**Subject : Numerical analysis and Engineering**

**Units: 4**

**Weekly Hours : Theoretical : 2**

**Experimental: −**

|  |  |
| --- | --- |
| **week** | **Syllabus** |
| 1-6 | Laplace Transformation   Properties, Forward and Inverse transformation and associated theorems.   Convolution and Translation and their properties.   Solving differential equations using Laplace transformation.   Applications |
| 7-12 | General power series methods   Convergence of the power series.   Solution of differential equations   Legendre equation, Legendre polynomials.   Bessel equation, Bessel functions |
| 13-18 | Function of complex variables.   Cartesian and polar coordinates of complex numbers.   Analytical function, Cauchy-Riemann equations.   Cauchy integral theorem.   Integration in the complex plane. |
| 19-24 | Matrix Theory   Definitions, Ad joint, Inverse of a matrix, sum and multiply of matrices.   System of linear equations.   Characteristic equation, Eigen values and Eigen vectors |

|  |  |
| --- | --- |
|  |  Matrix differential equations |
| 25-30 | Fourier series and Transformation   Derivation of Fourier series   Odd and Even Functions   Half-wave Fourier series   Frequency spectra of different time functions, Fourier transformation   Applications |

**Subject : Laser physics**

**Units: 4**

**Weekly Hours : Theoretical : 2**

**Experimental: −**

|  |  |
| --- | --- |
| **week** | **Syllabus** |
| 1-10 | Laser Gain   Fluorescence line shape of the laser   Fluorescence linewidth.   Mathematical expressions of fluorescence linewidth   Laser Gain curve   Broadening the fluorescence line.   Natural broadening.   Doppler broadening.   Pressure broadening   Loop Gain.   Calculating loop gain (GL) without losses.   Calculating loop gain (CL) with losses.   Calculating gain threshold (GL)th.   Hole Burning in the laser gain curve   Active medium gain with lasing and without - Hole Burning   Saturation gain in a continuous wave laser   Gain and Output power of CW laser   Continuous wave laser   Pulsed laser   Pulse shape out of a pulsed Ruby laser. |

|  |  |
| --- | --- |
| 11-20 | Laser Radiation Properties   Radiometry and units measuring electromagnetic radiation.   Spatial distribution of the emitted radiation at the output coupler.   Transverse electromagnetic modes of the laser radiation.   Gaussian Laser Beam.   Beam Divergence.   Divergence Angle.   Near field and far field.   Rayleigh range and Gaussian beam divergence   Diffraction through a circular hole.   Fresnel number.   Beam focusing.   Characteristics of Laser Radiation Pulses   Single pulse of laser radiation.   Excitation of the laser with pulsed energy.   Different types of pulses.   Special mechanisms for creating short pulses   Control of the duration of the laser radiation pulse by the excitation  Mechanism   Q-switched lasers.   Q (Quality) factor.   Q switch   Different methods for Q Switching   Cavity Dumped Lasers   Mode-Locked Lasers |
| 21-30 | Controlling the laser radiation properties   Controlling the transverse optical modes of the beam.   Some common laser resonators   Plane-plane optical cavity.   Circular mirrors with large radius of curvature.   Confocal optical cavity   Circular optical cavity   Half circular optical cavity.   Unstable optical cavity.   Controlling the wavelength spectrum emitted from the laser Selective excitation of the active medium.   Selective coating on the cavity mirrors.   Special optical element inside the optical cavity   Prism.   Diffraction Grating   Etalon |

**Subject : Electronics II & Wireless communication systems**

**Units: 6**

**Weekly Hours : Theoretical : 2**

**Experimental: 2**

|  |  |
| --- | --- |
| **week** | **Syllabus** |
| 1 | Introduction: Communication and propagation systems |
| 2-10 | Modulation   Analogue Modulation   AM Modulation   FM Modulation   PM Modulation   Digital Modulation systems   Pulse modulation systems (PM)   A/D and D/A convertors   PCM   TDM   FDM   ASK   FSK   PSK   PSK & BPSK |
| 11-15 | Noise   External noise figure   Internal noise figure |

|  |  |
| --- | --- |
|  |  Maximum power transfer   SN ratio   Nosie figure and noise factor   Noise temperature   Carrier to noise ratio   BER |
| 16-20 | Transistor and amplifiers properties |
| 20-25 | Rectifier, Thyristor, and trigger |
| 25-30 | Power supply, generator, and Max generator |
|  | |

