Biotechnology

B.TECH. PROGRAMME

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B.Tech. Biotechnology Curriculum

1st Year 1st Semester Syllabus:

Theory							
Sl. No	**Course Code**	**Course Name**	**Contact Hrs per Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	HMTS1101	Business English	2	0	0	2	2
2	PHYS1001	Physics I	3	1	0	4	4
3	MATH1101	Mathematics I	3	1	0	4	4
4	ECEN1001	Basic Electronics Engineering	3	1	0	4	4
5	MECH1101	Engineering Mechanics	3	1	0	4	4
		Total Theory	**14**	**4**	**0**	**18**	**18**

Laboratory							
Sl. No	**Course Code**	**Course Name**	**Contact Hrs per Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	PHYS1011	Physics I Lab	0	0	3	3	2
2	ELEN1011	Basic Electronics Engineering Lab	0	0	3	3	2
3	MECH1011	Workshop Practice	1	0	3	4	3
4	HMTS1111	Language Practice Lab (Level 1)	0	0	2	2	1
		Total Laboratory	**1**	**0**	**11**	**12**	**8**

Sessional							
Sl. No	**Course Code**	**Course Name**	**Contact Hrs per Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	HMTS1121	Extra curricular activities	0	0	2	2	1
		Total Sessional	**0**	**0**	**2**	**2**	**1**
		Total of Semester	**15**	**4**	**13**	**32**	**27**

1st Year 2nd Semester Syllabus:

Theory							
Sl. No	**Course Code**	**Course Name**	**Contact Hrs per Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	CSEN1201	Introduction to Computing	3	1	0	4	4
2	CHEM1001	Chemistry I	3	1	0	4	4
3	MATH1201	Mathematics II	3	1	0	4	4
4	ELEC1001	Basic Electrical Engineering	3	1	0	4	4
5	MECH1201	Engineering Thermodynamics and Fluid Mechanics	3	1	0	4	4
		Total Theory	**15**	**5**	**0**	**20**	**20**

Laboratory / Practical							
Sl. No	**Course Code**	**Course Name**	**Contact Hrs per Week**				**Credit Points**
			L	**T**	**P**	**Total**	
1	CSEN1211	Introduction to Computing Lab	0	0	3	3	2
2	CHEM1011	Chemistry I Lab.	0	0	3	3	2
3	ELEC1011	Basic Electrical Engineering Lab	0	0	3	3	2
4	MECH1012	Engineering Drawing	1	0	3	4	3
		Total Laboratory	**1**	**0**	**12**	**13**	**9**
		Total of Semester	**16**	**5**	**12**	**33**	**29**

2nd Year 1st Semester:

A. THEORY								
Sl No	**Code**	**Field**	**Theory**	**Contact Hours/Week**				**Cr. Points**
				L	**T**	**P**	**Total**	
1	**HMTS2002**	Humanities	Indian Culture and Heritage	2	0	0	2	1
2	**BIOT2101**	Basic Science	Chemistry of biomolecules	3	1	0	4	4
3	**CHEM2001**	Basic Science	Basic Environmental Engineering & Ecology	3	0	0	3	3
4	**BIOT2102**	Prof. Core	Industrial Stoichiometry	3	1	0	4	4
5	**BIOT2103**	Prof. core	Biochemistry	3	1	0	4	4
6	**BIOT2104**	Prof. core	Microbiology	3	1	0	4	4
			Total of Theory				**21**	**20**
B. PRACTICAL/ LABORATORY								
7	**BIOT2111**	Basic Science	Biomolecular Chemistry Lab	0	0	3	3	2
9	**BIOT2112**	Prof. core	Biochemistry Lab	0	0	5	3	2
10	**BIOT2113**	Prof. core	Microbiology Lab	0	0	5	5	3
			Total of Practical				**11**	**7**
			Total of Semester				**32**	**27**

2nd Year 2nd Semester:

A. THEORY								
Sl No	**Code**	**Field**	**Theory**	**Contact Hours/Week**				**Cr. Points**
				L	**T**	**P**	**Total**	
1	**HMTS2001**	Humanities	Human Values and Professional Ethics	2	0	0	2	2
2	**MATH2002**	Basic Science	Numerical & Statistical Methods	3	0	0	3	3
3	**BIOT 2201**	Basic Science	Thermodynamics & Kinetics	3	1	0	4	4
4	**BIOT2202**	Prof. Core	Transfer Operation-I	3	0	0	3	3
5	**BIOT2203**	Prof. core	Molecular Biology	3	1	0	4	4
6	**BIOT2204**	Prof. core	Industrial Microbiology & Enzyme Technology	3	1	0	4	4
			Total of Theory				**20**	**20**
B. PRACTICAL/ LABORATORY								
7	**HMTS2011**	Humanities	Language Practice Lab (Level 2)	0	0	3	3	2
8	**MATH2012**	Basic Science	Numerical & Statistical Methods Lab	0	0	2	2	1
9	**BIOT2211**	Prof. Core	Transfer Operation-I Lab	0	0	3	3	2
10	**BIOT2212**	Prof. core	Molecular Biology Lab	0	0	3	3	2
11	**BIOT2214**	Prof. core	Enzyme Technology & Fermentation Technology Lab	0	0	3	3	2
			Total of Practical				**14**	**9**
			Total of Semester				**34**	**29**

3rd Year 1st Semester:

A. THEORY								
Sl No	**Code**	**Field**	**Theory**	**Contact Hours/Week**				**Cr. Points**
				L	**T**	**P**	**Total**	
1	**HMTS3101**	Humanities	Economics for Engineers	3	0	0	3	3
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	**CSEN3106**	Engineering Science	Data Structure & Algorithm	3	0	0	3	3
			Total of Theory				**18**	**18**
B. PRACTICAL/ PRACTICAL								
7	**BIOT3111**	Prof. core	Genetics lab	**0**	**0**	**3**	3	2
8	**BIOT3112**	Prof. core	Bioinformatics lab	**0**	**0**	**3**	3	2
9	**BIOT3113**	Prof. core	Recombinant DNA Technology lab	**0**	**0**	**3**	3	2
10	**BIOT3114**	Prof. core	Transfer Operation-II lab	**0**	**0**	**3**	3	2
11	**CSEN3116**	Engineering Science	Data Structure & Algorithm lab	**0**	**0**	**3**	3	2
			Total of Practical				**15**	**10**
			Total of Semester				**33**	**28**

3rd Year 2nd Semester:

A. THEORY								
Sl No	**Code**	**Field**	**Theory**	**Contact Hours/Week**				**Cr. Points**
				L	**T**	**P**	**Total**	
1	**HMTS3201**	Humanities	Principles of Management	3	0	0	3	2
2	**BIOT3201**	Prof. core	Immunology	3	0	0	3	3
3	**BIOT3202**	Prof. core	Plant Biotechnology	3	0	0	3	3
4	**BIOT3203**	Prof. core	Bioreactor Design and Analysis	3	0	0	3	3
5	**CSEN3205**	Engineering Science	Data Base Management System and Computer Networking	3	0	0	3	3
6	**BIOT3241**	Prof. elective-I	Molecular Modeling & Drug Designing	3	0	0	3	3
	BIOT3242		Biophysics of Macromolecules					
	BIOT3243		Biosensors and Diagnostics					
	BIOT3244		Biofertilizers and Biopesticides					
			Total of Theory				**18**	**17**
B. PRACTICAL/ LABORATORY								
7	**BIOT3211**	Prof. core	Immunology lab	0	0	3	3	2
8	**BIOT3212**	Prof. core	Plant Tissue Culture lab	0	0	3	3	2
9	**BIOT3213**	Prof. core	Bioreactor Design lab	0	0	3	3	2
10	**CSEN3215**	Engineering Science	Data Base Management System and Computer Networking lab	0	0	3	3	2
			Total of Practical				**12**	**8**
B. SESSIONAL								
11	**HMTS3221**	Sessional	Personality Development	0	0	2	2	1
12	**BIOT3222**	Sessional	Seminar-I	0	0	3	3	2
			Total of Sessional				**5**	**3**
			Total of Semester				**35**	**28**

4th Year 1st Semester:

A. THEORY								
Sl No	**Code**	**Field**	**Theory**	**Contact Hours/Week**				**Cr. Points**
				L	**T**	**P**	**Total**	
1	**BIOT4101**	Prof. core	Animal Cell Culture & Animal Biotechnology	3	0	0	3	3
2	**BIOT4102**	Prof. core	Bioseparation Technology	3	1	0	4	4
3	**BIOT4151**	Prof. elective-II	Food Biotechnology	3	0	0	3	3
	BIOT4152		Environmental Biotechnology					
	BIOT4153		Bioprocess & Process Instrumentation					
4	**BIOT4161**	Prof. elective-III	Modeling & Simulation of Bioprocess	3	0	0	3	3
	BIOT4162		Biomaterials					
	BIOT4163		Biometallurgy					
	BIOT4164		Proteomics and Protein Engineering					
	BIOT4165		Human Genomics					
5		Free elective-I *		3	0	0	3	3
			Total of Theory				**16**	**16**
B. PRACTICAL/ LABORATORY								
6	**BIOT4156**	Prof. elective-II	Food Biotechnology Lab	0	0	0	3	2
	BIOT4157		Environmental Biotechnology lab					
	BIOT4158		Bioprocess & Process Instrumentation lab					
			Total of Practical				**5**	**4**
B. SESSIONAL								
7	**HMTS4121**	Humanities	Group Discussion for Professionals	0	0	3	3	2
8	**BIOT4121**	Sessional	Seminar-II	0	0	3	3	2
9	**BIOT4122**	Sessional	Industrial Training	4 to 6 weeks				2
10	**BIOT4123**	Sessional	Project-I	0	0	6	6	4
			Total of Sessional				**9**	**8**
			Total of Semester				**35**	**28**

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

**** List enclosed at the end of the curriculum***

4th Year 2nd Semester:

A. THEORY								
Sl No	**Code**	**Field**	**Theory**	**Contact Hours/Week**				**Cr. Points**
				L	**T**	**P**	**Total**	
1	**HMTS4203**	Humanities	Bioethics & IPR	3	0	0	3	2
2	**BIOT4271**	Prof. elective-IV	Renewable Energy Technology	3	1	0	4	4
	BIOT4272		Tissue Engineering					
	BIOT4273		Biomedical Engineering					
	BIOT4274		Post Harvest Technology					
	BIOT4275		Metabolic Engineering					
	BIOT4276		Medical & Pharmaceutical Biotechnology					
	BIOT4277		Basic Process Equipment Design					
3		Free elective-II*		3	0	0	3	3
			Total of Theory				**10**	**9**
B. SESSIONAL								
7	**BIOT4221**	Sessional	Comprehensive Viva Voce					3
8	**BIOT4222**	Sessional	Project-II	0	0	16	16	8
			Total of Sessional				**16**	**11**
			Total of Semester				**26**	**20**

**** List enclosed at the end of the curriculum***

List of Professional Electives:

Professional Elective1	Professional Elective 2	Professional Elective 3	Professional Elective 4
BIOT3241 Molecular Modeling & Drug Designing	BIOT4151 Food Biotechnology	BIOT4161 Modeling & Simulation of Bioprocess	BIOT4171 Renewable Energy Technology
BIOT3242 Biophysics of Macromolecules	BIOT4152 Environmental Biotechnology	BIOT4162 Biomaterials	BIOT4172 Tissue Engineering
BIOT3243 Biosensors and Diagnostics	BIOT4153 Bioprocess & Process Instrumentation	BIOT4163 Biometallurgy	BIOT4173 Biomedical Engineering
BIOT3244 Biofertilizers and Biopesticides		BIOT4164 Proteomics and Protein Engineering	BIOT4174 Post Harvest Technology
		BIOT4165 Human Genomics	BIOT4175 Metabolic Engineering
			BIOT4176 Medical & Pharmaceutical Biotechnology

List of Free Electives:

Free Elective 1		Free Elective 2	
Paper Code	**Title of the Paper**	**Paper Code**	**Title of the Paper**
CNEN4171	Industrial Safety and Hazard Analysis	**CNEN4281**	Catalysis & Catalytic Reactor Design
CNEN4172	Project Engineering	**CNEN4282**	Total Quality Management
INFO4131	Cyber Law and Security	**INFO4231**	Cryptography & Network Security
		INFO4242	Soft Computing
ECEN4160	VLSI Design Automation	**ECEN4260**	Cellular and Satellite Communication
ECEN4161	Control Systems and Engineering	**ECEN4261**	VLSI Design
ECEN4162	Principles of Communication Systems	**ECEN4262**	VLSI Testing and Verification
AEIE4141	Instrumentation & Telemetry	**AEIE4231**	Sensor Technology
AEIE4142	Introduction to Embedded System	**AEIE4232**	Control Systems & Applications
ELEC4191	Electrical Wiring & Installation	**ELEC4291**	Performance of Electrical Equipments
ELEC4192	Non-Conventional Engergy	**ELEC4292**	Illumination Engineering
MATH4101	Operations Research and Optimization Techniques	**MATH4201**	Advanced Graph Theory
MATH4102	Probability and Stochastic Processes	**MATH4202**	Combinatorics
CSEN4160	Cloud Computing	**CSEN4270**	Mobile Computing
CSEN4161	Web Intelligence and Big data	**CSEN4271**	Image Processing
MECH 4174	Computational Fluid Dynamics (CFD)	**MECH 3262**	Renewable Energy Systems
MECH 4183	Operations Research (OR)	**MECH 3264**	Materials Handling
CIVL 4171	Principles of Surveying	**CIVL 4181**	Environmental Impact Assessment
CIVL 4172	Building Materials	**CIVL 4182**	Hydra logy
CIVL 4174	Finite Element Methods	**CIVL 4134**	Remote Sensing and GIS

Course Name : BUSINESS ENGLISH					
Course Code: HMTS1101					
Contact hrs per week:	L	T	P	Total	Credit points
	2	0	0	2	2

Module I – [5L]

Communication Skill
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 II-[12L]

Business Communication- Scope & Importance
Writing Formal Business Letters
Writing Reports
Organizational Communication: Agenda & minutes of a meeting, notice, memo, circular
Project Proposal
Technical Report Writing
Organizing e-mail messages
E-mail etiquette
Tips for e-mail effectiveness

Module III-[10L]

Language through Literature
Modes of literary & non-literary expression
Introduction to Fiction, (An Astrologer's Day by R.K. Narayan and Monkey's Paw by W.W. Jacobs), Drama (The Two Executioners by Fernando Arrabal) or (Lithuania by Rupert Brooke) & Poetry (Night of the Scorpion by Nissim Ezekiel and Palanquin Bearers by Sarojini Naidu)

Module IV-[3L]

Grammar in usage (nouns, verbs, adjectives, adverbs, tense, prepositions, voice change) -to be dealt with the help of the given texts.

