DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBHAJINAGAR.

CIRCULAR NO.SU/B.Sc./CBC&GS/109/2024

It is hereby inform to all concerned that, the syllabus prepared by the Board of Studies and recommended by the Dean, Faculty of Science & Technology, Academic Council at its meeting held on 08 April 2024 has accepted the **B.Sc. Physics (Optional) Vth and VIth semester under the Faculty of Science & Technology as per Choice Based Credit Grading System** run at the Affiliated Colleges, Dr.Babasaheb Ambedkar Marathwada University as appended herewith.

This is effective from the Academic Year 2024-25 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and neccssary action.

University Campus,
Aurangabad-431 004.
REF.NO.SU/2024/91-99
Date:- 01.06.2024.

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Deputy Registrar,
Academic Section

Copy forwarded with compliments to :-

1] **The Principal of all concerned Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,
2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

Copy to :-

1] The Director, Board of Examinations & Evaluation, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
2] The Section Officer,[B.Sc.Unit] Examination Branch, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
3] The Programmer [Computer Unit-1] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
4] The Programmer [Computer Unit-2] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
5] The In-charge,[E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
6] The Public Relation Officer, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
7] The Record Keeper, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBHAJINAGAR

FACULTY OF SCIENCE AND TECHNOLOGY

Bachelor of Science in Physics

(B. Sc. in Physics)

(3 Year U. G. Program)

As Per

Choice Based Credit & Grading System

Course Structure and Curriculum

B. Sc. Third Year
(Semester V & VI)

01/06/2024

05/06/2024

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBHAJINAGAR

Effective from Academic Year: 2024-25

Title of the Course: B. Sc. Physics

Preamble:

The curriculum for the B. Sc. (Physics) programme is designed to cater to the requirement of Choice Based Credit System following the University Grants Commission (UGC) guidelines. In the proposed structure, due consideration is given to Core and Elective Courses (Discipline specific - Physics), along with Ability Enhancement (Compulsory and Skill based) Courses. Furthermore, continuous assessment is an integral part of the CBCS, which will facilitate systematic and thorough learning towards better understanding of the subject. The systematic and planned curricula from first year to the third year (comprised of six semesters) shall motivate the student for pursuing higher studies in Physics and inculcate enough skills for becoming an entrepreneur.

Objectives:

- To foster scientific attitude, provide in-depth knowledge of scientific and technological concepts of Physics.
- To enrich knowledge through problem solving, minor/major projects, seminars, tutorials, review of research articles/papers, participation in scientific events, study visits, etc.
- To familiarize with recent scientific and technological developments
- To create foundation for research and development in Physics.
- To help students to learn various experimental and computational tools thereby developing analytical abilities to address real world problems.
- To train students in skills related to research, education, industry, and market.
- To help students to build-up a progressive and successful career in Physics.

Structure of the Course

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

Choice Based Credit System (CBCS) Curriculum for Physics Under Faculty of Science and Technology
Course Structure and Scheme of Examination
B.Sc. Three Year Undergraduate Degree Program

	Course Code	Course Title	Total periods (Teaching periods/ week)	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Semester V								
Optional I (DSC-1C) Core Courses	PHY-511	Core Course **(Classical & Quantum Mechanics)**	45(3/week)	2	50	10	40	20
	PHY-512	Core Course **(Electrodynamics)**	45(3/week)	2	50	10	40	20
	PHY-521	Lab course 7 (Based on PHY-511)	45(3/week)	1.5	50	10	40	20
	PHY-522	Lab course 8 (Based on PHY-512)	45(3/week)	1.5	50	10	40	20
Skill Enhancement course (SEC-1)	SEC-513	SEC-1 Any one skill to be chosen out of two SEC-1(A): **Soil Physics,** SEC-1(B): **Data Science**	45(3/week)	2	50	10	40	20
			225	09	250	50	200	100
Total Credits for Semester V : 09 (Theory : 06 ; Laboratory : 3)								
Semester VI								
Optional I (DSC-1D) Core Courses	PHY-611	Core Course **(Atomic and Molecular Physics)**	45(3/week)	2	50	10	40	20
	PHY-612	Core Course **(Optical fiber and Communication)**	45(3/week)	2	50	10	40	20
	PHY-621	**Lab course 9** (Based on PHY- 611)	45(3/week)	1.5	50	10	40	20
	PHY-622	**Lab course 10** (Based on PHY- 612)	45(3/week)	1.5	50	10	40	20
Skill Enhancement course (SEC-2)	SEC-613	SEC-2 Any one skill to be chosen out of two SEC-2 (C): **Basics of Space Science** SEC-2 (D): **Smart Materials and Structures**	45(3/week)	2	50	10	40	20
			225	09	250	50	200	100
Total Credits for Semester VI : 09 (Theory : 06; Laboratory : 03)								
Total Credits for three years: Sem 1 (11.5) + Sem II (15.5) + Sem III (15) Sem IV (17) Sem V (09) + Sem VI (09)= 77 Credits								

