molar quantities; Gibbs-Duhem Equation; Criteria for Thermodynamic Equilibrium; Phase Equilibrium Criteria, Non- ideal Solutions; Residual and Excess Properties; Fugacity and Activity Coefficient models; Pure Component Phase Equilibria, Vapour-Liquid Equilibria (VLE), Raoult's Law and Modified Raoult's Law; High-Pressure VLE; Henry's law; Chemical Reaction Equilibrium: Homogeneous and Heterogeneous reactions; Multi-reaction Equilibria; Liquid-Liquid Equilibria; Solid – Liquid Equilibria; Solid – Vapour Equilibria

Text/ Reference Books:

- J.M. Smith, H.C. Van Ness, M.M. Abbott, Introduction to Chemical Engineering Thermodynamics, 6th Ed., McGraw-Hill, 2001
- S.I. Sandler, Chemical, Biochemical and Engineering Thermodynamics, 4th Ed., Wiley India, 2006
- Y. V. C. Rao, Chemical Engineering Thermodynamics, 1st Ed., Universities Press, India, 1997
- P. K. Nag, Engineering Thermodynamics, 5th Ed., Tata Mc-Graw Hill Education, 2013
- J.M. Prausnitz, R.N. Lichtenthaler, E.G. Azevedo, Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd Ed., Prentice Hall, 1998
- J.W. Tester, M. Modell, Thermodynamics and its Applications, 3rd Ed., Prentice Hall, 1999
- R.C. Reid, J.M. Prausnitz, B.E.Poling, Properties of Gases and Liquids, 4th Ed., McGraw-Hill, 1987

Product Realization

This course introduces students to design principles, enables them design using software tools, and then provides them the experience of realizing the design in a manufacturing environment using modern prototyping machines and tools. The emphasis would be on building working models integrated with the use of embedded devices like motors and electronic controllers as necessary.

Text/ Reference Books:

- Tomovic, Mileta M., and Shaoping Wang. *Product Realization: A Comprehensive Approach*. Springer, 2009.

IPR and Law

Nature of Intellectual Property; Patents, Industrial Design, Trademark and Copyright; Process of patenting and development; technological research, innovation, patenting, development; International cooperation on Intellectual Property; International treaties on IPRs; Patenting under PCT. Procedure for grants of patents. Scope of Patent Rights; Licensing and transfer of technology; Patent information and databases; Geographical Indications. Module III: Administration of Patent System. New developments in IPR; IPR of biological systems, plant varieties, computer software's etc. Traditional knowledge; Case Studies; IPR and IITs.

Text/ Reference Books:

- Cornish, W. R., David Llewelyn, and T. Aplin. *Intellectual Property: Patents, Copyrights, Trademarks and Allied Rights (4th)*. London: Sweet and Maxwell, 1999.
- Bently, Lionel, and Brad Sherman. *Intellectual property law*. Oxford University Press, USA, 2014.
- Kumar, Ashok. *Intellectual Property Rights*. No. 1. Allied Publishers, 1994.

Engineering Foundation (Engineering Mechanics)

Rigid bodies Degrees of freedom Equations of equilibrium, Structural systems and modeling Trusses - Intro, axial members, method of joints Method of sections, stability, etc Method of sections, Method of force equilibrium, Zero force members and stability, Beams, Shear Force Diagram & Bending Moment Diagrams, Friction, Plane kinematics - fixed frame Plane kinematics - moving frame, Laws of plane kinetics, Plane kinetics, Vibrations, Free undamped vibration, Forced undamped vibration, Forced damped vibration

Text/ Reference Books:

- H. Shames, Engineering Mechanics: Statics and dynamics, 4th Ed, PHI, 2002.
- F. P. Beer and E. R. Johnston, Vector Mechanics for Engineers, Vol I - Statics, Vol II – Dynamics, 9th Ed, Tata McGraw Hill, 2011.
- J. L. Meriam and L. G. Kraige, Engineering Mechanics, Vol I – Statics, Vol II – Dynamics, 6th Ed, John Wiley, 2008.
- R. C. Hibbler, Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press, 2006.

Biology

Biomolecules & Cellular Organization: Cell Structure and evolution, Structure & function of biomolecules: Carbohydrates, Proteins, Lipids and Nucleic Acids, Cell division & cell cycle Fundamental Processes: Replication, repair & recombination, Transcription and RNA processing, Protein synthesis and ProcessingGenome Organization & Regulation: Structure and organization of genome, Concept of Gene, Gene RegulationMethods in Molecular Biology: DNA sequencing and PCR, Gene Expression Analysis, Proteomics & Metabolite Analysis, Recombinant DNA TechnologyApplications of Omics sciences in Health & Agriculture

Text/ Reference Books:

- Gerald Kalp, Cell and Molecular Biology: Concepts and Experiments;
- Lodish, Molecular Cell Biology
- Lubert Stryer, John L. Tymoczko And Jeremy Mark Berg, Biochemistry;
- Klug, Cummings, Spencer And Palladino,Concepts of Genetics;
- Dale, Schantz And Plant, From Genes to Genomes: Concepts Applications of DNA Technology;
- Julia Lodge, Pete Lund And Steve Minchin, Gene Cloning: Principles and Applications;
- T.A. Brown, Gene Cloning and DNA Analysis: An Introduction;
- P.S. Verma and V.K. Agarwal,Genetics

