BHARATHIDASAN UNIVERSITY
TIRUCHIRAPPALLI

M.Sc., Physics

(For the candidates admitted from the academic year 2014 -15 onwards offered through Centre for Distance Education)

Course Duration: 2 Years – (Non-Semester System)

Eligibility: B.Sc. Physics

Sem	Particulars	Title of the Paper	Marks
I	Major Paper I	Mathematical Physics and Numerical Methods	100
	Major Paper II	Classical Dynamics and Relativity	100
	Major Paper III	Analog Electronics and Microprocessor	100
	Major Paper IV	Electromagnetic Theory	100
	Major Paper V	**Physics Practicals- I** (General Experiments)	100
II	Major Paper VI	Quantum Mechanics	100
	Major Paper VII	Statistical Mechanics	100
	Major Paper VIII	Solid State Physics	100
	Major Paper IX	Atomic & Molecular Physics / Nuclear & Particle Physics	100
	Major Paper X	**Physics Practicals- II** (Advanced Electronics Experiments)	100
TOTAL MARKS			**1000**

(Passing minimum 50% - both theory and practical)

Note: Compulsory Record should be submitted at the time of practical examination.

Major Paper I

Mathematical Physics and Numerical Methods

Unit I **Vector Analysis and Matrix theory** Gradient, Divergence, Curl and laplacian – Gauss Theorm, Green.s theorem, stokes theorem and applications.

Characteristic equation of a matrix- Eigen values and Eigen vectors – Caley Hamilton theorem – Reduction of a matrix to diagonal form – Jacobi and method sylvester's theorem.

Unit II : Complex Analysis
Functions of complex variables – Differentiability -- Cauchy-Riemann 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 III Special Functions
Gamma and Beta functions – Sturm-Liouville problem – Legendre, Associated Legendre, Bessel, Laugerre and Hermite differential equations : series solution – Rodriguez formula – Generating functions – Orthogonality relations – Important recurrence relations.

Unit IV Group Theory

Basic definitions – Multiplication table – Subgroups, Cosets and Classes – Direct Product groups – Point groups -- Space groups – Representation theory – Homomorphism and isomorphism– Reducible and irreducible representations – Schur's lemma – The great Orthogonality theorem – Character table -- C3v and D3h as examples – Elementary ideas of Rotation groups.

Unit V Numerical Methods

Newton – Raphson method – Gauss elimination method – Gauss seidel method – Trapezoidal rule – Simpson's rule – Runge Kutta methods – Euler's method – Improved Euler's method – C program for solving above.

Books for Study and Reference
Relevant chapters in

1. A.W. Joshi, Matrices and Tensors in Physics, Wiley Eastern Ltd., New Delhi (1975)
   Eugene Butkov, Mathematical Physics, Addison Wesley, London (1973)
2. L.A.Pipes and L.R. Harvill, Applied Matematics for Engineers and Physcists, McGraw Hill Company, Signgapore (1967)
3. P.K.Chattopadhyay, Mathematical Physics, Wiley Eastern Ltd., New Delhi (1990)
4. A.K. Ghattak, T.C.Goyal and S.J. Chua, Mathematical Physics, Macmillan, New Delhi (1995)
5. G.Arfken and H.J.Mathemattical Methods for Physicists, 4th ed. *Physicists* (Prism Books, Bangalore, 1995).
6. Introductory Methods of Numerical analysis – S.S. Sastry, Prentice – Hall of India, New Delhi (2003) 3rd Edition.
7. Numerical Methods in Science and Engineering – The National Publishing Co. Madras (2001).
8. Numerical Recipes in C, W.H. Press, B.P.Flannery, S.A.Teukolsky, W.T. Vetterling, Cambridge University (1996).
9. Monte Carlo : Basics, K.P.N. Murthy, ISRP, Kalpakkam, 2000.
10. Numerical Methods in C and C++, Veerarajan, S.Chand, New Delhi (2006).

Major Paper II

Classical Dynamics and Relativity

Unit 1 : Fundamental Principles and Lagrangian Formulation
Mechanics of a particle and system of particles – Conservation laws – Constraints – Generalized coordinates – D' Alembert's principle and Lagrange's equation – Hamilton's principle – Lagrange's equation of motion – conservation theorems and symmetry properties – Motion under central force : General features – The Kepler problem Scattering in a central force field.

