ac.il+8ia601608.us.archive.org+4University of Mustansiriyah+4ResearchGate+4
3. https://nibmehub.com/opac-service/pdf/read/Basics%20of%20Laser%20Physics-%202nd%20edition-%202017.pdfNibme Hub+1ehs.msu.edu+1
4. **Download PDF:** https://www2.mvcc.edu/users/faculty/jfiore/Linear/SemiconductorDevices.pdfpd-zdh.xaut.edu.cn+11www2.mvcc.edu+11scribd.com+11
5. **Download PDF:** https://cdck-file-uploads-europe1.s3.dualstack.eu-west-1.amazonaws.com/arduino/original/4X/3/7/2/37218a2afce0442a0da50d7c267055ddb4b6fc59.pdfdunham.ece.uw.edu+4cdck-file-uploads-europe1.s3.dualstack.eu-west-1.amazonaws.com+4Oxford University Press+4talkingelectronics.com

PART-D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Examination (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz (2): **20&20** Assignment/ Seminar (1): **10** Total Marks: **30**	Better marks out of the two Test/Quiz + marks obtained in Assignment shall be considered against **30 Marks**
End Semester Exam (ESE):	**Two section - A & B** Section A: Q1. Objective - **10 x1 = 10 Mark**; Q2. Short answer type - **5x4 = 20 Marks** Section B: Descriptive answer type qts, **1 out of 2** from each unit - **4x10 = 40 Marks**	

Name and Signature of Convener & Members of BOS:

ONE YEAR POST – GRADUATE PROGRAM (NEP2020)
PROGRAM: MASTER IN SCIENCE (2025-26)
DISCIPLINE –PHYSICS
SESSION – 2025-26

PART-A: INTRODUCTION				
Program : Master in Science (Physics)			Semester: III	Session:2025-26
1	Course Code	PHSE-15P		
2	Course Title	Lab Course		
3	Course Type	Discipline Specific Elective		
4	Pre-requisite (if any)	As per Program		
5	Course Learning Outcomes (CLO)	After going through the course, the student should be able to: 1. **Understand semiconductor properties** using experiments like four-probe and Hall effect to determine band gap and carrier concentration. 2. **Apply optical techniques** to measure wavelengths and study atomic/molecular spectra using lasers and spectrometers. 3. **Explore nuclear and radiation physics** by operating GM tubes, measuring half-life, and verifying the inverse-square law. 4. **Investigate material properties** such as ultrasonic velocity, Curie temperature, and forbidden gap under varying conditions. 5. **Use precision instruments** like interferometers, X-ray diffractometers, and Fabry-Perot etalons for modern physics experiments.		
6	Credit Value	01 Credits	1 Credit = 30 Hours Laboratory or Field learning / Training	
7	Total Marks	Maximum Marks: 50	Minimum Pass Marks: 20	

PART-B: CONTENT OF THE COURSE		
Total No. of learning-Training / performance Periods -30 Periods (30 Hours)		
Module	**Topics (Course contents)** **At least 10 of the following or related Experiments)**	**No. of Periods**
Lab./ Field / Training/ Experiments Contents of Course	1. Determination of band gap of semiconductor by four prob method. 2. Measurement of Hall Coefficient of given semiconductor: identification of type of semiconductor and estimation of charge carrier on centration. 3. Determination of wavelength of mercury light by constant deviation spectrometer. using Hartmann formula. 4. Ultrasonic velocity in a liquid as a function of temperature using ultrasonic interferometer. 5. Experiment on transmission line (A) Determination of characteristics impedance, (B) Study of voltage distribution. 6. Determination of the Curie temperature of ferromagnetic material.	30

	7. Determination of forbidden gap of a diode by plotting reverse saturation current as a function of temperature. 8. Determination of operating voltage and study the characteristics of a GM tube. 9. Determination of operating voltage of a GM tube and determine the linear absorption coefficient. 10. Determination of operating voltage of a GM tube and verify inverse-square law. 11. Determination of short half-life of a given source which can be obtained from a mini generator or produced with a neutron source by activation. 12. X-ray diffraction by Telexometer. 13. Determination of ionization potential of Lithium/Mercury. 14. Determination of e/m of electron by Normal Zeeman Effect using Febry-Perot Etalon. 15. Determination of Dissociation energy of iodine (I_2) Molecule by photography, the absorption bands of I_2 in the visible region. 16. Measurement of wavelength of He-Ne Laser light using a ruler and thickness of thin wire by the laser. 17. To study Faraday Effect using He-Ne Laser.	
Keywords:	***Semiconductors (band gap, Hall effect, carrier concentration), nuclear physics (GM tube, half-life, absorption). Optics and spectroscopy (lasers, spectrometers, Zeeman effect, X-ray diffraction), material properties (Curie temp, ultrasonic velocity).***	

Name and Signature of Convener & Members of BOS:

PART-C: LEARNING RESOURCES

Text Books, Reference Books Recommended and Others

Text Books &Reference Books Recommended –

Textbooks:

1. **B.L. Theraja** – *Basic Electronics (Solid State)*
2. **V.K. Mehta & Rohit Mehta** – *Principles of Electronics*
3. **Ghatak, Ajoy** – *Optics*
4. **Arthur Beiser** – *Concepts of Modern Physics*
5. **H.S. Mani & G.K. Mehta** – *Introduction to Modern Physics*

Reference Books:

1. **S. Chattopadhyay, C. Upadhyay & K. Upadhyay** – *Experimental Physics*
2. **Indu Prakash & Ramakrishna** – *A Textbook of Practical Physics*
3. **B.S. Arora** – *Practical Physics*
4. **Elby & Van Heuvelen** – *Teaching Physics with Physics Suite*
   S.L. Gupta & V. Kumar – *Elements of Spectroscopy*

Online Resources (e-books/learning portals/ other e-resources)

1. https://epathshala.nic.in/
2. https://ndl.iitkgp.ac.in/
3. https://books.google.com/
4. https://archive.org/
5. https://www.gutenberg.org/
6. https://link.springer.com/
7. https://www.sciencedirect.com/
8. https://onlinelibrary.wiley.com/

PART-D: ASSESSMENT AND EVALUATION

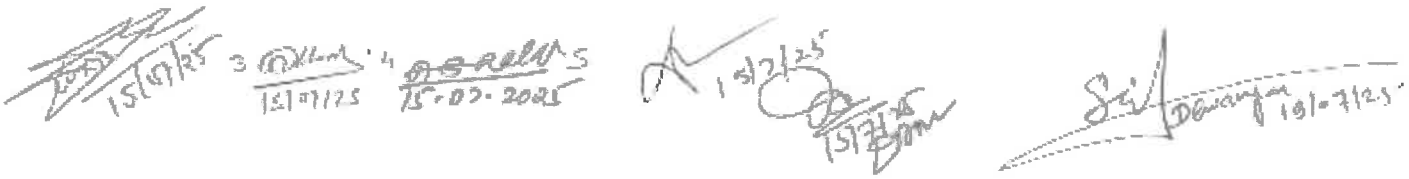
Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Examination (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz - (2):	**10&10**	Better marks out of the two Test / Quiz + marks obtained in Assignment shall be considered against **15 Marks**
	Assignment/ Seminar (1):	**05**	
	Total Marks:	**15**	

End Semester Exam (ESE):	**Laboratory/Field Skill Performance : On Spot Assessment** A. Performed the Task based on Lab. work – **20 Marks** B. Spotting based on tools & technology (written)- **10 marks** C. Viva-voce (based on principle/technology)- **05 marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of BOS:



ONE YEAR POST – GRADUATE PROGRAM (NEP2020)
PROGRAM: MASTER IN SCIENCE (2025-26)
DISCIPLINE –PHYSICS
SESSION – 2025-26

PART-A: INTRODUCTION				
Program : Master in Science (Physics)			Semester: III	Session:2025-26
1	Course Code	PHSE-16T		
2	Course Title	Electronics & Communication		
3	Course Type	Discipline Specific Elective		
4	Pre-requisite (if any)	As per Program		
5	Course Learning Outcomes (CLO)	After going through the course, the student should be able to: • Analyze wave propagation and mode patterns in rectangular and circular waveguides. • Explain the structure, operation, and Q-factor of microwave cavity resonators. • Describe the principles and modes of operation of transferred electron devices (TEDs). • Apply digital modulation techniques for efficient communication system design. • Evaluate the effects of noise and filtering on digital data transmission and reception.		
6	Credit Value	03 Credits	1 Credit 15 Hours for Learning & Observation	
7	Total Marks	Maximum Marks: 100	Minimum Pass Marks: 40	

