

# Andhra University

## I/IV B.Tech. Biotechnology (First year) (Effective from the admitted batch of 2009-2010)

S.No	Course Code	Title	Work Load				Total Marks		Credits
			Theory		Practi- cals	Total	Univ. Exam.	Sessional Marks	
			L	T					
1	BTM-101	English	2		1	3	70	30	2
2	BTM-102	Mathematics-I	3	-	-	3	70	30	4
3	BTM-103	Mathematics-II	3		-	3	70	30	4
4	BTM-104	Physics	3		-	3	70	30	4
5	BTM-105	Chemistry	3	-	-	3	70	30	4
6	BTM-106	History of Science & Technology	3	-	-	3	70	30	2
7	BTM-107	CPNM*	3	-		3	70	30	4
8	BTM-108	Engineering Graphics	2	-	4	6	70	30	5
9	BTM-109	Physics Laboratory	-	-	3	3	50	50	2
10	BTM-110	Chemistry Laboratory	-	-	3	3	50	50	2
11	BTM-111	Workshop Practice	-	-	3	3	50	50	2
12	BTM-112	Programming Laboratory	-	-	3	3	50	50	2
<b>Total:</b>			<b>22</b>		<b>17</b>	<b>39</b>	<b>760</b>	<b>440</b>	<b>37</b>

**CPNM: Computer Programming and Numerical Methods**

**II/IV B.Tech. Biotechnology (First semester)**  
**(Effective from the admitted batch of 2009-2010)**

S.No	Course Code	Title	Work Load				Total Marks		Credits
			Theory		Practi-cals	Total	Univ. Exam.	Sessional Marks	
			L	T					
1	BTM-211	Mathematics – III	3	1	-	4	70	30	4
2	BTM-212	Fundamentals of Biology	5	-	-	5	70	30	4
3	BTM-213	Inorganic and Physical Chemistry	3	1	-	4	70	30	4
4	BTM-214	Organic Chemistry	4	-	-	4	70	30	4
5	BTM-215	Microbiology	4	-	-	4	70	30	4
6	BTM-216	Basic Electrical & Electronics Engineering	3	1	-	4	70	30	4
7	BTM-217	Chemistry Laboratory-II (Organic Chemistry)	-	-	3	3	50	50	2
8	BTM-218	Micro Biology Laboratory	-	-	3	3	50	50	2
<b>Total:</b>			<b>22</b>	<b>3</b>	<b>6</b>	<b>31</b>	<b>520</b>	<b>280</b>	<b>28</b>

**II/IV B.Tech. Biotechnology (Second semester)**  
**(Effective from the admitted batch of 2009-2010)**

S.No	Course Code	Title	Work Load				Total Marks		Credits
			Theory		Practi-cals	Total	Univ. Exam.	Sessional Marks	
			L	T					
1	BTM-221	Bio Chemistry	3	1	-	4	70	30	4
2	BTM-222	Genetics	3	1	-	4	70	30	4
3	BTM-223	Process Calculations	3	1	-	4	70	30	4
4	BTM-224	Bio Analytical Techniques	3	1	-	4	70	30	4
5	BTM-225	Fluid Mechanics & Heat Transfer	4	1	-	5	70	30	4
6	BTM-226	Environmental Studies	3	-	-	3	70	30	3
7	BTM-227	Bio Chemistry & Bio Analytical Techniques Laboratory	-	-	3	3	50	50	2
8	BTM-228	Fluid Mechanics Laboratory	-	-	3	3	50	50	2
<b>Total:</b>			<b>19</b>	<b>5</b>	<b>6</b>	<b>30</b>	<b>520</b>	<b>280</b>	<b>27</b>