References

1. Armand Matterlart and Michele Matterlart, Theories of Communication: A Short Introduction, Sage Publications Ltd., 1998.

2. Chan, Janis Fisher, and Diane Lutovich. Professional Writing Skills. San Anselmo, CA:
   Advanced Communication Designs, 1997.

3. Geffner, Andrew P. Business English. Hauppauge, New York: Barron's Educational Series, 1998.

4. Good, Edward C. Mightier Than the Sword. Charlottesville: Word Stone Publications, 1989.

5. Edward P.Bailey, Writing and Speaking at Work: A Practical Guide for Business Communication, Prentice-Hall, 7th edn, 2004.

6. Kitty O. Locker, Business and Administrative Communication, McGraw-Hill/ Irwin, 7th edn, 2004.

7. Lillian Chaney and Jeanette Martin, Intercultural Business Communication, Prentice Hall, 4th edn, 2005.

8. Yudkin, Marcia. Persuading on Course Name. Lansing, IL: Infinity Publishing, 2001.

Course Name : Chemistry 1					
Course Code: CHEM 1001					
Contact hrs per week:	L	T	P	Total	Credit points
	3	1	0	4	4

Module I [10 L]

Thermodynamics & Spectroscopy

Chemical Thermodynamics & Thermochemistry

Concept of Thermodynamic system, Introduction to first law of thermodynamics, Enthalpy Heat Capacity, Reversible and Irreversible processes, Adiabatic changes, Application of first law of thermodynamics to chemical processes, 2nd law of thermodynamics, Evaluation of entropy, Work function and free energy, Phase Changes, Clausius Clapeyron Equation, Chemical Potential, Gibbs Duhem Relation, Activity and Activity coefficient.

Spectroscopy

Electromagnetic Radiation, Basic idea of UV-visible & IR spectroscopy.

Module II [10 L]

Structure & Bonding

Chemical Bonding

Covalent bond, VSEPR Theory, Molecular Orbital Theory, Hydrogen bond, Intermolecular forces-vander Waals forces, Ionization energy, Electronegativity, Electron affinity, Hybridisation, Dipole moment

Solid State Chemistry

Introduction to stoichiometric defects (Schottky & Frenkel) and non – stoichiometric defects (Metal excess and metal deficiency). Role of silicon and germanium in the field of semiconductor.

Ionic Equilibria and Redox Equlibria

Acid Base Equilibria in water, Strength of acids and bases, Hydrogen ion exponent, Ionic product of water, Salt Hydrolysis and Henderson Equation, Buffer solutions, pH indicator, Common ion Effect, Solubility product, Fractional Precipitation, Redox Equilibria,

Structure and reactivity of Organic molecule

Inductive effect, resonance, hyperconjugation, electromeric effect, carbocation, carbanion and free radicals.
Brief study of some addition, eliminations and substitution reactions.

Module III [10 L]

Electrochemistry & Reaction Dynamics

Conductance

Conductance of electrolytic solutions, specific conductance, equivalent conductance, molar conductance, ion conductance, effect of temperature and concentration (Strong and Weak electrolyte). Kohlrausch's law of independent migration of ions, transport numbers and hydration of ions. Conductometric titrations: SA vs SB & SA vs WB; precipitation titration KCl vs $AgNO_3$.

Electrochemical Cell

Cell EMF and thermodynamic derivation of the EMF of a Galvanic cell (Nernst equation), single electrode potentials, hydrogen half-cell and calomel half cell (construction, representation, cell reaction, expression of potential, discussion, application) Storage cell, fuel cell (construction, representation, cell reaction, expression of potential, discussion, application). Application of EMF measurement on a) the change in thermodynamic function (ΔG, ΔH, ΔS) b) the equilibrium constant of a reversible chemical reaction c) the valency of an ion.

Kinetics

Reaction laws: rate expression, order and molecularity, zero, first and second order kinetics. Pseudounimolecular reaction, Arrhenius equation.
Mechanism and theories of reaction rates (Collision theory and Transition state theory,).
Catalysis: Homogeneous catalysis (Definition, example, mechanism, kinetics).

Module IV [10 L]

INDUSTRIAL CHEMISTRY & POLYMERIZATION

Industrial Chemistry

Solid Fuel: Coal, Classification of coal, constituents of coal, carbonization of coal (HTC and LTC), Coal analysis: Proximate and ultimate analysis.
Liquid fuel: Petroleum, classification of petroleum, Refining, Petroleum distillation, Thermal cracking, Octane number, Cetane number, Aviation Fuel (Aviation Gasoline, Jet Gasoline), Bio-diesel.
Gaseous fuels: Natural gas, water gas, coal gas, bio gas.

Polymerization

Concepts, classifications and industrial applications. Polymer molecular weight (number avg. weight avg. viscosity avg.: Theory and mathematical expression only), Poly dispersity index (PDI). Polymerization processes (addition and condensation polymerization), degree of polymerization, Copolymerization, stereo-regularity of polymer, crystallinity (concept of T_m) and amorphicity (Concept of T_g) of polymer.

Preparation, structure and use of some common polymers: plastic (PE: HDPE, LDPE, PVC, Bakelite, PP), rubber (natural rubber, SBR, NBR) and Vulcanization., fibre(nylon 6.6, Nylon 6, Polyester).
Conducting and semi-conducting polymers.

Text Books

1. Engineering Chemistry, Gourkrishna Dasmohapatra, Vikas Publishing House
2. A Text book of Engineering Chemistry, Shashi Chawla, Dhanpat Rai & Co Pvt Ltd
3. Engineering Chemistry, K. L. Chugh, Kalyani Publishers.

Reference Books

1. General & Inorganic Chemistry, R. P. Sarkar, Fuels and Combustion, New Central Book Agency P Ltd
2. L. Finar, Organic Chemistry, Addison Wesley Longman, Inc
3. Organic Chemistry, Morrison & Boyd, Prentice Hall of India
4. Physical Chemistry, K. L. Kapoor, McMillan
5. P. C. Rakshit, Physical Chemistry, Sarat Book House (7th Edition).

Course Name : MATHEMATICS I					
Course Code: MATH1101					
Contact hrs per week:	L	T	P	Total	Credit points
	3	1	0	4	4

Module I [10L]

Matrix:

Matrices and their basic attributes, Determinant of a square matrix, Minors and Cofactors, Laplace's method of expansion of a determinant, Product of two determinants, Adjoint of a determinant, Jacobi's theorem on adjoint determinant. Singular and non-singular matrices, Adjoint of a matrix, Inverse of a non-singular matrix and its properties, Orthogonal matrix and its properties, Special Complex Matrices: Hermitian, Unitary, Normal(definition only), Rank of a matrix and its determination using elementary row and column operations, Solution of simultaneous linear equations by :Cramer's Rule and Matrix inversion method, Consistency and inconsistency of a system of homogeneous and inhomogeneous linear simultaneous equations, Characteristic Equation and computation of eigenvalues and eigenvectors of a square matrix (of order 2 or 3), Cayley-Hamilton theorem and its applications(with special reference to higher power of matrices, e.g. Idempotent and Nilpotent matrices)

Module II [10 L]

Mean Value Theorems & Expansion of Functions:

Rolle's theorem: its geometrical interpretation and its application, Concavity and Convexity of curves, Mean Value theorems – Lagrange & Cauchy and their application, Taylor's theorem with Lagrange's and Cauchy's form of remainders and its application, Expansions of functions by Taylor's and Maclaurin's theorem, Maclaurin's infinite series expansion of the functions: $\sin x, \cos x, e^x, \log(1+x), (a+x)^n, n$ being an integer or a fraction (assuming that the remainder $R_n \to 0$ as $n \to \infty$ in each case).

Infinite Series:

Preliminary ideas of sequence, Infinite series and their convergence/divergence, Infinite series of positive terms, Tests for convergence: Comparison test, Cauchy's Root test, D' Alembert's Ratio test(statements and related problems on these tests), Raabe's test, Proof of e being irrational, Alternating series, Leibnitz's Test (statement, definition) illustrated by simple examples, Absolute convergence and Conditional convergence,

Module III [10 L]

Successive differentiation:

Higher order derivatives of a function of single variable, Leibnitz's theorem (statement only and its application, problems of the type of recurrence relations in derivatives of different orders and also to find $(y_n)_0$).

Calculus of Functions of Several Variables:

Recapitulation of some basic ideas of limit and continuity of functions of single variable, 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, Chain rules, Differentiation of implicit functions, Total differentials and their related problems, Jacobians up to three variables and related problems, Maxima, minima and saddle points of functions and related problems.

Module-IV [10 L]

Multiple Integration and Vector Calculus:

Concept of line integrals, Double and triple integrals. 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, Green's theorem, Gauss Divergence Theorem and Stoke's theorem (Statements and applications).

Reduction formula:

Reduction formulae both for indefinite and definite integrals of types:

$\int \sin^n x, \int \cos^n x, \int \sin^m x \cos^n x, \int \cos^m x \sin nx, \int \frac{dx}{(x^2+a^2)^n}, m, n$ are positive integers.

References

1. Advanced Engineering Mathematics: Erwin Kreyszig by Wiley India
2. Engineering Mathematics: B.S. Grewal (S. Chand & Co.)
3. Higher Engineering Mathematics: John Bird (Elsevier)
4. Advanced Engineering Mathematics: Wiley and Barrett (Tata McGraw-Hill)
5. Calculus: M. J. Strauss, G. L. Bradley and K. L. Smith (Pearson Education)
6. Engineering Mathematics: S. S. Sastry (PHI)
7. Advanced Engineering Mathematics: M.C. Potter, J.L. Goldberg and E.F. Abonfadel (OUP),Indian Edition.
8. Linear Algebra(Schaum's outline series): Seymour Lipschutz, Marc Lipson (McGraw Hill Education)
9. Vector Analysis(Schaum's outline series): M.R. Spiegel, Seymour Lipschutz, Dennis Spellman (McGraw Hill Education)
10. Introduction to Real Analysis: S.K.Mapa (Sarat Book Distributors)

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

Module-I: [12 L]

DC Network Theorem: Kirchhoff's law, nodal analysis, mesh analysis, Superposition theorem, Thevenin's theorem, Norton theorem, Maximum power transfer theorem, star-delta conversion.

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.

Module-II [8L]

Electrostatics: Gauss's law and its applications to electric field and potential calculation. Capacitor, capacitance of parallel plate capacitor, spherical capacitor and cylindrical capacitor.

Electromagnetism: Amperes law, Biot-savart's law, Ampere's circuital law and their applications, Magnetic circuits, analogy between magnetic and electric circuits, Faraday's law, self and mutual inductance. Energy stored in a magnetic field, Hysteresis and Eddy current losses.

Module-III [10L]

AC single phase system: concept of alternating signal, average and RMS values of alternating signal, peak factor, form factor, phase and phase difference, phasor representation of alternating quantities, phasor diagram, AC series , parallel and series parallel circuits, Active power, Reactive power, power factor, Resonance in RLC series and parallel circuit, Q factor, bandwidth.

Three phase system: balanced three phase system, delta and star connection, relationship between line and phase quantities, phasor diagrams. Power measurement by two wattmeter method.

Module-IV [10L]

Single phase 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.

3-phase induction motor: Concept of rotating magnetic field, principle of operation, Construction, equivalent circuit and phasor diagram, torque-speed/slip characteristics, Starting of Induction Motor.

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 : ENGINEERING MECHANICS					
Course Code: MECH 1101					
Contact hrs per week:	L	T	P	Total	Credit points
	3	1	0	4	4

Module-I [10L]

Importance of Mechanics in Engineering ; Definition of Mechanics; Concepts of particles & rigid bodies;

Vector and scalar quantities; Vector algebra –definition and notation; Types of vectors – equal , equivalent , free , bound , sliding ; Addition , subtraction of vectors ; Parallelogram law , triangle law , vector polygon ; Scalar multiplication of vectors ; Resolution of vectors in Cartesian co–ordinate system ; Unit vector, unit co–ordinate vectors ($\hat{i}$, $\hat{j}$, $\hat{k}$) ; Direction cosines ; Addition/ subtraction of vectors in components form.

Definition of force vector ; Dot product , cross product and the application ; Important vector quantities (position vector , displacement vector) ; Moment of a force about a point and about an axis , moment of a couple ; Representation of force and moments in items of $\hat{i}$, $\hat{j}$, $\hat{k}$. Principle of transmissibility of force (sliding vector); Varignon's theorem for a system of concurrent forces with proof; Resolution of a force by its equivalent force-couple system; Resultant of forces.

Module-II [10L]

Type of forces – collinear, concurrent, parallel, concentrated, distributed; Active and reactive forces, different types of reaction forces; Free body concept and diagram; Concept and equilibrium of forces in two dimensions; Equations of equilibrium; Equilibrium of three concurrent forces -- Lami's theorem.

Concept of friction: Laws of Coulomb's friction; Angle of friction, angle of repose, coefficient of friction -- static and kinematic.

Module-III [12L]

Distributed force system; Centre of gravity; Centre of mass & centroid; Centroid of an arc; Centroid of plane areas – triangle, circular sector, quadrilateral and composite area consisting of above figures.

Area moment of inertia: Moment of inertia of a plane figure; Polar moment of inertia of a plane figure; Parallel axes theorem.

Concept of simple stress and strain ; Normal stress , shear stress , normal strain, shear strain; Hooke's law; Poisson's ratio; stress- strain diagram of ductile and brittle material; Proportional limit, elastic limit, yield point , ultimate stress, breaking point; Modulus of elasticity.

