TUMKUR UNIVERSITY

Program Name	B.Sc. in Physics	**Semester**	V
Course Title	**ELEMENTS OF MODERN PHYSICS** (Theory)		
Course Code	PHY501 (DSC)	**No. of Credits**	03
Contact Hours	45 Hours	**Duration of SEP/Exam**	3 Hours
Formative Assessment Marks	20	**Summative Assessment Marks**	80

COURSE LEARNING OUTCOMES (CO)

After the successful completion of the course, the student will	
CO1	Understand the basics principles of special theory of relativity and quantum mechanics.
CO2	Enrich the knowledge of Quantum nature of light and particles.
CO3	Get the knowledge and importance of understanding quantum properties of materials.
CO4	Understand the importance of special theory of relativity and quantum mechanics.

MAPPING OF COURSE LEARNING OUTCOMES (CO) WITH PROGRAMME OUTCOMES (PO)

Course Outcomes (CO)	Programme Outcomes (PO)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	3	2	3	2	2	3	2	1	2	2	3	2
CO2	3	1	3	1	3	1	2	2	2	2	2	2
CO3	3	2	2	3	3	2	2	2	3	3	3	3
CO4	3	2	3	2	2	1	3	1	2	1	2	1

Score indicators: High=3, Medium=2, Low=1

Pedagogy: Interactive lectures, inquiry-based learning, blended learning, learning based on experiments.

V SEMESTER B.Sc. PHYSICS SYLLABUS

Discipline Specific Core: PHY501 (DSC)

ELEMENTS OF MODERN PHYSICS

Course duration: 15 weeks with 3 hours of instruction per week

UNIT-I

Reference frames: Inertial and non-inertial frames with examples. Assumptions of Classical relativity - Galilean transformations; Galilean invariance. Galilean addition of velocities applied to the speed of light. Reasons for Aether hypothesis, Michelson-Morley Experiment and discussion of its outcomes. Numerical problems.

Relativistic Kinematics: Postulates of Special Theory of Relativity. Lorentz Transformations of space and time. Simultaneity and order of events. Length contraction. Time dilation. Relativistic transformation of velocity and frequency. Relativistic addition of velocities; Relativistic Doppler effect. Numerical problems. (15 Hours)

UNIT-II

Relativistic Dynamics: Rest mass and relativistic mass of particles, rest-massless particles, Derivation of Mass-energy Equivalence. Transformation of Energy and Momentum. Comparison of Galilean and special relativity assumptions and results. Numerical problems.

Early quantum mechanics: Brief discussion of classical ideas of particle, its energy continuity and representation in phase space, its time evolution and phase portrait. Failure of classical physics to explain the phenomena such as stability of an atom, atomic spectra and black body radiation. Photoelectric effect – Experimental observations and Einstein's explanation; Compton effect–Derivation of Compton shift. Qualitative discussion of specific heat of solids based on quantum ideas. De Broglie's matter wave hypothesis–Expression for wavelength. Heisenberg's uncertainty principle and discussion of its three versions with examples and plotting of $\Delta x \cdot \Delta p_x \geq \frac{\hbar}{2}$. Numerical problems. (15 Hours)

UNIT-III

Double-slit experiment with classical particles and quantum particles. Wave description of particles using wave packets; group velocity and phase velocity, and the relation between them. Experimental evidence for matter waves: the Davisson–Germer experiment and the G. P. Thomson experiment, and their outcomes. Wave function ψ and its physical interpretation, normalization of the wave function. Concept of probability and probability density. Operators and commutators, eigen values and eigen states, expectation values of operators. Basic postulates of quantum mechanics. Derivation of the time-independent Schrödinger equation from the time-dependent Schrödinger equation. Applications of the Schrödinger equation: Particle in a one-dimensional infinite square well potential. Qualitative discussion of particle in a three-dimensional infinite square well potential. Discussion of degenerate energy levels. Numerical problems.

