Chaudhary Bansi Lal University

(A State University established under Haryana Act No. 25 of 2014)

Scheme of Examination

for

Physics Subject

in

Undergraduate Programmes

as per NEP 2020

Curriculum and Credit Framework for Undergraduate Programmes (Multiple Entry-Exit, Internships and Choice Based Credit System LOCF)

With effect from the session 2024-25 (in phased manner)

DEPARTMENT OF PHYSICS

Chaudhary Bansi Lal University, Prem Nagar-127021

Bhiwani

HARYANA, INDIA

Chaudhary Bansi Lal University Bhiwani

Scheme of Examination for the Physics Subject in Under Graduate Programmes

as per NEP 2020 Curriculum and Credit Frame work for Undergraduate Programmes

(Multiple Entry-Exit, Internships and Choice Based Credit System LOCF) with effect from the session 2024-25 (in a phased manner)

Semester-IV

Course Type	Applicable Scheme	Course Code	Nomenclature of paper	Credits	Contact hours	Internal marks	End term Marks	Total Marks	Duration of exam (Hrs) T+P
CC-4/ MCC-6	A,B&C	24UN-PHY-401	Waves and Optics	3	3	20	50	70	3
			Practicum	1	2	10	20	30	3
MCC-7	B & C	24UN-PHY-402	Introductory Quantum Mechanics	3	3	20	50	70	3
			Practicum	1	2	10	20	30	3
MCC-8	B & C	24UN-PHY-403	Atomic spectroscopy	3	3	20	50	70	3
			Practicum	1	2	10	20	30	3
DSE-1	B & C	24UN-PHY-404	Laser Physics & Fiber Optics	3	3	20	50	70	3
			Practicum	1	2	10	20	30	3
		OR							
		24UN-PHY-405	Physics of Nano Materials	3	3	20	50	70	3
			Practicum	1	2	10	20	30	3
CC-M4 (V)	A, B & C	From Available pool of Minor (Vocational) Courses VOC 4							
AEC-4	A,B&C	From Available pool of Ability Enhancement Courses as per NEP							

VAC-3	A & B	From Available pool of Value Added Courses as per NEP	
VAC-4	C	From Available pool of Value Added Courses as per NEP	
Internship	A,B&C	24UN-PHY-406	Internship of 4 Credits of 4-6 weeks duration after 4nd Semester (Mandatory in case of exit)

Chaudhary Bansi Lal University Bhiwani Undergraduate Programs

Course:CC-4/MCC-6

Session:2024-25			
Part A-Introduction			
Subject	Physics		
Semester	4th		
Name of the Course	**Waves and Optics**		
Course Code	24UN-PHY-401		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	CC/MCC		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course(if any)	Appearedorpassedthe3rdsem(B.Sc. Physical Science/ equivalent)		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Have understanding of Interference - by Division of Wave front, by Division of Amplitude and Interference due to transmitted light & reflected light 2. Learn about Huygens-Fresnel's theory, diffraction at a straight edge and at a circular aperture, diffraction due to a narrow slit and due to a narrow wire. Understand and explain the Fraunhoffer diffraction, dispersive power of grating, Rayleigh's criterion and resolving power of telescope & a grating 3. Understand the theories and laws of polarization along with understanding of the production and detection of (i) Plane polarized light (ii)Circularly polarized light and (iii)Elliptically polarized light 4. Understand and appreciate the applications of Lasers in developing LED, Holography, in materials processing, in Medicine, Industry and Military. Have the idea ofoptical fibres, their properties and principle of propagation of electromagnetic waves through optical fibres		
Credits	Theory	Practical	Total

	3	1	4
Contact Hours	3	2	5

Max. Marks:100 **Time:3hrs**
InternalAssessmentMarks:30 End
Term Exam Marks: 70 [Theory (50) + Practicum (20)]

Part B-Contents of the Course

Instructions for Paper-Setter

1. Nine questions will be set in total.
2. Question no. 1will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
1. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	**INTERFERENCE** **Interference by Division of Wave front:** Young's double slit experiment, Coherence, Conditions of interference, Fresnel's bi-prism and its applications to determine the wavelength of sodium light and thickness of a mica sheet, phase change on reflection. **Interference by Division of Amplitude:** Plane parallel thin film, production of colors in thin films, Interference due to transmitted light and reflected light, wedge shaped film (Basic idea), Newton's rings	10
II	**DIFFRACTION** Fresnel's diffraction: Huygens-Fresnel's theory, Fresnel's assumptions, rectilinear propagation of light, diffraction at a straight edge, rectangular slit and diffraction at a circular aperture (Basic idea). Fraunhoffer diffraction: Single slit diffraction, double slit diffraction, plane transmission grating spectrum, dispersive power of grating, limit of resolution, Rayleigh's criterion, resolving power of a grating	10
III	**POLARIZATION** Polarization: Polarisation by reflection, refraction and scattering, Malus Law, Phenomenon of double refraction, Huygens's wave theory of double refraction (Normal and oblique incidence), Analysis of polarized Light. Nicol prism, Quarter wave plate and half wave plate, production and detection of (i) Plane polarized light (ii) Circularly polarized light and (iii) Elliptically polarized light. Optical activity, Polarimeters (Basic idea)	10

IV	**Lasers:** Basic concept of absorption and emission of radiations, amplification and population inversion; Main components of lasers: (i) Active Medium (ii) Pumping (iii) Optical Resonator; Properties of laser beam, Metastable state, Types of Lasers (He-Ne Laser & Ruby Laser), Applications of Lasers **Fibre optics:** Optical fibres and their properties, Principal of light propagation through a optical fibre, Acceptance angle and numerical aperture, Types of optical fibles: Single mode and multimode fibres, Advantages and Disadvantages of optical fibers.	10
	Practicum 1 To determine Refractive index of the material of a prism using sodium source. 2 Determination of wavelength of sodium light using Newton's Rings. 3 To determine the dispersive power and Cauchy constants of the material of a prism using Mercury discharge source. 4 To draw a graph between wave length and minimum deviation for various lines from a Mercury discharge source. 5 Determination of wavelength of sodium light by using a diffraction grating. 6 Resolving power of a telescope. 7 Resolving power of a prism. 8 Resolving power of a grating. 9 Comparison of Illuminating Powers by a Photometer. 10 Measurement of (a) Specific rotation (b) concentration of sugar solution using polarimeter. 11 Ordinary and extraordinary refractive indices for calcite or quartz. 12 To find the equivalent focal length of a lens system by nodal slide assembly. **Note: Student will perform at least six experiments. The examiner will allot one practical at the time of end term examination.**	30
Suggested Evaluation Methods		
Internal Assessment: ➢ **Theory(20Marks)** • Class Participation: **05Marks** • Seminar/presentation/assignment/quiz/classtestetc.:**05Marks** • Mid-TermExam:**10 Marks** ➢ **Practicum(10Marks)** • Class Participation: **Nil** • Seminar/Demonstration/Viva-voce/Lab records etc.: **10Marks** • Mid-Term Exam: **Nil**		**End Term Examination :50Marks** **20 Marks**
Part C-Learning Resources		

Recommended Books/e-resources/LMS:

1. Principles of Optics, M. Bornand, E. Wolf, Pergamaman Press
2. Optics, Ajoy Ghatak, Tata McGraw Hill (2008)
3. Fundamentals of Optics, Jenkins and White, McGraw Hill Book Co.Ltd., New Delhi
4. Optics, K.D. Muller, University Science Books, Millally California
5. An Introduction to Interferometery, Tolansky,John Wiley & Sons,NewDelhi
6. Polarized Light, Production and Use, Shurcliff, Harward University Press, Cambridge, M A (USA)
7. Lasers and Non-Linear Optics, B.B. Laud, NewAge International(P) Ltd., Publishers, New Delhi
8. Lasers, Principles, Types and Applications, K.R. Nambiar, New Age International(P) Ltd., Publishers, New Delhi
9. Laser, Theory & Applications. K. Thyagarajan and A.K. Ghatak, Macmillan India limited
10. A text book of optics, N. Subrahmanyam and Brijlal, S.Chand & Company
11. B.Sc. Practical Physics, C.L. Arora, S. Chand Publisher, New Delhi
12. Advanced Level Practical Physics, M. Nelkon and Ogborn,Henemann Education Books Ltd., New Delhi
13. Practical Physics, S.S. Srivastava and M.K.Gupta, Atma Ram & Sons,Delhi
14. Practical Physics, S.L.Gupta andV.Kumar, Pragati Prakashan Meerut
15. Modern Approach to Practical Physics, R.K. Singla, Modern Publishers, Jalandhar
16. Advanced Practical Physics for students, B.L. Flintand H.T. Worsnop, Asia Publishing House

Chaudhary Bansi Lal University Bhiwani Undergraduate Programs

Course: MCC-7

Session:2024-25	
Part A-Introduction	
Subject	Physics
Semester	4th
Name of the Course	**Introductory Quantum Mechanics**
Course Code	24UN-PHY-402
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	MCC
Level of the course(Asper Annexure-I	100-199
Pre-requisite for the course(if any)	Appeared or passed the 3rd sem(B.Sc. Physical Science(H)/ equivalent)
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Know main aspects of the inadequacies of classical mechanics and understand historical development of quantum mechanics and understand the theory of quantum measurements, wave packets and uncertainty principle. 2. Understand the central concepts of quantum mechanics: wave functions, Interpretation of Wave Function, momentum and energy operator, expectation values, the Schrodinger equation, time dependent and time independent cases, probability density, the normalization techniques, Eigen functions, Eigen values and their significance. 3. Understanding the behavior of quantum particle encountering the (i) barrier & ii) potential. 4. Solve Schrodinger equation for ground state energy and wave functions of various simple quantum mechanical one dimensional and three dimensional potentials. 5. Learn to present observations, results, analysis and different concepts related to experiments of Elements of Quantum Mechanics.

Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5

Max. Marks:100 **Time:3hrs**
InternalAssessmentMarks:30 End
Term Exam Marks: 70 [Theory (50) + Practicum (20)]

Part B-Contents of the Course

Instructions for Paper-Setter

1. Nine questions will be set in total.
2. Question no. 1will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	**The Origin Quantum Physics** Inadequacies in Classical Physics, Overview of quantum physics, boundary between classical and quantum phenomena, Blackbody Radiation, Planck's Quantum Theory, Photons, Photoelectric effect, Compton effect (theory and result),Frank-Hertz experiment, de-Broglie hypothesis, Davisson and Germer experiment, wave packet, phase velocity, group velocity and their relation, Heisenberg's uncertainty principle, Time energy and angular momentum, position uncertainty. Uncertainty principle from de Broglie wave.(Wave particle duality).Gamma Ray Microscope, Electron diffraction from a slit	12
II	**The Schrodinger Wave Equation-I** Time dependent and time independent Schrodinger equation, dynamical evolution of a quantum state; properties of Wave Function, Interpretation of Wave Function, Condition for physical acceptability of Wave Functions. Eigenvalues and Eigen functions, Mathematical consideration of Schrodinger equation: Normalization, Orthogonality, Observables, Stationary states, Position, Linear momentum & Energy operators; commutator of position and linear momentum operators; Postulates of quantum mechanics, Probability current density, Expectation values of position and linear momentum, Ehrenfest's theorem	11
III	**The Schrodinger Wave Equation-II** Solution of time dependent Schrodinger equation, Proof of Uncertainty principle (1D wave packet), Gaussian wave packet, Spread of Gaussian wave packet, Fourier analysis and Parseval's formula (main results only),	12

	Fourier integral theorem from Parseval's formula, General forms of Fourier transform, Kronecker delta and Dirac delta functions, Coordinate and momentum representations, Schrodinger equation in momentum representation, Significance of momentum wave functions, Box and Dirac delta normalization, Momentum wave functions for a free particle	
IV	**One-Dimensional Problems** Eigen Functions and Eigen values for a Particle in a One Dimensional Box, Potential step: reflectance and transmittance, Penetration of a barrier: reflectance, transmittance and tunnel effect, Application of barrier penetration, Tunnel diode and alpha decay (Qualitative description), One Dimensional Simple Harmonic Oscillator: Energy Levels and Wave Functions. Zero Point Energy	10
	Practicum 1. To find the specific heat of a solid by a method of mixture. 2. To find the specific heat of a liquid (Turpentine oil) by law of cooling. 3. To find coefficient of apparent expansion of glycerin 4. Study of Electron spin resonance-determine magnetic field as a function of the resonance frequency 5. Study of Zeeman effect with external magnetic field; Hyperfine splitting 6. To study the quantum tunneling effect with solid state device, e.g. tunneling current in backward diode or tunnel diode. 7. Determination of Planck's constant using the Photoelectric Effect. 8. Determination of work function using the Photoelectric Effect. 9. To demonstrate the concept of quantization of the energy levels according to the Bohr's model of an atom. 10. Study of excitations of a given atom by Franck Hertz setup. 11. To determine the ionization potential of mercury 12. Study of Arc emission spectrum of given samples (Fe and Cu). 13. Determination of e/m of an electron by Helical method. 14. Determination of e/m of an electron by Thomson method **Note: Student will perform at least six experiments. The examiner will allot one practical at the time of end term examination.**	30
Suggested Evaluation Methods		

Internal Assessment:	End Term Examination
➢ **Theory(20Marks)** • Class Participation: **05Marks** • Seminar/presentation/assignment/quiz/classtestetc.:**05Marks** • Mid-TermExam:**10 Marks**	**:50Marks**
➢ **Practicum(10Marks)** • Class Participation: **Nil** • Seminar/Demonstration/Viva-voce/Lab records etc.: **10Marks** • Mid-Term Exam: **Nil**	**20 Marks**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Quantum Mechanics, Leonard I. Schiff, 3rd Edn2010,Tata McGraw Hill.
2. A Text book of Quantum Mechanics, P.M. Mathews and K.Venkatesan, 2nd Edn, 2010, McGraw Hill.
3. A. Ghatak & S. Lokanathan, Quantum Mechanics: Theory and Applications, 5th Edition, Macmillan India (2004)
4. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn, 2002, Wiley.
5. Quantum Mechanics, G.Aruldhas, 2nd Edn2002,PHILearningofIndia.
6. Quantum Mechanics, B.H.Bransden and C.J. Joachain, Pearson Education, New Delhi.
7. Introductory Quantum Mechanics, David J.Griffith,2nd Ed.2005,Pearson Education.
8. Quantum Physics of Atoms Molecules, Solids, Nuclei and Particles, R.M. Eisberg and R. Resnick, Wiley Eastern Ltd, New Delhi
9. Quantum Mechanics, GR Chatwal and SKAnand, Himalaya Publishing House, New Delhi
10. Quantum Physics (Berkeley Physics Course),E H Witchman, Tata McGraw Hill, Chennai
11. B.Sc. Practical Physics, C.L. Arora, S. Chand Publisher, NewDelhi
12. Advanced Level Practical Physics, M. Nelkon and Ogborn, Henemann Education Books Ltd., New Delhi
13. Practical Physics, S.S. Srivastava and M.K. Gupta, Atma Ram & Sons, Delhi
14. Practical Physics, S.L. Gupta and V. Kumar, Pragati Prakashan Meerut

Chaudhary Bansi Lal University Bhiwani Undergraduate Programs

Course:MCC-8

Session:2024-25	
Part A-Introduction	
Subject	Physics
Semester	4th
Name of the Course	**Atomic spectroscopy**
Course Code	24UN-PHY-403
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	MCC
Level of the course (Asper Annexure-I	100-199
Pre-requisite for the course(if any)	Appeared or passed the 3rdsem (B.Sc. Physical Science(H)/ equivalent)
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Acquire knowledge about the historical background and developments of atomic spectroscopy through the study of spectral series in Hydrogen atom, effect of nuclear motion on line spectra (correction of finite nuclear mass), short comings of Bohr's theory, Wilson sommerfeld quantization rule, Sommerfeld's extension of Bohr's model, Sommerfeld relativistic correction, Short comings of Bohr-Sommerfeld theory and finally Vector atom model 2. Understand and explain the vector atom model, various coupling schemes and atomic spectra of one and two electron atoms 3. Understand the LS & JJ coupling 4. Explain the influence on the spectra of atoms in the presence of external applied electric and magnetic field i.e. Zeeman effect, Paschen-Back effect,Starke ffect 5. Learn to present observations, results, analysis and different concepts related to experiments of Elements of Atomic and Molecular Physics.

Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5

Max. Marks:100 **Time:3hrs**
InternalAssessmentMarks:30 End
Term Exam Marks: 70 (Theory(50)+Practicum(20))

Part B-Contents of the Course

Instructions for Paper-Setter

1. Nine questions will be set in total.
2. Question no. 1will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	**Historical background of atomic spectroscopy:** Introduction of early observations, emission and absorption spectra, atomic spectra, wave number, Bohr atomic model(Bohr's postulates) , spectra of Hydrogen atom , explanation of spectral series in Hydrogen atom, un-quantized states and continuous spectra, spectral series in absorption spectra, effect of nuclear motion online spectra (correction of finite nuclear mass), variation in Rydberg constant due to finite mass, short comings of Bohr's theory, Vector atom model; space quantization, electron spin, coupling of orbital and spin angular momentum, spectroscopic terms and their notation, quantum numbers associated with vector atom model, transition probability and selection rules.	11
II	**Vector atom model (single valance electron):** Orbital magnetic dipole moment (Bohr magnaton), behavior of magnetic dipole in external magnetic field; Larmor's precession and Larmor's theorem. Penetrating and Non-penetrating orbits, Penetrating orbits on the classical model; Quantum defect, spin orbit interaction energy of the single valance electron. Hydrogen fine spectra, Main features of Alkali Spectra and their theoretical interpretation, term series and limits, Rydeburg- Ritze combination principle, Absorption spectra of Alkali atoms.observeddoubletfinestructureinthespectraofalkalimetalsandits Interpretation, Intensity rules for doublets, comparison of Alkali spectra and Hydrogen spectrum	12

III	**Vector atom model (two valance electron):** Essential featuresof spectra of Alkaline-earth elements. Vector model for two valance electron atom: application of spectra. Coupling Schemes; LS or Russell – Saunders Coupling Scheme and JJ coupling scheme, Interaction energy in L-S coupling (sp,pd configuration), Lande interval rule, Pauli principal and periodic classification of the elements. Interaction energy in JJ Coupling (sp, pd configuration), equivalent and non-equivalent electrons, Two valance electron system-spectral terms of non-equivalent and equivalent electrons, comparison of spectral terms in L-S And J-J coupling. Hyperfine structure of spectral lines and its origin; isotope effect, nuclear spin	12
IV	**Atom in external field:** Zeeman Effect (normal and Anomalous), Experimental set-up for studying Zeeman effect, Explanation of normal Zeeman effect (classical and quantum mechanical), Explanation of anomalous Zeeman effect (Lande g-factor), Zeeman pattern of D1 andD2 lines of Na-atom, Paschen-Back effect of a single valence electron system. Weak field Stark effect of Hydrogen atom.	10
	Practicum 1. To determine the value of Boltzmann Constant by studying Forward Characteristics of a Diode. 2. To determine the value of Planck's Constant by using four different LEDs. 3. To determine the value of e/m by (a) Magnetic Focussing or (b) Bar Magnet. 4. To determine the wavelengths of Hydrogen spectrum and hence to Determine the value of Rydberg's Constant. 5. To determine the Wavelength of H-alpha Emission Line of Hydrogen Atom. 6. To determine the Wavelength and the Angular Spread of a He-Ne Laser. 7. T To determine the value of Stefan's Constant. 8. To determine the Wavelength and the Velocity of Ultrasonic Waves in a liquid (Kerosene Oil, Xylene, etc.) by studying the Diffraction of light through an Ultrasonic Grating 9. To estimate the temperature of Sodium flame by studying the reversal of spectral lines (D lines). 10. To study the characteristics of LASER. **Note: Student will perform at least six experiments. The examiner will allot one practical at the time of end term examination.**	30
	Suggested Evaluation Methods	

Internal Assessment:	End Term Examination
➢ **Theory(20Marks)** • Class Participation: **05Marks** • Seminar/presentation/assignment/quiz/classtestetc.:**05Marks** • Mid-TermExam:**10 Marks** ➢ **Practicum(10Marks)** • Class Participation: **Nil** • Seminar/Demonstration/Viva-voce/Lab records etc.: **10Marks** • Mid-Term Exam: **Nil**	**:50Marks** **20 Marks**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Concept of Modern Physics(1987) A.Beiser, McGrawHill CoLtd.NewDelhi
2. Atomic Physics(2007),J.B. Rajab,S Chand&Co,New Delhi
3. Atomic PhysicsVolII(1991),J.H.Fewkes and J.Yarwood,OxfordUniversityPress
4. Physics of Atoms and Molecules2nd Ed(2009),B.H.BransdenandC.J. Joachain, Pearson Education, New Delhi
5. Fundamental of Molecular Spectroscopy, ColinN.Banwell and ElaineM. McCash,McGraw Hill Co Ltd. New Delhi
6. Atomic and Nuclear Physics Vol I(1996)S.N.Ghoshal,S.Chand & Com.,New Delhi
7. Atomic and Nuclear Physics(19 2).K. Gopalkrishnan, Mc MillanIndia,New Delhi
8. Elements of Spectroscopy S.L.(upta,V.KumarandR.C.Sharma ,Pragati Prakashan, Meerut.
9. Geeta Sanon, BSc Practical Physics, 1stEdn. (2007),R. Chand&Co.
10. B. L. Worsnop and H. T. Flint, Advanced Practical Physics, Asia Publishing House, New Delhi.
11. Indu Prakash and Ramakrishna, AText Book of Practical Physics, Kitab Mahal,New Delhi.
12. D.P.Khandelwal,A Laboratory Manual of Physics for Undergraduate Classes, Vani Publication House, New Delhi.
13. Nelson and Jon Ogborn, Practical Physics.

Chaudhary Bansi Lal University Bhiwani Undergraduate Programs

Course: DSE-1

Session:2024-25			
Part A-Introduction			
Subject	Physics		
Semester	4th		
Name of the Course	**Laser Physics & Fiber Optics**		
Course Code	24UN-PHY-404		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course (Asper Annexure-I	100-199		
Pre-requisite for the course (if any)	Appearedorpassedthe3rdsem(B.Sc. Physical Science(H)/ equivalent)		
Course Learning Outcomes (CLO):	After completing this course, the learner will be able to: 1. Understand the basic principle of laser, Einstein's coefficients and their physical significance. Line broadening and its reasons 2. Qualitative understanding of different lasing mechanism, variation of output laser power around threshold and basic idea of oscillating of modes in laser cavity and their roles in propagation 3. Understand about optical fibres and its classification, basic principle involved in propagation of light through optical fibre and its application in communication 4. Have the idea of Fibre materials, Fibre Cables and Fabrication Techniques 5. Understand how and why to use of laser source in performing experiments in laboratory and have the idea how the signal that carries information transmitted through the optical fibre.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5

Max. Marks:100 **InternalAssessmentMarks:30 End** **Term Exam Marks: 70** [Theory(50)+Practicum(20)]	**Time:3hrs**

Part B-Contents of the Course

Instr uctions for Paper-Setter

1. Nine questions will be set in total.
2. Question no. 1will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the an swer should be in brief but not in Yes/No.
3. Four more questions are to be attem pted, selecting one question out of two questions set from each unit. Each question may contain wo or more parts. All questions will carry equal marks.
4. 20%numericalproblemsareto beset.
5. Use of scientific (non-programmable) alculator is allowed.

Unit	Topics	Contact Hours
I	**Introduction to Laser:** The Einstein Coefficients, Absorption and Emission cross-sections; Light amplification by an atomic system; Threshold condition; Origin of Line Shape function: Lorentzian and Gaussian shape functions; Line Broadening mechanisms - Homogeneous broadening: Natural Broadenin , Collision broadening; Inhomogeneous broadening: Doppler Broadenin	11
II	**Laser Rate Equations:** Two Le el laser system, Three Level laser system, Four Level Laser Systems (Th eshold Population, threshold pump rate, Laser power output with sui ple examples), Variation of laser power around threshold; Optimum o tput coupling. Cavity modes: Number of modes in 1D, 2D and 3D cav ies, Mode locking, Q switched lasers and methods of Q-switching	12
III	**Optical fibres:** Introduction; step index fibre, numerical aperture, pulse dispersion in step index fibre, graded index, material dispersion. Comparison of step and graded index fibres Propagation of light in optical Fibres : Basic structure and optical path of an optical fibre, Modes of propagation, meridional and skew rays, number of modes and cut off parameters of fibres, Single mode propagation. Disadvantage of mono mode and graded index multimode fibre	11
IV	**Fibre materials & Fabrication Techniques**: Glass fibre, plastic fibre, losses of fibres; bending losses, intrinsic fibre losses, scattering losses and absorption losses. Fibre Cables: Fibre cable construction, Strength member, cable tensile loading, Minimum bend radius, Losses incurred during installation of cables or during subscriber service, testing of cables, cable selection criteria. Outside vapour phase oxidation, vapour phase axial deposition, modified chemical vapour deposition	11
	Practicum 1. To determine wavelength and angular divergence of LASER beam.	30