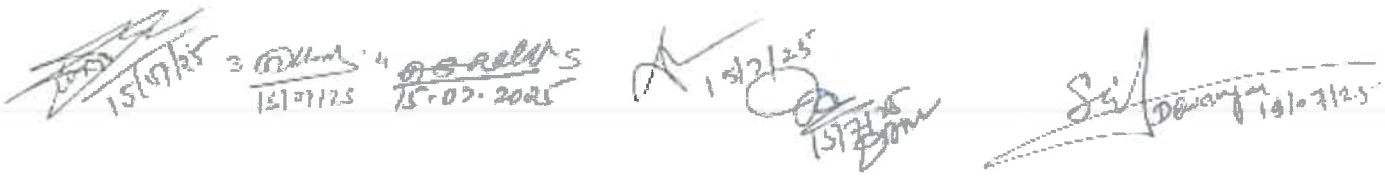
PART-B: CONTENT OF THE COURSE

Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Periods
I	**Microwave wave guides &components**: (Wave modes) rectangular wave guides: solution of wave equation in rectangular coordinates, TE modes in rectangular wave guides, TM modes in rectangular wave guides. Circular wave guides: solutions of wave equation in Cylindrical coordinates, TE modes in Circular wave guides, TM modes in Circular wave guides, TEM modes in Circular wave guides.	12
II	**Microwave cavities:** rectangular cavity resonator, circular-cavity resonator & semicircular cavity resonators Q- factor of a cavity resonator. **Transferred Electrons devices (TEDs)** Gunn effect diodes, principle of operation, modes of operations, read diodes, IMPATT diodes, TRAPATT diodes. Microwave communications: advantages of microwave transmission, loss in free space, propagation of microwave.	11

III	**Digital communications** Pulse modulation systems, Sampling Theorem, Low pass & Band pass signal, PAM- Channel BE for PAM signal, Natural Sampling. Flattop sampling. Signal through holding, Quantization of signals, quantization error. **Digital modulation techniques** PCM, Differential PCM, Delta modulation, Adaptive, delta modulation (CVSD). BPSK, DPSK, QPSK, PSK, QASK, BFSK, FSK, MSK	**11**
IV	**Data Transmission I** Base band signal receiver, Probability of error optimum filter, White noise: Matched filter & probability of error, Coherent reception correlation, PSK, FSK, Non-Coherence detection on FSK, Differential PSK, QASK. **Data Transmission II** Noise in pulse code & delta modulation system, PCM transmission, Calculation of quantization noise output signal power, Effect of thermal noise, output signal to noise ratio in PCM.	**11**
Keywords:	***Waveguides, Microwave Resonators, Transferred Electron Devices (TEDs), Digital Modulation, Noise Analysis & Data Transmission.***	

Name and Signature of Convener & Members of BOS:



PART-C: LEARNING RESOURCES

Text Books, Reference Books Recommended and Others

Text Books &Reference Books Recommended -

1) "Microwaves" by K.L. Gupta Wiley Estern Ltd.Delhi.
2) Advanced Electronic communication system by Wayne Tomsi Physicseducation.
3) Principle of communication of system-by Toub& Schilling: 2nd ed. TMH1994
4) Communication system: by SimanHaykin, 3rd ed. John wiley&sonsinc. 1994.
5) Microwave devices & circuits by: Samuel, Y.Liau.
6) Electronic communication: Georgekennedy.

Online Resources (e-books/learning portals/ other e-resources)

1. All e-books of physics https://www.e-booksdirectory.com/listing.php?category=2
2. Direct PDF: https://pce-fet.com/common/library/books/33/9509_%5BDavid_M._Pozar%5D_Microwave_and_Rf_Design_of_Wirele%28b-ok.org%29.pdfUniversity of Diyala+9PCE-FET+9Scribd+9
3. https://www.commscope.com/globalassets/digizuite/2912-microwave-communication-basics-ebook-co-109477-en.pdfUniversity of Diyala+3CommScope+3telecomHall Forum+3
4. Direct PDF: https://students.aiu.edu/submissions/profiles/resources/onlineBook/S9E6A7_digital%20microwave%20communication%20telecommunications.pdfpdfcoffee.com+15students.aiu.edu+15CommScope+15
5. Access PDF or read online: https://archive.org/details/microwaveenginee0004edpoza
6. NPTEL Online courses https://nptel.ac.in/courses/115105098;
7. https://archive.nptel.ac.in/courses/115/106/115106123/;

PART-D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Examination (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz (2): **20&20** Assignment/ Seminar (1): **10** Total Marks: **30**	Better marks out of the two Test/Quiz + marks obtained in Assignment shall be considered against **30 Marks**
End Semester Exam (ESE):	**Two section - A & B** Section A: Q1. Objective - **10 x1 = 10 Mark**; Q2. Short answer type - **5x4 = 20 Marks** Section B: Descriptive answer type qts, **1 out of 2** from each unit - **4x10 = 40 Marks**	

Name and Signature of Convener & Members of BOS:

ONE YEAR POST – GRADUATE PROGRAM (NEP2020)
PROGRAM: MASTER IN SCIENCE (2025-26)
DISCIPLINE –PHYSICS
SESSION – 2025-26

PART-A: INTRODUCTION				
Program : Master in Science (Physics)			Semester: III	Session:2025-26
1	Course Code	PHSE-16P		
2	Course Title	Lab Course		
3	Course Type	Discipline Specific Elective		
4	Pre-requisite (if any)	As per Program		
5	Course Learning Outcomes (CLO)	After going through the course, the student should be able to: 1. Apply microprocessor programming skills to perform data conversions, arithmetic operations, and memory data transfers. 2. Understand and verify digital logic circuits including logic gates, Boolean theorems, adders, encoders, decoders, multiplexers, and counters. 3. Analyze data conversion techniques by studying and implementing Digital-to-Analog and Analog-to-Digital converters. 4. Explore memory and sequential circuits such as ROM, RAM, shift registers, and Phase-Locked Loops (PLLs). 5. Demonstrate basic concepts of communication systems through modulation/demodulation, optical fiber, and microwave measurements.		
6	Credit Value	01 Credits	1 Credit = 30 Hours Laboratory or Field learning / Training	
7	Total Marks	Maximum Marks: 50	Minimum Pass Marks: 20	

PART-B: CONTENT OF THE COURSE

Total No. of learning-Training / performance Periods -30 Periods (30 Hours)

Module	Topics (Course contents) At least 10 of the following or related Experiments)	No. of Periods
Lab./ Field / Training/ Experiments Contents of Course	1. Experiments with microprocessor. ✓ Convert BCD in to binary & vice versa. ✓ To transfer group of data blocks from one location to another location. ✓ To write programme for addition &subtraction. ✓ To write programme for multiplication &division. 2. Logic gate study DTL &RTL. 3. To study& verify the De'Morgon's Theorem. 4. Study of Adder / Subtractor. 5. Study of Encoder & Decoder.	30

	6. Study of Multiplexer & DE multiplexer 7. Study of digital to analog converter. 8. Study of analog to digital converter. 9. Study of 4-bit Counter/ ripple Counter. 10. Study of left/right shift register. 11. Study of read only memory. 12. Study of Random Access Memory. 13. Study of Phase locked loop. 14. Study of BCD to seven segments Decoder. 15. Study of modulation & demodulation. 16. Optical fiber based experiment. 17. Microwave characterization and measurements.	
Keywords:	***Microprocessor (BCD, arithmetic, data transfer), logic gates, adders, encoders, multiplexers. Counters, shift registers, memory (ROM/RAM), ADC/DAC, PLL, 7-segment decoder. Modulation, demodulation, optical fiber, microwave measurements.***	

Name and Signature of Convener & Members of BOS:

PART-C: LEARNING RESOURCES

Text Books, Reference Books Recommended and Others

Text Books &Reference Books Recommended –

Textbooks:

1. Ramesh S. Gaonkar – Microprocessor Architecture, Programming and Applications with the 8085
2. M. Morris Mano – Digital Logic and Computer Design
3. P. Malvino & D. Leach – Digital Principles and Applications
4. V.K. Mehta & Rohit Mehta – Principles of Electronics
5. Kennedy & Davis – Electronic Communication Systems

Reference Books:

1. Albert Paul Malvino – Electronic Principles
2. Douglas V. Hall – Microprocessors and Interfacing: Programming and Hardware
3. William Stallings – Computer Organization and Architecture
4. Taub & Schilling – Digital Integrated Electronics.
5. John G. Proakis – Digital Signal Processing

Online Resources (e-books/learning portals/ other e-resources)

1. 8085 Microprocessor Programming (NPTEL)
2. Microprocessor Tutorials – TutorialsPoint
3. 8085 Instruction Set – GeeksforGeeks
4. Digital Circuits – NPTEL Course by Prof. S. S. Iyengar
5. Logic Gates and Circuits – Khan Academy
6. Boolean Algebra & Theorems – All About Circuits
7. Encoders & Decoders – Electronics Tutorials
8. Multiplexer/Demultiplexer Explained – GeeksforGeeks
9. DAC and ADC – Electronics Tutorials

PART-D: ASSESSMENT AND EVALUATION

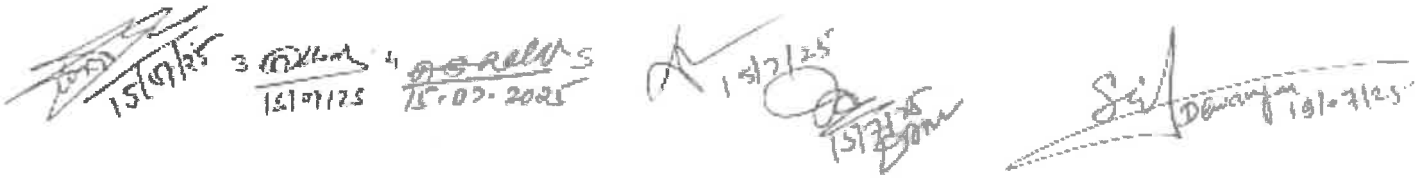
Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Examination (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz - (2):	**10&10**	Better marks out of the two Test / Quiz + marks obtained in Assignment shall be considered against **15 Marks**
	Assignment/ Seminar (1):	**05**	
	Total Marks:	**15**	

