BIOTECHNOLOGY

B.TECH. PROGRAMME

With effect from July 2018

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B.Tech. Biotechnology Curriculum

1st Year 1st Semester

A. THEORY							
Sl. No	**Course Code**	**Course Name**	**Contact Hours/ Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	PHYS1001	Physics	3	1	0	4	4
2	MATH1101	Mathematics I	3	1	0	4	4
3	CSEN1001	Programming for Problem Solving	3	0	0	3	3
		Total of Theory				**11**	**11**
B. PRACTICAL/ LABORATORY							
4	PHYS1051	Physics Lab	0	0	3	3	1.5
5	CSEN1051	Programming for Problem Solving Lab	0	0	4	4	2
6	MECH1051	Workshop / Manufacturing Practices	1	0	4	5	3
		Total of Practical				**12**	**6.5**
		Total of Semester				**23**	**17.5**

1st Year 2nd Semester

A. THEORY							
Sl. No	**Course Code**	**Course Name**	**Contact Hours/ Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	CHEM1001	Chemistry I	3	1	0	4	4
2	MATH1201	Mathematics II	3	1	0	4	4
3	ELEC1001	Basic Electrical Engineering	3	1	0	4	4
4	HMTS1202	Business English	2	0	0	2	2
		Total of Theory				**14**	**14**
B. PRACTICAL/ LABORATORY							
5	CHEM1051	Chemistry I Lab	0	0	3	3	1.5
6	ELEC1051	Basic Electrical Engineering Lab	0	0	2	2	1
7	MECH1052	Engineering Graphics and Design	1	0	4	5	3
8	HMTS1251	Language Lab	0	0	2	2	1
		Total of Practical				**12**	**6.5**
		Total of Semester				**26**	**20.5**

2nd Year 1st Semester

A. THEORY								
Sl No	**Course Code**	**Field**	**Course Title**	**Contact Hours/Week**				**Credit Points**
				L	**T**	**P**	**Total**	
1	**EVSC2016**	Mandatory	Environmental Sciences	2	0	0	2	0
2	**HMTS2001**	Humanities	Human Values and Professional Ethics	3	0	0	3	3
3	**BIOT2101**	Basic Science	Chemistry of Biomolecules	3	0	0	3	3
4	**BIOT2102**	Prof. Core	Industrial Stoichiometry	3	0	0	3	3
5	**BIOT2103**	Prof. Core	Biochemistry	3	0	0	3	3
6	**BIOT2104**	Prof. Core	Microbiology	3	0	0	3	3
7	**MATH2101**	Basic Science	Mathematical & Statistical Methods	3	0	0	3	3
			Total of Theory				**20**	**18**
B. PRACTICAL/ LABORATORY								
7	**BIOT2151**	Basic Science	Biomolecular Chemistry Lab	0	0	3	3	1.5
8	**BIOT2153**	Prof. Core	Biochemistry Lab	0	0	3	3	1.5
9	**BIOT2154**	Prof. Core	Microbiology Lab	0	0	4	4	2
			Total of Practical				**10**	**5**
			Total of Semester				**30**	**23**

2nd Year 2nd Semester

A. THEORY								
Sl No	**Course Code**	**Field**	**Course Title**	**Contact Hours/Week**				**Credit Points**
				L	**T**	**P**	**Total**	
1	**BIOT2201**	Basic Science	Thermodynamics & Kinetics	3	0	0	3	3
2	**BIOT2202**	Prof. Core	Transfer Operation-I	3	0	0	3	3
3	**BIOT2203**	Prof. Core	Molecular Biology	3	0	0	3	3
4	**BIOT2204**	Prof. Core	Industrial Microbiology & Enzyme Technology	3	0	0	3	3
5	**CSEN2005**	Engg Science	Data Structure	3	0	0	3	3
			Total of Theory				**15**	**15**
B. PRACTICAL/ LABORATORY								
7	**BIOT2252**	Prof. Core	Transfer Operation-I Lab	0	0	3	3	1.5
8	**BIOT2253**	Prof. Core	Molecular Biology Lab	0	0	2	2	1
9	**BIOT2254**	Prof. Core	Enzyme Technology & Fermentation Technology Lab	0	0	2	2	1
10	**CSEN2055**	Engg Science	Data Structure Lab	0	0	3	3	1.5
			Total of Practical				**10**	**5**
			Total of Semester				**25**	**20**

3rd Year 1st Semester

A. THEORY								
Sl No	**Course Code**	**Field**	**Course Title**	**Contact Hours/Week**				**Credit Points**
				L	**T**	**P**	**Total**	
1	**INCO3016**	Mandatory	Indian Constitution and Civil Society	2	0	0	2	0
2	**BIOT3101**	Prof. Core	Genetics	3	0	0	3	3
3	**BIOT3102**	Prof. Core	Bioinformatics	3	0	0	3	3
4	**BIOT3103**	Prof. Core	Recombinant DNA Technology	3	0	0	3	3
5	**BIOT3104**	Prof. Core	Transfer Operation-II	3	0	0	3	3
6	**BIOT3131**	Prof. Elective 1	Food Biotechnology	3	0	0	3	3
	BIOT3132		Environmental Biotechnology					
	BIOT3133		Bioprocess & Process Instrumentation					
			Total of Theory				**17**	**15**
B. PRACTICAL/ LABORATORY								
7	**BIOT3151**	Prof. Core	Genetics lab	0	0	2	2	1
8	**BIOT3152**	Prof. Core	Bioinformatics lab	0	0	2	2	1
9	**BIOT3153**	Prof. Core	Recombinant DNA Technology lab	0	0	2	2	1
10	**BIOT3154**	Prof. Core	Transfer Operation-II lab	0	0	2	2	1
11	**BIOT3181**	Prof. Elective 1	Food Biotechnology Lab	0	0	2	2	1
	BIOT3182		Environmental Biotechnology Lab					
	BIOT3183		Bioprocess & Process Instrumentation Lab					
			Total of Practical				**10**	**5**
			Total of Semester				**27**	**20**

3rd Year 2nd Semester

A. THEORY								
Sl No	**Course Code**	**Field**	**Course Title**	**Contact Hours/Week**				**Credit Points**
				L	**T**	**P**	**Total**	
1	**HMTS3201**	Humanities	Economics for Engineers	3	0	0	3	3
2	**BIOT3201**	Prof. Core	Immunology	3	0	0	3	3
3	**BIOT3202**	Prof. Core	Bioreactor Design and Analysis	3	0	0	3	3
4	**CSEN3207**	Engg Science	RDBMS Concept and Computer Networking	3	0	0	3	3
5	**BIOT3231**	Prof. Elective 2	Molecular Modelling and Drug Designing	3	0	0	3	3
	BIOT3232		Biophysics of Macromolecules					
	BIOT3233		Biosensors and Diagnostics					
6	**BIOT3221**	Emerging Area / Open Elective 1	Medical and Pharmaceutical Biotechnology	3	0	0	3	3
	BIOT3222		Basics of Nanotechnology					
	CHEN3221		Materials for engineering applications					
	CHEN3221		Industrial safety and hazards					
			Total of Theory				**18**	**18**
B. PRACTICAL/ LABORATORY								
7	**BIOT3251**	Prof. Core	Immunology lab	0	0	2	2	1
8	**BIOT3252**	Prof. Core	Bioreactor Design lab	0	0	2	2	1
9	**CSEN3257**	Engg Science	RDBMS Concept lab	0	0	2	2	1
10	**BIOT3293**	Seminar	Term paper & Seminar	0	0	4	4	2
			Total of Practical				**10**	**5**
			Total of Semester				**28**	**23**

4th Year 1st Semester

A. THEORY								
Sl No	**Course Code**	**Field**	**Course Title**	**Contact Hours/Week**				**Credit Points**
				L	**T**	**P**	**Total**	
1	**HMTS4101**	Humanities	Principles of Management	3	0	0	3	3
2	**BIOT4131**	Prof. Elective 3	Biomaterials	3	0	0	3	3
	BIOT4132		Biofertilizers and Biopesticides					
	BIOT4133		Post-harvest Technology					
	BIOT4134		Biometallurgy					
3	**BIOT4121**	Emerging Area / Open Elective 2	Proteomics and Protein Engineering	3	0	0	3	3
	BIOT4122		Human Genomics					
	BIOT4123		Biomedical Engineering					
	CHEN4121		Industrial total quality management					
	CHEN4122		Industrial pollution control					
4	**CHEN4123**	Open Elective 3	Statistical methods in design of experiments	3	0	0	3	3
	CHEN4124		Reactor Design					
			Total of Theory				**12**	**12**
B. SESSIONAL								
5	**BIOT4191**	Internship	Industrial Training / Internship	4 to 6 weeks				2
6	**BIOT4195**	Project	Project 1			8	8	4
			Total of Sessional				**8**	**6**
			Total of Semester				**20**	**18**

Training in a suitable industry, R&D Organization, Reputed Laboratory or Research Institute for 4 to 6 weeks to be arranged during summer vacation.

4th Year 2nd Semester

A. THEORY								
Sl No	**Course Code**	**Field**	**Course Title**	**Contact Hours/Week**				**Credit Points**
				L	**T**	**P**	**Total**	
1	**BIOT4231**	Prof. Elective 4	Bioethics & IPR	3	0	0	3	3
	BIOT4232		Bio-entrepreneurship and Regulations					
2	**BIOT4241**	Prof. Elective 5	Renewable Energy Technology	3	0	0	3	3
	BIOT4242		Tissue Engineering					
	BIOT4243		Metabolic Engineering					
	BIOT4244		Basic Process Equipment Design					
	BIOT4245		Bioprocess Modelling					
3	**CHEN4221**	Open Elective 4	Nanotechnology	3	0	0	3	3
	CHEN4222		Introduction to solar and wind technology					
			Total of Theory				**9**	**9**
B. SESSIONAL								
4	**BIOT4295**	Project	Project-II	0	0	16	16	8
5	**BIOT4297**	Viva	Comprehensive Viva Voce					1
			Total of Sessional				**16**	**9**
			Total of Semester				**25**	**18**

List of Open Electives offered by the Department of Biotechnology

A. THEORY								
Sl No	**Course Code**	**Field**	**Course Title**	**Contact Hours/Week**				**Credit Points**
				L	**T**	**P**	**Total**	
1	**BIOT4124**	Open Elective 3 for other Departments (in Sem 7)	Biosensor	3	0	0	3	3
	BIOT4125		Biopolymer					
	BIOT4026		Biology for Engineers					
			Total of Theory				**3**	**3**

A. THEORY								
Sl No	**Course Code**	**Field**	**Course Title**	**Contact Hours/Week**				**Credit Points**
				L	**T**	**P**	**Total**	
1	**BIOT4221**	Open Elective 4 for other Departments (in Sem 8)	Computational Biology	3	0	0	3	3
	BIOT4222		Non-conventional Energy					
	BIOT4026		Biology for Engineers					
			Total of Theory				**3**	**3**

List of Honours papers (additional 20 credits) for B.Tech. Honours degree

1st yr 1st semester

A. THEORY								
Sl No	**Course Code**	**Field**	**Course Title**	**Contact Hours/Week**				**Credit Points**
				L	**T**	**P**	**Total**	
1	**ECEN1011**	Honours	Basic Electronics	3	0	0	3	3
B. PRACTICAL/ LABORATORY								
2	**ECEN1061**	Honours	Basic Electronics Lab	0	0	2	2	1
			Total of Semester				**5**	**4**

1st yr 2nd semester

A. THEORY								
Sl No	**Course Code**	**Field**	**Course Title**	**Contact Hours/Week**				**Credit Points**
				L	**T**	**P**	**Total**	
1	**HMTS1011**	Honours	Communication for Professionals	3	0	0	3	3
B. PRACTICAL/ LABORATORY								
2	**HMTS1061**	Honours	Professional Communication Lab	0	0	2	2	1
			Total of Semester				**5**	**4**

2nd yr 2nd semester

A. THEORY								
Sl No	**Course Code**	**Field**	**Course Title**	**Contact Hours/Week**				**Credit Points**
				L	**T**	**P**	**Total**	
1	**BIOT2211**	Honours	Bioseparation Technology	3	1	0	4	4
			Total of Semester				**4**	**4**

3rd yr 2nd semester

A. THEORY								
Sl No	**Course Code**	**Field**	**Course Title**	**Contact Hours/Week**				**Credit Points**
				L	**T**	**P**	**Total**	
1	**BIOT3211**	Honours	Plant Biotechnology	3	0	0	3	3
B. PRACTICAL/ LABORATORY								
2	**BIOT3261**	Honours	Plant Tissue Culture Lab	0	0	2	2	1
			Total of Semester				**5**	**4**

4th yr 1st semester

A. THEORY								
Sl No	**Course Code**	**Field**	**Course Title**	**Contact Hours/Week**				**Credit Points**
				L	**T**	**P**	**Total**	
1	**BIOT4111**	Honours	Animal Cell Culture & Animal Biotechnology	4	0	0	4	4
			Total of Semester				**4**	**4**

1st yr 1st semester detailed syllabus

Subject Name: PHYSICS					
Paper Code: PHYS1001					
Contact Hours Per Week	L	T	P	Total	Credit Points
	3	1	0	4	4

Course Outcomes:

PHYS 1001.1	Interpret oscillations under different conditions, with the understanding of Resonance phenomena followed by calculation of Q factor
PHYS 1001.2	Analyze the Quantum phenomenon like Black body radiation , Compton effect and origin of X-ray spectrum
PHYS 1001.3	Understand the wave character of light through the phenomenon of interference, diffraction and polarization.
PHYS 1001.4	Study of various crystal structures and classification of different crystal planes.
PHYS 1001.5	Explain the working principle of LASER, and apply the knowledge in different lasing system and their engineering applications in holography
PHYS 1001.6	Understand the dual nature of matter, Heisenberg's uncertainty relation and it's various application.

