2nd Year, 2nd Term					
Course Code	Course Tittle	L	T	P	C
Theory					
CSE 2227	Programing Techniques	3	0	0	3
Math 2227	Statistics and Numerical Analysis	3	0	0	3
MSE 2201	Phase Diagrams and Transformations	3	0	0	3
MSE 2203	Mechanical Behavior of Materials	3	0	0	3
Ph 2227	Basic Quantum Mechanics and Solid State Physics	3	0	0	3
Sessional					
CSE 2228	Sessional on Programing Techniques	0	0	3	1.5
MSE 2208	Materials Testing Sessional	0	0	3	1.5
MSE 2206	Compositional and Microstructural Analysis	0	0	3	1.5
	Total				**19.5**

Distribution of Marks

i. Theory Courses:

Class participation, attendance and assignments	10 %
Class tests, Quizzes, Spot tests etc.	20%
Term Final Examination	70%
Total	100%

N.B. Students fail to attend 60% of the class will not allow to sit in the final exam in any circumstance.

ii. Independent laboratory/design/field work courses:

Class participation and attendance	10 %
Quizzes, Viva-Voce conducted in lab class	20%
Viva-Voce conducted centrally	20%
Performance and reports	50%
Total	100%

iii. Project/thesis (Continued for two terms):

a) *__At the end of 4th year 1st Term__*: 30% of the total marks to be evaluated as follows:

Presentation and (Viva-Voce conducted by a Viva-Voce committee)	10%
Supervisor	20%
Total	30%

b) *__At the end of 4th year 2nd Term__*: 70% of the total marks to be evaluated as follows:

Presentation and Viva-Voce (conducted by a Viva-Voce committee)	20%
Supervisor	40%
External examiner (any other teacher of the department/ a member of examination committee	10%
Total	70%

2nd Year, 2nd Term

CSE 2227 Programing Techniques

Credit: **3.00**
Contact hour: 3 hrs/wk
Referred Textbooks:

- ''Programming in ANSI C'', by Balagurusamy, Tata McGraw-Hill Education.
- ''The C Programming Language'' by Brian W. Kernighan, Dennis M. Ritchie
- ''Problem Solving with C++: The Object of Programming'' by Walter Savitch, 8th Edition.
- ''Object Oriented Programming with C++'' by E Balaguruswamy.

Contents:
Introduction: Programming languages, Basic program syntax; Programming techniques: Structured (C programming Language) and Object Oriented Programming (C++ programming Language).
Structured Programming: Declaring variables and data types, Basic program structure, Input / output operations, Basic Operators, Control Statements, Conditional statements, Loops, Functions - declarations and calling, Strings, Pointers, Dynamic Memory allocation.
Object Oriented Programming: Introduction to Classes and Objects; File handling; Structure and Union.

Math 2227 Statistics and Numerical Analysis

Credit: **3.00**
Contact hour: 3 hrs/wk
Referred Textbooks:

- ''Probability and Statistics for Engineers'' by Richard A. Johnson, Irwin Miller, John Freund.
- ''Statistics'' by David Freedman, Robert Pisani, Roger Purves.
- ''Introductory Statistics'' Prem S. Mann, ISBN: 978-1-119-24894-1.
- ''Numerical Methods'' by Douglas Faires, Richard Burden, ISBN: 9780495114765.
- ''Numerical Methods and Modelling for Engineering'' by Khoury, Richard, Harder, Douglas Wilhelm.
- ''Numerical Analysis for Engineers: Methods and Applications'' by Bilal Ayyub, Richard H. McCuen.

Contents:
Statistics: Overview of the measures of central tendency and dispersion; Moments, skewness and kurtosis; Elementary probability theory, random variable and probability distribution, expectation; Discontinuous probability distributions e.g. binomial, Poison and negative binomial along with their properties and illustrations; Continuous probability distributions, e.g. normal and exponential along with their properties and illustrations; Elementary sampling theory; Estimation; Hypothesis testing of mean; simple Correlation and regression analysis.