(15 Hours)

REFERENCES

1. **Govinda S. Krishnaswami,** (2024). *Classical Mechanics: From Particles to Continua and Regularity to Chaos*. Springer (Texts and Readings in Physical Sciences Series, co-published with Hindustan Book Agency).
2. **Resnick, R.** (1968). *Introduction to Special Relativity*. John Wiley & Sons.
3. **French, A. P.** (1968). *Special Relativity*. W. W. Norton & Company.
4. **Devanathan, V.** (2015). *The Special Theory of Relativity*. Narosa Publishing House.
5. **Beiser, A.** (2009). *Perspectives of Modern Physics*. McGraw-Hill.
6. **Serway, R. A., & Jewett, J. W.** (2014). *Physics for Scientists and Engineers with Modern Physics* (9th ed.). Cengage Learning.
7. **Wichman, E. H.** (2008). *Quantum Physics* (Berkeley Physics Course Vol. 4). Tata McGraw-Hill.
8. **Griffiths, D. J.** (2018). *Introduction to Quantum Mechanics* (3rd ed.). Cambridge University Press.
9. **Cohen-Tannoudji, C., Diu, B., & Laloë, F.** (1986). *Quantum Mechanics* (Vols. 1). John Wiley & Sons.
10. **Dutta Roy, B.** (2017). *Elements of Quantum Mechanics*. New Age International Publishers.

11. **Zettili, N.** (2009). *Quantum Mechanics: Concepts and Applications* (2nd ed.). John Wiley & Sons.
12. **Chaddha, G. S.** (2006). *Quantum Mechanics* (1st ed.). New Age International (P) Ltd.
13. **Arora, C. L., & Hemne, P. S.** (2014). *Physics for Degree Students B.Sc. Third Year* (1st ed.). S. Chand & Company Pvt. Ltd.

TUMKUR UNIVERSITY

Program Name	B.Sc. in Physics	Semester	V
Course Title	**SOLID STATE PHYSICS** (Theory)		
Course Code	PHY502 (DSC)	No. of Credits	03
Contact Hours	45 Hours	Duration of SEP/Exam	3 Hours
Formative Assessment Marks	20	Summative Assessment Marks	80

COURSE LEARNING OUTCOMES (CO)

After the successful completion of the course, the student will	
CO1	Understand the basics principles and various theories of free electron theory and band theory of solids.
CO2	Enrich the knowledge of semiconductor physics and its significance
CO3	Get the knowledge and importance of semiconductor electronics, their application in day-to-day life.
CO4	Understand the working of simple semiconductor devices.

MAPPING OF COURSE LEARNING OUTCOMES (CO) WITH PROGRAMME OUTCOMES (PO)

Course Outcomes (CO)	Programme Outcomes (PO)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	3	2	3	2	3	1	2	1	2	2	3	2
CO2	3	2	3	2	3	1	2	2	2	2	3	2
CO3	3	2	3	3	3	2	2	2	2	3	3	3
CO4	3	2	3	2	3	1	1	1	2	1	2	1

Score indicators: High=3, Medium=2, Low=1

Pedagogy: Interactive lectures, inquiry-based learning, blended learning, learning based on experiments.

V SEMESTER B.Sc. PHYSICS SYLLABUS

Discipline Specific Core: PHY502 (DSC)

SOLID STATE PHYSICS

Course duration: 15 weeks with 3 hours of instruction per week

UNIT-I: Free Electron and Band Theory of Solids

Classical free electron theory – Assumptions of Drude model, Mention of expression for electrical and thermal conductivity; Wiedemann-Franz law (Statement and explanation only), Expression for drift velocity and mobility, Limitations of classical theory (Failure to explain specific heat and temperature dependence of resistivity); Numerical problems.

Quantum free electron theory – Sommerfeld model, Fermi-Dirac distribution (qualitative only), Fermi level in metals – expression for Fermi energy, Fermi velocity and Fermi temperature; Numerical problems.

Band theory of solids – Brief discussion of origin of energy bands, Bloch's theorem (qualitative), Concept of effective mass of an electron and concept of holes; Classification of solids – Insulators, Conductors, Semiconductors and Semimetals. Numerical problems.