Module 1: Mechanics (7+5) = 12L

Elementary concepts of grad, divergence and curl. Potential energy function; F=-grad V, Equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, Curl of a force field; Central forces ; conservation of angular momentum; Energy equation and energy diagrams; elliptical, parabolic and hyperbolic orbit; Kepler Problem; Application : Satellite manoeuvres .

Non-inertial frames of reference; rotating coordinate system; five term acceleration formula-centripetal and coriolis accelerations; applications: Weather system, Foucault pendulum.

Module 2: Optics = (4+3+5) = 12 L

Oscillatory Motion:

Damped harmonic motion – Over damped, critically damped and lightly damped oscillators; Forced oscillation and resonance. Electrical equivalent of mechanical oscillator, Wave equation, plane wave solution.

Optics:

Elementary features of polarization of light waves. Double refraction, Production and analysis of linearly, elliptic and Circularly polarized light, Polaroid and application of polarizations.: Polarimeter.

Laser & Fiber Optics:

Characteristics of Lasers, Spontaneous and Stimulated Emission of Radiation, Meta-stable State, Population Inversion, Lasing Action, Einstein's Coefficients and Relation between them, Ruby Laser, Helium-Neon Laser, Semiconductor Diode Laser, Applications of Lasers.
Fiber optics - principle of operation, numerical aperture, acceptance angle, Single mode , graded indexed fiber.

Module 3: **Electrostatics (8+4) = 12 L**

Electrostatics in free space

Calculation of electric field and electrostatic potential for a charge distribution, Divergence and curl of electrostatic field, Laplace's and Poisson's equation for electrostatic potential. Boundary conditions of electric field and electrostatic potential. Method of images , energy of a charge distribution and its expression in terms of electric field.

Electrostatics in a linear dielectric medium

Electrostatic field and potential of a dipole, Bound charges due to electric polarization, Electric displacement, Boundary conditions on displacement, Solving simple electrostatic problem in presence of dielectric – point charge at the centre of a dielectric sphere, charge in front of dielectric slab, Dielectric slab and dielectric sphere in uniform electric field.

Module 4: **(6+3+3) = 12L**

Magnetostatics :

Biot-Savart law, divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; equation for vector potential and it's solutions for given current densities .

Magnetostatics in a linear magnetic medium:

Magnetization and associated bound currents; Auxiliary magnetic field $\vec{H}$; boundary conditions on $\vec{B}$ and $\vec{H}$. Solving for magnetic field due to simple magnet like a bar magnet; Magnetic susceptibility ; ferromagnetic , paramagnetic and diamagnetic materials; Qualitative discussion of magnetic field in presence of magnetic materials.

Faraday's Law:

Differential form of Faraday's law expressing curl of electric field in terms of time derivative of magnetic field and calculating electric field due to changing magnetic fields in quasi static approximation. Energy stored in a magnetic field.

Books of reference:

1. Optics – Eugene Hecht Pearson Education India Private Limited
2. Introduction to Electrodynamics, David J. Griffiths, Pearson Education India Learning Private Limited
3. Waves and Oscillations by N.K. Bajaj
4. Principles of Physics, 10ed, David Halliday, Robert Resnick Jearl Walker , Wiley
5. Electricity, Magnetism, and Light, Wayne M. Saslow, Academic Press
6. Classical mechanics, Narayan Rana, Pramod Joag, McGraw Hill Education
7. Introduction to Classical Mechanics, R Takwale, P Puranik, McGraw Hill Education
8. Optics, Ghatak, McGraw Hill Education India Private Limited
9. Refresher Course in B.Sc. Physics – Vol1 and Vol 2 – C.L.Arora

Subject Name: MATHEMATICS-I					
Paper Code: MATH1101					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course Outcomes

MATH1101.1 Apply the concept of rank of matrices to find the solution of a system of linear simultaneous equations.

MATH1101.2 Develop the concept of eigen values and eigen vectors.

MATH1101.3 Use Mean Value Theorems for power series expansions of functions of one variable.

MATH1101.4 Analyze the nature of sequence and infinite series.

MATH1101.5 Describe the concept of differentiation and integration for functions of several variables with their applications in vector calculus.

MATH1101.6 Combine the concepts of gradient, curl, divergence, directional derivatives, line integrals, surface integrals and volume integrals.

Module I [10L]

Matrix:

Inverse and rank of a matrix; Elementary row and column operations over a matrix; System of linear equations and its consistency; Symmetric, skew symmetric and orthogonal matrices; Determinants; Eigen values and eigen vectors; Diagonalization of matrices; Cayley Hamilton theorem; Orthogonal transformation.

Module II [10 L]

Vector Calculus:

Vector function of a scalar variable, Differentiation of a vector function, Scalar and vector point functions, Gradient of a scalar point function, divergence and curl of a vector point function, Directional derivative, Related problems on these topics,

Infinite Series:

Convergence of sequence and series; Tests for convergence: Comparison test, Cauchy's Root test, D' Alembert's Ratio test(statements and related problems on these tests), Raabe's test; Alternating series; Leibnitz's Test (statement, definition); Absolute convergence and Conditional convergence.

Module III [10 L]

First order ordinary differential equations:

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Ordinary differential equations of higher orders:

General linear ODE of order two with constant coefficients, C.F. & P.I., D-operator methods, Method of variation of parameters, Cauchy-Euler equations.

Module IV [10L]

Calculus of functions of several variables

Introduction to functions of several variables with examples, Knowledge of limit and continuity, Determination of partial derivatives of higher orders with examples, Homogeneous functions and Euler's theorem and related problems up to three variables,

Multiple Integration

Concept of line integrals, Double and triple integrals. Green's Theorem, Stokes Theorem and Gauss Divergence Theorem.

Suggested Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2000.
2. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2006.
3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
5. K. F. Riley, M. P. Hobson, S. J. Bence. Mathematical Methods for Physics and Engineering, Cambridge University Press, 23-Mar-2006.
6. S. L. Ross, Differential Equations", Wiley India, 1984.
7. G.F. Simmons and S.G. Krantz, Differential Equations, McGraw Hill, 2007.
8. Vector Analysis(Schaum's outline series): M.R. Spiegel, Seymour Lipschutz, Dennis Spellman (McGraw Hill Education)
9. Engineering Mathematics: S. S. Sastry (PHI)
10. Advanced Engineering Mathematics: M.C. Potter, J.L. Goldberg and E.F. Abonfadel (OUP), Indian Edition.
11. Linear Algebra (Schaum's outline series): Seymour Lipschutz, Marc Lipson (McGraw Hill Education)

Course Name: PROGRAMMING FOR PROBLEM SOLVING					
Course Code: CSEN 1001					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Learning Objectives: Introduction to the concept of computer and computation and solving of problems using C as a programming language. Coverage of C will include basic concepts, arithmetic and logic, flow control, and data handling using arrays, structures, pointers and files.

Course outcome:

CO 1: Understand and remember functions of the different parts of a computer.

CO 2: Understand and remember how a high-level language (C programming language, in this course) works, different stages a program goes through.

CO 3: Understand and remember syntax and semantics of a high-level language (C programming language, in this course).

CO 4: Understand how code can be optimized in high-level languages.

CO 5: Apply high-level language to automate the solution to a problem.

CO 6: Apply high-level language to implement different solutions for the same problem and analyze why one solution is better than the other.

Module I: [10L]

Fundamentals of Computer

History of Computers, Generations of Computers, Classification of Computers.

Basic Anatomy of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices. Basic Concepts of Assembly language, High level language, Compiler and Assembler.

Binary & Allied number systems (decimal, octal and hexadecimal) with signed and unsigned numbers (using 1's and 2's complement) - their representation, conversion and arithmetic operations. Packed and unpacked BCD system, ASCII. IEEE-754 floating point representation (half- 16 bit, full- 32 bit, double- 64 bit).

Basic concepts of operating systems like MS WINDOWS, LINUX

How to write algorithms & draw flow charts.

Module II: [10L]

Basic Concepts of C

C Fundamentals:

The C character set identifiers and keywords, data type & sizes, variable names, declaration, statements.

Operators & Expressions:

Arithmetic operators, relational and logical operators, type, conversion, increment and decrement operators, bit wise operators, assignment operators and expressions, precedence and order of evaluation. Standard input and output, formatted output -- printf, formatted input scanf.

Flow of Control:

Statement and blocks, if-else, switch-case, loops (while, for, do-while), break and continue, go to and labels.

Module III: [10L]
Program Structures in C

Basic of functions, function prototypes, functions returning values, functions not returning values. Storage classes - auto, external, static and register variables – comparison between them. Scope, longevity and visibility of variables.

C preprocessor (macro, header files), command line arguments.

Arrays and Pointers:

One dimensional arrays, pointers and functions – call by value and call by reference, array of arrays. Dynamic memory usage– using malloc(), calloc(), free(), realloc(). Array pointer duality.

String and character arrays; C library string functions and their use.

Module IV: [10L]
Data Handling in C

User defined data types and files:
Basic of structures; structures and functions; arrays of structures.

Files – text files only, modes of operation. File related functions – fopen(), fclose(), fscanf(), fprintf(), fgets(), fputs(), fseek(), ftell().

Text Books

1. Schaum's outline of Programming with C – Byron Gottfried
2. Teach Yourself C- Herbert Schildt
3. Programming in ANSI C – E Balagurusamy

Reference Books

1. C: The Complete Reference – Herbert Schildt
2. The C Programming Language- D.M.Ritchie, B.W. Kernighan

Course Name: PHYSICS LAB					
Course Code: PHYS1051					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	3	3	1.5

Course Outcomes:

1. To gain practical knowledge by applying the experimental methods to correlate with the Physics theory.
2. To learn the usage of electrical and optical systems for various measurements.
3. Apply the analytical techniques and graphical analysis to the experimental data.
4. Understand measurement technology, usage of new instruments and real time applications in engineering studies.
5. To develop intellectual communication skills and discuss the basic principles of scientific concepts in a group.

Minimum of six experiments taking at least one from each of the following four groups :

Group 1: Experiments in General Properties of matter

1. Determination of **Young's modulus** by **Flexure Method**
2. Determination of **bending moment** and **shear force** of a rectangular beam of uniform cross- section.
3. Determination of **modulus of rigidity** of the material of a rod by **static method**
4. Determination of **rigidity modulus** of the material of a **wire by dynamic method.**
5. Determination of **coefficient of viscosity** by Poiseulle's capillary flow method.

Group 2: Experiments in Optics

1. Determination of **dispersive power** of the material of a prism
2. Determination of wavelength of light by **Newton's ring** method.
3. Determination of wavelength of light by **Fresnel's biprism method.**
4. Determination of the **wavelength of a given laser** source by diffraction method

Group 3: Electricity & Magnetism experiments

1. Determination of **dielectric constant** of a given dielectric material.
2. Determination of resistance of **ballistic galvanometer by half deflection** method and study of variation of **logarithmic decrement** with series resistance.
3. Determination of the **thermo-electric power** at a certain temperature of the given thermocouple.
4. Determination of **specific charge (e/m)** of electron.

Group 4: Quantum Physics Experiments

1. Determination of **Planck's constant**.
2. Determination of **Stefan's radiation** constant.
3. Verification of **Bohr's atomic orbital** theory through **Frank-Hertz experiment**.
4. Determination of **Rydberg constant** by studying **Hydrogen/ Helium** spectrum.
5. Determination of **Hall co-efficient of semiconductors.**
6. Determination of **band gap** of semiconductors.
7. To study current-voltage characteristics, load response, areal characteristics and spectral response of photo voltaic solar cells.

Course Name: PROGRAMMING FOR PROBLEM SOLVING					
Course Code: CSEN1051					
Contact Hours	**L**	**T**	**P**	**Total**	**Credit Points**
per week	**0**	**0**	**4**	**4**	**2**

Course outcome:
After completion of this course the students should be able:

1. To write simple programs relating to arithmetic and logical problems.
2. To be able to interpret, understand and debug syntax errors reported by the compiler.
3. To implement conditional branching, iteration (loops) and recursion.
4. To decompose a problem into modules (functions) and amalgamating the modules to generate a complete program.
5. To use arrays, pointers and structures effectively in writing programs.
6. To be able to create, read from and write into simple text files.

Software to be used: GNU C Compiler (GCC) with LINUX
NB: Cygwin (Windows based) may be used in place of LINUX

Topic 1: LINUX commands and LINUX based editors
Topic 2: Basic Problem Solving
Topic 3: Control Statements (if, if-else, if-elseif-else, switch-case)
Topic 4: Loops - Part I (for, while, do-while)
Topic 5: Loops - Part II
Topic 6: One Dimensional Array
Topic 7: Array of Arrays
Topic 8: Character Arrays/ Strings
Topic 9: Basics of C Functions
Topic 10: Recursive Functions
Topic 11: Pointers
Topic 12: Structures
Topic 13: File Handling

Text Books

1. Schaum's outline of Programming with C – Byron Gottfried
2. Teach Yourself C- Herbert Schildt
3. Programming in ANSI C – E Balagurusamy

Course Name: WORKSHOP /MANUFACTURING PRACTICES					
Course Code: MECH 1051					
Contact Hours per week	L	T	P	Total	Credit Points
	1	0	4	5	3

Workshop/Manufacturing Practices [L: 1; T: 0; P: 0 (1 credit)]
(i) Lectures & videos: (13 hours)
Detailed contents

1. Introduction on Workshop and Safety Precautions. **(1 lecture)**
2. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 lectures)**
3. CNC machining, Additive manufacturing **(1 lecture)**
4. Fitting operations & power tools **(1 lecture)**
5. Electrical & Electronics **(1 lecture)**
6. Carpentry **(1 lecture)**
7. Plastic moulding, glass cutting **(1 lecture)**
8. Metal casting **(1 lecture)**
9. Welding (arc welding & gas welding), brazing **(2 lecture)**
10. **Viva-voce** **(1 lecture)**

Suggested Text/Reference Books:

(i) Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
(ii) Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
(iii)Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
(iv) Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
(v) Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

Course Outcomes

Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

(ii) Workshop Practice :(52 hours)[L : 0; T:0 ; P : 4 (2 credits)]

1. Machine shop	**(12 hours)**
2. Fitting shop	**(8 hours)**
3. Carpentry	**(4 hours)**
4. Electrical & Electronics	**(4 hours)**
5. Welding shop **(Arc welding 4 hrs + gas welding 4 hrs)**	**(8 hours)**
6. Casting	**(4 hours)**
7. Smithy	**(4 hours)**
8. Plastic moulding& Glass Cutting	**(4 hours)**
9. Sheet metal Shop	**(4 hours)**

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Laboratory Outcomes

- Upon completion of this laboratory course, students will be able to fabricate components with their own hands.
- They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
- By assembling different components, they will be able to produce small devices of their interest.

