GOVERNMENT ARTS COLLEGE (AUTONOMOUS)

KUMBAKONAM 612 002

Re - accredited With 'A' Grade by NAAC & Affiliated to Bharathidasan University

DEPARTMENT OF PHYSICS

(Effective for those admitted from 2017-2018 onwards)

SYLLABI

M.Sc., PHYSICS

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM.

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M.Sc., PHYSICS

(Effective for those admitted from 2017-2018 onwards)

SEMESTER - I

CC 1 - MATHEMATICAL PHYSICS I

Subject Code: 17P1P1	Credits: 4	External Marks: 75	Hours: 6

Objectives:

- *To acquire mathematical knowledge and apply it to various physical problems.*
- *To develop problem solving ability related to physical problems.*

Unit I: **Vector Fields**

Concept of vector and scalar fields - Gradient, divergence, curl and Laplacian – Vector identities – Line integral, surface integral and volume integral – Gauss theorem, Green's Theorem, Stoke's theorem – Orthogonal curvilinear coordinates – Expressions for gradient, divergence, curl and Laplacian in cylindrical and spherical co-ordinates.

Unit II: **(a) Vector spaces**

Definitions – Linear independence of vectors – Bilinear and quadratic forms – change of Basis – Schmidt's orthogonalization process – Schwartz inequality.

(b) Tensors

Transformation of coordinates – Summation convention – Contravariant, Covariant and mixed tensors – Rank of tensor – Symmetric and antisymmetric tensors – Contraction of tensors – Raising and lowering of suffixes – Moment of Inertia tensor.

Unit III: **Matrix Theory**

Solution of linear algebraic equations – Rank of a matrix – Characteristic equation of a matrix – Eigen values and Eigen vectors – Trace of a matrix – Caley – Hamilton theorem – Reduction of a matrix to diagonal form – Jacobian method– Hermitian and unitary matrices – Direct sum and products of matrices – Sylvester'stheorem – Functions of matrices.

Unit IV: **Complex Analysis**

Functions of complex variables – Differentiability – Cauchy-Reimann conditions – Complex integration – Cauchy's integral theorem and integral formula – Taylor's and Laurent's series – Residues and singularities – Cauchy's Residue theorem – Evaluation of definite integrals.

Unit V: **Integral Transforms**

Fourier series – Dirichlet's condition – Determination of Fourier coefficients – Fourier integrals – Faltung theorem – Application to heat and wave equation – Laplace transform – Convolution theorem – Inverse Laplace transform – Solution of ordinary differential equations.

Books for Study and Reference: Relevant chapters in

1. A.W.Joshi, Matrices and Tensors in Physics, Wiley Eastern Ltd., New Delhi (1975).
2. Eugene Butkov, Mathematical Physics, Addison Wesley, London (1973).
3. L. A. Pipes and L. R. Harvill, Applied Mathematics for Engineers and Physicists, Mc Graw Hill Company, Singapore (1967).
4. P. K. Chattopadhyay, Mathematical Physics, Wiley Eastern Ltd., New Delhi(1990)
5. A. K. Ghattak, T. C. Goyal and S. J. Chua, Mathematical Physics, Macmillan, New Delhi(1995)
6. G. Arfken and H. J. Weber, Mathematical Methods for Physicists, 4th ed. Prism Books, Bangalore, (1995).
7. M. D. Greenberg, Advanced Engineering Mathematics, 2nd ed. International ed.,Prentice – Hall International, NJ,(1998)
8. E. Kreyszig, Advanced Engineering Mathematics, 8th ed., Wiley, NY, (1999).
9. A.B.Gupta , Fundamentals of Mathematical Physics, Books and Allied Pvt. Limited,India,2010.

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SEMESTER - I

CC 2 - CLASSICAL DYNAMICS & RELATIVITY

Subject Code: 17P1P2	Credits: 4	External Marks: 75	Hours: 6

Objectives:

- *To understand the fundamental principles of classical mechanics.*
- *To understand the applications of classical mechanics.*
- *To learn and apply the concepts of Relativistic mechanics.*

Unit I: Fundamental Principles and Lagrangian Formulation

Mechanics of a particle and system of particles - conservation laws – constraints –Types of constraints – generalized coordinates – D' Alembert's principle and Lagrange's equation – Problem: Free particle in a system – Atwood's machine – Time dependent constraint – bead sliding on a rotating wire – Hamilton's principle – Lagrange's equation of motion from Hamilton's principle – conservation theorems and symmetry properties.

Unit II: Two body central force problems

Equations of motion and first integrals - The equivalent one - dimensional problem and classification of orbits - The Kepler problem - Inverse square law of force, the Laplace Runge - Lenz Vector - Scattering in a central force field - Scattering in laboratory and centre of mass frames.

Unit III: Hamilton's Formulation

Hamilton's canonical equations of motion – Hamilton's equations from variational principle – Principle of least action – Generating functions – Canonical transformations – Poisson brackets – Hamilton – Jacobi method – Solution of Kepler's problem by Hamilton –Jacobi method-Action and angle variables.

Unit IV: Rigid Body Dynamics and Oscillatory Motion

Euler angles – Moments and products of inertia – Euler's equations – Symmetrical top. Theory of small oscillations – Normal modes and frequencies – Two coupled harmonic oscillators – Linear triatomic molecule.

Unit V: Relativity

Review of basic ideas of special relativity – Energy momentum four vector – Minkowski's four dimensional space – Lorentz transformation in Minkowski's space – Compositions of Lorentz Transformation about two orthogonal directions – Invariance of Maxwell's equations under Lorentz transformation – Elements of general theory of relativity.

Books for study and Reference

Relevant chapters in

1. H. Goldstein, Classical Mechanics, Narosa Book distributors, New Delhi (1980).
2. N. C. Rana and P. S. Joag, Classical Mechanics, Tata McGraw Hill, New Delhi (1991).
3. S.L. Gupta, V. Kumar and H.V. Sharma, Classical Mechanics, Pragati Prakashan, Meerut (2001).

