

**Govt. Nagarjuna PG
College of Science,
Raipur (CG)**

Department of Physics

**COURSE STRUCTURE & SCHEME OF MARKS
UNDERGRADUATE (B.Sc.)**

**B.Sc. V Semester & B.Sc. VI Semester (Pilot)
(Maths Group)**

Session - 2026-2027

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UNDERGRADUATE (B.Sc.)**

B.Sc. V Semester Pilot (Maths Group)

Session - 2026-2027

Part A – Introduction

Program: Certificate		Class: B.Sc. V Sem.	Year:2026	Session:2026-27
Subject: Physics				
1.	Course Code	S5-PHY-5T		
2.	Course Title	: DIGITAL AND ANALOG CIRCUITS AND INSTRUMENTATION		
3.	Course Type	Discipline Specific Elective (DSE)		
4.	Pre-requisite (if any)	To study this course, a student must have had the subject Physics in IV sem		
5.	Course Learning Outcomes (CLO)	• Get an idea about Semiconductor Devices. • Understand the use of transistors. • Get knowledge about CRO & POWER Supply. • Get the introductory understanding about Operational Amplifiers • Get the introductory knowledge of Digital Circuits		
6.	Credit Value	4		
7.	Marks	Max. Marks- 10 + 40 = 50	Min. Marks – 20	

Part B – Content of the Course

Total numbers of Lectures (in hours):60		
Unit	Topics	Number of Lectures
I	Semiconductor Devices and Amplifiers: Semiconductor Diodes: p and n type semiconductors. Barrier Formation in PN Junction Diode. Qualitative Idea of Current Flow Mechanism in Forward and Reverse Biased Diode. PN junction and its characteristics. Static and Dynamic Resistance. Principle and structure of (1) LEDs (2) Photodiode (3) Solar Cell.	12
II	: Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Active, Cut off, and Saturation Regions. Current gains α and β . Relations between α and β . Load Line analysis of Transistors. DC Load line and Q- point. Voltage Divider Bias Circuit for CE Amplifier. h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output impedance current, voltage and power gains. Class A,B,AND C Amplifiers	12

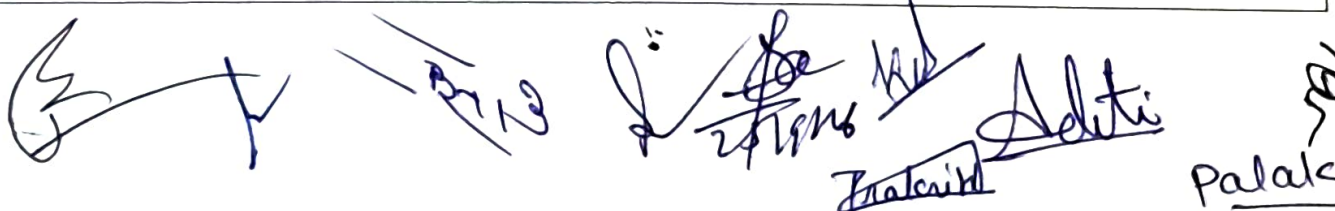
III	Instrumentations: Introduction to CRO: Block Diagram of CRO. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference. Power Supply: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers Calculation of Ripple Factor and Rectification Efficiency, Basic idea about capacitor filter, Zener Diode and Voltage Regulation	12
IV	Operational Amplifiers (Black Box approach): Characteristics of an Ideal and Practical Op-Amp (IC 741), Open-loop & Closed-loop Gain. CMRR, concept of Virtual ground. Applications of Op-Amps: (1) Inverting and Non-inverting Amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Zero Crossing Detector.	12
V	Digital Circuits Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion, AND, OR and NOT Gates (Realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates.	12

Part C – Learning Resources

- **Text Books, Reference Books, Other resources** Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
- Electronic devices and circuits, S. Salivahanan and N. Suresh Kumar, 2012, TataMc-Graw Hill.
- Microelectronic Circuits, M.H. Rashid, 2nd Edn., 2011, Cengage Learning.
- Modern Electronic Instrumentation & Measurement Tech., Helfrick & Cooper, 1990, PHI Learning
- Digital Principles & Applications, A.P. Malvino, D.P. Leach & Saha, 7th Ed., 2011, Tata McGraw Hill
- Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press.
- Fundamentals of Digital Circuits, A. Anand Kumar, 2nd Edition, 2009, PHI Learning Pvt. Ltd.
- OP-AMP and Linear Digital Circuits, R.A. Gayakwad, 2000, PHI Learning Pvt. Ltd.