	2. Demonstration of Temporal coherence and measurement of wavelength of laser light using Michelson interferometer. 3. Measurement of refractive index using Brewster angle. 4. Febry- Parrotinter fero meter. 5. Study of spectrum of iodine vapour and deduce force constant for the iodine molecule. 6. To study modulation and demodulation (Amplitude and frequency). 7. To study and perform Pulse Amplitude Modulation and Demodulation. 8. To study and perform Pulse Width Modulation and Demodulation. 9. To study and perform Pulse Position Modulation and Demodulation. 10. To determine Numerical aperture and acceptance angle of a given optical fiber. 11. Determination of diameter of wire using He-Ne Laser. 12. Study double slit interference by He-Ne laser 13. Determination of wavelength of He-Ne Laser by using a diffraction grating. 14. To measure the numerical aperture of an optical fibre using He-Ne laser source. **Note: Student will perform at least six experiments. The examiner will allot one practical at the time of end term examination.**	
Suggested Evaluation Methods		
Internal Assessment: ➢ **Theory(20Marks)** • Class Participation: **05Marks** • Seminar/presentation/assignment/quiz/classtestetc.:**05Marks** • Mid-TermExam:**10 Marks** ➢ **Practicum(10Marks)** • Class Participation: **Nil** • Seminar/Demonstration/Viva-voce/Lab records etc.: **10Marks** • Mid-Term Exam: **Nil**		**End Term Examination :50Marks** **20 Marks**
Part C-Learning Resources		

Recommended Books/e-resources/LMS:

1. Laser and Optical Engineering P. Das, Narosa Publication.
2. Lasers and Nonlinear Optics-B.B. Land.
3. Optical Electronics-A Ghatak and K. Thyagarayan.
4. Principles of Lasers, O.Svelto, Plenum(1989)
5. Laser Physics, L.V. Tarasov, Mir (1983)
6. Quantum Electronics, A.Yavir, John Wiley(1992)
7. Laser: Theory & Applications, A.Ghatak & K.Tayagrajan, MacmillanIndia
8. Optical fibre communication (secondedition)-GerdKeiser,McGrawHill,Inc.NewYork.
9. Optical fibres and fibre optic communication systems- S. Sarkar.
10. Lasers:Principle,Typesandapplications-K.R.NambiarNewAgeInternationalPublishers

Chaudhary Bansi Lal University Bhiwani Undergraduate Programs

Course: DSE-1

Session:2024-25			
Part A-Introduction			
Subject	Physics		
Semester	4th		
Name of the Course	**Physics of Nanomaterials**		
Course Code	24UN-PHY-405		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	DSE		
Level of the course(Asper Annexure-I	100-199		
Pre-requisite for the course(if any)	Appearedorpassedthe3rdsem(B.Sc. Physical Science(H)/ equivalent)		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understand the properties of Nanomaterials/ nanostructures 2. Understand the basic Physics of methods for preparation of Nanomaterials/nanostructures. 3. Understand the basic Physics of Characterization & Instrumentation Technique for Nanomaterials/ nanostructures. 4. Understand the application and advantages of Nanomaterials 5. Understand the analysis and plotting of experimental data using various techniques.		
Credits	Theory	Practical	Total
	3	1	4
Contact Hours	3	2	5
Max. Marks:100 **Internal Assessment Marks:30** **End Term Exam Marks: 70** [Theory (50) + Practicum (20)]		**Time:3hrs**	
Part B-Contents of the Course			

Instructions for Paper-Setter

1. Nine questions will be set in total.
2. Question no. 1will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20%numericalproblemsareto beset.
5. Use of scientific(non-programmable)calculator is allowed.

Unit	Topics	Contact Hours
I	Definition, Length scale, Historical background & developments, Richard Feynman Statement, Moore's law, Vision and objective of Nano-technology, Top down and Bottom up approach, Surface to Volume Ratio, Quantum confinement, Size effect in nano system, Quantum dots, Nanowires, Different Allotropes of carbon, Introduction to CNTs, Structure of CNTs, Types of CNTs- SWNTs, MWNTs, Bucky balls (C60),Graphene, Semiconductor Nano particles–types and properties.	10
II	**Synthesis methods for Nanomaterials/Nano structures:** Bottom up and top down approaches for synthesis of nanomaterials, Synthesis of zero-dimensional nanostructures (Nanoparticles): Sol-Gel Process, Epitaxial core-shell nanoparticles, Ball milling, Synthesis of One-dimensional nanostructures (Nanowires, Nanorods, Nanotubes): Electrochemical deposition, Lithography, Synthesis of Two- dimensional nanostructures (Thin Films & Quantum wells): Molecular beam epitaxy (MBE), MOCVD, Cluster beam evaporation, Ion beam deposition.	12
III	**Characterization & Instrumentation Technique for Nanomaterials/Nanostructures**: X -ray Diffraction (XRD): Basic principle and idea of instrumentation, Determination of crystallite/particle size and strain in nanomaterials using Debye Scherer's formula and Williamson–Hall's plot, UV Visible spectroscopy: Basic principle and idea of instrumentation, optical energy band gap, Tauc plot, surface plasmon peaks Photoluminescence (PL) spectroscopy: Basic principle and idea of instrumentation, Shift in PL peaks with particle Size, Determination of alloy composition in thin films of compound semiconductors, Estimation for width of quantum wells, Raman spectroscopy: Basic principle and idea of instrumentation, Variations in Raman spectra of nanomaterials with particle size, Study of Raman spectra of carbon nanotubes and graphene.	13
IV	**Applications of Nanomaterials:** Importance of nano-scale and technology, Applications of Nanotechnology in different field: Automobiles, Electronics and Devices, Nano-biotechnology, Materials, Medicine, Food, Textiles and Fabrics, Sporting Equipment and Goods, Chemical and Bio sensor,EnhancingWaterQuality,SpaceScience,ImprovingAirQuality,IT sector, Environmental Remediation, agriculture; Advantages of Nanomaterials	10

	Practicum 1. To analyze the crystal structure of simple cubic, FCC and associated defects using XRD data. 2. To study the crystallite by W-H analysis of XRD data. 3. To study wave length used by using standard FCC/BCC lattice in XRD. 4. To analyze the structural of different carbonaceous material (Quantum dot, CNT, graphene, amorphous, graphite) using RAMAN spectroscopy data. 5. To study the RAMAN spectra of Poly carbonate monomer structure. 6. To study the band gap/energy gap of different materials using UV-visible spectroscopy data. 7. To study the Transmission spectra using UV-visible spectroscopy data. 8. To study the Absorption spectra using UV-visible spectroscopy data. 9. To study the band transition in different luminescent materials using PL spectroscopy data. 10. To study the emission and absorption spectra of a material using PL spectroscopy data. **Note: Student will perform at least six experiments. The examiner will allot one practical at the time of end term examination.**	30
Suggested Evaluation Methods		
Internal Assessment: ➢ **Theory(20Marks)** • Class Participation: **05Marks** • Seminar/presentation/assignment/quiz/classtestetc.:**05Marks** • Mid-TermExam:**10 Marks** ➢ **Practicum(10Marks)** • Class Participation: **Nil** • Seminar/Demonstration/Viva-voce/Lab records etc.: **10Marks** • Mid-Term Exam: **Nil**		**End Term Examination :50Marks** **20 Marks**
Part C-Learning Resources		

Recommended Books/e-resources/LMS:

1. Nanotechnologies: The Physics of Nanomaterials Volume I, David S. Schmool.
2. Introduction to Nanoscience by Gabor L Hornyak and Joydeep Dutta
3. Nano physics and Nanotechnology by Edward LWolf
4. Essentials in Nano-science and nanotechnology by Narendra Kumar, Sunit Kumbhat
5. Nanostructures & Nanomaterials: Synthesis, Properties & Applications by Guozhong Cao
6. Nanotechnology: Principles and Practices by Sulabha K Kulkarni
7. Introduction to Nano: Basics to Nanoscience and Nanotechnology byAmretashis Sengupta and Chandan Kumar Sarkar.