Unit 2: Lagrangian Formulation: Applications
a) Rigid Body Dynamics
Euler angles – Moments and products of inertia – Euler's equations – Symmetrical top.
b) Oscillatory Motion
Theory of small oscillations – Normal modes and frequencies – Linear triatomic molecule
Wave motion – wave equation – Phase velocity – Group Velocity dispersion

Unit 3: Hamilton's Formulation
Hamilton's canonical equations of motion – Hamilton's equations from variational principle – Principle of least action – Canonical transformations – Poisson brackets – Hamilton – Jacobi method – Action and angle variables – Kepler's problem in action – angle variables.

Unit 4: Nonlinear Dynamics
Linear and nonlinear oscillators- phase trajectories – Period doubling phenomenon in Duffing oscillator.
Soliton: Linear and nonlinear waves – Solitary Waves – KdV equation – Numerical experiments of Kruskal and Zabusky – Solitons.

Unit 5: Relativity
Reviews of basic ideas of special relativity – Energy momentum four vector – Minkowski's four dimensional space – Lorentz transformation as rotation in Minkowski's space – Compositions of L.T. about two orthogonal directions – Thomas precession – 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 Mc: Graw Hill, New Delhi (1991)
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For unit 4
3. M.Lakshmanan and S.Rajasekar: Nonlinear Dynamics: Integrability, Chaos and Patterns, Springer – Verlag, Berlin (2003), Springer (India) 2004
4. M.Lakshmanan and K.Murali: Chaos in Nonlinear Oscillators, world Scientific Co., Singapore (1996). Chapters 2-4.

Major Paper III
Analog Electronics and Microprocessor

Unit I Semiconductor Devices

Varactor diode- Schottky diode – Tunnel diode Gunn diode – Optoelectronic diode – LASER LED and Photo diode – UJT characteristics – relaxation oscillator- SCR characteristics - application in power control DIAC and TRIAC.

Unit II OPERATIONAL AMPLIFIER:

Operational amplifier characteristics – inverting and non-inverting amplifier – instrumentation amplifier – voltage follower –integrating and differential circuits –log & antilog amplifiers – opamp as comparator – Voltage to current and current to voltage conversions-active filters : low pass, high pass, band pass & band rejection filters-Solving simultaneous and differential equations.

Unit III OP-AMP APPLICATIONS (OSCILLATORS AND CONVERTORS)

Wien bridge, phase shift oscillators and twin-T oscillators – triangular, saw-tooth and square wave generators-Schmitt's trigger – sample and hold circuits – Voltage control oscillator – phase locked loops. Basic D to A conversion: weighted resistor DAC – Binary R-2R ladder DAC – Basic A to D conversion: counter type ADC – successive approximation converter – dual slope ADC.

Unit IV Microprocessor 8085 and Programming

8085 architecture -Instruction set – Data transfer group – Logical group – Branch group – Stack and I/O control Instructions – Addressing modes.

Addition – Subtraction – Multiplication – Division – BCD arithmetic – Sorting of an array - Choosing the biggest and smallest number from a list-Time Delay-Square wave generator

Unit V Interfacing I /O devices and application programs

Types of interfacing devices – Programmable peripheral interface (8255 A) -8253 Timer interface – Programmable interrupt controller (8259)- programmable communication interface (8251)-Application programs – Traffic control – Stepper motor – ADC – DAC – Temperature control.

REFERENCES:

1. T.F.Schubert and E.M.Kim, “Active and Nonlinear Electronics”, John Wiley Sons, New York (1996)
2. L.Floyd, Electronic Devices, “Pearson Education” New York (2004)
3. Dennis Le Crissitte, Transitors, Printice Hall India Pvt. Ltd (1963)
4. J.Milman and C.C. Halkias, Integrated Electronics, McGraw Hill (1972)
5. A. Mottershed, Semiconductor Devices and Applications, New Age Int Pub,
6. M.Goodge, Semiconductor Device Technology Mc Millan (1983)
7. S.M.Sze, Physices of Semiconductor Devices, Wiley-Eastern Ltd (1981)
8. Milman and Taub, Pulse, digital and switching waveforms, McGraw Hill (1965)
9. Ben.G.Streetman, Solid state electronic devices, Printice Hall, Englewood cliffs, NJ (1999)
10. R.A.Gayakwad, Op-Amps&Linear integrated circuits, Printice Hall India Pvt Ltd.(1999)
11. R. Goankar, *Micropressor Architecture, Programming and Applications* (Wiley Eastern, New Delhi, 1985).
12.. B. Ram, *Fundamentals of Microprocessors and Microcomputers* (Dhanapet Rai & Sons, New Delhi, 1995).