**Subject : Power electronics**

**Units: 4**

**Weekly Hours : Theoretical : 2**

**Experimental: −**

|  |  |
| --- | --- |
| **week** | **Syllabus** |
| 1 | Introduction |
| 2-5 | Power Electronics Defined and power diodes   Key Characteristics   Trends in Power Supplies   Conversion Examples   Tools For Analysis and Design   Diode as a Switch   Some Properties of PN Junction   Common Diode Types   Typical Diode Ratings   Snubber Circuits for Diode   Series and Parallel Connection of Power Diodes   Typical Applications of Diodes |
| 6-10 | Thyristors and Gate Trun-OFF Thyristors   Basic Structure and Operation   Static Characteristics   Dynamic Switching Characteristics   Thyristor Parameters   Types of Thyristors   Gate Drive Requirements   PSpice Model   Gate Turn-Off Thyristors; Basic Structure and Operation   GTO Thyristor Models   Static Characteristics   Switching Phases   SPICE GTO Model |

|  |  |
| --- | --- |
| 11-20 |  Power Bipolar Transistors   Basic Structure and Operation   Static Characteristics   Dynamic Switching Characteristics   Transistor Base Drive Applications   SPICE Simulation of Bipolar Junction Transistors   BJT Applications   The Power MOSFET   The Need for Switching in Power Electronic Circuits   General Switching Characteristics   The Power MOSFET   MOSFET Structure   MOSFET Regions of Operation   MOSFET PSPICE Model   Comparison of Power Devices |
| 21-30 |  Insulated Gate Bipolar Transistor   Basic Structure and Operation   Static Characteristics   Dynamic Switching Characteristics   IGBT Performance Parameters   Gate-Drive Requirements   Circuit Models   MOS Controlled Thyristors (MCTs)   Equivalent Circuit and Switching Characteristics   Comparison of MCT and Other Power Devices   Gate Drive for MCTs   Protection of MCTs.   Generation-1 and Generation-2 MCTs   * N-channel MCT    Base Resistance-Controlled Thyristor   MOS Turn-Off Thyristor   Applications of PMCT |

**Subject : Semiconductors**

**Units: 4**

**Weekly Hours : Theoretical : 2**

**Experimental: −**

|  |  |
| --- | --- |
| **week** | **Syllabus** |
| 1 | Introduction |
| 2-10 |  Energy bands in typical semiconductors   Structure of atom.   Degeneracy of energy levels in free atoms   Formation of energy bands in crystals   Filling of energy bands by electrons   Division of solids into conductors , semiconductors and Insulators   Bad structure of semiconductors   Free electrons and holes concentrations in semiconductors   Types of semiconductors (doping)   Intrinsic semiconductors (pure )   Extrinsic semiconductors (doping)   The general equations of intrinsic and Extrinsic semiconductor   Semiconductor in Equilibrium   Non- Equilibrium Excess carriers in Semiconductor   Fermi-level in semiconductor   Movement of change carrier in semiconductor (majority and minority carriers)   Hall effect and carrier density |

|  |  |
| --- | --- |
| 11-20 |  Elementary transport in semiconductors.   Electric field transport.   Mobility   Conduction by diffusion   Carrier lifetime   diffusion length   Contact phenomena   Electron-Hole junction.   Methods of producing pn junction.   Equilibrium state of a pn junction.   Rectifying properties a pn junction.   Breakdown of a pn junction. |
| 21-25 |  Semiconductor diode   P-N junction Zero applied bias.   P-N junction forward biasing.   P-N junction reverses biasing.   V/I characteristics of diode.   Current components in a pn junction.   Load Line.   Linear diode model equivalent circuit.   Zener diode   Zener Breakdown.   Avalanche Breakdown.   Transistor   Junction transistor.   Bipolar transistor.   Field effect transistor (JFET ,MOSFET[ DE-MOSFET,EMOSFET]) |
| 26-30 |  Measuring the electromagnetic spectrum,   Photo detectors   Vacuum photodetectors   Semiconductor detectors   P-N photodetectors   P-i-N diodes   Avalanche photodiode   Basic principle of photo detector   Detector arrays   CCD detector |