Scheme of Examination for MDC

Semester	Course Type	Course Code	Nomenclature of paper	Credits T+P	Contact hours T+P	Internal marks	End term Marks	Total Marks	Duration of exam (Hrs) T + P
3	MDC-3	24UN-PHY-MDC301	Elements of modern Physics	2+1	2+2	20	50	70	3

Scheme of Examination for VAC & VOC

Semester	Course Type	Course Code	Nomenclature of paper	Credits	Contact hours	Internal marks	End term Marks	Total Marks	Duration of exam (Hrs) T + P
3	VAC-3	24UN-PHY-VAC301	Indian Astronomy in the 18th and 19th Centuries	2	2	15	35	50	3
3	VAC-3	24UN-PHY-VAC302	Basics of Indian Astronomy	2	2	15	35	50	3
3	VAC-3	24UN-PHY-VAC303	Exploring the Journey of Indian Space Satellites	2	2	15	35	50	3
4	VAC-4	24UN-PHY-VAC401	Physics in Everyday Life	2	2	15	35	50	3
4	VAC-4	24UN-PHY-VAC402	Radiations and its Hazards in Daily Life	2	2	15	35	50	3

Scheme of Examination for VOC

Semester	Course Type	Course Code	Nomenclature of paper	Credits T+P	Contact hours T+P	Internal marks	End term Marks	Total Marks	Duration of exam (Hrs) T + P
4	VOC-4	24UN-PHY-VOC401	Refrigeration and Air Conditioning	2+2	2+4	30	70	100	3
4	VOC-4	24UN-PHY-VOC402	Maintenance of Laboratory Instruments	2+2	2+4	30	70	100	3

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Course: MDC-3

Session:2024-25			
Part A-Introduction			
Subject	Physics		
Semester	3rd		
Name of the Course	**Elements of modern Physics**		
Course Code	24UN-PHY-MDC301		
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	MDC		
Level of the course(Asper Annexure-I	100-199		
Pre-requisite for the course(if any)	Not studied Physics subject at level4 (i.e. 10+2or equivalent)		
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Have introductory idea about the importance of semiconductors and basic semiconductor devices 2. Have the knowledge about the lasers and optical fibers and their importance in scientific and technological fields 3. Understand importance of radio isotopes, Nuclear fission and fusion reactions and their hazardous aspects 4. Have the knowledge about the importance of some scientifically and technologically advanced materials. 5. Learn to present observations, results, analysis and different concepts related to experiments of Elements of modern Physics.		
Credits	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4
Max. Marks:70 **Internal Assessment Marks:20** **End Term Exam Marks: 50**		**Time:3hrs** [Theory (35) + Practicum (15)]	
Part B-Contents of the Course			

Instructions for Paper-Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	Basics of semiconductor and semiconductor devices-Atomic structure and energy levels, energy bands (basic idea), definition of conductor, semiconductor and insulators (on the basis of energy gap), Intrinsic semiconductors, extrinsic semiconductors-p-type and n-type semiconductor), P-N junction diode-depletion layer, forward biasing and reverse biasing, V-I characteristics; Principle, working and applications of-Zener diode, Photodiode, Solar cell and Light emitting diode (LED).	8
II	Basics of Laser systems - introduction to LASER, important properties of laser light, Principle of laser- Light amplification, population inversion and pumping; Working of laser- schematic diagram for functioning of laser, three level and four level Laser systems; applications of Lasers in different fields of science and technology.	5
III	Basics of fiber optics- introduction to optical fibers, total internal reflection and the optical fibers, structure and types of optical fiber (basic idea), advantages and disadvantages of optical fibers, optical fiber communication system (basic idea), applications of optical fibers.	5
IV	Magnetic Materials- Introduction, classification and applications of magnetic materials; Piezoelectricity and applications of Piezoelectric materials; Superconductors and their applications; Nanomaterials - Introduction to nanomaterials, extraordinary properties of nanomaterials, applications and limitations of nanotechnology	6
	Practicum 1. V-I characteristics of p-n junction diode.	30

	2. V-I characteristics of Zener diode. 3. Characteristics of Solar Cell 4. To verify the inverse square law of light using a photo-voltaic cell. 5. To determine value of Boltzmann constant using V-I characteristic of PN diode. 6. To study the effect of intensity of light (by varying distance of the source) on an LDR 7. To verify the characteristics of LASER 8. To measure the numerical aperture of an optical fibre using He-Ne laser source. 9. Study double slit interference by He-Nelaser 10. Determine the diameter of a wire using (He-Ne Laser) diffraction method **Note: Student will perform at least six experiments. The examiner will allot one practical at the time of end term examination.**	

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory(15 Marks)** • Class Participation: **4Marks** • Seminar/presentation/assignment/quiz/classtestetc.:**4 Marks** • Mid-TermExam:**7 Marks** ➢ **Practicum(5Marks)** • Class Participation: **Nil** • Seminar/Demonstration/Viva-voce/Lab records etc.: **5 Marks** • Mid-Term Exam: **Nil**	**End Term Examination** **:Marks** **: 35 Marks** **:15 Marks**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Concept of Modern Physics, Arthur Beiser, McGraw Hill Education.
2. Modern Physics (2nd edition), S.L.Kakani and Shubhra Kakani,Viva Books, NewDelhi.
3. Semiconductor Devices-Physics and Technology, S.M.Sze ,Wiley (1985)
4. Laser and Non-linear optics, B.B. Laud,Wiley Eastern Limited (1985)
5. Semiconductor Electronics, A.K.Sharma, New Age International Publisher (1996)
6. Introductory Nuclear Physics, KennethS.Krane , Wiley,NewYork (1988)
7. Radiation detection and measurement, G.F. Knoll, Wiley,NewYork (2000)
8. Crystallography for Solid State Physics, Verma and Srivastava, Wiley,NewYork (1982)
9. Solid State Physics, Rajnikant,Willey India (2011).
10. Materials Science, J.C. Anderson, KD. Leaver, R.D. Rawlings andJ.M. Alexander,4th Edition, Chapman Hall, London (1990).
11. Materials Science and Engineering, V.Raghavan,3rdEd., Prentice-Hall India,NewDelhi (1993).
12. Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop, Asia Publishing House (1971)

13. Advanced level Physics Practical's, Michael Nelson and Jon M. Ogborn, 4Edition, Heinemann Educational Publishers (1985)
14. B.Sc. Practical Physics, C.L. Arora, RChand & Co.New Delhi
15. B.Sc. Practical Physics,Harnam Singh and Dr.P.S.Hemne,S Chand &Company Ltd.

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Undergraduate Programs

Course: VAC-3

Session: 2023-24			
Part A - Introduction			
Subject	Physics		
Semester	3rd		
Name of the Course	**Indian Astronomy in the 18th and 19th Centuries**		
Course Code	24UN-PHY-VAC301		
Course Type: (CC/MCC/MDC/CC-M/DSEC/ VOC/DSE/PC/AEC/VAC)	VAC		
Level of the course	100-199		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understand the Classical Astronomy in India and Early astronomical measurements. 2. Understand the Growth and Development of Space and Radio Astronomy in India 3. Understand the Growth of Optical Astronomy in India 4. Understand the Astronomy in ancient, medieval and early telescopic era of India.		
Credits	Theory	Practical	Total
	2	NA	2
Contact Hours	2	NA	2
Max. Marks:50 **Internal Assessment Marks:15** **End Term Exam Marks: 35**		**Time:3hrs** [Theory (35) + Practicum (15)]	
Part B- Contents of the Course			

Instructions for Paper- Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Classical Astronomy in India- Astronomy of the Vedas, Vedanga Jyotisa, Siddhantas- Famous Astronomers and Their Works, Aryabhata-I (b. 476 AD), Earth's Shape and Rotation, Post-Aryabhatan Astronomy, Indian Astronomers and Eclipses, Early astronomical measurements: Measurement of Earth's radius by Eratosthenes; Lunar and solar motion studies by Hipparchus - equinoxes and solstices, lunar and solar eclipses;	8
II	Aryabhatta-I and his seminal contributions to astronomy - relative motion, spinning Earth, eclipses, etc.; Varahamihira, Brahmagupta and other siddhantic astronomers of India; symbiotic relation between mathematics and astronomy; evidence of the precession of equinox from vedic literature; Jai Singh and his Jantar Mantar **Developments of Space Astronomy in India**-Satellite Experiments, Astrosat instruments,	7
III	**Growth and Development of Radio Astronomy in India-** Introduction, Radio Recombination Lines, The Gauribidanur T-array Radio Telescope, The Mauritius Radio Telescope, Pulsar Studies, Observations of Neutral Hydrogen Gas, Millimetre Wave Astronomy, Interplanetary Scintillations, Solar Wind and Solar Studies, Solar Radio Emission and Space Weather, Quasar and Pulsars	7
IV	**Growth of Optical Astronomy in India-** Birth of the Kodaikanal Observatory, Takhtasinghji Observatory and the Bhavnagar Telescope, Nizamiah Observatory, Post-war Development of Astronomy, Kodaikanal Observatory, The Vainu Bappu Observatory (VBO), Near-Infrared Astronomy, Udaipur Solar Observatory (USO)	8

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory (15 Marks)** • Class Participation: **4 Marks** • Seminar/presentation/assignment/quiz/class test etc.: **04 Marks** • Mid-Term Exam: **7 Marks**	**End Term Examination : 35 Marks**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Astronomy in India: A Historical Perspective
2. The Story Of Astronomy In India by Chander Mohan
3. Indian Astronmy-An introduction by S Balachandra Rao Books

