Course Structure and Syllabus of
Five Year Integrated
M- Tech. in Engineering Physics
FIVE –YEAR INTEGRATED M.TECH. PROGRAMME IN “ENGINEERING PHYSICS”

FIRST YEAR

<table>
<thead>
<tr>
<th>I- Semester:</th>
<th>Contact Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Same as B.Tech.Part-I (1st Semester)</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>Practicals:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Same as B.Tech.Part-I (1st Semester)</td>
<td>12</td>
<td>08</td>
</tr>
<tr>
<td>Total</td>
<td>29</td>
<td>25</td>
</tr>
</tbody>
</table>

II- Semester:

| Theory:               |                  |        |
| Same as B.Tech.Part-I (2nd Semester) | 20              | 20     |
| Practicals:           |                  |        |
| Same as B.Tech.Part-I (2nd Semester) | 09              | 06     |
| Total                | 29               | 26     |
## SECOND YEAR

### III-Semester:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Contact Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP- 2101</td>
<td>Thermal Physics</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>AP- 2102</td>
<td>Quantum Physics</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>AM-2101</td>
<td>Mathematical Methods</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>AC- 2101</td>
<td>Chemistry of Polymers</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>EE- 2112A</td>
<td>Electrical Engineering</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>EC- 2112A</td>
<td>Electronic Devices &amp; Components</td>
<td>03</td>
<td>03</td>
</tr>
</tbody>
</table>

**Practicals:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Contact Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP- 2301</td>
<td>Physics Lab.</td>
<td>03</td>
<td>02</td>
</tr>
<tr>
<td>AC- 2301</td>
<td>Chemistry Lab.</td>
<td>03</td>
<td>02</td>
</tr>
<tr>
<td>AM-2301</td>
<td>Computer Lab.</td>
<td>03</td>
<td>02</td>
</tr>
</tbody>
</table>

**Total:** 27 24

### IV-Semester:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Contact Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP- 2201</td>
<td>Electromagnetic theory &amp; wave guides</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>AP- 2202</td>
<td>Fluid Dynamics</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>AM-2201</td>
<td>Numerical Analysis</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>AC- 2201</td>
<td>Chemical Thermodynamics</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>EE- 2212A</td>
<td>Power Transmission &amp; Distribution</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>EC- 2212A</td>
<td>Analog Circuits &amp; Systems</td>
<td>03</td>
<td>03</td>
</tr>
</tbody>
</table>

**Practicals:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Contact Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP- 2401</td>
<td>Physics Lab.</td>
<td>03</td>
<td>02</td>
</tr>
<tr>
<td>AC- 2401</td>
<td>Chemistry Lab.</td>
<td>03</td>
<td>02</td>
</tr>
<tr>
<td>AM-2401</td>
<td>Computer Lab.</td>
<td>03</td>
<td>02</td>
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</table>

**Total:** 27 24
### THIRD YEAR

#### V-Semester:

<table>
<thead>
<tr>
<th>Course ID</th>
<th>Course Title</th>
<th>Contact Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP-3101</td>
<td>Space Physics</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>AP-3102</td>
<td>Physics of Materials</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>AP-3103</td>
<td>Digital Electronics &amp; Microprocessors</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>AP-3104</td>
<td>Semiconductor Physics &amp; Devices</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>AM-3105</td>
<td>Linear Algebra</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>MS-3105A</td>
<td>Crystallography &amp; crystal structure</td>
<td>03</td>
<td>03</td>
</tr>
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</table>

**Practicals:**

<table>
<thead>
<tr>
<th>Course ID</th>
<th>Course Title</th>
<th>Contact Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP-3301</td>
<td>Physics Lab.</td>
<td>03</td>
<td>02</td>
</tr>
<tr>
<td>EC-3312A</td>
<td>Digital Communication Lab.</td>
<td>03</td>
<td>02</td>
</tr>
<tr>
<td>EE-3312A</td>
<td>Electrical Engg. Lab.</td>
<td>03</td>
<td>02</td>
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</tbody>
</table>

**Total:** 27 24

#### VI-Semester:

<table>
<thead>
<tr>
<th>Course ID</th>
<th>Course Title</th>
<th>Contact Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP-3201</td>
<td>Advances Electromagnetic theory &amp; special Relativity</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>AP-3202</td>
<td>Atomic Physics &amp; Nuclear Engg.</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>AP-3203</td>
<td>Microwave and Radar Engg.</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>AP-3204</td>
<td>Statistical Mechanics</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>AM-3203</td>
<td>Statistics &amp; Stochastic process</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>HU-320X</td>
<td>Humanatics (Open elective) *</td>
<td>03</td>
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**Practicals:**

