SEMESTER 2

MATHEMATICS - II

UNIT I MATRICES

Eigenvalues and Eigenvectors of a real matrix – **Characteristic equation – Properties of eigenvalues and eigenvectors – Cayley-Hamilton theorem** – **Diagonalization of matrices** – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II VECTOR CALCULUS

Gradient and directional derivative – **Divergence and Curl – Irrotational and Solenoidal vector fields** – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green‘s, **Gauss divergence and Stoke‘s theorems** – **Verification and application in evaluating line, surface and volume integrals.**

UNIT III ANALYTIC FUNCTION

Analytic functions – **Necessary and sufficient conditions for analyticity** - Properties – **Harmonic conjugates** – Construction of analytic function - **Conformal mapping – Mapping by functions - Bilinear transformation.**

UNIT IV COMPLEX INTEGRATION

Line integral - **Cauchy‘s integral theorem – Cauchy‘s integral formula – Taylor‘s and Laurent‘s series** – Singularities – Residues **– Residue theorem – Application of residue theorem for evaluation of real integrals** – Use of circular contour and semicircular contour with no pole on real axis.

UNIT V LAPLACE TRANSFORMS

Existence conditions – **Transforms of elementary functions – Transform of unit step function and unit impulse function** – Basic properties – **Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem** — Transform of periodic functions – **Application to solution of linear ordinary differential equations with constant coefficients.**

PH7255 PHYSICS FOR ELECTRONICS AND INFORMATION

UNIT I ELECTRICAL PROPERTIES OF MATERIALS

Classical free electron theory - **Expression for electrical conductivity – Thermal conductivity, expression - Wiedemann-Franz law** – Success and failures - **Quantum free electron theory – Particle in a finite potential well** – Tunneling- **Particle in a three dimensional box** – degenerate states – **Fermi- Dirac statistics** – Density of energy states – Electron in periodic potential – **Energy bands in solids – tight binding approximation - Electron effective mass** – concept of hole.

UNIT II SEMICONDUCTORS AND TRANSPORT PHYSICS

Intrinsic Semiconductors – **Energy band diagram** – direct and indirect band gap semiconductors **– Carrier concentration in intrinsic semiconductors** – extrinsic semiconductors - **Carrier concentration in N-type & P-type semiconductors** – **Variation of carrier concentration with temperature** – Carrier transport in Semiconductors: **Drift, mobility and diffusion – Hall effect and devices** – Ohmic contacts – Schottky diode.

UNIT III MAGNETIC PROPERTIES OF MATERIALS

Magnetisation of matter: Magnetic dipole moment – **atomic magnetic moments- magnetic permeability and susceptibility** - **Magnetic material classification : diamagnetism – paramagnetism – ferromagnetism – antiferromagnetism – ferrimagnetism** – Ferromagnetism: origin and exchange interaction- **saturation magnetization and curie temperature** – **Domain Theory- M versus H behaviour – Hard and soft magnetic materials – examples and uses**–– Magnetic principle in computer data storage – Magnetic tapes – Magnetic hard disc (GMR sensor) - Magnetic recording materials .

UNIT IV OPTICAL PROPERTIES OF MATERIALS

Classification of optical materials – Absorption emission and scattering of light in metals, insulators & Semiconductors - LED's – **Organic LED's – Plasma light emitting** devices – **LCD's** – Laser diodes – Optical data storage techniques (including DVD, Blue -ray disc, Holographic data storage).

UNIT V NANO DEVICES

Electron density in a conductor – **Significance between Fermi energy and volume of the material** – Quantum confinement – Quantum structures – Density of states in lower dimensions – Band gap of nanomaterials –**Tunneling** – Single **electron phenomena – Single electron Transistor.** Conductivity of metallic nanowires **– Ballistic transport** – Quantum resistance and conductance **– Carbon nanotubes: Properties and applications** - Transport of spin – Spintronic devices and applications.

EC7251 CIRCUIT THEORY

UNIT I DC CIRCUIT ANALYSIS

Basic Components of electric Circuits, Charge, current, Voltage and Power, Voltage and Current Sources, **Ohms Law, Kirchoff's Current Law, Kirchoff's voltage law**, The single Node – Pair Circuit, **series and Parallel Connected Independent Sources, Resistors in Series and Parallel, voltage and current division, Nodal analysis, Mesh analysis**.

UNIT II NETWORK THEOREM AND DUALITY

Useful Circuit Analysis techniques - Linearity and superposition, **Thevenin and Norton Equivalent Circuits, Maximum Power Transfer, Delta-Wye Conversion**. Duals, Dual circuits.

UNIT III SINUSOIDAL STEADY STATE ANALYSIS

Sinusoidal Steady – **State analysis , Characteristics of Sinusoids,** The Complex Forcing Function, **The Phasor, Phasor relationship for R, L, and C, impedance and Admittance, Nodal and Mesh Analysis,** Phasor Diagrams, AC Circuit Power Analysis, **Instantaneous Power, Average Power, apparent Power and Power Factor, Complex Power.**

UNIT IV TRANSIENTS AND RESONANCE IN RLC CIRCUITS

Basic RL and RC Circuits, The **Source- Free RL Circuit, The Source-Free RC Circuit,** The **Unit-Step Function,** Driven RL Circuits, Driven RC Circuits, RLC Circuits, **Frequency Response, Parallel Resonance, Series Resonance, Quality Factor.**

UNIT V COUPLED CIRCUITS AND TOPOLOGY

Magnetically Coupled Circuits, mutual Inductance, the Linear Transformer, the Ideal Transformer, **An introduction to Network Topology, Trees and General Nodal analysis**, Links and Loop analysis

EC7201 ELECTRONIC DEVICES

UNIT I PN DIODE and BIPOLAR JUNCTION TRANSISTOR

PN junction diode, current equations, V-I characteristics, the bipolar transistor action, minority carrier, distribution, **low frequency common base, current gain,** non-ideal effects, equivalent circuits, **Ebers Moll Model-Gummel Poon-model, Hybrid-pi model,** frequency limitations, large signal switching characteristics, SiGe and hetro-junction- **bipolar junction transistor.**

UNIT II FUNDAMENTALS OF FIELD EFFECT TRANSISTORS

Fundamentals of JFETs and their device characteristics, Two terminal MOS structures, threshold voltage and charge distribution, capacitance-voltage characteristics, **MOSFET structures, I-V relationships, transconductance and substrate effects,** frequency limitations, non-ideal effects, MOSFET scaling, threshold voltage modification due to short and narrow channel effects, **avalanche breakdown, drain induced barrier effects.**

UNIT III POWER DEVICES AND DISPLAY DEVICES

SCR, Diac, Triac, Power BJT, Power MOSFET, IGBT Heat sinks and junction temperature, **LED, LCD, Photo transistor, Opto Coupler, Solar cell, CCD.**

UNIT IV SPECIAL SEMICONDUCTOR DEVICES

Metal-Semiconductor Junction-MESFET, **Schottky barrier diode-Zener diode-Varactor diode –Tunnel diode-Gallium Arsenide device, LASER diode, UJT, LDR.**

UNIT V SEMICONDUCTOR PROCESSING

Semiconductor materials, Silicon **crystal growth and refining, Doping techniques**, Ion implantation, Doping impurity diffusion, Gas-phase diffusion, **Oxidation, Chemical vapor deposition (CVD), Silicon deposition and epitaxy**, Dielectric layer deposition, **Photolithography Etching,** Metallization, Metal deposition, Metal silicides, **CMOS process, bipolar process**