Major Paper IV

ELECTROMAGNETIC THEORY

Unit 1: Introduction to Electrostatics
Coulomb's law – Electric field – Gauss Law – Scalar potential – Surface distribution of charges and dipoles – Poisson and Laplace Equations – Green's theorem – Dirichlet and Neumann boundary conditions – Electrostatic boundary value problems : Solution using Green's function – Method of Images – Illustrations : Point charge in the presence of (i) a grounded conducting sphere, (ii) a charged, insulated and conducting sphere, (iii) near a conducting sphere at fixed potential and (iv) conducting sphere in a uniform electric field – Green's function for the sphere.

Unit 2: Electrostatics of Macroscopic Media
Multipole expansion – Elementary treatment of electrostatics with ponderable media – Boundary value problems with dielectrics -- Illustrations : (i) a point charge embedded at a distance away from a dielectric interface, (ii) dielectric sphere in a uniform electric field and (iii) spherical cavity in a dielectric medium with applied electric field – Molecular polarizability and electric susceptibility – Electrostatic energy in dielectric media.

Unit 3: Magnetostatics
Biot and Savart law – Force between current carrying conductors – Differential equations of magnetostatics and Ampere's law – Vector potential – Magnetic field of a localized current distribution, magnetic moment – Force and torque and energy of a localized current distribution in an external magnetic induction - Macroscopic equations – Boundary conditions on B and H -- Methods of solving boundary value problems in magnetostatics – Uniformly magnetized sphere.

Unit 4: Electromagnetics
Faraday's law of induction – Maxwell's displacement current – Maxwell equations - Maxwell equations in terms of vector and scalar potentials – Gauge transformations – Lorentz gauge, Coulomb gauge – Poynting's theorem – Conservation of energy and momentum for a system of charged particles and electromagnetic fields.

Unit 5: Plane ElectromagneticWaves and Wave Propagation
Plane waves in a nonconducting medium – Linear and circular polarization, Stokes 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. J. D. Jackson, *Classical Electrodynamics* (Wiley Eastern Ltd., New Delhi, 1999).
2. D. Griffiths, *Introduction to Electrodynamics* (Prentice-Hall, New Delhi, 1999).
3. R. P. Feynman et al, *The Feynman Lectures on Physics, Vol.II* (Narosa, New Delhi, 1989).

Physics Practical - I

(General experiments)

Any fifteen Experiments only

1. Determination of q, n, b by elliptical fringes method
2. Determination of q, n, b by hyperbolic fringes method
3. Determination of bulk modulus of a liquid by ultrasonic wave propagation
4. Determination of Stefan's constant
5. Identification of prominent lines by spectrum photography – Copper spectrum
6. Identification of prominent lines by spectrum photography – Iron spectrum
7. Determination of dielectric constant at high frequency by Lecher wire
8. Determination of e/m of an electron by magnetron method
9. Determination of L of a coil by Anderson's method
10. Photoelectric effect (Planck's constant Determination)
11. Four probe method – Determination of resistivities of powdered samples.
12. Determination of carrier concentration and Hall coefficients in semiconductors.
13. Determination of magnetic susceptibility of liquid by Guoy method.
14. Determination of magnetic susceptibility of liquids by Quincke's method.
15. Determination of wavelength and thickness of a film by using Michelson's interferometer.
16. Brass spectrum – Determination of composition.
17. Charge of an electron by spectrometer.
18. Polarizability of liquids by finding the refractive indices at different wavelengths.
19. Determination of wavelength of monochromatic source using biprism.
20. Determination of refractive index of liquids using biprism (by scale & telescope method).
21. Determination of specific rotatory power of a liquid using polarimeter.
22. Rydberg's constant using spectrometer.
23. Determination of coefficient of coupling by AC bridge method.
24. .Forbe's method of determining thermal conductivity.
25. Determination of dielectric loss using CRO.
26. Particle size determination using He-Ne Laser.

