TUMKUR UNIVERSITY

Program Name	B.Sc. in Physics	Semester	III
Course Title	Electricity and Magnetism (Theory)		
Course Code	PHY301 (DSC)	No. of Credits	04
Contact Hours	60 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, laws and relations of electrostatics and magnetostatics and their application.
CO2	Enrich the knowledge of electrodynamics through the laws and equations.
CO3	Get the knowledge and importance of network theorems, AC circuits and bridges.
CO4	Understand the basics of various electric and magnetic properties of materials.

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.

III SEMESTER B.Sc. PHYSICS SYLLABUS

Discipline Specific Core: PHY301 (DSC)

ELECTRICITY AND MAGNETISM

Course duration: 15 weeks with 4 hours of instruction per week.

UNIT-I: ELECTROSTATICS

Vector calculus: Cartesian coordinate system; scalar and scalar field, vector and vector field, and their differences. Directional and normal derivatives (qualitative), Del and Laplacian operators; gradient of a scalar field with a brief geometrical interpretation, divergence and curl of a vector field with a brief conceptual explanation. Gauss's Divergence Theorem and Stokes' Theorem (statement and explanation only). problems.

(6 Hours)

Electrostatics: Review of Coulomb's Law, electrostatic field, and field strength. Electric flux and Gauss's theorem in electrostatics (differential and integral form). Applications of Gauss's theorem: electric field due to a point charge, a finite line of uniformly distributed charge (at a finite distance) and a uniformly charged flat sheet. Limitations of Gauss's law. Electric potential as the line integral of the electric field; potential due to a point charge, an electric dipole, a uniformly charged spherical shell, and a solid sphere (outside, on the surface and inside). Capacitance of an isolated spherical conductor and a parallel plate capacitor with and without dielectric material. Expression for the energy stored in a capacitor. Numerical problems. (9 Hours)

UNIT-II: ELECTROMAGNETISM

Magnetostatics: Review of Biot–Savart's Law, magnetic field due to a straight conductor of finite length and infinite length as a special case. Derivation of the expression for the magnetic field along the axis and at the center of a circular coil. Magnetic flux and Ampère's circuital Law: integral and differential form, magnetic field due to a very long solenoid (inside and outside). Numerical problems. (5 Hours)

Electromagnetic Induction: Review of electromagnetic induction (coil–magnet and coil–coil experiments). Faraday's laws (differential and integral form) and Lenz's law of electromagnetic induction. Self-inductance: expression for the self-inductance (L) of a

coil. Mutual inductance (qualitative). Expression for the energy stored in an inductor. Numerical problems. (3 Hours)

Maxwell's Equations and Electromagnetic Waves: Equation of continuity. Maxwell's correction to the Ampère's circuital law (While charging of capacitor) and displacement current density. Differences between current density due to charges and displacement current density. Mention of Maxwell's four electromagnetic equations and their Physical interpretation. Derivation of Electromagnetic wave equations. Expression for the velocity of an electromagnetic wave in free space and in dielectric medium. Establishment of the transverse nature of electromagnetic waves. Poynting vector and Poynting Theorem (qualitative). Numerical problems. (7 Hours)

UNIT-III: CIRCUIT ANALYSIS AND MEASUREMENT

Transient Circuits: Charging and discharging of a capacitor through resistor (DC source): Expressions for charge, voltage, and current. Growth and decay of current in an inductor through a resistor. Series LCR circuit: expressions for charge, voltage, and current during charging and discharging (qualitative) and their graphical representations. Numerical problems. (4 Hours)

Alternating Current Circuits: Alternating current: peak-to-peak voltage, RMS voltage, and their relationship; time period, frequency, and phase factor of AC. Series LCR circuit: impedance and admittance using the *j*-operator method; series resonance, quality factor, and bandwidth. Parallel LCR circuit: qualitative discussion. Numerical problems. (4 Hours)

Network Theorems: Thevenin's theorem and Maximum Power Transfer Theorem with proof. Superposition theorem and Norton's theorem (qualitative). Numerical problems. (4 Hours)

Electrical Measurements and Instrumentation: Multimeters, types, block diagram of digital multimeters and their applications. Transformers, types and their working principle; Block diagram of CRO and its applications. Numerical problems. (3 Hours)

UNIT IV: ELECTRIC AND MAGNETIC MATERIALS

Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Classification of magnetic materials. Explanation of

dia- para- and ferro-magnetic materials. Langevin's classical theory of diamagnetism and paramagnetism. Derivation of paramagnetic susceptibility–Curie's law. Ferromagnetism and ferromagnetic domains (qualitative). B-H curve, Hysteresis and energy loss. Numerical problems. (8 Hours)