References:

1. Bhatt, N.D., Panchal V.M. & Ingle P.R., (2014) "Elementary Engineering Drawing" ; Charotan Publishing House.
2. Narayana, k.L. and Kannaaiah P "Engineering Graphics"; TMH.
3. Lakshminarayanan, V. and Vaish Wanar, R.s "Engineering Graphics" Jain Brothers.
4. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education.
5. Agarwal B. & Agarwal C. M. (2012), Engineering graphics, TMH Publications.

HONOURS COURSE

Course Title : BASIC ELECTRONICS					
Course Code: ECEN1011					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:
After going through this course, the students will be able to

1. Categorize different semiconductor materials based on their energy bands and analyze the characteristics of those materials for different doping concentrations based on previous knowledge on semiconductors acquired.
2. Describe energy band of P-N Junction devices and solve problems related to P-N Junction Diode both from device and circuit perspectives.
3. Design different application specific circuits associated with diodes operating both in forward and reverse bias.
4. Analyze various biasing configurations of Bipolar Junction Transistor and categorize different biasing circuits based on stability.
5. Categorize different field-effect transistors based on their constructions, physics and working principles and solve problems associated with analog circuits based on operational amplifiers.
6. Design and implement various practical purpose electronic circuits and systems meant for both special purpose and general purpose and anlayze their performance depending on the type of required output and subsequently the applied input.

Module I [10 L]
Basic Semiconductor Physics:
Crystalline materials, Energy band theory, Conductors, Semiconductors and Insulators, Concept of Fermi Energy level, intrinsic and extrinsic semiconductors, drift and diffusion currents in semiconductor

Diodes and Diode Circuits:
Formation of p-n junction, Energy Band diagram, forward & reverse biased configurations, V-I characteristics, load line, breakdown mechanisms, Zener Diode and its Application.
Rectifier circuits: half wave & full wave rectifiers: ripple factor, rectification efficiency.

Module II [8 L]
Bipolar Junction Transistors (BJT):
PNP & NPN BJT structures, current components in BJT, CE, CB, CC configurations, V-I Characteristics of CB & CE modes, regions of operation, Base width modulation & Early effect, thermal runaway, Concept of Biasing: DC load line, Q-point, basics of BJT amplifier operation, current amplification factors, different biasing circuits: fixed bias, collector to base bias, voltage divider bias.

Module III [9 L]
Field Effect Transistors (FET):
n-channel Junction Field Effect Transistor (JFET) structure & V-I characteristics.

Metal Oxide Semiconductor Field Effect Transistor (MOSFET): enhancement & depletion type MOSFETs (for both n & p channel devices), drain & transfer characteristics.

MOSFET as a digital switch, CMOS inverter, voltage transfer characteristic (VTC), NAND & NOR gate realization using CMOS logic.

Moore's Law, evolution of process node, state of integration (SSI, MSI, LSI, VLSI, ULSI), Classification of Integrated circuits (IC) and their applications.

Module IV [9 L]
Feedback in amplifiers :
Concept of feedback, advantages of negative feedback (qualitative), Barkhausen criteria.

Operational Amplifier:
Ideal OPAMP characteristics, OPAMP circuits: inverting and non-inverting amplifiers, Adder, Subtractor, Integrator, Differentiator, Basic Comparator.

Special Semiconductor Devices:
Light Emitting Diode (LED), Silicon Controlled Rectifier (SCR), Photodiode: Operations, characteristics & applications.

References:

1. Boylestad & Nashelsky: Electronic Devices & Circuit Theory
2. R.A Gayakwad:Op Amps and Linear IC's, PHI
3. D. Chattopadhyay, P. C Rakshit : Electronics Fundamentals and Applications
4. Adel S. Sedra, Kenneth Carless Smith: Microelectronics Engineering
5. Millman & Halkias: Integrated Electronics.
6. Salivahanan: Electronics Devices & Circuits.
7. Albert Paul Malvino: Electronic Principle.

Course Title : BASIC ELECTRONICS LABORATORY					
Course Code: ECEN1061					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

Course Outcomes:

1. The students will correlate theory with diode behavior.

2. They will design and check rectifier operation with regulation etc.

3. Students will design different modes with BJT and FET and check the operations.

4. They will design and study adder, integrator etc. with OP-AMPs.

List of Experiments (from)

1. Familiarization with passive and active electronic components such as Resistors, Inductors, Capacitors, Diodes, Transistors (BJT) and electronic equipment like DC power supplies, multi-meters etc.
2. Familiarization with measuring and testing equipment like CRO, Signal generators etc.
3. Study of I-V characteristics of Junction diodes.
4. Study of I-V characteristics of Zener diodes.
5. Study of Half and Full wave rectifiers with Regulation and Ripple factors.
6. Study of I-V characteristics of BJTs in CB mode
7. Study of I-V characteristics of BJTs in CE mode
8. Study of I-V characteristics of Field Effect Transistors.
9. Determination of input-offset voltage, input bias current and Slew rate of OPAMPs.
10. Determination of Common-mode Rejection ratio, Bandwidth and Off-set null of OPAMPs.
11. Study of OPAMP circuits: Inverting and Non-inverting amplifiers, Adders, Integrators and Differentiators.

1st yr 2nd semester detailed syllabus

Course Name: CHEMISTRY-1					
Course Code: CHEM1001					
Contact Hours	L	T	P	Total	Credit Points
per week	3	1	0	4	4

The subject code CHEM1001 corresponds to chemistry theory classes for the first year B. Tech students, which is offered as Engineering Chemistry and is common for all branches of engineering subjects. The course provides basic knowledge of theory based subjects like quantum mechanics, thermodynamics, reaction dynamics, electrochemistry, structure and reactivity of molecules. The course outcomes of the subject are

1. Knowledge of understanding the operating principles and reaction involved in batteries and fuel cells and their application in automobiles as well as other sectors to reduce environmental pollution.
2. An ability to analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.for engineering applications.
3. Have knowledge of synthesizing nano materials and their applications in industry, carbon nano tube technology is used in every industry now-a-days.
4. Understanding of bulk properties and processes using thermodynamic considerations.
5. Elementary knowledge of IR, UV, NMR and X-ray spectroscopy is usable in structure elucidation and characterisation of various molecules.
6. Knowledge of electronic effect and stereochemistry for understanding mechanism of the major chemical reactions involved in synthesis of various drug molecules.

MODULE-I

Atomic structure and Wave Mechanics (3L)

Brief outline of the atomic structure, Duel character of electron, De Broglies's equation, the Heisenberg uncertainty principle, brief introduction of quantum mechanics, the Schrodinger wave equation, Hermitian operator, solution of the Schrodinger equation for particle in a one dimensional box, interpretation of the wave function Ψ, concept of atomic orbital.

Thermodynamics (3L)

Carnot cycle, 2nd law of thermodynamics, entropy, Clausius inequality, free energy and work function, Clausius Clapeyron Equation, Chemical Potential, Activity and Activity coefficient. Gibbs Duhem Relation.

Spectroscopic Techniques & Application (4L)

Electromagnetic spectrum: EMR interaction with matter - absorption and emission of radiation.
Principle and application of UV- visible and IR spectroscopy
Principles of NMR Spectroscopy and X-ray diffraction technique

MODULE-II

Chemical Bonding (5L)

Covalent bond, VSEPR Theory, hybridization, molecular geometries, Dipole moment, Intermolecular forces, V.B. and M.O. Theory and its application in Homo and Heteronuclear diatomic molecules, Band theory of solids, Pi-molecular orbitals of ethylene and butadiene.

Periodicity (3L)

Effective nuclear charge, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electro-negativity, inert pair effect.

Ionic Equilibria (2L)

Acid Base Equilibria, Salt Hydrolysis and Henderson Equation, Buffer solutions, pH indicator, Common ion Effect, Solubility product, Fractional Precipitation.

MODULE-III

Conductance (3L)

Conductance of electrolytic solutions, Strong and Weak electrolytes, effect of temperature and concentration. Kohlrausch's law of independent migration of ions, transport numbers and hydration of ions. Application of conductance Acid-base and precipitation titration.

Electrochemical Cell (4L)

Thermodynamic derivation of Nernst equation, Electrode potential and its application to predict redox reaction; Standard Hydrogen Electrode, Reference electrode, cell configuration, half cell reactions, evaluation of thermodynamic functions; Reversible and Irreversible cells; Electrochemical corrosion.

Electrochemical Energy Conversion: Primary & Secondary batteries, Fuel Cells.

Reaction dynamics (3L)

Rate Laws, Order & Molecularity; zero, first and second order kinetics. Pseudo-unimolecular reaction, Arrhenius equation.

Mechanism and theories of reaction rates (Transition state theory, Collison theory).

Catalysis: Homogeneous catalysis (Definition, example, mechanism, kinetics).

MODULE-IV

Stereochemistry (4L)

Representations of 3- dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.

Structure and reactivity of Organic molecule (3L)

Inductive effect, resonance, hyperconjugation, electromeric effect, carbocation, carbanion, free radicals, aromaticity.

Organic reactions and synthesis of drug molecule (3L)

Introduction to reaction mechanisms involving substitution, addition, elimination and oxidation-reduction reactions. Synthesis of commonly used drug molecules.

TEXT BOOKS

1. Atkins' Physical Chemistry, P.W. Atkins (10th Edition)
2. Organic Chemistry, I. L. Finar, Vol-1 (6th Edition)
3. Engineering Chemistry, Jain & Jain,(16th Edition)
4. Fundamental Concepts of Inorganic Chemistry, A. K. Das, (2nd Edition)
5. Engineering Chemistry -I, Gourkrishna Dasmohapatra, (3rd Edition)

REFERENCE BOOKS

1. General & Inorganic Chemistry, R. P. Sarkar
2. Physical Chemistry, P. C. Rakshit, (7th Edition)
3. Organic Chemistry, Morrison & Boyd , (7th Edition)
4. Fundamentals of Molecular Spectroscopy, C.N. Banwell, (4th Edition)
5. Physical Chemistry, G. W. Castellan, (3rd Edition)
6. Basic Stereo chemistry of Organic Molecules, Subrata Sen Gupta, (1st Edition)

Course Name: MATHEMATICS-II					
Course Code: MATH1201					
Contact Hours	**L**	**T**	**P**	**Total**	**Credit Points**
per week	**3**	**1**	**0**	**4**	**4**

Course Outcomes

After successfully completing this course the students will be able to:

MATH1201. 1. Demonstrate the knowledge of probabilistic approaches to solve wide range of engineering problem.

MATH1201. 2. Recognize probability distribution for discrete and continuous variables to quantify physical and engineering phenomenon.

MATH1201. 3. Develop numerical techniques to obtain approximate solutions to mathematical problems where analytical solutions are not possible to evaluate.

MATH1201. 4. Analyze certain physical problems that can be transformed in terms of graphs and trees and solving problems involving searching, sorting and such other algorithms.

MATH1201. 5. Apply techniques of Laplace Transform and its inverse in various advanced engineering problems.

MATH1201. 6. Interpret differential equations and reduce them to mere algebraic equations using Laplace Transform to solve easily.

Module-I Fundamentals of Probability (10L)

- Random experiment, Sample space and events
- Classical and Axiomatic definition of probability
- Addition and Multiplication law of probability
- Conditional probability
- Bayes' Theorem
- Random variables
- General discussion on discrete and continuous distributions
- Expectation and Variance
- Examples of special distribution: Binomial and Normal Distribution

Module-II Numerical Methods (10L)

- Solution of non-linear algebraic and transcendental equations: Bisection Method, Newton-Raphson Method, Regula-Falsi Method.
- Solution of linear system of equations: Gauss elimination method, Gauss-Seidel Method, LU Factorization Method, Matrix Inversion Method.

- Solution of Ordinary differential equations: Euler's and Modified Euler's Method , Runge-Kutta Method of 4^{th} order.

Module-III Basic Graph Theory (10L)

- Graphs: Digraphs, Weighted graph, Connected and disconnected graphs, Complement of a graph, Regular graph, Complete graph, Subgraph
- Walks, Paths, Circuits, Euler Graph, Cut sets and cut vertices
- Matrix representation of a graph, Adjacency and incidence matrices of a graph
- Graph isomorphism
- Bipartite graph
- Definition and properties of a tree
- Binary tree, Spanning tree of a graph, Minimal spanning tree, properties of trees
- Algorithms: Dijkstra's Algorithm for shortest path problem, Determination of minimal spanning tree using DFS, BFS, Kruskal's and Prim's algorithms

Module-IV Laplace Transformation (10L)

- Basic ideas of improper integrals, working knowledge of Beta and Gamma functions (convergence to be assumed) and their interrelations.
- Introduction to integral transformation
- Functions of exponential order, Definition and existence of Laplace Transform(LT) (statement of initial and final value theorem only)
- LT of elementary functions, Properties of Laplace Transformations , Evaluation of sine , cosine and exponential integrals using LT
- LT of periodic and step functions
- Definition and properties of inverse LT
- Convolution Theorem (statement only) and its application to the evaluation of inverse LT
- Solution of linear ODEs with constant coefficients (initial value problem) using LT

Suggested Books:

1. Advanced Engineering Mathematics , *E.Kreyszig*, Wiley Publications
2. Introduction to Probability and Statistics for Engineers and Scientists, *S.Ross*, Elsevier
3. Introductory methods of Numerical Analysis, *S.S. Sastry*, PHI learning
4. Introduction to Graph Theory, *D. B. West*, Prentice-Hall of India
5. Engineering Mathematics, *B.S. Grewal*, S. Chand & Co.