(15 Hours)

UNIT-II: Semiconductor Physics

Semiconductors: Classification of semiconductors – Intrinsic and extrinsic semiconductors, Elemental and compound semiconductors, Direct and indirect bandgap semiconductors; Expression for carrier concentration of intrinsic semiconductors. Extrinsic semiconductors – Types, Expression of carrier concentration, Qualitative discussion of Fermi level in extrinsic semiconductors. Generation and recombination of charge carriers – Discussion of direct and indirect recombination, Lifetime of carriers. Hall effect – Expression of Hall voltage and Hall coefficient and its application in determination of carrier type and concentration. Numerical problems. (15 Hours)

UNIT-III: Semiconductor Devices

PN junction diode – Formation of p-n junction, drift and diffusion currents, expression for barrier potential and width, IV characteristics of an ideal diode, Breakdown – Avalanche and Zener breakdown; Application of diode as half-wave, full-wave and bridge rectifiers (no derivation), Zener diode as voltage regulator. LED – Construction, working and applications; Solar cell – Construction, working, fill factor, efficiency and applications. Numerical problems.

Bipolar Junction Transistor: Principle of operation of transistor, current gains, Configurations – CB, CE, CC; characteristics of CE configuration, Biasing of transistor – Voltage divider bias, operating point; Application of transistor as switch and working of CE amplifier using npn transistor. Numerical problems. (15 Hours)

REFERENCES

1. Solid State Physics, R.K. Puri and V.K. Babbar, S. Chand & Company, 2018
2. Solid State Physics, S.O. Pillai, New Age International Publishers, 2010
3. Solid State Physics, R.J. Singh, Pearson/Dorling Kindersley, 2012
4. Solid State Physics, N.W. Ashcroft and N.D. Mermin, Cengage Learning, 1976
5. Semiconductor Physics and Devices, Donald A. Neamen and Dhrubes Biswas, McGraw Hill Education (India), 2012
6. Semiconductor Physics, Dr. G. Shanmugam, Vasantha Books, 2023
7. Electronic Devices and Circuits Theory, Robert L. Boylestad and Louis Nashelsky, Pearson, 2011
8. Basic Electronic Devices and Circuits, Mahesh B. Patil, PHI learning, 2022
9. Semiconductor Devices, Nandini Dasgupta, Prentice-Hall of India, 2004
10. Solid State Electronic Devices, Ben G. Streetman and Sanjay Banerjee, Pearson, 2015

TUMKUR UNIVERSITY

Program Name	B.Sc. in Physics	Semester	V
Course Title	MODERN PHYSICS AND SOLID STATE PHYSICS PRACTICALS		
Course Code	PHY503 (DSC)	No. of Credits	02
Contact Hours	4 Hours/week	Duration of SEP/Exam	3 Hours
Formative Assessment Marks	10	Summative Assessment Marks	40

V SEMESTER B.Sc. PHYSICS PRACTICALS

Discipline Specific Core: PHY503 (DSC)

MODERN PHYSICS AND SOLID STATE PHYSICS PRACTICALS

Course duration: 15 weeks with 4 hours of lab work per week. Minimum **EIGHT** of the following experiments are to be performed.

1. To determine the Planck's constant using photocell.
2. Characteristics of Photo emissive cell.
3. Determination of Planck’s constant and work function of a material using Photo Electric Effect.
4. Spectral response of Photo cell and determination of energy gap.
5. Determination of temperature coefficient of resistance of copper or aluminium wire.
6. Determination of Fermi energy of copper.
7. Determination of energy gap of a semiconductor using diode or transistor.
8. Determination of energy gap of a semiconductor using thermistor.
9. Study of characteristics of PN junction diode.
10. Half Wave rectifier with and without filter.
11. Full wave or bridge rectifier with and without filter.
12. Zener diode as a voltage regulator.
13. Transistor characteristics in Common Emitter (CE) configuration.

14. Study of transistor as Switch and determination of its current amplification factors.
15. Study of frequency response of CE amplifier.
16. Determination of Planck’s constant using LED.
17. Determination of fill factor and efficiency of solar cell.