Module-III [16L]

Introduction to dynamics: Kinematics & kinetics; Newton's laws of motion; Law of gravitation and acceleration due to gravity; Rectilinear motion of particles with uniform & non – uniform acceleration.
Plane curvilinear motion of particles: Rectangular components (projectile motion), normal and tangential components.
Kinetics of particles: D'Alembert's principle and free body diagram; Principle of work & energy; Principle of conservation of energy.
Impulse momentum theory: Conservation of linear momentum

References:

1. Engineering Mechanics:- Statics and Dynamics by Meriam & Kreige , Wiley india

2. Engineering Mechanics:- Statics and Dynamics by I.H. Shames, P H I

3. Engineering Mechanics by Timoshenko , Young and Rao , TMH

4. Element of strength of materials by Timoshenko & Young, E W P

5. Fundamentals of Engineering Mechanics by Nag & Chanda – Chhaya Prakashani.

Course Name : CHEMISTRY I LAB					
Course Code: CHEM 1011					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	3	3	2

List of Experiments:

1. To determine the alkalinity in a given water sample.
2. Estimation of iron using $KMnO_4$: self indicator.
3. Estimation of iron using $K_2Cr_2O_7$: redox sensitive indicator.
4. To determine total hardness and amount of calcium and magnesium separately in a given water sample.
5. To determine the value of the rate constant for the hydrolysis of ethyl acetate catalyzed by hydrochloric acid.
6. Heterogeneous equilibrium (determination of partition coefficient of acetic acid between n-butanol and water).
7. Conductometric titration for determination of the strength of a given HCl solution by titration against a standard NaOH solution.
8. pH- metric titration for determination of strength of a given HCl solution against a standard NaOH solution.
9. Iodometric estimation of Cu^{2+}.
10. To determine chloride ion in a given water sample by Argentometric method (using chromate indicator solution)

Course Name : BASIC ELECTRICAL ENGINEERING LAB.					
Course Code: ELEC1011					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	3	3	2

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 Drawing					
Course Code: MECH 1012					
Contact hrs per week:	L	T	P	Total	Credit points
	1	0	3	4	3

1. Importance of engineering drawing; Acquaintance with different drafting equipment & accessories;
2. Introduction to lines : Practising different types of lines; Basic concepts in Lettering : Practising vertical & inclined letters (Practice Sheet 1)
3. Different systems of dimensioning with practice.Introduction to the concept of scale of drawing. (Practice Sheet 2)
4. Introduction to concept of orthographic projection: 1st angle and 3rd angle projection method; Symbols; projection of points. (Practice Sheet 3)
5. Projection of straight lines for different orientation including inclined to both the planes. (Practice Sheet 4)
6. Projection of plane surfaces inclined to HP and parallel to VP; Inclined to VP and Parallel to HP (Practice Sheet 5)
7. Projection of solids: Cube, rectangular prism, Hexagonal prism, Cylinder, Pyramid, Cone. (Practice Sheet 6)
8. Section of solids and their projections on principal and auxiliary planes for true shape: Cylinder, hexagonal pyramid. (Practice Sheet 7)
9. Isometric projections: Basic concepts, isometric scale; Isometric projection and view.
10. Practice with simple laminar and solid objects. (Practice Sheet 8)

References:

1. “Elementary Engineering Drawing” by Bhatt, N.D; Charotan Book Stall, Anand
2. “Engineering Graphics” by Narayana, K.L. and Kannaaiah P; TMH
3. “Engineering Graphics” by Lakshminarayanan, V. and Vaish Wanar, R.S, JainBrothers.

Course Name : Language Practice Lab (level 1)					
Course Code: HMTS 1111					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

Module I [3P]

Introduction to Linguistics (Phonology)
Phonetics-Vowel and Consonant Sounds (Identification &articulation)
Word- stress
Intonation (Falling and rising tone)
Voice Modulation
Accent training

Module II [3P]

Listening Skills
Principles of Listening
Approaches to listening
Guidelines for Effective Listening
Listening Comprehension
Audio Visual (Reviews)

Module III [2P]

Discourse Analysis-
Spoken Discourse
Conversational Skills/Spoken Skills
Analysing Speech dynamics
(Political Speeches
Formal Business Speeches)

Module IV [9P]

Writing Skill-
Descriptive, narrative and expository writing
Writing with a purpose---Convincing skill, argumentative skill/negotiating Skill (These skills will be repeated in oral skills).
Writing reports/essays/articles—logical organization of thoughts
Book review

References

1. Munter, Mary. Guide to Managerial Communication. 5th ed. Upper Saddle River, NJ: Prentice Hall, 1999.
2. Cypres, Linda. Let's Speak Business English. Hauppauge, NY: Barron's Educational Series, 1999. Crystal, David. 1971. *Linguistics.* Baltimore: Penguin Books.
3. Larsen-Freeman, D. (1986). "Techniques and principles in language teaching." Oxford: Oxford University Press.
4. Littlewood, W. (1981). "Language teaching. An introduction." Cambridge: Cambridge University Press.
5. Savignon, S. J., & Berns, M. S. (Eds.). (1983). "Communicative language teaching: Where are we going? Studies in Language Learning," 4(2). (EDRS No. ED 278 226, 210 pages)

Course Name : Co Curricular Activities					
Course Code: HMTS 1121					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	2	2	1

Objective: This course aims at instilling a sense of social responsibility. This objective can be achieved by bringing in awareness about the contemporary issues relevant to the GenX and Gen Y through enlightened discussions and active participation. Since the course has 1 credit detailed planning regarding the area of activities and method of evaluation should be charted at the start of the semester.

Module I:

Project Work
Development of projects based on integral and holistic developmental models to be implemented in rural areas or underdeveloped areas in the peripheral areas of cities. This could include a wide area of activity –
from taking up a research projects to analyse the need of a particular under-developed area to trying to implement a project already formulated. This could also relate to mobilizing funds for a specific project.

Module II:

Action-oriented schemes

e.g.Organising Blood –donation camps
Conducting child –healthcare services
Helping the old and sick
(in coordination with NGOs and other institutes)

Module III:

Society and Youth

Developing Awareness among the youth about social issues both local and global for e.g. Eradication of social evils like drug abuse, violence against women and others.

Module IV:

Youth and Culture

Generating new ideas and help the participants to be creative and innovative for e.g.Enacting street plays, encouraging creative writing by organizing workshops and competitions. Active participation of the students in the nation building process by making positive changes in the social and individual space.

Course Name : Introduction to Computing					
Course Code: CSEN 1201					
Contact hrs per week:	L	T	P	Total	Credit points
	3	1	0	4	4

Learning Objective: 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.

Module I: [13L]

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. Assembly language, high level language, compiler and assembler (basic concepts).

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). Binary Arithmetic & logic gates. Boolean algebra – expression, simplification, Karnaugh Maps.

Basic concepts of operating systems like MS WINDOW, LINUX. How to write algorithms & draw flow charts.

Module II: [5L]

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.

Module III: [8L]

Program Structures in C

Flow of Control:

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

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.

Module IV: [14L]

Data Handling in C

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.

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();

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 1					
Course Code: PHYS 1001					
Contact hrs per week:	L	T	P	Total	Credit points
	3	1	0	4	4

Module I: [22 L]

Optics

1.Interference :

The principle of superposition of waves, Superposition of waves: Two beam superposition, Multiple-beam superposition, coherent and incoherent superposition. Two source interference pattern (Young's double slit), Intensity distribution. Interference in thin films, wedge shaped films and Newton's rings, applications of interference. Newton's rings: Determination of wavelength of light, refractive index of liquid.

2 Diffraction:

Diffraction of light waves at some simple obstacles. Fraunhoffer diffraction through double slit and diffraction grating, grating spectra, resolving power of grating.

3. Polarisation & Fibre Optics:

Elementary features of polarization of light waves.Production and analysis of linearly, elliptic and Circularly polarized light, polaroids and application of polarizations. fibre optics - principle of operation, numerical aperture, acceptance angle

4 Laser

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.

Module II : [8L]

Waves & Oscillation

Superposition of two linear SHMs (with same frequency), Lissajous' figures. Damped vibration – differential equation and its solution, Critical damping, Logarithmic decrement, Analogy with electric circuits. Forced vibration – differential equation and solution, Amplitude and Velocity resonance, Sharpness of resonance and Quality factor. Progressive wave- Wave equation and its differential form, Difference between elastic (mechanical) and electromagnetic waves.

Module III : [9L]

Quantum Mechanics

Need for Quantum physics-Historical overviews, Particle aspects of radiation-Black body radiation, Compton scattering, pair production., Origin of X-ray spectrum. Wave aspect of particles- matter wave, de Broglie Hypothesis, Heisenberg Uncertainty principles- Statement, Interpretation and application.

Module IV: [6L]

Introduction of Crystallography

Space Lattice**,** Unit Cell, Lattice Parameters, Crystal Systems, Bravais Lattices, Miller Indices and its applications, Crystal Planes and Directions, Inter Planar Spacing of Orthogonal Crystal Systems, Atomic Radius, Co-ordination Number and Packing Factor of SC, BCC, FCC. Bragg's law and its applications.

Text Books

1. Atomic Physics Vol 1 – S.N. Ghoshal
2. Optics – Ajoy Ghak
3. Waves & Oscillation – N.K. Bajaj
4. Quantum Physics of Atoms , Molecules, Solids, Nuclei and particles – Eisberg and Resnick

Reference Books

1. Introduction to Special Relativity – Robert Resnick
2. Prespective on Modern Physics - Arthur Beiser
3. Optics – Jenkins and White
4. University Press – Sears & Zemansky
5. Introduction to modern Physics – Mani and Meheta
6. Optics – Brijlal and Subrahmanyam

Course Name : Mathematics II					
Course Code: MATH1201					
Contact hrs per week:	L	T	P	Total	Credit points
	3	1	0	4	4

Module I [10 L]

Ordinary differential equations (ODE)-

First order and first degree: Exact equations, Necessary and sufficient condition of exactness of a first order and first degree ODE (statement only), Rules for finding Integrating factors, Linear and non-linear differential equation, Bernoulli's equation. General solution of ODE of first order and higher degree (different forms with special reference to Clairaut's equation).

Second order and first degree:

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

Module II:[10L]

Basics of Graph Theory

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.

Tree:

Definition and properties, 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 III [10L]

Improper Integral:

Basic ideas of improper integrals, working knowledge of Beta and Gamma functions (convergence to be assumed) and their interrelations.

Laplace Transform:

Introduction to integral transformation, functions of exponential order, Definition and existence of 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.

Module IV [10L]

Three Dimensional Geometry

Equation of a plane. General form. Transformation to the normal form. Intercepts. Equation of the plane through three given points. Equation of a plane passing through the intersection of two planes. Angle between two intersecting planes. Bisectors of angles between two intersecting planes. Parallelism and perpendicularity of two planes.

Canonical equation of the line of intersection of two intersecting planes. Angle between two lines. Shortest distance between two lines. Condition of coplanarity of two lines. Length of the perpendicular from a point to a given line.

References:

1. Advanced Engineering Mathematics, Erwin Kreyszig, (Wiley Eastern)
2. Graph Theory: V. K. Balakrishnan, (Schaum's Outline, TMH)
3. A first course at Graph Theory: J. Clark and D. A. Holton (Allied Publishers LTD)
4. Introduction to Graph Theory: D. B. West (Prentice-Hall of India)
5. Graph Theory: N. Deo (Prentice-Hall of India)
6. Engineering Mathematics: B.S. Grewal (S. Chand & Co.)
7. Higher Engineering Mathematics: John Bird (4th Edition, 1st Indian Reprint 2006, Elsevier)
8. Calculus: Strauss, Bradley and Smith (3PrdP edition, Pearson Education)
9. Engineering Mathematics (Volume 2): S. S. Sastry (Prentice-Hall of India)
10. Introductory Course in Differential Equations: Daniel A. Murray (Longmans & Green).
11. Co-ordinate Geometry – S. L. Loney.
12. Analytical Geometry And Vector Algebra- R M Khan

Course Name : Basic Electronics Engineering					
Course Code: ECEN1001					
Contact hrs per week:	L	T	P	Total	Credit points
	3	1	0	4	4

Module I [10 L]

Semiconductors:

Crystalline material, Energy band theory, Fermi levels; Conductors, Semiconductors and Insulators: electrical properties, band diagrams. Semiconductors: intrinsic and extrinsic, energy band diagram, electrical conduction phenomenon, P-type and N-type semiconductors, drift and diffusion carriers.

Diodes and Diode Circuits:

Formation of P-N junction, energy band diagram, built-in-potential forward and reverse biased P-N junction, formation of depletion zone, V-I characteristics, Zener Diode and its Application, Zener and Avalanche breakdown.
Simple diode circuits, load line, piecewise linear model; Rectifier circuits: half wave, full wave, PIV, DC voltage and current, ripple factor, efficiency, idea of regulation.

Module II [10 L]

Bipolar Junction Transistors:

Formation of PNP / NPN junctions, energy band diagram; transistor mechanism and principle of transistors, CE, CB, CC configuration, transistor characteristics: cut-off, active and saturation modes of operation, transistor action, input & output characteristics, load line & amplifier operation and current amplification factors for CB and CE modes. Biasing and Bias stability: calculation of stability factor.

Module III [9 L]

Field Effect Transistors:

Junction field effect transistor (JEET): Principle of operation, JFET parameters, eqv. Circuit, JFET biasing, self bias, design of bias circuits, load line, amplifier characteristics.

MOSFETs:

Construction & principle of operation of p- & n-channel enhancement & depletion mode MOSFETs, drain & transfer characteristics, threshold voltage & its control.

Cathode Ray Osilloscope:

Construction and working principle of CRO, Lissajous pattern.

Module IV [9 L]

Feed Back Amplifier:

Concept-block diagram, properties, positive and negative feedback, loop gain, open loop gain, feedback factors; topologies of feedback amplifier; effect of feedback on gain, condition of oscillation, Barkhausen criteria.

Operational Amplifier:

Introduction to integrated circuits, operational amplifier and its terminal properties; Application of operational amplifier; Concept of op-amp saturation, inverting and non-inverting mode of operation, Adders, Subtractors, Voltage follower, Integrator, Differentiator, Basic Comparator Circuit.

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 Name : Engineering Thermodynamics & Fluid Mechanics					
Course Code: MECH1201					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Module I [10 L]

Basic concepts of Thermodynamics:

Introduction; Macroscopic and microscopic concept; Definition of Thermodynamic systems; Surrounding, universe; Open, closed and isolated systems; Concept of control volume; Thermodynamic properties: intensive, extensive & specific properties; state.

Thermodynamic equilibrium; Change of state; Thermodynamic processes and cycles; Quasi-static processes; Reversible processes; Zeroth law of Thermodynamics -concept of temperature.

Heat & Work:

Definition of Thermodynamic work; Work transfer-displacement work for a simple compressible system, path function, PdV work in various quasi-static processes(isothermal, isobaric, adiabatic, polytropic, isochoric); Free expansion; Indicated diagram (P-V diagram) .
Definition of heat; Heat transfer-a path function; Similarities and dissimilarities between heat and work.