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SEMESTER - I

CC 3 - STATISTICAL MECHANICS AND ELECTROMAGNETIC THEORY

Subject Code: 17P1P3	Credits: 4	External Marks: 75	Hours: 5

Objectives:

- *To study the consequences of laws of thermodynamics.*
- *To study principles and application of clinical and quantum statistical mechanics.*
- *To study the basics of electromagnetic theory and propagation of electromagnetic waves.*

Unit I: Thermodynamics and their Consequences

Energy and first law of thermodynamics – Heat content and heat capacity – Specific heat – Entropy and second law of thermodynamics – Thermodynamic potential and the reciprocity relations – Maxwell's relations – Deductions – Properties of thermodynamics relations – Gibb's –Helmholtz relation – Thermodynamic equilibrium - Nernst Heat theorem of third law – Consequences of third law – Phase- Gibb's phase rule – Chemical potential.

Unit II: Classical Statistical Mechanics

Macro and micro states – Statistical equilibrium – Phase space and ensembles – Micro canonical ensemble and Grand canonical ensembles – Liouville's theorem – Maxwell-Boltzmann distribution law – Principles of equipartition of energy – Partition function – Relation between partition function and thermodynamic quantities.

Unit III: Quantum Statistical Mechanics

Black body and Planck's radiation – Photons – Ideal Bose gas energy, pressure and thermal properties – Bose-Einstein condensation – Liquid Helium – Fermi-Dirac gas – Properties – Degeneracy – Electron gas – Free electron model and thermionic emission – Fermi Energy – Richardson Dushman equation – Ising model.

Unit IV: Electromagnetic

Faraday's law of induction – Current density – Ampere's Circuital law – Basics of dielectrics – Maxwell's displacement current – Maxwell's equations – Maxwell equations in terms of vector and scalar potentials – Gauge transformations – Lorentz gauge, Coulomb gauge – Poynting's theorem – Conservation of energy – Dynamics of charged particles in static and uniform electromagnetic fields.

Unit V: Plane Electromagnetic waves and wave propagation

Plane waves in a non conducting medium – Linear and circular polarization, Stoke's parameters – Reflection and refraction of electromagnetic waves at a plane interface between dielectrics – Fields at the surface of and within a conductor – Propagation of electromagnetic waves in hollow metallic cylinders: Cylindrical and rectangular wave guides – TM and TE modes – Wave propagation in optical fibers.

Books for Study and Reference (Relevant chapters in)

1. K.Huang, Statistical Mechanics (Willey Eastern Limited, New Delhi, 1963).
2. B. K. Agarwal and M. Eismer, Statistical Mechanics (Willey Eastern Limited, New Delhi, 1994).
3. F. Reif, Fundamentals of Statistical and Thermal Physics(Mc Graw Hill, Singapore, 1985)
4. Electromagnetic theory –Chopra and Agarwal
5. Electromagnetic Theory and applications – Chatopadhyaya
6. Classical Electrodynamics – J.D. Jackson.
7. Statistical Mechanics- Gupta Kumar- S.Chand & Co.

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SEMESTER - I

CC 4 – CRYSTAL GROWTH AND THIN FILM PHYSICS

Subject Code: 17P1P4	Credits: 4	External Marks: 75	Hours: 5

Objective:

- *To understand the theories and techniques involved in crystal growth and thin film science.*

Unit I: Basic concepts and Growth kinetics

Nucleation – Types of nucleation- Kinetic theory of nucleation – Formation of critical nucleus-Induction period measurement by conductivity method – Nucleation rate – Energy of formation of spherical and cylindrical nucleus – Theories of crystal growth – Surface energy theory – Diffusion theory – Adsorption (Volmer) theory – Kossel's theory.

Unit II: Solution, Flux and Gel growth

Solution growth: Characteristics of solvent – Solubility and super solubility – Expression for supersaturation – Miers T-C diagram – Slow cooling, solvent evaporation and temperature gradient methods – Advantages. Flux growth – Properties of flux – Advantages and disadvantages – Gel growth – Principle – Types of gel – Structure of gel – Single and double diffusion techniques – Advantages.

Unit III: Melt, Hydrothermal and Vapour growth

Melt growth – Czochralski, Bridgman, Verneuil and Zone melting methods. Hydrothermal growth – Characteristics of autoclave – Growth of Quartz – Advantages and disadvantages – Vapour growth – Physical vapour transport – Chemical vapour transport – Advantages and limitation.

Unit IV: Thin film deposition techniques

Fundamentals of thin film – Nature of thin film- Deposition techniques – Physical methods – Evaporation – Thermal evaporation – Flash evaporation – electron beam method – Sputtering – Diode sputtering – Reactive sputtering – R.F sputtering – Chemical methods – Thermal decomposition – Chemical vapour deposition – Electro deposition.

Unit V: Film growth and characterization

Substrate – Cleaning methods – Substrate effect – Nucleation and film growth – Incorporation of defects and impurities – AFM – SEM – Thickness determination – Microbalance technique – Multiple beam interferometry – FECO technique – Interaction of electrons with a solid – EPMA – XPS (ESCA).

Books for study:

1. P. Santhanaragavan and P.Ramasamy, Crystal Growth Process and Methods (KRV Publications, Kumbakonam, 2001).
2. I.V. Markov, Crystal Growth for Beginners: Fundamentals of Nucleation, Crystal Growth and Epitaxy (2004) 2nd Edition.
3. A. Goswami, Thin Film Fundamentals (New Age, New Delhi, 2008)
4. J. C. Brice, Crystal Growth Process (John Wiley, New York, 1986).