TUMKUR UNIVERSITY

Program Name	B.Sc. in Physics	Semester	V
Course Title	CRYSTALLOGRAPHY AND NANOMATERIALS		
Course Code	PHY504 (SEC)	No. of Credits	02
Contact Hours	45 Hours	Duration of SEP/Exam	1.5 Hours
Formative Assessment Marks	10	Summative Assessment Marks	40

COURSE LEARNING OUTCOMES (CO)

After the successful completion of the course, the student will	
CO1	Understand the basics principles periodic arrangement and crystalline nature of solids
CO2	Enrich the knowledge of important structural properties of materials
CO3	Get the knowledge about significance of nanomaterials and their synthesis.
CO4	Understand the method of determining structure using X-ray diffraction.

MAPPING OF COURSE LEARNING OUTCOMES (CO) WITH PROGRAMME OUTCOMES (PO)

Course Outcomes (CO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	2	3	2	3	2	2	3	2	1	3	2
CO2	2	3	2	2	3	3	2	2	2	2	3	3
CO3	2	3	3	3	2	2	2	2	3	3	3	2
CO4	3	2	3	2	3	1	1	1	2	1	2	1

Score indicators: High=3, Medium=2, Low=1

Pedagogy: Interactive lectures, inquiry-based learning, blended learning, learning based on experiments.

V SEMESTER B.Sc. PHYSICS SYLLABUS

Skill Enhancement Course: PHY504 (SEC)

Crystallography and Nanomaterials

Course duration: 15 weeks with 1 hour of instruction per week

Distinction between crystalline, polycrystalline and amorphous materials, Lattice vectors in crystals, Unit cell and primitive cell, packing fraction, 14 Bravais lattices and 7 crystal systems. Concept of crystallographic planes and directions, Miller indices for planes and directions, Interplanar spacing formula for simple cubic structure. X-ray diffraction – Principle of X-ray diffraction, Derivation of Bragg's law. X-ray powder diffraction pattern – Indexing of cubic structures and determination of lattice parameters, systematic absences. Nanomaterials – Definition and Types of nanomaterials, concept of electron confinement; Methods of synthesis of nanomaterials – Top-down and bottom-up approaches. (15 Hours)

Course duration: 15 weeks with 2 hours of lab work per week. All experiments must be performed.

Experiments:

1. Drawing miller planes in cubic structure.
2. Determination of lattice parameters of NaCl powder diffraction pattern.
3. Determination of packing fraction in cubic and hexagonal structures.
4. Determination of particle size of nanomaterial using Debye-Scherrer formula.

REFERENCES

1. Solid State Physics, S.O. Pillai, New Age International Publishers, 2010
2. Solid State Physics, M.A. Wahab, Narosa Publishing House, 2013
3. Elements of X-ray Diffraction, B.D. Cullity and S.R. Stock, Prentice Hall, 2001
4. Introduction to Nanotechnology, Charles P. Poole and Frank J., John Wiley & Sons, 2003

TUMKUR UNIVERSITY

Program Name	B.Sc. in Physics	**Semester**	VI
Course Title	Elements of Atomic and Molecular Physics (Physics)		
Course Code	PHY601 (DSC)	**No. of Credits**	03
Contact Hours	45 Hours	**Duration of SEP/Exam**	3 Hours
Formative Assessment Marks	20	**Summative Assessment Marks**	80

COURSE LEARNING OUTCOMES (CO)

After the successful completion of the course, the student will	
CO1	Understand the basics principles and atomic theories.
CO2	Understand the vector atom model
CO3	Get the knowledge and importance atomic and molecular spectroscopy
CO4	Understand the theory and experiment set up of Raman effect

MAPPING OF COURSE LEARNING OUTCOMES (CO) WITH PROGRAMME OUTCOMES (PO)

Course Outcomes (CO)	**Programme Outcomes (PO)**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	3	2	3	2	3	1	2	1	2	2	3	2
CO2	3	2	3	2	3	1	2	2	2	2	3	2
CO3	3	2	3	3	3	2	2	2	2	3	3	3
CO4	3	2	3	2	3	1	1	1	2	1	2	1

Score indicators: High=3, Medium=2, Low=1

Pedagogy: Interactive lectures, inquiry-based learning, blended learning, learning based on experiments.