- P.K. Gupta,Cell and Molecular Biology

Chemistry-II

Spectroscopy- Introduction and classification, Fundamental principles, Instrumentation and applications of Ultra Violet-Visible Spectroscopy, Infra-Red Spectroscopy, Raman Spectroscopy and Nuclear Magnetic Resonance SpectroscopyPolymer Chemistry-Introduction, Polymerisation, Properties, Polymer processing, Industrial polymers, conducting polymersFuels and Combustion- Properties of fuels, Calorific value, Petroleum and petrochemicals, biofuels Electrochemistry- Applications of electrochemistry at the interface of science and technology, Batteries, Fuel cells, Biomedical devices,Corrosion and its controlLubricants- Mechanism of lubrication,Types,Propertiesand selection of lubricants

Text/ Reference Books:

- H.D. Gesser, Applied Chemistry - A Textbook for Engineers and Technologists Springer Engineering Chemistry, Wiley, 2011
- J. M. Hollas, Modern Spectroscopy, Wiley
- Colin Banwell and Elaine McCash, Fundamentals of molecular spectroscopy, Tata McGraw Hill Education Pvt. Ltd.
- Fred W. Billmeyer, Text Book of Polymer Science, Wiley India Pvt. Ltd.

Physics-II

Properties of Matter: Hooke's law, Factors affecting elasticity, Bending moment, Depression of a cantilever, Young's modulus by uniform bending, I-shaped girders. Thermal Physics: Thermal properties of materials, Specific Heat of Solids, Einstein Model, Debye Model, Lattice Vibrations, Phonons, Modes of heat transfer, Thermal conductivity, Newton's law of cooling, Linear heat flow, Lee's disc method, Radial heat flow.Oscillation and Waves: Simple harmonic oscillation, damped harmonic oscillation, forced vibration, resonance, coupled oscillation. Waves as periodic variation quantity in space and time, wave equation, Reflection and transmission of waves at boundary of two media.

Text/ Reference Books:

- C. Kittle, W. D. Knight, and M. A. Ruderman, Mechanics, Berkeley Physics Course, McGraw-Hill, 1965
- C. Kittle, H.Kroemer, Thermal Physics, W. H. Freeman, 1980

Engineering Foundation (Numerical Methods)

Computing Arithmetic, Significant Digits and Numerical Instability, Root finding methods. Bisection, Newton Raphson, Secant and Regula Falsi, methods for multiple roots. System of Linear Algebraic Equations and Eigenvalue problems-Gauss Elimination, LU Decomposition. Jacobi-Gauss-Seidel and SOR methods, Interpolation and Approximation-

spline approximation. Linear, quadratic and Cubic, Differentiation and Integration-Richardson's extrapolation, Gauss Quadrature methods, ordinary differential equations-Initial and Boundary Value Problems, introduction to numerical solutions of Partial Differential Equations.

Text/ Reference Books:

- M.K. Jain, SRK Iyengar, R.K.Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publishers, 2003.
- S.C. Chopra and R. P. Canale, Numerical Methods for Engineers, McGraw-Hill Higher Education, 2005.
- S.D. Conte h C. de Boor, Elementary Numerical Analysis: An Algorithmic Approach, McGraw-Hill Book Company, 1980.
- E.W. Cheney and D. R. Kincaid, Numerical Analysis, Brooks Cole, 1996.

Engineering Foundation (Data Structure)

Introduction to Data Structures, algorithms, pseudo-code, time and space complexities; arrays and their applications, sparse matrix, stacks and their applications such as recursion, queues including priority queues and their applications, linked lists and their applications, Introduction to trees, forest, static tree structures: binary tree, threaded binary tree, their traversal techniques, Binary Search Trees, including their applications, dynamic tree structures: AVL trees, B-trees, B+ trees, B* tree, including their applications, Introduction to Graphs, DFS, BFS. Sorting and searching algorithms, hashing.

Text/ Reference Books:

- H Ellis, S. Sahni, Fundamentals of Data Structures, W H Freeman and Co. 1995.
- J. P. Tremblay, P. G. Sorenson, Introduction to Data Structures: With Applications, McGraw Hill Higher Education, 1983.
- Kruse Robert L., "Data Structures and Program Design", Prentice Hall, 2007
- R. Gilberg, B. A. Forouzan, Data Structures: A Pseudocode Approach with C, Course Technology Inc, 2004.

Professional Practices & Ethics

Basics of Professional Ethics, Ethical Human Conduct, Humanistic Constitution and universal human order, To identify the scope and characteristics of people.
Professional Ethics in practice: Profession and Professionalism, Engineering Profession and Ethics, Professional Responsibilities.

Text/ Reference Books:

- R. Subramanian, Professional Ethics, Oxford University Press.
- Prof. D.R. Kiran, Professional Ethics & Human Values: Tata Mc Graw Hill Education.

- Edmond G. Seebauer & Robert L. Barry, Fundamentals of Ethics, Oxford University Press.

Technical Writing

Significance of literature review, Writing scientific report, structure and components of research report, revision, writing project proposal, writing a Research Paper, Citation counting and Impact factor, Science citation index (SCI)/ Science citation index Expended (SCI-E), H-index, Academic Ethics and Plagiarism, Intellectual Property Rights and Patent law.

Text/ Reference Books:

- P. Oliver, Writing Your Thesis,New Delhi:Vistaar Publications, 2004.
- Gregory, Ethics in Research, Continuum, 2005.