Dielectric materials: Introduction, Polar and non-polar molecules with examples, Gauss law in dielectric medium. Dielectric in an electric field, Electric polarization, electric displacement, electric susceptibility, polarizability. Relation between D, E and P. Mechanism of electric polarization, Derivation of Claussius–Mossotti equation and its limitations. Piezoelectric and Ferroelectric materials: Principle, Properties and applications. Numerical problems. (7 Hours)

REFERENCE BOOKS:

1. Balakrishnan, V. (2018). *Mathematical Physics with Applications, Problems and Solutions*. ANE Books Pvt. Ltd.
2. Pal, S., & Bhunia, S. C. (2015). *Engineering Mathematics*. Oxford University Press.
3. Fleisch, D. A. (2011). *A Student's Guide to Vectors and Tensors*. Cambridge University Press.
4. Purcell, E. M., & Morin, D. J. (2013). *Electricity and Magnetism* (3rd ed.). Cambridge University Press.
5. Fleisch, D. A. (2008). *A Student's Guide to Maxwell's Equations*. Cambridge University Press.
6. Zangwill, A. (2012). *Modern Electrodynamics*. Cambridge University Press.
7. McMahon, D. (2007). *Circuit Analysis Demystified*. McGraw-Hill Education.
8. Fewkes, J. H., & Yarwood, J. (1965). *Electricity and Magnetism* (Vol. I). University Tutorial Press.
9. Tayal, D. C. (2015). *Electricity and Magnetism*. Himalaya Publishing House.
10. Edminister, J. A. (1993). *Electromagnetics*. Schaum's Outline Series. McGraw-Hill Education.
11. Kip, A. F. (1962). *Fundamentals of Electricity and Magnetism*. McGraw-Hill Education.
12. Reese, R. L. (2000). *University Physics* (Vol. 2). Brooks/Cole Publishing Company.

13. Griffiths, D. J. (2015). *Introduction to Electrodynamics* (4th ed.). Pearson Education India.
14. Theraja, B. L. (2005). *Electrical Networks* (Vol. I). S. Chand Publishing.
15. Tewari, K. K. (1995). *Electricity and Magnetism*. S. Chand Publishing.
16. Pillai, S. O. (2022). *Solid State Physics* (10th ed.). New Age Publishers.
17. Halliday, D., & Resnick, R. (1978). *Physics Part II* (3rd ed.). John Wiley & Sons.
18. Feynman, R. P., Leighton, R. B., & Sands, M. (1963). *The Feynman lectures on physics* (Vols. 1–3). Addison-Wesley.
19. Kasap, S. O. (2018). *Principles of electronic materials and devices* (4th ed.). McGraw-Hill Education.

FORMATIVE ASSESSMENT FOR THEORY	
Assessment Type	**Marks**
Assessment Test	10
Assignment	5
Quiz	5
Total	**20**

TUMKUR UNIVERSITY

Program Name	B.Sc. in Physics	**Semester**	III
Course Title	Electricity and Magnetism (Practical)		
Course Code	PHY302 (DSC)	**No. of Credits**	02
Contact Hours	4 Hours/week	**Duration of SEP/Exam**	3 Hours
Formative Assessment Marks	10	**Summative Assessment Marks**	40

III SEMESTER B.Sc. PHYSICS PRACTICALS

Discipline Specific Core: PHY302 (DSC)

ELECTRICITY AND MAGNETISM

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 the unknown capacitance of a capacitor and verification of combination laws for capacitors using De-Sauty's bridge.
2) Determination of self-inductance of a given coil using Anderson's bridge.
3) Study of magnetic field distribution along the axis of a circular coil.
4) Study of magnetic field strength and its variation in a solenoid.
5) Study of charging and discharging of capacitor in a series RC circuit and determination of time constant.
6) Study of series LCR circuit and determination of (a) Resonant frequency, (b) Bandwidth and (c) Quality factor.
7) Study of parallel LCR circuit and determination of (a) Resonant frequency, (b) Bandwidth and (c) Quality factor.
8) Determination of self-inductance and resistance of a coil.
9) Verification of Thevenin's theorem.
10) Verification of Norton theorem.
11) Verification of Superposition theorem.
12) Verification of Maximum power transfer theorem.
13) Determination of inductance and capacitance using equal voltage method for two different inductors and capacitors.

14) Study of frequency response and impedance in a series RC circuit and determination of capacitance.
15) Study of frequency response and impedance in a series RL circuit and determination of inductance.
16) Determination of reduction factor and B_H using tangent/Helmholtz galvanometer.
17) Measurement using CRO: DC voltage, AC peak-to-peak voltage, RMS voltage, time period and frequency.
18) Study of magnetic hysteresis curve for a ferromagnetic material.
19) Determination of velocity of light in a dielectric medium such as glass.