VI SEMESTER B.Sc. PHYSICS SYLLABUS

Discipline Specific Core: PHY601 (DSC)

ELEMENTS OF ATOMIC AND MOLECULAR PHYSICS

Course duration: 15 weeks with 3 hours of instruction per week

UNIT-I: Atomic models

Thomson's atomic model, theory of Alpha particle scattering, Mention the expression for Impact parameter, Rutherford scattering formula (derivation) and results, Rutherford atomic model and limitations, Bohr atomic model: postulates, derivation of expression for radius and velocity of electron in stationary orbits, expression for total energy of electron, Hydrogen spectrum, spectral series of Hydrogen, de Broglie's interpretation of Bohr's quantization law, Excitation potential and ionization potential (qualitative), Franck-Hertz experiment, Statement of Bohr's correspondence principle and limitations. Sommerfeld atomic model (qualitative), mention of the expression for energy of electron with relativistic correction, Fine structure constant and its significance (qualitative). Numerical Problems. (15 Hours)

UNIT-II: Vector atom model

Vector atom model, Quantum numbers associated with vector atom model, Space quantization, spin of electron, Pauli's exclusion principle - statement and significance, Expression for magnetic dipole moment due to orbital motion of electron (derivation). Bohr magneton, Study of Stern- Gerlach experiment- principle and derivation, Spin orbit coupling, L-S coupling, Spectral terms and spectral notations, selection rules, Sodium spectrum - sodium D lines, Zeeman effect, Larmor precession – Derivation of expression for Larmor frequency, Experimental study of normal Zeeman effect, Derivation of expression for Zeeman shift, Anomalous Zeeman effect (qualitative), Stark effect (qualitative), Numerical Problems. (15 Hours)

UNIT-III: Molecular spectroscopy

Types of molecules based on their moment of inertia, examples, types of molecular motions and energies, Born-Oppenheimer approximation, Origin of molecular spectra, Nature of molecular spectra, Pure rotational spectra, Theory of rigid rotator – Expression for rotational energy, selection rule, Energy level and spectrum, Qualitative discussion of non-rigid rotator and centrifugal distortion. Vibrational spectroscopy - Theory of vibrating molecule as simple harmonic oscillator, selection rule, energy level and spectrum, Diatomic molecule as vibrating rotator, Rotational - vibrational energy levels and spectrum. Numerical Problems.

Raman effect - Stokes and Anti-stokes lines, Characteristics of Raman spectra, classical theory and quantum theory of Raman effect, Experimental arrangement to study Raman effect, Applications of Raman effect. Numerical Problems.

Electronic spectra of molecules – Qualitative discussion of fluorescence and phosphorescence. (15 Hours)

REFERENCES

1. Modern Physics, R. Murugeshan, Kiruthiga Sivaprakash, Revised Edition, 2009, S. Chand & Company Ltd.
2. Atomic & Molecular spectra: Laser, Raj Kumar, Revised Edition, 2008, Kedar Nath Ram Nath Publishers, Meerut.
3. Atomic Physics, S.N. Ghoshal, Revised Edition, 2013, S. Chand & Company Ltd.
4. Concepts of Atomic Physics, S.P. Kuila, First Edition, 2018, New Central Book Agency (P) Ltd.
5. Concepts of Modern Physics, Arthur Beiser, Seventh Edition, 2015, Shobhit Mahajan, S. Rai Choudhury, 2002, McGraw-Hill.
6. Fundamentals of Molecular Spectroscopy, C.N. Banwell and E.M. McCash, Fourth Edition, 2008, Tata McGraw-Hill Publishers.
7. Elements of Spectroscopy – Atomic, Molecular and Laser Physics, Gupta, Kumar and Sharma, 2016, Pragati Publications.

TUMKUR UNIVERSITY

Program Name	B.Sc. in Physics	Semester	VI
Course Title	**NUCLEAR PHYSICS** (Theory)		
Course Code	PHY602 (DSC)	No. of Credits	03
Contact Hours	45 Hours	Duration of SEP/Exam	3 Hours
Formative Assessment Marks	20	Summative Assessment Marks	80

COURSE LEARNING OUTCOMES (CO)

After the successful completion of the course, the student will	
CO1	Understand the basics ideas of properties of nucleus and nuclear models.
CO2	Enrich the knowledge radioactivity, its importance and implications.
CO3	Get the knowledge about construction and working of nuclear detectors and nuclear reactors.
CO4	Understand the classification of elementary particles and standard model.