Numerical Analysis:
Interpolation: Simple differences, Newton's formulae for forward and backward interpolation, Divided differences, Tables of divided differences, Relation between divided and simple differences, Newton's general interpolation formula, Lagrange's interpolation formula; Inverse interpolation by Lagrange's formula and by successive approximations.
Numerical Differentiation: numerical differentiation by Newton's forward and backward formulae.
Numerical integration: General quadrature formula for equidistant ordinates, Trapezoidal rule, Simpson's rule, Waddle rule, Calculation of errors, Gauss's quadrature formula, Newton's-cotes formula; Curve fitting: Principle of least squares; Linear, curvilinear and polynomial Curve fitting for one independent variables.
Finding of Roots: Regula-Falsi method, Newton-Raphson method, geometrical significance of the methods, convergence of methods; Solution of linear equations by iteration methods, Norm and condition number, Gauss elimination method, Gauss Seidel and Gauss Jordon methods.

Ph 2227 Basic Quantum Mechanics and Solid State Physics

Credit: **3.00**
Contact hour: 3 hrs/wk
Referred Textbooks:

- ''Quantum Physics of Atoms, Molecules, Solids, Nuclei & Particles'' by Robert Eisberg & Robert Resnick, ISBN: 978-0471-873730
- ''Introduction to Quantum Mechanics'' by Pauling L. and Wilson E.B., McGraw-Hill
- ''Nanoscience and Nanotechnology: Fundamentals of frontiers'' by M.S. Ramachandara Rao and Shubra Singh.
- ''Quantum Mechanics: An Introduction'' by Greiner W. Springer-Verlag, ISBN 3-540-58079-4
- ''Introduction to Quantum Mechanics'' by David Griffith, Cambridge University Press.
- ''Principles of Quantum Mechanics'' by Shankar, Springer, ISBN: 978-0306-447907
- ''Solid State Physics'' by Ashcroft N.W. & Mermin N.D., ISBN: 978-0030-839931
- ''Fundamentals of Solid State Physics'' by Christman J.R., Wiley, ISBN 0-471-81095-9
- ''Introduction to Solid State Physics'' by Kittel C., Wiley, ISBN 978-0-471-41526-8

Contents:
Basic Quantum Mechanics: Photo-electric effect, Compton Effect, Atom model (Bohr's, Somerfield, Vector atom model), Hydrogen atom model, Wave properties of particles, Schrödinger equation, Quantum tunneling; Operator, Simple Harmonic Oscillation, Spherical and Polar co-ordinates.
Nanotechnology: Nanometer; Nanomaterials and nanotechnology; Classification of nanomaterials; Shape and structure of nanomaterials; Quantum well; Quantum dots; Semiconductor nanoparticles.
Solid State Physics: Lattice Vibration, Specific heat, Einstein Model, Debby Model, Free electron theory of metal, Transport properties (Static and Dynamic), Electrical and Thermal conductivity (Hall effect), Electron drift, Electron excitation, Photon excitation, , Quantum Process, Quantum confinement effect, Principle, Population inversion, Optical pumping.
LASER: Characteristics and application of LASER (history of LASER), Types of LASER (Ruby, He-Ne gas, Free electron LASER).

MSE 2201 Phase Diagrams and Transformations

Credit: **3.00**
Contact hour: 3 hrs/wk
Referred Textbooks:

- ''Phase Diagrams: Understanding the Basics'' by F.C. Campbell, ASM International.
- ''Phase Diagrams in Metallurgy'' by F.N. Rhines, McGraw Hill.
- ''Ternary Phase Diagrams in Materials Science'' by West and Saunders, Maney Publishing.
- ''Phase Transformations in Metals and Alloys'', by Porter and Easterling, CRC press.

Contents:
Thermodynamics and phase diagrams: definition of few terms- Equilibrium, Phase, Components; Unary systems; Binary systems; Single component systems; Gibbs free energy as a function of temperature; the driving force for solidification; Nonequilibrium cooling.
Binary phase diagrams: A simple phase diagram; Systems with a miscibility gap; Ordered alloys; Simple eutectic systems; Phase diagrams containing intermediate phases; Eutectic morphologies; Solidification and scale of eutectic structures; Competitive growth of dendrites and eutectics; Peritectic systems; The Gibbs phase rule; The lever rule; The effect of temperature on Solid Solubility.
Common example of binary phase diagrams: Aluminum-silicon eutectic system; Phase diagram of ceramics with example; Iron-Iron carbide phase diagram; Phase diagrams of common stainless steel and other non-ferrous systems.