<table>
<thead>
<tr>
<th>Course ID</th>
<th>Course Title</th>
<th>Contact Hrs/Week</th>
<th>Credit</th>
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</thead>
<tbody>
<tr>
<td>AP-3401</td>
<td>Physics Lab.</td>
<td>03</td>
<td>02</td>
</tr>
<tr>
<td>EC-3412A</td>
<td>Microwave Engg. Lab.</td>
<td>03</td>
<td>02</td>
</tr>
<tr>
<td>EE-3412A</td>
<td>Electrical Engg. Lab.</td>
<td>03</td>
<td>02</td>
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</tbody>
</table>

**Total:** 27 24

* any one of:

- HU-3201: History of science & technology
- HU-3202: Industrial & Organizational Psychology
- HU-3203: Intellectual Property Rights
- HU-3204: Energy Management
- HU-3205: Industrial Sociology
- HU-3206: Ethics Philosophy & Values
- HU-3207: Entrepreneurship Development
# FOURTH YEAR

## VII-Semester:

<table>
<thead>
<tr>
<th>Course</th>
<th>Contact Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP-4101: Alternative Energy Sources</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>AP-4102: Elements of Fiber Optics</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>AP-4103: Quantum Electronics</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>AP-4104: Condensed Matter Physics</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>EE-4112A: Digital Control System</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>EC-4112A: Optical Communication</td>
<td>03</td>
<td>03</td>
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## Practical:

<table>
<thead>
<tr>
<th>Course</th>
<th>Contact Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP-4301: Physics Lab.</td>
<td>03</td>
<td>02</td>
</tr>
<tr>
<td>EC-4312A: Optical Communication Lab.</td>
<td>03</td>
<td>02</td>
</tr>
<tr>
<td>Seminar / Group Discussion</td>
<td>03</td>
<td>02</td>
</tr>
<tr>
<td>Summer Training *</td>
<td>-</td>
<td>02</td>
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Total: 27  26

## VIII-Semester:

<table>
<thead>
<tr>
<th>Course</th>
<th>Contact Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP-4201: Magnetohydrodynamics</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>AP-4202: Nano Materials</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>AP-4203: Elements of Microwave Remote Sensing</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>AP-4204: Instrumentation, Measurement &amp; Analysis</td>
<td>03</td>
<td>03</td>
</tr>
<tr>
<td>AP-4205: Seismology &amp; Heliseismology</td>
<td>03</td>
<td>03</td>
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## Practical:

<table>
<thead>
<tr>
<th>Course</th>
<th>Contact Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP-4401: Physics Lab.</td>
<td>03</td>
<td>02</td>
</tr>
<tr>
<td>EC-4312A: CAD Lab.</td>
<td>03</td>
<td>02</td>
</tr>
<tr>
<td>Project</td>
<td>06</td>
<td>04</td>
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Total: 27  23

* Summer Training of Six weeks duration
### FIFTH YEAR

#### VIII-Semester:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Contact Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

#### IX-Semester:

**Theory:**
- AP-5101: Physics of Atmospheric Sciences   03  03
- AP-5102: Fiber & Integrated Optics          03  03
- Electives: I, II, and III
- AP-5103: Solar Physics & Space Physics       03  03
- AP-5104: Photonics & Optoelectronics         03  03
- AP-5105: Fluids & Plasmas                    03  03
- AP-5106: Microwave Remote Sensing            03  03
- AP-5107: Atmospheric & Meteorology           03  03
- MS-5122: Nano materials and Nano structures   03  03
- MS-5124: Diffraction Techniques in materials sciences  03  03
- MS-5125: Advanced Polymers                   03  03
- MC-5109: Chemistry of Electronic Ceramics    03  03
- AC-5108: Solid State Chemistry               03  03
- CR-5104: Nano Ceramics                       03  03
- CH-5110: Renewable Energy Technology         03  03

**PG-Practicals:**
- AP-5301: Physics Lab.                         03  02
- Dissertation Interim Evaluation               09  05
- Seminar on Dissertation                       -   05

**Total** 27  27

#### X-Semester:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Contact Hrs/Week</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**X-Semester:**

- PG-Seminar                                       02  01
- Dissertation Evaluation                           -   10
- Dissertation Open Defence                         --  05