Module II [8 L]

First law of Thermodynamics: Statement; 1st law for a closed system executing a cycle; Concept of stored energy; Energy as a property, different forms of stored energy, internal energy, first law for a non-flow process; Flow work; Definition of enthalpy, C_p, C_v; Energy of an isolated system; Flow energy; First law for an open system - steady flow energy equation; Examples of steady flow devices(nozzle and diffuser, turbine, pump, compressor, boiler, condenser and throttling device); PMM-I

Module III [10 L]

Second law of Thermodynamics:

Qualitative difference between heat and work; Definition of source & sink: cyclic heat engine, heat pump and refrigerator, thermal efficiency of heat engine, C.O.P of heat pump and refrigerator; Kelvin-Plank and Clausius statements of second law; Equivalence of the two statements.

Reversible process; Irreversible process; Factors for irreversibility; Carnot cycle and Carnot efficiency; Reversible heat engine and heat pump; PMM-ll

Entropy: Mathematical statement of Clausius Inequality: Entropy as a property; Entropy principle; T-s plot for reversible isothermal, adiabatic, isochoric & isobaric processes.

Air standard Cycles:

Otto cycle & Diesel cycle, P-V & T-s plots, Net work done and thermal efficiency.

Module IV [10 L]

Properties & Classification of Fluid:

Definition of fluid; Concept of Continuum; Fluid properties- density, specific weight, specific volume, specific gravity; Viscosity : definition , causes of viscosity , Newton's law of viscosity, dimensional formula and units of viscosity, kinematic viscosity; Variation of viscosity with temperature. Ideal and Real fluids; Newtonian and Non-Newtonian fluids; No-slip condition.
Compressibility and Bulk modulus of elasticity.
Difference between compressible and incompressible fluids.

Fluid Statics:

Introduction; Pascal's Law--statement and proof; Basic Hydrostatic Law and its proof; Variation of pressure with depth in incompressible fluid, piezometric head, pressure head; Unit and scales of pressure measurement.
Measurement of fluid pressure: Piezometer, Manometers -Simple and Differential U-tube manometer, Inverted tube manometer, Inclined tube manometer.
Characteristics and choice of manometric fluid.

Module V [10 L]

Fluid Kinematics:

Definition; Flow field and description of fluid motion(Eulerian & Lagrangian method), steady and unsteady flow, uniform and non-uniform flow-examples.
Acceleration of a fluid particle-local acceleration, convective acceleration. Stream line, Stream tube, Path line and Streak line; Laminar and Turbulent flow, Reynolds Number. Equations of streamlines and path lines.
Continuity equation for unidirectional flow and for differential form in 3-D Cartesian coordinate system.

Dynamics of Ideal fluids:

Introduction, Euler's equation of motion along a streamline; Bernoulli's equation-assumptions and significance of each term of Bernoulli's equation.
Application of Bernoulli's equation-problem on pipe line. Measurement of flow rate: Venturimeter and orificemeter .
Static pressure, Dynamic pressure, Stagnation pressure-measurement of velocity by Pitot tube.

References:

1. Engineering Thermodynamics- Nag, P.K. - T. M.H
2. Fundamentals of Thermodynamics- Sonntag, Borgnakke & Van Wylen, Wiley India
3. Thermodynamics- an Engineering approach - 6e, Cengel & Boles, TM
4. Fluid Mechanics & Hydraulic Machines – R.K. Bansal, Laxmi Publications Ltd, India
5. Introduction to Fluid Mechanics and Fluid Machines- S.K. Som, G. Biswas, & S. Chakraborty , T.M.H
6. Fluid Mechanics – A.K. Jain, Khanna Publishers.

Course Name : Introduction to Computing Lab					
Course Code: CSEN1211					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	3	3	2

Basic Computation & Principles of Computer Programming Lab

Softwares to be used: Cygwin and notepad++, Tiny C

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

Course Name : PHYSICS I Lab					
Course Code: PHYS 1011					
Contact hrs per week:	L	T	P	Total	Credit points
	0	0	3	3	2

1. Determination of Young's modulus by Flexure Method and calculation of bending moment and shear force at a point on the beam.
2. Determination of modulus of rigidity by Static/Dynamic Method.
3. Determination of thermal conductivity of a good conductor by Searle's Method.
4. Determination of thermal conductivity of a bad conductor by Lee's and Chorlton's Method.
5. Determination of dielectric constant of a given dielectric material.
6. Use of Carey Foster's bridge to determine unknown resistance.
7. Determination of wavelength of light by Newton's ring method.
8. Determination of wavelength of light by Fresnel's biprism method.
9. Determination of wavelength of light by Laser diffraction method.
10. Determination of dispersive power of the material of a given prism.
11. Determination of co-efficient of viscosity of a liquid by Poiseulle's capillary flow method.

Course Name : Basic Electronics Engineering Lab					
Course Code: ECEN1011					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

List of Experiments

1. Familiarisation with passive and active electronic components such as Resistors, Inductors, Capacitors, Diodes, Transistors (BJT) and electronic equipment like DC power supplies, multimeters etc.
2. Familiarisation 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

Course Name : Workshop Practice					
Course Code: MECH1011					
Contact hrs per week:	L	T	P	Total	Credit points
	1	0	3	4	3

Job 1: General awareness of a typical workshop.

Theory requirements: Workshop definition, various shops in a typical workshop, Carpentry, Fitting, Foundry; Sheet Metal Shop, Welding and Brazing Shop, Machine Shop , Forging & Blacksmithy, Safety precautions to be followed in a workshop, Familiarization of Various safety devices and their uses.

Job 2: Making of a wooden pattern.

Theory requirements: Market forms of converted Timber ,eg, log, balk, plank,batten, beam ,Types of Wood, Hard Wood, Soft Wood, particle board; Seasoning of wood, Natural seasoning, Artificial seasoning, Carpentry Tools- Marking Tools, Cutting Tools, Planing Tools, Boring Tools, Striking Tools , Holding & Misc. Tools, Carpentry Processes (marking, sawing, planning, chiselling, boring, grooving, joining etc.), Safety precautions in Carpentry Shop.

Job 3: Making of a matched profile form MS plate.

Theory requirements: Work Bench, Fitting Tools (Bench Vice,Chisel,Hammer,Different types of Files, (Rough,Bastard, Second Cut, Half Round, Triangular File),Saw(Hack saw etc.), Scriber, Punch, Try Square, Angle Plate, caliper (outside & inside), Universal Surface Gauge, Centre Punch, Prick Punch, Drill (Flat,straight fluted, taper shank twist drill).
Fitting Operations,Filing, Marking, Drilling, Tapping (Rougher,Intermediate, Finisher taps), Tap Drill size (D=T-2d), Sawing, Dieing . Safety precautions in Fitting Shop.

Job 4: Making of an internal and external thread.

Theory requirements : Thread standards and thread classifications, Internal Thread,External Thread, Thread Nomenclature (Major dia, Minor dia, Pitch dia, pitch, Lead, TPI, Metric, BSP , Nominal size), Specifications of threaded fasteners (in Metric System). Safety precautions in Dieing and Tapping.

Job 5: Making of a green sand mould using the pattern made under Job no. 2.

Theory requirements: Mould making, Preparation of sand, (silica, clay, moisture, and misc items and their functions), Properties of a good sand mould, General procedure for making a good sand mould, Different tools used for preparation of a mould, Explanation of various terms , Cope and Drag Box, Runner, Riser, Gating and its utility, Parting sand, Vent holes.

Job 6: Demonstration of metal melting and casting

Theory requirements: Metal melting furnaces: Ladles, Using of Tongs, Molten metal pouring procedure, Safety precautions in pouring molten metal in a mould.

Job 7. Making of a stepped pin in a centre lathe. (2 Classes)

Theory requirements: Machining and common machining operations , Lathe M/c and its specifications, Head stock, Tailstock, Chuck-Self centering chuck , 4 jaw chuck, Bed, Carriage, Feed mechanism, Screw cutting mechanism, various lathe operations like turning, facing, grooving, chamfering, taper turning ,Thread cutting, Knurling, Parting, Cutting speed, Feed, Depth of cut , Different types of cutting tools-Safety precautions in a machine shop.

Job 8: Making of square prism from a round shaft by Shaping Machine

Theory requirements: Description of a Shaping machine, Base , Column, Saddle, Clapper box, Quick return mechanism, Feed Mechanism, Table, Rotation of table, Adjustment of stroke length, Adjustment of starting point of cut. Safety Precautions while working in Shaping Machine.

Job 9: Making of square prism from a round shaft by Milling Machine

Theory requirements: Description of a milling machine, Specification of a Milling machine, Types of Milling-Up Milling, Down Milling, Vertical Milling Machine, Horizontal Milling Machine , Safety precautions while working in Milling Machine.

Job 10 : Arc Welding practice and making of a welded joint

Theory requirements: Welding, Weldability, Types of Welding, MMAW, Gas Welding, Electrode , Functions of Flux, Equipment for MMAW, Different types of Flames in Gas Welding and Gas Cutting (Neutral-Oxidising-Reducing Flames), Different types of welding joints, AC Welding , DC Welding; Safety precautions in Welding Shop.

Job 11 : Sheet Metal forming & Brazing

Theory requirement: Specification of sheet metal, SWG vs. mm, HR sheet, CR sheet, GI Sheet, Stainless Steel Sheet, Aluminum sheets, Tin Plates, Sheet metal working Tools, Micrometer, Chisels, Punches, Hammers, Mallets, Hand Shear or Snippets, Various sheet metal forming operations, Shearing, Marking, Punching, Drilling, Bending, Drawing, Brazing, Safety precautions in Sheet Metal Working Shop.

References:

1. Elements of Workshop Technology (Vol- I and II)- Hajra Choudhury, Media Promoter &Publishers Privet Limited.
2. Workshop Technology (Vol- I and II) – Chapman , Viva Books Privet Limited.

Course Name : Indian Culture and Heritage					
Course Code: HMTS2002					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	2	**0**	**0**	**2**	**1**

Module-I: Indian Religion & Philosophy [10L]
1. Orthodox Indian Philosophy
2. Unorthodox Indian philosophy
3. Essentials of Hinduism
4. An overview of Jainism, Buddhism, Sikhism, Islam, Christianity religions

Module-II: Values and Personality [10L]
1. Aspects of Indian Values
2. Essentials of Personality Building
3. Ethics at work place
4. Aspects of Leadership qualities

Module-III: Indian Scriptures [10L]
1. Selections from the Vedas
2. Select verses from Upanishad
3. An overview of Gita
4. XVIth chapter of Gita

Module-IV: Indian Psychology [10L]
1. Aspects of Yoga Philosophy
2. Mind and its workings according to Yoga
3. Law of Karma
4. Selections from Manusmriti

References:

1. Indian Philosophy by S.C. Chatter and D. M. Dutta, Calcutta University Press
2. Spiritual Heritage of India, Swami Prabhavananda, Sri Ramakrishna Math, Chennai
3. Raja Yoga by Swami Vivekananda, Advaita Ashrama, Mayavati
4. Vedic Selection, Calcutta University Press
5. Gita by Swami Swarupananda, Advaita Ashrama, Kolkata
6. Upanishads by any press
7. Carving a Sky (MSS) by Samarpan
8. Essentials of Hinduism (MSS) by Samarpan
9. The Call of the Vedas — Bharatiya Vidya Bhavan

Course Name : Chemistry of Biomolecules					
Course Code: BIOT2101					
Contact hrs per week:	L	T	P	Total	Credit points
	3	1	0	4	4

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

Introduction: Structure of water molecules, Weak inter-molecular interactions in biomacromolecules, Basic concepts of pH, buffer, pKa**.** Chemistry of Carbohydrates: Definition, classification, structure and chemical properties of: Monosaccarides; Sucrose, Lactose, Maltose; Glucosamine, Muramic Acid; Starch, Glycogen, Cellulose, Chitin, Agar, Proteoglycans; Sialic acids and blood group polysaccharides. Stereochemistry of Carbohydrates: Projection formula (Fischer, flying-wedge, Sawhorse, Newman & Howarth), Configuration, conformation, Optical isomerism (d/l, D/L and R/S nomenclature), Anomer, Epimer, Mutarotation.

Module-II: Chemistry of Lipids [10L]

Lipids: Definition, classification. Structure, Reactions and characterization of: fatty acids, Triacyl glycerols. Structure of Prostaglandins, Oil, Wax. Geometrical isomerism (cis/trans, syn/anti, E/Z) of Fatty acids. Hydrolysis, saponification value, iodine number, rancidity and Biological significance of fats. Phospholipids: Introduction and importance. Glycerophospholipids, lecithins, cephalins, phosphatidyl serine, phosphatidyl inositol, plasmalogens, sphingomyelines. Glycolipids: cerbrosides, gangliosides. Steroids and carotenoids: Introduction, and importance, cholesterol, modifications of sterols, bile acids, steroid hormones, carotenes.

Module-III: Chemistry of Amino Acids, Proteins and Nucleic acids [10L]

Classification, Structure, pH titration curve and Important Chemical reactions. Structure of Amino Acids. Peptide bond, Solid phase peptide synthesis, peptide sequencing. Four levels structures, Conformation (Ramachandran plot, domains, motif and folds), Separation Methods based on structure and chemical properties; denaturation and renaturation of proteins. Example: RNaseA, keratins, collagen, Lectins, myoglobin, hemoglobin. Stability of protein. Chemistry of Nucleic Acids: Structure, nomenclature of Nucleoside, Nucleotides. Four levels structures, Functions, Conformations, Nucleotide sequence composition of DNA and RNA. Supercoiled structure, Denaturation and renaturation kinetics of DNA. Stability of Nucleic acids

Module-IV: Techniques for estimation and structure determination of Biomolecules [10L]

Introduction to absorption and emission spectroscopy and Lambert**–**Beer law**.** Estimation of biomolecules by spectroscopic, colorimetric, phosphorescence, and luminescence method. Basic concepts and principles for structure determination techniques: X-ray diffraction, crystallography; spectroscopy: UV and visible, fluorescence, Infrared, Nuclear Magnetic Resonance, circular dichroism, Optical Rotatory Dispersion, Surface plasmon resonance, Electron Spin Resonance Spetroscopy, Microscopy: atomic force (AFM) and 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 4^{th} Edn. (2011) Voet, D. and Voet JG. (Wiley)
4. Biochemical Calculations by Irwin H. Segel, John Wiley & Sons

Reference books:

1. Biochemistry by Lubert Stryer. W. H. Freeman & Company, NY
2. Biochemistry by Zubey. Wm. C. Brown publishers
3. Organic Chemistry, Finar, IL. Part II.
4. Biochemistry, 5th edition (2002) by Berg, Tymoczko, and Stryer. (W H Freeman)
5. David Friefelder, Physical Biochemistry
6. Practical Biochemistry Principles and techniques :Ed Wilson and Walker, Cambridge University Press
7. Physical Chemistry, Principles and Applications in Biological Sciences (2001) by Tinoco, Sauer and Wang,, Prentice Hall, 4th Edition
8. Physical Chemistry for the Life Sciences (2005) by Atkins,, W.H. Freeman
9. Physical Chemistry with Applications to the Life Sciences(1979) by Eisenberg & Crothers, Benjamin/Cummings Publishing Co.
10. Principles of Physical Biochemistry (1998) by K. E. van Holde, W. C. Johnson, and P.S. Ho.
11. Biophysical Chemistry (1981), Part I: The Conformation of Biological Macromolecules, Part II: Techniques for the Study of Biological Structure and Function by C.R. Cantor and P.R.Schimmel.