MAPPING OF COURSE LEARNING OUTCOMES (CO) WITH PROGRAMME OUTCOMES (PO)

Course Outcomes (CO)	Programme Outcomes (PO)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	3	2	3	2	3	1	2	1	2	2	3	2
CO2	3	2	3	2	3	1	2	2	2	2	3	2
CO3	3	2	3	3	3	2	2	2	2	3	3	3
CO4	3	2	3	2	3	1	1	1	2	1	2	1

Score indicators: High=3, Medium=2, Low=1

Pedagogy: Interactive lectures, inquiry-based learning, blended learning, learning based on experiments.

VI SEMESTER B.Sc. PHYSICS SYLLABUS

Discipline Specific Core: PHY602 (DSC)

NUCLEAR PHYSICS

Course duration: 15 weeks with 3 hours of instruction per week

UNIT-I

Properties of Nucleus: Constituents of nucleus and their intrinsic properties, quantitative facts about – mass, radii, charge density, mass density, mass defect, binding energy, specific binding energy of nucleus. Salient features of specific binding energy versus mass number curve, angular momentum, parity, magnetic dipole moment and electric quadrupole moments. The proton-neutron hypothesis. Nuclear forces and their characteristics. Yukawa's theory (qualitative). Numerical Problems

Nuclear Models: Liquid-drop model. Derivation of Semi empirical mass formula. Qualitative discussion of shell model and magic numbers.

Nuclear reactions: Types of reactions, kinematics of reactions, Q-value (Derivation), reaction rate, concept of compound and direct reactions, Reactions induced by particles (proton, neutron, deuteron, etc.). Numerical Problems (15 Hours)

UNIT-II

Radioactivity: Radioactivity and properties radioactive particles (α, β and γ), Radioactive disintegration law (qualitative), Theory of successive disintegration, Radioactive equilibrium, half-life and mean life. Alpha decay: basics of α-decay, Gamow's theory of α emission, Geiger-Nuttall law. β-decay: Energy kinematics for β-decay, types of β-decay, Pauli's neutrino hypothesis. Gamma decay: Gamma ray emission - Selection rules, internal conversion process. Numerical Problems

Nuclear Detectors: Gas detectors: estimation of electric field, mobility of a charged particle in ionization chamber. GM Counter - basic principles, construction and working. Scintillation Detector - Basic principles, construction and working of Photo Multiplier Tube (PMT) and scintillation counter. Qualitative discussion of semiconductor detectors for charged particles and photon detection (concept of charge carrier and mobility). Numerical Problems. (15 Hours)

UNIT-III

Accelerators: Construction and working of Linear accelerator and Cyclotron, Qualitative discussion of Synchrotron. Numerical Problems.

Nuclear Reactors: Fission, Fusion, Estimation of the fission energy on the basis of the liquid-drop model, Thermo-nuclear reactions, Electric and magnetic confinement of plasma- Tokamak, types of nuclear reactors, Qualitative discussion of four-factor formula, thermal neutron and fast breeder reactors. Nuclear programs of India. Numerical Problems.

Particle Physics: Elementary particles, Particles and anti-particles. Types of interaction between elementary particles; Strong, Weak, Electromagnetic and Gravitational interactions with examples, Classification of particles. Conservation laws. A qualitative introduction to quarks and standard model. Numerical Problems

(15 Hours)

REFERENCES

1. Irving Kaplan: Nuclear Physics, 2nd edition, Narosa Publishing House, 1987 (Reprint2002).
2. K. S. Kranes: Introductory Nuclear Physics, Wiley India, 2008.
3. S. N. Ghoshal: Nuclear Physics, 1st edition, S. Chand and Co, 1994(Reprint 2002) .
4. D.C.Tayal : Nuclear Physics, 5th edition, Himalaya Publishing House, 2008
5. H. Semat and I.R. Albright : Introduction to atomic and nuclear physics.
6. K. S. Kranes: Introductory Nuclear Physics, Wiley India, 2008
7. M K PAL , Theory of Nuclear Structure, East-West Press Delhi (1983).
8. Roy and Nigam , Nuclear Physics, New Age international New Delhi 2001.
9. Khanna M.P., Introduction to Particle Physics, Prentice Hall of India Pvt. Ltd (2004).
10. Jearl Walker/David Halliday /Robert Resnick : Principles of Physics , WILEY, 10th edition, Reprint 2015.
11. Griffiths D. J. (2008). *Introduction to Elementary Particles* (2nd ed.). Wiley-VCH.