Suggested Readings:

Suggested equivalent online courses:


 A collection of handwritten signatures and initials in blue ink, including names like 'Aditi', 'Palak', and various initials, likely representing faculty or students.

Part C – Learning Resources

- **Text Books, Reference Books, Other resources** **Reference Books:** Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
- Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
- OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, PrenticeHall.
- Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.

Suggested Readings:

Suggested equivalent online courses:

Part D – Assessment and Evaluation

Suggested Continuous Evaluation Methods: Internal (CCE)+ External Assessment (ESE)

Assessment	Mode	Max. Marks	Min. Marks	Pattern
CCE	Class Test/ Assignment/Presentation	-	-	
ESE	Autonomous Semester Exam	-	-	
	Total Marks	50	20	

Part A – Introduction

Program: Certificate		Class: B.Sc. V Sem.	Year: 2025	Session: 2025-26
Subject: Physics				
1.	Course Code	S5-PHY-5T		
2.	Course Title	: SOLID STATE PHYSICS		
3.	Course Type	Discipline Specific Elective (DSE)		
4.	Pre-requisite (if any)	To study this course, a student must have had the subject Physics in IV sem		
5.	Course Learning Outcomes (CLO)			
6.	Credit Value	4		
7.	Marks	Max. Marks- 10 + 40 = 50	Min. Marks – 20	

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Part B – Content of the Course

Total numbers of Lectures (in hours):60

Unit	Topics	Number of Lectures
I	Crystal Structure: Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law. Atomic and Geometrical Factor.	12
II	Elementary Lattice Dynamics: Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids. T^3 law	12
III	Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia – and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss.	12
IV	Dielectric Properties of Materials: Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeier relations. Langevin-Debye equation. Complex Dielectric Constant. Optical Phenomena. Application: Plasma Oscillations, Plasma Frequency, Plasmons.	12
V	Elementary band theory: Kronig Penny model. Band Gaps. Conductors, Semiconductors and insulators. P and N type Semiconductors. Conductivity of Semiconductors, mobility, Hall Effect, Hall coefficient. Superconductivity: Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Isotope effect.	12

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**COURSE STRUCTURE & SCHEME OF
MARKS UNDERGRADUATE (B.Sc.)**

B.Sc. VI Semester Pilot (Maths Group)

Session – 2026-2027

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Part A – Introduction

Program: Certificate		Class: B.Sc. VI Sem.	Year: 2027	Session: 2026-27
Subject: Physics				
1.	Course Code	S6-PHY-6T		
2.	Course Title	ELEMENTS OF MODERN PHYSICS		
3.	Course Type	Discipline Specific Elective (DSE)		
4.	Pre-requisite (if any)	To study this course, a student must have had the subject Physics in V sem		
5.	Course Learning Outcomes (CLO)	• Get an idea about De Broglie matter waves. • Understand the uncertainty principle. • Get knowledge about Application of schrodinger equation . • Get the introductory understanding about nuclear physics • Get the introductory knowledge of radioactivity.		
6.	Credit Value	4		
7.	Marks	Max. Marks- 10 + 40 = 50		Min. Marks – 20

Part B – Content of the Course

Total numbers of Lectures (in hours): 60		
Unit	Topics	Number of Lectures
I	Planck's quantum, Planck's constant and light as a collection of photons; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson- Germer experiment. Problems with Rutherford model- instability of atoms and observation of discrete atomic spectra; Bohr's quantization rule and atomic stability; calculation of energy levels for hydrogen like atoms and their spectra	12
II	Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle- impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle. Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of wave function, probabilities and normalization; Probability and probability current densities in one dimension	12
III	One dimensional and three dimensional box- energy eigen values and eigen functions, normalization; Quantum mechanical scattering and tunnelling in one dimension - across a step potential and across a rectangular potential barrier.	12

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IV	Structure of nuclei:- Basic Properties of Nuclei: (1) Mass, (2) Radii, (3) Charge, (4) Angular Moments, (5) Spin, (6) Magnetic Moment (μ), (7) Stability and (8) Binding Energy, Nuclear Models:- Liquid Drop Model, Mass formula, shell Model, Types of Nuclear reactions, laws of conservation, Q-value of reactions, Interaction of Energetic particles with matter, Ionization chamber, GM Counter, Cloud Chambers.	12
V	Fundamental Interactions, Classification of Elementary Particles, Particles and Antiparticles, Baryons, Hyperons, Leptons and Mesons, Elementary Particle Quantum Numbers: Baryon Number, Lepton Number, Strangeness, Electric charge, Hypercharge and Isospin.	12