**Total** 02  16
SECOND YEAR

AP- 2101: Thermal Physics

Principles of thermodynamics and illustration with applications to simple fluids. Concept of thermodynamics state, extensive and intensive variables; internal energy function and first and second law of thermodynamics. Fundamental relation and equations of states; concepts of entropy and temperature as conjugate pair of variables; entropy maximum and energy minimum principles. Thermodynamic potential, enthalpy, Helmholtz potential, Gibbs potential; conditions of equilibrium, concepts of state, metastable and unstable equilibrium, components ad phase, Gibbs-Duchem relations, Maxwell relations, first order phase transitions and Clausius-Clapeyron equation; concepts associated with critical and multicritical phenomena. Basic Postulates, partition functions, ensembles, fluctuations, simple applications, quantum statistics of ideal gases, non-ideal system, phase equilibria.

Text Books:
2. An Introduction to Thermodynamics by Y.V.C.Rao, Willey-Eastern Ltd.

AP- 2102: Quantum Physics


Text Books:

AM 2101: Mathematical Methods

Solutions in series, Bessel function and Legendre function: Self – adjoint differential equations, Power series method of solving second order differential equation, Bessel’s functions of first kind \( J_n(x) \) and second kind \( Y_n(x) \), Recurrence relations, Generating functions of \( J_n(x) \), Orthogonal property of Bessel functions, Legendre’s equation, Legendre polynomials \( P_n(x) \), Rodrigues formula, Generating function of \( P_n(x) \), Orthogonal property of \( P_n(x) \), Sturm-Liouville problem.

Books Suggested:


AC-2101 Chemistry of Polymers


Recommended Books:

2. George Odian, Principles of Polymerization, John Wiley & Sons. 4th Ed.

EE-2112A: Electrical Engineering

Electrical Circuits: Network elements- Voltage and Current sources, Kirchhoff's voltage and current law, loop and nodal analysis, Superposition theorem, Thévenin's theorem, Nortons theorem, Maximum Power Transfer theorem. Sinusoidal Steady State analysis- RL and C elements, power and power factor, phasor diagram, resonance, mutual inductance and coefficient of coupling. Three-phase circuits, line and phase relationship, power measurement.

Electrical Machines: Transformer- Principle of working, EMF equation, Equivalent circuit, voltage regulation and efficiency, Open-circuit and short-circuit tests, autotransformer. DC Machines- Constructional features, DC Generators- No load Magnetization and external characteristic. DC motor- starting, speed-torque characteristics, speed control, applications.

**EC-2112 A: Electronic Devices and Components**


**AP- 2201: Electromagnetic Theory and Waveguides**

Electrostatics; Boundary value problems Dielectrics, Steady currents, Magnetostatics; Time-varying fields, Maxwell’s equations, Lorentz force equation and motion of charges. Plane electromagnetic waves. Waveguides and resonant cavities, fields at the surface of and within a conductor, cylindrical cavities and waveguides, modes in a rectangular waveguide, energy flow and attenuation in waveguides, perturbation of boundary conditions, resonant cavities, power losses in a cavity, Earth and ionosphere as resonant cavity, dielectric waveguide.

**Text Books:**
1. Introduction to Electrodynamics by Griffiths, D.J., Printice- Hall Pvt.Ltd.
2. Electromagnetics by J.D.Kraus, Tata- McGraw Hill.

**AP- 2202: Fluid Dynamics**

Neutral fluids, Boltzmann equation, collisions in a dilute neutral gas, collision integral, Maxwellian distribution, Conservation equations, Moment equations, Zero-order approximation, transport phenomena, hydrodynamic properties of ideal fluids, macroscopic derivation of hydrodynamic equations, equations of motion, equation of energy, vorticity equation, incompressible and barotropic fluids, hydrodynamic equations in conservative forms, Bernoulli’s
principle for steady flows, tangential stress in a Newtonian fluid, Navier-Stokes equation, flow through a circular pipe, scaling and Reynolds number, viscous flow past solid bodies, boundary layers, aerodynamic lift, accretion discs in astrophysics, thermodynamic properties of a perfect gas, acoustic waves.