Important Notes:

i) **Nomenclature**: DSC- Discipline Specific Core course, SEC – Skill Enhancement Course, AECC- Ability Enhancement compulsory course, DSE- Discipline Specific Elective, UA-University Assessment (Semester End), CIA-Continuous Internal Assessment.

ii) **There shall be one skill enhancement course (SEC) IIIrd to VIth Semester (any one SEC course to be chosen (any one from three optional subjects) from the basket of SEC courses for the respective semester.**

iii) **Code description**: XXX code has to be decided by BoS of the respective subject while designing their respective curriculum (e.g., for Physics it will be PHY; for Electronics it will be ELE)

- The codes for first semester courses will start from XXX-111, Second-semester courses will start from XXX-211 and so on
- XXX-111: The first digit indicates the Semester Number; the second two digits indicate paper numbers for the first-semester courses and the same analogy is for the remaining semesters
- The codes for theory courses will start from XXX-111 (for the first semester and the same analogy is for the remaining semesters)
- The codes for practical courses will start from XXX-121 (for the first semester and the same analogy is for the remaining semesters)
- The codes for Ability Enhancement compulsory courses will start from XXX-131 (for the first semester and the same analogy is for the remaining semesters)

iv) **Assessment**: 80% for University Assessment (Semester End Examination) and 20 % for Continuous Internal Assessment (CIA)

v) **Continuous Internal Assessment (CIA): Theory** (10 Marks): Internal Test 05 Marks (Two Internal Tests of 05 marks each and average of the two tests will be considered) and 05 Marks for Assignment/tutorials.

vi) **Continuous Internal Assessment (CIA): Practical** (10 Marks): 07 Marks for Internal Practical Examination and 03 Marks for record book/submission of collection and field survey report and excursion report

vii) Practical examination: Annual examination

B. Sc. THIRD YEAR

SEMESTER-V

B. Sc. Third Year Physics
(Semester V)
(Classical and Quantum Mechanics)
Course Code: PHY-511

Periods: 45 **Credit: 02** **Max. Marks: 50 (CIA =10, UA 40)**

Course Outcomes: On successful completion of this course students will be able to:

- Idea and concepts in classical physics
- Basic concepts in Vibrational principle and Principle of Least Actions.
- Difference between classical and quantum mechanical theory and approach
- Linear Vector Space, operators and tools to calculate Eigen values
- Various techniques to solve time dependent and time independent Schrodinger equations using different coordinate systems

Unit I - Classical Mechanics **[11 L]**

Mechanics of Particle, Mechanics of system of particles Constraints, Classification of Constraints, Virtual Work, D'Alembert's principle, Lagrange's equation, Simple application of Lagrangian formulation –Simple Pendulum, Particle in space, Linear Harmonic Oscillator, Atwood's Machine.

Unit II - Origin of Quantum theory **[12 L]**

Introduction, Failure of Classical mechanics, Black body Radiation (Distribution of Energy), Plank's Quantum theory-Plank's Quantum postulates, linear momentum of photon in terms of wave vector, Plank's radiation law-Wein's law and Rayleigh's law, Einstein's equation: Quantum theory of photoelectric effect, Quantum effect.