Chaudhary Bansi Lal University Bhiwani
Undergraduate Programs Course: VAC-3

Session: 2024-25			
Part A - Introduction			
Subject	Physics		
Semester	3rd		
Name of the Course	**Basics of Indian Astronomy**		
Course Code	24UN-PHY-VAC302		
Course Type: (CC/MCC/MDC/CC-M/DSEC/ VOC/DSE/PC/AEC/VAC)	VAC		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understand the Astronomy and Astronomical Scales 2. Learn about the Astronomical Instruments, Astronomy in the Internet Age and Citizen Science Initiatives 3. Understand Sun and the solar family & Physics of Galaxies 4. Learn about the Astronomy in ancient, medieval and early telescopic era of India,		
Credits	Theory	Practical	Total
	2	NA	2
Contact Hours	2	NA	2
Max. Marks:50 **Internal Assessment Marks:15** **End Term Exam Marks: 35**		**Time:3hrs**	
Part B- Contents of the Course			
Instructions for Paper- Setter 1.Nine questions will be set in total. 2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No. 3. Four more questions are to be attempted, selecting one question out of two questions set from			

each unit. Each question may contain two or more parts. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Introduction to Astronomy and Astronomical Scales:** History of astronomy, wonders of the Universe, overview of the night sky, diurnal and yearly motions of the Sun, size, mass, density and temperature of astronomical objects, basic concepts of positional astronomy: Celestial sphere, Astronomical coordinate systems, Horizon system and Equatorial system	7
II	**Astronomical Instruments:** Observing through the atmosphere (Scintillation, Seeing, Atmospheric Windows and Extinction). Basic optical definitions for telescopes: Magnification, Light Gathering Power, Limiting magnitude, Resolving Power, Diffraction Limit. Optical telescopes, radio telescopes, Hubble space telescope, James Web space telescope, Fermi Gamma ray space telescope. **Astronomy in the Internet Age:** Overview of Aladin Sky Atlas, Astrometrica, Sloan Digital Sky Survey, Stellarium, virtual telescope **Citizen Science Initiatives:** Galaxy Zoo, SETI@Home, RAD@Home India	8
III	**Sun and the solar family :** Solar parameters, Sun's internal structure, solar photosphere, solar atmosphere, chromosphere, corona, solar activity, origin of the solar system, the nebular model, tidal forces and planetary rings **Physics of Galaxies:** Basic structure and properties of different types of Galaxies, Nature of rotation of the Milky Way (Differential rotation of the Galaxy), Idea of dark matter	8
IV	**Astronomy in India:** Astronomy in ancient, medieval and early telescopic era of India, current Indian observatories (Hanle-Indian Astronomical Observatory, Devasthal Observatory, Vainu Bappu Observatory, Mount Abu Infrared Observatory, Gauribidanur Radio Observatory, Giant Metre-wave Radio Telescope, Udaipur Solar Observatory, LIGOIndia) (qualitative discussion), Indian astronomy missions (Astrosat, Aditya).	7

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory (15 Marks)** • Class Participation: **4 Marks** • Seminar presentation/assignment/quiz/class test etc.: **04 Marks** • Mid-Term Exam: **7 Marks**	**End Term Examination : 35 Marks**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. 1. Seven Wonders of the Cosmos, Jayant V Narlikar, Cambridge University Press
2. Fundamental of Astronomy, H. Karttunen et al. Springer
3. Modern Astrophysics, B.W. Carroll and D.A. Ostlie, Addison-Wesley Publishing Co.
4. Introductory Astronomy and Astrophysics, M. Zeilik and S.A. Gregory, Saunders College Publishing.
5. The Molecular Universe, A.G.G.M. Tielens (Sections I, II and III), Reviews of Modern Physics, Volume 85, July-September, 2013
6. Astronomy in India: A Historical Perspective, Thanu Padmanabhan, Springer
7. Textbook of Astronomy and Astrophysics with elements of cosmology, V.B.Bhatia, Narosa Publication
8. https://aladin.u-strasbg.fr/
9. http://www.astrometrica.at/
10. https://www.sdss.org/
11. http://stellarium.org/
12. https://www.zooniverse.org/projects/zookeeper/galaxy-zoo/

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Course: VAC-3

Session: 2024-25			
Part A - Introduction			
Subject	Physics		
Semester	3rd		
Name of the Course	**Exploring the Journey of Indian Space Satellites**		
Course Code	24UN-PHY-VAC303		
Course Type: (CC/MCC/MDC/CC-M/DSEC/ VOC/DSE/PC/AEC/VAC)	VAC		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Learn about the Concept, , ideas and theories of Satellite and Orbits. 2. Elementary understanding of Satellite Systems and their Applications. 3. Get the idea of Indian Communications satellites and their applications and Classification of Satellites. 4. Get knowledge about Milestones in India's Space Programme.		
Credits	Theory	Practical	Total
	2	NA	2
Contact Hours	2	NA	2
Max. Marks:50 **Internal Assessment Marks:15** **End Term Exam Marks: 35**		**Time:3hrs**	
Part B- Contents of the Course			
Instructions for Paper- Setter 1.Nine questions will be set in total. 2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.			

3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Concept of Satellite, ideas and theories, Concept of Orbits, The transfer orbit, hurdles in launching a satellite, space scarcity in space. Indian pace program, Objectives of the Indian Space Program, Organizational set-up.	7
II	Communication Satellite: Orbit and Description: A brief History of Satellite Communication, Satellite Frequency bands, Satellite Systems, Applications, Orbital Period and Velocity, Effects of Orbital inclination, Azimuth and Elevation, Coverage and Slant range, Eclipse, Orbital perturbations , Placement of a Satellite in a Geo-Stationary Orbit	8
III	Space Centres and institutes, Genesis of Indian's space program, Indian Satellites, Indian Communications satellites and their applications. Classification of Satellites based on Orbit Height. Indian remote sensing satellites, Indian National Satellites	8
IV	Launch vehicle technology, Milestones in India's Space Programme.	7

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory (15 Marks)** • Class Participation: **4 Marks** • Seminar/presentation/assignment/quiz/class test etc.: **04 Marks** • Mid-Term Exam: **7 Marks**	**End Term Examination : 35 Marks**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. https://www.indiascience.in/videos/isro-indias-space-journey-e-2
2. https://www.indiascience.in/videos/isro-indias-space-journey-part-2-e-1
3. https://www.insightsonindia.com/science-technology/space-technology/milestones-in-indias-space-programme/
4. https://www.clearias.com/indian-space-program/
5. SCIENCE 366: A Chronicle of Science and Technology, Basu Biman
6. Science and technology, Praveen Chandra Mishra, Chronicle Books

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Undergraduate Programs
Course: VAC-4

Session: 2024-25			
Part A - Introduction			
Subject	Physics		
Semester	4th		
Name of the Course	**Physics in Everyday Life**		
Course Code	24UN-PHY-VAC401		
Course Type: (CC/MCC/MDC/CC-M/DSEC/ VOC/DSE/PC/AEC/VAC)	VAC		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Elementary understanding of the mechanical concepts and application in daily life related to Force, weight, work, energy, power. 2. Get the idea of working of refrigerator, air conditioner, Bernoulli principle, pressure cooker.in various engines. 3. Learn about the daily life activities related to sound and optics. 4. Basic understanding some electrical and electronic appliances		
Credits	Theory	Practical	Total
	2	NA	2
Contact Hours	2	NA	2
Max. Marks:50 **Internal Assessment Marks:15** **End Term Exam Marks: 35**		**Time:3hrs**	
Part B- Contents of the Course			
Instructions for Paper- Setter 1. Nine questions will be set in total.			

2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. Thisquestion may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Mechanics** Every day activities related to Force, weight, work, energy, power and centrifuge; washing machine.	7
II	**Heat** Variation of boiling point with pressure, pressure cooker, cooling by expansion, refrigerator, air conditioner, Bernoulli principle – Bunsen burner, aeroplane	8
III	**Sound And Optics** Sound waves, Doppler Effect, power of lens, long sight and short sight, microscope, telescope, binocular camera, video camera.	8
IV	**Electrical And Electronic Appliances** Working of the tube light and fan, kilowatt hour, fuse and heating elements, microwave oven, electric heater, photoelectric effect.	7

Suggested Evaluation Methods

Internal Assessment: **Theory (15 Marks)** • Class Participation: **4 Marks** • Seminar/presentation/assignment/quiz/class test etc.: **04 Marks** • Mid-Term Exam: **7 Marks**	**End Term Examination : 35 Marks**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. R. Murugeshan, Allied Physics I & II, S. Chand & Co, New Delhi (2006).
2. D.S. Mathur, Elements of properties of matter and acoustics, S. Chand & Company Ltd., New Delhi(2010)
3. R.Murugeshan, Properties of matter and acoustics, S. Chand & Co, New Delhi(2012)
4. Brijal&Dr.N. Subramanyan and P.S. Hemne, Heat and Thermodynamics, S. Chand & Co, New Delhi, (2004)
5. R. Murugeshan, Electricity, S. Chand & Co, New Delhi (2010)
6. R. Murugeshan and KiruthigaSivaprasath, Modern Physics, S. Chand & Co, New Delhi (2016)
7. N. Subramaniyam, Brijlal and M.N.Avadhanulu, A textbook of Optics S. Chand & Co, New Delhi (2012)