**III/IV B.Tech. Biotechnology (First semester)  
(Effective from the admitted batch of 2009-2010)**

S.No	Course Code	Title	Work Load				Total Marks		Credits
			Theory		Pract- icals	Total	Univ. Exam.	Sessional Marks	
			L	T					
1	BTM-311	Thermodynamics	3	1	-	4	70	30	4
2	BTM-312	Immunology	4	-	-	4	70	30	4
3	BTM-313	Mass Transfer	3	1	-	4	70	30	4
4	BTM-314	Cell and Molecular Biology	4	-	-	4	70	30	4
5	BTM-315	Elective-I	4	-	-	4	70	30	4
6	FE-01	Free Elective-I	4	-	-	4	70	30	4
7	BTM-316	Unit Operations Lab	-	-	3	3	50	50	2
8	BTM-317	Cell and Molecular Biology Laboratory	-	-	3	3	50	50	2
9	BTM-318	Soft Skills	-	-	3	3	-	50	1
<b>Total:</b>			<b>22</b>	<b>2</b>	<b>9</b>	<b>33</b>	<b>520</b>	<b>330</b>	<b>29</b>

**Elective-I**

1. Energy Engineering
2. Food Technology
3. Process Optimization
4. Systems Biology

**Free Elective (FE-01)**

1. Basic Biotechnology
2. Biosensors and Bioelectronics

**III/IV B.Tech. Biotechnology (Second Semester)  
(Effective from the admitted batch of 2009-2010)**

S.No	Course Code	Title	Work Load				Total Marks		Credits
			Theory		Pract- icals	Total	Univ. Exam.	Sessional Marks	
			L	T					
1	BTM-321	Biostatistics	3	1	-	4	70	30	4
2	BTM-322	Chemical Reaction Engineering	3	1	-	4	70	30	4
3	BTM-323	Bioprocess Engineering	3	1	-	4	70	30	4
4	BTM-324	Down Stream Processing	3	1-	-	4	70	30	4
5	BTM-325	Environmental Biotechnology	3	1	-	4	70	30	4
6	BTM-326	Elective-II	4	-	-	4	70	30	4
7	BTM-327	Down Stream Processing Laboratory	-	-	3	3	50	50	2
8	BTM-328	Bioprocess and Reaction Engg. Laboratory	-	-	3	3	50	50	2
<b>Total:</b>			<b>20</b>	<b>4</b>	<b>6</b>	<b>30</b>	<b>520</b>	<b>280</b>	<b>28</b>

**Elective II**

1. Pharmaceutical Biotechnology
3. Animal cell culture and Hybridoma technology

2. Cancer Biology
4. Stem cells in Health care

**\*\*Summer Industrial Training is compulsory at the end of III year second semester and assessment will be carried out at the end of IV year first semester.**

**IV/IV B.Tech. Biotechnology (First semester)**  
**(Effective from the admitted batch of 2009-2010)**

S.No	Course Code	Title	Work Load				Total Marks		Credits
			Theory		Practicals	Total	Univ. Exam.	Sessional Marks	
			L	T					
1	BTM-411	Enzyme Engineering	3	1	-	4	70	30	4
2	BTM-412	Bioinformatics	3	1	-	4	70	30	4
3	BTM-413	Genetic Engineering	4	-	-	4	70	30	4
4	BTM-414	Process Dynamics and Control	3	1	-	4	70	30	4
5	BTM-415	Industrial Biotech Products	4	-	-	4	70	30	4
6	BTM-416	Elective - III	4	-	-	4	70	30	4
7	BTM-417	Bioinformatics Laboratory	-	-	3	3	50	50	2
8	BTM-418	Process Control Laboratory	-	-	3	3	50	50	2
9	BTM-419	Seminar	-	-	3	3	-	100	2
10	BTM-420	Industrial Training Report	-	-	-	-	-	100	2
<b>Total:</b>			<b>21</b>	<b>3</b>	<b>9</b>	<b>33</b>	<b>520</b>	<b>480</b>	<b>32</b>

**Elective - III**

1. Biomedical Engineering
2. Metabolic Engineering
3. Agricultural Biotechnology
4. Industrial Management and Entrepreneurship Development

**IV/IV B.Tech. Biotechnology (Second semester)**  
**(Effective from the admitted batch of 2009-2010)**

S.No	Course Code	Title	Work Load				Total Marks		Credits
			Theory		Practicals	Total	Univ. Exam.	Sessional Marks	
			L	T					
1	BTM-421	<i>Engineering</i> Economics and Bioprocess Design	3	1	-	4	70	30	4
2	BTM-422	Plant Cell and Tissue Culture	4	-	-	4	70	30	4
3	BTM-423	Elective - IV	4	-	-	4	70	30	4
4	FE-02	Free Elective - II	4	-	-	4	70	30	4
5	BTM-424	Plant Cell and Tissue Culture Laboratory	-	-	3	3	50	50	2
6	BTM-425	Project	-	-	6	6	50	50	8
<b>Total:</b>			<b>15</b>	<b>1</b>	<b>9</b>	<b>25</b>	<b>380</b>	<b>220</b>	<b>26</b>

