SEMESTER – I								
S.No	**Course**	**Code**	**Title of the course**	**H/W**	**C**	**SEE**	**IA**	**Total marks**
1.	CC	101	Classical and Statistical Mechanics	4	4	70	30	100
2.		102	A. Solid State Physics B. Material Science	4	3	50	25	75
		103	A. Electromagnetic theory and Modern Optics B. Optical, Microwaves and satellite Communications	4	3	50	25	75
	P	104	Core Practicals	6	2	35	15	50
	SOC	105	A. Advanced digital electronics and micro controllers B. Advanced micro processors and applications	4	3	50	25	75
		106	A. Mathematical Physics B. Computational methods and programming	4	3	50	25	75
	P	107	SOC based Practicals	6	2	35	15	50
	Audit Course	108	Indian Knowledge Systems – 1	4	0	0	0	0
			Total	36	20	340	160	500

101: CLASSICAL AND STATISTICAL MECHANICS

UNIT – I: Lagrangian Mechanics and Hamiltonian Mechanics

Newtonian mechanics of one and many particle systems: Conservation laws, Constraints and their classification, Degrees of freedom: Generalized coordinates: Principle of virtual work, D'Alemberts principle, Lagrange's equations of motion. Applications: Inclined plane, Linear harmonic oscillator and simple pendulum.Hamiltonian principle, Lagrange's equation from Hamilton's principle, Hamilton's equation of motion. Applications: Simple pendulum, Compound pendulum.

UNIT – II: Canonical Transformations and Hamilton - Jacobi Theory

Canonical Transformations, Generating function and their properties, Condition for transformation to be canonical, Illustration of canonical transformation, Poisson Brackets, Canonical equations in terms of Poisson's Bracket notation. Lagrange Brackets and their properties. Hamiltonian - Jacobi equation, one dimensional harmonic oscillator, Action Angle variables, Kepler problem in action angle variables.

UNIT- III: Ensembles and Partition Functions

Ensembles: Phase space – Concept of ensembles – Types of ensembles:Microcanonical ensemble - Canonical ensemble – Grand canonical ensemble - Comparison of various ensembles.

Partition Functions: Canonical partition function – Molecular partition function – Transnational partition function – Rotational partition function – Vibrational partition function – Electronic and Nuclear partition functions. Applications of Rotational partition function.

UNIT –IV: Classical and Quantum statistics

Classical statistics: Maxwell - Boltzmann distribution –EquipartitiontheoremQuantum statistics: Bose – Einstein distribution, Bose – Einstein condensation - Einstein and Debye's theories of heat capacities - Fermi - Dirac distribution – Electrons in metals – Thermionic emission - Comparison of statistics.

Books for Reference

1. Classical Mechanics by N.C. Rana and P.S. Joag Tata Mc-graw Hill (1991).
2. Classical Mechanics by H. Goldstein, AddiWesely, (1980).
3. Classical Mechanics by J.C. Upadyaya, Himalaya Publishing House (2014).
4. Classical Mechanics by Gupta, Kumar and Sharma, Pragati Edition, (2019).
5. Classical dynamics of particles and systems by J.B.Marion, Thomson Books/cole, (2004).
6. Statistical Mechanics by B.K. Agarwal, Melvin Eisner - Publisher John Wiley & Sons, 1988
7. Statistical Mechanics and properties of Matter by ESR Gopal – Publishers Ellis Horwood, 1974
8. Statistical and Thermal Physics by F. Reif - Publisher Waveland Press, 2009
9. Elementary Statistical Mechanics by C.Kittel- Dover Publications, 2012

102 (A): SOLID STATE PHYSICS

UNIT–I: Crystallography,LatticeEnergiesandLatticeVibrations

Bravaislattices–Reciprocallattice–X-raydiffraction–structuralfactor. Origin of chemical binding in ionic and van der Waals crystals, Lattice energy calculations for ionic and van der Waals crystals –-– Lattice vibrations:Monoand diatomiconedimensionalinfinitelylonglattices– Quantizationoflatticevibrations– Phonons – Properties. Elastic properties – Stress and strain – Elastic moduli