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Course: VAC-4

Session: 2024-25			
Part A - Introduction			
Subject	Physics		
Semester	4th		
Name of the Course	**Radiations and its Hazards in Daily Life**		
Course Code	24UN-PHY-VAC402		
Course Type: (CC/MCC/MDC/CC-M/DSEC/ VOC/DSE/PC/AEC/VAC)	VAC		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understanding of the sources of Radiation exposure Realize the importance of radiation protection and safe disposal of radioactive 2. Get the idea of Basics of Radiation detectors. 3. Learn about Hidden hazards of various radiation sources in the daily life. 4. Basic understanding of Cares against Hidden hazards of radiations.		
Credits	Theory	Practical	Total
	2	NA	2
Contact Hours	2	NA	2
Max. Marks:50 **Internal Assessment Marks:15** **End Term Exam Marks: 35**		**Time:3hrs**	
Part B- Contents of the Course			
Instructions for Paper- Setter 1.Nine questions will be set in total. 2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.			

3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Radiation and need for its measurement, Physical features of radiation, Conventional sources of radiations. Exposure to natural radiation: external to the body, Radiation from cosmic rays and solar radiation, Internal exposure to the body, Radioactivity arising from technological development: Possible health hazards from nuclear and laser radiations. Maximum permissible level of radiation. Radiation quantities and units of energy flux, energy influence, cross-section.	7
II	Biological effects of radiation: Dose response characteristics, Direct and indirect action, Acute effects, Delayed effects, Cumulative effect, Accidental exposure, Radiation induced chemical changes in tissues, Radiation protection procedures (diagnostics and therapy). Radioactive waste disposal and management: Type of radioactive waste, Airborne waste, Solid and liquid waste, Assessment of Hazard.	8
III	Hidden hazards of Non-Thermal Radiation, RF and microwave radiation, Non-Thermal Effects of Pulsed RF EMR, Power Line 50/60 Hz Electric and Magnetic Fields (EMFs), Airport Scanners, Occupational Exposure, Electricity, Non-Thermal Radiation, Cell phones, Cell Phone Towers, Wi-Fi, Smart meters, microwave oven.	8
IV	Basic radiation safety criteria, Protection from direct radiation, Energy deposition, Effect of distance and shielding, Protection from contamination, Preparation of a safe radiation area, Basic Cares against Hidden hazards, Exposure Controls, Designing of labs to reduce radiation hazards.	7

Suggested Evaluation Methods

Internal Assessment:	**End Term Examination : 35 Marks**
➢ **Theory (15 Marks)** • Class Participation: **4 Marks** • Seminar/presentation/assignment/quiz/class test etc.: **04 Marks** • Mid-Term Exam: **7 Marks**	

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. RF and Microwave Radiation Safety Handbook by Ronald Kitchen
2. Hidden Dangers 5G By Captain Jerry G. Flynn
3. Health Physics: Radiation-Generating Devices, Characteristics, and Hazards by Joseph John Bevelacqua
4. Basics of Radiation Protection for Everyday Use by Leonie Munro
5. Radiation Safety Officer's Handbook by Gunhild von Oertzen and Detlof von Oertzen
6. Physics for Radiation Protection: A Handbook (Second Edition) by James E. Martin

7. Atoms, Radiation, and Radiation Protection (3rd edition) James E. Turner
8. Radiation Protection: A guide for Scientists, Regulators and Physicians (4th Edition) by Jacob Shapiro
9. Introduction to Radiobiology and Radiation Dosimetery - F.H. Aurix, John Wiley.
10. Techniques of Radiation Dosimetery - Eds K. Mahesh and DR Vij Wiley Eastern Limited.
11. Nuclear Energy - Raymond L. Murray Pergamon Press, N.Y.

Chaudhary Bansi Lal University Bhiwani Undergraduate Programs
Course: VOC-4

Session: 2024-25			
Part A - Introduction			
Subject	Physics		
Semester	4th		
Name of the Course	**Refrigeration and Air Conditioning**		
Course Code	24UN-PHY-VOC401		
Course Type: (CC/MCC/MDC/CC-M/DSEC/ VOC/DSE/PC/AEC/VAC)	VOC		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Learn about the factors contributing to food spoilage, causes of food spoilage, methods of food preservation 2. Learn about the Commercial Applications of air-conditioning 3. Understand the principles of ice production, different methods of ice manufacturing 4. Learn about the Industrial Applications of air-conditioning		
Credits	Theory	Practical	Total
	2	2	4
Contact Hours	2	4	6
Max. Marks:100 **Internal Assessment Marks:30** **End Term Exam Marks: 70**		**Time:3hrs** [Theory (35] + Practicum (35]	
Part B- Contents of the Course			
Instructions for Paper- Setter 1.Nine questions will be set in total.			

2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.

3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Food Preservation: Introduction, factors contributing to food spoilage, causes of food spoilage, methods of food preservation, freezing method of food preservation, preservation of food with direct contact of liquid N2, freeze drying, preservation of different products, cold storage and commercial cabinets	8
II	Commercial Applications: Introduction, air-conditioning of houses, offices, hotels and restaurants, air-conditioning of departmental stores, air-conditioning of theatres and auditoriums, hospitals and medical applications	7
III	Ice-Manufacturing: Introduction, principles of ice production, different methods of ice manufacturing, treatment of water for making ice, brines, freezing tanks, ice cans, quality of ice	7
IV	Industrial Applications: Introduction, importance of RH in different industries, ice-cream manufacturing, refrigeration for breweries, selection of refrigerant for breweries, use of liquid N2 for fabric, quality, air conditioning in textile and photographic industries	8
	Practicum 1. Measurement of temperature using Thermocouples in preserved samples. 2. To perform Insulation effectiveness test using thermocol/foam boxes and thermometers. 3. To Steady various method of food preservation. 4. To Measure relative Humidity using Psy chrometer or hygrometer. 5. To study cold storage and commercial cabinates. 6. To study the effect of brine on depression of freezing point. 7. To compare the ice quality using tap vs Distilled water (observation on clarity, melting rate etc.). 8. To study energy consumption analysis of cooling devices (Refrigerator / Ac) etc. 9. To study water purification method using simple filteration. 10. To study PH of various water samples using PH meter. 11. To study the TDS level of various water samples using TDS meter. 12. To study water purification method by the using UV radiations. **Note: Student will perform at least eight experiments. The examiner will allot one practical at the time of end term examination.**	30
	Suggested Evaluation Methods	

Internal Assessment:	End Term Examination
➢ **Theory (15 Marks)** • Class Participation: **4 Marks** • Seminar/presentation/assignment/quiz/class test etc.: **4Marks** • Mid-Term Exam: **7** ➢ **Practicum (15 Marks)** • Class Participation: **5** • Seminar/Demonstration/Viva-voce/Lab records etc.: **10Marks** • Mid-Term Exam: **Nil**	**: 35 Marks** **:35 Marks**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Refrigeration and Air Conditioning, Sadhu Singh, Khanna Publishing House
2. Refrigeration and Air Conditioning by C.P.Arora, McGraw Hill education (India) (P) limited, New Delhi
3. Principles of Refrigeration by Roy J. Dossat, Pearson education, New Delhi
4. Refrigeration and Air Conditioning by Manohar Prasad, New age international (P) limited, New Delhi
5. Course in Refrigeration and Air Conditioning by S.C. Arora and S. Domkundwar, Dhanpatrai andsons, Delhi

Chaudhary Bansi Lal University Bhiwani Undergraduate Programs

Course: VOC-4

Session: 2024-25			
Part A - Introduction			
Subject	Physics		
Semester	4th		
Name of the Course	**Maintenance of Laboratory Instruments**		
Course Code	24UN-PHY-VOC402		
Course Type: (CC/MCC/MDC/CC-M/DSEC/ VOC/DSE/PC/AEC/VAC)	VOC		
Level of the course (As per Annexure-I	100-199		
Pre-requisite for the course (if any)			
Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Understand the SOP related to Physics Laboratory. 2. Understand the Maintenance of Electronics experiment 3. Understand the Maintenance of mechanics experiments 4. Understand the Maintenance of optics experiments		
Credits	Theory	Practical	Total
	2	2	4
Contact Hours	2	4	6
Max. Marks:100 **Internal Assessment Marks:30** **End Term Exam Marks: 70**		**Time:3hrs** [Theory (35) + Practicum (35)]	
Part B- Contents of the Course			
Instructions for Paper- Setter **1.** Nine questions will be set in total. **2.** Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No. **3.** Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.			