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SEMESTER – I

CC 5 - PRACTICAL I : GENERAL & ELECTRONICS

Subject Code: 17P1PP1	Credits: 4	External Marks: 60	Hours: 8

(Choosing a minimum of six experiments from each part)

A. General Experiments

1. Determination of q, n, σ by elliptical fringes method
2. Determination of q, n, σ by hyperbolic fringes method
3. Determination of Bulk modulus of a liquid by Ultrasonic wave propagation
4. Determination of Stefan's constant
5. Determination of dielectric constant at high frequency by Lecher wire
6. Determination of e/m of an electron by magnetron method
7. Determination of e/m of an electron by Helical coil method

B. Electronics Experiments

8. Design and study of monostable multivibrator
9. Design and study of Wein Bridge oscillator (Op-Amp)
10. Design and study of Phase shift oscillator (Op-Amp)
11. Characteristics of LDR
12. Characteristics of UJT & relaxation oscillator
13. Common source amplifier using FET
14. Tuned drain oscillator – FET

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SEMESTER - II

CC 6 – MATHEMATICAL PHYSICS II

Subject Code: 17P2P5	Credits: 5	External Marks: 75	Hours: 6

Objective:

- *To acquire knowledge about differential and partial differential Equations, Special Functions, Numerical analysis and Group Theory and to develop the problem solving ability.*

Unit I: **Special Functions**

Gamma and Beta functions – Hermite, Legendre, Bessel and Laugerre differential equations- series solution – Rodrigue's formula – Generating functions – Orthogonality relations – Recurrence relations.

Unit II: **Second Order Differential Equations**

Linear second order differential equations with constant and variable coefficients – Complimentary function and particular integrals-– Variation of parameters – Frobenius method – Physical examples: Classical harmonic oscillator- Damped simple harmonic motion- Forced vibrations.

Unit III: **Partial differential equations**

Method of forming partial differential equation – Solution by direct integration – Method of separation of variables – Partial differential equations in Physics problems – Laplace equation-Wave equation – Equation of vibrating string – One dimensional heat flow .

Unit IV: **Numerical Analysis**

Solutions of algebraic and transcendental equations – Bisection method – Iteration method – Newton-Raphson method.

Interpolation

Forward, Backward and Central differences – Newton's interpolation formula – Stirling and Bessel central difference interpolation formula – Lagrange's interpolation formula.

Unit V: **Group Theory**

Basic definitions – Multiplication Table – Subgroups, Cosets and Classes – Direct product groups – Point groups – Representation theorem – Homomorphism and Isomorphism – Reducible and irreducible representation – The great Orthogonality theorem – Character table – C_{2v} as example.

Books for Study and Reference

Relevant chapters in

1. L. A. Pipes and L. R. Harvill, Applied Mathematics for Engineers and Physicists (Mc Graw Hill, Singapore, 1970)
2. E. Kreyszig, Advanced Engineering Mathematics (Wiley Eastern, New Delhi,1983)
3. G. Arfken and H. J. Weber, Mathematical Methods for Physicists (Prism Books, Bangalore, 1995)
4. A.K.Ghatak, I.C.Goyal and A.J.Chua, Mathematical Physics (Mc Millan, New Delhi, 1995)
5. P.K Chattopadhyay, Mathematical Physics(Wiley Eastern, New Delhi,1990)
6. W.W.Bell, Special functions for Scientists and Engineers (Van Nostrand, New york, 1968)
7. A.W.Joshi, Elements of Group theory for Physicists (Wiley Eastern, New Delhi, 1971)
8. F.A.Cotton, Chemical Applications of Group Theory (Wiley Eastern, NewDelhi, 1987)
9. S. S. Sastry**,** Introductory Methods of Numerical Analysis, Eastern Economy Edition, Fifth Edition.

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SEMESTER - II

CC 7 – QUANTUM MECHANICS

Subject Code: 17P2P6	Credits: 5	External Marks: 75	Hours: 6

Objective:

- *To make the students understand the fundamental concepts of quantum mechanics and their applications to microscopic systems.*

Unit I: General Formulation of Quantum Mechanics

Schrodinger's one dimensional time independent and time dependent equations – Physical interpretation of wave equation – Normalized and orthogonal wave functions – Expectation values - Operator formalism – Hermitian operator and its properties – Hilbert space – Dirac's Bra and Ket notation – properties – Operation of linear operators on Bra and Ket vectors – Uncertainty principle – uncertainty relation for operators –Minimum uncertainty condition.

Representation Theory: Schrodinger's – Heisenberg pictures – Comparison.

Unit II: Applications of Schrodinger's equation and Scattering Theory

Applications of Schrodinger's equation: Linear Harmonic oscillator – Solution to one dimensional Schrodinger's equation – Rectangular barrier potential – Rigid rotator – Hydrogen atom.

Scattering Theory: Scattering cross section and Amplitude – Green's function in scattering theory – Born Approximation –Validity criteria for Born Approximation.

Unit III: Time independent and dependent perturbation theory

Time independent perturbation theory: Non-degenerate and degenerate perturbation theories (first order) – Stark effect – First order stark effect in Hydrogen atom- WKB approximation.

Time dependent perturbation theory: First order – Transition probability – Fermi-Golden rule – Harmonic perturbation.

Unit IV: Angular Momentum and Spin matrices

Orbital angular Momenta – Commutation rules among position, Linear momentum and Angular momentum – Spin angular momentum – Pauli's spin matrices - Total angular momentum – Ladder operators – Eigen values for J^2 and J_z – Addition of angular momenta – Clebsch –Gordon coefficients – Recursion relation and construction of C. G coefficients – Calculation of C.G Coefficients for $J_1 = ½$ and $J_2 = ½$ .Identical particles with spin – Symmetric and Asymmetric wave functions – Pauli's exclusion principle.

Unit V: Relativistic Wave Equation

Klein – Gordon equation for a free particle and Hydrogen atom – Dirac equation for a free particle – Plane wave equation – Negative energy states – Zitterbewegung – Dirac equation in a central field – Spin of a Dirac particle – Spin- orbit coupling.

Books for Study and Reference:

1. L.Schiff, Quantum Mechanics, Tata McGraw Hill, New Delhi.
2. P.M. Mathews and K.Venkatesan, A text book of Quantum Mechanics,Tata McGraw Hill, New Delhi.
3. S.L. Gupta and I.D. Gupta, Advanced Quantum theory and fields, S. Chand and Co, New Delhi.
4. V. K. Thankappan, Quantum Mechanics, Wiley –Eastern, New Delhi.
5. J. Singh , Quantum Mechanics, Fundamentals and Applications to Technology, John-Wiley, New York.
6. A. Goswami, Quantum Mechanics, W. C. Brown, Dubuque.
7. Suresh Chandra, Quantum Mechanics, CBS publishers, New Delhi.
8. Satya Prakash, Advanced Quantum Mechanics, Kedarnath Publication, New Delhi.