Major Paper VI

QUANTUM MECHANICS

Unit 1: Schrödinger Equation and General Formulation
Schrödinger Equation – Physical meaning and conditions on the wave function – Expectation values and Ehrenfest's theorem – Hermitian operators and their properties – Commutator relations - Uncertainty relation - Bra and ket vectors - Hilbert space – Schrödinger, Heisenberg and interaction pictures.

Unit 2: Exactly Solvable Systems
Linear harmonic oscillator -- Solving the one dimensional Schrödinger equation -- Abstract operator method – Particle in a box – Square well potential -- Rectangular barrier potential – Rigid rotator – Hydrogen atom.

Unit 3: Approximation Methods
Time independent perturbation theory: Non-degenerate and degenerate perturbation theories -- Stark effect – WKB Approximation -- Application to tunneling problem and quantization rules**.**
Time dependent perturbation theory: Harmonic Perturbation -- Transition probability.

Unit 4: Scattering Theory and Angular Momentum
Scattering theory: Scattering cross section – Green's function approach -- Born Approximation – Partial wave analysis .
Angular momentum: Matrix Representation of J -- Spin angular momentum -- Eigenvalues -- Addition of angular momenta - Clebsch-Gordan coefficients (basic ideas only).

Unit 5: Relativistic Quantum Mechanics
Klein-Gordon equation for a free particle and in an electromagnetic field – Dirac equation for a free particle -- Charge and current densities -- Dirac matrices – Plane wave solution – Negative energy states – Zitterbewegung – Spin angular momentum – Spin-orbit coupling.

Books for Study and Reference :
Relevant Chapters in
1. L. Schiff, *Quantum Mechanics* (Tata McGraw Hill, New Delhi, 1968).
2. V. Devanathan, *Quantum Mechanics*, Naroso Publishing House (2005)
3. P. M. Mathews and K. Venkatesan, *A Text Book of Quantum Mechanics* (Tata McGraw Hill, New Delhi, 1987).
4. V. K. Thankappan, *Quantum Mechanics* (Wiley-Eastern, New Delhi, 1985).

Major Paper VII

STATISTICAL MECHANICS

Unit 1: Thermodynamics
Laws of thermodynamics – Some consequences of the laws of thermodynamics – Entropy – Calculation of entropy changes in reversible processes – The principle of increase of entropy – Thermodynamic potentials –Enthalpy, Helmholtz and the Gibbs functions – Phase transitions – The Clausius-Clapeyron equation – van der Waals equation of state.

Unit 2: Kinetic Theory
Distribution function and its evolution -- Boltzmann transport equation and its validity – Boltzmann's H-theorem – Maxwell-Boltzmann distribution -- Transport phenomena – Mean free path – Conservation laws – Hydrodynamics (no derivation).

Unit 3: Classical Statistical Mechanics
Review of probability theory – Macro-and micro states – Statistical equilibrium – Phase space and ensembles – Density function -– Liouville's theorem – Maxwell-Boltzmann distribution law – Micro canonical ensemble – Ideal gas – Entropy – Partition function – Principle of equipartition of energy – Canonical and grand canonical ensembles.

Unit 4: Quantum Statistical Mechanics
Basic concepts – Quantum ideal gas – Bose-Einstein and Fermi-Dirac statistics – Distribution laws – Sackur-Tetrode equation – Equations of state -- Bose-Einstein condensation.

Unit 5: Applications of Q.S.M.
Ideal Bose gas : Photons – Black body and Planck radiation – Photons – Specific heat of solids – Liquid Helium.
Ideal Fermi gas : Properties – Degeneracy – Electron gas – Pauli paramagnetism.
Ferromagnetism : Ising and Heisenberg models.