Course Name: BASIC ELECTRICAL ENGINEERING					
Course Code: ELEC1001					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**1**	**0**	**4**	**4**

Course Outcomes

CO1	Analyze DC circuits using KCL, KVL and network theorems like Superposition Theorem, Thevenin's Theorem, Norton's Theorem and Maximum Power Transfer Theorem.
CO2	Analyze DC Machines; Starters and Speed control of DC motors.
CO3	Analyze magnetic circuits and apply Gauss' law for electric field and potential calculation.
CO4	Analyze single and three phase AC circuits.
CO5	Analyze the operation of single phase transformers.
CO6	Analyze the operation of three phase induction motors.

Module-I:

DC Network Theorem: Kirchhoff's laws, Nodal analysis, Mesh analysis, Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Star-Delta conversion. [6L]

Electromagnetism: Review of magnetic flux, Force on current carrying conductors, Magnetic circuit analysis, Self and Mutual inductance, B-H loop, Hysteresis and Eddy current loss, Lifting power of magnet. [5L]

Module-II

AC single phase system: Generation of alternating emf, Average value, RMS value, Form factor, Peak factor, representation of an alternating quantity by a phasor, phasor diagram, AC series, parallel and series-parallel circuits, Active power, Reactive power, Apparent power, power factor, Resonance in RLC series and parallel circuit. [10L]

Module-III

Three phase system: Generation of three-phase AC power, Balanced three phase system, delta and star connection, relationship between line and phase quantities, phasor diagrams, power measurement by two wattmeter method. [4L]

DC Machines: Construction, EMF equation, Principle of operation of DC generator, Open circuit characteristics, External characteristics, Principle of operation of DC motor, speed-torque characteristics of shunt and series machine, starting of DC motor, speed control of DC motor. [7L]

Module-IV

Transformer: Construction, EMF equation, no load and on load operation and their phasor diagrams, Equivalent circuit, Regulation, losses of a transformer, Open and Short circuit tests, Efficiency, Introduction to three phase transformer. [6L]

Three-phase induction motor: Concept of rotating magnetic field, Principle of operation, Construction, Equivalent circuit and phasor diagram, torque-speed/slip characteristics. [4L]

Text Books:

1. Basic Electrical engineering, D.P Kothari & I.J Nagrath, TMH, Second Edition
2. Basic Electrical Engineering, V.N Mittle & Arvind Mittal, TMH, Second Edition
3. Basic Electrical Engineering, Hughes
4. Electrical Technology, Vol-I,Vol-II,Surinder Pal Bali, Pearson Publication
5. A Text Book of Electrical Technology, Vol. I & II, B.L. Theraja, A.K. Theraja, S.Chand & Company

Reference Books:

1. Electrical Engineering Fundamentals, Vincent Del Toro, Prentice-Hall
2. Advance Electrical Technology, H.Cotton, Reem Publication
3. Basic Electrical Engineering, R.A. Natarajan, P.R. Babu, Sictech Publishers
4. Basic Electrical Engineering, N.K. Mondal, Dhanpat Rai
5. Basic Electrical Engineering, Nath & Chakraborti
6. Fundamental of Electrical Engineering, Rajendra Prasad, PHI, Edition 2005.

Course Name: BUSINESS ENGLISH					
Course Code: HMTS1202					
Contact Hours per week	L	T	P	Total	Credit Points
	2	0	0	2	2

Course Outcome

The learner will

1. Acquire competence in using English language to communicate.

2. Be aware of the four essential skills of language usage-listening, speaking, reading and writing.

3. Be adept at using various modes of written communication at work.

4. Attain the skills to face formal interview sessions.

5. Write reports according to various specifications.

6. Acquire the skill to express with brevity andclarity

Module- I (6hrs.)

Grammar (Identifying Common Errors in Writing)

- Subject-verb agreement
- Noun-pronoun agreement
- Misplaced Modifiers
- Articles
- Prepositions
- Redundancies

Module- II (6hrs.)

Basic Writing Strategies

Sentence Structures

- Use of phrases and clauses in sentences
- Creating coherence
- Organizing principles–accuracy, clarity, brevity
- Techniques for writing precisely
- Different styles of writing: descriptive,narrative, expository
- Importance of proper punctuation

Module- III (8hrs)

Business Communication- Scope & Importance
Writing Formal Business Letters: Form and Structure-Parts ofa Business letter, Business Letter Formats, Style and Tone, Writing strategies.

Organizational Communication: Agenda & minutes of a meeting, Notice, Memo, Circular
Organizing e-mail messages, E-mail etiquette
Job Application Letter: Responding to Advertisements and Forced Applications, Qualities of well-written Application Letters: The You-Attitude, Length, Knowledge of Job Requirement, Reader-Benefit Information, Organization, Style, Mechanics – Letter Plan: Opening Section, Middle Section, Closing Section

Resume and CV: Difference, Content of the Resume – Formulating Career Plans: Self Analysis, Career Analysis, Job Analysis, Matching Personal Needs with Job Profile – Planning your Resume – Structuring the Resume: Chronological Resume, The Functional Resume, Combination of Chronological and Functional Resume, Content of the Resume: Heading, Career Goal or Objectives, Education, Work Experience, Summary of Job Skills/Key Qualifications, Activities, Honors and Achievements, Personal Profile, Special Interests, References

Module- IV (6hrs)

Writing skills

- Comprehension: Identifying the central idea, inferring the lexical and contextual meaning, comprehension passage - practice
- Paragraph Writing: Structure of a paragraph, Construction of a paragraph, Features of a paragraph, Writing techniques/developing a paragraph.
- Précis: The Art of Condensation-some working principles and strategies. Practice sessions of writing précis of given passages.
- Essay Writing:Characteristic features of an Essay, Stages in Essay writing, Components comprising an Essay, Types of Essays-Argumentative Essay, Analytical Essay, Descriptive Essays, Expository Essays, Reflective Essays

References:

1. Theories of Communication: A Short Introduction, Armand Matterlart and Michele Matterlart, Sage Publications Ltd.
2. Professional Writing Skills, Chan, Janis Fisher and Diane Lutovich. San Anselmo, CA: Advanced Communication Designs.
3. Hauppauge, Geffner, Andrew P. Business English, New York: Barron's Educational Series.
4. Kalia, S. &Agarwal,S. Business Communication,Wiley India Pvt. Ltd., New Delhi, 2015
5. Mukherjee, H.S., Business Communication- Connecting at work., , Oxford University Press.2nd Edition.2015
6. Raman, M. and Sharma, S., Technical Communication: Principles and Practice, 2nd Ed., 2011.

Course Name: CHEMISTRY-I LAB					
Course Code: CHEM1051					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**3**	**3**	**1.5**

The subject code CHEM1051 corresponds to chemistry laboratory classes for the first year B. Tech students. This course enhances the students' experience regarding handling of various chemicals along with various laboratory equipments. Hands on experiments increase the depth of knowledge that is taught in the theory classes as well as it increases research aptitude in students because they can see the direct application of theoretical knowledge in practical field. The course outcomes of the subject are:

1. Knowledge to estimate the hardness of water which is required to determine the usability of water used in industries.
2. Estimation of ions like Fe^{2+}, Cu^{2+} and Cl^{-} present in water sample to know the composition of industrial water.
3. Study of reaction dynamics to control the speed and yield of various manufactured goods produced in polymer, metallurgical and pharmaceutical industries.
4. Handling physico-chemical instruments like viscometer, stalagmometer, pH-meter, potentiometer and conductometer.
5. Understanding the miscibility of solutes in various solvents required in paint, emulsion, biochemical and material industries.
6. Knowledge of sampling water can be employed for water treatment to prepare pollution free water.

List of experiments:

1. Estimation of iron using KMnO4 self indicator.
2. Iodometric estimation of Cu2+.
3. Determination of Viscosity.
4. Determination of surface tension.
5. Adsorption of acetic acid by charcoal.
6. Potentiometric determination of redox potentials.
7. Determination of total hardness and amount of calcium and magnesium separately in a given water sample.
8. Determination of the rate constant for acid catalyzed hydrolysis of ethyl acetate.
9. Heterogeneous equilibrium (determination of partition coefficient of acetic acid in n-butanol and water mixture).
10. Conductometric titration for the determination of strength of a given HCl solution against a standard NaOH solution.
11. pH-metric titration for determination of strength of a given HCl solution against a standard

NaOH solution.
12. Determination of chloride ion in a given water sample by Argentometric method (using chromate indicator solution)

Reference Books:

1. Vogel's Textbook of Quantitative Chemical Analysis-G. H. Jeffery, J. Bassett, J. Mendham, R. C. Denney.
2. Advanced Practical Chemistry- S. C. Das
3. Practicals in Physical Chemistry- P. S. Sindhu

Course Name: BASIC ELECTRICAL ENGINEERING LABORATORY					
Course Code: ELEC1051					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**2**	**2**	**1**

Course Outcomes: The students are expected to

1. Get an exposure to common electrical apparatus and their ratings.
2. Make electrical connections by wires of appropriate ratings.
3. Understand the application of common electrical measuring instruments.
4. Understand the basic characteristics of different electrical machines.

List of Experiments:

1. Characteristics of Fluorescent lamps
2. Characteristics of Tungsten and Carbon filament lamps
3. Verification of Thevenin's & Norton's theorem
4. Verification of Superposition theorem
5. Verification of Maximum Power Transfer theorem
6. Calibration of ammeter and voltmeter.
7. Open circuit and Short circuit test of a single phase Transformer.
8. Study of R-L-C Series / Parallel circuit
9. Starting and reversing of speed of a D.C. shunt Motor
10. Speed control of DC shunt motor.
11. No load characteristics of D.C shunt Generators
12. Measurement of power in a three phase circuit by two wattmeter method.

Course Name: ENGINEERING GRAPHICS & DESIGN					
Course Code: MECH1052					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	1	**0**	**4**	**5**	**3**

Course Outcomes:

After going through the course, the students will be able

1. To understand the meaning of engineering drawing.
2. To have acquaintance with the various standards (like lines, dimensions, scale etc.) and symbols followed in engineering drawing.
3. To represent a 3-D object into 2-D drawing with the help of orthographic and isometric projections.
4. To read and understand projection drawings.
5. To draw the section view and true shape of a surface when a regular object is cut by a section plane.
6. To use engineering drawing software (CAD).

Lecture Plan (13 L)

1. Importance and principles of engineering drawing	(1 L)
2. Concepts of Conic sections and Scale	(1 L)
3. Introduction to concept of projection (Projections of points, lines and surfaces)	(4 L)
4. Definitions of different solids and their projections	(1 L)
5. Section of solids and sectional view	(1 L)
6. Isometric projection	(2 L)
7. Introduction to CAD	(2 L)
8. Viva Voce	(1 L)

Detailed contents of Lab hours (52 hrs)

Module 1: Introduction to Engineering Drawing covering,
Principles of Engineering Graphics and their significance, usage of Drawing instruments, lines, lettering & dimensioning, Conic section like Ellipse (General method only); Involute; Scales – Plain, Diagonal.

(4 hrs + 4 hrs)

Module 2: Orthographic Projections covering,
Principles of Orthographic Projections - Conventions - Projections of Points and lines inclined to both planes; Projections on Auxiliary Planes. Projection of lamina.

(4 hrs + 2 hrs)

Module 3: Projections of Regular Solids covering,
those inclined to both the Planes- Auxiliary Views.

(2 hrs + 4 hrs)

Module 4: Sections and Sectional Views of Right Angular Solids covering,
Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids.

(4 hrs + 2 hrs)

Module 5: Isometric Projections covering
Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions.

(2 hrs + 4 hrs)

Module 6: Overview of Computer Graphics covering
listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids.

(4 hrs)

Module 7: Customisation & CAD Drawing
consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

(4 hrs + 2 hrs)

Module 8: Annotations, layering & other functions covering
applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation.

(2 hrs + 4 hrs)

Module 9: Demonstration of a simple team design project that illustrates
Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame.

(4 hrs)

References:

1. Bhatt, N.D., Panchal V.M. & Ingle P.R., (2014) “Elementary Engineering Drawing”, Charotan Publishing House.
2. Narayana, K.L. and Kannaaiah P. “Engineering Graphics”, TMH.
3. Lakshminarayanan, V. and Vaish Wanar, R.S “Engineering Graphics”, Jain Brothers.
4. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education.
5. Agarwal B. & Agarwal C. M. (2012), Engineering graphics, TMH Publications.

Course Name: LANGUAGE LAB					
Course Code: HMTS1251					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**2**	**2**	**1**

Course Outcomes

The learner will

i) Acquire the techniques to become an effective listener.
ii) Acquire the skill to become an effortless speaker.
iii) Organize and present information for specific audience.
iv) Communicate to make a positive impact in professional and personal environment.
v) Engage in research and prepare authentic, formal, official documents.
vi) Acquire reading skills for specific purpose.

Module- I (4hrs)

Listening Skills

- Principles of Listening: Characteristics, Stages.
- Types of Listening: Passive listening, Marginal or superficiallistening, Projective Listening, Sensitive or Empathetic Listening, Active or Attentive listening.
- Guidelines for Effective Listening
- Barriers to Effective Listening
- Listening Comprehension

Module- II (8hrs)

- Interviewing
  Types of Interviews, Format for Job Interviews: One-to-one and Panel Interviews, Telephonic Interviews,Interview through video conferencing.
- Interview Preparation Techniques, Frequently Asked Questions, Answering Strategies, Dress Code, Etiquette, Questions for the Interviewer, Simulated Interviews.