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SEMESTER - II

EC 1 – ELECTRONICS

Subject Code: 17P2P7EC	Credits: 5	External Marks: 75	Hours: 5

Objective:

- *To acquire the basic knowledge of advanced special semi conductor devices, working principle of operational amplifier and its day today applications and to understand the fundamentals of digital circuits and integrated circuits.*

Unit I: **Special Semiconductor devices**

Metal Semiconductor interfaces – Varactor diode – Schottky diode – Tunnel diode – JFET – construction – Theory of operation – Drain characteristics – Transfer characteristics – JFET parameters – DC biasing – DC load line – CSJFET Amplifier – Depletion and Enhancement type MOSFET – Construction – Working – Unijunction Transistor (UJT) – Construction – Characteristics – Relaxation oscillator – Silicon controller Rectifier (SCR) – Construction – Characteristics – Application in power control – DIAC – TRIAC – Construction – Characteristics.

Unit II: **Transducers and Opto electronic devices**

Transducers: Resistive position transducer – Capacitive pressure transducer – Tachometer – Electromagnetic flow meter – Linear variable differential transformer – Construction and working – Piezoelectric transducer –Strain Gauge – Resistance temperature detectors – Thermistors –Thermocouples – Carbon Microphone – Crystal Microphone –Capacitor Microphone – Loud speaker.

Opto electronic devices: Photo multiplier tube – Photo conductive cells – construction – working Applications – photo diode – Photo transistor – Construction – Characteristics – Applications – Solar cells – Light Emitting Diode (LED) – Construction – Applications.

Unit III: **Operational Amplifier and Applications**

Op-Amp differentiator – Integrator – Comparator – Current to voltage converter – Solving simultaneous and differential equations – Active filters: Low pass, high pass, band pass and band rejection filters – Wien's bridge oscillator – Phase shift oscillator – Square wave generator – Triangular wave generator – Schmitt trigger – Monostable multivibrator – Basis principles of phase locked loops.

Unit IV: **Digital Circuit techniques**

Half adder – Full adder – Half subtractor – Full subtractor - Multiplexer – DeMultiplexer – Decoder – BCD to Seven segment decoder – Encoder – SR, Clocked SR, JK, D and T Flip flops – Shift right shift registers – Shift left shift registers – Ring counter – Ripple/asynchronous counter – Mod-16 counter – Up/Down (Mod-10) counter.

Unit V: **Digital converters and Integrated circuits**

Basic digital to analog conversion – Binary Weighted resistor DAC – Binary R – 2R ladder DAC – Basic Analog to digital conversion – Counter type ADC Successive approximation ADC – Dual slope ADC – Fabrication of monolithic integrated circuits – Monolithic resistors, diodes, transistors and capacitors – 555 timer – description of the functional diagram – Monostable operation.

Books for Study (Relevant chapters in)

1. B.L. Theraja, Basic Electronics solid state, S.Chand & Company Ltd., 2001.
2. V.K. Mehta, Rohit Mehta, Principles of Electronics, S. Chand & Company Ltd., 2010.
3. Dr. S. Durai, Dr. T.E. Parthasarathy, Electronics Part I, S. Viswanathan (Printers & Publishers) Pvt. Ltd., 1997.
4. D. Roy choudhury and S. Jain, Linear integrated circuits, New Age International Publications, New Delhi, 2010.
5. V. Vijayendran, Introduction to integrated electronics, Digital & Analog, S. Vishwanathan (Printers & Publishers) Pvt. Ltd., 2007.
6. Dr. R.K. Kar, Electronics (Classical & Modern), Books & Allied (P) Ltd., 2007.

Books for Reference

1. J. Millman, C. Halkias, Electronic devices and circuits, Mc Graw-Hill international editions, (2010).
2. J. Millman, C. Halkias, and C.D. Parikh, Integrated Electronics, Analog and Digital Circuits and systems (TMGH) 2010.
3. D.P. Leach and A.P. Malvino, Digital principles and Application, Tata McGraw-Hill, New Delhi, 2006.
4. R.P. Jain, Modern digital electronics, Tata Mc Graw-Hill, New Delhi, 1998.
5. R.A. Gayakwad, Op-Amps & Linear integrated circuits, Printince Hall, New Delhi, 1999.

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SEMESTER – II
EC 2 – MICROPROCESSOR AND MICROCONTROLLER

Subject Code: 17P2P8EC	Credits: 5	External Marks: 75	Hours: 5

Objectives:

- *To acquire knowledge about microprocessor and apply it to various interfacing applications.*
- *To introduce the basics of micro controller.*

Unit I: **Digital Computer Architecture And 8085 Microprocessor**

Basic components of a digital computer – CPU – I/O – Memory – Semi Conductor memory – RAM, ROM etc., – 8085 microprocessor Architecture – Bus System – Various registers – Pin configuration of 8085. Timing diagrams for OP code fetch cycle and READ and WRITE operations.

Unit II: **Programming With 8085**

Instruction set – Data transfer group – Arithmetic group – Logical group – Branch group – stack and I/O control instructions -Addressing modes – Direct, register I ndirect – immediate and implicit. Programming in the 8085 – Addition, Subtraction, Multiplication, Division, Biggest and Smallest of a set of numbers-Ascending and Descending order, maximum, minimum number of an array.

Unit III: **Data transfer and Interrupt structure**

Data transfer schemes – Synchronous and asynchronous – Direct memory Access (DMA) – Cycle stealing – Burst mode – Memory interfacing – Memory mapped I/O scheme –I/O mapped memory scheme – interfacing memory ICs with 8085 – Interrupts of 8085 – Hardware and software – priority of interrupts – hand shaking.