REFERENCE BOOKS:

1. Mahajan, A. S., & Rangwala, A. A. (n.d.). *Electricity & Magnetism*. New Delhi: Tata McGraw-Hill.
2. Worsnop, B. L., & Flint, H. T. (1991). *Advanced Practical Physics for Students*. New Delhi: Khosla Publishing House.
3. Arora, C. L. (n.d.). *B.Sc. Practical Physics*. New Delhi: S. Chand Publishing.
4. Wolf, S. E., & Smith, R. F. M. (1990). *Student Reference Manual for Electronic Instrumentation*. New Delhi: PHI Learning.
5. Coombs, C. F. (Ed.). (1972). *Basic Electronic Instrument Handbook*. New York: McGraw-Hill Book Company.

TUMKUR UNIVERSITY

Program Name	B.Sc. in Physics	Semester	III
Course Title	Analog and Digital Electronics (Theory)		
Course Code	PHY303 (DSE)	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 of semiconductors and semiconductor devices.
CO2	Enrich the knowledge of application of semiconductor devices in analog and digital electronics.
CO3	Get the knowledge of conversion among various number systems.
CO4	Understand the concepts of digital electronics and Boolean algebra.

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	1	3	1	1	1	1	1	1	1
CO2	3	2	3	3	3	2	2	1	2	2	1	2
CO3	3	2	3	3	3	2	2	2	2	3	3	3
CO4	3	2	3	3	3	2	2	2	2	3	3	3

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

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

III SEMESTER B.Sc. PHYSICS SYLLABUS

Elective: PHY303 (DSE)

ANALOG AND DIGITAL ELECTRONICS

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

UNIT I: SEMICONDUCTOR PHYSICS

Semiconductors: Intrinsic and extrinsic semiconductors, expression for the carrier concentration in p-type and n-type semiconductors, PN-junction diode – Expression for barrier potential and barrier width, Biasing and characteristics, Zener diode – application as a voltage regulator. LED–Principle, working and Expression for the wavelength of light emitted. Solar cell–Principle, working and expression for the fill factor and efficiency. Transistor–Construction, working, expression for current gain, voltage divider biasing of a transistor, Application as a switch and an amplifier. (12 Hours)

Integrated Circuits: Introduction, Advantages and disadvantages of integrated circuits, Classification of IC, Level of integration. Fabrication of components on monolithic IC. (3 Hours)

UNIT II: ANALOG ELECTRONICS

Differential amplifiers: Balanced and unbalanced output differential amplifiers. Operational amplifiers – Block diagram of Op-amp, Characteristics of ideal and practical Op-amp, Open loop and closed loop configuration, Modes of operation of Op-amp, closed loop inverting and non-inverting amplifiers using Op-amp and the expression for gain. Applications of Op-amp: Adder, Subtractor, Integrator and differentiator using Op-amp. (11 Hours)

Oscillators: Feedback circuits, types of feedback and expression for gain, Barkhausen criterion. Phase shift and Wien bridge oscillator using Op-amp and derivation for the frequency of the signal generated. (4 Hours)

UNIT III: DIGITAL ELECTRONICS

Number Systems: Decimal, binary, octal and hexadecimal number systems. Interconversion among different number systems. Logic gates: Basic gates–AND, OR and NOT gates, construction using diodes and transistors. Universal gates–NAND and NOR

gates, Exclusive gates–XOR and XNOR gates, Construction of basic and exclusive gates using universal gates. (7 Hours)

Boolean Algebra: Laws of Boolean algebra, De Morgan's theorem and their equivalency using truth table. Algebraic simplification of Boolean expressions. Developing logical circuits from Boolean expressions and truth tables. Simplification using K-map. Combinational and sequential logic – Flipflops, JK flipflop and SR flipflop. (8 Hours)

REFERENCE BOOKS:

1. Solid State Physics, S.O. Pillai, New Age International Publishers (2022).
2. Elementary Solid State Physics: Principles and Applications, Ali Omar, Pearson Education, Inc. (1999).
3. Semiconductor Physics and Devices: Basic Principles, Donald A. Neamen, Mc Graw-Hill (2003).
4. Principles of the Solid State, H. V. Keer, New Age International Publishers (1993).
5. Linear Integrated Circuits, Roy Choudhury and Shail B. Jain, New Age International Publishers (2003). [Chapter 1]
6. Solid State Electronic Devices, Ben G. Streetman and Sanjay Kumar Banerjee, Pearson Education Limited (2016).

TUMKUR UNIVERSITY

Program Name	B.Sc. in Physics	Semester	III
Course Title	Data and Error Analysis (Theory)		
Course Code	PHY305 (DSE)	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 statistical concepts of data analysis.
CO2	Enrich the knowledge of distribution of data obtained from various measurements.
CO3	Get the knowledge of probability distributions.
CO4	Understand the concepts of data fitting and regression.