End Semester Exam (ESE):	**Laboratory/Field Skill Performance : On Spot Assessment** A. Performed the Task based on Lab. work – **20 Marks** B. Spotting based on tools & technology (written)- **10 marks** C. Viva-voce (based on principle/technology)- **05 marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of BOS:



ONE YEAR POST – GRADUATE PROGRAM (NEP2020)
PROGRAM: MASTER IN SCIENCE (2025-26)
DISCIPLINE –PHYSICS
SESSION – 2025-26

PART-A: INTRODUCTION				
Program : Master in Science (Physics)		**Semester: III**	**Session:2025-26**	
1	**Course Code**	**PHSE-17T**		
2	**Course Title**	**Astronomy & Astrophysics**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite (if any)**	**As per Program**		
5	**Course Learning Outcomes (CLO)**	After going through the course, the student should be able to: • **Explain** the concepts of apparent and absolute magnitudes, color index, and use of the Hertzsprung–Russell (H-R) diagram in stellar classification. • **Describe** the internal structure of stars and the processes involved in their formation, evolution, and end states (e.g., white dwarfs, neutron stars, black holes). • **Understand** the physical characteristics of the Sun and solar phenomena like sunspots, solar flares, and solar wind. • **Analyze** the structure and dynamics of the Milky Way and other galaxies, including active galaxies and quasars. • **Apply** cosmological principles to study the origin, evolution, and large-scale structure of the universe, including concepts like the Big Bang, dark matter, and cosmic microwave background.		
6	**Credit Value**	**03 Credits**	**1 Credit 15 Hours for Learning & Observation**	
7	**Total Marks**	**Maximum Marks: 100**	**Minimum Pass Marks: 40**	

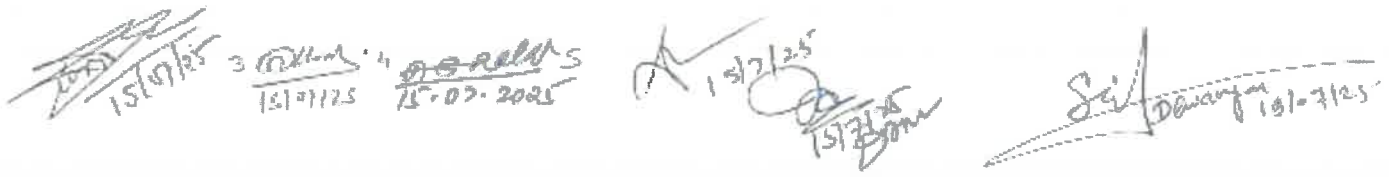
PART-B: CONTENT OF THE COURSE

Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Periods
I	Stars-apparent magnitudes, Colour index, Spectral classification, Stellar distances, Absolute magnitude, The H-R diagram of stars. Stellar interiors: The basic equations of stellar structure. Formation and evolution of stars: Inter stellar dust and gas, Formation of proto-stars, Pre-main sequence evolution, Post main sequence evolution and Evolution on the main sequence for low and high mass stars, Late stages of evolution, Fate of massive stars, Supernovae and its characteristics.	11
II	End states of stars, degenerate states, White dwarfs, and Chandrasekhar limit, Neutron stars and Pulsars, Black holes. Binary stars and their classification, close binaries. Solar Physics: Physical Characteristics of sun, Photosphere: Limb darkening.	11

	Granulation, Faculae, Solar Chromo-sphere and Corona, Prominences, Solar Cycle and Sunspots, Solar Magnetic Fields, Theory of Sunspots, Solar flares, solar wind.	
III	The Milky Way Galaxy: Structure of the Milky way, Oort's theory of galactic rotation, Dynamics of the spiral arms, Distribution of Interstellar matter, Central regions of the Milky way. Normal Galaxies: Classification of galaxies, Hubble sequence: Elliptical, Lenticulars and Spiral galaxies, and their properties. Active galaxies: Active Galactic Nuclei (AGNs), Seyfert galaxies, Radio galaxies: General properties, Superluminal motion, Quasars: Properties and Energy requirements, Nature of quasar redshifts, Supermassive black hole model.	**11**
IV	Cosmology: Cosmological principle, Observational support and other arguments to support cosmological principle, Models of the universe, Friedmann models, Quantitative predictions of FRW model, Open and closed universes, Hubble's law, Angular size. Relics of the big bang, the early universe, Thermodynamics of the early universe, Primordial neutrinos, Helium synthesis and other nuclei, Microwave background, the very early universe, the formation of structures in the Universe. Observations of the cosmological significance, Measurement of Hubble's constant, Age of the universe, Abundance of light nuclei, Dark matter.	**12**
Keywords:	***Hertzsprung – Russell (H-R) Diagram, Stellar Evolution, Compact Objects, Solar Activity (Sunspots, Solar Flares, Solar Wind), Galaxies and Quasars, Big Bang Cosmology***	

Name and Signature of Convener & Members of BOS:



PART-C: LEARNING RESOURCES

Text Books, Reference Books Recommended and Others

Text Books &Reference Books Recommended -

1. Astrophysics for Physicists, Arnab Rai Choudhuri, Camb. University Press, 2010.
2. Modern Astrophysics, B.W. Carroll and D.A. Ostlie, Addison-WealeyPub.Co.
3. Introductory Astronomy and Astrophysics, M.Zeilik and S.A. Gregory, 4th edition, Saunders collegepublishing.
4. Theoretical Astrophysics, vol. II: Stars and stellar systems, T. Padmanabhan, Cambridge universitypress.
5. The Physical Universe: An introduction to astronomy, F.Shu, Mill valley: University
6. Textbook of astronomy and astrophysics with elements of cosmology, V.B. Bhatia, Pb -New Delhi, Narosa publishing house. Modern Astrophysics, B.W. Carroll and D.A. Ostlie, Addison Wesley publish.co.
7. Introductory astronomy and astrophysics, M.Zeilik and S.A.Greogry, 4 th edition, Saunders college publishing.
8. Theoretical Astrophysics, vol. I: Astrophysical processes T. Padmanabhan, Cambridge university press.
9. Introduction to cosmology, J.V. Narlikar, 3rd edition, Cambridge uni. press.
10. Structure formation in the universe, T. Padmanbhan, Cambridge University, press.

Online Resources (e-books/learning portals/ other e-resources)

1. All e-books of physics https://www.e-booksdirectory.com/listing.php?category=2
2. https://saaubi.people.wm.edu/TeachingWebPages/Physics172_Spring2025/Physics172_Spring2025.html
3. https://icourse.club/uploads/files/fa6ee05bde8c18abf27d7e7e444eb7a5e5c47bc7.pdf
4. https://fys.kuleuven.be/ster/education/sse/sse-2021c.pdf
5. https://astronomy.org/moravian/C14-BASN-Stellar-Evolution.pdf
6. https://arxiv.org/pdf/2308.13302
7. Cambridge University Books for Physics https://www.cambridgeindia.org/5. Books for solving physics problems https://bookboon.com/en/physics-ebooks
8. NPTEL Online courses https://nptel.ac.in/courses/115105098;
9. https://archive.nptel.ac.in/courses/115/106/115106123/;

PART-D: ASSESSMENT AND EVALUATION

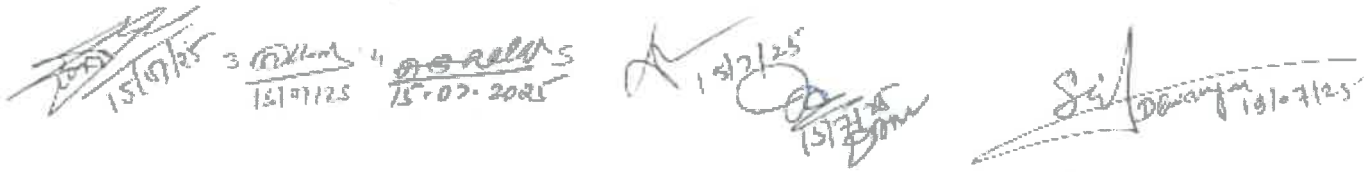
Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Examination (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): **(By course teacher)**	Internal Test/ Quiz (2): **20&20** Assignment/ Seminar (1): **10** Total Marks: **30**	Better marks out of the two Test/Quiz + marks obtained in Assignment shall be considered against **30 Marks**

End Semester Exam (ESE):	**Two section - A & B** Section A: Q1. Objective - **10 x1 = 10 Mark**; Q2. Short answer type - **5x4 = 20 Marks** Section B: Descriptive answer type qts, **1 out of 2** from each unit - **4x10 = 40 Marks**

Name and Signature of Convener & Members of BOS:



ONE YEAR POST – GRADUATE PROGRAM (NEP2020)
PROGRAM: MASTER IN SCIENCE (2025-26)
DISCIPLINE –PHYSICS
SESSION – 2025-26

PART-A: INTRODUCTION				
Program : Master in Science (Physics)		**Semester: III**	**Session:2025-26**	
1	**Course Code**	**PHSE-17P**		
2	**Course Title**	**Lab Course**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite (if any)**	**As per Program**		
5	**Course Learning Outcomes (CLO)**	After going through the course, the student should be able to: • **Understand stellar and galactic phenomena** such as quasars, binary stars, Cepheid variables, and pulsars. • **Apply observational techniques** like photometry and spectral analysis to study stars and star clusters. • **Analyze cosmic motion and distances** through proper motion, Hubble's law, and redshift data. • **Estimate astrophysical parameters** such as mass of planets, pulsar periods, and the age of the Universe using astronomical data.		
6	**Credit Value**	**01 Credits**	**1 Credit = 30 Hours Laboratory or Field learning / Training**	
7	**Total Marks**	**Maximum Marks: 50**	**Minimum Pass Marks: 20**	