Text Books:

AC – 2201 Chemical Thermodynamics


AM-2202 Numerical Analysis


Books Suggested:
EC-2201: Analog Circuits & Systems

Semiconductor diodes, Bipolar Junction Transistors and MOSFETs.
Half-wave and full-wave rectifiers. Filters and regulated power supplies.
Biasing circuits of BJT, FET and MOSFET, RC and DC coupled amplifiers, wide-band and
tuned amplifiers. Active impedance transformers, power amplifiers, impedance matching.
Feedback Amplifiers. RC and LC Oscillators, Blocking Oscillators.
Characteristics, limitations and applications of OP-AMPS. Internal structure of OP-AMPs.
Special purpose amplifiers. Analog multipliers.
Voltage regulators, Timers, VCO, PLL and function generators.
Analog switches and multiplexers. ADC and DAC.

EE-2202: Power Transmission and Distribution

Introduction: Generation, transmission and distribution of electrical power, AC and DC systems,
underground and overhead lines.

Economics of Generation: Cost of electrical energy, load and diversity factors, combined
operation of power stations.

Distribution Systems: Radial and ring systems, selection of feeders and distributors, DC and AC
distribution, concentrated and distributed loads, design considerations of a distribution system,
house and factory wiring, power factor improvement, economic aspects, tariff.

Underground Cables: Constructional details of various types of cables, oil and gas-filled cables,
voltage gradient, grading, sheath loss, thermal ratings, parameters.

Line Insulators: Different types, string efficiency, voltage equalization.

Overhead Transmission Lines: Resistance, inductance, capacitance, GMR, GMD, Bundled and
hollow conductors, inductive interference, surge impedance

Line Performance: Generalized circuit constants, nominal and equivalent T and representation,
long line equations, efficiency and regulation, power circle diagram, series and shunt
compensation, surge impedance loading
THIRD YEAR

AP- 3101: Space Physics

The Sun and the Solar wind, Solar wind plasma interactions with the planetary magnetosphere, Convection in the magnetosphere; coupling with ionosphere, dynamics of particles and fields in the Van-Allen radiation Belt, magnetospheres of inner planets; Venus, Mars, Mercury, magnetospheres of outer planets, basic plasma processes in magnetosphere, Single particle motion, statistical description, fluid description of plasma, waves in plasma, plasma waves in magnetized plasma, kinetic theory of waves and instabilities, dispersion relations, Whistler and VLF emissions in earth’s magnetosphere, parametric instabilities and striations in ionosphere modification.

Text Books:
2. The solar-terrestrial environment by J.K.Hargreaves, Cambridge University Press,

AP- 3102: Physics of Materials

Crystal structure, atomic bonding, atomic packing, atomic shape and size, crystal imperfection, atomic diffusion, thermal properties of materials, electrical properties of materials, local field and Clausius-Mossotti relation, types of polarization, piezo, ferro and pyro dielectricity, free electron model of metals, density of states, concept of plasmons, polarons, optical properties of materials, excitons, photo-conductivity, dia, para, ferro and anti-ferro magnetism, magnetic domains, magnetic materials and applications.

Text Books:

AP- 3103: Digital Electronics and Microprocessors

Logic families; characteristics, limitation and application SSI and MSI basic building blocks, analog and digital signals, digital circuits, logic functions and logic gates, binary numbers, combinational logic NAND/NOR logic, exclusive or logic, architecture of a microprocessor, software instruction set, addressing scheme, arithmatic logic and control schemes, memory systems, input/output interface, technology of microprocessor. Transducers and signal conditioning, instrumentation, amplifiers, choppers, filters, analog multiplexers, A/D, D/A converters, pay load design.
Text Books:

AP-3104: Semiconductor Physics and Devices


Text Books:

AM-3105: Linear Algebra


Books Suggested:
3. David W. Lewis: Matrix Theory, Allied Publisher.
AP- 3201: Advanced Electromagnetic Theory and Special Relativity

Maxwell’s equations, wave equations in scalar and vector potential, solutions of scalar and vector wave equations by Fourier analysis. Relativistic motion in electromagnetism, postulates of special theory of relativity, Lorenz transformation, relativistic mechanics, contraction of length, dilation of time, magnetism as relativistic effect, four vector, co-variance of Maxwell’s equations, Lienard-Wiechert potentials and the field of a uniformly moving electron, radiation from an accelerated charge, cyclotron synchrotron, Bremsstrahlung anf Cerenkov radiations. Scattering and absorption of electromagnetic waves, antenna, radiated power and angular distribution of radiation, electric dipole radiation.