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	1	3	1	1	1	1	1	1	1
CO2	3	2	3	3	3	2	2	1	2	2	1	2
CO3	3	2	3	3	3	2	2	2	2	3	3	3
CO4	3	2	3	3	3	2	2	2	2	3	3	3

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

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

III SEMESTER B.Sc. PHYSICS SYLLABUS

Elective: PHY305 (DSE)

DATA AND ERROR ANALYSIS

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

UNIT-I: BASIC STATISTICAL CONCEPTS

Basic Concepts: Definition of data, discrete and continuous variables, independent and dependent variables, functions (linear and nonlinear), rounding of data, scientific notation for large numbers, significant figures and their applications in scientific data, rectangular coordinates and graphs, inequalities and their uses in data analysis.

(8 Hours)

Statistical Concepts: Raw data, arrays, frequency distributions, class intervals and class limits, class boundaries; size or width of a class interval. General rules for forming frequency distributions, bar charts and histograms, index or subscript notation, summation notation. (7 Hours)

UNIT-II: STATISTICAL MEASURES AND DISPERSIONS

Statistical Measures and Distributions: Measures of central tendency: arithmetic mean, weighted arithmetic mean, and properties of the arithmetic mean, median and mode (for ungrouped and grouped data), empirical relationship between mean, median, and mode, geometric mean, harmonic mean, and root mean square. Measures of position: quantiles, deciles, and percentiles. (6 Hours)

Measures of Dispersion: Range, mean deviation, standard deviation, variance, and properties of the standard deviation. Justification of the mean as the best estimate.

(3 Hours)

Probability Distributions: Fundamental probability rules (qualitative); binomial distribution, normal distribution, and Poisson distribution; discussion of properties—mean, variance, and standard deviation of each distribution (qualitative).

(6 Hours)

UNIT-III: ERROR ANALYSIS

Errors: Types of errors; propagation of errors, importance of precise measurements, trial or preliminary experiments, repetition of measurements, common faults such as ambiguity and vagueness. (6 Hours)

Graphical Representation: Use of graphs; choice of scaling—linear and logarithmic, proper use of units, indicating errors and sensitivity, hints for drawing and interpreting graphs. (3 Hours)

Regression: Concepts of regression, covariance, and correlation; theory of least squares fitting—discussion of the theory, examples using manual methods and direct calculations with a calculator, least squares fitting for polynomial and exponential functions. (6 Hours)

(Subject to time constraints, an adequate number of examples and worked problems should be studied and discussed in each unit.)

REFERENCE BOOKS:

1. Bevington, P. R., & Robinson, D. K. (2003). *Data reduction and error analysis for the physical sciences* (3rd ed.). McGraw-Hill Education. ISBN: 978-0-07-247227-1
2. Berendsen, H. J. C. (2011). *A student's guide to data and error analysis*. Cambridge University Press. ISBN: 978-0-521-13492-7 (Paperback), 978-0-521-11940-5 (Hardback)
3. Gupta, S. C. (2018). *Fundamentals of statistics* (7th ed.). Himalaya Publishing House. ISBN: 978-9350517697
4. Spiegel, M. R., & Stephens, L. J. (2008). *Schaum's outline of statistics* (4th ed.). McGraw-Hill Education. ISBN: 978-0-07-154425-2
5. Squires, G. L. (2001). *Practical physics* (4th ed.). Cambridge University Press. ISBN: 978-0521779405
6. Taylor, J. R. (2022). *An introduction to error analysis: The study of uncertainties in physical measurements* (3rd ed.). University Science Books. ISBN: 978-1-940380-08-1
7. Box, G. E. P., Hunter, W. G., & Hunter, J. S. (2005). *Statistics for experimenters: Design, innovation, and discovery* (2nd ed.). Wiley-Interscience. ISBN: 978-0471718130
8. Dieck, R. H. (2007). *Measurement uncertainty: Methods and applications* (4th ed.). ISA – The Instrumentation, Systems, and Automation Society. ISBN: 978-1936007096

TUMKUR UNIVERSITY

Program Name	B.Sc. in Physics	Semester	IV
Course Title	Optics, Radiation and Statistical Physics (Theory)		
Course Code	PHY401 (DSC)	No. of Credits	04
Contact Hours	60 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 of Interference and diffraction, types, conditions and applications.
CO2	Obtain understanding of the principles of polarization.
CO3	Enrich the knowledge of lasers and optical fibers, types and applications.
CO4	Understand the fundamental properties of Radiation and Statistical Physics.

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	1	3	1	1	1	1	1	1	1
CO2	3	2	3	3	3	2	2	1	2	2	1	2
CO3	3	2	3	3	3	2	2	2	2	3	3	3
CO4	3	2	3	3	3	2	2	2	2	3	3	3

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

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

IV SEMESTER B.Sc. PHYSICS SYLLABUS

Discipline Specific Core: PHY401 (DSC)

OPTICS, RADIATION AND STATISTICAL PHYSICS

Course duration: 15 weeks with 4 hours of instruction per week.