PART-B: CONTENT OF THE COURSE

Total No. of learning-Training / performance Periods -30 Periods (30 Hours)

Module	Topics (Course contents) At least 10 of the following or related Experiments)	No. of Periods
Lab./ Field / Training/ Experiments Contents of Course	1. Study of Quasar. 2. Study of the orbit of a visual binary Star. 3. Determine the mass of Saturn &its rotational velocity. 4. Verification of Hubble's law and determination of Hubble' sconstant. 5. Identification of element from Fraunhoffer spectrum of the sun. 6. Study of sunspots. 7. Study of light curves of Cepheid variable stars 8. Study of Proper motion of stars. 9. Determination of Pulsar period and distance. 10. Photo-electric photometry of Pleiades star cluster. 11. Study of expansion of the universe and calculate the age of the Universe.	**30**

Keywords:	***Quasars and Pulsars, Binary Stars and Variable Stars, Hubble's Law and Cosmic Expansion, Spectral Analysis (Fraunhofer Lines), Stellar Photometry and Proper Motion.***

Name and Signature of Convener & Members of BOS:

PART-C: LEARNING RESOURCES

Text Books, Reference Books Recommended and Others

Text Books &Reference Books Recommended –

Textbooks:

1. Astrophysics for Physicists" by Arnab Rai Choudhuri
2. An Introduction to Modern Astrophysics" by Bradley W. Carroll & Dale A. Ostlie
3. Fundamental Astronomy" by Karttunen et al.
4. Introductory Astronomy and Astrophysics" by Zeilik & Gregory
5. Observational Astronomy" by D. Scott Birney, Guillermo Gonzalez & David Oesper

Reference Books:

1. The Physical Universe: An Introduction to Astronomy" by Frank Shu
2. Measuring the Universe" by Kitty Ferguson
3. The Cosmic Perspective" by Bennett, Donahue, Schneider & Voit
4. Astronomical Photometry" by Henden & Kaitchuck
5. The Observation and Analysis of Stellar Photospheres" by David F. Gray

Online Resources (e-books/learning portals/ other e-resources)

1. https://www.space.com/15476-quasars.html
2. https://www.nasa.gov/mission_pages/chandra/news/H-12-331.html
3. https://www.astro.princeton.edu/~gk/A403/binarystars.pdf
   https://www.astro.umd.edu/~ssm/ASTR121/binary.html
4. https://map.gsfc.nasa.gov/universe/uni_age.html
   https://www.nasa.gov/feature/goddard/2016/nasa-researchers-detect-signature-of-universe-s-first-stars

PART-D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Examination (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz - (2): Assignment/ Seminar (1): Total Marks:	**10&10** **05** **15**	Better marks out of the two Test / Quiz + marks obtained in Assignment shall be considered against **15 Marks**

End Semester Exam (ESE):	**Laboratory/Field Skill Performance : On Spot Assessment** A. Performed the Task based on Lab. work – **20 Marks** B. Spotting based on tools & technology (written)- **10 marks** C. Viva-voce (based on principle/technology)- **05 marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of BOS:

ONE YEAR POST – GRADUATE PROGRAM (NEP2020)
PROGRAM: MASTER IN SCIENCE (2025-26)
DISCIPLINE –PHYSICS
SESSION – 2025-26

PART-A: INTRODUCTION				
Program : Master in Science (Physics)		**Semester: III**	**Session:2025-26**	
1	**Course Code**	**PHSE-18T**		
2	**Course Title**	**Physics of Nano-Material**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite (if any)**	**As per Program**		
5	**Course Learning Outcomes (CLO)**	After going through the course, the student should be able to: • **Demonstrate an understanding** of the fundamental physical properties of materials at the nanoscale. • **Explain** the structure, synthesis, and behavior of nanoparticles, including metal and semiconductor clusters. • **Describe** the properties and applications of carbon nanostructures such as fullerenes and carbon nanotubes. • **Identify** various synthesis techniques for nanomaterials and their influence on material properties. • **Apply knowledge** of nanomaterials in emerging technologies like sensors, nanoelectronics, and nanorobotics		
6	**Credit Value**	**03 Credits**	**1 Credit 15 Hours for Learning & Observation**	
7	**Total Marks**	**Maximum Marks: 100**	**Minimum Pass Marks: 40**	

PART-B: CONTENT OF THE COURSE

Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Periods
I	**Nano Materials** Properties of Nano-Particles: Metal Nano-clusters: Magic Numbers, theoretical modeling of nanoparticles, geometric and electronic structure, Reactivity, Fluctuations, magnetic clusters, Bulk to Nano transition. Semiconducting nanoparticles: optical properties, Photo fragmentation, Columbic Explosion. Rare gas and molecular clusters: Inert-Gas Clusters, Superfluid Clusters, Molecular Clusters. Methods of Synthesis: RF Plasma, Chemical Methods, Thermolysis, Pulsed Laser Methods.	11
II	**Carbon Nanostructures** Carbon Molecules: Nature of Carbon Bonds, New Carbon Structures. Carbon Clusters: Small Carbon Clusters, Discovery of C60, Structure of C60 and its Crystal, Alkali-Doped C60, Superconductivity in C60, Larger and Smaller Fullerenes, Other Bucky balls. Carbon Nanotubes: Fabrication, structure, Electrical Properties, Vibrational Properties, Mechanical Properties. Applications of Carbon	11

	Nanotubes: Field Emission and Shielding, Computers, Fuel Cells, Chemical Sensors, Catalysis, Mechanical Reinforcement.	
III	**Bulk Nanostructured Materials** Solid Disordered Nanostructures: Methods of Synthesis, Failure Mechanisms of Conventional Grain-Sized Materials, Mechanical Properties, Nanostructured Multilayers, Electrical Properties, Other Properties, Metal Nano cluster Composite Glasses, Porous Silicon. Nanostructured Crystals: Natural Nano crystals, Computational Prediction of Cluster Lattices, Arrays of Nanoparticles in Zeolites, Crystals of Metal Nanoparticles, Nanoparticle Lattices in Colloidal Suspensions, Photonic Crystals. Nanostructured Ferromagnetism: Basics of Ferromagnetism, Effect of Bulk Nano structuring of Magnetic Properties, Dynamics of Nano magnets, Nano pore Containment of Magnetic Particles, Nano carbon Ferro magnets, Giant and Colossal Magneto resistance, Ferro fluids.	**12**
IV	**Applications of Nano-materials** Quantum wells, wires and dots. Organic Semiconductors, Organic Light Emitting Diodes (OLEDs), self-assembly of complex organic molecules. molecular switches, thermochromic switches, Motor molecules and bio-mimetic components, charge transfer complexes, molecular connections, contact issues, conducting polymers, light emitting polymers, polymer-polymer heterostructures, plastic FETs, photodiodes &solar cells, Nano Robotics: Nano robots and NEMS, Sensors and actuators, Artificial molecular machines, Biomotors, Other Nano machines, Propulsion, Control, Communication, Programming and coordination.	**11**
Keywords:	***Nanoparticles, Carbon Nanostructures, Synthesis Techniques, Quantum Effects, Magnetic Nanomaterials, Nanoelectronics & Devices, Nanorobotics & Molecular Machines***	

Name and Signature of Convener & Members of BOS:

PART-C: LEARNING RESOURCES

Text Books, Reference Books Recommended and Others

Text Books &Reference Books Recommended -

1. Nanostructures & Nanomaterials: Synthesis, Properties & Applications: Guozhang Cao.
2. Introduction to Nanotechnology: Charles P. Poole Jr and Franks J.Qwens.
3. Handbook of Analytical instruments, R.S.Khandpur
4. Nano materials: Synthesis properties, characterization and application: A.S Edelstein and R.CCammaratra
5. Nanotechnology, Kohlr, Michael.
6. Handbook of Nanotechnology: Bhushan (Ed), Springer Verlag, New York(2004).
7. Nanostructures and Nanomaterials- Synthesis properties and Applications by Guozhong Cao (Empirical College Press World Scientific Pub.,2004)
   Carbon Nanotubes, Elizer

Online Resources (e-books/learning portals/ other e-resources)

1. All e-books of physics https://www.e-booksdirectory.com/listing.php?category=2
2. https://swayam.gov.in/nd1_noc23_ph15/preview
3. https://www.routledge.com/Nanotechnologies-The-Physics-of-Nanomaterials-Volume-1/Schmool/p/book/9781774639658
4. https://dokumen.pub/physics-of-nanomaterials-educational-methodological-manual-a-aaa-9786010437319.html
5. https://nanohub.org
6. Cambridge University Books for Physics https://www.cambridgeindia.org/
7. Books for solving physics problems https://bookboon.com/en/physics-ebooks
8. NPTEL Online courses https://nptel.ac.in/courses/115105098;
9. https://archive.nptel.ac.in/courses/115/106/115106123/;