Part C – Learning Resources

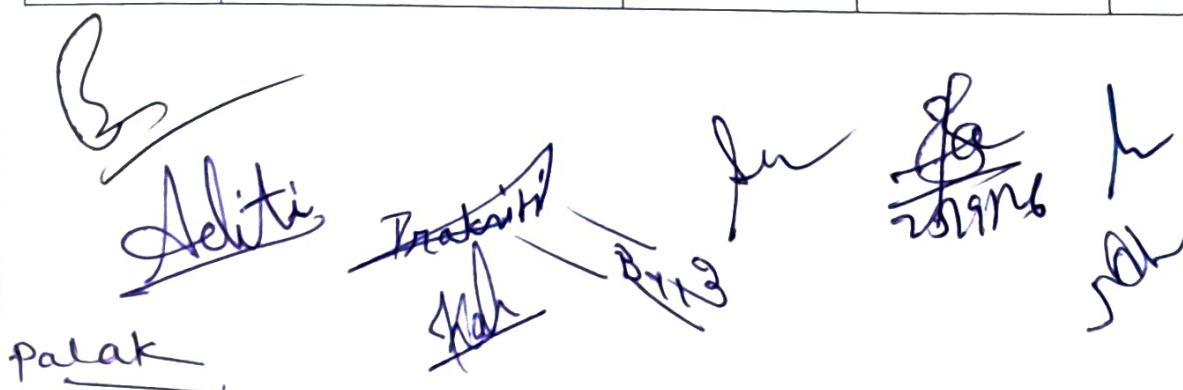
- **Text Books, Reference Books, Other resources** Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill
- Modern Physics, John R. Taylor, Chris D. Zafiratos, Michael A. Dubson, 2009, PHI Learning
- Six Ideas that Shaped Physics: Particle Behave like Waves, Thomas A. Moore, 2003, McGraw Hill
- Quantum Physics, Berkeley Physics Course Vol.4. E.H. Wichman, 2008, TataMcGraw-Hill Co.
- Modern Physics, R.A. Serway, C.J. Moses, and C.A. Moyer, 2005, Cengage Learning
- Modern Physics, G. Kaur and G.R. Pickrell, 2014, McGraw Hill

Suggested Readings:

Suggested equivalent online courses:

Part D – Assessment and Evaluation

Suggested Continuous Evaluation Methods: Internal (CCE)+ External Assessment (ESE)				
Assessment	Mode	Max. Marks	Min. Marks	Pattern
CCE	Class Test/ Assignment/Presentation	10	-	
ESE	Autonomous Semester Exam	40	-	
	Total Marks	50	20	



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Part D – Assessment and Evaluation

Suggested Continuous Evaluation Methods: Internal (CCE)+ External Assessment (ESE)				
Assessment	Mode	Max. Marks	Min. Marks	Pattern
CCE	Class Test/ Assignment/Presentation			
ESE	Autonomous Semester Exam			
	Total Marks	50	20	

Part A – Introduction

Program: Certificate		Class: B.Sc. VI Sem.	Year:2027	Session:2026-27
Subject: Physics				
1.	Course Code	S6-PHY-6T		
2.	Course Title	MATHEMATICAL PHYSICS		
3.	Course Type	Discipline Specific Elective (DSE)		
4.	Pre-requisite (if any)	To study this course, a student must have had the subject Physics in V sem		
5.	Course Learning Outcomes (CLO)			
6.	Credit Value	4		
7.	Marks	Max. Marks- 10 + 40 = 50		
		Min. Marks – 20		

Part B – Content of the Course

Total numbers of Lectures (in hours):60		
Unit	Topics	Number of Lectures
I	Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers.	12
II	Fourier Series: Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions.Application. Summing of Infinite Series.	12
III	Frobenius Method and Special Functions: Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its	12

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	applications to differential equations. Legendre, Bessel, Hermite and Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Orthogonality. Simple recurrence relations.	
IV	Some Special Integrals: Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error function (Probability Integral). Partial Differential Equations: Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry.	12
V	Complex Analysis: Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions: poles and branch points, order of singularity, branch cuts. Integration of a function of a complex variable. Cauchy's Inequality. Cauchy's Integral formula.	12

Part C – Learning Resources

Reference Books:

- Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
- Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
- Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
- An Introduction to Ordinary Differential Equations, Earl A Coddington, 1961, PHI Learning.
- Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
- Essential Mathematical Methods, K.F. Riley and M.P. Hobson, 2011, Cambridge University Press
- Partial Differential Equations for Scientists and Engineers, S.J. Farlow, 1993, Dover Publications.
- Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, VivaBooks.