UNIT I: INTERFERENCE

Theories of light: Elements of Huygen's theory of light; Electromagnetic theory of light – Electromagnetic spectrum, Wave length range and properties of each type of radiation; Quantum theory of light – Concept of photon as a wave packet. (3 Hours)

Interference: Definition of interference, coherent and incoherent sources of light. Conditions for sustained interference pattern, Methods of producing coherent sources. Interference by Division of Wavefront: Young's double slit experiment: expression for fringe width, Expression for displacement of fringes on introduction of a thin transparent plate. Interference by division of amplitude: Phase change upon reflection-Stoke's treatment; Multiple Reflection-Expression for the additional optical path of light reflected by the lower surface, Newton's rings–Expression for the ring diameter and radius of curvature of plano convex lens, Measurement of wavelength and refractive index using Newton's rings; Air wedge– Expression for the fringe width, Determination of thickness of a thin wire/foil; Application for testing optical surfaces; Anti reflective coatings (qualitative). Numerical problems. (12 Hours)

UNIT II: DIFFRACTION AND POLARIZATION

Diffraction: Types of diffraction. Fraunhofer diffraction: Diffraction at a single slit– Expression for intensity distribution, the position of maxima and minima and width of central maxima. Diffraction at double slit–Expression for intensity distribution and position of maxima and minima. Plane diffraction grating–theory at normal incidence, condition for principal maxima and minima, width of principal maxima, determination of wavelength, angular dispersion and resolving power of grating, Rayleigh criteria for resolution. Fresnel diffraction: Fresnel's assumptions, Half Period Zones, expressions for radius of half period zones, amplitude contributions by various zones at a point, expression for resultant amplitude, construction and theory of zone plate, Fresnel diffraction at a straight edge, expressions for positions of maxima and minima. Numerical Problems. (9 Hours)

Polarization: Plane polarized and unpolarized light, Polarization by reflection (Brewster's law), refraction and scattering; Polarization by birefringence–Double refraction, uniaxial and biaxial crystals; Theory of quarter wave plate and half wave plate. Production and detection of circularly and elliptically polarized light; Applications of polaroids in photography, eye wears and LCD displays. Numerical problems.

(6 Hours)

UNIT III: LASERS AND OPTICAL FIBRES

Lasers: Introduction to Lasers, induced absorption, Spontaneous and stimulated emission, Expression for Einstein's A and B coefficients, Population inversion, pumping and its types, lasing action, Properties of laser light, spatial and temporal coherence. Construction, Working principle, and energy transfer mechanism of He-Ne laser and Nd: YAG laser, their applications. Holography: construction of hologram and reconstruction of image, Numerical problems. (8 Hours)

Optical Fibres: Structure of optical fibre: core, cladding, expression for Acceptance angle and Numerical Aperture (NA), mechanism of light propagation in optical fibre: Total Internal Reflection. Types of fibres: step-index, graded-index; single-mode and multi-mode. Transmission Characteristics: absorption losses, expression for Attenuation coefficient. Dispersion and Bending losses. Applications of Optical Fibres: Optical fibre communication-block diagram. Medical uses(qualitative): endoscopy, Sensors and industrial monitoring. Numerical problems. (7 Hours)

UNIT IV: RADIATION AND STATISTICAL PHYSICS

Radiation: Black body radiation, Kirchoff's law of radiation. Radiation pressure (qualitative), Stefan's law and its derivation using radiation pressure. Method for determination of Stefan's constant. Derivation of Planck's law of radiation, Deduction of Wien's distribution and displacement law and Rayleigh-Jean's law from Planck's law. Problems. (7 Hours)

Statistical physics: Phase space, Macrostate and Microstate, Relation between Entropy and Thermodynamic probability, Maxwell-Boltzmann distribution law-distribution of velocity of gas molecules. Quantum statistics-Fermi-Dirac distribution law, Expression for Fermi energy for electron gas, Bose-Einstein distribution law, Bose's derivation of Planck's law, comparison of three statistics. Problems. (8 Hours)

REFERENCE BOOKS:

1. Optics, Ajoy Ghatak, Mc Graw Hill Education (2010).
2. Optics, Eugene Hecht and A. R. Ganesan, Pearson Education (2009).
3. Fundamentals of Optics, Jenkins and White, Mc Graw Hill (1976).
4. Textbook of Optics, N. Subrahmanyam and Brij Lal, S Chand and Company Limited (2001).
5. Elements of X-Ray Diffraction B.D. Cullity and S.R. Stock, Pearson New International Edition (2014).
6. Principles of Lasers, Orazio Svelto, Springer US (2016).
7. Optical Fiber Communications, Gerd Keiser, Mc Graw-Hill (2000).
8. Fibre Optics and Laser Instrumentation, S. Mohan, MJP Publishers (2017).
9. Semiconductor optoelectronic devices, Pallab Bhattacharya, Prentice Hall of India Private Limited (2009).
10. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
11. A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press.
12. Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
13. Heat and Thermodynamics, M.W. Zemansky and R. Dittman, 1981, McGraw Hill
14. Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W. Sears
15. G.L. Salinger. 1988, Narosa, University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
16. Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications.
17. Heat and thermodynamics, Subramanyam and Brijlal
18. Statistical Mechanics- Agarwal & Eisner.
19. Feynman, R. P., Leighton, R. B., & Sands, M. (1963). *The Feynman lectures on physics* (Vols. 1–3). Addison-Wesley.