Module- III (6hrs)

- Public Speaking:TheSpeech Process: The Message, The Audience, The Speech Style, Encoding, Feedback.
- Characteristics of a good speech : content and delivery, structure of a speech

- Modes of delivery in public speaking: Impromptu, Extemporaneous, Prepared or Memorized, Manuscript.
- Conversation: Types of conversation: formal and informal, Strategies for effective conversation, Improving fluency.
- Situational conversation practice: Greetings and making introductions, Asking for information and giving instructions, agreeing and disagreeing.
- Conversational skills in the business scenario: One-to-one and Group communication, Gender and Culture Sensitivity, Etiquette, Sample Business Conversation, Telephonic Conversation

Module- IV (8hrs)

Presentation Skills

- Speaking from a Manuscript, Speaking from Memory, Impromptu Delivery, Extemporaneous Delivery, Analyzing the Audience, Nonverbal Dimensions of Presentation
- Organizing the Presentation: The Message Statement, Organizing the Presentation: Organizing the Speech to Inform, The Conclusion, Supporting Your Ideas – Visual Aids: Designing and Presenting Visual Aids, Selecting the Right Medium.
- Project Team/Group Presentations

References:

1. Carter, R. And Nunan, D. (Eds), The Cambridge guide to Teaching English to Speakers of Other Languages, CUP, 2001
2. Edward P. Bailey, Writing and Speaking At Work: A Practical Guide for Business Communication, Prentice Hall, 3rd Ed., 2004
3. Munter, M., Guide to Managerial Communication: Effective Business Writing and Speaking, Prentice Hall, 5th Ed., 1999
4. Sen, S.,Mahendra,A. &Patnaik,P.,Communication and Language Skills, Cambridge University Press, 2015
5. Locker,Kitty O. Business and Administrative Communication McGraw-Hill/ Irwin.
6. Chaney,L.andMartin,J., Intercultural Business Communication. Prentice Hall

HONOURS COURSE

Course Name: COMMUNICATION FOR PROFESSIONALS					
Course Code: HMTS1011					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:
Students will be able to:
1. Write business letters and reports
2. Communicate in an official and formal environment.
3. Effectively use the various channels of communicationatwork place.
4. Use language as a tool to build bridges and develop interpersonal relations in multi-cultural environment.

Module- I (9hrs.)

Introduction to Linguistics

- Phonetics- Vowel and Consonant Sounds (Identification & Articulation)
- Word- stress, stress in connected speech
- Intonation (Falling and Rising Tone)
- Voice Modulation
- Accent Training
- Vocabulary Building
- The concept of Word Formation
- Root words from foreign languages and their use in English
- Acquaintance with prefixes and suffixes from foreign languages in Englishto formderivatives
- Synonyms, Antonyms and standard abbreviations

Module- II (10hrs.)

Communication Skills

- Definition, nature & attributes of Communication
- Process of Communication
- Models or Theories of Communication
- Types of Communication
- Levels or Channels of Communication
- Barriers to Communication

Module- III (10hrs.)

Professional Writing Skills

- Letter Writing : Importance, Types , Process, Form and Structure, Style and Tone
- Proposal Writing: Purpose,Types of Proposals, Structure of Formal Proposals.
- Report Writing: Importance and Purpose, Types of Reports, Report Formats, Structure of Formal Reports, Writing Strategies.

Module- IV (10hrs.)

Communication skills at Work

- Communication and its role in the workplace
- Benefits of effective communication in the workplace
- Common obstacles to effective communication
- Approaches and Communication techniques for multiple needs at workplace: persuading, convincing, responding, resolving conflict, delivering bad news, making positive connections,
- Identify common audiences and design techniques for communicating with each audience

References:

1 Kumar,S. &Lata, P. Communication Skills, OUP, New Delhi2011
2 Rizvi,Ashraf,M. Effective Technical Communication, Mc Graw Hill Education(India) Pvt. Ltd..Chennai,2018
3 Raman, M. and Sharma, S., Technical Communication: Principles and Practice, 2nd Ed., 2011

Course Name: PROFESSIONAL COMMUNICATION LAB					
Course Code: HMTS1061					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**2**	**2**	**1**

Course Outcomes:

Students will be skilled in the following areas:

1. Using English to communicate.
2. Learn to articulate opinions and views in a comprehensive manner.
3. Gain knowledge of phonetics and learn correct pronunciation.
4. Prepare and present formal presentations.

Module- I (4hrs)

Techniques for Effective Speaking

Voice Modulation: Developing correct tone

Using correct stress patterns: word stress, primary stress, secondary stress

Rhythm in connected speech

Module- II (6hrs.)

Effective Speaking and Social awareness

The Art of Speaking

- Encoding Meaning Using Nonverbal Symbols
- How to Improve Body Language
- Eye Communication, Facial Expression, Dress and Appearance
- Posture and Movement, Gesture, Paralanguage
- Encoding meaning using Verbal symbols: How words work and how to use words
- Volume, Pace, Pitch and Pause
- Cross-Cultural Communication : Multiple aspects/dimensions of culture
- Challenges of cross-cultural communication
- Improving cross-cultural communication skills at workplace.

Module- III (6hrs)

- Group Discussion: Nature and purpose

- Characteristics of a successful Group Discussion
- Group discussion Strategies: Getting the GD started, contributing systematically, moving the discussion along, promoting optimal participation, Handling conflict, Effecting closure.

Module- IV (10hrs.)

Professional Presentation Skills

Nature and Importance of Presentation skills

Planning the Presentation: Define the purpose, analyze the Audience, Analyze the occasion and choose a suitable title.

Preparing the Presentation: The central idea, main ideas, collecting support material, plan visual aids, design the slides

Organizing the Presentation: Introduction-Getting audience attention, introduce the subject, establish credibility, preview the main ideas, Body-develop the main idea, present information sequentially and logically, Conclusion-summaries, re-emphasize, focus on the purpose, provide closure.

Improving Delivery: Choosing Delivery methods, handling stage fright

Post-Presentation discussion: Handling Questions-opportunities and challenges.

References:

1. Carter, R. And Nunan, D. (Eds), The Cambridge guide to Teaching English to Speakers of Other Languages, CUP, 2001
2. Edward P. Bailey, Writing and Speaking At Work: A Practical Guide for Business Communication, Prentice Hall, 3rd Ed., 2004
3. Munter, M., Guide to Managerial Communication: Effective Business Writing and Speaking, Prentice Hall, 5th Ed., 1999
4. R. Anand, Job Readiness For IT & ITES- A Placement and Career Companion, , McGraw Hill Education.2015
5. Malhotra, A.,Campus Placements, McGraw Hill Education.2015

2nd yr 1st semester detailed syllabus

Course Name : Environmental Sciences					
Course Code: EVSC2016					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	2	0	0	2	0

Course outcome for the subject code EVS2016

The subject code EVS2016 corresponds to basic environmental chemistry for the 2nd year B.Tech students, which is offered as Environmental Sciences and is mandatory for all branches of engineering. The course provides basic knowledge of various environmental pollutions as well as its impact and ways to curb it. The course outcomes of the subject are:

1. Understand the natural environment and its relationships with human activities.
2. Characterize and analyze human impacts on the environment.
3. Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems.
4. Educate engineers who can work in a multi-disciplinary environment to anticipate and address evolving challenges of the 21st century.
5. Understand and implement scientific research strategies, including collection, management, evaluation, and interpretation of environmental data.
6. Design and evaluate strategies, technologies, and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments.

Module 1

Socio Environmental Impact
6L

Basic ideas of environment and its component
Population growth: exponential and logistic; resources; sustainable development.
3L
Concept of green chemistry, green catalyst, green solvents
Environmental disaster and social issue, environmental impact assessment, environmental audit, environmental laws and protection act of India. 3L

Module 2
6L
Air Pollution
Structures of the atmosphere, global temperature models
Green house effect, global warming; acid rain: causes, effects and control.
3L
Lapse rate and atmospheric stability; pollutants and contaminants; smog; depletion of ozone layer; standards and control measures of air pollution.
3L

Module 3
6L

Water Pollution

Hydrosphere; pollutants of water: origin and effects; oxygen demanding waste; thermal pollution; pesticides; salts.

Biochemical effects of heavy metals; eutrophication: source, effect and control.

2L

Water quality parameters: DO, BOD, COD.

Water treatment: surface water and waste water.

4L

Module 4

6L

Land Pollution

Land pollution: sources and control; solid waste: classification, recovery, recycling, treatment and disposal.

3L

Noise Pollution

Noise: definition and classification; noise frequency, noise pressure, noise intensity, loudness of noise, noise threshold limit value; noise pollution effects and control.

3L

Text/Books

1. GourKrishna Das Mahapatra, Basic Environmental Engineering and Elementary Biology, Vikas Publishing House P. Ltd.
2. A. K. De, "Environmental Chemistry", New Age International.
3. A. K. Das, Environmental Chemistry with Green Chemistry, Books and Allied P. Ltd.

References/Books

1. S. C. Santra, Environmental Science, New Central Book Agency P. Ltd.
2. D. De, D. De, Fundamentals of Environment & Ecology, S. Chand & Company Ltd.

Course Name : Human Values and Professional Ethics					
Course Code: HMTS2001					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Course Outcomes:

After completion of this course, the students will :

i) be aware of the value system and the importance of following such values at workplace
ii) learn to apply ethical theories in the decision making process
iii) follow the ethical code of conduct as formulated by institutions and organizations
iv) Implement the principles governing work ethics
v) Develop strategies to implement the principles of sustainable model of development
vi) Implement ecological ethics wherever relevant and also develop eco-friendly technology

Module I (10 L)

Human society and the Value System
Values: Definition, Importance and application.
Formation of Values: The process of Socialization
Self and the integrated personality
Morality, courage, integrity
Types of Values:
Social Values: Justice, Rule of Law, Democracy, Indian Constitution, Secularism
Aesthetic Values: Perception and appreciation of beauty
Organizational Values: Employee: Employer--- rights, relationships, obligations
Psychological Values: Integrated personality and mental health
Spiritual Values &their role in our everyday life
Value Spectrum for a Good Life, meaning of Good Life
Value Crisis in Contemporary Society
Value crisis at----
Individual Level
Societal Level
Cultural Level
Value Crisis management --- Strategies and Case Studies

Module II (10L)

Ethics and Ethical Values
Principles and theories of ethics
Consequential and non-consequential ethics
Egotism,Utilitarianism, Kant's theory and other non-consequential perspectives
Ethics of care, justice and fairness, rights and duties
Ethics-- Standardization
Codification
Acceptance
Application
Types of Ethics--- Ethics of rights and Duties
Ethics of Responsibility
Ethics and Moral judgment
Ethics of care

Ethics of justice and fairness
Work ethics and quality of life at work

Professional Ethics

Ethics in Engineering Profession;
moral issues and dilemmas, moral autonomy(types of inquiry)
Kohlberg's theory, Gilligan'stheory (consensus and controversy)
Code of Professional Ethics Sample Code of ethics like ASME, ASCE. IEEEInstitute of Engineers, Indian Institute of materials management, Institute of Electronics and telecommunication engineers
Violation of Code of Ethics---conflict, causes and consequences
Engineering as social experimentation, engineers as responsible experimenters (computer ethics, weapons development)
Engineers as managers, consulting engineers, engineers as experts, witnesses and advisors, moral leadership
Conflict between business demands and professional ideals
social and ethical responsibilities of technologies.
Whistle Blowing: Facts, contexts, justifications and case studies

Ethics and Industrial Law

Institutionalizing Ethics: Relevance, Application, Digression and Consequences

Module III (10L)

Science, Technology and Engineering

Science, Technology and Engineering as knowledge and profession
----Definition, Nature, Social Function and Practical application of science
Rapid Industrial Growth and its Consequences
Renewable and Non- renewable Resources: Definition and varieties
Energy Crisis
Industry and Industrialization
Man and Machine interaction
Impact of assembly line and automation
Technology assessment and Impact analysis
Industrial hazards and safety
Safety regulations and safety engineering
Safety responsibilities and rights
Safety and risk, risk benefit analysis and reducing risk
Technology Transfer: Definition and Types
The Indian Context

Module IV (6L)

Environment and Eco- friendly Technology

Human Development and Environment
Ecological Ethics/Environment ethics
Depletion of Natural Resources: Environmental degradation
Pollution and Pollution Control
Eco-friendly Technology: Implementation, impact and assessment

Sustainable Development: Definition and Concept
Strategies for sustainable development
Sustainable Development--- The Modern Trends

Appropriate technology movement by Schumacher and later development
Reports of Club of Rome.

Suggested Readings:

1. Tripathi,A.N., Human Values, New Age International, New Delhi,2006.
2. Ritzer, G., Classical Sociological Theory, The McGraw Hill Companies, New York,1996.
3. Doshi,S.L., Postmodern Perspectives on Indian Society, Rawat Publications, New Delhi,2008.
4. Bhatnagar, D.K., Sustainable Development, Cyber Tech Publications, New Delhi, 2008.
5. Kurzwell,R., The age of Spiritual Machines, Penguin Books, New Delhi,1999.
6. Weinberg, S.K., Social Problems in Modern Urban Society, Prentice Hall,Inc.,USA, 1970.
7. Giddens, Anthony 2009. Sociology. London: Polity Press (reprint 13th Edition).

Course Name : Chemistry of Biomolecules					
Course Code: BIOT2101					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Course Outcomes:

After completion of this course, the students will be able to:

1. Calculate the pH of a buffer system, identify different stereoisomer's of carbohydrate and lipids and understood the chemistry of carbohydrate and lipids.
2. Explain the different structural components and physiochemical properties of amino acids, proteins.
3. Analyses and explain the different structural components and physiochemical properties of DNA and RNA.
4. Select and apply suitable spectroscopic techniques for estimation biomolecules.
5. Select and apply suitable techniques for and structure determination of of biomolecules.
6. Able to solve mathematical problems related to estimation and structural features of biomolecules.