**Subject : Materials & Spectroscopy**

**Units: 4**

**Weekly Hours : Theoretical : 2**

**Experimental: −**

|  |  |
| --- | --- |
| **week** | **Syllabus** |
| 1 | Introduction |
| 2-15 | Adiabatic Approximation and the Concept of Molecular Potentials   Quantum-Mechanical Description of Free Molecules   Separation of Electronic and Nuclear Wavefunctions   Born-Oppenheimer Approximation   Adiabatic Approximation   Potentials, Curves and Surfaces, Molecular Term Diagrams and Spectra   Electronic States of Diatomic Molecules   Exact Treatment of the Rigid H+ Molecule  2   Classification of Electronic Molecular State   Energetic Ordering of Electronic States   Symmetries of Electronic Wavefunction |
| 16-30 |  Electronic Angular Momenta   Electron Configurations and Electronic States   The Approximation of Separated Atom   The “United Atom” Approximation   Approximation Methods for the Calculation of Electronic Wavefunction   The H2 Molecule   Quantum-mechanical Treatment  Rotation of Diatomic Molecules   The Rigid Rotor   Centrifugal Distortion   The Influence of Electron Rotation   Molecular Vibrations   The Harmonic Oscillator   Vibration-Rotation Interaction   The material structure   PN junction   P-I-N junction   Hetero junction structure   Alloys |

**Subject : Quantum mechanics**

**Units: 4**

**Weekly Hours : Theoretical : 2**

**Experimental: −**

|  |  |
| --- | --- |
| **week** | **Syllabus** |
| 1 | Introduction |
| 2-10 |  The structure of matter   Length scales from cosmology to elementary particles   States of matter   Elementary constituents   The fundamental interactions   Black-body radiation   The photoelectric effect   Wave–particle duality   Wave quantisation   Heisenberg uncertainty principle   Schrödinger’s equation   Expectation values and the momentum operator   Some properties of Wavefunctions   The variational principle |
| 11-20 |  Energy levels   Energy levels in classical mechanics and classical models of the atom   The Bohr atom |

|  |  |
| --- | --- |
|  |  Orders of magnitude in atomic physics   Hilbert spaces of finite dimension   Linear operators on ℋ   Linear, Hermitian, unitary operators   Projection operators and Dirac notation   Unitary operators and Hermitian operators   Operator-valued functions |
| 21-30 |  Dirac – Delta function   One dimensional Dirac – Delta function   Helm Holts theorem   Potentials |

**Subject : Microprocessors**

**Units: 6**

**Weekly Hours : Theoretical : 4**

**Experimental: −**

|  |  |
| --- | --- |
| **week** | **Syllabus** |
| 1 | Introduction |
| 2-10 |  Architecture of 8085 microprocessor: Block diagram; registers ALU; control unit.   Instructions set and programming of 8085 microprocessors   Stack and Subroutine |
| 11-20 |  Time delay and Counters   Interrupts   Addressing modes   Pin out of 8085 microprocessor, Buses system, and Control signals. |
| 21-30 |  Memories: Type of memory; storage element; memory addressing multi chips memory.   fetch and execute cycle   Interfacing I/O devices   8086 microprocessor: Block diagram; architecture; registers; pin out; Introduction to programming. |

**Subject : Computer Applications**

**Units: 4**

**Weekly Hours : Theoretical :1**

**Experimental: 2**

|  |  |
| --- | --- |
| **week** | **Syllabus** |
| 1 | Introduction |
| 2-15 | Mat lab Design |
| 16-30 | Programming with C++ language |