FORMATIVE ASSESSMENT FOR THEORY	
Assessment Type	**Marks**
Assessment Test	10
Assignment	5
Quiz	5
Total	**20**

TUMKUR UNIVERSITY

Program Name	B.Sc. in Physics	Semester	IV
Course Title	Optics, Radiation and Statistical Physics (Practical)		
Course Code	PHY402 (DSC)	No. of Credits	02
Contact Hours	4 Hours/week	Duration of SEP/Exam	3 Hours
Formative Assessment Marks	10	Summative Assessment Marks	40

IV SEMESTER B.Sc. PHYSICS PRACTICALS

Discipline Specific Core: PHY402 (DSC)

OPTICS, RADIATION AND STATISTICAL PHYSICS

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

1) Determination the dispersive power of the material of a given prism using mercury light.
2) Determination the Cauchy's constants of the material of a prism.
3) Determination the wavelength of sodium light/radius of curvature of plano convex lens using Newton's rings.
4) Determination the refractive index of water using Newton's rings.
5) Determination the thickness of paper/hair/wire/thin film using interference at an air wedge.
6) Determination the wavelength of laser light using Young's double slit method.
7) Determination the slit width of a single slit using diffraction at a single slit by laser.
8) Determination the wavelength of mercury spectral lines using a diffraction grating at normal incidence.
9) Measurement of Numerical aperture and acceptance angle of an optical fiber.
10) Determination of Fermi energy of metal.
11) Determination the wavelength of sodium light using diffraction grating.
12) Determination the resolving power of a plane diffraction grating.
13) Determination the wavelength of laser light using a diffraction grating.
14) Determination intensity of diffraction patterns of single/double slits using a photosensor.

15) Determination the resolving power of a telescope.
16) Variation the Malus's law.
17) Determination Stefan's constant by electrical method.
18) Determination Planck's constant using blackbody radiation.
19) Verification of Stefan's law of radiation using the electrical method.
20) Determination the diameter of a thin wire using laser diffraction.
21) Determination the particle size of lycopodium spores using a laser.
22) Determination the refractive index of thick glass plates using total internal reflection of laser light.

REFERENCE BOOKS:

1. B.Sc. Practical Physics, C. L. Arora, S. Chand & Co.
2. A Text Book of Practical Physics, Indu Prakash, Rama Krishna, Kitab Mahal.
3. A Laboratory Manual of Physics for undergraduate classes, D. P. Khandelwal, Vani Publications.
4. An advanced course in practical physics, D. Chattopadhyay, P. C. Rakshit, B. Saha, New Central Book Agency Pvt Ltd.

TUMKUR UNIVERSITY

Program Name	B.Sc. in Physics	Semester	IV
Course Title	Mathematical Methods of Physics (Theory)		
Course Code	PHY403 (DSE)	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 of various curvilinear coordinate system, linear algebra and their applications in various branches of Physics.
CO2	Enrich the knowledge of solving differential equations and obtaining integral transforms.
CO3	Get the knowledge of application of numerical analysis in various dimensions of Physics.
CO4	Understand the importance of mathematical methods in Physics.

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	1	3	1	1	1	1	1	1	1
CO2	3	2	3	3	3	2	2	1	2	2	1	2
CO3	3	2	3	3	3	2	2	2	2	3	3	3
CO4	3	2	3	3	3	2	2	2	2	3	3	3

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

Pedagogy: Interactive lectures, inquiry-based learning, blended learning, learning with the help of tutorials.