Unit IV: **Interfacing**

Interfacing devices and peripheral subsystems-Types of interfacing devices-programmable peripheral Interface (8255) – programmable DMA controller (8257) – programmable Interrupt controller (8259) – ADC & DAC-Stepper motor interfacing-Applications –Temperature measurement-Digital clock (using 8085).

Unit V: **Microcontroller**

Microcontroller and Embedded Processors – Overview of 8051 family-Pin description of 8051-Register – Program Counter – PSW, SFR – Loop and Jump instruction – Time delay generation and Calculation – Addressing mode – Arithmetic and Logical Instruction – Bit Instruction.

Books for study:

1. R.F.Coughlin and F.F.Driscoll, 'Operational amplifiers and linear integrated circuits', Pearson Education Inc, New Delhi, 2001.
2. R.Gaonkar, Microprocessor Architecture programming and applications, Wiley Eastern Ltd., New Delhi, 1985.
3. Marris Mano, Computer System Architecture, PHI Ltd., New Delhi, 1994.
4. B.Ram, Fundamentals of Microprocessors and Microcomputers, Dhanapat Rai and Sons, New Delhi, 1995.
5. Malvino, Electronic principles, Tata McGraw Hill Ltd., New Delhi, 1995
6. Muhammad Ali Mazidi and Janice Gillispie Mazidi, The 8051 Microcontroller and Embedded Systens, Pearson Education,NewDelhi, 2000.

Books for Reference:

1. T.L. Floyd “Electronic devices”, Pearson education, New York 2004.
2. T.L. Floyd “Digital Fundamentals” Pearson education, New York 2004.
3. P.Horowit and W. Hill, “The Art of Electronics”, Cambridge University Press Cambridge 1995.
4. Microcomputer Systems: The 8086/8088 Family, Yu cheng Liu and Glenn A Gibson, Prentice hall of India PVT Ltd, New Delhi, 2004,
5. A.Nagoor Kani, Microprocessor and Microcontroller, Ist Edition, RBA Publications, Chennai – 2006.

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SEMESTER – II

CC 8 - PRACTICAL II : GENERAL AND ELECTRONICS EXPERIMENTS

Subject Code: 17P2PP2	Credits: 4	External Marks: 75	Hours: 8

GENERAL:

1. Determination of wavelength of spectral lines – Brass arc spectrum
2. Determination of wavelength of spectral lines – Copper arc spectrum
3. Determination of wavelength of spectral lines – Iron arc spectrum
4. Rydberg's constants using spectrometer
5. Hartmann's constants using spectrometer
6. B-H curve – Anchor ring
7. Forbe's method – Thermal conductivity of a good conductor
8. e/m – Spectrometer
9. Planck's constant
10. Anderson's Bridge
11. Thermionic work function
12. Photo transistor – Characteristics

ELECTRONICS:

1. DIAC,TRIAC Characteristics
2. Op-amp characteristics
3. Op-amp – Adder, Subtractor, Integrator, Differentiator
4. Construction of Schmitt trigger
5. NAND and NOR as Universal gates
6. Op-amp as waveform generator
7. Half adder and Full adder using NAND gates
8. Half and Full Subtractor
9. Clipping and Clamping circuits
10. K-Map verification
11. Dual power supply
12. OP-AMP filter circuits

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SEMESTER - III

CC 9 – SOLID STATE PHYSICS

Subject Code: 17P3P9	Credits: 5	External Marks: 75	Hours: 5

Objectives:

- *To learn the basics of crystal structure.*
- *To understand theories for the description of certain properties and phenomena of solid states.*

Unit I: **Crystal structure**

Basics of crystal systems – Symmetry elements in a crystal – Point groups and Space Groups – Bravais lattices – Defects and dislocations – Bonding of solids - Bragg's law – Atomic scattering factor – Experimental X-ray diffraction methods of crystal structure analysis – Laue method – Rotating crystal method – Powder method – Ordered phases of matter: Translational and Orientational orders – Kinds of liquid crystalline order – Quasicrystals.

Unit II: **Lattice vibration and Thermal properties:**

Vibration of monoatomic lattices – diatomic lattice vibration – Quantisation of lattice vibration – Phonon momentum – N-Process and Umpklapp process – Local Phonon modes – Inelastic scattering of Photons by long wave phonons – Lattice specific heat – Classical Theory – Electronic specific heat – Einstein's and Debye's Theory – Response and Relaxation phenomena –Thermo electric power.

Unit III: **Band theory of solids:**

Free electron gas in three dimension – Drude and Sommerfeld model of electrical and thermal conductivity – Widemann Franz law – Bloch theorem – Kronig–Penney model – Velocity of electrons according to Band theory – Brillouin zones –Number of possible wave functions per band – Distinction between metals, insulators and semiconductors – Metal-insulator transition – Hall effect.

Unit IV: **Magnetism:**

Origin of permanent magnetic moment – Quantum theory of paramagnetism – Paramagnetism of rare earth and iron group ions – Ferromagnetism – Weiss theory – Molecular field – Heisenberg's exchange interaction – Ferro magnetic domains –Domain structure – Origin of Domains – Bloch Walls – Coercive force and hysteresis - Antiferromagnetic order – Ferrimagnetism - Ferrites.

Unit V: **Dielectrics and Superconductivity:**

Dielectrics: Polarization – Dielectric constant and Polarisability – Clausius-Mossotti
equation – Electronic, Ionic and Orientational polarisability – Ferro electric crystals classification – Polarisation catastrophe.

Superconductivity: Zero resistance – Behaviour in magnetic field – Meissner effect – Type I &Type II superconductors – London equation – Penetration depth – BCS theory, AC and DC Josephson effects (Qualitative study) – Properties and applications of superconductors - High Tc superconductors.