Unit III - Wave Particle duality **[12L]**

Introduction, de-Broglie's hypothesis for matter waves, de-Broglie's wavelength in terms of energy and temperature, de-Broglie phase velocity and particle velocity (relation between them), Group velocity, Relation between group velocity and phase velocity, Davisson-Germer Experiment, Heisenberg uncertainty principle, Applications of Heisenberg uncertainty principle (1) Nonexistence of electrons in nucleus (2) Binding energy of an electron in an atom.

Unit IV - The Schrodinger Equation and its applications **[10 L]**

Wave Function (Ψ) of a moving particle, Time dependent Schrodinger's wave equation, Expectation value, Operators, Time independent Schrodinger equation (steady state form), particle in onc dimensional box, Quantization of energy and momentum.

Reference Books

1) Classical Mechanics- H- Goldstein
2) Classical Mechanics – N.C. Rana and P.S. Joag
3) Classical Mechanics – Gupta, Kumar and Sharma
4) Physics for degree student – C.L. Arora, P.S. Hemne (Ist edition S. Chand Publication).
5) Quantum Chemistry- Donald Allan Macquarie (Viva-Books Pvt. Ltd.).
6) Concepts of Modern Physics - Arthur Beiser, ShobhitMahajan, S. RaiChoudhary (VIth Edition- Mc- Graw Hill).
7) Perspective of Modern Physics – Arthur Beiser.

B. Sc. Third Year Physics
(Semester V)
(Electrodynamics)
Course Code: PHY-512

Periods: 45 **Credit: 02** **Max. Marks: 50 (CIA =10, UA 40)**

Course Outcomes: On successful completion of this course students will be able to:

- The difference between static and dynamical systems
- Maxwell's equations and time-varying fields
- Gauges in electrodynamics, retarded potentials and its applications
- Radiation from time varying source, charged particle dynamics and relativistic electrodynamics

Unit – I: Electrostatics **[12 L]**

Introduction : Electric field lines , electric flux and Gauss law, the divergence of E, Curl of E, Application of Gauss law: i) Electric field due to a uniform charged sphere ii) Electric field due to charged cylinder, Gaussian pillbox, Poisson's equation, Laplace's equation, Uniqueness theorem (First and Second)

Unit – II: Time varying field **[10 L]**

Faraday's Law of Electromagnetic induction, Lenz's law, Self-Induction, Mutual Induction, equation of continuity, Maxwell's displacement current, Maxwell's equation (Derivation, Differential form)

Unit – III: Electromagnetic waves III **[15 L]**

Origin of electromagnetic waves, characteristics of electromagnetic wave, electromagnetic wave equations in a conducting medium, transverse nature of electromagnetic wave, plane polarized electromagnetic wave, The Poynting Vector, Poynting theorem, Polarization of Electromagnetic waves

Unit – IV: Interaction of Electromagnetic waves with matter **[08 L]**

Boundary condition for the electromagnetic field vector –**B,E,D and H** at the interface between the two media, reflection and refraction at the boundary of two non-conducting media.

Reference Books:

1. Introduction to Electrodynamics-David J. Griffiths, Third Edition.
2. Mechanics and Electrodynamics - Brijlal N. Subrahmanyam, JivanSeshan
3. Classical Electrodynamics – S.P. Pure
4. Electrodynamics- B.B. Laud
5. Electrodynamics-Gupta, Kumar and Singh, Pragati Prakashan, Meerut
6. Electromagnetic waves and fields –R.N.Singh

B. Sc. Third Year Physics
(Semester V)
Physics Practical: Lab Course-7
Course Code: PHY-521

Credit: 1.5 Max. **Marks: 50 (CIA-10 and UA-40)**

List of Experiments:

1. Thermal conductivity of bad conductor by using Lees disc method
2. Steafan's constant by using thermocouple
3. Study of absorption spectra of iodine and determination of its wavelength using grating
4. Temperature coefficient of resistance of semiconductor
5. Temperature of sodium flame
6. To determine the coefficient of thermal conductivity of copper by Searl's apparatus
7. Y by Koeing's method
8. Surface tension by ripple method.