Module –I: Introduction and Chemistry of Carbohydrates and lipids [10L]

Introduction: Structure of water molecules, weak inter-molecular interactions in biomacromolecules, concepts of pKa, pH, buffer**.** Chemistry of Carbohydrates: Definition, classification, structure and chemical properties of: monosaccharides, disaccharides and polysaccharides. Chemistry of Lipids: Definition, classification. structure, reactions and characterization of: lipids, phospholipids, glycolipids, cholesterol, steroids and carotenoids. Stereochemistry of carbohydrates and lipids: configuration, conformation, nomenclature of optical isomers of carbohydrates and geometrical isomers lipids.

Module-II: Chemistry of Amino Acids and Proteins [10L]

Chemistry of amino acids: Classification, structure, pH titration curve and important chemical reactions of amino acids. Chemistry of proteins: Peptide bond, four levels of structures (primary, secondary, tertiary and quaternary structure with example of: RNaseA, keratins, collagen, lectins, myoglobin, and haemoglobin) and conformation (Ramachandran plot, domains, motif and folds), of proteins. Identification and separation methods of proteins based on structure and chemical properties. Stability of protein, denaturation and renaturation of proteins.

Mod III: Chemistry of Nucleotides and Nucleic Acids [10L]

Chemistry of nucleoside and nucleotides: Classification, structure, nomenclature of nucleoside, nucleotides. Chemistry of nucleic acids: Four levels structures of nucleic acids (primary, secondary, tertiary and quaternary structure), conformations (A-, B-, Z-,DNA), t-RNA, micro-RNA. Nucleotide sequence composition of DNA and RNA. Supercoiled structure of DNA, stability of nucleic acids, denaturation and renaturation kinetics of DNA. Identification, isolation, separation and analysis of nucleic acids.

Module-IV: Techniques for analysis and structure determination of biomolecules [10L]

Principles and types of spectroscopy, Lambert–Beer law**.** Basic concepts and principles of analytical techniques: spectroscopy- UV and visible, fluorescence, infrared, circular

dichroism, optical rotatory dispersion, surface plasmon resonance, electron spin resonance. Structure determination techniques: Nuclear Magnetic resonance spectroscopy, X-ray diffraction, crystallography; Microscopy: atomic force (AFM), Electron microscopy (SEM, STM, cryoelectron). Radioisotopic techniques.

Textbooks:

1. Lehninger Principles of Biochemistry by Nelson and Cox, McMillan publishers.
2. Van Holde, Principles of Physical Biochemistry, Pearson.
3. Biochemistry,by 4th Edn. (2011) Voet, D. and Voet JG. (Wiley)
4. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology 8thedn. (2018) by Andreas Hofmann, Samuel Clokie.
5. Biochemical Calculations by Irwin H. Segel, John Wiley & Sons.

Course Name : Industrial Stoichiometry					
Course Code: BIOT2102					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Course Outcomes:

After completion of this course, the students will be able to:

1. Solve problems related to units and conversions and fit the given data using the methodologies.
2. Able to make *material balances* on unit operations and processes.
3. Understand stoichiometry of microbial growth and product formation.
4. Solve problems related to energy balance for steady state processes.
5. Determine the heat of reaction for processes with biomass and secondary metabolite production.
6. Design simultaneous material and energy balances in biochemical processes.

Module 1: Basic Chemical Calculations [10L]

Dimension – Systems of units, engineering FPS, Engineering MKS & SI systems –Conversion from one system to the other – composition of mixtures and solutions - mass fraction, mole fraction, mass ratios, molarity, molality, normality, ppm, composition by density. Ideal and actual gas equations, application to pure gas & gas mixtures – partial pressures, partial volumes. Use of log-log and semi-log graph paper, graphical differentiation and graphical, integration, treatment and interpretation of data by least square analysis.

Module II: Material balance [10L]

Introductory Concepts- simplification of the general mass balance equation for steady and unsteady state processes, procedure for material balance calculations, material balance without chemical reactions: application of humidification, distillation column. Material balance with chemical reaction: combustion.

Stoichiometry of growth and product formation- growth stoichiometry and elemental balances. Material Balance with recycle, bypass and purge streams in bioprocess.

Module-III: Energy Balance [10L]

General energy balance equation for steady state processes - without and with chemical reaction. Enthalpy calculation procedures: enthalpy change due to reaction, heat of combustion, heat of reaction for chemical processes.

Energy-balance equation for cell culture -heat of reaction for processes with biomass and secondary metabolites production in fermentation processes.

Module-IV: Combined material and energy balance in bioprocesses [10L]

Simultaneous material and energy balances in biochemical processes: growth associated, non-growth associated and mixed growth associated product production process.

Textbook:

1. Bhatt & Vora, Stoichiometry, 4th Ed., Tata McGraw Hill.

Reference books:

1. Hougen and Watson, Chemical Process Principles (Part one): 2nd ed, John Wiley.
2. Basic Principles and Calculations in Chemical Engineering: Himmelblau, 6th Ed. PHI.
3. Bioprocess Engineering: 2nd edition, Michael L. Shuler, Filkert Kargi. Prentice Hall India.

Course Name : Biochemistry					
Course Code: BIOT2103					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Course Outcomes

After completion of this course, the students will be able to:

1) Explain the basic concepts of enzymes.
2) Understand and apply mathematical knowledge to solve Enzymatic Kinetics particularly related to Michaelis-Menton Equation.
3) Understand and grasp knowledge about main principles behind how various cell signalling works.
4) Explain the basic concepts of how extracellular matrix works.
5) Explain the basis behind lipid synthesis and lipid β oxidation pathways.
6) Understand how Cholesterol synthesis happens.

Module-I: Introduction to Enzyme & Carbohydrate Metabolism [10L]
Enzymes: Basic concept of enzyme-substrate reaction, Classification and nomenclature, active site, allosteric regulation. Metabolism of carbohydrates and their regulation: glycolysis, TCA cycle, pentose phosphate pathway, Glyoxalate cycle, Cori cycle, glucuronate pathway, glycogenolysis, gluconeogenesis glycogenesis. Oxidative phosphorylation: electron transport chain, ATP synthesis, and its regulation. Photosynthesis: Photophosrylation, Calvin cycle. Disorder/ diseases of carbohydrate metabolism.

Module-II: Metabolism of lipids and vitamins [10L]
Oxidation of Fatty acid and its regulation: Beta oxidation, Alpha oxidation and omega oxidation of fatty acids - saturated and unsaturated fatty acids - even and odd numbered. Catabolism of phospholipids. Biosynthesis of fatty acids, phospholipids, cholesterol, steroids and Ketonbodies and their regulation. Disorder/ diseases of lipid metabolism. Vitamins and hormones: classification, Structure and Function; Micronutrients.

Module-III: Metabolism of Amino acid and nucleic acid [10L]
Oxidation of amino acids: Transamination, oxidative deamination. Urea cycle and its regulation. Overview of amino acid degradation. Biosynthesis of amino acids and its regulation; Protein turnover. Disorder/ diseases of amino acids metabolism.
Nucleic acid metabolism: nucleotide metabolism, Overview of purine and pyrimidine biosynthesis and degradation, De Novo and Salvage Pathways. Disorder of purines and pyrimidines metabolism.

Module-IV: Cell Signaling [10L]
Cell signaling and signal transduction pathways: Ligands and their receptors, cell surface receptor, signaling through G-protein coupled receptors, second messengers, regulation of signaling pathways, general principles of cell communication, extracellular matrix.

Textbook:

1. Lehninger's Principles of Biochemistry by Nelson & Cox, W.H. Freeman Pub.

Reference books:

1. Molecular Biology of the Cell by Bruce Alberts, 4th ed, Garland Science Publishers, 2002
2. Lubert Stryer, Bio chemistry, Freeman & Co, NY
3. Voet & Voet, Fundamentals of Biochemistry, John Willey & Sons
4. Harper's Illustrated Biochemistry - R.K.Murray et al. (McGraw Hill)
5. Outline of Biochemistry - Conn & Stump (John Willey & Sons)

Course Name : Microbiology					
Course Code: BIOT2104					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Course Outcomes:

After completing this course, students will be able to:

1. Describe different cell structures with subcellular functional organelles.
2. Describe the working principles of different types of microscopes.
3. Isolate pure culture from different environmental sources.
4. Preserve and maintain pure culture.
5. Understand various microbial identification processes.
6. Apply their knowledge of microbes in different environmental aspects.

Module-I: Introduction to Microbiology [10L]

Development of microbiology: Historical aspect.

Cell structure with subcellular functional organelles. Bacteria, Yeast, Fungi, Algae and Virus: General morphology and subcellular structure, growth and reproduction.

Biochemical & Molecular Taxonomical identification of microorganisms.

Module-II: Basic principles and methods in microbiology [10L]

Microscopy: Optical microscope with special utility (phase contrast, fluorescence and inverted microscope), Electron microscope (TEM & SEM).

Cultivation of microbes – General media for the growth of bacteria, yeast and fungi, Types of growth media (synthetic, complex, enriched, selective- definition with example), pure culture methods (streak plate, spread plate, pour plate, stab culture, slant culture). Anaerobic (thioglycolate, anaerobic chamber, Robertson's media, microaerophilic), liquid shake culture of aerobic bacteria. Control of microbes: Sterilization, tyndallisation, pasteurization; Physical agents: dry heat, moist heat, UV light, ionizing radiation, filtration, HEPA filter; Chemical agents: antibiotics and antiseptics, disinfectants.

Module-III: Microbial Growth and Metabolism [10L]

Growth of bacteria- Definition, growth phases, kinetics of growth, direct and indirect measurement of growth, The mathematical nature and expression of growth. growth principles of nutrition, influence of environmental factors-pH, temperature, oxygen, Heavy metals and Other compounds. Bacterial growth, fermentation and putrification, Aerobic and anaerobic respiration (definition, examples), fermentation (alcoholic, mixed acid, acetic acid, lactic acid), Entner Duodruffs pathway, bacterial photosynthesis (green and purple bacteria), biochemical nitrogen fixation – non-symbiotic, symbiotic (definition and examples), basic concept of nif-genes. Nod genes, nitrogenase complex, leghaemoglobin.

Module-IV: Environmental microbiology [10L]

Air microbiology- Microorganisms in the air, sampling techniques, air borne pathogens. Microbiology of fresh water and wastewater (sewage), water borne diseases (name of pathogen, pathogenicity and preventive measures). Outlines of method for determination of microbial safety of drinking water (presumptive, confirmatory and completed tests). Soil microbiology: soil microbes, different kinds of associations, importance of soil microbes in agriculture.

Textbook:

1. R.C Dubey and D. K Maheshwari -A Text Book of Microbiology, 3rd ed, S. Chand and Company.
2. C.B Powar and H.F Daginawala- General Microbiology (Vol I & II) 3rd ed, Himalaya Publishing House.

Reference books:

1. Stanier R. –General Microbiology, 5thed, Macmilan Press ltd.
2. M. Pelczar, E.Chan, N.Kreig, Microbiology, 5thed, MGH
3. Salle.A.J- Fundamental Principles of Bacteriology, Tata Mcgraw Hill.
4. Hans G. Schlegel, General Microbiology, 7thed, Cambridge Low Price Edition.
5. A.H. Rose, Chemical Microbiology, 3rded, Butterworth World Student Reprints

Course Name : Mathematical & statistical Methods					
Course Code: MATH2101					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

After completing the course, students will be able to:

MATH2101.1 Apply numerical methods to obtain approximate solutions to mathematical problems where analytic solutions are not possible.

MATH2101.2 Implement appropriate numerical methods for solving advanced engineering problems dealing with interpolation and integration.

MATH2101.3 Design stochastic models to predict the outcomes of events.

MATH2101.4 Recognize the significance of the expansion of a function in Fourier Series.

MATH2101.5 Provide deterministic mathematical solutions to physical problems through partial differential equations.

MATH2101.6 Employ statistical methods to make inferences on results obtained from an experiment.

MODULE-I – PARTIAL DIFFERENTIAL EQUATIONS (10L)

- Introduction to partial differential equations
- Formation of partial differential equations
- Lagrange's and Charpit's method of solution.
- Second order partial differential equations with constant coefficients.
- Solution by the method of separation of variables.
- Solution to the wave equation in two dimensions.

MODULE-II – NUMERICAL METHODS FOR INTERPOLATION AND INTEGRATION (10L)

- Basics of interpolation ,
- Newton's Forward and Backward Interpolation Method.
- Lagrange's Interpolation.
- Central difference interpolation: Striling's formula.
- Divided difference and their properties.
- Numerical Interpolation : Trapezoidal and Simpson's 1/3rd rule.

MODULE-III – FOURIER SERIES (10L)

- Definite Integral ,Orthogonality of Trigonometric Functions , Power Series and its convergence.
- Periodic Functions , Even and Odd Functions , Dirichlet's Conditions.
- Euler Formulas for Fourier coefficients.
- Fourier series representation of a function, e.g. Periodic square wave, Half wave rectifier, Unit step function.
- Half Range series: Sine and Cosine ,Parseval's Identity.

MODULE-IV – PROBABILITY DISTRIBUTIONS AND STATISTICS (10L)

- Special Distributions: Hypergeometric, Poisson, Uniform, Exponential, Gamma and Normal.
- Measures of Central Tendency and Dispersion
- Mean, Median, Mode and Standard Deviation for grouped and ungrouped frequency distribution.
- Moments: Skewness and Kurtosis.
- Simple Correlation and Regression, rank correlation coefficient.