PART-D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Examination (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz (2): **20&20** Assignment/ Seminar (1): **10** Total Marks: **30**	Better marks out of the two Test/Quiz + marks obtained in Assignment shall be considered against **30 Marks**
End Semester Exam (ESE):	**Two section - A & B** Section A: Q1. Objective - **10 x1 = 10 Mark**; Q2. Short answer type - **5x4 = 20 Marks** Section B: Descriptive answer type qts, **1 out of 2** from each unit - **4x10 = 40 Marks**	

Name and Signature of Convener & Members of BOS:

ONE YEAR POST – GRADUATE PROGRAM (NEP2020)
PROGRAM: MASTER IN SCIENCE (2025-26)
DISCIPLINE –PHYSICS
SESSION – 2025-26

PART-A: INTRODUCTION				
Program : Master in Science (Physics)		**Semester: III**	**Session:2025-26**	
1	**Course Code**	**PHSE-18P**		
2	**Course Title**	**Lab Course**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite (if any)**	**As per Program**		
5	**Course Learning Outcomes (CLO)**	After going through the course, the student should be able to: • **Understand and apply various synthesis techniques** for nanoparticles including chemical, physical, and combustion methods. • **Analyze structural and optical properties** of nanomaterials using UV-Vis, FTIR, XRD, and other spectroscopic tools. • **Use advanced characterization tools** like SEM, TEM, and AFM for nanoparticle analysis. • **Measure electrical and mechanical properties** of nanomaterials using four-probe, Hall effect, and tensile testing methods. • **Evaluate synthesis parameters** such as the role of capping agents in controlling nanoparticle size.		
6	**Credit Value**	**01 Credits**	**1 Credit = 30 Hours Laboratory or Field learning / Training**	
7	**Total Marks**	**Maximum Marks: 50**	**Minimum Pass Marks: 20**	

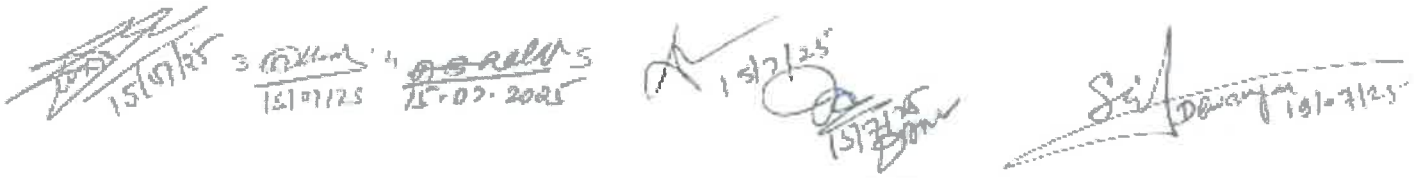
PART-B: CONTENT OF THE COURSE

Total No. of learning-Training / performance Periods -30 Periods (30 Hours)

Module	Topics (Course contents) At least 10 of the following or related Experiments)	No. of Periods
Lab./ Field / Training/ Experiments Contents of Course	1. Synthesis of II-IV semiconductor nanoparticles by Wet chemical method. 2. Synthesis of nanoparticles (ZrO_2) by Combustion method. 3. Synthesis of nanoparticles by Sol-gel method. 4. Synthesis of nanoparticles by Ball milling method. 5. Synthesis of Quantum cells structures using vacuum coating unit. 6. Synthesis of nanoparticles using Solid state reaction method. 7. Measurement of band gap energy and size of the nano particle of II-IV semiconductor using absorption spectrophotometer. 8. To make the peak analysis of IR transmission spectra of nanoparticle using FTIR spectrometer. 9. Study of effect of capping agent on the size of the nanoparticle during synthesis	**30**

	10. To determine the average particle size of nano materials by XRD using Sherer's formula. 11. To determine the Hall coefficient and carrier type for a semiconducting nanoparticles. 12. To determine the Band gap of a given semiconductor using Four probe method fromroom temperature to 100°C. 13. To determine the average size of nanoparticles using Zetasizer. 14. To measure the change of dielectric constant and dielectric loss of nanoparticle with thechange of signal frequency by impedance analyzer. 15. To characterize the mechanical properties by tensile testing. 16. To estimate the particle size by SEM. 17. To perform electron diffraction analysis from TEM image. 18. To do roughness analysis of nanostructured sample using AFM.	
Keywords:	***Nanoparticle Synthesis, Characterization Techniques, Band Gap Measurement, Structural Analysis (XRD, SEM, TEM), Electrical and Mechanical Properties, Capping Agent Effect.***	

Name and Signature of Convener & Members of BOS:



PART-C: LEARNING RESOURCES

Text Books, Reference Books Recommended and Others

Text Books &Reference Books Recommended –

Textbooks:

1. Introduction to Nanoscience and Nanotechnology" – K.K. Chattopadhyay & A.N. Banerjee
2. Nanotechnology: Principles and Practices" – Sulabha K. Kulkarni
3. Textbook of Nanoscience and Nanotechnology" – B.S. Murty, P. Shankar, et al.
4. Nanomaterials: Synthesis, Properties and Applications" – Guozhong Cao & Ying Wang
5. Principles of Nanoscience and Nanotechnology" – M.A. Shah & Tokeer Ahmad

Reference Books:

1. Characterization of Nanostructures" – CNR Rao, A. Müller & A.K. Cheetham
2. Scanning Probe Microscopy" – Roland Wiesendanger
3. Materials Characterization: Introduction to Microscopic and Spectroscopic Methods" – Yang Leng
4. Nanotechnology for Dummies" – Richard Booker & Earl Boysen
5. Handbook of Nanotechnology" – Bharat Bhushan

Online Resources (e-books/learning portals/ other e-resources)

1. [NPTEL – Introduction to Nanotechnology by Dr. A.K. Tyagi (IIT Madras)] https://nptel.ac.in/courses/118106008
2. MIT OpenCourseWare – Nanomaterials and Nanotechnology https://ocw.mit.edu/courses/materials-science-and-engineering/3-27-interfacial-engineering-of-materials-sma-5107-spring-2006/
3. **[ScienceDirect – Nanoscience Journals and Articles (Elsevier)]** https://www.sciencedirect.com/journal/nano-today
4. **[SpringerLink – Books on Nanoparticles and Characterization Techniques]** https://link.springer.com/search?query=nanoparticles+characterization
5. **[AZoNano – Nanotechnology News, Methods, and Instrumentation]** https://www.azonano.com/
6. **[Nanohub.org – Simulations and Lectures on Nanotechnology]** https://nanohub.org/

PART-D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Examination (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz - (2):	**10&10**	Better marks out of the two Test / Quiz + marks obtained in Assignment shall be considered against **15 Marks**
	Assignment/ Seminar (1):	**05**	
	Total Marks:	**15**	

End Semester Exam (ESE):	**Laboratory/Field Skill Performance : On Spot Assessment** A. Performed the Task based on Lab. work – **20 Marks** B. Spotting based on tools & technology (written)- **10 marks** C. Viva-voce (based on principle/technology)- **05 marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of BOS:

PROGRAM: MASTER IN SCIENCE (2025-26)
DISCIPLINE –PHYSICS
SESSION – 2025-26

PART-A: INTRODUCTION				
Program : Master in Science (Physics)		**Semester: III**	**Session:2025-26**	
1	**Course Code**	**PHSE-19T**		
2	**Course Title**	**Space Physics**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite (if any)**	**As per Program**		
5	**Course Learning Outcomes (CLO)**	After going through the course, the student should be able to: • **Understand the physical structure and energy generation processes of the Sun**, including thermonuclear reactions, sunspots, flares, solar wind, and coronal mass ejections. • **Analyze the characteristics of planets and minor bodies** (asteroids, comets, exoplanets), including atmospheric composition, magnetism, and geological features through space missions. • **Use observational techniques across electromagnetic spectrum** (radio to gamma rays), and understand the function of ground-based and space-borne instruments. • **Comprehend solar-terrestrial interactions**, such as geomagnetic storms, ionospheric layers, magnetospheric processes, and their role in shaping space weather. • **Explain the origin, structure, and evolution of the universe**, including star life cycles, galaxies, cosmic background radiation, and concepts like dark matter and dark energy.		
6	**Credit Value**	**03 Credits**	**1 Credit 15 Hours for Learning & Observation**	
7	**Total Marks**	**Maximum Marks: 100**	**Minimum Pass Marks: 40**	

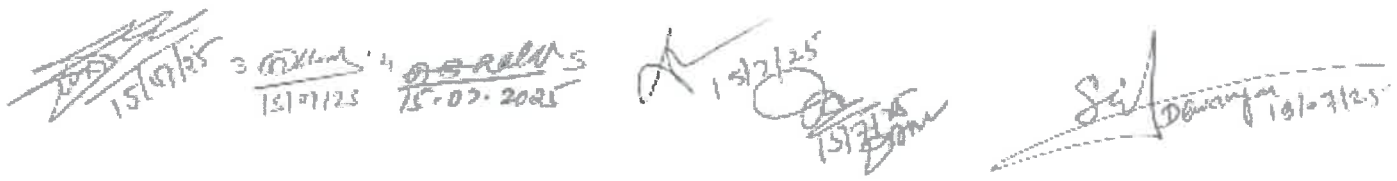
PART-B: CONTENT OF THE COURSE

Total No. of Teaching-learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	**Topics (Course contents)**	**No. of Periods**
I	**Solar Physics & planetary system:** Physical Characteristics of sun, Source of solar energy, thermonuclearreaction and building up of higher elements, Description of solar internal and external layers, Photosphere: Limb darkening, Granulation, Faculae, Solar Chromosphere and Corona, Heating of the solar chromosphere and corona, Prominences, Solar Cycle and Sunspots, Solar Magnetic Fields, Theory of Sunspots, Solar flares, Solar wind, Coronal mass ejections. Solar planetary system, Major characteristics of the Planets, Atmospheric Composition, Planetary magnetism, Magnetic fields, Magnetic dipole, Asteroids, Comets, Extra Solar Planets.	**11**