Note: Students should perform at least six experiments

B. Sc. Third Year Physics
(Semester-V)
Physics Practical: Lab Course-8
Course Code: PHY-522

Credit: 1.5 **Max. Marks: 50 (CIA-10 and UA-40)**

List of Experiments:

1. Field along the axis of circular coil
2. Determination of absolute value of BH and BV by using Earths Inductor
3. B-H curve using magnetometer
4. To find the coefficient of mutual inductance of two coils
5. To find the coefficient of self-inductance by Rayleigh method.
6. To determine the charge sensitivity of a moving coil B.G. using known capacitor.
7. Determination of frequency of AC mains by Sonometer.
8. Bridge Rectifier

Note: Students should perform at least six experiments

B. Sc. Third Year Physics
(Semester-V)
Skill Enhancement Course

NOTE:
Any one skill Enhancement Course to be chosen out of two either 'SEC-1(A): Soil Physics or SEC-1(B): Data Science

B. Sc. Third Year Physics

(Semester V)

Title of the course: SEC-1(A) Soil Physics

Course code: SEC-513

Periods: 45 **Credit: 02** **Max. Marks: 50 (CIA=10, UA=40)**

Learning Objectives:

At the completion of this course, the student should be –

- Understanding Soil Composition: Gain knowledge of the composition of soil, including minerals, organic matter, air, and water, and their influence on soil properties.
- Soil Structure and Texture: Learn how soil particles are organized to form aggregates and how particle size distribution affects soil texture and structure.
- Soil Water Relations: Understand the movement, retention, and availability of water in soils, soil water potential.

Unit – I: Introduction to Soil Physics **[10L]**

Introduction, Importance of Soil Physics, Interactions of Soil Physics with Other Disciplines, Soil Formation, Soil Profile, Soil Texture, Soil Separates, Methods for Particle Size Measurement, Particle Shapes

Unit – II: Soil Physical Properties **[10L]**

Physical Properties of Soil, Soil Color, Soil Particle Density, Soil Bulk Density, Soil Porosity, Soil Water Content, Soil Structure, Types of Soil Structure, Properties of Soil Aggregates

Unit – III: Energy State of Soil Water **[10L]**

Definitions and Components of Soil Water Potential, Total Soil Water Potential, Pressure Potential, Matric Potential, Gravitational Potential, soil-moisture characteristic curve; hysteresis, measurement of soil-moisture potential.

Unit – IV: Modes of energy transfer in soils **[10L]**

Introduction, Energy balance, thermal properties of soil, measurement of soil temperature, soil temperature in relation to plant growth; soil temperature management.

Reference Books:

1. Soil physics an introduction by Manoj K. Shukla, CRC press, Taylor & Francis group (2014).
2. Textbook of Soil Physics By Arun Kumar Saha, Anuradha Saha, Kalyani Publishers, India (2012)
3. Textbook of Soil Science by T. Biswas, S Mukherjee McGraw Hill Education (India); 2nd edition (2017)
4. Fundamentals of soil science Henry D. Forth, John Wiley & Sons, 8th Edition (1990).
5. Soil physics companion by A. W. Warrick, CRC press, (2002).
6. Soil Physics by Ghildyal BP & Tripathi RP, New Age International (2001)

B. Sc. Third Year Physics
(Semester V)
Title of the course: SEC-1(B) Data Science
Course code: SEC-513

Periods: 45 **Credit: 02** **Max. Marks: 50 (CIA=10, UA=40)**

Learning Objectives:

At the completion of this course, the student should be –

- Integration of physics principles into data science.
- Insights into leveraging physics concepts for data collection, analysis, and modeling.
- Acquisition of fundamental physics understanding for practical application in data science contexts.

Unit – I: Introduction to Data Science **[10L]**

Introduction, purpose of data science, components of data science, role of a data scientist, problems and solutions using data science, benefits, challenges, and applications of data science, data science life cycle.