Books for study and Reference:

1. Gupta Kumar Sharma, Solid State Physics,K. Nath& Co, Meerut, 2013.
2. S.L. Kakani andC.A.Hemaranjini, Text book of Solid State Physics, Sultan Chand & sons, New Delhi, 1996.
3. R.K.Puri and V.K. Babbar,Solid State Physics,S.Chand& Company Ltd, New Delhi, 1996.
4. BsSaxena, Rc Gupta and PnSaxena,Fundamentals of Solid State PhysicsPragatiprakashan, Meerut, 2016.
5. S.O.Pillai, Solid State Physics, New age international, New Delhi, 2006.
6. Charles Kittel, Introduction to Solid State Physics, John wiley& Sons Inc, USA, 2005.

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SEMESTER - III

CC 10 – NUCLEAR AND PARTICLE PHYSICS

Subject Code: 17P3P10	Credits: 5	External Marks: 75	Hours: 5

Objective:

- *To acquire knowledge about nuclear structure, Radioactive Decays, Nuclear Fission and Fusion, Nuclear Reactions and Elementary Particles.*

Unit I: **Nuclear and Nuclear forces**

Nuclear mass – Nuclear stability, Binding energy, Mass defect and Packing fraction – Weiszacker's semi empirical mass formula – Mass parabolas for isobaric nuclei – nuclear magnetic moment – Determination of nuclear magnetic moment by magnetic resonance method – Electric Quadrupole moment.

Ground state of Deutron – n-p scattering at low energies – spin dependence – scattering length – effective range – exchange forces – meson theory.

Unit II: **Radioactive decay:**

Gamow's theory of Alpha decay – Geiger-Nuttal law – Beta decay – Neutrino hypothesis – Fermi theory of Beta decay – Selection rules – non conservation of parity – Gamma emission –internal conversion – nuclear isomerism – Basic principles of particle detectors – Ionization chamber – Cloud chamber – Bubble chamber –GM counter–Scintillation counter- Semiconductor detector.

Unit III: **Nuclear reactions and nuclear models:**

The Q-equation – Nuclear reaction cross section – Compound nucleus – energy levels – reciprocity theorem – Briet-Wigner dispersion formula for resonance scattering and reactions – optical model – shell model – liquid drop model – collective model.

Unit IV: **Accelerators and reactors:**

Linear accelerators -Cyclotron – Synchrocyclotron – Betatron – Electron synchrotron — Nuclear fission – Mass distribution of fission fragments – spontaneous fission – Bohr –Wheeler theory – Nuclear chain reaction – Homogeneous reactors – Heterogeneous reactors – Nuclear fusion – Thermonuclear reactions as source of stellar energy.

Unit V: **Elementary particles:**

Classification of elementary particles – General ideas of gravitational, strong, weak and electromagnetic interactions – conservation laws and their validity – The C.P.T theorem – Strangeness – Gellmann-Nishijima relation – SU(3) classification of Hadrons – Octets and Decuplets – Elementary ideas of quarks.

Books for Study and Reference

Relevant chapters in

1. K.S. Krane, Introductory Nuclear Physics (Tata McGraw Hill, New Delhi, 1987).
2. D.C. Tayal, Nuclear Physics
3. Pandya and Yadav, Nuclear Physics
4. R. C. Sharma, Nuclear Physics
5. S.B. Patel, Nuclear Physics: An Introduction (Wiley-Eastern, New Delhi, 1991).
6. B.L. Cohen Concepts of Nuclear Physics (Tata Mcgraw Hill, New Delhi, 1988).
7. S.N.Ghoshal-Nuclear Physics

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SEMESTER - III

EC 3 – OBJECT ORIENTED PROGRAMMING USING C++

Subject Code: 17P3P11EC	Credits: 4	External Marks: 75	Hours: 5

Objectives:

- *To understand the basic concepts of object oriented programming using C++.*
- *To impart practical training of real time problems in C++.*

Unit I: **Basics of OOP and C++ Programming**

Basic concepts of Object-Oriented Programming –Advantages – Benefits of OOP and applications– Structure of C++ Program – Tokens, Expressions. Control Structures - Decision Making and Statements : If .. else ,jump, goto, break, continue, Switch case statements - Loops in C++ : For,While, Do – Operators – scope resolution, member dereferencing, memory management operators – Manipulators – Operator overloading - Overloading unary, binary operators.

Unit II: **Classes and Inheritance**

Functions in C++ - Inline functions – Function Overloading - class – specifying a class- Defining member functions - Objects – private and static member functions – array of objects - friend function - Constructors – types - Destructors - Inheritance– Single, Multilevel, Multiple, Hierarchal, Hybrid inheritance.

Unit III: **Pointer and templates**

Pointers –Pointer to Class , Object – this pointer – Pointers to derived classes and Base classes -Virtual Functions and Polymorphism-Managing Console I/O Operations – Files – File stream classes – file modes – Sequential Read / Write operations – Binary and ASCII Files – Random Access Operation.

Unit IV: **Libraries and system development**

Templates – Exception Handling - Standard Template Library– Object Oriented Systems - String – Declaring and Initializing string objects – String Attributes – Miscellaneous functions - Development – prototyping paradigm – wrapping up.

Unit V: **Programs**

1. Write a Program using class to represent a Bank Account with Data Members – Name of depositor, Account number, Type of account and balance and member functions- deposit amount- withdrawal amount. Show name and balance. Check the program with own data.
2. Write the program to read an integer and find the sum of all the digits until it reduces to a single digit using constructer, destructor and default constructor.
3. Prepare pay roll of an employee using inheritance.
4. a. Write a program to find the number of vowels in a given text.
   b. Write the program to check for palindrome.
5. Prepare electricity bill for customers generating and handling any two exceptions.

Book for study and programs of unit v:

1. E. Balagurusamy, OBJECT-ORIENTED PROGRAMMING WITH C++, Tata Mc-Grawhill Publication, 6th Ed 2013.

REFERENCE BOOKS:

1. Ashok N Kamthane , OBJECT-ORIENTED PROGRAMMING WITH ANSI AND TURBOC C++, Pearson Education publication. 2003.
2. Maria Litvin & Gray Litvin , C++ for you, Vikas publication, 2002.
3. John R Hubbard, Programming with C++, 2nd Edition, TMH publication, 2002.