II	**Space and Observational tools** Electromagnetic bands of observation: radio, infrared, optical, UV, X-ray and Gamma-ray windows. Ground-based, balloon-borne and satellite-borne telescopes, Radio telescopes interferometry, X-ray and Gamma-ray detectors, Neutrino and Cosmic Ray astronomy, Radar. **Space Missions** Early Spacecraft visits to moon, unmanned Lunar Landers, Chandrayan I,II,III, Exploration of Mercury, Venus, Mars - the Red Planet Structure of Mars, Martian atmosphere; ice at the poles, Martian landscapes: linear features, volcanoes, and impact craters; exotic terrains; Study of Planetary moons with space missions, The Cassini-Huygens Mission, The Deep Impact Mission.	**11**
III	**Glimpse of Universe** Universe description, origin, its evolution, age and size; Stars-birth, life, death, spectral analysis, stellar composition element synthesis in stars, Exotic stars- novae, supernovae, pulsars, black holes and gamma ray bursts, Galaxies; Starbursts and Active Galactic Nucleus, Evidence for the Big Bang, Cosmic Background Radiation; Expansion Models; Dark Matter and Energy Recent innovations about the concept of Universe: Dark Energy and an accelerating universe.	**11**
IV	**Solar Wind and Interactions** The ionospheric layers D, E, F and their formation, effect of radiation on earth's atmosphere, photochemical processes, variations of geomagnetic field, quiet and disturbed variations and geomagnetic storms, equatorial and auroral phenomena. Solar wind, model of solar winds, interaction in the interplanetary medium and with the planets. Magnetosphere: interaction of solar wind with the geomagnetic field and formation of the magnetospheric tail, storm and sub-storm phenomena, Van Allen radiation belts. **Space Weather** Space Weather Effects on Communication, Space Weather Effects on Power Grids, Space Radiation Protection, Effects on Spacecraft's hardware and Operations, Effects on Satellite Navigation, Forecast of Space Weather.	**12**
Keywords:	***Solar Physics, Planetary System, Space Weather, Chandrayan Solar Wind and Magnetosphere, Universe and Cosmic Evolution.***	

Name and Signature of Convener & Members of BOS:



PART-C: LEARNING RESOURCES

Text Books, Reference Books Recommended and Others

Text Books &Reference Books Recommended -

1) Solar System Astrophysics, J. C. Brandt and P. W.Hodge
2) Introduction to Experimental Physics, W. B. Fretter.
3) Earth's Magnetospheric Process, Ed. B. M. Mc Cormac, D. Reidel PublishersH. Campbell, Academic Press
4) Physics of the Magnetosphere, Eds. R. L. Corovillano, J. T. McCaulley and H. Radosky, D. Reidel Publishers
5) Solar System Plasma Physics, Vol. I, II and III, Eds. C. F. Kennel, L. J.Lanzenrutti and E. N. Parker
6) Dynamics of the Geomagnetically Trapped Radiation (Physics and Chemistry in Space, Vol II)
7) Solar Terrestrial Physics, Ed. E. R. Dyer, D. Reidel Publishers
8) Solar Magneto-Hydrodynamics, E.R. Priest; D Reidel, 1982
9) Concepts in Space Sciences Edited by R.R.Daniel

Online Resources (e-books/learning portals/ other e-resources)

1. All e-books of physics https://www.e-booksdirectory.com/listing.php?category=2
2. https://geosci.uchicago.edu/~kite/doc/Lewis_2004.pdf
3. https://ntrs.nasa.gov/api/citations/19720018160/downloads/19720018160.pdf
4. https://archive.org/details/vyazanitsyn-physics-of-the-solar-system
5. https://www.coursera.org/learn/solar-system
6. https://www.youtube.com/playlist?list=PL8dPuuaLjXtOfse2ncvffeelTrqvhrz8H
7. Cambridge University Books for Physics https://www.cambridgeindia.org/
8. Books for solving physics problems https://bookboon.com/en/physics-ebooks
9. NPTEL Online courses https://nptel.ac.in/courses/115105098;
10. https://archive.nptel.ac.in/courses/115/106/115106123/;

PART-D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Examination (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz (2): **20&20** Assignment/ Seminar (1): **10** Total Marks: **30**	Better marks out of the two Test/Quiz + marks obtained in Assignment shall be considered against **30 Marks**
End Semester Exam (ESE):	**Two section - A & B** Section A: Q1. Objective - **10 x1 = 10 Mark**; Q2. Short answer type - **5x4 = 20 Marks** Section B: Descriptive answer type qts, **1 out of 2** from each unit - **4x10 = 40 Marks**	

Name and Signature of Convener & Members of BOS:

ONE YEAR POST – GRADUATE PROGRAM (NEP2020)
PROGRAM: MASTER IN SCIENCE (2025-26)
DISCIPLINE –PHYSICS
SESSION – 2025-26

PART-A: INTRODUCTION				
Program : Master in Science (Physics)			**Semester: III**	**Session:2025-26**
1	**Course Code**	**PHSE-19P**		
2	**Course Title**	**Lab Course**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite (if any)**	**As per Program**		
5	**Course Learning Outcomes (CLO)**	After going through the course, the student should be able to: • Understand the **energy generation and transport mechanisms in the Sun**, and analyze solar features like **sunspots and spectral lines** to identify elements and magnetic activity. • Apply observational techniques such as **astrometry and photometry** to study celestial objects like **asteroids, pulsars, and star clusters** (e.g., Pleiades). • Explain and analyze astronomical phenomena such as the **transit of planets, Jupiter's moons**, and their role in determining fundamental constants like the **speed of light.** • Investigate the **expansion of the Universe,** estimate its age, and explore its **large-scale structure** using observations of pulsars and galactic distributions.		
6	**Credit Value**	**01 Credits**	**1 Credit = 30 Hours Laboratory or Field learning / Training**	
7	**Total Marks**	**Maximum Marks: 50**	**Minimum Pass Marks: 20**	

PART-B: CONTENT OF THE COURSE

Total No. of learning-Training / performance Periods -30 Periods (30 Hours)

Module	**Topics (Course contents)** **At least 10 of the following or related Experiments)**	**No. of Periods**
Lab./ Field / Training/ Experiments Contents of Course	1. The flow of energy out of the Sun. 2. Study of Sun-spot. 3. Astrometry of asteroids. 4. Study of expansion of the universe and calculate the age of the Universe. 5. Identification of element from Fraunh offer spectrum of the sun. 6. The transit of Venus and Mercury. 7. Jupiter's Moon and speed of light. 8. Determination of Pulsar period and distance. 9. Photo-electric photometry of Pleiades star cluster. 10. The large scale structure of the Universe.	**30**

Keywords:	***Solar Energy Transport, Sunspots and Solar Activity, Astrometry and Minor Bodies, Cosmic Expansion and Age of the Universe, Fraunhofer Spectrum and Element Identification, Photometry and Celestial Measurements.***

Name and Signature of Convener & Members of BOS:

PART-C: LEARNING RESOURCES

Text Books, Reference Books Recommended and Others

Text Books &Reference Books Recommended –

Textbooks:

1. An Introduction to Modern Astrophysics" – Bradley W. Carroll & Dale A. Ostlie
2. Fundamental Astronomy" – Hannu Karttunen et al.
3. Observational Astronomy" – D. Scott Birney, Guillermo Gonzalez & David Oesper.
4. The Physical Universe: An Introduction to Astronomy" – Frank Shu
5. Astrophysics for Physicists" – Arnab Rai Choudhuri

Reference Books:

1. Measuring the Universe: The Cosmological Distance Ladder" – Stephen Webb
2. The Cambridge Encyclopedia of Stars" – James B. Kaler
3. The Cosmos: Astronomy in the New Millennium" – Jay M. Pasachoff & Alex Filippenko
4. Astronomical Photometry: A Text and Handbook for the Advanced Amateur and Professional Astronomer" – Henden & Kaitchuck
5. Cosmos" – Carl Sagan

Online Resources (e-books/learning portals/ other e-resources)

1. NASA Solar System Exploration – Sun, Planets, Moons, and Transits
2. ESA – Hubble Space Telescope & Universe Expansion
3. NPTEL – Introductory Astronomy Courses
4. Sky & Telescope – Observing Guides and Astrometry Tools
5. AAVSO – American Association of Variable Star ObserversAstrobites – Daily Research Highlights from Astronomy

PART-D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Examination (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz - (2): Assignment/ Seminar (1): Total Marks:	**10&10** **05** **15**	Better marks out of the two Test / Quiz + marks obtained in Assignment shall be considered against **15 Marks**
End Semester Exam (ESE):	**Laboratory/Field Skill Performance : On Spot Assessment** A. Performed the Task based on Lab. work – **20 Marks** B. Spotting based on tools & technology (written)- **10 marks** C. Viva-voce (based on principle/technology)- **05 marks**		**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of BOS:

15/7/25 3 15/7/25 4 15.07.2025 5 15/7/25 15/7/25

ONE YEAR POST – GRADUATE PROGRAM (NEP2020)
PROGRAM: MASTER IN SCIENCE (2025-26)
DISCIPLINE –PHYSICS
SESSION – 2025-26

PART-A: INTRODUCTION				
Program : Master in Science (Physics)			Semester: IV	Session:2025-26
1	Course Code	PHSC-10		
2	Course Title	Research Work & Dissertation		
3	Course Type	Discipline Specific Course		
4	Pre-requisite (if any)	As per Program		
5	Course Learning Outcomes (CLO)	After going through the course, the student should be able to: • **CO1:** Demonstrate the ability to conduct independent research in a specialized area of physics, using appropriate theoretical, computational, or experimental methods. • **CO2:** Critically review scientific literature, identify research gaps, and formulate a research problem or hypothesis with clear objectives. • **CO3:** Design and implement a research methodology to address the chosen problem, adhering to scientific and ethical standards. • **CO4:** Analyze and interpret research data rigorously, draw valid conclusions, and evaluate the significance of findings in the context of current scientific knowledge. • **CO5:** Communicate research outcomes effectively through a well-structured dissertation and oral presentation, demonstrating clarity, coherence, and academic integrity.		
6	Credit Value	12 Credits	1 Credit = 15 Hours for Learning & Observation	
7	Total Marks	Maximum Marks: 400	Minimum Pass Marks: 160	

PART-B: CONTENT OF THE COURSE

Components	Course Timeline & Content	Weeks
Component 1	**Synopsis Presentation & Research Proposal** • Topic selection in consultation with supervisor • Literature review & identification of research gap • Defining objectives, methodology, tools, and timeline • Oral presentation and approval of proposal	1-2
Component 2	**First Project Progress Report** • Initial implementation: setting up experiments or simulations • Report on methodology, challenges, adjustments • First progress seminar and feedback session	3-5

Component 3	**Second Project Progress Report** • Continued research, initial data collection and analysis • Presentation of findings so far and revised timelines • Mid-term evaluation by internal committee	**6-10**
Component 4	**Training & Experimental/Theoretical Work** • Intensive lab work, simulations, data gathering, or theoretical modeling • Application of analytical tools/software (e.g., Python, MATLAB, Origin) • Maintenance of a research logbook or lab notebook	**1-14**
Component 5	**Final Dissertation Report** • Structuring of the report: Abstract, Introduction, Methodology, Results, Discussion, Conclusion • Formatting (preferably LaTeX), referencing (APA/IEEE style) • Supervisor review, revision, and final submission	**14-16**
Component 6	**Final Presentation & Viva-Voce** • Oral defense before an examination panel • Questions on methodology, results, limitations, and future scope • Evaluation based on clarity, depth, and originality	**17**
Keywords:	***Scientific research methodology, literature review, problem formulation, and proposal writing; experimental or theoretical investigation with data analysis using tools like Python or MATLAB; structured progress reporting; dissertation writing with proper formatting and citation; and final presentation with viva-voce defense.***	

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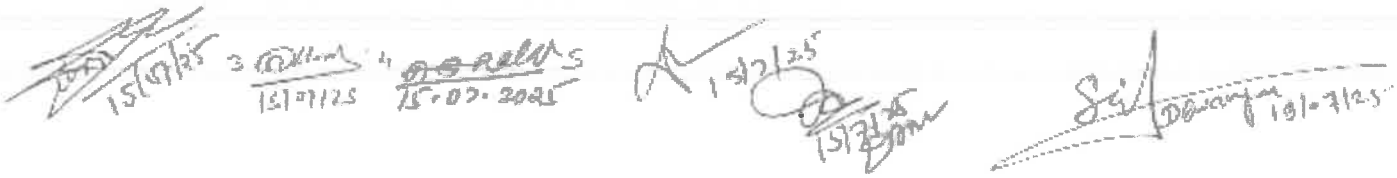

PART-C: LEARNING RESOURCES

Recommended Tools & Resources:-

1. Research Methodology: Methods and Techniques, Author: C.R. Kothari & Gaurav Garg, Publisher: New Age International Publishers
2. Scientific Writing and Communication: Papers, Proposals, and Presentations, Author: Angelika H. Hofmann, Publisher: Oxford University Press
3. Writing Your Thesis, Author: Paul Oliver, Publisher: Sage Publications
4. Numerical Recipes: The Art of Scientific Computing (3rd Edition), Authors: William H. Press, Saul A. Teukolsky, William T. Vetterling, Brian P. Flannery, Publisher: Cambridge University Press
5. Practical Physics, Author: G.L. Squires, Publisher: Cambridge University Press
6. A Student's Guide to Python for Physical Modeling, Author: Jesse M. Kinder & Philip Nelson, Publisher: Princeton University Press
7. Research Methods for Science, Author: Michael P. Marder, Publisher: Cambridge University Press
8. The Craft of Scientific Writing, Author: Michael Alley, Publisher: Springer
9. An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements, Author: John R. Taylor, Publisher: University Science Books
10. Introduction to Research Methods: A Practical Guide for Anyone Undertaking a Research Project, Author: Catherine Dawson, Publisher: Robinson
11. Experimental Physics, Author: R.A. Dunlap, Publisher: Oxford University Press
12. Python for Data Analysis, Author: Wes McKinney, Publisher: O'Reilly Media
13. The Elements of Style, Authors: William Strunk Jr. & E.B. White, Publisher: Pearson
14. Guide to Publishing a Scientific Paper, Author: Ann M. Körner, Publisher: Routledge
15. LaTeX: A Document Preparation System, Author: Leslie Lamport, Publisher: Addison-Wesley

Online Resources (e-books/learning portals/ other e-resources)

1. https://nptel.ac.in/courses/127/105/127105018/
2. https://www.vanderbilt.edu/gradschool/academics/thesis/dissertation-guidelines/
3. https://www.overleaf.com/learn/latex/Learn_LaTeX_in_30_minutes
4. https://arxiv.org/
5. https://jakevdp.github.io/PythonDataScienceHandbook/

PART-D: ASSESSMENT AND EVALUATION

S.No.	Component	Description	Max Marks	Min Marks	CIA	ESE	Credits
1	Synopsis Presentation & Research Proposal	Identification of research topic, literature review, objectives, and methodology	**50**	20	50	-	**1**
2	First Project Progress Report (Presentation)	Presentation of early findings, methodology in progress, challenges faced	**50**	20	50	-	**1**
3	Second Project Progress Report (Presentation)	Mid-term progress report with substantial results and data discussion	**50**	20	50	-	**1**

4	Training & Experimental/Theoretical Work	Execution of the project work: data collection, simulation, modeling, etc.	**75**	30	-	75	**3**
5	Final Dissertation Report	Compilation and submission of a well-written dissertation	**100**	40	-	100	**4**
6	Final Presentation & Viva-Voce	Oral defense and presentation of project work to an evaluation committee	**75**	30	-	75	**2**
	Total		**400**	**160**	**150**	**250**	**12**

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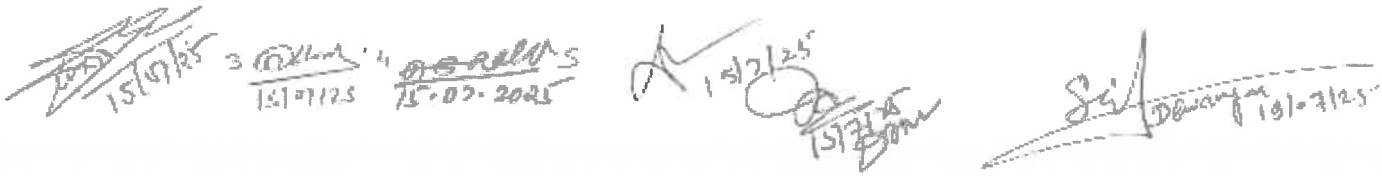

ONE YEAR POST – GRADUATE PROGRAM (NEP2020)
PROGRAM: MASTER IN SCIENCE (2025-26)
DISCIPLINE –PHYSICS
SESSION – 2025-26

PART-A: INTRODUCTION				
Program : Master in Science (Physics)		**Semester: IV**	**Session:2025-26**	
1	**Course Code**	**PHSE-20T**		
2	**Course Title**	**Quantitative Methods In Physics**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite (if any)**	**As per Program**		
5	**Course Learning Outcomes (CLO)**	After going through the course, the student should be able to: • **Understand and apply structural characterization techniques** such as X-ray diffraction (XRD) to analyze crystal structure, phase identification, and particle size determination in solid materials. • **Demonstrate proficiency in microscopic techniques** including SEM, TEM, STEM, STM, and AFM for morphological, structural, and surface characterization at nano- and micro-scales. • **Utilize spectroscopic methods** such as FTIR, Raman, NMR, and ESR to identify functional groups, bonding environments, and electronic structures in solid-state materials. • **Analyze ion transport properties in solid state ionic materials** using techniques like AC impedance spectroscopy, DC polarization methods, and transient ionic current (TIC) to measure conductivity, mobility, ion concentration, and related parameters across varying temperatures.		
6	**Credit Value**	**04 Credits**	**1 Credit = 15 Hours for Learning & Observation**	
7	**Total Marks**	**Maximum Marks: 100**	**Minimum Pass Marks: 40**	