IV SEMESTER B.Sc. PHYSICS SYLLABUS

Elective: PHY403 (DSE)

MATHEMATICAL METHODS OF PHYSICS

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

UNIT I: COORDINATE SYSTEMS, VECTORS AND MATRICES

Coordinate Systems: Review of cartesian coordinate system, Spherical and Cylindrical coordinate systems, Conversion among them. Problems. (3 Hours)

Vector Calculus: Vector differentiation – Vector differential operator; gradient, divergence, and curl and their physical interpretations; Normal and directional derivatives; Vector integration – Line, surface and volume integrals with examples of related physical quantities; Stoke's and Gauss's divergence theorem. Problems. (5 Hours)

Linear Algebra: Matrices, types of matrices; algebra of matrices; determinants and their properties; minors and cofactors; adjoint and inverse of a matrix; rank and nullity of a matrix; eigenvalues and eigenvectors; Cayley-Hamilton theorem; Orthogonal and unitary matrices. Dirac notation basics – Representation of vectors in bra-ket notations, inner and outer product of vectors, Advantages of bra-ket notations. Problems. (7 Hours)

UNIT II: DIFFERENTIAL EQUATIONS AND INTEGRAL TRANSFORMS

Ordinary Differential Equations: First order ODEs – separable, linear and exact equations and their solutions; Second order linear ODEs with constant coefficients and their solutions; Harmonic oscillator and damped oscillator differential equations and their solutions. Problems. (8 Hours)

Integral Transforms: Fourier integral transforms in exponential, sine and cosine forms; Convolution and Fourier transforms. Diffraction pattern as Fourier transform of obstacle causing diffraction. Inverse Fourier transforms and their applications. Dirac delta function and its Fourier transform. Problems. (7 Hours)

UNIT III: NUMERICAL METHODS

Numerical Analysis: Solution of Algebraic Equations: Determination of roots – Bisection method and Newton-Raphson method. Data fitting – Regression, Method of least squares. Numerical differentiation: Finite differences – Forward and backward differences, Linear

interpolation. Numerical integration: Trapezoidal rule, Simpson's $1/3^{rd}$ rule, Simpson's $3/8^{th}$ rule. Numerical solution of ordinary differential equations: Euler's method and Runge-Kutta method. Problems. (15 Hours)

REFERENCE BOOKS:

1. Mathematical Methods for Physicists, Arfken, Weber, and Harris, Academic Press.
2. Balakrishnan, V. (2018). *Mathematical Physics with Applications, Problems and Solutions*. ANE Books Pvt. Ltd.
3. Pal, S., & Bhunia, S. C. (2015). *Engineering Mathematics*. Oxford University Press.
4. Fleisch, D. A. (2011). *A Student's Guide to Vectors and Tensors*. Cambridge University Press.
5. Mathematical Physics, H. K. Dass, S Chand Publications
6. Higher Engineering Mathematics, B. S. Grewal, S. Chand Publications.
7. Ordinary and Partial Differential Equations, M. D. Raisinghania, S. Chand Publications
8. Introductory Methods of Numerical Analysis, S. S. Sastry, PHI Publications.

TUMKUR UNIVERSITY

Program Name	B.Sc. in Physics	Semester	IV
Course Title	Measurement and Instrumentation in Physics (Theory)		
Course Code	PHY405 (DSE)	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 of working of various instruments used in Physics.
CO2	Enrich the knowledge of working of AC bridges and CRO.
CO3	Get the knowledge of instruments used in optics laboratory such as microscopes, telescopes and spectrometers.
CO4	Understand the working principle and use of advanced instruments used in nuclear physics and solid state physics.

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	1	3	1	1	1	1	1	1	1
CO2	3	2	3	3	3	2	2	1	2	2	1	2
CO3	3	2	3	3	3	2	2	2	2	3	3	3
CO4	3	2	3	3	3	2	2	2	2	3	3	3

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

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

IV SEMESTER B.Sc. PHYSICS SYLLABUS

Elective: PHY405 (DSE)

MEASUREMENTS AND INSTRUMENTATION IN PHYSICS

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

UNIT – I: INSTRUMENTS AND BRIDGES

Introduction to Instruments: Types of electronic Instruments - Analog instruments & Digital Instruments, basics of DC Voltmeter and AC Voltmeter, Ammeters, Digital Multimeter-Block diagram and working principle, Sensitivity, Ohmmeters, Diode Rectifiers (qualitative), Transformers and types (qualitative), Zener diode and IC-74XX voltage regulators. DC Power supply–explanation with block diagram. Problems.

(6 Hours)

AC/DC Bridges: Wheatstone's bridge, introduction to function generator, Basic concepts of resistance, inductor and capacitors, impedance, Measurement of Impedance-A.C. bridges, Measurement of Self Inductance (Anderson's bridge), Measurement of Capacitance (De Sauty's bridge). Problems. (6 Hours)

Cathode ray oscilloscope: Block Diagram, CRT, Screen of CRT, sweep generators, vertical amplifiers, measurement of voltage, frequency, and phase using Oscilloscope. Problems.