Unit – II: Data Science and Physics **[10L]**

Understanding the course's interdisciplinary nature, A physicist's view of the natural world and probabilities, data – types of data, data to information, information to knowledge, critical differences between information and knowledge.

Unit – III: Data Acquisition Techniques in Physics **[10L]**

Exploring the fundamental concepts of physics in data science, Data Collection in Physics, Data Sampling, Data Calibration, Data Analysis, Benefits of Data Science in Physics, Challenges and Limitations

Unit – IV: Foundations of Machine Learning [10L]

Introduction to machine learning and its relevance to physics, Overview of supervised, unsupervised, and reinforcement learning., Basic concepts: training, testing, validation, and evaluation., Introduction to popular machine learning algorithms (Linear Regression, Logistic Regression, Decision Trees, Random Forests, Support Vector Machines (SVM))

Reference Books:

1. Physics of Data Science and Machine Learning by Ijaz A. Rauf, CRC Press, Taylor & Francis Group, LLC (2022)
2. Data Science: A Beginner's Guid: A Beginner's Guide by C. Raju, Penguin Business-India, (2023)
3. Data Science for Civil Engineering, A Beginner's Guide by R. K. Jain P. S. Dhotre D. T. Mane P. N. Mahalle, CRC Press, Taylor & Francis Group, LLC (2023)
4. Data Analysis Techniques for Physical Scientists by Pruneau Claude A, Cambridge University Press (2017)

B. Sc. THIRD YEAR

SEMESTER-VI

B. Sc. Third Year Physics
(Semester VI)
(Atomic and Molecular Physics)
Course code PHY-611

Periods: 45 **Credit: 02** **Max. Marks: 50 (CIA=10, UA=40)**

Course Outcomes: On successful completion of this course students will be able to:

- Gain the thorough understanding of the basic structure of hydrogen like atoms
- Learn the selection rules for two-electron atoms and many-electron atoms
- Apply various molecular spectroscopy principles
- Apply knowledge of physics to become successful in national level examinations

Unit – I: The Atom Model: **[10 L]**

Introduction, Thomson atom model, the Rutherford nuclear atom model, drawbacks of Rutherford atomic model, the Bohr's atom model, Bohr's theory of origin of spectral lines, diagrammatic representation of the series spectrum of the H-atom in the light of Bohr's theory.

Unit – II: Vector Atom Model: **[12 L]**

Introduction-vector atom model, Quantum numbers associated with the vector atom model, L-S coupling, j-j coupling, Lande's g factor, The Pauli's exclusion principle, Selection rules, Intensity Rules, Interval Rule, Normal Zeeman effect, Anomalous Zeeman effect, Stark effect and its experimental study.

Unit – III: Molecular spectra: **[13 L]**

Born-Oppenheimer approximation, rotational spectra of diatomic molecules-rigid rotator, vibrational-rotational spectra of diatomic molecule- harmonic oscillator, effect of an-harmonicity, electronic spectra of diatomic molecules, Intensity of Vibrational Electronic Spectra, Frank-Condon principle.

Unit - IV: Raman Spectroscopy: **[10 L]**

Raman Effect, Characteristics properties of Raman lines, Classical theory of Raman effect, Electron spin resonance (ESR), Nuclear magnetic resonance (NMR), Effect of Nuclear spin on intensities of rotational Raman spectra

Reference Books:

1. Atomic Physics – J.B. Rajam, S. Chand & Company Ltd.
2. Physics for degree students – C.L. Arora, Dr. P.S. Hemne, S. Chand Publication
3. Modern Physics – R. Murugeshan, Er. Kiruthiga Sivaprasath, S. Chand Publication
4. Introduction of Atomic Spectra-white.
5. Fundamentals of Molecular Spectroscopy- C.N. Banwell and E.M. McCash (McGraw Hill International Edition)

B. Sc. Third Year Physics
(Semester VI)
(Optical Fiber and Communication)
Course code PHY-612

Periods: 45 **Credit: 02** **Max. Marks: 50 (CIA=10, UA=40)**

Course Outcomes: On successful completion of this course students will be able to:

- Realize the significance of optical fiber communications.
- Design the optical system.
- Understand the construction and working of optical fiber cable.
- Develop the knowledge of fibre fabrication.
- Identify and understand the needs of OFC.