Course Name : Basic Environmental Engineering & Ecology					
Course Code: CHEM2001					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module-I: Environment & Ecology (General discussion) [10L]

Basic ideas of environment and its component

Mathematics of population growth: exponential and logistic and associated problems, definition of resource, types of resource, renewable, non-renewable, potentially renewable, Population pyramid and Sustainable Development.

General idea of ecology, ecosystem – components, types and function.

Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundarban); Food chain (definition and one example of each food chain), Food web.

Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphorus, Sulphur].

Biodiversity- types, importance, Endemic species, Biodiversity Hot-spot, Threats to biodiversity, Conservation of biodiversity.

Module-II: Air pollution and control [10L]

Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause. 1L

Green house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food. Global warming and its consequence, Control of Global warming. Acid rain: causes, effects and control. Earth's heat budget, carbon capture, carbon footprint

Lapse rate: Ambient lapse rate, adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion). Atmospheric dispersion, Maximum mixing depth

Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria pollutant. Sources and effect of different air pollutants- Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN.

Smog: Photochemical smog and London smog. Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other green house gases, effect of ozone modification

Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP, cyclone separator, bag house, catalytic converter, scrubber (ventury), Statement with brief reference).

Module-III: Water Pollution and Control [10L]

Hydrosphere, Hydrological cycle and Natural water. Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides,

River/Lake/ground water pollution: River: DO, 5 day BOD test, Unseeded and Seeded BOD test, BOD reaction rate constants, COD.

Lake: Eutrophication [Definition, source and effect]. Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only)

Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening]

Waste water treatment system, primary and secondary treatments [Trickling filters, rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds]

Water pollution due to the toxic chemicals effects: Lead, Mercury, Cadmium, Arsenic

Noise Pollution

Definition of noise, effect of noise pollution, noise classification [Transport noise, occupational noise, neighbourhood noise]. Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, L_{10} (18hr Index), effective perceived noise level.

Noise pollution control.

Module-IV: Land Pollution [10L]

Solid Waste: Municipal, industrial, commercial, agricultural, domestic, pathological and hazardous solid wastes, electronic waste

Recovery and disposal method- Open dumping, Land filling, incineration, composting, recycling.

Social Issues, Health and Environment

Environmental disasters: Bhopal gas tragedy, Chernobyl disaster, Three Mile Island disaster, cancer and environment: carcinogens, teratogens and mutagens (general aspect)

Environmental impact assessment, Environmental audit, Environmental laws and protection act of India.

Energy audit, Green building, Green sources of energy, Concept of Green Chemistry, Green catalyst, Green solvents (replacement of VOC)

References/Books

1. Masters, G. M., "Introduction to Environmental Engineering and Science", Prentice-Hall of India Pvt. Ltd., 1991.
2. De, A. K., "Environmental Chemistry", New Age International.
3. Asim K. Das, Environmental Chemistry with Green Chemistry, Books and Allied P. Ltd
4. S. C. Santra, Environmental Science, New Central Book Agency P. Ltd
5. GourKrishna Das Mahapatra, Basic Environmental Engineering and Elementary Biology, Vikas Publishing House P. Ltd.

Course Name : Industrial Stoichiometry					
Course Code: BIOT2102					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Module-I: Units and Dimensions [10L]

Small units and dimensions, dimensionless groups, dimensional analysis. Conversion of equations. 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. Prentice Hall India.
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	**1**	**0**	**4**	**4**

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 Ketone bodies 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, cell adhesion and different adhesion molecules, gap junctions, extracellular matrix, integrins.

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	**1**	**0**	**4**	**4**

Module-I: Introduction to Microbiology [10L]
Development of microbiology: rejection of abiogenesis theory- major contributions by different scientists: diversification of basic microbiology into different application domains.
Bacteria: morphology, cell structure with subcelluar functional organelles,
Archaebacteria and actinomyces: General morphology, growth characteristics.
Yeast: General morphology and subcellular structure, growth and reproduction.
Fungi: General morphology, sexual and asexual reproduction.
Algae: Classes of algae, cyanobacteria.
Virus: General morphology, virulence, types.
Applications of microbes and Algae in Biotechnology.
Biochemical & Molecular Taxonomical identification of microorganisms.

Module-II: Basic principles and methods in microbiology [10L]
Microscopy: Human visibility and microorganisms, history of development of Microscope, description optical complex microscope. Resolving power, numerical aperture and chromatic aberration Microscopy II: 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 (natural, 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. Mod genes, nitrogenase complex, legheamoglobin.

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 : Biomolecular Chemistry Lab					
Course Code: BIOT2111					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

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: BIOT2112					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	2	**0**	**0**	**2**	**1**

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 2113					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**5**	**5**	**3**

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.

Course Name : Human Values and Professional Ethics					
Course Code: HMTS2001					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	2	**0**	**0**	**2**	**1**

Module-I [10L]

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,Utilatirianism, 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, Giligan's theory(consensus and controversy)
Code of Professional Ethics Sample Code of ethics like ASME, ASCE. IEEE,Institute 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 [10L]

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 : Numerical and Statistical Methods					
Course Code: MATH2002					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Module-I: Numerical solution to linear and non-linear equations [8L]

Solution of non-linear algebraic equations 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.

Module-II: Numerical solution to integration and ordinary differential equations [8L]

INTERPOLATION AND INTEGRATION:
Newton's Forward and Backward Interpolation Method, Lagrange's Interpolation, Trapezoidal and Simpson's $1/3^{rd}$ Rule.
SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS:
Euler's and Modified Euler's Method, Runge-Kutta Method of 4^{th} order.

Module-III: Fundamentals of Probability [5L]

Prerequisites- Set Theory.
Random experiment, Sample space , Events .
Definition of Probability,
Addition law of probability, Multiplication law and Conditional Probability.
Bayes' Theorem (Statement only)

Module-IV: Probability distributions and Statistics [15L]

Random Variables – Discrete and Continuous, Probability Mass Function, Probability, Density and Cumulative Distribution Functions, Mathematical Expectation and Variance.
Special Distributions: Binomial, Poisson, Uniform, Exponential and Normal.
Measures of Central Tendency and Dispersion – Mean, Median, Mode and Standard Deviation for grouped and ungrouped frequency distribution.
Simple Correlation and Regression.

Suggested Books:

1. Miller & Freund's Probability and Statistics for Engineers, R.A.Johnson Prentice Hall of India
2. Numerical Mathematical Analysis, J.B.Scarborough, Oxford and IBH Publishing Co. Pvt. Ltd.
3. Numerical Methods (Problems and Solution), Jain, Iyengar & Jain, New Age International Publishers
4. Fundamentals of Mathematical Statistics, S.C. Gupta and V.K. Kapoor, Sultan Chand & Sons.
5. A First course in Probability, Sheldon Ross, Pearson

Course Name : Thermodynamics and Kinetics					
Course Code: BIOT 2201					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**1**	**0**	**4**	**4**

Module-I: Basic concept of thermodynamics [10L]

Concept of Enthalpy and Entropy; Phase Rule; PVT behavior of pure substances; Equation of states: Van der Waal's Equation, Virial Equation and its Application; Low temperature processes: Refrigeration and Liquefaction; Residual properties; Chemical Potential and Phase Equilibrium; Fugacity and Fugacity Coefficient; Vapour/Liquid Equilibrium, Roult's Law, Modified Raoult's Law, Henry's law.

Module-II: Bioenergetics and Thermodynamics [**10L]**

Importance of thermodynamic laws and free energy in Biological system; Thermodynamic properties to understand: Enzymes, ATP synthesis and hydrolysis within cell, metabolism and ATP yield; Protein folding and free energy funnel. Transport across membrane: active transport; activation energy; gradient of chemical potential as driving force in biological process.

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**

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.

Textbook:
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	**1**	**0**	**4**	**4**

Module-I: Replication and DNA repair 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. Mechanisms of different types of DNA Repairs, SOS repair. Repair defects and human diseases. Recombination: Mechanism of general, 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, tRNA, rRNA, siRNA, miRNA; 5'-Cap formation; 3'-end processing and polyadenylation; Splicing (different types); RNA editing; Nuclear export of mRNA; mRNA stability; Catalytic RNA, RNA transport, localization and function. Inhibitors of transcription; Reverse transcription; Ribozyme.

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 translationa: structure and function of ORF, tRNA, rRNA, Ribosomes, RBS, aminoacyl synthetases. 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]
Molecular structure of gene and its nomenclature. Principle of gene regulation: Negative and Positive Regulation, Structure and function of gene regulatory protein. 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, Chromatin remodeling, Gene silencing and Epigenetic regulation. Regulations at level of translation, Riboswitch.

Text books:

1. Molecular Biology of the Gene, 6th Edition, - by J.D. Watson, N.H. Hopkins, J.W Roberts, J. A. Seitz & A.M. Weiner.
2. Benjamin Lewin, Gene IX, 9th Edition, Jones and Barlett Publishers, 2007.
3. Essentials of molecular Biology, by Malacinski and Freifelder Jones and Bartlelt Publishers.

Reference books:

1. Molecular and Cellular Biology- by Stefen Wolfe, Wordsworth Publishing Co.
2. Genomes, by T. A. Brown, John Wiley and Sons PTE Ltd.
3. Cell and molecular Biology, Concepts and experiments by Gerald Karp, John Wiley & Sons.
4. The Cell - A molecular approach, by G. M. Cooper, ASM Press.
5. Molecular biology of cell 4thed Alberts, Bruce; Watson, J D(2002) Garland Science Publishing,
6. Molecular cell biology 4th ed Lodish, Harvey and. Baltimore,D(2000) W.H. Freeman and Co.
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**
	2	**0**	**0**	**2**	**1**

Module-I: Fermentation process and high-yielding microbes [10L]
Definition and scope, Basic idea on fermentation process, submerged, stationary, solid and semi-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: Fermentation processes [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. Postproduction techniques and future.

Module III: Enzyme Technology [10L]
Enzyme : brief overview, classification and nomenclature , 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. Commercial enzymes: Industrial application Food processing Enzymes of Analytical, diagnostic and medicinal applications Stable enzyme : selection of extremophilic producer Stable enzymes by protein engineering Enzyme electrode & Enzyme sensor Use of Enzymes in non aqueous media.

Module IV: Enzyme applications [10L]
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
General overview on the use of enzymes in different industrial processes
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 : Language Practice Lab (Level 2)					
Course Code: HMTS 2011					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

Module-1: Formal verbal communication

- Introduction to formal verbal communication, Interpersonal Skills & Public Speaking: Building Positive Relationships, Focusing on Solving Problems, Time Management, Dealing with Criticism: Offering Constructive Criticism, Responding to Criticism – Managing Conflict: Approaches to Conflict, Resolving Conflict

- Conversational skills in the business scenario: One-to-one and Group communication, Gender and Culture Sensitivity, Etiquette, Sample Business Conversation, Telephonic Conversation

Module-II: Presentation skills

- Speech Purposes - General: Informative Speeches, Persuasive Speeches, Entertaining Speeches, Methods of Speaking: Speaking from a Manuscript, Speaking from Memory, Impromptu Delivery, Extemporaneous Delivery, Analyzing the Audience, Nonverbal Dimensions of Presentation

- Organising the Presentation: the Message Statement, Organising the Presentation: Organizing the Speech to Inform, The Conclusion, Supporting Your Ideas – Visual Aids: Designing and Presenting Visual Aids, Selecting the Right Medium, Post- presentation Discussion

Module-III: Group Discussion

- Introduction to Group Communication
  Factors in Group Communication, Status – Group Decision Making: Reflective Thinking, Brainstorming, Body Language, Logical Argument, The Planning Process, Strategies for Successful GDs, Role of Social Awareness (Newspapers, Magazines, Journals, TV News, Social Media), Practice GDs

Module-IV: Job Application and Personal Interview

- **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 Chronological and Functional

Resume – Content of the Resume: Heading, Career Goal or Objectives, Education, Work Experience, Summary of Job Skills/Key Qualifications, Activities, Honours and Achievements, Personal Profile, Special Interests, References

- **Interviewing**
  Types of Interviews, Format for Interviews: One-to-one and Panel Interviews, Employment Interviews, Frequently Asked Questions, Dress Code, Etiquette, Questions for the Interviewer, Simulated Interviews

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. Raman, M. and Sharma, S., Technical Communication: Principles and Practice, 2nd Ed., 2011

Course Name : Numerical and Statistical Methods					
Course Code: MATH 2012					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**2**	**2**	**1**

Development of computer programs in C for the following problems:

1. Regula-Falsi Method
2. Newton-Raphson Method
3. Gauss-elimination Method
4. Gauss-Seidel Method
5. Newton's Forward Interpolation
6. Lagrange's Interpolation
7. Trapezoidal and Simpson's 1/3rd rule
8. Euler's and Modified Euler's Method
9. Runge-Kutta method of 4th order
10. Computation of Mean , Median , Mode and Standard Deviation for grouped and ungrouped frequency distribution
11. Computation of Correlation coefficient and Regression equation for Bivariate data.