Books for Study and Reference :

Relevant Chapters in
1. K. Huang, *Statistical Mechanics* (Wiley Eastern Limited, New Delhi, 1963).
2. B. K. Agarwal and M. Eisner, *Statistical Mechanics* (Wiley Eastern Limited, New Delhi, 1994).
3. F. Reif, *Fundamentals of Statistical and Thermal Physics* (McGraw Hill, Singapore, 1985).
4. N. Sears and L. Salinger, *Thermodynamics* (Narosa, New Delhi, 1989).
5. W. Greiner, L. Neise and H. Stocker, *Thermodynamics and Statistical Mechnaics* (Springer, New York, 1995).

Major Paper IX

SOLID STATE PHYSICS

Unit 1: Crystal Structure

Crystal classes and symmetry – 2D, 3D lattices – Bravais lattices – Symmetry point groups – Space groups – Reciprocal lattice – Ewald's sphere construction – Bragg's law – Systematic absences – Atomic scattering factor – Diffraction – Structure factor – Experimental techniques – Laue, Powder, Rotation methods – Phase problem – Electron density distribution (elementary ideas only).

Unit 2: Lattice Vibrations and Thermal Properties
Vibration of monoatomic lattices – Lattices with two atoms per primitive cell – Quantization of lattice vibrations – Phonon momentum – Inelastic scattering of neutrons by phonons -- Lattice heat capacity – Einstein model – Density of modes in one-dimension and three-dimension – Debye model of the lattice heat capacity – Thermal conductivity – Umklapp process.

Unit 3: Free Electron Theory, Energy Bands and Semiconductor Crystals
Energy levels and density of orbitals – Fermi-Dirac distribution – Free electron gas in threedimensions
– Heat capacity of the electron gas – Electrical conductivity and Ohm's law –
Motion in magnetic fields – Hall effect – Thermal conductivity of metals – Nearly free electron model – Electron in a periodic potential – Semiconductors – Band gap – Effective mass – Intrinsic carrier concentration.

Unit 4: **Diamagnetism, Paramagnetism, Ferro magnetism and Antiferromagnetism**
Langevin classical theory of Diamagnetism and paramagnetism – Weiss theory - Quantum theory of paramagnetism – Demagnetization of a paramagnetic salt – Paramagnetic susceptibility of conduction electrons - Hund's rules - Ferroelectric order – Curie point and the exchange integral – Temperature dependence of saturation magnetization – Magnons – Ferromagnetic order – Antiferromagnetic order –Ferromagnetic domains – Origin of domains – Coercive force and hysteresis.

Unit 5: Dielectrics and Ferroelectrics and Superconductivity
Macroscopic electric field – Local electric field at an atom – Dielectric constant and polarizability – Clausius-Mossotti equation – Polarizaion catastrophe – Occurrence of Superconductivity – Meissner effect – Thermodynamics of superconducting transition – London equation – Coherence length – BCS theory – Flux quantization – Type I and Type II Superconductors – Josephson superconductor tunneling – DC and AC Josephson effect – SQUID – Recent developments in high Temperature Superconductivity – Application of superconductors.

Books for Study and Reference: Relevant Chapters in

1. C. Kittel, *Introduction to Solid State Physics* (Wiley Eastern, New Delhi, 1977).
2. N. W. Ashcrof and N. D. Mermin, *Solid State Physics* (Holt, Rinehart and Winston, Philadelphia).
3. J. S. Blakemore, *Solid State Physics* (Cambridge University Press, Cambridge, 1974).
4. A. J. Dekker, *Solid State Physics* (McMillan, Madras, 1971).
5. M. M. Woolfson, *An Introduction to X-ray Crystallography* (Cambridge University Press, Cambridge, 1991).
6. S. O. Pillai, *Solid State Physics* (New Age International, New Delhi, 1995).

Major Paper IX

ATOMIC & MOLECULAR PHYSICS / NUCLEAR & PARTICLE PHYSICS

Unit 1 : Basic Nuclear Properties
Nuclear size, shape, mass – Charge distribution – Spin and parity – Binding energy – Semi empirical mass formula – Nuclear stability – Mass parabola -- Nature of nuclear forces – Ground state of deuteron – Magnetic dipole moment of deuteron – Proton-neutron scattering at low energies – Scattering length, phase shift – Properties of nuclear forces – Spin dependence – Charge symmetry – Charge independence – Repulsion at short distances – Exchange forces – Meson theory.

