

**Department of Electronics and Physics  
Institute of Science, GITAM University**

**Physics - Syllabus for M.Phil. & Ph.D. entrance examination**

**PART-A**

**Unit-I**

**Classical , Quantum and Statistical Mechanics**

**Classical Mechanics**

D'Alembert's Principle, Lagrange's equation, Hamilton's equation of motion and conservation theorems. Euler angles, Canonical transformation and Poisson brackets.

**Quantum Mechanics**

General formalism of wave mechanics Schrödinger's wave equation, Angular momentum operators, Time independent and dependent perturbation theory. Scattering phenomena, differential – cross section and Born approximation.

**Statistical Mechanics**

Postulates of statistical mechanics, probability calculations and general interaction between systems. Ensemble- its types- probability calculations, mean energies and dispersions of ensembles. Quantum Statistics .Equation of state for Ideal Bose and Fermi gas, Bose -Einstein condensation, Theory of white dwarf stars.

**Unit-II**

**Electrodynamics**

Electromotive force-ohm's law, EMF, Motional EMF Electromagnetic induction –Faraday laws, induced electric field, Inductance, Energy in magnetic fields. Maxwell equations-magnetic charge, Maxwell equations in matter, Charge and Energy equation, Pointing theorem Electromagnetic Theory.

**Unit-III**

**Solid State Physics & Nuclear Physics**

Crystal structure, Lattice Vibrations -mono and Diatomic, specific heat theories- Einstein and Debye theories. Energy bands in solids- Kronig penney model, Concept effective mass. Polarisability- theory of electronic, ionic and orientational polarization and Classification of magnetic materials.

**Nuclear Physics**

General properties of Nuclei, Scattering of  $\alpha$ -particles – Experimental verification – Nuclear size – Theories of nuclear composition, – Binding energy – semi empirical mass formula and applications. Interaction of gamma rays with matter – photo electric effect, Compton effect, pair production. Detection of nuclear radiation- ionization chamber and proportional counter. Nuclear Fission and Fusion

**Unit-IV**

**Low dimensional Physics and Electronics**

Electromagnetic Spectrum, Molecular energies, Classification of molecules, Rotational, vibrational and vibrational-rotational spectra of diatomic molecules, Characteristic group absorptions, IR spectrometer, Electronic Spectra, Frank Condon principle

Hydrogen atom-spectrum, Orbital angular momentum, Larmor precession, Stern and Gerlach experiment, Energy levels and transitions in Helium atom, Normal and anomalous Zeeman effect

**Electronics**

Basics of semiconductor; p-n junctions, diodes, transistors, LCR circuits, rectifiers, amplifiers, active filters and oscillators. Basics of OPAMPs and their applications. Basics of digital electronics.

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**PART-A**

**Unit-I**

**BJT and FET**

**Bipolar Junction Transistor(BJT)**

Three configurations of transistor, Biasing, BJT as an amplifier, BJT characteristics, Applications of Transistor.

**Field Effect Transistor(FET)**

Construction and characteristics, Biasing, FET as an amplifier, Applications of FET. MOSFET: Introduction, Depletion and Enhancement type MOSFETs. Feedback concepts: Practical feedback circuits, Feedback amplifiers, Oscillator operation, types of oscillators

**Unit-II**

**Operational amplifiers**

Op-amp Basics, parameters, Practical op-amp circuits – Integrator, Differentiator and Summing amplifier.

Op-amp Applications-Constant gain multiplier, Voltage to Current Converter, Current to Voltage Converter and filters.

**Unit-III**

**Combinatorial and Sequential logic circuits**

**Combinatorial logic circuits**

Simplification of Boolean expressions, Karnaugh map method, Encoders and Decoders, Multiplexers and Demultiplexers Binary addition, subtraction, multiplication and division.

**Sequential logic circuits**

Flip-Flops, Counters: Asynchronous (ripple) counters, Down counter, Synchronous counters, Up-down counter, Ring counter, Johnson counter.

**Unit-IV**

**Communication & Microprocessors**

**Communications**

Amplitude Modulation: Modulation Index, Frequency spectrum, Average Power. A.M Broadcast Transmitter and Super heterodyne receiver Output S/N ratio.

FM Modulation-Direct and Indirect methods. Detection methods - Slope detector, balanced slope detector, Amplitude limiter, Pre-emphasis and De-emphasis.

**Microprocessors**

Evolution of Microprocessors, Architecture and Pin Description of 8086, Instruction set. Memory organization- Register structure, Interfacing devices: 8255-I/O Ports and Programming, 8251-Serial communication interface and Programmable Interval Timer 8253 and Programmable Interrupt Controller 8259

## **PART –B**

*(Common to both Physics and Electronics)*

### **Unit-I**

#### **Interpolation:**

Forward and backward differences. Newton's formula for interpolation, Lagrange's interpolation formula, Simpson's rule and Trapezoidal rule-.Matrices,Inverse of matrices,types of matrices,eigen values and eigen vectors of matrices and rank of matrix.

### **Unit-II**

#### **Complex analysis**

CR equations, Elementary functions of complex variable, Harmonic functions. Determination of poles and residues of contour. Cauchy residue theorem , calculation of residues and Cauchy Integral formula.

### **Unit-III**

#### **Laplace transforms & Basics of C language**

##### **Laplace transforms**

Laplace transform, Inverse Laplace transforms and its computation for various functions. Application of laplace transform to differential equations with constant coefficients.

##### **Basics of C- language**

Introduction to C, constants ,variables, data types, declaration of variables, user defined declaration, operators, Control statements: if, switch, conditional operator, go to, if ---- else; Decision making and looping statements: while, do --- while and for loop.

### **Unit-IV**

#### **Instrumentation methods:**

Digital Storage Oscilloscopes, mixed signal oscilloscopes, Arbitrary waveform generators, RF, generators, RF power meter, EMI/EMC Tester, Spectrum analyzers, Impedance analyzer, Lock-in-Amplifier and Semiconductor Parameter analyzer. Characterization techniques with UV visible IR Raman-XRD- TEM and SEM. Measurement techniques of Radio activity