Text Books:
1. Introduction to Special Relativity by R.Resnik, Wiley Eastern Ltd.
2. Classical Electrodynamics by J.D. Jackon,

AP- 3202: Atomic Physics and Nuclear Engineering.

Electron spin, Vector model, coupling of angular momentum, spin-orbit interaction, atomic magnetism, Zeeman and Paschen back effects, electronic, vibrational and rotational spectra of diatomic molecules, static properties of nuclei, nuclear binding energy and forces. $\alpha, \beta, \gamma$ decay, interaction of radiations with matter, fission and fusion as energy source. nuclear reactors, neutron cross sections, condition for criticality, types of nuclear reactors, breeder reactor, consideration of reactor design, control rods, scintillation counters, solid state detectors.

Text Books:
1. Nuclear Physics by I.Kaplan, Addison-Wiley.
2. Introduction to Atomic Spectra by H.E. White,McGraw-Hill.
3. Atomic Spectra and Atomic Structure by G.Herzberg, Dover, Newyork

AP- 3203: Microwave and Radar Engineering

Microwave, classification of microwave bands, microwave sources, Tunnel diode, Gun diode, IMPATT diode oscillator, Reflex klystron microwave amplifier, measurement of Microwave power, microwave antennas, radiation pattern, directivity, gain, impedance, bandwidth, polarization, size of antenna, Microwave radar system, radar equation, pulsed radar, CW doppler radar, FMCW radar, microwave communication system, terrestrial system, satellite communication system, Industrial application of microwave.

Text Books:

AP-3204: Statistical Mechanics

Review of thermodynamics and kinetic theory, phase space, Liouville theorem, the most probable distribution in energy, distinguishable and indistinguishable systems, Boltzmann, Bose-Einstein and Fermi-Dirac statistics, Partition function, Boltzmann statistics and its applications to ideal gas, Bose-Einstein statistics and its application to black body radiation, Fermi-Dirac statistics and its applications to free electron gas, Grand canonical ensemble.

Text Books:

AM-3203: Statistics & Stochastic Process

Statistics: Sampling techniques, Test of significance, Normal tests, c2 – tests, t – test and F – test. Design of experiments, Analysis of variance, one way and two way classifications.

Books Suggested:
1. Irwin Miller and John E. Freund.. Probability and Statistics for Engineers, Prentice Hall of India.
FOURTH YEAR

AP- 4101: Alternative Energy Sources

Fundamentals of solar radiation, fundamentals of heat transfer flat plate solar collector, solar concentrator, Photo Voltaic effect, basic theory of a solar cell, homo and hetero type p-n junction, single crystalline silicon solar cell, solar cells, alternatives materials, PV module, Panel and Array, energy storage. Recent techniques of manufacturing, effect of temperature on the efficiency of a solar cell, Thermo Photo Voltaic devices, Photo electric conversion, solar energy collection and transmission from space. Photo chemical energy conversion, Photo Electro Chemical solar cells, fuel cells and Photo Galvanic effect, introduction to wind power, tidal power, bio-mass, bio-gas, plants, geothermal energy.

AP- 4102: Elements of Fiber Optics

Over view of optical fiber communications, the evolution of fiber optics systems, elements of an optical fiber transmission links. Electromagnetic analysis of optical waveguides, classification of modes for a planner waveguide, TE and TM modes in a symmetric step index planner waveguide, power associated with a mode, excitation of guided modes, Maxwell equations in inhomogeneous media: TE and TM modes in planner waveguide. Leaky modes, leakage of power from the core, bending loss in optical waveguides. Optical fiber waveguides, optical fiber types, numerical aperture, pulse dispersion in step index fibers, scalar wave equations and modes of a fiber, Modal analysis for a step index fiber and graded-index fiber. Linearly polarized modes, power flow, multi mode fibers with optimum profiles, single mode fiber, propagation modes in single mode fibers, fiber materials, fiber fabrication. Vapor-deposition methods, Fiber optic cables, optical fiber connections, joints and couplers, signal degradation in optical fiber, absorption loss, radiation loss, attenuation, signal distortion in optical waveguides, pulse broadening, mode coupling.

Text Books:
1. Optical fiber communication by Keiser and Seniar.
2. Introduction to Optical fiber by A.K.Ghatak, Cambridge University Press.

