Full marks 70 + internal 30

Paper I: Research Methodology & Computer Applications

Paper I: (a) Research Methodology (Number of Lectures=15)

1) Meaning of Research Methodology: Difference(s) between Methods of Research & Research Methodology; Motivation for Research. Research approaches and Related Tool. Conditions and criteria for good research.

2) Literature Survey

3) General Introduction about all the elective courses by teachers concern

4) Interface with computer and mathematical tools: MSWord, Power point, Excel and programming with MATLAB.

Paper I: (b) Computer Applications (Number of Lectures=35)

1) Programming in C or FORTRAN:

Constants, variables, data-types; operators: arithmetic, relational, logical, problems involving assignments, increment / decrement, formatted input and formatted output, decision making and branching, creation of loops: For loop, While loop, and do-while loop. 1D and 2D arrays, reading strings from terminal, writing strings to the screen.

2) Numerical Analysis:

Interpolation with two variables. Numerical integration: Newton-Cotes, Orthogonal polynomials and Gaussian quadrature. Accuracy of quadrature formulae. Numerical differentiations; Numericalsolution of ordinary differential equations : one step and multistep methods. Euler's, Adam's, Runge- Kutta's methods. Predictor-corrector methods. Errors and accuracy. Numerical solution of nonlinear equation in one variable: Separation of roots and initial approximation.

References:

1. "How to write and Publish" by Robert A. Day and Barbara Gastel. (Cambridge University Press).
2. "Survival skills for Scientists" by Federico Rosei and Tudor Johnson. (Imperial College Press).
3. "Probability and Statistics for Engineers and Scientists" by Sheldon Ross. (Elsevier Academic Press).
4. "The Craft of Scientific Writing" by Michael Alley. (Springer).
5. Numerical Methods for scientific and engineering Computation by M.K.Jain, S.R.K Iyengar and R.K. Jain, Wiley Eastern Limited
6. Numerical Analysis by Shastri.
7. FORTRAN 77 AND Numerical Methods by C. Xavier (New Age International Publishers)
8. FORTRAN - 77 by Schaum Series.
9. Programming in C and C++ by Schaum Series.

10/10/2014 Shaltiya 16.10.2014 10/10/2014

Papor II: Fundamentals of Physics revisited

The total syllabus for the course is divided into 7 compulsory units each of 10lectures. The Teacher will discuss only the gist important principles etc in the class. More emphasis will be on application in solving problems, improve the understanding of students (Discussing multiple-choice questions, objective and descriptive questions etc.)

i. **Mathematical Methods:**
Application of vector calculas in classical mechanics and electrodynamics. Vector spaces and operator algebra, matrices and their application in quantum mechanics. Linear first order and second order differential equations in physics. Fourier series. Fourier and Laplace transforms. Complex analysis its applications in evaluating intergrals. [10]

ii. **Electronics**
Semiconductor Devices: p-n junction, BJT, FET, MOSFET, UJT, SCR. Feedback amplifiers and oscillators. Modulation and Demodulation: AM, FM, PM. **Digital:** Boolean algebra, logic gates, adder, subtractor, flip-flops. [10]

iii. **Electrodynamics:**
Laplace and Poisson equations, boundary value problems. Electrostatics in dielectric media. Maxwell's equations in free space and in linear isotropic media. Boundary conditions on fields at interfaces. scalar and vector potentials. Electromagnetic waves - reflection and refractions, dispersion, interference, coherence, diffraction, polarization, electrodynamics of charged particles in electric and magnetic fields. Radiation from moving charges and from a dipole, retarded potentials and fields. [10]

iv. **Quantum Mechanics:**
One dimensional problems, Harmonic oscillator, hydrogen atom , spherically symmetric potential; bound states and scattering states, angular momentum algebra, time independent and time dependent perturbation theories, WKB approximation, identical particles and symmetry. [10]

v. **Statistical Mechanics:**
Probability theory, statistical description of macroscopic systems, phase space, ensembles, partition function, laws of thermodynamics, thermodynamic potentials and Maxwell's relations. Chemical potential, free energy and connection with thermodynamic quantities. Ideal gas, Classical and quantum statistics, degenerate electron gas, Bose-Einstein condensation. [10]

vi. **Atoms and Molecules:**
Electrons in atoms, exchange symmetry of wavefunctions, atomic and molecular spectra and their explanations including spin-orbit coupling, fine structure, relativistic corrections, spectroscopic terms and selection rules, hyperfine structure, Zeeman, Paschen-Back and Stark effects, principles of ESR and NMR bondings in molecules, rotation and vibration spectra, Raman spectra. Bindings in molecules, rotation and vibration spectra, Raman spectra. [10]

vii. **Condensed Matter Physics:**
Crystal classes and systems, lattice vibration, free electron theory, energy bands in solids, electronic structure of quantum confined structures, impurity levels in doped semi conductor structures. Electron transport, dielectrics, Clausius-Mosstti equation, ferroelectricity, dia-, para, ferro-, antiferro- and ferri-magnetism, superconductivity, Messiner effect. Type 1 and Type 2 superconductors, high Tc super conductors. [10]

Paper III

Elective Course - 2 (Electronics) - 30 lectures

Opto-electronic devices (solar cell, photo-detectors, LED, [illegible]) and their applications. Digital techniques and application- (registers, counters, [illegible] circuits). A/D and D/A converters. Microprocessor and microcontroller basics. Role of atmosphere on the propagation of EM wave – a brief introduction. In-situ and Remote sensing system: RADAR: Background science, working principles and basic design. Doppler radar (CW and pulse operations). LIDAR: Doppler, fluorescent, aerosol, Raleigh and Differential absorption LIDAR and their applications. Signal retrieval and processing techniques.

Elective course -3 (Sc. and Technology of Renewable Energy) - 30 Lectures

1. Fundamentals of Renewable Energy sources – 4 lectures
2. Renewable Energy current status in India and world – 2 lectures
3. Fundamentals of PV technology, system design and components – 4 lectures
4. PV System design for home lighting, solar pumping etc. – 4 lectures
5. Solar Thermal systems (solar distillation, hot water system, drying system) – 6 lectures
6. Wind energy and its application – 2 lectures
7. Introduction to Biofuels, Geothermal , hydropower, Hydrogen energy, Ocean Thermal, Ocean waves etc. – 6 lectures
8. Limitations and future prospects of renewable energy – 2 lectures

Elective course - 4 (Environmental Physics) - 30 Lectures

1. Introduction – 2 lectures
2. Structure and thermodynamics of Atmosphere, energy momentum, stratification and stability - 6 lectures
3. Elements of weather and climate – 4 lectures
4. Physics of radiation, scattering, diffusion and energy balance – 6 lectures
5. Energy and Environment – 4 lectures
6. Transportation of pollutants – 2 lectures
7. Heat Island Effect – 4 lectures
8. Application of environmental physics – 2 lectures

Elective course - 5 (Atomic and Molecular Physics) – 30 lectures

Elementary idea of Quantum Mechanics
Schrödinger equation, Wave function, probability density function, Normalization of wave function
Schrödinger equation for (i) a free particle, (ii) a particle in spherically symmetric field and their solutions.
Addition of angular momenta.
Theory of scattering:- Partial wave method and Born's approximation and their applications.

10/10/2014