UNIT–II:TransportPhenomenaandBandTheory

Conceptofelectricalandthermalresistivity–Expressionforthermalandelectricalconductivitiesfor metals – Lorenz number - Different scattering mechanisms – Matheissens rule- Distribution function -FormulationofBoltzmanntransportequation– Relaxationtimeapproximation.Summerfeld model – its consequences – electron-lattice interaction (Quantitative only) – Bloch function -Motion of electron in periodic potential – Kronig - Penny model – Formation of energy bands in solids –Brillouinzones– Conceptofeffectivemass–Distinctionbetweenmetals,insulatorsandsemiconductors.

UNIT–III:SemiconductorPhysics

IntrinsicandextrinsicsemiconductorsExpressionforpositionofFermi levelsandcarrierconcentrations – Variation of Fermi level with temperature – np product – Carrier mobility, conductivity and theirvariation with temperature – Direct and indirect band gap semiconductors – Differences and examples –Hall effect - Continuity equation – Drift and Diffusion – Einstein relation – Generation, Recombinationand life time of non-equilibrium carriers – Heyness-Schockley experiment – Determination of life time,diffusionlength ofminoritychargecarriers.

UNIT–IV:Superconductivity

Conceptofzeroresistance–Magneticbehavior–
Distinctionbetweenaperfectconductorandsuperconductor–Meissnereffect–Isotopeeffect–
Specificheatbehavior–Two-fluidmodel–Expression for entropy difference between normal and superconducting states – London's equations –Penetration depth – BCS theory – Josephson junctions – SQUIDS and its applications - Applications ofsuperconductors–High $T_C$superconductors–Preparation – Properties.

Books for Reference

1. SolidStatePhysics,C.Kittel, Edition:8th2012,JohnWiley&Sons.
2. SolidStatePhysics,A.J.Dekkar,Edition: 1st,2000.MacmillanIndiaLtd.
3. SolidStateElectronicDevices,B.G.Streetman.Edition7th,2018,PearsonEducationIndia
4. ElementarySolidStatePhysics,M.AliOmar,1993,Addison-Wesley.
5. SolidStatePhysics,M.A.Wahab,Edition: 3rd,2020,NarosaPublishingHouse.
6. High T_CSuperconductivity,C.N.R.RaoandS.V.Subramanyam,worldscientificpu

blishingcompany,1989
7. SolidStatePhysics,S.O.Pillai.Edition:6th,2009,NewAcademicScienceLtd
8. SolidStatePhysics,S.L.KakaniandC.Hemarajan,Edition:4th,2005,SultanChandand Sons

102 (B): MATERIALS SCICENCE

Unit-I:Crystal Structure and Imperfections:

Introduction and structure of materials, Structure of atoms - Quantum states-Atomic bonding in solids-binding energy-interatomic spacing - variation in bonding characteristics - Single crystals – polycrystalline - Non crystalline solids - Imperfection in solids – Vacancies – Interstitials - Geometry of dislocation - Schmid´s law - Surface imperfection - Importance of defects - Microscopic techniques - grain size distribution.

Unit-II:Mechanical properties

Stress, Strain, Elastic properties – Deformation – elasticity – hardness Solid solutions and alloys - Phase diagrams - Gibbs phase rule - Single component systems – Eutectic phase diagram – lever rule - Study of properties of phase diagrams - Phase transformation.