Ternary and multiphase phase diagrams: Introduction to ternary and quaternary systems and associated phase diagrams; The Gibbs triangle and construction rules for ternary phase diagrams; Space model of ternary systems; The Gibbs triangle; Tie lines; Ternary isomorphous systems.
Diffusion: Atomic mechanism of diffusion; Interstitial diffusion; Substitutional diffusion; Atomic mobility.
Solidification: Nucleation in Pure Metals-Homogeneous nucleation, Homogeneous nucleation Rate, Heterogeneous nucleation, Nucleation of melting, Growth of a pure solid; Continuous growth; Lateral growth; Surface nucleation; Alloy solidification; Solidification of single-phase alloys; Nucleation of precipitates from a supersaturated solid solution; Equilibrium solidification; Cellular and dendritic solidification; Eutectic solidification.
Diffusionless Transformation in Solids: Characteristics of diffusionless transformations; The solid solution of carbon in Irion; CCT diagram; Martensite crystallography; The bain model of the fcc~bct transformation; Comparison of crystallographic theory with experimental results; Theories of martensite nucleation; Martensite growth; Effect of retained austenite; The development of nonequilibrium transition phases due to interfacial energy effects; Coherent, semi-coherent, and incoherent interfaces and energetics.

MSE 2203 Mechanical Behavior of Materials

Credit: **3.00**
Contact hour: 3 hrs/wk
Referred Textbooks:

- ''Mechanical Behavior of Materials'' by B. W. F. Hosford, Cambridge University Press.
- ''Mechanical Metallurgy'' by Dieter, Wiley.
- ''Mechanical Behavior of Materials'' by Courtney, T. H. McGraw-Hill.
- ''Deformation and Fracture Mechanics of Engineering Materials'' by Hertzberg, R. W.
- ''Mechanical Behavior of Materials'' by Dowling McGraw Hill.
- ''Introduction to Dislocations'' by Hull and Bacon, Oxford University Press.

Contents:
Elasticity: Isotropic elasticity; Variation of Young's modulus; Isotropic thermal expansion; Elastic anisotropy; Orientation dependence of elasticity
Mechanical Testing: Tensile specimens; Stress-strain curves; Ductility; True stress and strain; Compression test; Plane strain compression; Plane strain tension; Torsion test; Bend tests; Correlation of Hardness and ultimate tensile strength.
Strain Hardening of Metals: Introduction; Mathematical approximations; Power Law approximation; Necking; Work per volume; Localization of strain at defects; Notes; Problems.
Plasticity, Slip and Dislocation: Yield criteria; Von Mises Criterion; Flow rules; Slip systems; Schmid's law; Strains produce by slips; Strain hardening of fcc single crystals; Tensile deformation of fcc crystals; Slip in bcc crystals; Lattice rotation in tension; Lattice rotation in compression; Texture formation in polycrystals; Deformation of polycrystals; Dislocation geometry and energy-Theoretical strength of crystals, The nature of dislocations, Burgers vectors, Energy of a screw dislocation, Reactions between parallel dislocations and Frank's rule, Stress fields around dislocations, Stacking faults, Application of simple dislocation theory to plastic deformation; Dislocation mechanics-Frank-Read sources, Dislocation pile-ups, Cross-slip, Dislocation intersections, Climb;
Fracture mechanics: Basic mechanism of ductile and brittle fracture; Griffith and Orowan theories of ideally brittle fracture; Fracture modes and fractography; Linear-elastic fracture mechanics; Stress concentration and concept of fracture toughness; Fracture mechanics in design; Ductile to Brittle Transition Temperature (DBTT); Factors affecting DBTT; Determination of DBTT
Creep and stress rupture: Creep mechanisms; Structural changes during creep; Temperature dependence of creep; Metallurgical factors affecting creep; Deformation mechanism maps; creep-fatigue; Visco-elasticity; Alloys of high temperature use.
Fatigue: Fatigue failure; Stress cycles, effect of mean stress; Factors affecting fatigue; Structural changes accompanying fatigue; Stress-strain/life description in fatigue (S-N curves, endurance

strengths/fatigue limits; Crack propagation; Goodman relationship, Neuber's and Miner's rules, fatigue strength reduction factors); Low and high cycle fatigue; Application of fracture mechanics to fatigue-crack growth; Fatigue resistant design; Fatigue thresholds.

CSE 2228 Programing Techniques Sessional

Credit: **1.5**
Contact hour: 3 hrs/wk
Topics: Laboratory based on CSE 2227