Unit 2 : Radioactive Decays
Alpha emission – Geiger-Nuttal law – Gamow theory – Neutrino hypothesis – Fermi theory of beta decay – Selection rules – Nonconservation of parity – Gamma emission – Selection rules - Interaction of charged particles and X-rays with matter – Basic principles of particle detectors – Ionization chamber – Proportional counter and G.M counters – Solid state detectors – Scintillation and semiconductor detectors.

Unit 3 : Nuclear Reactions and Nuclear Models
Q-values and kinematics of nuclear cross sections – Energy and angular dependence – Reciprocity theorem – Breit-Wigner formula – Compound nucleus – Resonance theory – Optical model -- Shell model – Liquid drop model – Collective model.

Unit 4 : Accelerators and Reactors
Cyclotron – Synchrocyclotron – Betaron – Synchrotron – Linear accelerators --Characteristics of fission – Mass distribution of fragments – Radioactive decay processes – Fission cross section – Energy in fission – Bohr-Wheeler's theory of nuclear fission – Fission reactors – Thermal reactors – Homogeneous reactors – Heterogeneous reactors – Basic fusion processes - Characteristics of fusion – Solar fusion – Controlled fusion reactors.

Unit 5 : Elementary Particles
Building blocks of nucleus – Nucleons, leptons, mesons, baryons, hyperons, hadrons, strange particles - Classification of fundamental forces and elementary particles – Basic Conservation laws – Additional Conservation laws : Baryonic, leptonic, strangeness and isospin charges/quantum numbers — Gell-Mann-Nishijima formula – Multiplets -- Invariance under time reversal (T) charge conjugation (C) and parity (P) – TCP theorem -- Parity nonconservation in weak interactions – CP violation – Eight-fold way and supermultiples – SU(3) symmetry and quark model - Basic ideas on the theories of weak and strong interactions.

Books for Study and Reference: Relevant Chapters in

1. K. S. Krane, *Introductory Nuclear Physics* (John-Wiley, New York, 1987).
2. V. Devanathan, Nuclear Physics, Naroso Publishing House (2006)
2. S. B. Patel, *Nuclear Physics: An Introduction* (Wiley-Eastern, New Delhi, 1991).
3. B. L. Cohen*, Concepts of Nuclear Physics* (Tata McGraw Hill, New Delhi, 1988).
4. H. S. Hans, *Nuclear Physics: Experimental and Theoretical* (New Age International Publishers, New Delhi, 2001).
5. D. C. Cheng and G. K. O'Neill, *Elementary Particle Physics: An Introduction* (Addison-Wesley, 1979).
6. D. Griffiths, *Introduction to Elementary Particles* (Wiley International, New York, 1987).

Physics Practical – II
Advanced Electronics

(Any fifteen experiments only)

1. Logic gates – Universality of NAND / NOR gates Using IC's
2. Verification of Demorgans theorems and Boolean Expressions
3. Construction of dual regulated power supply
4. Digital to analog converter - R-2R method and Weighted method
5. 17. Study the function of multiplexer and demultiplexer
6. BCD to seven segment display
7. 24. Study of counter using IC 7490 (0-9 and 00-99)
8. Characteristics of JFET
9. Characteristics of UJT
10. Characteristics of SCR
11. Characteristics of LDR
12. MICROPROCESSORS AND COMPUTER LABORATORY
13. 8 bit addition, subtraction, multiplication and division using 8085/Z80.
14. Study of DAC interfacing (DAC 0900).
15. Study of ADC interfacing (ADC 0809).
16. Study of programmable interrupt controller (IC 8259).
17. Traffic control system using microprocessor.
18. Microprocessor as digital thermometer (temperature controller).
19. Control of stepper motor using microprocessor.
20. Roots of algebraic equations -- Newton-Raphson method.
21. Least-squares curve fitting – Straight-line fit.
22. Least-squares curve fitting – Exponential fit.
23. Solution of simultaneous linear algebraic equations – Gauss elimination method.
24. Numerical integration – Composite trapezoidal rule.
25. Numerical differentiation – Euler method.
26. Solution of ordinary differential equations – Runge-Kutta 2nd order method.

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