Suggested Readings:

Suggested equivalent online courses:

Part D – Assessment and Evaluation

Suggested Continuous Evaluation Methods: Internal (CCE)+ External Assessment (ESE)				
Assessment	Mode	Max. Marks	Min. Marks	Pattern
CCE	Class Test/ Assignment/Presentation	10	-	
ESE	Autonomous Semester Exam	40	-	
	Total Marks	50	20	

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Part A – Introduction

Program: Diploma		Class: B.Sc. VI Sem.	Year: 2027	Session: 2026-27
Subject: Physics				
1.	Course Code	S6-PHY-6P		
2.	Course Title	MATHEMATICAL PHYSICS PRACTICAL		
3.	Course Type	Discipline Specific Elective (DSE)		
4.	Pre-requisite (if any)	To study this course, a student must have had the subject Physics in V sem.		
5.	Course Learning Outcomes (CLO)	- Highlights the use of computational methods to solve physical problems - Use of computer language as a tool in solving physics problems (applications) - The course will consist of lectures (both theory and practical) in the ComputerLab - Evaluation done not on the programming but on the basis of formulating the problem - Aim at teaching students to construct the computational problem to be solved - Students can use anyone operating system Linux or Microsoft Windows		
6.	Credit Value	2		
7.	Marks	Max. Marks- 50	Min. Marks - 20	

Part B – Content of the Course

Topics	Description with Applications
Introduction and Overview	Computer architecture and organization, memory and Input/output devices
Basics of scientific computing	Binary and decimal arithmetic, Floating point numbers, algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, underflow & overflow- emphasize the importance of making equations in terms of dimensionless variables, Iterative methods
Errors and error Analysis	Truncation and round off errors, Absolute and relative errors, Floating point computations.

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Review of C & C++ Programming fundamentals	Introduction to Programming, constants, variables and data types, operators and Expressions, I/O statements, scanf and printf, c in and c out, Manipulators for data formatting, Control statements (decision making and looping statements) (<i>If-statement. If-else Statement. Nested if Structure. Else-if Statement. Ternary Operator. Goto Statement. Switch Statement. Unconditional and Conditional Looping. While-Loop. Do-While Loop. FOR Loop. Break and Continue Statements. Nested Loops</i>), Arrays (1D&2D) and strings, user defined functions, Structures and Unions, Idea of classes and objects
Programs: using C/C++ language	Sum & average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of numbers in ascending-descending order, Binary search
Random number generation	Area of circle, area of square, volume of sphere, value of π
Solution of Algebraic and Transcendental equations by Bisection, Newton Raphson and Secant methods	Solution of linear and quadratic equation, solving $\alpha = \tan \alpha$; $I = I_0 \left(\frac{\sin \alpha}{\alpha} \right)^2$ in optics
Interpolation by Newton Gregory Forward and Backward difference formula, Error estimation of linear interpolation	Evaluation of trigonometric functions e.g. $\sin \theta$, $\cos \theta$, $\tan \theta$, etc.
Numerical differentiation (Forward and Backward difference formula) and Integration (Trapezoidal and Simpson rules), Monte Carlo method	Given Position with equidistant time data to calculate velocity and acceleration and vice-versa. Find the area of B-H Hysteresis loop
Solution of Ordinary Differential Equations (ODE) First order Differential equation Euler, modified Euler and Runge-Kutta (RK) second and fourth order methods	First order differential equation - Radioactive decay - Current in RC, LC circuits with DC source - Newton's law of cooling - Classical equations of motion Attempt following problems using RK 4 order method: - Solve the coupled differential equations $\frac{dx}{dt} = y + x - \frac{x^3}{3} ; \frac{dy}{dx} = -x$ for four initial conditions $x(0) = 0, y(0) = -1, -2, -3, -4$. Plot x vs y for each of the four initial conditions on the same screen for $0 \leq t \leq 15$ The differential equation describing the motion of a pendulum is $\frac{d^2 P}{dt^2} = -\sin(P)$. The pendulum is released from rest at an angular displacement α, i. e. $P(0) = \alpha$ and $P'(0) = 0$. Solve the equation for $\alpha = 0.1, 0.5$ and 1.0 and plot P as a function of time in the range $0 \leq t \leq 8\pi$. Also plot the analytic solution valid for small P ($\sin(P) = P$)

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