Unit-III:Semiconductor and Dielectric Properties

Band model of semiconductors - carrier concentrations in intrinsic, extrinsic semiconductors – organic semiconductors - Fermi level - variation of conductivity, mobility with temperature – law of mass action - Hall effect - Hall coefficients for intrinsic and extrinsic semiconductors – Hall effect devices .Dielectric Properties: Polarization and susceptibility-Dielectric constant and Polarizability-Sources of polarizability: Electronic,Ionic and Dipolar Polarizability- - Ferroelectricity and Piezoelectricity

Unit-IV:Magnetic properties

paramagnetism - ferromagnetism - domain theory - magnetic hysteresis, Weiss molecular field theory, Heisenberg's theory - magnetic anisotropy - domain walls - Exchange energy – Antiferromagnetism. Gaintmagnetoresistance, Tunneling magnetoresistance, Colossalmagnetoresistance, Superparamagnetism High Tc materials: YBCO and Bi-systems (Brief idea), Superconducting nano-materials & their properties and applications.

Books for Reference

1. W. D. Callister, "Materials Science and Engineering: An Introduction", John Wiley & Sons, 2007.
2. K. VijayamohananPillai and MeeraParthasarathi Functional Materials: A Chemist’s Perspective by, Orient Blackswan (21 November 2013)
3. C. Kittel, "Introduction to Solid State Physics" Wiley Eastern Ltd, 2005.
4. V. Raghavan, “Materials Science and Engineering: A First Course", Prentice Hall, 2006
5. A.J. Dekker, "Solid State Physics”, Macmillan & Co, 2000.

6. Michael Shur, "Physics of Semiconductor Devices", Prentice Hall of India, 1995.

103 (A): ELECTROMAGNETIC THEORY, LASERS AND MODERN OPTICS

UNIT – I: Electromagnetic Theory

Electromagnetic radiation; Introduction – electromagnetic induction – Maxwell's equations in differential and integral forms - General wave equation – Propagation of light in isotropic dielectric medium – Dispersion – Propagation of light in conducting medium - skin depth – Reflection and refraction at the boundary of a dielectric interface – Fresnel's equations – Propagation of light in crystals - Double refraction.

UNIT – II: Lasers and Non-Linear Optics

Introduction to lasers – Spontaneous and stimulated emission – Laser beam properties - Einstein coefficients – Population inversion – Pumping schemes – Losses in laser radiation - Threshold condition for laser oscillation – Laser cavity - Q factor– different experimental methods – Ruby laser - GaAs laser - He-Ne laser – Argon ion laser – CO2 laser – Laser applications.

Basic Principles – Origin of optical nonlinearity - Harmonic generation – Second harmonic generation – Phase matching condition – Third harmonic generation – Optical mixing – Parametric generation of light – Parametric light oscillator – Frequency up-conversion – Guided wave optics - Pulse compression - Optical solutions.

UNIT – III: Holography, Fourier Optics

Introduction to Holography – Basic theory of Holography– Fresnel and Fourier transform Holography. Applications of Holography.

Introduction to Fourier optics – Two-dimensional Fourier transforms – Transforms of Dirac-delta function – The convolution integral – convolution theorem- Spectra and correlation – Parsevel's formula – Apodization – Array theorem.

UNIT – IV: Fiber Optics: Introduction to Fiber Optics-Total internal reflection - Optical fiber modes and configuration – Single mode fibers – Graded index fiber structure – Fiber materials and fabrication – Mechanical properties of fibers – Fiber optic cables – Attenuation – Signal distortion on optical wave guides - Erbium doped fiber amplifiers - Block diagram of fiber optic communication system - Applications of optical fibers

Books for Reference

1. Introduction to Electrodynamics, D.J. Griffiths, Prentice-Hall, India, 2015
2. Electromagnetics, B.B. Laud, Wiley-Eastern, New Delhi, 2011
3. Introduction to Modern Optics, G. R. Fowels, 2012
4. Lasers and their Applications, M.J. Beesly, Taylor and Francis, 1976
5. Lasers and Non-Linear Optics, B.B. Laud, Wiley Eastern Ltd., 1983
6. Optics, E. Hecht, Addison Wiley, 1974
7. Optical Fiber Communications, G. Keiser, McGraw Hill Book, 2000

103 (B): OPTICAL, MICROWAVEANDSATELLITECOMMUNICATIONS

UNIT – I: Microwave Communications
Advantages and Disadvantages of microwave transmission, loss in free space, propagation of microwaves, atmospheric effects on propagation, Fresnel zone problem, ground reflection, fading Sources, Detectors, components, antennae used in MW communication systems.