(3 Hours)

UNIT – II: OPTICAL DEVICES

Optical Instruments: Laws of Reflection and refraction using Fermat's principle, Lenses (thick and thin), Concave and convex lenses, Focal Length-Lens makers formula (derivation), Lens equation, combination of lenses, Cardinal points of a lens system, two thin lenses separated by a distance (derivation). Problems. (6 Hours)

Microscopes and Telescopes: Microscopes, Construction and working of simple microscope, resolving power of microscope, Telescopes, types, Construction and working of simple telescope, Resolving power of telescope. Eye-piece, Huygen's and Ramsden eye pieces (qualitative). Problems. (5 Hours)

Spectrometer: Light dispersion, principle of dispersion of light using prism and grating, Construction and working of Spectrometer, Determination of refractive index of prism. Problems. (4 Hours)

UNIT- III: NUCLEAR DETECTORS AND X-RAYS

Nuclear accelerators and detectors: Nuclear Accelerators-Linear accelerator, Cyclotron and Betatron. Nuclear radiations: Alpha, Beta and Gamma radiations and their properties, Nuclear Radiation Detectors: Gas filled counters, Ionization chamber, G.M. Counter (detailed study). Problems. (7 Hours)

Nuclear Reactor: General aspects of Reactor Design. Nuclear fission reactors (Principle, construction, working and application). (3 Hours)

Solid State Physics: X-rays – Properties of X-rays and their production using Coolidge tube. X-ray diffraction - Bragg's law (derivation), X-ray powder diffraction. Construction and working of SEM and TEM. Problems. (5 Hours)

REFERENCE BOOKS:

1. Electronic Instrumentation and Measurement Techniques, W.D. Cooper and A. D. Helfrick, Prentice Hall (2005).
2. Measurement Systems: Application and Design, E.O. Doebelin, McGraw Hill Book - fifth Edition (2003).
3. Electronic Devices and Circuits, David A. Bell, Oxford University Press (2015).
4. Instrumentation Devices and Systems, S. Rangan, G. R. Sarma and V. S. Mani, Tata McGraw Hill (1998).
5. A K Sawhney, A course in electrical and electronics measurement and instrumentation, Dhanpatrai and Co. (1978).
6. Principles of Optics (I-Edition) – B.K. Mathur – New Gopal Printing Press, 1962.
7. Fundamentals of Optics (V-Edition) – Khanna & Bedi – R. Chand & Co., New-Delhi,1971.
8. A Text book of Optics (I-Edition)–Brijlal & Subramanyam - S. Chand & Company Ltd., New-Delhi, 2006.
9. Fundamentals of optics- Khanna and Gulati.
10. Optics (IV-Edition) – Ajay Ghatak –Tata Mc Graw-Hill, New-Delhi, 2006.
11. Fundamentals of Optics (III-Edition) – Jenkins & White - Mc Graw-Hill, 1957.
12. Geometrical Optics (I-Edition) – D.P. Acharya – Oxford & IBH Pub. Co., NewDelhi,1970.
13. Optics & Spectroscopy (VI-Edition) – Murugeshan, Kirutiga & Shivaprasath - S. Chand & Company Ltd., New-Delhi, 2006.

14. Kaplan I, Nuclear Physics, 2nd Ed (1962), Oxford and IBH, New Delhi.
15. Sriram K, Nuclear Measurement Techniques, (1986), AEWP, New Delhi.
16. Tayal D C, Nuclear Physics (1994), HPH, Bombay.
17. Ghoshal S N, Atomic and Nuclear Physics Vol II (1994), S Chand & Co New Delhi.
18. Srivastava B N, Basic Nuclear Physics, (1993), Pragati Prakashan Meerut14.
19. Introduction to solid state physics, Charles Kittel, VII edition, (1996).
20. Solid state Physics, A J Dekker, McMillan India Ltd., (2000).
21. Essentials of Crystallography, M A Wahab, Narosa Publications (2009).
22. Modern Physics, R Murugeshan, S Chand Publishers.

TUMKUR UNIVERSITY

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

QUESTION PAPER PATTERN FOR DSC AND ELECTIVE THEORY

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. *Equal weightage must be given to all the units while setting the question paper.*

ii. While framing question paper, weightage must be given to the subunits based on the number of hours prescribed in the syllabus.

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

Tumkur University

B.Sc. Programme

SCHEME OF EVALUATION FOR DSC PAPER PRACTICALS

During the semester, internal assessment evaluations for C1 and C2 will be conducted for a total of 10 marks. For C1 and C2, students must compulsorily submit their practical record to the laboratory teachers for evaluation.

In the semester-end practical examination, with a duration of 3 hours, students will be evaluated based on skill, comprehension, recording of results, and experiment-related knowledge. For the practical examinations, *the completed record* must be certified by the Head of the Department. The final practical examination will be conducted and evaluated for 40 marks as per the following scheme.

Component	Marks
Required Formula with proper unit and description of terms, nature of graphs	04
Tracing of schematic ray/block/circuit/experimental setup diagram with description	04
Tabulation	04
Essential experimental skills	10
Calculations and drawing graphs	06
Accuracy of the result with proper unit	02
Record	05
Viva	05
Total	**40**