**Elective-IV**

1. Good manufacturing practices
2. IPR and Commercialization of Biotechnology
3. Molecular modeling and Drug design
4. Marine Biotechnology

**Free Elective (FE-02)**

1. Nanotechnology
2. Introductory Bioinformatics

**B.Tech. Biotechnology**  
**(Effective from the admitted Batch of 2009-10)**  
**1/4 B.Tech. First year**

**BTM-101**

**English**

The emphasis on English Language is enormously increasing as an effective medium of communication in all sectors the World over. As a consequence of this, the acquisition of effective communication skills in English has become most important to the students to flourish in their careers. In this connection, there is a need to train the students to equip themselves with the necessary skills required for effective communication in English thereby enabling them to get a good placement immediately after the completion of their undergraduate courses. To meet the objectives of developing proficiency in English communication skills and developing Listening, Speaking, Reading and Writing (LSRW) skills, the following curriculum is designed.

**Theory and Practice (Language Laboratory)**

**1. A text with focus on Skills approach:**

Intended to develop the language skills of Listening, Speaking, Reading and Writing,

**2. Vocabulary:**

- a) One – word substitutes
- b) Words often confused – Pairs of Words
- c) Synonyms and Antonyms
- d) Foreign Phrases
- e) Phrasal verbs derived from the following dynamic verbs: Go, Get, Run, Take, Look, Hold, Put, Stand Etc.
- f) Idioms and phrases

**3. Grammar:**

- a) Error analysis
  - Correction of errors in a given sentence, errors in the use of words, errors of indianisms, use of slang, errors in punctuation
- b) Concord
- c) Articles, prepositions and words followed by prepositions
- d) Tenses

**4. Writing skills:**

1. Précis writing
2. Note making
3. Letter writing
4. Technical Report Writing
5. Preparation of C.V and Resume writing
6. Reading comprehension
7. Memo
8. Notices/Circulars agenda and Minutes of a meeting
9. E-Mail etiquette

## 10. Essay writing

### **Text book:**

In order to improve the proficiency of the student in the acquisition of the above mentioned skills, the following texts and course content is prescribed.

• **LEARNING ENGLISH : A Communicative Approach**, Hyderabad: Orient Long man.  
(selected lessons)

**The following lessons are prescribed from the above text:**

- i) Astronomy (1)
- ii) Travel and transport (3)
- iii) Humour (4)
- iv) Environment (6)
- v) Inspiration (7)
- vi) Human interest (8)

### **Reference books:**

1. 'English for Engineering Students' by Sharma, G.V.L.N.,
2. 'Examine your English' by Margaret M Maison, Orient Longman
3. 'Current English for Colleges' by Krishnaswami, N. and Sriraman, T., Macmillan
4. 'Creative English for Communication' by Krishnaswami, N. and Sriraman, T., Macmillan
5. 'Effective Technical Communication' by Rizvi, M Ashraf, McGraw – Hill
6. 'English for Technical Communication' by K.R. Lakshminarayana, SCITECH

**Partial differentiation and its applications:** Functions of two or more variables, partial derivatives, homogeneous functions- Euler's theorem, total derivative, differentiation of implicit functions, geometrical interpretation - tangent plane and normal to a surface, change of variables, Jacobians, Taylor's theorem for functions of two variables, Jacobians, Taylor's theorem for functions of two variables, errors and approximations, total differential, maxima and minima of functions two variables, Lagrange's method of undetermined multiples, differentiation under the integral sign – Leibnitz Rule, involutes and evolutes,

**Multiple integrals and their applications:** Double integrals, change of order of integration, double integrals in polar co-ordinates, areas enclosed by plane curves, triple integrals, volume of solids, change of variables, area of a curve of a curved surface, calculation of mass, center of gravity, center of pressure, moment of inertia, product of inertia, principle axes, beta function, gamma function, relation between beta and gamma functions, error function or probability integral,