TUMKUR UNIVERSITY

Program Name	B.Sc. in Physics	**Semester**	VI
Course Title	**ATOMIC, MOLECULAR AND NUCLEAR PHYSICS PRACTICALS**		
Course Code	PHY603 (DSC)	**No. of Credits**	02
Contact Hours	4 Hours/week	**Duration of SEP/Exam**	3 Hours
Formative Assessment Marks	10	**Summative Assessment Marks**	40

VI SEMESTER B.Sc. PHYSICS PRACTICALS

Discipline Specific Core: PHY603 (DSC)

ATOMIC, MOLECULAR AND NUCLEAR PHYSICS PRACTICALS

Course duration: 15 weeks with 4 hours of lab work per week. Minimum **EIGHT** of the following experiments are to be performed.

1. Determination of Rydberg constant using Hydrogen spectrum.
2. Determination of wavelength of spectral lines of Hydrogen using spectrometer and Hydrogen discharge tube source.
3. Determination of fine structure constant by measuring fine structure separation of Sodium D- lines using diffraction grating and spectrometer.
4. Determination of ionization potential of mercury / Xenon.
5. To determine the value of e/m by Thomson's method.
6. Franck-Hertz experiment to determine excitation potentials.
7. Analysis of rotational spectrum of diatomic molecule and determination of Rotational constant and bond length.
8. Analysis of vibrational spectrum of Iodine and determination of force constant and vibrational frequency.
9. Analysis of rotational Raman spectrum of diatomic molecule and determination of Rotational constant and bond length.

10. Analysis of Raman spectrum of CCl_4 and determination of vibrational frequency and force constants
11. Study of characteristics of GM tube and determination of operating voltage and plateau length
12. Study of counting statistics using background radiation using GM counter.
13. Study of absorption of beta particles in Aluminum using GM counter.
14. Study of absorption of gamma particles in Aluminum using GM counter
15. Verification of inverse square law using GM counter
16. Range of Beta particles in Aluminium using GM counter
17. Study of absorption of beta particles in Copper using GM counter and determination of mass attenuation coefficient.
18. Study of attenuation of gamma rays in lead foils and determination of mass attenuation coefficient.
19. Study of attenuation of gamma rays in polymer materials and determination of mass attenuation coefficient.
20. Determination of end point energy of beta particles in Aluminium.
21. Plotting of specific binding energy curve and determination of stable element region.

TUMKUR UNIVERSITY

Program Name	B.Sc. in Physics	**Semester**	VI
Course Title	**ASTROPHYSICS**		
Course Code	PHY604 (SEC)	**No. of Credits**	02
Contact Hours	45 Hours	**Duration of SEP/Exam**	1.5 Hours
Formative Assessment Marks	10	**Summative Assessment Marks**	40

COURSE LEARNING OUTCOMES (CO)

After the successful completion of the course, the student will	
CO1	Understand the basics properties of stars.
CO2	Enrich the knowledge of HR diagram.
CO3	Get the knowledge and importance various parts of HR diagram.
CO4	Understand the essential knowledge of astrophysics.

MAPPING OF COURSE LEARNING OUTCOMES (CO) WITH PROGRAMME OUTCOMES (PO)

Course Outcomes (CO)	**Programme Outcomes (PO)**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	3	2	3	2	3	1	2	1	1	2	3	2
CO2	3	3	2	2	3	3	2	2	2	2	3	2
CO3	1	2	2	3	3	2	3	2	3	3	3	3
CO4	3	2	3	2	3	1	1	1	2	1	2	1

Score indicators: High=3, Medium=2, Low=1

Pedagogy: Interactive lectures, inquiry-based learning, blended learning, learning based on experiments.