Course Name : Transfer Operations-I Lab					
Course Code: BIOT2211					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

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. To study the working characteristics of a Jaw Crusher, calculate the energy consumption as a function of size reduction and compare it with the actual energy requirements.
8. To study the working characteristics of a Ball Mill, calculate the energy consumption as a function of size reduction and determine the critical speed.
9. To Determine 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: BIOT 2212					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

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 of proteins from bacterial cells and separation by SDS-PAGE.
8. Induced mutation by: (a) Chemical (b) Ultraviolet light.
9. Phage Titration.

Reference Book:
Molecular Cloning – A laboratory manual: 3rd Edition Vol. 1-3. Sambrook J and Russell D.W. (2001). CSHL Press, New York

Course Name : Enzyme Technology & Fermentation Technology Lab					
Course Code: BIOT2214					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	**0**	**3**	**3**	**2**

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 : Economics for Engineers					
Course Code: HMTS3101					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Module 1:
Market: Meaning of Market, Types of Market, Perfect Competition, Monopoly, Monopolistic and Oligopoly market.
The basic concept of economics – needs, wants, utility.
National Income-GDP, GNP. Demand & Supply, Law of demand, Role of demand and supply in price determination, Price Elasticity.
Inflation: meaning, reasons, etc. (6L)

Module II:
Business: Types of business, Proprietorship, Partnership, Joint-stock company, and cooperative society – their characteristics.
Banking: role of commercial banks; credit and its importance in industrial functioning. Role of central bank: Reserve Bank of India.
International Business or Trade Environment. (4L)

Module III:
Financial Accounting-Journals. Ledgers, Trial Balance, Profit & Loss Account, Balance Sheet.
Financial Statement Analysis (Ratio and Cash Flow analysis). (8L)
Cost Accounting- Terminology, Fixed, Variable and Semi-variable costs.
Break Even Analysis. Cost Sheet. Budgeting and Variance Analysis.
Marginal Cost based decisions. (6L)

Module IV:
Time Value of Money: Present and Future Value, Annuity, Perpetuity.
Equity and Debt, Cost of Capital. (4L)
Capital Budgeting: Methods of project appraisal - average rate of return - payback period - discounted cash flow method: net present value, benefit cost ratio, internal rate of return.
Depreciation and its types, Replacement Analysis, Sensitivity Analysis. (8L)

Suggested Readings:

1. R. Narayanswami, *Financial Accounting- A Managerial Perspective.* Prentice-Hall of India Private Limited. New Delhi
2. Horne, James C Van, *Fundamentals of Financial Management*. Prentice-Hall of India Private Limited, New Delhi
3. H. L. Ahuja., *Modern Economic Theory*. S. Chand. New Delhi.
4. Newman, Donald G., Eschenbach, Ted G., and Lavelle, Jerome P. *Engineering Economic Analysis.* New York: Oxford University Press. 2012.

Course Name : Genetics					
Course Code: BIOT3101					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module I: Classical Genetics and its deviations [10L]
Principles of Mendelian inheritance, multiple alleles, pseudoallele, Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and chromosome mapping, sex linkage, sex limited and sex influenced characters; sex determination, extra-nuclear inheritance, special types of chromosomes; structural and numerical chromosomal abnormalities and their genetic implications; pedigree analysis, lod score for linkage testing, linkage disequilibrium.

Mod-II: Mutation and Cancer Genetics [10L]
Gene Mutation: Induced and spontaneous mutation**,** mutation types, causes and detection, mutant types. Molecular basis of genetic disorders, karyotypes, inborn errors of metabolism. Cancer Genetics: genetic rearrangements in progenitor cells, oncogenes, proto-oncogenes, tumour suppressor genes – p53, RB and others, virus-induced cancer; cell cycle check points and cancer.

Module III: Microbial and Developmental Genetics [10L]
Methods of genetic transfers: transformation, conjugation, transduction and sex-duction. Gene mapping methods: interrupted mating, recombination and complementation analysis. Genetics of animal virus. Developmental genetics in Drosophila model: egg-polarity genes and formation of body axes; molecular control of segmentation: gap genes, pair-rule genes, segment polarity genes; homeotic genes, Wnt and cadherin pathways; cellular ageing & senescence.

Module IV: Biostatistics and Population Genetics [10L]
Biostatistics: Mean, median, mode, standard deviation, variance, discrete and continuous probability distributions, Poisson, normal and binomial distributions; T test, chi-square analysis, ANOVA. Population genetics: Hardy-Weinberg equilibrium, allele frequency and genotype frequency. Extensions of H-W equilibrium: mutation, selection, continuous variation, genetic drift, migration.

Textbook:

1. Concepts of Genetics, 7th edition. M.R. Cummings, A.W. Klug. Pub: Pearson Education.
2. Genetics, 3rd edition. M.W. Strickberger. Pub: Pearson Education.

Reference Books:

1. Introduction to Genetic Analysis, 8th edition, Anthony J. F. Griffiths, Jeffrey H. Miller, David T. Suzuki, Richard C. Lewontin, and William M. Gelbart. Pub: W.H. Freeman & Co.
2. Principles of Genetics, 5th edition. D. Peter Snustad, Arthur J. Simmons. Pub: John Wiley & Sons.
3. iGenetics: a Conceptual Approach, 3rd edition. Peter J. Russell. Pub: WH Freeman & Co.
4. Microbial Genetics, 2nd edition. Stanley R. Maloy, John E. Cronan, David Freifelder. Pub: Jones and Bartlett Publisher Inc.
5. Genetics: analysis of genes and genomes, 6th edition. D.L. Hartl & E.W. Jones. Pub: Jones and Bartlett Publishers.
6. Genetics: From genes to Genomes, 5th edition. L.H. Hartwell, M.L. Goldberg, J.A. Fischer, L. Hood , C.F. Aquadro. Pub: McGraw Hill.
7. Genetics-a Conceptual Approach. 4th edition. B.A. Pierce. Pub: W.H. Freeman & Co.
8. An introduction to Human Molecular Genetics: Mechanism of Inherited Diseases. 2nd edition. J. Pasternak. Pub: Fitzgerald Science Press.
9. Thompson and Thompson Genetics in Medicine, 8th edition. R.L. Nussbaum, R.R. McInnes, H.F. Willard. Pub: Elsevier.
10. Landmarks in Medical Genetics. (Ed.) P.S. Harper. Pub: Oxford University Press.
11. Developmental Biology, 10th edition. S.F. Gilbert. Pub: Sinauer Associates.
12. Introduction to Biostatistics, 2nd edition, Pranab Kumar Banerjee. Pub: S. Chand & Co.
13. Problems on Genetics, Molecular Genetics and Evolutionary Genetics. Pranab Kumar Banerjee. New Central Book Agency Pvt. Ltd.
14. Statistics in Biology and Psychology, 4th edition. Debajyoti Das, Arati Das. Academic Publishers.

Course Name : Bioinformatics					
Course Code: BIOT3102					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Module 1: Bioinformatics Resources and Databases [10L]

Definition and application of bioinformatics to biological research; Introduction to different primary and secondary databases (viz: Genbank,PDB) introduction to different modules of NCBI

Module 2: Sequence Analysis of proteins and nucleic acids [10L]

Introduction to sequence analysis, Basic concepts: Sequence similarity, identity and similarity, definitions of homologues, orthologues, paralogues, Tandem and Interspersed repeats, local and global alignment, pair wise and multiple alignment, sequence alignment algorithm: Needleman -Wunsch and Smith-Waterman algorithms; Substitution Matrices;

Introduction to phylogenetics analysis through multiple sequence alignment: CLUSTALW A brief introduction to gene prediction

Module 3: Perl Programming [10L]

Accessing and installing Perl and BioPerl , Using modules, like BioPerl. Sequences and Strings : Variables, Arrays, Files .Motifs and Loops-Flow control, String operators , Writing files. Subroutines -Scoping , Arguments ,Command line arguments , Passing data to subroutines ,Modules and Libraries , Debugging . Data Structures and Algorithms for Biology-Hashes, Translating DNA into Proteins, Working with the FASTA Format , Reading frames. Regular Expressions

Module 4: Protein structure prediction and drug designing [10L]

Hierarchical organization of protein structures-e.g.SCOP, CATH ; Secondary structure prediction via Chou-Fasman , GOR and other methods; Hidden Markov Model and Neural network algorithms and their applications; 3D protein structure prediction using homology modeling, fold recognition and ab-initio methods; CASP; Drug design applications: Receptor-ligand interactions; binding sites, docking and virtual screening; Structure and Ligand Based drug design; QSAR and in silico predictions of drug activity and ADMET.

Textbook:

1. Xiong.J, Essential Bioinformatics, Cambridge University Press
2. An Introduction to Bioinformatics, Arthur W. Lesk, Cambridge University Press.
3. Bioinformatics-Principles and applications-Ghosh and Mallick- Oxford University Press.
4. James Tisdall, Beginning Perl for Bioinformatics, SPD

Reference books:

1. Cynthia Gibbs and Per Jambeck, Introduction to Bioinformatics computer Skills, 2001 SPD
2. Atwood, Introduction to Bioinformatics, Person Education
3. Baxevanis, A.D, Quellette. B.F.F, Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins.
4. Andrew Leach, Molecular Modelling: Principles and Applications,Pearson Education
5. Molecular Modelling and Drug Design-K.Anand Solomon-1st edition (2011)-MJP Publishers

Course Name : Recombinant DNA Technology					
Course Code: BIOT3103					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Module -I: Tools of Recombinant DNA Technology [10L]

DNA & RNA manipulating enzymes and other tools used in Recombinant DNA technology: Restriction endonuclease; DNA polymerases (DNA Pol I, T4, T7, Taq), reversetranscriptases, DNA ligases; alkaline phosphatases; polynucleotidekinase; terminal deoxy-nucleotidetransferase; topoisomerases; DNase; RNase and others; linker and adapter. Physical map, specific host and features of Vectors: Plasmids, bacteriophage vectors, cosmids, phagemids, PAC, BAC, YAC, and MAC, Expression vectors (pET vectors, Baculovirus vectors and others).

Module -II: Techniques Recombinant DNA Technology: [10L]

DNA and RNA labeling (radioactive and non radioactive methods); Restriction mapping; DNA sequencing (Maxum & Gilbert, Sangers, pyro-sequencing, and others methods); Protein and RNA sequencing; Polymerase chain reactions (PCR), different modified PCR and Real time PCR; Techniques of separation of nucleic acid and protein (electrophoresis, chromatography and others); Southern, northern, and western blotting & hybridization; In-situ hybridization; Site-directed mutagenesis; DNA and protein based microarray.

Module -III: Gene Cloning Methods: **[10L]**

Isolation and preparation of DNA fragments from prokaryotic and eukaryotic source; Different types of cloning and expression methods of gene in prokaryotic and eukaryotic host cell system using different vectors (by restriction enzyme, PCR product cloning and other methods); Transfer of recombinant DNA into host; Screening & Expression of cloned gene; Gene isolation; Subcloning strategies; Generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors and their screening.

Module - IV: Application of Recombinant DNA technology [10L]

Genetically engineered vaccine; DNA vaccine; recombinant Biopharmaceuticals (insulin, human growth factor and others); Gene therapy (gene transfer technologies, antisense and ribozyme technology); Molecular biomarker in disease diagnostics and forensic science (RFLP, RAPD, AFLP SNP, EST and others), DNA fingerprinting; Human genome project (strategies for genome sequencing and its application); Genetically modified organism and food; Large scale gene expression analysis.

Textbook:

1. Principles of Gene Manipulation& Genomics, 7th Ed, (2006) Old and Primrose, Pub: Blackwell Scientific.
2. Genetic Engineering by S. Rastogi and N. Pathak, Pub: Oxford Univ. Press.
3. Molecular Cloning: A Laboratory Manual (3-volume set 4th Edn.): (2012) by Michael R. Green, Joseph Sambrook , Pub: CSHL press

Reference books:

1. Molecular Biotecnology: Principles and Applications of Recombinant DNA, 4th Edn. (2010) by Glick, Pasternak and Pattern. Pub: ASM press
2. Recombinant DNA: Genes and Genomes - A Short Course, 3rd Edn. (2007) by James D. Watson, Richard M. Meyers , Amy A. Caudy, Jan A. Witkowski. pub: CSHL
3. H.K. Das, Text Book of Biotechnology, 4th ed, 2010, Wiley Publishers
4. Genetics a Molecular Approach, 7th Ed (2010) by Brown, T.A., pub: Chapman and Hall,
5. Genomes, 3rd ed (2006) by Brown TA, Pub: Garland Science
6. Human Molecular Genetics, 4th Ed. (2011) by Tom Strachan, Andrew Read**,** Pub: Garland Science

Course Name : Transfer Operations - II					
Course Code: BIOT3104					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Module I: Introduction to Mass Transfer [10L]

Introduction to Mass Transfer: Molecular diffusion in fluids. Diffusivity, Mass Transfer Coefficients, Interphase

Mass Transfer, Gas Absorption, co-current and counter-current multistage operation, Packed Tower, Drying, adsorption and Leaching principles

Module II: Distillation [10L]

Distillation: Vapor-liquid equilibrium, Rayleigh's Equation, Flash and Differential distillation, McCabe-Thiele Method to determine stages

Module III: Miscellaneous Mass Transfer Operations [10L]

Liquid–liquid equilibrium. Liquid extraction, Stagewise contact; Adsorption Equilibria: batch and fixed bed adsorption, Batch drying and mechanism of batch drying. Freeze drying, Basic idea of crystallization

Module IV: Advanced Separation Processes [10L]

Advanced Separation Processes: Dialysis, Ultrafiltration, Reverse osmosis, Pervaporation, Electrodialysis and Membrane separation- Principle and operation

Textbook:

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

Reference books:

1. Transport Processes & Unit operations: Geankopolis, PHI, 3rd edition
2. Chemical Engineering, Vol-I & II: Coulson & Richardson, Butterworth Heinemann
3. Treybal, R.E., Mass-Transfer Operations, MGH 4. Perry, Chilton & Green, Chemical Engineers' Handbook, MGH

Course Name : Data Strcuture & Algorithm					
Course Code: CSEN3106					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

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

Introduction (2L):
Why we need data structure?
Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type.
Algorithms and programs, basic idea of pseudo-code.Algorithm efficiency and analysis, time and space analysis of algorithms – 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, linked list representation of polynomial and applications.

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

Stack and Queue (4L):
Stack and its implementations (using array, using linked list), applications.
Queue, circular queue, deque. Implementation of queue- both linear and circular (using array, using linked list)
Recursion (2L):
Principles of recursion – use of stack, differences between recursion and iteration, tail recursion.