**Solid geometry (Vector treatment ):** Equation of a plane, equations of straight line, condition for a line to lie in a plane, coplanar lines, shortest distance between two lines, intersection of three planes, equation of sphere, tangent plane to a sphere, cone, cylinder, quadric surfaces,

**Infinite series:** Definitions - convergence, divergence and oscillation of a series, general properties, series of positive terms, comparison tests, integral test, D'Alembert's ratio test, Raabe's test, Logarithmic test, Cauchy's Root test, alternating series- Leibnitz's rule, series of positive or negative terms, power series, convergence of exponential, logarithmic and binomial series, uniform convergence, Weirstrass M-test, properties of uniformly convergent series.

**Fourier series:** Euler's formulae, conditions for a Fourier expansion, functions having points of discontinuity, change of interval, odd and even functions – expansions of odd or even periodic function, half range series, Parseval formula, practical harmonic analysis,

**Text books:**

1. 'Higher Engineering Mathematics' by B.S.Grewal
2. 'Mathematics for Engineering' by Chandrica Prasad

**Reference books:**

1. 'Higher Engineering Mathematics' by M.K.Venkatraman
2. 'Advanced Engineering Mathematics' by Erwin Kreyszig

**Linear algebra:** Rank of a matrix, Eigen values, Eigen vectors of a matrix, Cayley Hamilton theorem, consistency of equations, matrix inversion, Gaussian Elimination scheme, Cholesky factorization, Jacobi and Gauss-Seidal iterative methods for solving simultaneous equations, Eigen value solution using forward iteration, inverse iteration, Hermitian and skew Hermitian forms, unitary matrix, functions of a matrix, quadratic forms and conical forms,

**Differential equations of first order and its applications:** Formation of differential equations, solution of a differential equation, geometrical meaning, equations of the first order and first degree, variables separable, homogeneous equations, linear equations, Bernoulli's equation, exact equations, equation reducible to exact equations, equations of the first order and higher degree, Clairaut's equation, geometric applications, orthogonal trajectories, physical applications, simple electric circuits, heat flow, chemical applications, Newton's law of cooling,

**Linear differential equations:** Higher order linear differential equations with constant coefficients, deflection of beams, simple harmonic motion, oscillatory electric circuits,

**Series solutions of differential equations:** Frobenius method, special function as solution from series, Bessel equation, Bessel functions of first and second kind, equation reducible to Bessel's equations, Legendre's equations, Legendre polynomial, Rodrigues formula, generating functions, recurrence relation, orthonogolity relation for Bessel functions and Legendre polynomial,

**Laplace transforms:** Transforms of elementary functions, properties of Laplace transforms, existence conditions, inverse transforms, transform of derivatives, transform of integrals, multiplication's by 't'- division by 't', convolution theorem, application to ordinary differential equations and simultaneous linear equations with constant coefficients, unit step function, impulse functions and periodic functions.

**Text books:**

1. 'Theory of Matrices' by Shanti narayanan.
2. 'Higher Engineering Mathematics' by B.S. Grewal
3. 'Advanced Mathematics for Engineering students, vol. 2' by Narayana, Manieavachgon Pillay, Ramanaiah

**Reference books:**

1. 'Higher Engineering Mathematics' by M.K.Venkataraman
2. 'Advanced Engineering Mathematics' by Erwin Kreyozig
3. 'Engineering Mathematics' by P.P. Gupta
4. 'A text book on Engineering Mathematics' by N.P.Bali

**Thermodynamics:** Heat and work, first law of thermodynamics and its applications, reversible and irreversible processes, Carnot cycle and efficiency, entropy, second law of thermodynamics, entropy and disorder, entropy and probability, third law of thermodynamics, thermography and its applications.