UNIT – II: Radar Systems
Radar block diagram and operation, radar frequencies, pulse considerations. Radar range equation, derivation of the radar range equation, minimum detectable signal, receiver noise, Signal to noise ratio, Integration of radar pulses, Radar cross section, Pulse repetition frequency, Antenna parameters, System Losses and propagation losses, Radar transmitters, receivers, Antennas, Displays.

UNIT - III: Digital Communications
Digital Communications: Principles of digital communications, digital radio, frequency shift keying, phase shift keying, quadrature amplitude modulation.

UNIT – IV: Optical and Satellite Communications
Optical Communications: Optical transmitter and receiver for analog and digital communications, coherent and non-coherent detection, signal to noise ratio, error rate, coding, synchronization and equalization in optical data transmission. Satellite Communications: Orbital satellites, geostationary satellites, orbital patters, look angles, orbital spacing, satellite systems, Link modules. BooksforStudy

Books for Reference

1. MicroelectronicsbyJacobMillman,2nd Edition,McGraw-Hill, InternationalBookCo.,NewDelhi,1990.
2. Optoelectronics:TheoryandPractice,editedbyAllenChappel,1 1th Edition,McGrawHill,International BookCo.,New York,1978.
3. Microwaves"byK.C.Gupta, 2nd Edition,WileyEasternLimited,NewDelhi,1979.
4. AdvancedElectronicsCommunicationsSystemsbyWayneTomasi, 6th Edition,PrenticeHall,1998.

105 (A): ADVANCED DIGITAL ELECTRONICS AND MICROCONTROLLERS

UNIT – I: Combinational and Sequential Logics

Combinational Logic: Multiplexers, Demultiplexer, Decoders- BCD-to-Decimal decoder, BCD-to-Seven-Segment Decoder. Encoders and Priority Encoders: Octal-to-Binary Encoder, Decimal-to-BCD Encoder.

Sequential Logic: Flip–Flops, A1-bit memory, The RS Flip-Flop, JK Flip – Flop, JK Master Slave Flip–Flops, T-Flip-Flop, D-Flip-Flop

UNIT – II: Shift Registers and Counters

Shift Registers: Serial-in Serial-out, Serial-in Parallel-out, Parallel-in Serial-out, Parallel-in Parallel-out Registers.

Counters: Asynchronous- Ripple Counter, Decoding Gates. Synchronous Counter-Binary Counter, Modified Counters: MOD-3, MOD-5, MOD-6, MOD-10 Counters**.**

UNIT – III : IC Logic families

Digital IC terminology, TTL logic family, TTL series characteristics, Improved TTL series, TTL loading and fan-out, other TTL characteristics, Connecting TTL outputs together, tristate TTL, ECL family, MOS digital ICs & Characteristics, CMOS logic & characteristics, Bilateral switch, TTL driving CMOS and vice-versa, Low voltage technology.

UNIT – IV: Microcontrollers

Introduction: 8051 Internal Architecture, Register Structure, I/O pins, Memory Organization, 8051 Addressing modes. 8051 Assembly Language Programming Tools.

8051 Instruction set: Data Transfer Instructions, Arithmetic instructions, Logical instructions, Boolean Variable Manipulation Instructions-Bit Addressability, Single-Bit instructions, Program Branching Instructions-Jump, Loop, and Call instructions, Rotate Instructions, Stack Pointer.

Books for Reference

1. Digital Systems by Ronald J. Tocci, 6th Edition, PHI, 1999.
2. Digital Principles and Applications by A.P. Malvino and Donald P. Leach, Tata McGraw- Hill, New Delhi, 1993.
3. S.K. Bose, “Digital Systems”, 2/e, New Age International (P) Limited, 1992.
4. Digital Electronics by D.K. Kaushik, DhanpatRai Publishing company, 2005.
5. The 8051 Microcontroller and Embedded systems, by Mahammad Ali Mazidi and Janice GillispieMazidi, Pearson Education Asia, Pvt. Ltd., 2000.