PART-B: CONTENT OF THE COURSE

Total No. of Teaching-learning Periods (01 Hr. per period) - 60 Periods (60 Hours)

Unit	Topics (Course contents)	No. of Periods
I	**Techniques for Structural, Microscopic and Spectroscopic Characterization** X-ray diffraction: coherent scattering of X-rays, reflected intensities, experimental methods of crystallography, particle size determination. Microscopy: Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Scanning Transmission Electron Microscopy (STEM), Scanning Tunneling Microscopy (STM), Atomic Force Microscopy (AFM). Spectroscopy: Fourier Transform Infrared (FTIR) and Raman spectroscopy, Nuclear Magnetic Resonance (NMR), Electron Spin Resonance (ESR).	15

II	**Techniques for Characterization of Solid State Ionic Materials** Solid State Ionic Materials: Characterization of ion transport properties; AC Impedance Spectroscopy (IS) for conductivity of (σ) measurements; DC polarization methods viz, Tubandt's method, Wagher's method. Transient Ionic Current (TIC) method for lonic mobility (μ), ionic transference number (t_{ion}), mobile ion concentration (η) and ionic drift velocity (v_d) measurements. Temperature dependent studies on σ, μ, η , v_d etc. and computation of respective energies. Thermal analysis: Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC). Thermal Gravimetric Analysis (TGA).	**15**
III	**Luminescence Techniques** Basic mechanisms of Photoluminescence (PL):- Excitation & Emission spectra, radiative & non-radiative transition, up & down conversion Multiphonon and cross relaxation, Crystal field splitting, Energy transfer processes. Measurement techniques to study Photoluminescence response, Techniques for ML measurement. TL measurement techniques Basic TL apparatus, Heating system, Light detection, recording and display. TL glow curve, UV-visible spectrometry.	**15**
IV	**Astronomical Techniques** Photometry: Instrumental magnitudes and colors, seeing and atmospheric effects, extinction correction. Standard photometric systems: UBV and other systems. Transformation to standard photometric systems. Absolute and differential photometry. Basics of CCD data reduction: Plate scale, readout noise and gain, signal-to-noise ratio. Correction for bias, dark and flat fielding, fringing and cosmetic effects.	**15**
Keywords:	***Characterization techniques using XRD, electron and probe microscopy (SEM, TEM, AFM), and spectroscopy (FTIR, Raman, NMR, ESR). Analysis of ion transport in solid-state materials via impedance, DC methods, and TIC. Includes thermal (DSC, TGA), luminescence (PL, TL), and astronomical photometry with CCD data handling.***	

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PART-C: LEARNING RESOURCES

Text Books, Reference Books Recommended and Others

Text Books &Reference Books Recommended -

1. Characterization of Materials: Wachtman JB (Butterworth-Heinemann)
2. Condensed Matter Physics by Michal P. Marder (Willy Inter. Science Pub., 2000)
3. Superionic Solids- Principle and applications by S. Chandra (NH Pub., 1980)
4. Luminescence of Solids: R Vij (Plenum Press)
5. Digital Image processing: Gonzalez R. C. and Woods R. E. (Addision-Wesley)
6. Astronomical Photometry: Henden A. A. and Kaitchuck RH (Willmann-Bell)
7. Astrophysical techniques: Kitchin CR, third edition (IOP publishing)
8. Optical Astronomical Spectroscopy: Kitchin C R (IOP Publishing).

Online Resources (e-books/learning portals/ other e-resources)

1. **NPTEL: Impedance Spectroscopy**
2. **NPTEL: FTIR Spectroscopy**
3. **NPTEL: Scanning Electron Microscopy**
4. **NPTEL: Chemical Crystallography**

PART-D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Examination (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz (2): **20&20** Assignment/ Seminar (1): **10** Total Marks: **30**	Better marks out of the two Test/Quiz + marks obtained in Assignment shall be considered against **30 Marks**
End Semester Exam (ESE):	**Two section - A & B** Section A: Q1. Objective - **10 x1 = 10 Mark**; Q2. Short answer type - **5x4 = 20 Marks** Section B: Descriptive answer type qts, **1 out of 2** from each unit - **4x10 = 40 Marks**	

Name and Signature of Convener & Members of BOS:

ONE YEAR POST – GRADUATE PROGRAM (NEP2020)
PROGRAM: MASTER IN SCIENCE (2025-26)
DISCIPLINE –PHYSICS
SESSION – 2025-26

PART-A: INTRODUCTION				
Program : Master in Science (Physics)		**Semester: IV**	**Session:2025-26**	
1	**Course Code**	**PHSE-21T**		
2	**Course Title**	**Research Methodology In Physics**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite (if any)**	**As per Program**		
5	**Course Learning Outcomes (CLO)**	After going through the course, the student should be able to: • Identify the research gap and various methodologies to solve the problems • Analyze the data by using different methods and develop presentation skills • Engage in research in the field of pure and applied physics and involve in lifelong learning		
6	**Credit Value**	**04 Credits**	**1 Credit = 15 Hours for Learning & Observation**	
7	**Total Marks**	**Maximum Marks: 100**	**Minimum Pass Marks: 40**	

PART-B: CONTENT OF THE COURSE

Total No. of Teaching-learning Periods (01 Hr. per period) - 60 Periods (60 Hours)

Unit	Topics (Course contents)	No. of Periods
I	**Research and Research Design:** Introduction to Research. Types of research: exploratory, conclusive, modeling and algorithmic, Tools used for review, journals, conferences, books, magazines and their quality and authenticity, effective searches, find relevant papers related to your area of research, capture critical information, understand and identify the bias, theoretical position and evidence produced, compare ideas and concepts from different papers, distinguishing own work from others work and acknowledging such references.	15
II	**Problem identification and its solution:** Identification of research problems. Identify key areas 08 In research field, Identification of a problem and literature survey. Collection of data and analysis, Determine the nature and extension of papers that should be read, Identify the research gaps, Formulate the Problem Statement. Examples of effective and ineffective titles.	15

III	**Data Analysis:** Identify problem and experimental/theoretical data for comparison with 07 proposed model, extrapolate/scale data for validation, Error Analysis and Numerical Methods, editing and coding of data, tabulation, graphic presentation of data, cross tabulation, testing of hypotheses.	**15**
IV	**Presentation & Scientific Writing:** Goals and Objectives, Structure of documents, importance of 07 clear title, abstract or summary. Main message of presentation, highlight review points, structure of presentation key components of an oral presentation, show support material, feedback on oral presentation, prepare a set of questions	**15**
Keywords:	***Research types, problem identification, literature review, data collection, numerical analysis, hypothesis testing, scientific writing, presentation skills, and source evaluation. Focus on critical thinking, ethical referencing, structured documentation, and effective communication of research findings.***	

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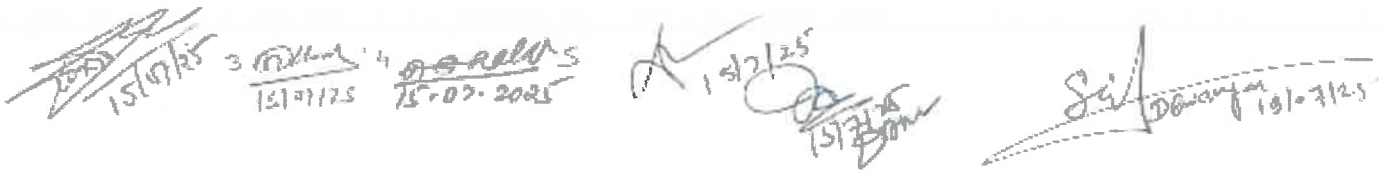

PART-C: LEARNING RESOURCES

Text Books, Reference Books Recommended and Others

Text Books &Reference Books Recommended -

1. RL. Dominowski: Research Methods (Prentice Hall of India, NJ 1980)
2. John R Rice: Numerical Methods, Software and Analysis (Mc Graw Hill ISE, 1985)
3. Gaur R. R., Sangal R., & Bagaria G. P. (2010). A foundation course in human values and professional ethics. New Delhi: Excel Publishers.
4. Naagarazan R. S. (2006). A textbook on professional ethics and human values. New Delhi: New Age International Pvt Ltd.
5. Verma R. (2003). Modern trends in teaching technology. New Delhi: Anmol publishers Pvt. Ltd.
6. Rao U. (2001). Educational teaching. New Delhi: Himalaya publishing house.

Online Resources (e-books/learning portals/ other e-resources)

1. **[NPTEL – Research Methodology Course (IIT Kanpur)]**
2. https://nptel.ac.in/courses/127/105/127105007/
3. **[Coursera – Understanding Research Methods (University of London)]** https://www.coursera.org/learn/research-methods
4. **[Google Scholar – Research Articles & Literature Search Tool]** https://scholar.google.com/
5. **[SpringerLink – Books on Research Methodology]** https://link.springer.com/search?query=research+methodology
6. **[ResearchGate – Academic Research Community & Papers]** https://www.researchgate.net/
7. **[SAGE Research Methods – Tools for Every Step of Research](Free trial or library access)** https://methods.sagepub.com/

PART-D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Examination (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz (2): **20&20** Assignment/ Seminar (1): **10** Total Marks: **30**	Better marks out of the two Test/Quiz + marks obtained in Assignment shall be considered against **30 Marks**
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