Unit	Topics	Contact Hours
I	Standard Operating Procedure for Maintenance of Lab Equipment, safety rules and policies, culture of laboratory safety, responsibility and accountability for laboratory safety, special safety considerations in Physics Lab, other factors that influence laboratory safety programs,	7
II	Equipment Maintenance Documentation, Maintenance of Electronics experiment, Symbols, Terminal identification & List applications of various semiconductor devices- Diodes, Transistors, SCR, UJT etc. Introduction to voltage regulator, List types of regulators, CRO, GM Counter.	8
III	Maintenance of mechanics experiments, Basic Terms related to experiments of Mechanics,	8
IV	Maintenance of optics experiments, Basic Terms related to experiments of optics. Circuit designing and testing.	7
	Practicum 1. To study proper connection techniques, zero error checks, handling knobs and terminals using voltmeter, ammeter, rheostat to verify Ohm's Law. 2. To study zero adjustment, proper reading alignment, cleaning the jaws using vernier caliper. 3. To study backlash error using ratchet, checking zero error using screw gauge. 4. To study battery check, probe condition, dial setting and safe usage of digital multimeter. 5. To identify the faults in connection, proper field maintenance using ammeter, voltmeter, connecting wires, breadboard. 6. To study the alignment checking, handling lenses safely, dust protection using optical bench, lens ,screen. 7. To learn the prevention of mercury/alcohol spillage, safe heating, cleaning probes of and Thermometer and temperature sensors 8. To study battery replacement, button cell care, accuracy checking of stop watches and timers. 9. To study probe handling, CRT care, avoiding exposure to high voltage using CRO. 10. To study the capacitor safety, handling polarity, checking capacitance of capacitors using RC circuit. 11. To identify and use of fire extinguisher, safety gloves, lab coats etc. 12. To learn cable care, avoiding overloading, dial setting skills using function generator. **Note: Student will perform at least eight experiments. The examiner will allot one practical at the time of end term examination.**	30

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory (15 Marks)** • Class Participation: **4 Marks** • Seminar/presentation/assignment/quiz/class test etc.: **4Marks** • Mid-Term Exam: **7** ➢ **Practicum (15 Marks)** • Class Participation: **5** • Seminar/Demonstration/Viva-voce/Lab records etc.: **10Marks** • Mid-Term Exam: **Nil**	**End Term Examination : 35 Marks** **:35 Marks**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. B.Sc. Practical Physics, C.L. Arora, S. Chand Publisher, New Delhi
2. Advanced Level Practical Physics, M. Nelkon and Ogborn, Henemann Education Books Ltd., New Delhi
3. Practical Physics, S.S. Srivastava and M.K. Gupta, Atma Ram & Sons, Delhi
4. Practical Physics, S.L. Gupta and V. Kumar, Pragati Prakashan Meerut
5. Modern Approach to Practical Physics, R.K. Singla, Modern Publishers, Jalandhar
6. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, Asia Publishing House

Scheme of Examination for SEC

Semester	Course Type	Course Code	Nomenclature of paper	Credits T+P	Contact hours T+P	Internal marks	End term Marks	Total Marks	Duration of exam (Hrs) T + P
3	SEC-3	24UN-PHY-SEC301	Radiation Safety	2+1	2+2	20	50	70	3

Chaudhary Bansi Lal University Bhiwani Undergraduate Programs

Course: SEC-3

Session:2024-25	
Part A-Introduction	
Subject	Physics
Semester	3rd
Name of the Course	**Radiation Safety**
Course Code	24UN-PHY- SEC301
Course Type: (CC/MCC/MDC/CC-M/DSEC /VOC/DSE/PC/AEC/VAC)	SEC
Level of the course(Asper Annexure-I	100-199
Pre-requisite for the course(if any)	Appeared or passed the 2nd sem. (B.Sc. Physical Science)

Course Learning Outcomes(CLO):	After completing this course, the learner will be able to: 1. Have introductory idea about Basic concept of atomic structure and composition of nucleus and its properties. 2. Have the knowledge about the types of Radiation: Alpha, Beta, Gamma and Neutron and their sources. 3. Understand importance of radio isotopes, Nuclear fission and fusion reactions and their hazardous aspects 4. Have the knowledge about the importance of some scientifically and technologically advanced materials: 5. Learn to present observations, results, analysis and different concepts related to experiments nuclear and radiation physics.

Credits	Theory	Practical	Total
	2	1	3
Contact Hours	2	2	4

Max. Marks:70 **Time:3 hours**
Internal Assessment Marks:20
End Term Exam Marks: 50 [Theory (35) + Practicum (15)]

Part B-Contents of the Course

Instructions for Paper-Setter

1. Nine questions will be set in total.
2. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit	Topics	Contact Hours
I	Basics of Atomic and Nuclear Physics: Basic concept of atomic structure; X rays characteristic and production; concept of bremsstrahlung and auger electron, The composition of nucleus and its properties, mass number, isotopes of element, spin, binding energy, stable and unstable isotopes, law of radioactive decay, Mean life and half life, basic concept of alpha, beta and gamma decay, concept of cross section and kinematics of nuclear reactions, types of nuclear reaction, Fusion, fission.	8

II	Types of Radiation: Alpha, Beta, Gamma and Neutron and their sources, sealed and unsealed sources. Interaction of Photons Photoelectric effect, Compton Scattering, Pair Production, Linear and Mass Attenuation Coefficients, Interaction of Charged Particles: Heavy charged particles Beth-Bloch Formula, Scaling laws, Mass Stopping Power, Range, Straggling, Channeling and Cherenkov radiation. Beta Particles- Collision and Radiation loss (Bremsstrahlung), Interaction of Neutrons- Collision, slowing down and Moderation	8
III	Radiation detection and monitoring devices: Radiation Quantities and Units: Basic idea of different units of activity, KERMA, exposure, absorbed dose, equivalent dose, effective dose, collective equivalent dose. Radiation detection: Basic concept and working principle of gas detectors (Ionization Chambers, Proportional Counter, and Gieger Muller Counter), Scintillation Detectors.	7
IV	Radiation safety management: Biological effects of ionizing radiation, Operational limits and basics of radiation hazards evaluation and control: radiation protection standards, Application of nuclear techniques: Application in medical science (e.g., MRI, PET, Projection Imaging Gamma Camera, radiation therapy), Archaeology, Art, Crime detection, Mining and oil. Industrial Uses: Tracing, Gauging, Material Modification, Sterization, Food preservation.	7
	Practicum 1. Study the background radiation levels using Radiation meter. Study of characteristics of GM tube and determination of operating voltage and plateau length using background radiation as source (without commercial source). 2. Study of counting statistics using background radiation using GM counter. 3. Study of radiation in various materials (e.g. KSO4 etc.). Investigation of possible radiation in different routine materials by operating GM at operating voltage. 4. Study of absorption of beta particles in Aluminum using GM counter. 5. Detection of a particles using reference source & determining its half life using spark counter 6. Gamma spectrum of Gas Light mantle (Source of Thorium) 7. Characteristics of Geiger Muller (GM) Counter: **Note: Student will perform at least six experiments. The examiner will allot one practical at the time of end term examination.**	30

Suggested Evaluation Methods	

Internal Assessment:
• **Theory (15 Marks)**
  ◦ Class Participation: **4 Marks**
  ◦ Seminar/presentation/assignment/quiz/classtestetc.:**4 Marks**
  ◦ Mid-TermExam:**7 Marks**
Practicum (5 Marks)
  ◦ Class Participation: **Nil**
  ◦ Seminar/Demonstration/Viva-voce/Lab records etc.: **5 Marks**
  ◦ Mid-Term Exam: **Nil**
	End Term Examination
	:Marks
	: 35 Marks
	
	:15 Marks

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. W.E. Burcham and M. Jobes- Nuclear and Particle Physics - Longman (1995)
2. G.F.Knoll, Radiation detection and measurements
3. Thermo luminescense Dosimetry, Mcknlay, A.F., Bristol, Adam Hilger (Medical Physics Handbook 5)
4. W.J. Meredith and J.B. Massey, "Fundamental Physics of Radiology", JohnWright and Sons, UK, 1989.
5. J.R. Greening, "Fundamentals of Radiation Dosimetry", Medical Physics HandBook Series, No.6, Adam Hilger Ltd., Bristol 1981.
6. Practical Applications of Radioactivity and Nuclear Radiations, G.C. Lowentaland P.L. Airey, Cambridge University Press, U.K., 2001
7. W.R. Hendee, "MedRadiation Physics", Year Book-Medical Publishers Inc. London, 1981.