Unit – I: Introduction to fiber optic: **[10 L]**

Introduction, Construction of optical fiber cable, working of optical fiber, Strength members, types of optical fiber: step index fiber, graded index fiber, plastic optical fiber, glass fiber, importance of optical fiber, advantages and disadvantages of fiber optics

Unit – II: Fiber Fabrication: **[12 L]**

Introduction, Process of fiber fabrication, types of fiber fabrication: outside vapor phase oxidation (OVPO), vapor phase axial deposition (VAD), modified chemical vapor deposition (MCVD), plasma-activated chemical vapor deposition (PCVD), general fiber fabrication

Unit – III: Optical Fiber Communication (OFC): **[13 L]**

Introduction, General optical communication system, needs of optical communication, advantages of optical fiber communication, optical fiber waveguide, Ray theory: reflection, refraction, transmission total internal reflection, Snell's law, critical angle, acceptance angle, numerical aperture. Applications of Optical Fiber Communication

Unit - IV: Transmission Characteristic of Optical Fiber: **[10 L]**

Introduction, Attenuation, Attenuation unit, absorption, extrinsic and intrinsic absorption, Rayleigh scattering loss, bending loss, core and cladding loss, signal distortion in optical wave guide.

Reference Books:

1. Fiber Optics and Optoelectronics - R.P. Khare, Oxford University Press.
2. Optical Fiber Communication- Gerd Keiser, 4th Ed., MGH, 2008.
3. Optical Fiber Communications- John M. Senior, Pearson Education. 3rd Impression, 2007.
4. Fiber optic communication – Joseph C Palais: 4th Edition, Pearson Education.
5. Optical Fiber Communications - Gerd Keiser, Tata Mc Graw-Hill International edition, 4th Edition, 2008
6. Text Book on Optical Fibre Communication and its Applications - S.C. Gupta, PHI, 2005.
7. Fiber Optic Communication Systems – Govind P. Agarwal, John Wiley, 3rd Edn, 2004.

B. Sc. Third Year Physics
(Semester VI)
Physics Practical: Lab Course-9
Course Code: PHY-621

Credit: 1.5 **Max. Marks: 50 (CIA: 10 and UA: 40)**

List of Experiments:

1. Cauchy's constant by using spectrometer
2. λ by grating (normal incidence)
3. Edser's A pattern
4. Hartmann dispersion formula
5. To measure numerical aperture of optical fibre.
6. To study the variation in bending loss in multimode fibre.
7. Comparisons of capacitor by using D'saughty method
8. Comparisons of capacitor by using D'saughty method

Note: Students should perform at least six experiments

B. Sc. Third Year Physics
(Semester VI)
Physics Practical: Lab Course-10
Course Code: PHY-622

Credit: 1.5 **Max. Marks: 50 (CIA=10 and UA=40)**

List of Experiments:

1. Full wave rectifier with pi filter
2. High resistance by leakage through condenser.
3. e-by Millikan's oil drop method
4. R.I. of optical fibre
5. Maxwell's bridge
6. Transistorized Regulated power supply using Zener diode.
7. Study of CRO
8. To measure the phase difference between current and voltage for C-R circuit using CRO.
9. To study Lissajous figures

Note: Students should perform at least six experiments

B. Sc. Third Year Physics
(Semester VI)
Skill Enhancement Course

NOTE:
Any one skill Enhancement Course to be chosen out of two either 'SEC-2(C) Basics of Space Science or 'SEC-2(D) Smart Materials

B. Sc. Third Year Physics
(Semester VI)
Title of the course: SEC-2(C) Basics of Space Science
Course code: SEC-613

Periods: 45 **Credit: 02** **Max. Marks: 50 (CIA=10, UA=40)**

Learning Objectives: At the completion of this course, the student should be –

- Understand the formation and evolution of the solar system.
- Understand the significance of the Sun within the solar system and grasp foundational concepts of solar astronomy and observational techniques.
- Identify and describe the various celestial bodies in the solar system.
- Analyze the historical perspectives on the solar system and comprehend the motion of planets.