V SEMESTER B.Sc. PHYSICS SYLLABUS

Skill Enhancement Course: PHY604 (SEC)

Astrophysics

Course duration: 15 weeks with 1 hour of instruction per week

Parallax and stellar distances: Units of stellar distances - Definition of parsec (pc), astronomical unit (AU), light year (ly) and their relations. Helio-centric parallax: Relation between distance and parallax of a star.

Stellar Luminosity: A qualitative review of blackbody radiation, Wien's Displacement Law, and the Stefan–Boltzmann Law. Stars as blackbody radiators; colour of a star and its relation to effective temperature; determination of the effective surface temperature of a star; luminosity of a star; apparent brightness (flux); apparent magnitude (Hipparchus magnitude scale); absolute magnitude; distance modulus relationship; and the distinction between visual and bolometric magnitudes.

Stellar classification: E. C. Pickering classification and Yerkes Luminosity Classification (qualitative). Construction of the Hertzsprung–Russell (H–R) diagram; axes and scales (Temperature–Luminosity and Colour–Magnitude diagrams); principal regions of the H–R diagram: Main Sequence, Giants, Supergiants, White Dwarfs and the Instability Strip (qualitative); physical properties of Main Sequence stars (mass, radius, luminosity, effective temperature, and Mass–Luminosity relation). (15 Hours)

Course duration: 15 weeks with 2 hours of lab work per week. All experiments must be performed.

LIST OF EXPERIMENTS

1. Parallax Method - Distance of objects using trigonometric parallax.
2. Plotting of H.R Diagram and the physical properties of stars.
3. Analysis of stellar spectra and determination of surface temperature.
4. Analysis of sunspot photographs and solar rotation period.

REFERENCES

1. **Dufay J**. *Introduction to Astrophysics*. Dover Publications.
2. **Sorout M.** *Astrophysics Simplified: A Simple Guide to the Universe*. Independently Published.
3. **Harwit M**. *Astrophysical Concepts* (4th ed.). Springer.
4. **Choudhuri A. R.** *Astrophysics for Physicists*. Cambridge University Press.
5. **Abhyankar K. D.** *Astrophysics: Stars and Galaxies*. Universities Press (India) Pvt. Ltd.
6. **Basu B.** *An Introduction to Astrophysics*. Prentice-Hall of India Pvt. Ltd.
7. **Sasidharan G. K.** *The Great Universe*. S. Chand & Company Pvt. Ltd.
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TUMKUR UNIVERSITY

B. Sc. Programme (Physics): 2024-25

QUESTION PAPER PATTERN FOR DSC

Instructions to Candidates: Answer all the Questions.

Time: 3 Hours Max. Marks: 80

PART – A

1. Answer all the following questions. Each question carries two marks. $(8 \times 2 = 16)$

   (a)

   (b)

   (c)

   (d)

   (e)

   (f)

   (g)

   (h)

PART – B

Answer any five of the following questions. Each question carries eight marks.

$(8 \times 5 = 40)$

2.
3.
4.
5.
6.
7.
8.
9.

PART – C

Answer any six of the following problems. Each problem carries four marks.

$(6 \times 4 = 24)$

10.
11.
12.

13.
14.
15.
16.
17.

Note:

i. *Almost equal weightage must be given to all the units while setting the question paper.*

ii. *Questions in PART – B can be split into two sub-questions (This is optional).*

TUMKUR UNIVERSITY

B. Sc. Programme (Physics): 2024-25

QUESTION PAPER PATTERN FOR SEC

Instructions to Candidates: Answer all the Questions.

Time: 1.5 Hours | Max. Marks: 40

PART – A

1. Answer any four of the following questions. Each question carries two marks.

$(4 \times 2 = 8)$

(a)

(b)

(c)

(d)

(e)

PART – B

Answer any four of the following questions. Each question carries eight marks.

$(4 \times 8 = 32)$

2.
3.
4.
5.
6.
7.

Note:

iii. *Out of six questions given in PART-B, three questions must be asked from theory portion and three questions must be asked based on practical.*

iv. *Questions in PART – B can be split into two sub-questions (This is optional).*