Module -III. Nonlinear Data structures [13L]

Trees (9L):
Basic terminologies, tree representation (using array, using linked list). Binary trees - binary tree traversal (pre-, in-, post- order), threaded binary tree. Binary search tree- operations (creation, insertion, deletion, searching). Height balanced binary tree – AVL tree (insertion, deletion with examples only). B- Trees – operations (insertion, deletion with examples only).

Graphs (4L):
Graph representations/storage implementations – adjacency matrix, adjacency list, Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS)

Module - IV Searching, Sorting, Hashing. [9L]

Sorting Algorithms (5L):
Bubble sort, insertion sort, selection sort, merge sort, quicksort, heap sort, radix sort.
Searching (1L):
Sequential search, binary search
Hashing (3L):
Hashing functions, collision resolution techniques (Open and closed hashing).

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 Anderson-freed.
3. “Data Structures in C” by Aaron M. Tenenbaum.
4. “Data Structures” by S. Lipschutz.
5. “Introduction to Algorithms” by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.

Course Name : Genetics lab					
Course Code: BIOT3111					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	0	3	3	2

List of Experiments:

1. Biometry
2. Finding statistical significance of a given data using ‘t test’
3. Pedigree analysis
4. Preparation of different stages of Mitosis and Meiosis
5. Estimation of mitotix index
6. Barr body preparation from buccal smear
7. Cell viability assay
8. Karyotyping analysis and human chromosomal syndromes identification
9. Study of chromosomal aberrations in animal and plant cells.

Course Name : Bioinformatics lab					
Course Code: BIOT3112					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	0	3	3	2

List of experiments

1. Basic understanding of biological databases.
2. Pair wise sequence alignment (LOCAL and GLOBAL Alignment)
3. Multiple sequence alignment (CLUSTALW)
4. Introduction to Gene Prediction
5. Prediction of Secondary structure of globular and membrane proteins
6. *In silico* analysis of enzyme and other biomolecular modifications
7. Structure viewer and analysis; protein 3D structure prediction
8. Basics of molecular modeling and protein-ligand binding
9. PERL Programming

Course Name : Recombinant DNA Technology lab					
Course Code: BIOT3113					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	0	3	3	2

List of experiments:

1. Restriction enzyme digestion of DNA and construction of Restriction map
2. Extraction of DNA from agarose gel
3. Ligation of DNA fragments with cloning vector pUC18 or pBR322.
4. Preparation of competent cells and Transformation into *E.coli* with recombinant vector.
5. Isolation of recombinants and confirmation of insert DNA in vector.
6. Primer design for PCR and amplification of DNA by PCR.
7. Expression of cloned gene.
8. Southern/Western/Northern blotting
9. DNA finger printing

Course Name : Transfer Operations – II lab					
Course Code: BIOT3114					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	0	3	3	2

List of experiments:

1. Batch Distillation to verify Rayleigh's equation.
2. Drawing the vapour-liquid equilibrium diagram from Othmer Still.
3. Study of performance of a Rectification Column.
4. Determination of gas-liquid mass transfer coefficient (Wetted Wall column or packed bed).
5. Study of drying characteristic curves under constant drying condition in tray dyer.
6. Determination of Distribution Coefficient in liquid- liquid extraction operation
7. Study of adsorption efficiency and adsorption isotherm using activated carbon as an adsorbent in a batch reactor.
8. Calculation of diffusivity of a volatile liquid

Course Name : Data Structure & Algorithm lab					
Course Code: CSEN3116					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	0	3	3	2

List of experiments:

1. Implementation of array operations.
2. Stacks and Queues: adding, deleting elements Circular Queue: Adding & deleting elements Merging Problem.
3. Evaluation of expressions operations on Multiple stacks & queues.
4. Implementation of linked lists: inserting, deleting, inverting a linked list.
5. Implementation of stacks & queues using linked lists
6. Polynomial addition.
7. Sparse Matrices : addition.
8. Recursive and Nonrecursive traversal of Trees.
9. DFS and BFS.
10. Application of sorting and searching algorithms.

Course Name : Principles of Management					
Course Code: HMTS3201					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	2

Module I:
Management: Definition, nature, purpose and scope of management, Skills and roles of a Manager, functions, principles; Evolution of Management Thought: Taylor Scientific Management, Behavioral Management, Administrative Management, Fayol's Principles of Management, Hawthorne Studies. (4L)

Module II:
a) Planning: Types of plans, planning process, Characteristics of planning, Traditional objective setting, Strategic Management, premising and forecasting.
b) Organizing: Organizational design and structure, Coordination, differentiation and integration.
c) Staffing: Human Resource Management and Selection, Performance appraisal and Career strategy, Managing Change.
d) Decision-Making: Process, Simon's model of decision making, creative problem solving, group decision-making.
e) Coordinating: Concepts, issues and techniques.
f) Controlling: Concept, planning-control relationship, process of control, Types of Control, Control Techniques (8L)

Module III:
Span of management, centralization and de-centralization Delegation, Authority & power - concept & distinction, Line and staff organizations. (4L)

Module IV:
Organization Behaviour: Motivation, Leadership, Communication, Teams and Teamwork. (6L)
Management by Objectives (MBO): Management by exception; Styles of management: (American, Japanese and Indian), McKinsey's 7-S Approach, Self Management. (2L)

Suggested Readings:

1. Harold Koontz & Heinz Weihrich, Essentials of Management, TMH.
2. Stoner, Freeman, Gilbert Jr., Management, PHI.
3. Bhatt & Kumar, Principles of Management, OUP.

Course Name : Immunology					
Course Code: BIOT3201					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Module 1: Basics of Immunology [10L]

History and evolution of immune system; innate and acquired immunity, hematopoiesis; humoral and cell-mediated immunity; cells of the immune system; complement system: activation pathways, functions and regulation; primary and secondary lymphoid organs: structure and function; concept of epitope, immunogens, haptens, adjuvants;
B and T cells: maturation, activation and differentiation; organization and rearrangement of TCR genes; macrophage and other Antigen Presenting Cells (APCs).

Module II: Antibodies: structure, functions and applications [10L]

Structure and function of antibody classes, concept of isotype, allotype and idiotype; genetic basis of antibody diversity: DNA rearrangements, somatic hypermutation, class switching, allelic exclusion; antibody engineering; phage display libraries; antibodies as *in vitro* and *in vivo* probes, abzymes; primary and secondary immune response; monoclonal antibody: hybridoma technology and applications, recombinant and chimeric antibodies, humanized and bispecific antibodies, immunotoxins; antigen-antibody reaction and its application; immunoelectrophoresis, Immunodiffusion, RIA and ELISA.

Module III: Major Histocompatibility Complex (MHC) and host-graft reactions [10L]

General organization, structure and functions of MHC molecules; antigen processing and presentation; transplantation immunology: graft versus host reaction, HLA typing, immunosuppressive therapy; development of inbred mouse strain, blood group classification and Rh factor; cytokines and other co-stimulatory molecules.

Module IV: Immune tolerance, immune disorders and vaccinology [10L]

Immune tolerance: T cell anergy and T cell elimination; hypersensitivity reactions; autoimmunity with respect to Myasthenia gravis and Rheumatoid arthritis; immunodeficiency, animal models for disease study; tumour immunology: tumour antigens, tumor vaccines and immunotherapy; active and passive immunization: live, killed, attenuated, sub-unit vaccines; vaccine technology: recombinant DNA and protein based vaccines, plant-based vaccines; reverse vaccinology; peptide vaccines, conjugate vaccines.

Text books:

1. Immunology and Immune Technology by A. Chaktraborty, Oxford Univ. Pub.
2. Weir, Immunology, 8th ed, W.B. Saunders & Co.

Reference books:

1. Kuby Immunology, 6th edition. T. Kindt, R. Goldsby, B. Osborne. Pub: W.H. Freeman & Co.
2. Immunology, 7th edition. D. Male, J. Brostaff, D. Roth & I. Roitt, I. Pub: Mosby.
3. Cellular and molecular Immunology, 6th edition. .A.K. Abbas, A.H. Lichtman, S. Pillai. Pub: Saunders.
4. Fundamental Immunology, 7th edition. William E. Paul. Pub: Lippincott Williams & Wilkins.
5. Basic Immunology, 2nd edition. A.K. Abbas & A.H. Lichtman. Pub: Elsevier.
6. Immunology: A short Course, 5th edition. R. Coico, G. Sunshine, E. Benjamini. Pub: Wiley-Liss.
7. Technological Applications of Immunochemicals (BIOTOL). L.S. English. Pub: Butterworth- Heinemann, Oxford Freeman & Co.
8. The Elements of Immunology. F.H. Khan. Pub: Pearson Education.
9. Immunology. C.V.Rao. Pub: Narosa Publishing House, New Delhi.
10. Roitt's Essential Immunology, 10th edition. I.M. Roitt & P.J. Delves. Pub: Blackwell Science. Ltd.
11. Janeway's Immunobiology, 7th edition. K. M. Murphy, P. Travers, M. Walport. Pub: Garland Science.
12. Immunology: An Introduction. Tizard. Pub: Cengage Learning India (P) Limited

Course Name : Plant Biotechnology					
Course Code: BIOT 3202					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Module I: Plant tissue culture – theory and methods [10L]

Propagation of plant tissue and cells under *in vitro* condition, Totipotency. Role of physico-chemical conditions and hormone requirement for propagation of plant cells and tissues . Mode of action of auxin and cytokinin. Micropropagation via axillary and adventitious shoot proliferation, somaclonal variation and haploid culture, protoplast culture, cybrids. Plant breeding and heterosis. Green revolution in India.

Module II: Mass cultivation of plant cell products: [10L]

Basic strategies and factors for secondary metabolite production, Immobilisation technology for yield enhancement , bioreactor system and models for mass cultivation of plant cells. Biotransformation for product development and selection of cell culture (only plant tissue culture products).

Module III: Structure and organization of plant genome [10L]

Structure, function and assembly of genetic material, regulation of plant genome expression at each step: Chromosome assembly, transcriptional, translational and post transcriptional regulation, protein localization and turnover; Basic structure of chloroplast and mitochondrial genome; rubisco synthesis and assembly. Transposon. (Arabidopsis should be taken as the model for study of plant genome).

Module IV: Plant genetic engineering[10L]

Direct and indirect methods of transgene incorporation; Design of plant expression vectors: Promoters, Plant selectable markers; Reporter genes; Ti-based binary vector system. Agrobacterium mediated gene delivery, Biolistic method. Transgene silencing and strategies to avoid transgene silencing, Chloroplast transformation, Targeted gene delivery and methods of detection.
Theory and techniques for the development of transgenic plants conferring resistance to herbicide (Glyphosate, Basta), pesticide (Bt gene), plant pathogens PR-Proteins. Plant engineering towards development of enriched food products – Golden rice, therapeutic products.

Textbooks:

1. Plant Biotechnology: The Genetic Manipulation of Plants,Slater.A., Nigel W.S,Flower. R.Mark , 2009, Oxford Univesity Press.
2. Comprehensive Biotechnology Ramawat.K.G. ,Goyal, S. 2009, S.Chand & Company, New Delhi

Reference books:

1. Biochemistry and Molecular Biology of Plants Buchaman, Gursam, Jones, , 1ed, 2000, L.K.International.
2. Plant Tissue Culture: Theory and Practice Bhozwani and Razdan –1996 Elsevier
3. In vitro Cultivation of Plant Cells, Butterworth & Heineman, Biotol Series.
4. Tissue culture and Plant science, H.E Street(ed) Academic press, London, 1974
5. Tissue and Organ Culture, Gamborg O.L.,.Phillips G.C, Plant Cell, Narosa Publishing House
6. Text Book of Biotechnology Das.H.K. -First Edition 2004, Wiley Dreamtech.

Course Name : Bioreactor design and Analysis					
Course Code: BIOT3103					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Module I: Basic reaction and microbial growth kinetics [10L]
Sterilization of air and media, Microbial growth and product kinetics: Monod equation, Chemostat, Dimension-less numbers and their importance in reactor operation.
Transport Phenomenon in Bioreactor: Role of dissolved oxygen concentration in mass transfer,Determination of mass transfer coefficient (K_La); Factors effecting K_La and their relationship.

Module II: Ideal Bioreactor [10L]
Overview of Chemical Reaction Engineering, Kinetics of homogenous reactions, Elementary Reactions. Molecularity and Order of reaction.
Introduction to batch reactor data –Different methods of analysis of data, Autocatalytic reactions, Reversible reaction, Differential method of analysis of data,Parallel and multiple reaction.Ideal batch, mixed flow and plug flow reactors and their analysis.

Module III: Non-ideal Bioreactors [10L]
Basics of non-ideal flow: Residence time distribution (RTD), Age distribution of fluids: C, E and F curve, experimental method and their relations,
Dispersion model:its significance and analysis.

Module IV: Modern bioreactor systems [10L]
Basic design operation and analysis: Fed-batch system, Surface and submerged fermentation, Air-lift reactor, Bubble column reactor, Membrane bioreactors, Photo bioreactors etc. Immobilized cell system: Diffusion limitation and Bioreactor consideration.
Scale-up and scale down: principles, methodology and problems associated with it.

Text books:

1. Chemical Reaction Engineering O.Levenspiel, Wiley Eastern Ltd. Third edition, 2004
2. Principles of fermentation technology P. F. Stanbury and A. Whitaker, Pergamon Press (1984)

Reference books:

1. Bioprocess Engineering: Basic Concepts, 2nd Edition, M. L. Shuler and F. Kargi, , Prentice Hall, 2001.
2. Bioprocess Engineering Principles, 1st Edition, Pauline M. Doran, Academic Press, 1995.
3. Biochemical Engineering Fundamentals, 2nd Revised Edition,James E. Bailey and David F. Ollis, McGraw-Hill, 1986.
4. Biochemical calculations, Wiley & Sons, Second Edition,I. H. Segel, 2004.

Course Name : Database Management System & Computer Networking					
Course Code: CSEN 3205					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Module I: [10L]
Introduction to Database Concepts, File Processing System and Database Management System, DBMS Architecture and Data Independence.
Data Model: Basic Concepts, Entity-Relationship Diagram, Keys, Cardinality, Weak Entity Set.
Introduction to relational algebra & SQL: Operators like select, project, rename, Cartesian product, join, union, intersect, minus, DDL, DML.