Unit – I: Introduction to Solar System **[10L]**

Formation and evolution of the solar system, Overview of celestial bodies in the solar system, Historical perspectives on the solar system, Motion of Planets, Keplars 1st and 2nd law.

Unit – II: The Sun **[10L]**

Overview of the Sun's importance in the solar system, Introduction to solar astronomy and observational techniques, Brief Study of Indian Solar mission "Aditya L-1, The Sun's internal structure: core, radiative zone, and convective zone, Composition of the Sun: hydrogen, helium, and trace elements., Nuclear fusion reactions in the Sun's core., Solar neutrinos and the solar energy generation process.

Unit – II: The Inner and Outer Planets **[10L]**

The Inner Planets: Introduction to the inner planets: Mercury, Venus, Earth, and Mars, Comparative planetology: similarities and differences among the inner planets., Geology and surface features of the inner planets.

The Outer Planets: Overview of the outer planets: Jupiter, Saturn, Uranus, and Neptune, Rings, moons, and unique features of the outer planets, Comparative analysis of the atmospheres and magnetospheres of the outer planets.

Unit – III: Moons, Asteroids, and Comets **[10L]**

The role and characteristics of moons: Types and functions of moons, Moons in the context of planetary systems, Key moons of the solar system, Moon formation and properties, Geology, atmospheres, and potential habitability, Notable moon missions and discoveries.

Asteroids and comets in the solar system: Types and distribution of asteroids, Asteroid composition and classification, Composition, structure, and orbits of comets, The life cycle of comets.

Reference Books:

1. The Origin and Evolution of the Solar System by MM Woolfson, Institute of Physics Publishing Bristol and Philadelphia, (2000)
2. Physics and Chemistry of the Solar System by John S. Lewis 2nd Edition, Elsevier Academic Press (2004)
3. A Brief History of Time by Stephen Hawking, Bantam Publisher (1988)

B. Sc. Third Year Physics
(Semester VI)
Title of the course: SEC-2(D) Smart Materials and Structures
Course code: SEC- 613

Periods: 45 **Credit: 02** **Max. Marks: 50 (CIA=10, UA=40)**

Learning Objectives: At the completion of this course, the student should be –

- Understand the fundamentals and applications of various smart materials and structures.
- Be able to identify major smart materials and their properties.
- Be able to identify major smart structures, mechanisms, and performance.
- Be able to select and use smart materials and structures for specific applications.
- Get familiar with the characterization and manufacturing techniques for smart materials, structures, and systems

Unit – I: Introduction to Smart Materials: **[12 L]**

Introduction to Smart Materials, Principles of Piezoelectricity, Perovskite Piezoceramic Materials, Single Crystals vs Polycrystalline Systems, Piezoelectric Polymers, Principles of Magnetostriction, Rare earth Magnetostrictive materials, Giant Magnetostriction and Magneto-resistance Effect, Introduction to Electro-active Materials, Electronic Materials, Electro-active Polymers, Ionic Polymer Matrix Composite (IPMC), Shape Memory Effect, Shape Memory Alloys, Shape Memory Polymers, Electro-rheological Fluids, Magneto Rhelological Fluids

Unit – II: High-Band Width, Low Strain Smart Sensors: **[13 L]**

Piezeoelctric Strain Sensors, In-plane and Out-of Plane Sensing, Shear Sensing, Accelerometers, Effect of Electrode Pattern, Active Fibre Sensing, Magnetostrictive Sensing, Villari Effect, Matteuci Effect and Nagoka-Honda Effect, Magnetic Delay Line Sensing, Application of Smart Sensors for Structural Health Monitoring (SHM), System Identification using Smart Sensors. Self-Sensing Piezoelectric Transducers, Energy Harvesting Materials, Autophagous Materials, Self-Healing Polymers, Intelligent System Design, Emergent System Design