AP- 4103: Quantum Electronics

Time dependent perturbation theory, transition probability, stimulated emission and absorption, quantization of electromagnetic field, Raman photon scattering, quantum electronic devices, Lasers, population inversion, amplification, various type of Lasers, gas Lasers, solid state lasers, semi-conductor lasers, masers, threshold requirement, steady state power out put, optical detectors and receivers, Q-switching.
Text Books:

AP-4104: Condensed Matter Physics

Crystal structure, point and space groups, reciprocal lattice, X-Ray, electron and neutron diffraction, lattice vibrations, normal modes, Einstein and Debye models, Phonons thermal conductivity and thermal expansion, free electron theory, Drude model of conductivity, Hall effect, Bloch theorem, energy bands in solids, density of states and conductivity, Effective mass, energy bands in semiconductors, Fermi surface, deHass-VanAlphen effect. Superconductivity, Meissner effect, tunneling in superconductor, Josephson junctions, high Tc superconductors, liquid crystals.

Text Books:

EC-4102: Optical Communication


AP-4201: Magnetohydrodynamics

Text Books:

AP-4202: Nano Materials

Physical chemistry of solid surfaces, quantum confinement in low-dimensional systems, zero-dimensional nanostructure, nano-particles, one-dimensional nanostructure, nano-wires and nano-rods, two dimensional nanostructures, thin films, special nano-materials, synthesis and fabrication of nanostructures, nanostructures fabricated by physical technique, characterization and properties of nanomaterials, nanoporous materials, carbon nano-tubes, characterization of nano-systems, thermal stability, basic materials properties, wear at the nanometer level semiconductor nanostructures, exciton polaritons in nanostructures and microcavities, light scattering in nanostructure, intraband optical spectroscopy of nanostructure, applications of nanomaterials.

Text Books:
2. Introduction to Nano Technology by Charles P. Poole Jr and F.J. Owens,

AP-4203: Elements of Microwave Remote Sensing

Remote sensing, the importance of remote sensing, physical properties of the atmosphere, absorption and emission by gases, water vapor absorption, oxygen absorption, total atmospheric gases absorption and emission, electromagnetic interaction with individual particles, atmospheric windows, active and passive remote sensing, scattering coefficient, surface parameters, smooth surface criteria, dependence on surface, roughness, dielectric constant, the nature of volume scattering for vegetation and soil, simple models relating scattering coefficient to physical parameters of soils and vegetation canopies.

Text Books:
AP- 4204: Instrumentation, Measurement and Analysis

General concepts of monitoring and control. Function elements of instruments. Classification of instrument, standards and calibration, errors and un-certainties in static performance parameters, the basic parameters, linearity, threshold, sensitivity resolution, hysteresis, impedance loading and matching, specifications of instruments. Generalized mathematical model of dynamic response of measurement systems. The operational transfer function, sinusoidal and Laplace transfer functions. Order of instruments, zero order instrument, step, ramp frequency and pulse/impulse response of first order and second order instruments. The basic idea of control system, basic control actions, proportional derivative and integral control. Stability criteria of control systems. Basic concepts of data analysis, measurement of dispersion, slandered deviation of a sample, properties of Gaussian distribution, chi square test, curving fitting of data.

Text Books:
1. Electronic Instrumentation by H.S.Kalsi, McGraall- Hill.
2. Automatic Control System by S.N. Verma, Khanna Publisher.
3. Automatic Control System, by B.C. Kuo, John Willey Publisher.

AP- 4205: Seismology and Helioseismology

Introduction to helioseismology, convection magnetoconvection, Schwarzschild criteria, convective instability, historical developments in helioseismology, Spatial an tempoaral filtering of oscillation data. Basic equations of hydrodynamics, perturbation analysis, radial and non-radial oscillation. Oscillation equations and properties, linear and adiabatic oscillation, dependence of frequencies on equilibrium model, physical nature of modes of oscillation, asymptotic theory for p and g modes, excitation and damping of oscillations.

Text Books:
FIFTH YEAR

AP- 5101: Physics of Atmospheric Sciences

The hydrostatic equation of atmospheric structure, conservation equations for mass, momentum, and energy of a gaseous mixture, atmospheric composition, thermal structure, ozone in Earth’s atmosphere, radiative transfer, radiative heating, Greenhouse effect, vertical mixing, diffusion equation, eddy diffusion, molecular diffusion, optical emissions from atmosphere, Airglow, excitation mechanism, solar extreme ultraviolet radiation (EUV), formation of ionosphere; ionization sources, basic theory of Photo-ionization, Chapman function, ion chemistry, continuity equation, transport processes in the ionosphere, thermal processes, ionization, excitation of atmospheric constituents by charged particles, aurora emissions, extraterrestrial atmospheres and ionospheres, Aurora an airglow.