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SEMESTER – III

EC 4 - PRACTICAL

MICROPROCESSOR AND MICROCONTROLLER PROGRAMMING

Subject Code: 17P3P12EC	Credits: 5	External Marks: 60	Hours: 8

Any twelve experiments only

1. Microprocessor – Arithmetic Operation
2. Microprocessor – Largest, Smallest, Ascending , Descending
3. Microprocessor – Square and Square root
4. Microprocessor – Hexadecimal and Decimal Conversion
5. Microprocessor – 16-bit arithmetic operaration
6. Microprocessor – Stepper Motor
7. Microprocessor – Display of Character and Words
8. Microprocessor – Display of rolling message
9. Microprocessor – Display of blinking message
10. Microprocessor – Generation of square and triangular wave
11. Microprocessor – Saw tooth and stair-case waves
12. Microprocessor – Generation of sine waves
13. Microprocessor – Study of 8-digit 7-segment display
14. Microprocessor – Interface with CRO
15. Microcontroller – Addition and subtraction
16. Microcontroller – Multiplication and division
17. Microcontroller– Ascending and Descending order
18. Microcontroller – Stepper motor.

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SEMESTER – III

CC 11 - PRACTICAL III : ADVANCED GENERAL AND ELECTRONICS

Subject Code: 17P3PP3	Credits: 5	External Marks: 60	Hours: 8

Minimum twelve experiments

1. Magnetic Susceptibility – Guoy's Method
2. Magnetic Susceptibility – Quincke's Method
3. Michelson Interferometer – Determination of separation of sodium lines
4. Michelson Interferometer – Thickness of the thin film
5. Op-Amp D/A Converter
6. 0 – 99 Counter
7. 7490 as a scalar
8. Seven segment decoder and Mod 16 counter
9. Ultrasonic Interferometer
10. Four probe method
11. Junction Diode Characteristics
12. Shift Register
13. Encoder and Decoder
14. Multiplexer and DeMultiplexer.
15. 555 Timer – Multivibrators.
16. Laser: Determination of wavelength and particle size
17. Hall Effect
18. Photo Voltaic Cell

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SEMESTER - IV

CC 12 – ATOMIC AND MOLECULAR SPECTROSCOPY

Subject Code: 17P4P13	Credits: 5	External Marks: 75	Hours: 5

Objectives:

- *To understand the atomic spectra and Quantum Chemistry of molecules.*
- *To study the principles of Microwave, Infrared, Raman and Resonance spectroscopy and its application.*

Unit I: Atomic Spectra

Vector atom model and Quantum numbers – Pauli's exclusion principle and atomic structures – periodic table – spectra of alkali and alkaline elements – fine and hyper fine structure of spectral lines – complex spectra – effect of magnetic and electric fields on the spectrum of an atom Zeeman effect (Normal and anomalous) – Pachen-Back effect – stark effect.

Unit II: Molecular Spectra

The variation method-Application of variation method – Orbitals – Hybridization – types – molecular orbital method (MO method) – Hydrogen molecule ion – Bonding and anti –bonding molecular orbitals – The hydrogen molecule – Huckel's molecular approximation – Application to Butadiene and Benzene.

Unit III: Microwave and IR Spectroscopy

Microwave Spectroscopy: Rotational spectra of diatomic molecules – Effect of isotopic substitution – The non rigid rotator – Rotational spectra of polyatomic molecules – Linear, symmetric top and asymmetric top molecules – Experimental techniques.

IR Spectroscopy: Vibrating diatomic molecules – Diatomic vibrating rotator – Linear and symmetric top molecules – Analysis by infrared techniques – Characteristics and group frequencies.

Unit IV: Raman and Electronic Spectroscopy of molecules

Raman Spectroscopy: Raman effect – Quantum theory of Raman effect – Rotational and Vibrational Raman shift of diatomic molecules – Selection rules – Applications – Laser Raman spectrometer.

Electronic Spectroscopy of molecules: Electronic spectra of diatomic molecules – The Franck-Condon principle – Dissociation energy and dissociation products – Rotational fine structure of electronic vibration transitions.

Unit V: Resonance Spectroscopy

NMR: Basic principles –Quantum mechanic description – Spin-spin and spin-lattice relaxation times – Chemical shift and Coupling constant – NMR Spectrometer – NQR.

ESR: Basic principles – ESR spectrometer – Nuclear interaction and hyperfine structure – Relaxation effects – g- factor – Characteristics – Free radical studies and Biological applications.

Books for Study and Reference

1. C.N.Banwell, Fundamentals of molecular spectroscopy (McGraw Hill, New York,1981)
2. B.P. Straughan and S. Walker, Spectroscopy Vol.I (Chapman and Hall,Newyork,1976)
3. R.P.Feynman et al. The Feynman Lectures in physics Vol III (Narosa, New Delhi,1989)
4. H.S.Mani and G.K.Mehta, Introduction to Modern physics (Affiliated East West, New Delhi,1991)
5. A.K. Chandra, Introductory Quantum chemistry (Tata McGraw Hill, New Delhi,1989)
6. Pople, Schneiduer and Berstein, High resolution NMR (McGraw Hill, New York)
7. Manaschanda, Atomic structure and chemical bond (McGraw Hill, New Delhi,1991)
8. Ira N. Levine, Qunatum chemistry (Prentice-Hall, New Delhi,1994)
9. Arthur Beiser, Concepts of Modern physics (McGraw Hill, New York,1995)
10. C.P.Slitcher, Principles of Magnetic Resonance (Harper and Row).

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SEMESTER - IV

CC 13 - COMMUNICATION ELECTRONICS

Subject Code: 17P4P14	Credits: 5	External Marks: 75	Hours: 5

Objectives:

- *Introducing various antennas and their properties for communication.*
- *Introducing knowledge about the generation and applications of microwaves and also RADAR*
- *To give the knowledge about the propagation of signals and the conversion of analog signal into digital signals based on various parameters*
- *To introduce the basic ideas about communications through optic fiber cables.*
- *To study about the signal processing technique in colour television regarding light and sound.*

Unit I: ANTENNAS

Introduction – Antenna equivalent circuits – Radiation fields – Polarization – Isotropic radiator – Power gain of an Antenna – Effective area of an Antenna - Effective length of an Antenna – Half wave Dipole Vertical Antennas – Non resonant Antennas - VHF – UHF Antennas – Microwave Antennas.