Unit – III: Smart Composites: **[8 L]**

Review of Composite Materials, Micro and Macro-mechanics, Modelling Laminated Composites based on Classical Laminated Plate Theory, Effect of Shear Deformation, Dynamics of Smart Composite Beam, Governing Equation of Motion, Finite Element Modelling of Smart Composite Beams

Unit – V: Carbon Based Materials: **[12 L]**

Diamond, Graphite, Graphene, Fullerenes, Metallofullerenes, Carbon nanotubes, Carbon dots, Carbon nanocones, Carbon nanohorns, Nanodiamond, Stability of carbon phases at nanolevel, Phase diagram. Chemical reactivity, Electrical conductivity, Thermal conductivity, Mechanical strength. Energy storage devices, Quantum computers, Antioxidants, Polymer electronics, Environmental protection, Food processing & packaging, Agrotechnology, Nanosensors, Drug delivery, Nanorobots, Cosmetics.

Reference Books:

1. Encyclopedia of Smart Materials, Ed.: M. Schwartz, John Wiley and Sons, New York, 2002
2. Brian Culsha, Smart Structures and Materials, Artech House, 2000.
3. M.V. Gandhi, B.D. Tompson, "Smart Materials and Structures" Springer Science & Business Media, 1992.
4. Jasprit Singh: Smart Electronic Materials: Fundamentals and Applications, Cambridge University Press, Cambridge, 2005
5. Graphene, Carbon Nanotubes, and Nanostructures: Techniques and Applications, James E. Morris, Krzysztof Iniewski, CRC Press, 2013

6. Carbon Nanotubes and Related Structures: Synthesis, Characterization and Applications, Edited by Dirk M. Guldi, Nazario Martín, Wiley-VCH Verlag, 2010

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Nature of Question Paper (Theory) for choice based credit system (CBCS) semester pattern.

Subject: Physics

Time: 2 hours | Max. Marks: 40

Instructions:

1. All questions are compulsory.
2. All questions carry equal marks.
3. Draw neat diagrams and give equations wherever necessary.
4. Figures to the right indicate full marks.
5. Use of logarithmic table and calculator is allowed.

Q. 1) Long answer questions (Solve any one) 10

A. Question from Unit – I

B. Question from Unit – III

Q. 2) Long answer questions (Solve any one) 10

A. Question from Unit – II

B. Question from Unit – IV

Q. 3) Short answer questions / problems 10

A. Short answer question / problem from Unit – I

B. Short answer question / problem from Unit – III

OR

A. Short answer question / problem from Unit – II

B. Short answer question / problem from Unit – IV

Q. 4) Multiple Choice Questions (MCQ) 10

Note: Ten MCQ's having four alternatives based on theory and numerical.
(Minimum two MCQ's from each chapter)

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Scheme of Practical examination and marks (Practical) for choice based credit system (CBCS) semester pattern.

B. Sc. Third Year Semester-V (**PHY-521, 522**) and Semester- VI (**PHY-621, 622**)

Subject: Physics

i) **Continuous Internal Assessment (CIA): Practical** (10 Marks): 07 Marks for Internal Practical Examination and 03 Marks for record book /submission of collection and field survey report and excursion report

ii) Practical examination: Annual examination

*Continuous Internal Assessment (CIA) For 40 Marks distribution

Course title	Internal Practical Examination	Record book	Total
PHY-521	07 Marks	03 Marks	10 Marks
PHY-522	07 Marks	03 Marks	10 Marks
PHY-621	07 Marks	03 Marks	10 Marks
PHY-622	07 Marks	03 Marks	10 Marks
Total	**28 Marks**	**12 Marks**	**40 Marks**

PRACTICAL EXAMINATION (UA)

1. Experimental performance 521 + 621 – 70 marks + Viva voce 10 marks = 80 Marks
2. Experimental performance 522 + 622 – 70 marks + Viva voce 10 marks = 80 Marks

01/06/2024