Suggested Books:

1. Miller & Freund's Probability and Statistics for Engineers
   R.A.Johnson
   Prentice Hall of India

2. Numerical Methods (Problems and Solution) Jain,
   Iyengar ,& Jain
   New Age International Publisher

3. Fundamentals of Mathematical Statistics
   S.C. Gupta and V.K. Kapoor
   Sultan Chand & Sons

4. Higher Engineering Mathematics
   B. V. Ramana
   Tata McGraw-Hill

5. Advanced Engineering Mathematics
   Kreyszig
   Wiley Publications

6. Numerical Methods (Problems and Solution) Jain,
   Iyengar , & Jain
   New Age International Publishers

Course Name : Biomolecular Chemistry Lab					
Course Code: BIOT2151					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	0	3	3	1.5

Course Outcomes:

After completion of this course, the students will be able to:

7. Determine the presence of carbohydrates, proteins and lipids in a solution.
8. Develop a concept of different types of buffer and pH.
9. Develop the basic principles of spectrophotometric anaylsis.
10. Quantify the concentration of an unknown solution by spectrophotometry.
11. Estimate DNA, RNA and reducing sugars.
12. Determine saponification number and iodine number of lipds.

List of experiments:

1. Qualitative tests For Carbohydrates, Amino acids, Proteins and Lipids.
2. Buffer & pH: Calibration of pH meter, Preparation of buffer (Tris-HCl or Acetate or Phosphate buffer system) and pH titration of amino acids and validation of the Henderson-Hasselbach equation.
3. Spectroscopy: Verification of Lambert-Beer's law and determination of molar extinction coefficient.
4. Estimation of Reducing Sugars (DNSA method)
5. Estimation of DNA /RNA by chemical method (DNA by diphenyl amine and RNA by orcinol)
6. Determination of Saponification number of lipid
7. Determination of Iodine Number of lipid

Reference Books:

1. Principles and techniques of Practical Biochemistry: K. Wilson and J. Walker (1994), CUP, Cambridge University Press.
2. Introductory practical Biochemistry by S.K. Sawhney and Randhir Singh (2000), Narosa Publishing House.
3. An introduction to Practical Biochemistry by David T. Plummer (1988), McGraw- Hill Book Company.

Course Name : Biochemistry Lab					
Course Code: BIOT2153					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	0	3	3	1.5

Course Outcomes:

After completion of this course, the students will be able to:

1. Estimate sugars by enzymatic method.
2. Develop the concept of enzyme kinetics
3. Determine the activity and specific activity of enzymes.
4. Determine the nature of enzyme inhibition.
5. Estimate the unknown concentration of a protein, cholesterol, vitamin C and liver enzymes.
6. Separate lipids and proteins by chromatographic techniques.

List of experiments:

1. Estimation of sugars by enzymatic method (GOD –POD method)
2. Determination of activity & specific activity of enzyme: K_m and V_{max}
3. Determination of optimum temperature & pH optima of an enzyme
4. Inhibition of Alkaline phosphatase by (F^- or arsenate) and determining the nature of inhibition.
5. Determination of SGPT, SGOT by colorimetric end point method in blood.
6. Estimation of proteins
7. Estimation of cholesterol
8. Estimation of Vitamin C in fruit juice using 2, 6-dichlorophenol indophenols
9. Separation of lipids/ amino acids/ carbohydrates by Thin layer Chromatography (TLC)/ Paper Chromatography.

Reference Books:

1. Principles and techniques of Practical Biochemistry: K. Wilson and J. Walker (1994), CUP, Cambridge University Press.
2. Introductory practical Biochemistry by S.K. Sawhney and Randhir Singh (2000), Narosa Publishing House.
3. An introduction to Practical Biochemistry by David T. Plummer (1988), McGraw-Hill, Book Company.

Course Name : Microbiology Lab					
Course Code: BIOT 2154					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	0	4	4	2

Course Outcomes:

After completion of this course, the students will be able to:

- Prepare different microbial media and plating.
- Isolate pure culture by streak, spread and pour plate method.
- Handle different types of microscopes
- Determine bacterial growth kinetics
- Perform the assay of antibiotic by zone inhibition method.
- Study the biochemical activity of micro organism by some standard tests: IMViC test, hydrolysis of starch, casein etc.

List of experiments:

1. General laboratory procedure; microbial safety and precaution; study of methods of sterilization
2. Preparation of microbial media and plating.
3. Isolation of pure culture by streak, spread and pour plate method.
4. Microscope and microscopy and identification of bacterial sample by differential staining.
5. Determination of microbial load in air, soil and water.
6. Determination of bacterial growth kinetics.
7. Assay of antibiotic by zone inhibition method.
8. Study of biochemical activity of micro organism by some standard tests: IMViC test, hydrolysis of starch, casein etc.
9. Isolation and morphological characterization of fungi.
10. Endospore staining.

2nd yr 2nd semester detailed syllabus

Course Name : Thermodynamics and Kinetics					
Course Code: BIOT2201					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Course Outcomes:

After completion of this course, the students will be able to:

1. Comprehend the thermodynamic properties and functions of different systems and processes.
2. Apply the thermodynamic laws in practical problems.
3. Relate the thermodynamic properties and functions to biological systems.
4. Explain effect of temperature on rate of reaction.
5. Determine the order of a reaction using different suitable analytical methods.
6. Understand the kinetic mechanism of enzyme-substrate reactions with/without the presence of inhibitor and solve related problems.

Module I: Concepts and Laws of Thermodynamics[10L]
Review of basic concepts – systems, surroundings, processes, properties (extensive/intensive), components (single/multi). Zeroth, first, second laws and their consequences. Refrigeration process. Thermodynamic functions and free energy concept, chemical potential, Maxwell's relations. Review of ideal gas, non-ideal gas, PVT behaviour, virial and cubic equations of state, generalized correlations, residual properties.

Module II: Thermodynamics and Bioenergetics[10L]
Partial molar properties, fugacity, ideal and non-ideal solutions, activity coefficient, Gibbs-Duhem equation. Phase rule, criteria for phase equilibrium, VLE for pure component, Transport across membrane-bioenergetics.

Module-III: Kinetics [10L]
Rate of chemical reaction; Effect of Temperature on Rate Constant, Arrehnius equation, Collision Theory, Transition State Theory, Order and Molecularity of a Chemical reaction, Elementary Reactions, First, Second and Third order reactions, Non Elementary Reactions, Pseudo-first order reaction, Determination of rate constant and order of reaction, Half life method, Fractional order reactions.

Module-IV: Applications of Kinetics [10L]
Interpretation of batch reactor data for simple and complex reactions. Kinetics of Enzyme catalyzed reactions for free and immobilized enzymes–derivation of Michaelis-Menten equation, Briggs-Haldane relationship, the determination and significance of kinetic constants,

Lineweaver-Burk, Hanes–Woolf plot and Eadie-Hofstee plot, Principles of enzyme inhibition: competitive, noncompetitive and uncompetitive.

Textbook:

1. Smith & Vanness, Thermodynamics for Chemical Engineers, McGraw Hill & Co.
2. Levenspiel. O. Chemical Reaction Engineering, Wiley Eastern Ltd.

Reference books:

1. Richardson, J.F., Peacock, D.G. Coulson & Richardson's Chemical Engineering, Volume 3rd ed., First Indian ed. Asian Books Pvt. Ltd. 1998.
2. Bailey & Olis, Biochemical Eng. Fundamentals, McGraw Hill & Co., 1990.
3. Gordon G. Hammes, Thermodynamics and Kinetics for the Biological Sciences; John Wiley & Sons, Inc., Publication; 2000.
4. Michael L. Shuler, Filkert Kargi, Bioprocess engineering: 2nd edition, Prentice Hall India.

Course Name : Transfer Operation-I					
Course Code: BIOT2202					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Course Outcomes:

After completion of this course, the students will be able to:

1. Understand thy physical properties of fluid, flow behavior and their consequence on fluid flow.
2. Apply the basic laws and equations to analyze fluid dynamics and solve numerical problems related to them.
3. Understand the importance of fluid flow measurement by various devices in industries.
4. Analyze and calculate various parameters involved in heat transfer by conduction, convection and thermal radiation.
5. Develop and design various equipment's associated with heat transfer and evaluate heat exchanger performance.
6. Develop the knowledge of principles of communition, mechanical separation aspects, working of equipments used in mechanical operation and calculate various parameters for energy requirement related to size reduction of solid.

Module I: Basic concepts of Fluid Mechanics [10L]

Fluid – rheological properties – compressible, incompressible fluids. Newtonian and non Newtonian fluids. Basic equations of fluid flow, fluid flow phenomena – through pipes and other devices – pressure drop calculations. Fluid friction- friction in flow through packed beds. Fundamentals of fluidization and inverse fluidization, gravity settling, terminal settling velocity. Basic concept of multiphase flow-flow regime, pressure drop measurement.

Module II: Flow measurements and machineries [10L]

Flow measuring devices- orifice and venturi meters, pitot tube, weirs, rotameters and other types of meters. Pipe fittings and valves. Pumps – classification, centrifugal and positive displacement type, peristaltic pump. Principle of compressor and blower.

Module III: Heat transfer [10L]

Classification of heat flow processes- conduction, convection, radiation. Conduction- Steady state and unsteady state heat conduction. Heat flow in fluids by convection (natural and forced). Heat exchanger- double pipe and shell and tube heat exchanger. Basic concept of radiation.

Module IV: Mechanical Operations [10L]

Principles of comminution, types of comminuting equipment, energy and power requirement. Crushing, grinding, mixing and agitation, power consumption in mixing. Mechanical separation-screening, filtration (constant pressure and constant rate), centrifugation.

Textbooks:

1. Unit Operations of Chemical Engineering: McCabe, Smith & Harriot, TMH, 5th edition.

Reference books:

1. Geankopolis, Transport Processes & Unit operations: 3rd edition, PHI.
2. Coulson & Richardson, Chemical Engineering, Vol-I & II:, Butterworth Heinemann.
3. D.Q. Kern, Heat Transfer, MGH.
4. Badger, W.L., Banchero, J.T., Introduction to Chemical Engineering, MGH.
5. Foust, A.S., Wenzel, L.A, et.al. Principles of Unit Operations, 2nd edition, JWS.

Course Name : Molecular Biology					
Course Code: BIOT2203					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Course Outcomes:

After completion of this course, the students will be able to:

1. Identify and analyze the different components and mechanism of replication.
2. Describe different types of DNA damage and repair systems and recombination process.
3. Comment on various components and detailed process of transcription.
4. Comment on various components and mechanism of translation.
5. Understood the rational of genetic code.
6. Comprehend on models of gene regulation and apply the knowledge of gene regulation as genetic switch.

Module-I: Replication, repair and Recombination in Prokaryotes & Eukaryotes [10L]

The biochemical basis of inheritance, DNA as the genetic material, central dogma of molecular biology. organization of genome. DNA Replication: mechanism, models; initiation, elongation & termination; enzymes and accessory proteins. Inhibitors of DNA replication; extrachromosomal replicons, replication in DNA and RNA virus. DNA damage and mechanisms of different types of DNA repairs, SOS repair. Repair defects and human diseases. Recombination: mechanism of general and site specific recombination.

Module-II: Transcription in Prokaryotes & Eukaryotes [10L]

Structure of and function of different types of RNA, promoter, RNA polymerases: structure and assembly; RNA polymerase I, II, III, transcription factors, terminators. Process of transcription: initiation, elongation & termination of transcription. Post transcriptional modifications: Processing of hnRNA, 5'-Cap formation; 3'-end processing and polyadenylation; Splicing (different types); RNA editing; RNA transport. Inhibitors of transcription; reverse transcription.

Module-III: Genetic Code & Translation in Prokaryotes & Eukaryotes [10 L]

Concept of genetic code: universal genetic code; degeneracy of codons; termination codons; isoaccepting-tRNA; wobble hypothesis. Components translation: structure and function of ORF, tRNA, rRNA, ribosomes, RBS, aminoacylsynthetases. Process of Translation: initiation, elongation, termination, proof-reading, translational inhibitors. Post translational modifications of protein, protein folding, protein trafficking, protein transport and degradation.

Module-IV: Regulation of Gene Expressions in Prokaryotes & Eukaryotes [10 L]

Organization of genes and its nomenclature. Principle of gene regulation: negative and positive regulation. Regulatory elements: Promoter, operator, inducer, repressor, activators, silencers, insulators, enhancers. Gene regulation in prokaryote: concept of operon model (*lac*,

gal, *trp* and *ara* operon), attenuation; antitermination in lambda virus. Gene regulation in Eukaryotes: DNA looping model, hormonal control of gene expression (steroid and non steroid), role of chromatin remodelling, gene silencing and epigenetic regulation. Regulations at level of translation, riboswitch, ribozyme. Structure and function of gene regulatory proteins.

Text books:

1. Molecular Biology of the Gene, 7th Editio (2017), - by J.D. Watson, Baker TA, Bell SP, Gann Alexander, Levine M, Losick R., Pub: Pearson Education.
2. Lewin's GENES XII (2017) by J. E. Krebs (Author), E. S. Goldstein (Author), S. T. Kilpatrick, Pub: Jones and Bartlett.
3. Freifelder's Essentials of molecular Biology, (2015) by Malacinski and Pub: Jones and Bartlett.

Reference books:

1. Molecular Biology of the Cell, 6th edn. (2014)by Bruce Alberts (Author), A D. Johnson, J Lewis, D Morgan, M Raff , K. Roberts, Pub: W. W. Norton & Company.
2. Molecular Cell Biology 8th edn. (2016) by H. Lodish, A. Berk , C.A.Kaiser, , A. Amon , H. Ploegh, A. Bretscher , M. Krieger, K C. Martin, pub: WH Freeman.
3. Cell and molecular Biology, Concepts and experiments by Gerald Karp, John Wiley & Sons.
4. Molecular and Cellular Biology- by Stefen Wolfe, Wordsworth Publishing Co.
5. Genomes, by T. A. Brown, John Wiley and Sons PTE Ltd.
6. The Cell - A molecular approach, by G. M. Cooper, ASM Press.
7. Cell and Molecular Biology 8th ed, Robertis, EDP De & Robertis, EMF De(2002) Lippincott, Williams & Wilkins International student edition.

Course Name : Industrial Microbiology and Enzyme Technology					
Course Code: BIOT2204					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Course Outcomes:

After completing this course, students will be able to:

1. Describe different methods for immobilization of enzymes.
2. apply enzymes in various industries that can benefit human life
3. Produce different useful secondary metabolites by microbes.
4. Modify the enzymes for better stability.
5. Design different biosensors for applications in biotechnology.
6. Develop the fermentation techniques and downstream processes.