Unit II: MICROWAVES AND RADAR

Introduction – Magnetron – Magnetron oscillation – Travelling wave Tube amplifiers – Klystrons – Microwave radar systems - Microwave communications systems – Industrial applications of Microwaves – RADAR – Equation of RADAR – Range – Applications.

Unit III: COMMUNICATIONS SYSTEMS

ANALOG : Amplitude modulation – Modulation index – Frequency spectrum for sinusoidal AM – Average power for sinusoidal AM – Non sinusoidal modulation.

DSBSC – Amplitude transmitters – AM Receivers.

SSB: Introduction – SSB generation – SSB reception – S /N Ratio for SSB – Balanced Modulators DIGITAL: Introduction – PAM – PCM – PFM- PTM- PPM – PWM –Frequency shift keying Phase shift keying – Differential phase shift keying.

Unit IV: FIBRE OPTIC COMMUNICATIONS:

Introduction – Principles of light transmission in a Fibre – Losses in Fibers – Dispersion – Light sources of Fibre Optics – Photo Detectors – Connectors and Splices – Fibre Optic Communication System – advantages.

Unit V: TELEVISION

Elements of television system – Picture transmission – Sound transmission – Picture reception – Sound reception – Colour television – Essentials of colour television – Perception – Three colour theory – Luminescence – Hue and saturation – TV camera– Image orthicon– Vidicon luminescence signal TV display tubes -LCD–LED screen (Basic concepts only)- Delta gun and Precision in line picture tubes – Convergence adjustments – Signal transmission – modulation of colour difference signals – Fleaible.

Books for study:

1. Millman and Halkias, Integrated Electronics, Tata Mc Grawhill Ltd., New Delhi, 1987.
2. Malvino, Electronic Principles, Tata McGraw hill Ltd., New Delhi, 1985.
3. Dennis Roddy, John Coolen Electronic Communications (Fourth Edition) Prentice Hall of India Private Ltd, 1997.
4. R.R.Gulati, Monochrome and Colour Television, Wiley Eastern, New Delhi, 1995.

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SEMESTER - IV

EC 5 - LASERS, NANO MATERIALS AND APPLICATIONS

Subject Code: 17P4P15EC	Credits: 4	External Marks: 75	Hours: 4

Objectives:

- *To enrich the knowledge in the field of laser and to learn the structures, properties, characterization and applications of nanomaterials.*

Unit I: LASERS

Principles of lasers – Population inversion – Laser Pumping quality factor – threshold condition –Schallow and Townes condition - He-Ne Laser – CO_2 Lasers – Nd-YAG Laser – Intrinsic semiconductor Laser – Holography – Recording and reconstruction of image – transmission technique only.

Unit II: INTRODUCTION TO NANOMATERIALS

Nanoparticle – classifications – Principles of Top- down and Bottom- up approaches – Chemistry of nanoparticle synthesis – Nucleation and growth of nanoparticles – Fullerence : Variations – properties – Quantum dots – Metal nanoparticles – fabrication – optical properties – applications.

Unit III: SYNTHESIS AND PROCESSING OF NANOMATERIALS

Synthesis of metallic and semi conductor nanoparticle - Physical and Chemical techniques – Ball milling – Laser ablation – Photo , e-beam , X-Ray lithography – Molecular Beam Epitaxy (MBE) – Plasma arching – Sol Gel technique – Electro chemical etching technique .

Unit IV: FABRICATION AND CHARACTERIZATION OF NANO STRUCTURED MATERIALS

Nano wires growth techniques – VLS and electrochemical etching technique – Carbon nanotubes – formation – growth – types and structure – Estimation of particle size – SEM, TEM – SPM – STEM – block diagram – working.

Unit V: APPLICATIONS OF NANOMATERIALS

Molecular electronics and nanoelectronics – Nanorobots – Biological applications of nanoparticles – catalysis by gold nanoparticles – Band-gap engineered quantum devices – Nanomechanics – CNT emitters – Photoelectrochemical cells – Photonic crystals – Plasmon waveguides.

Books for study

1. Nanotechnology- S.Shanmugam, TBH edition.
2. Nano the essential- T.Pradeep – McGraw Hill edition, Chennai.
3. G.Cao, Nanostructures and nanomaterials (Imperial college press London, 2004)

Books for References

1. Nanoscale materials in chemistry, Kenneth J. Klabunde, 2001 Wiley & sons, Publication.
2. C.P. Poole and F.J. Owens, Introduction to Nanotechnology – Wiley, New Delhi, 2003.

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SEMESTER – IV

CC 14 - PRACTICAL IV : COMPUTER PROGRAMMING WITH C AND C++

Subject Code: 17P4PP4	Credits: 4	External Marks: 60	Hours: 8

Any twelve programs

'C' PROGRAMMING:

1. Matrix Addition, Subtraction
2. Ascending and Descending Order
3. Hartmann's Constant
4. Iteration Method
5. Least Square Curve Fitting
6. Lagrangian Interpolation Method
7. Newton-Raphson method
8. Quadratic equation
9. Matrix mulplication
10. Matrix transpose

C++ PROGRAMMING:

1. Simple and Compound Interest using class and object.
2. Biggest and smallest number in an array.
3. Matrix multiplication.
4. Program to create a class FLOAT that contains one float data member. Overload all the four Arithmetic operators so that they operate on the object FLOAT.
5. Program to create a class STRING using any 5 STRING functions.
6. Program to create class, which consists of EMPLOYEE Detail like E_Number, E_Name, Department, Basic, Salary, Grade. Write a member function to get and display them. Derive a class PAY from the above class and write a member function to calculate DA, HRA and PF depending on the grade.

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SEMESTER – IV

PW 1 - PROJECT WORK

Subject Code: 17P4PPW	Credits: 4	External Marks: 80	Hours: 7