Text Books:
1. Atmosphere by Kellogg William and Mead Margaret, Castle House Publications Ltd.
2. Introduction to ionospheric physics by Rishbeth and Garriot, Academic Press.
3. Aurora and Airglow by B.McCormac, VN Reinhold Publisher.

Reference Books:

AP- 5102: Fiber and Integrated Optics


Text Books:
1. Optical Wave guide Theory by Snyder, A.W. and Love, J.D., Chapmann and Hall.
2. Introduction to optical fiber by A.K.Ghatak, Cambridge University Press.

AP- 5103: Solar Physics and Space Physics

Spectral classification of stars, electro-magnetic spectrum, dopplor shift, Plank’s radiation formula, thermal equilibrium and Boltzmann factor, Saha-Boltzmann ionization equation. The solar interior, solar neutrinos, nuclear reactions, formation and evolution of stars, White dwarves,
neutron stars and black holes, interstellar matter, galaxies and Quasars, solar wind, solar magnetic field and coronal flares.

**Text Books:**

**AP- 5104: Optoelectronics and Photonics**

Semiconductor lasers for optical fiber communications, Fabry-Perot cavity, heterostructure semiconductor lasers, single frequency semiconductor lasers, semiconductor lasers for coherent systems. Distributed feedback in Ga-As-P lasers. Device structure and fabrication, photodetectors for fiber optics, reverse bias photo-detectors, dark current, quantum efficiency, signal to noise ratio, types of detectors. Receivers for digital fiber optic communication systems: basic components, detectors for digital fiber optic receivers, PIN diode, Avalanche photodiode, Fronts ends for digital fiber optic receivers, equalizer for optical communication, receivers, PIN-FET receivers for longer wavelength communication systems. Coherent optical fiber transmission systems, coherent detection principles, comparison of direct and coherent performance, homodyne and heterodyne systems. Non linear process in optical fibers, phase matching in waveguide, phase matched harmonic generation in waveguides. Second harmonic generation (SHG) in integrated optics, Cerenkov configuration SHG. Optical fiber sensor and devices, intensity modulation through light interruption, distributed sensing with fiber optics. Basic principles of interferometric optical fiber sensor, signal processing in mono mode fiber optic sensor, photonic band gap materials.

**Text Books:**
1. Optical fiber communication by G.Keiser, McGraw-Hill.

**AP- 5105: Fluids and Plasma**

Phase space and Liouville theorem, Boltzmann- Vlasov equations, distribution function, fluid pictures, Magnetohydrodynamics equations, natural plasmas, solar wind, Magnetosphere, radiation belts, ionosphere, wave in incompressible and compressible fluids, flow of neutral and ionized gases, past obstacles, shock waves, highly ionized conducting fluid, effect of magnetic field, Alfen waves, waves in cold and hot plasmas, and in hot magnetized plasmas, transport processes in plasmas, plasma instabilities.

**Text Books:**
AP- 5106: Microwave Remote Sensing
Active Microwave sensing of Land: Scattering models for soil surfaces, Dependence on soil moisture content, Back Scattering behavior of cultural vegetation canopies- Modeling approaches, radiated transfer method, First order solution of radiative transfer model, First order model for a multi-constituent canopy, Penetration properties of Canopies.

Text Books:

AP- 5107: Atmospherics & Meteorology
Particles, aerosols and cloud structure, Lapse rates, cloud densities, heat capacities and latent heats, vapor pressures, cloud models, solar controls of Earth’s atmospheric processes, condensation and nucleation, temperature profiles in troposphere, stratosphere and mesosphere. Horizontal motion of the atmospheric winds, Hadley circulation, Thunderstorm and lighting processes, wave and cyclotron techniques of analyses and forecast, humidity prediction in the atmosphere, nature and scope of meteorological satellites, principles of meteorological satellites, Indian meteorological system and satellites, atmospheric energy budget, atmospheric moisture, wind circulation and global climatology, regional climatology. Linear and nonlinear disturbances of tropical weather, temperature of mid latitude and polar - regions, climate classification in view of the satellites data.

Text Books:
1. Atmosphere by Kellogg William and Mead Margaret, Castle House Publications Ltd.
2. Introduction to Ionospheric physics by Rishbeth and Garriot, Academic Prss.