Module-I: Fermentation process and strain improvement [10L]

Definition and scope, Basic idea on fermentation process, submerged and solid– with their merits and demerits, Microbial Culture systems; Media for Industrial fermentations; Media optimization; Sterilization of Industrial Media, Cellular control regulating production of microbial metabolites – Primary and Secondary metabolite – Induced mutation technique – Analogue resistant mutant – Catabolic derepressed mutants – Genetically engineered strain – Protoplast fusion technique.

Module-II: Production by fermentation [10L]

Microbial production: Production of organic acids and solvents, microbial polysaccharides, amino acids, enzymes, vitamins, growth factors and hormones, antibiotics and vaccines, alcoholic beverages and other microbial food products. Downstream processing and fermentation economics.

Module III: Enzyme Technology [10L]

Enzyme : brief overview, general characteristics ,Units of enzyme activity, physical and chemical factors affecting enzyme activity, outlines of extraction and purification of commercial enzymes from plant, animal and microbial sources, formulation and stabilization of commercial enzymes. Stable enzymes : selection of extremophilic producer, chemical modification of enzymes for better stability. Enzyme immobilization – Physical and chemical methods for enzyme immobilization. Adsorption, matrix entrapment, covalent binding, cross linking – advantages and disadvantages of different immobilization techniques. Immobilized enzyme kinetics.

Module IV: Industrial applications of enzymes [10L]

Commercial enzymes: Industrial applications of food processing enzymes; Analytical, diagnostic and medicinal applications of enzymes.

Enzyme electrode and application as biosensor in biotechnology and environmental monitoring. Different bioreactors for processes using immobilized enzymes.

Text books:

1. L.E. Cassida.Jr, Industrial Microbiology, New Age International Publisher.
2. W. Crueger, Annelise Crueger, Biotechnology: A Textbook of Industrial Microbiology, Sinauer Assoc. Inc.
3. Fundamentals of Enzymology by Nicolas C. price and Lewis Stevens. Oxford University Press.
4. Enzymes by Trevor palmer, East west Press 3. Enzyme Technology by Messing.

Reference books:

1. Prescott's and Dunn's, A. Industrial Microbiology, 4th edition. CBS Publishers, New Delhi, India, 1987.
2. Atkinson.B and Marituna.F, Biochemical Engineering and Biotechnology Handbok, The Nature Press, Macmillan Publ. Ltd.
3. Enzymes : Dixon and Webb.(IRL Press) Enzyme technology by Chaplin and Bucke. Cambridge University Press.
4. Biochemical engineering fundamentals, second edition. James E Bailey, David F., Ollis, McGraw Hill Intl. Edition.

Course Name : Data Structure					
Course Code: CSEN2005					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Course Outcomes:

Upon successful completion of this course students should be able to:

1. Identify and select appropriate data structures as applied to specified problem definition.
2. Implement operations like searching, insertion, deletion, traversal etc. on linear data structures like array, stack and queue.
3. Implement operations like searching, insertion, deletion, traversal etc. on nonlinear data structures like tree and graph.
4. Apply appropriate sorting/searching technique for given problem.
5. Analyze and compare the different sorting algorithms.
6. Design advanced data structure using Nonlinear data structures.

Module -I. Linear Data Structure I [8L]

Introduction (2L):

Concepts of data structures (Data, data structure, Abstract Data Type), Need of data structure, Basic idea of pseudo-code, algorithm analysis and order notations.

Array (2L):

Different representations – row major, column major. Sparse matrix - its implementation and usage. Array representation of polynomials.

Linked List (4L):

Singly linked list, Circular linked list, Doubly linked list (Creation, insertion at different positions, deletion from different positions of the list), Linked list representation of polynomial and applications.

Module -II: Linear Data Structure II [6L]

Stack and Queue (4L):

Stack and its implementations (using array and linked list), applications.

Queue, circular queue, deque. Implementation of queue- both linear and circular (using array and linked list).

Recursion (2L):

Principles of recursion – Design of recursive algorithms, differences between recursion and iteration, merits and demerits of recursion, Tail recursion.

Module -III. Nonlinear Data structures [12L]

Trees (9L):
Basic terminologies, tree representation (using array and linked list).
Binary trees - binary tree traversal (pre-order, in- order, post- order), threaded binary tree.
Binary search tree and its operations (creation, insertion, deletion, searching).
Height balanced binary tree – AVL tree and its operations (insertion, deletion with examples only).
B- Trees and its operations (insertion, deletion with examples only).
Graphs (3L):
Basic terminologies, Graph representations/storage implementations (using adjacency matrix and adjacency list)
Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS).

Module - IV Searching, Sorting, Hashing [10L]

Sorting Algorithms (6L):
Bubble sort, Insertion sort, Selection sort, Merge sort, Quick sort, Heap sort and their comparisons.
Searching (1L):
Linear search, binary search and their comparisons.

Hashing (3L):
Basic terminologies, Different hashing functions, Collision resolution techniques (Open addressing and Chaining).

Recommended books:

1. "Data Structures and Program Design In C", 2/E by Robert L. Kruse, Bruce P. Leung.
2. "Fundamentals of Data Structures of C" by Ellis Horowitz, Sartaj Sahni, Susan Andersonfreed.
3. "Classic Data Structures" by D.Samanta.
4. "Data Structures in C" by Aaron M. Tanenbaum.
5. "Data Structures" by S. Lipschutz.

Course Name : Transfer Operations-I Lab					
Course Code: BIOT2252					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	0	3	3	1.5

Course Outcomes:

After completion of this course, the students will be able to:

1. Design and conduct experiments on flow measurement by venturimeter.
2. Compare the energy loss that occurring in flow measuring devices like venturimeter and orificemeter.
3. Calibrate flow measuring device like rotameter.
4. Conduct experiment, analyze and interpret the data of packed bed reactor operation.
5. Evaluate the performance and calculate the heat transfer coefficient of a double pipe heat exchanger.
6. Understand the operation of comminution equipments like ball mill, jaw crusher and find the energy consumption in operation of those equipments.

List of experiments:

1. Experiments on Reynold's Apparatus-Determination of flow regime and plot of friction factor against NRe.
2. Experiments on flow measuring device—in closed conduit using Venturi meter.
3. Experiments on flow measuring device—in closed conduit using Orifice meter.
4. Experiments on flow measuring device—in closed conduit using Rotameter.
5. Determination of Pressure drop for flow through packed bed & verification of Ergun Equation, Kozeny-Karman equation, Blake-Plummer Equation.
6. Determination of pressure drop in flow through fluidized bed.
7. Study of working characteristics of a Jaw Crusher, calculation of the energy consumption as a function of size reduction and compare it with the actual energy requirements.
8. Study of working characteristics of a Ball Mill, calculate the energy consumption as a function of size reduction and determine the critical speed.
9. Determination of the Overall heat transfer coefficient of a double pipe heat exchanger.
10. Determination of thermal conductivity of metal rod or powder.

Course Name : Molecular Biology Lab					
Course Code: BIOT2253					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	0	2	2	1

Course Outcomes:

After completion of this course, the students will be able to:

1. Separate and visualize mixtures of DNA or mixtures of RNA or mixtures of protein.
2. Explain the mechanism of visualization of DNA, RNA and protein.
3. Determine the molecular size of unknown protein and DNA.
4. Estimate the amount of DNA, RNA and protein from a unknown solution by spectrophotometer.
5. Understood the basics of electrophoresis.
6. Able to design experiment to study gene regulation

List of experiments:

1. Agarose Gel Elctrophoresis (AGE).
2. Isolation of Genomic DNA from blood or plant cell or bacterial cell and analysis by AGE.
3. Isolation of Plasmids DNA and analysis by AGE.
4. Determination of molecular size of DNA.
5. Estimation of DNA, RNA and Protein by spectroscopic method.
6. Isolation of RNA and separation by Formaldehyde Agarose gel electrophoresis.
7. Isolation and purification of proteins from bacterial cells and separation by SDS-PAGE.
8. Induced mutation by: (a) Chemical (b) Ultraviolet light.
9. Study of gene regulation by *lac* operon.
10. Phage Titration.

Text Book:

1. Molecular Cloning – A laboratory manual: 4th Edition (2013) Vol. 1-3. by Michael R Green , Sambrook J, CSHL Press, New York

Reference

1. Biochemical calculation 2nd edn (2010) by I. Segel, Pub: Wiley.
2. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology (8th edn. 2018) by A. Hofmann, S. Clokie, Pub: Cambridge University Press.
3. Biochemical Methods (3rd edn. 2018) by S. Sadasivam. Publishers New Age Intern. Pvt. Ltd.

Course Name : Enzyme Technology & Fermentation Technology Lab					
Course Code: BIOT2254					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	0	3	3	1.5

Course Outcomes :

After completion of the course, students will be able to:

1. Draw different types of Bioreactors and different components of Bioreactors.
2. Study acid hydrolysis of sucrose in CSTR at different temperature.
3. Carry out immobilization of enzyme by entrapment method.
4. Study Batch Fermentation and assay of Antibiotics (like Penicillin / Streptomycin).
5. Design the steps of production and recovery of Alcohol.
6. Produce different metabolites by Solid State Fermentation technique/process.

List of experiments :

1. Basic Drawing of different types of Bioreactors [Air Lift Reactor (ALR), Bubble column, Continuous Stirred Tanked Reactor (CSTR)] and different components of Bioreactors.
2. Familiarization of different types of analytical instruments including Air Compressor and Autoclave (to know the operation with real sample).
3. Acid hydrolysis of sucrose in CSTR at different temperature.
4. Enzymatic hydrolysis of starch in ALR.
5. Immobilization of enzyme by entrapment method.
6. Operation of immobilized enzyme reactor using a Packed Bed Reactor.
7. Batch Fermentation and Assay of Antibiotics (like Penicillin / Streptomycin).
8. Production of Alcohol (Fermentation and Recovery)
9. Batch Fermentation of Organic Acid
10. Solid State Fermentation

Course Name : Data Structure Lab					
Course Code: CSEN2055					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	0	3	3	1.5

List of experiments:

1. Implementation of array operations.
2. Stacks and Queues: adding, deleting elements, Circular Queue: Adding & deleting elements.
3. Evaluation of expressions operations on stacks.
4. Implementation of linked lists: inserting, deleting, and inverting a linked list.
5. Implementation of stacks & queues using linked lists
6. Polynomial addition.
7. Addition of Sparse matrices.
8. Traversal of Trees.
9. DFS and BFS implementation.
10. Sorting and searching algorithms.

HONOURS COURSE

Subject Name: Bioseparation Technology					
Paper Code: BIOT 2211					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

After completion of this course, the students will be able to:

1. Acquire basic understanding of different bioseparation processes and design principle for commonly used process equipments.
2. Obtain knowledge about the basic principles and application of sedimentation, centrifugation and filtration.
3. Explain the principles of extraction and membrane based separation of bioproducts and can apply the knowledge for calculations of extraction process.
4. Understand the principle of adsorption, chromatography and relation of adsorption with chromatography.
5. Apply different chromatographic techniques for separation of different Bioproducts.
6. Comprehend the knowledge of precipitation, drying, crystallization and will be able to solve numerical problems related to these processes.

Module I: Introduction to Bioseparation [10L]
Overview of bioseparation technology;Basic design principles of separation equipments with its importance in biotechnology. Selection strategies of various purification methods based on different properties of biomolecules. Cell disruption for intracellular products by mechanical and non-mechanical methods: Chemical lysis, enzymatic lysis, physical methods. Sedimentation and Centrifugation– Objective, principle, applications;Principle of filtration, objective and methods, filtration at constant pressure and constant rate.

Module II: Extraction and Membrane based separation processes [10L]
Objective of extraction, extraction principles, phase separation and partitioning equilibria; Membrane separation - Factors affecting membrane separation processes, advantages of membrane separation processes over conventional separation techniques. Design principle and industrial application of Microfiltration, Ultrafiltration, Reverse osmosis, Dialysis, Electrodialysis, Diafiltration, Pervaporation, Structure and characteristics of membranes.

Module III: Adsorption and Chromatography[10L]
Principle of adsorption, adsorption equilibrium, adsorption isotherms;Chromatography- general theory, partition coefficient, resolution and other chromatographic terms and parameters,chromatographic method selection, adsorption and hydrophobic interaction chromatography (HIC), Gel filtration, molecular imprinting, Ion exchange chromatography, Chromatofocussing, Affinity chromatography, different type,Partition chromatography- Normal

phase, Reverse phase (RPC), HPLC, FPLC, GC,large scale purification of recombinant proteins,industrial application of chromatographic bioseparation methods.

Module IV: Precipitation, Crystallization, Drying [10L]

Objective of precipitation, protein solubility, structure, size, charge, solvent, initial mixing, nucleation, growth governed by diffusion, methods of precipitation;Principle of crystallization, solubility curve, Effect of heat on crystallization, Rate of crystal growth, design principle of crystallizer, industrial applications; Fundamental principle of drying, Relative humidity, heat and mass transfer, types of dryer - description and operation and application.

Textbook:

1. Bioseparation Science and Engineering -- Indian Edition. Roger G Harrison, Paul Todd, Scott R Rudge and Demerti P Petrides. Oxford University Press.

Reference books:

1. Schuler &Kargi, Bio-process Engg. PHI.
2. Bailey & Olis, Biochemical Engg. Fundamentals, McGraw-Hill, 1990.
3. Mukhopadhyay, S.N. Process Biotechnology Fundamentals, Viva Books Pvt. Ltd.2001.
4. Muni Cheryan, Handbook of Ultrafiltration.
5. Perry, Chilton & Green, Chemical Engineers' Handbook, McGraw-Hill.
6. Ho, W.S.W. & K. K. Sirkar, Membrane Handbook, Van Nostrand Reinhold, N.Y.(1992)