Module II: [12L]
Relational Database Design: Functional Dependencies, Normalization: Different anomalies in database designing,1NF, 2NF, 3NF and BCNF, Lossless-Join Decomposition and Dependency Preservation.
Introduction to Transaction Processing Concepts: ACID properties, Serializability and Recoverability.

Module III: [10L] Computer Networking: Introduction, topology, transmission mode, LAN/MAN/WAN, OSI 7 layer Model, Communication Techniques, TCP/IP Protocol Stacks.

Module IV: [10L] Inter Networking, WWW, URLs, search engines, electronic mails, Distributed System, Distributed Database System Concepts.

Text books:

1. Henry F. Korth and Silberschatz Abraham, “Database System Concepts, 4th Ed., McGraw Hill, Computer Science Series.
2. Behrouz A. Forouzan, Data Communications and Networking, 4th Ed., McGraw Hill.

Reference books:

3. Elmasri Ramez and Novathe Shamkant,“Fundamentals of Database Systems”, Pearson.
4. Ramakrishnan: Database Management System, McGraw-Hill.
5. Gray Jim and Reuter Address, “Transaction Processing: Concepts and Techniques”, Moragan Kauffman Publishers.
6. Jain: Advanced Database Management System, CyberTech.
7. Date C. J., “Introduction to Database Management”, Vol. I, II, IIIPearson.
8. Ullman J. D., “Principles of Database Systems”, Galgottia Publication.
9. James Martin, “Principles of Database Management Systems”, 1985, Prentice Hall of India, New Delhi.
10. Ramez Elmasri, Shamkant B.Navathe “Fundamentals of Database Systems”, Pearson.
11. Andrew S. Tanenbaum: Computer Networks, Pearson Education, fourth edition.

12. William Stallings: Data and Computer Communication, Prentice hall, Seventh edition.
13. William Stallings: High speed Networks and Internets, Pearson education, second edition.
14. Arun K.Majumdar, Pritimay Bhattacharya “Database Management Systems”, Tata McGraw Hill.

Course Name : Molecular Modeling & Drug Designing					
Course Code: BIOT3241					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Module I: Molecular Modeling: (**10L**)

Useful concept in molecular modeling; molecular simulation techniques-Monte Carlo methods-Metropolis Monte Carlo algorithm, types of Monte Carlo algorithm, flow calculations in Metropolis Monte Carlo algorithm with examples; molecular dynamics and simulations- basic concepts including the integration of dynamical Equations; structural information from molecular dynamics, Monte Carlo calculation and energy minimization methods.

Module II: Molecular Mechanics: (**10L**)

Introduction to Molecular mechanics, intra molecular interactions; physicochemical parameters in drug design: hydrophobicity, electronic effect, ionization constants, chelation, solubility and partition co- efficient; over view of molecular descriptors.

Module III: Drug Discovery, Design and Development: (10L)

Introduction to diseases, drugs and drug targets; pharmacodynamics and pharmacokinetics of drug**,** rational basis of drug designing, criteria for synthesizing drugs; types of drug designing: ligand based drug design, structure based drug design, lead optimization, receptor based design and other methods;case studies.

Module IV: Tools for Drug Design: (10L)

Overview of computer based tools for drug designing- Ludi, Ludi/CAP, Autodock, GRAMM, CAMD tools; Force fileld and types of force fields; protein-protein, protein-nucleic acid, protein-ligand interaction with example; types of scoring functions, scoring and docking mode; QSAR principles and methods in drug designing; current research in drug designing- a case study.

Textbooks:

1. Molecular Modeling Principles and application, 2nd edn. (2001) by A. Leach. Pub: Pearson
2. Introduction to Medicinal Chemistry (2013) by G. L. Patrick, Pub: OUP

Reference books:

1. Biopharmaceuticals-Biochemistry and Biotechnology 2nd edn. (2003) G.Walsh, pub: Wiley
2. Drug Discovery and Design (2001) by Scolnick. J.; pub: Academic Press,
3. Guidebook on Molecular Modeling in Drug Design (1996) by N. R. Cohen, Editor. Pub:AP,
4. Text Book of Drug Design and Discovery 3rd edn. (2002) by Liljefors, Krogsgaard,-Larsen pub: CRC press.

Course Name : Biophysics of Macromolecules					
Course Code: BIOT3242					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Module1: Fundamental interactions in macromolecules [10L]

Introduction to biophysics, strong and weak interactions in biomolecules: electrostatic and Van der Waal's interaction, hydrogen bonding, hydrophobic Interactions. Conformation and configuration of biomolecules. Structural characteristics of α-helix, β-sheet and β-turn, supersecondary structure, Protein domains and domain architecture. Tertiary structure: effect of amino acids on the structure of proteins. Quaternary structure of proteins. Conformation of nucleic acids: Structural characteristics of A, B and Z-DNA. 3D structure of t-RNA, ribozymes and riboswitches.

Module 2: Thermodynamics and kinetics of macromolecular transitions [10L]

Energy status of a protein molecule, denaturation and renaturation of proteins and DNA, helix coil transformation of proteins and DNA: kinetic study, Melting of helices: thermodynamics of melting / denaturation of alpha helix and DNA double helix, Cooperativity of melting of helices. Structure-function relations of enzymes, allosteric enzymes. Changes in nucleic acid structures during biochemical processes.

Module 3: Spectroscopic techniques for biomolecular structural analysis [10L]

Basic concepts of absorption spectroscopy, UV/visible, IR and FTIR spectroscopy, circular dichroism spectroscopy, NMRS; Emission spectroscopy - luminescence, phosphorescence and fluorescence, quenching, FRET and fluorescence lifetime measurements.

Module 4: Non-spectroscopic techniques for structural analysis

Methods for study of biomolecule structure and surface morphology: X-ray diffraction and X-ray crystallography, and electron microscopy (SEM and TEM), MS, Surface Plasma Resonance Method.

Textbooks:

1. Biophysical Chemistry Vol 2; Cantor & Schimmel, Oxford University Press
2. Biochemistry: Donald Voet, Judith G. Voet, 4th Ed, JOHN WILEY & SONS , INC.
3. Lehninger's Principles of Biochemistry by Nelson & Cox

References books:

1. Physical Biochemistry: David Friefelder, 5th Ed, PHI
2. Physical Biochemistry: Kensal E van Holde. PHI
3. Practical Biochemistry Principles and techniques: Editor Wilson and Walker, Cambridge University Press
4. Proteins: Structure and Function: David Whitford: John Wiley &Sons

Course Name : Biosensors and Diagnostics					
Course Code: BIOT3243					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Module I: Introduction to biosensor [10]

Biosensor: Principle, General Characteristics, Advantages and its limitations. Classification of biosensors based on bioreceptor. Immobilization and coupling of bioreceptors. Enzyme Biosensor: Principle, kinetics and its response to different types of inhibitors.

Module II: Bio-recognition element based sensors [10]

Principle, Operation and Limitation of: Microbial sensor, Immunological sensor, Nucleic acid sensor. Other bioreceptors (e.g. animal, plant tissue)

Module III: Biosensor based on transducer [10]

Classification of biosensor based on transducer. Principle, Construction, Calibration and Limitations of Calorimetric, Electrochemical (potentiometric, amperometric), Optical, Piezoelectric, Semiconductor biosensor etc.

Module IV: Application of biosensor [10]

Clinical and diagnostics sector, Industrial sector: Food, Environmental, defense sector and others. Commercially available biosensor.

Reference books:

1. Biosensors by Tran Minh Canh. London. Chapman and Hall, 1993.
2. Turner, A.P.F, Karube.I.,and Wilson,G.S, Biosensors Fundamentals and applications, Oxford Univ. Press.
3. Engineering biosensors, kinetics and design applications by Ajit Sadana..San Diego, Academic Press, 2002.

4. D.Thomas and J.M. Laval – Enzyme Technology in concepts in Biotechnology by Balasubramaniam et al, Univ. Press, 1996.

Course Name : Biofertilizers and Biopesticides					
Course Code: BIOT3244					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Module-I Biofertlizers in agriculture [10L]
Definition of bio-fertilizers; composition and nutritional role based classification of different bio-fertilzers viz., composts – vermicompost and nitrogen fixers; basic knowledge and procedure of bacterial, fungal and composite bio-fertilizer production; role of *Azola, Tichoderma Cianobacteria, Trichogramma* in bio-fertilization; importance of bio-fertilizer used in agriculture; knowledge of bacterial and fungal suspensions as inocula and their preparations.

Module-II Biological nitrogen fixation [10L]
Basic outline of processes, characteristics and significance of biological nitrogen fixation (BNF) and phosphate solubilizing bacteria/ micro organisms (PSB and PSM) functioning; outline of biological nitrogen fixation from biochemical and biological points of view with special reference to different enzymes and other key role players; biological and biochemical process of symbiosis in nitrogen fixation by *Rhizobium* sp. with legume plants and others.

Module-III Molecular Biology of symbiotic Nitrogen fixer [10l]
Biological and biochemical process of symbiosis in nitrogen fixation by *Rhizobium* through root nodulation process and nitrogen fixation by it.
Brief concept of nod genes and nitrogen fixing genes (nif genes) --- their organization and role in the different steps of biological nitrogen fixation. Rhizosphere engineering.

Module-IV Biopesticides [10l]
Use of chemical pesticides and environmental effects, Definition and importance of biological pests and bio-pesticides in agriculture.
Brief conception of Integrated Pest Management (IPM), Integrated Pest and Disease Management (IDPM).
Advantages of bio-pesticides over chemical pesticides and developing them.
Types of Bio-pesticides with special reference to protein with anti-pest activity; gene from *Bacillus thuringenensis* and its proteins as biopesticide

Textbook
1. Stacey, Burris and Evans (ed), Biological Nitrogen Fixation, Chapman & Hall, 1992

References :

1. J K Ladha, M B Peoples, Management of Biological Nitrogen Fixation for the Development of More Productive and Sustainable Agricultural Systems, Springer.
2. P.S. Nutman, Symbiotic Nitrogen Fixation in Plants, Cambridge University Press
3. Sushil K Khetan, Microbial Pest Control, Marcel Dekker
4. Opender Koul, G S Dhaliwal, Microbial Biopesticides, Taylor & Francis

Course Name : Immunology lab					
Course Code: BIOT3211					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	0	3	3	2

List of experiments:

1) Preparation of human blood film and identification of blood corpuscles.
2) Total count of R.B.C.
3) Total count of W.B.C.
4) Differential count of W.B.C.
5) Identification of human blood group antigens.
6) Radial Immunodiffusion assay
7) Ouchterlony immunodiffusion assay
8) Dot ELISA
9) Sandwich ELISA

Course Name : Plant Tissue Culture Lab					
Course Code: BIOT3212					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	0	3	3	2

List of experiments:

1. Study basic requirements for plant tissue culture lab.
2. Preparation of various tissue culture media (MS, B5).
3. Explants selection sterilization and inoculation.
4. Effect of growth hormones on organogenesis.
5. Callus and cell suspension culture; induction of growth parameters.
6. Plant regeneration from shoot tip/auxillary bud.
7. Androgenesis: anther and pollen culture.
8. Protoplast isolation.
9. Expression pattern study of secondary metabolite from plant cell culture.
10. Role of biotic and abiotic stress factors in callus culture.

Course Name : Bioreactor design Lab					
Course Code: BIOT3213					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	0	3	3	2

List of experiments:

1. Determination exit age distribution curve for liquid flowing through a vessel of a CSTR.
2. Development of flow pattern to represent the vessel from the tracer output data in an external loop airlift reactor.
3. Determination of RTD of liquid flowing through a bubble column reactor.
4. Calculation of vessel dispersion number D/uL from c-pulse data for (i) CSTR, (ii) airlift reactor, (iii) bubble column reactor.
5. Development of F- curve from c-curve for (i) CSTR, (ii) airlift reactor, (iii) bubble column reactor
6. Development of F- curve from E-curve for (i) CSTR, (ii) airlift reactor, (iii) bubble column reactor

Course Name : Data Base Management System & Computer Networking lab					
Course Code: CSEN3215					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	0	3	3	2

DBMS Lab :

Experiments on Database on RDBMS Platform (Oracle):

DDL Commands: Creating Tables along with constraints like: Primary Key, Foreign Key, unique, Not Null, Check. Altering Table Structure like adding and modifying constraints, adding column, modifying column data types, etc.

DML: Inserting rows, Updating rows, Deleting rows

SQL Query: Cartesian Product, Join, Union, Intersect, Minus, Single Row functions, multiple row functions using GROUP BY clause, ORDER BY Clause, Nested Sub-Queries

Introduction to PL/SQL: Programming Language Constructs in PL SQL like variable declaration, Conditional Statements, different types of loop structures, functions, etc. Programming using Cursors, Creating different types of Triggers.

Computer Networking Lab:

Basic Networking Commands**.**

Course Name : Personality Development					
Course Code: HMTS3221					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	0	2	2	1

Module 1: Self-Growth

i)Self Growth- Maslow's Hierarchy of Needs Theory
ii) Anger, Stress & Time Management- Theories and application
iii) SWOT Analysis

Module II: Stepping Up

i)Growth & Environment
ii)Competitive Spirit
iii)Responsibility Factor

Module III: Professional Communication

i) Impression Management- theory on social psychology
ii)Employability Quotient
iii)Cross-cultural communication

Module IV: Leadership & Team Playing

i) Leadership & Team Playing: Theories, Styles, Stages

ii) Motivation, Negotiation Skills, Conflict Management

iii) Planning & Envisioning: Initiative and Innovation in the Work Environment- De Bono's Six Thinking Hats

Suggested Reading

1. Personality Development and Soft Skills by Barun K. Mitra, Oxford University, 2011
2. Soft Skills: An Integrated Approach to Maxmise Personality by Gajendra Singh Chauhan and Sangeeta Sharma, Wiley, 2016
3. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success by Gopalaswamy Ramesh and Mahadevan Ramesh, Pearson, 2010

Course Name : Seminar-I					
Course Code: BIOT3222					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	0	0	3	3	2

Seminar-I: (Review of any field related to biotechnology and presentation by PPT)

1. Student will attend seminar by invited speakers in the field of biotechnology, to be arranged by the department and submit a write-up.

2. Student will review of any field of biotechnology and submit a review report. Finally students will present the review by PPT in a departmental seminar during a period not exceeding 30 minutes. Performance of the candidates in the seminar shall be evaluated jointly by one External or all internal Examiners.