105(B):ADVANCED MICROPROCESSORSANDAPPLICATIONS

UNIT – I: Microprocessors and its Architecture

Internal microprocessor architecture, Real mode and protected modes of memory addressing, Memory paging.

Addressing modes- Data addressing modes, program memory-addressing modes, Stack-memory addressing modes.

Instruction Set- Data movement instructions, Arithmetic and logic instructions, Program control instructions, Assembler details.

UNIT – II: Programming the Microprocessor

Modular programming, using the keyboard and video display, Data conversions.

Hardware Specifications- Pin-outs and the pin functions, clock-generator (8284A), Bus buffering and latching, Bus timing, Ready and Wait state, Minimum mode versus maximum mode.

UNIT – III: Memory Interface

Memory devices, Address decoding, 8088 and 80188 (8-bit) memory interface, 8086, 80186, 80286 and 80386 (16-bit) memory interface.

Basic I/O Interface- Introduction to I/O interface, I/O port address decoding, 8255, 8279, 8254, ADC and DAC (*excluding multiplexed display & keyboard display using 8255).*

UNIT – IV: Interrupts

Basic interrupt processing, Hardware interrupts, expanding the interrupt structure, 8259A PIC.

Direct Memory Access- Basic DMA operation, 8237 DMA controller.

Bookforreferene

1. B.B.Brey,“TheIntelMicroprocessors8086/8088,80186/80188,80286,80386, 80486,Pentium and Pentium pro processor architecture, programming and interfacing”, 4/e, PHI,1999.
2. K.J.Ayala,“The8086Microprocessor:Programming&InterfacingthePC”Penr amInternationalPublishing(India)Pvt.Ltd.,1995.
3. DouglasV.Hall,“MicroprocessorsandInterfacing,ProgrammingandHardware ”,2/e,McGrawHill,InternationalEdition,1992.
4. Muhammad Ali Mazidi and Janice GillispieMazidi, “The 80x86 IBMPC and CompatibleComputers,(VolumesI&II)”.2/e,Printice–Hall,Inc.,1998.
5. WalterA.TriebelandAvatarSingh,“Software,HardwareandApplications”PHI,1995.
6. YuChengLinandGlennA.Gibson,“Microcomputersystems:The8086/8088Fa milyArchitecture,ProgrammingandDesign”,PHI,1992.

106 (A): MATHEMATICAL PHYSICS

UNIT - I: Special Functions

Beta and Gamma Functions – Definitions and properties – Evaluation of integrals, Legendre, Bessel and Hermite differential equations – Solutions – Generating functions – Orthogonal properties of Legendre, Bessel and Hermite Functions (Proof not necessary) – Recurrence relations – (Proof for Legendre polynomials only).

UNIT - II: Integral Transforms

Fouriers Transforms: Properties of Fourier transforms – Fourier sine and cosine transforms- Power in Fourier series – Modulation theorem, Fourier transform of impulse function, Constants, Unit step function and Periodic functions.

Laplace Transforms: Definition and notation – Properties of Laplace transforms – Laplace transforms of Dirac delta function and periodic functions (Square wave, sawtooth wave and triangular wave) – Inverse Laplace transforms – properties.

UNIT - III: Numerical techniques

Solution of an equation – Bisection method, Regular False method, Newton - Rhapson method - Solutions of simultaneous – Gauss elimination method and Gauss-Seidel method - Interpolations - Newton's interpolation and Lagrange's interpolation, Curve fitting – Method of Least squares. Numerical differentiation and integration – Trapezoidal rule and Simpson's 1/3 rule – Solutions of differential equations- Euler's method and Runga-Kutta Methods.

UNIT – IV: Complex Variables

Functions – Complex differentiation - Analytic function - Cauchy – Reimann equations – Derivatives of elementary functions – Singular points and classification. Complex integration - Cauchy's theorem – Integrals of special functions – Cauchy's integral formula – Taylor's and Lorentz theorem (statements only) – Residues, calculations of residues - Residue theorem – evaluation of definite integrals.

Books for Reference

1. Functions for Scientists and Engineers, W.W. Bell, D.VanNostrand Company, London (1968)
2. Fourier Analysis, Hsu P Jewi, Unitech Division
3. Laplace Transforms by Murray Spiegle, Schaum's outline series, McGraw Hill, International Book Company, New York.
4. Applied Mathematics for Engineers, Pipes and Harval, Third Edition, McGraw Hill Books Co.
5. Mathematical Physics, H.K. Das and Ramaverma, S. Chand & Co Ltd., New Delhi, 2011.
6. Mathematical Physics, B. Bhattacharyya, New Central Book Agency Pvt. Ltd., 2010
7. Theory and Properties of Complex Variables, Murray R. Speigal, Schaum's outline series, McGraw Hill Book Co., Singapore.
8. Complex Variables and Applications, Churchle

106(B): COMPUTATIONAL METHODS & PROGRAMMING

UNIT – I: (a) Fundamentals of C language
C character set: Identifiers and keywords, Constants, Variables, Data types, Declaration of variables, Declaration of storage class, Defining symbolic constants, Assignment statement. Operators: Arithmetic operators, Relational operators, Logic operators, Assignment operators, Increment and decrement operators, Conditional operators.
(b) Expressions and I/O statements:
Arithmetic expressions, Precedence of arithmetic operators, Type converters in expressions, Mathematical (library) functions, Data input and output - Getchar and putchar functions, Scanf, Printf – Simple programs.
(c) Control statements:
If-Else statement, Switch statement, The ?operator, GO TO,While , Do-while, FOR statements, BREAK and CONTINUE statements.
One dimensional and two

UNIT – II: (a) Arrays
dimensional arrays – Initialization, Type declaration, Inputting and outputting of data for arrays, Programs of matrices addition, subtraction and multiplication.
(b) User Define functions: The form of C functions, Return values and their types – Calling a function, Category of functions, Nesting of functions Recursion, ANSI C functions, Function declaration.
(c) Pointers: Accessing the address of variable, Declaration and Initialization of pointer variables, Accessing the value of the variable through its pointer, Pointer Expressions, Pointers and Arrays, Pointers and structures.

UNIT – III: Linear and non-linear equations
(a) Solution of Algebraic and transcendental equations: Bisection, Falsi position and Newton Rhapson methods: Basic principles, Formulae, Algorithms.
(b) Simultaneous equations: Solutions of simultaneous linear equations: Gauss elimination and Gauss-Seidel iterative methods, Basic principles: Formulae, Algorithms.

UNIT – IV: (a) Interpolations
Concept of linear interpolation, Finite differences, Newton's and Lagrange's interpolation formulae, Principles and Algorithms, Curve fitting: regression, Least square fitting, Linear and quadratic**.**
(b) Numerical differentiation and integration: Numerical differentiation, algorithm for evaluation of first order derivatives using formulae based on Taylor's series, Numerical integration, Trapezoidal and Simpson's 1/3 rule, Formulae, Algorithms.
(c) Numerical solution of ordinary differential equations: Euler, method, Fourth order Runga-Kutta Method.

Books for Study

1. Programming with 'C' by Byron Gottfried, 4th Edition, Tata McGraw Hill, 2010.
2. Programming in 'C' by Balaguruswamy, 8th Edition, Tata McGraw-Hill, 1990.
3. Numerical Methods by E. Balaguruswamy, Tata McGraw Hill, 1999.
4. Computer oriented numerical methods by Raja Raman, 4th Edition, PHI Learning, 2018.
5. Let Us C, YeswanthKanetkar, 17th Edition, Infinity Science Press, 2008