**Electromagnetism:** Concept of electric field – point charge in electric field, dipole in an electric field, Gauss law, some applications, electric potential and field strength, potential due to a point charge and dipole, magnetic field – magnetic force on current, torque on current loop, hall effect, Ampere’s law, B near a long wire, B for a solenoid and toroid, the Biot-Savart’s law, B for a circular current loop, Faraday’s law of induction, Lenz’s law, calculation of inductance, L-R circuit, energy stored in magnetic field, induced magnetic fields, displacement current, energy density in electric and magnetic fields, Poynting vectors, Maxwells equations and electromagnetic waves (both differential and integral forms), magnetic properties of materials, paramagnetism, diamagnetism, ferromagnetism, ferrites and its applications,

**Optics:** Interference, principles of superposition, Young’s experiment, coherence, interference of thin films, wedge shaped film, Newtons rings, Michelson interferometer and its applications, diffraction – single slit (qualitative and quantitative treatment), polarization, polarisation by reflection, refraction and double refraction in uniaxial crystals, Nicol prism, quarter and half wave plate, circular and elliptical polarization and detection,

**Lasers and fibre optics:** Spontaneous and stimulated emissions, population inversions, Ruby laser, Gas laser, semiconductor laser, applications of lasers, fibre optics, optical fibre and total internal reflection, acceptance angle and cone of a fibre, fibre optics in communications, optical parts in fibre, fibre optic sensors,

**Ultrasonics:** Production of ultrasonics by magnetostriction and piezoelectric effects, ultrasonics and diffraction pattern, applications of ultrasonics,

**Modern physics:** The quantization of energy, photoelectric effect, De Broglie concept of matter waves, uncertainty principle, Schrodinger wave equation, application to a particle in a box, elementary concepts of Maxwell-Boltzman, Bose-Einstein’s and Fermi Dirac Statistics, Fermi Dirac distribution function (no derivations), free electron theory of metals, Band theory of solids, Kronig Penny model, metals, insulators and semiconductors, ferroelectrics and their applications, super conductivity, Meisner effect, types of superconductors and applications of superconductors, nanophase materials, synthesis, characterization of nanostructured materials, properties and applications, renewable energies – solar, wind and tidal, their applications.

**Text books:**

1. ‘Engineering Physics’ by R.K. Gaur and S.D. Gupta
2. ‘Physics’ by David Halliday and Robert Resnick – Part I and Part II
3. ‘Modern Engineering Physics’ by A.S. Vadudeva
4. ‘University Physics’ by Young and Freedman
5. ‘Materials Science’ by V. Rajendra and A. Marikani
6. ‘Nonconventional Energy’ by Ashoke V. Desai

**Water chemistry and pollution:**

**Water chemistry:** Sources of water, impurities – hardness and its determination, W.H.O. Limits, boiler troubles and their removal, water softening methods – lime soda, Zeolite and ion exchange, municipal water treatment – break point chlorination, desalination of sea water - electrodialysis and reverse osmosis methods,

**Water pollution:** Source – BOD, COD, sewage treatment - preliminary, primary, secondary and tertiary,

**Air pollution:** Source – air pollutants – CO , SO<sub>x</sub> , NO<sub>x</sub> , hydrocarbons and particulates, acid rain, green house effect, control of air pollution (general),

**Solid state chemistry:**

Classification of solids – Types of crystals, properties, imperfections in crystals, Band theory of solids, chemistry of semiconductors - intrinsic, extrinsic, compound and defect, organic semiconductors and superconductivity, purification of solids by zone refining, single crystal growth, epitaxial growth, elementary ideas on liquid crystals,

**Energy sources:**

**Thermal energy:** Coal- Ranking of coal - analysis (proximate and ultimate ), calorific value and determination (Bomb calorimeter method ), COKE, manufacture, Otto Hoffmann's process, applications,

**Chemical energy:** Electrode potential – calomel electrode, galvanic cells, primary, secondary – acid and alkaline cells, fuel cells,

**Nuclear Energy :** Fission and fusion, power reactors, atomic pile applications .

**Solar Energy :** Methods of utilization, thermal conversion, liquid flat-plate collector, photovoltaic conversion, solar cell – applications,

**Corrosion chemistry:**

Origin and theories of corrosion, types of corrosion, factors affecting corrosion, corrosion control methods, protective coatings, metallic coatings, chemical conversion coatings - phosphate, chromate, anodized, organic coating, paints, special paints, varnishes and lacquers,

**Fuels and Lubricants:**

Petroleum refining, motor fuels, petrol and diesel oil, knocking, octane number, Cetane number, synthetic petrol – Fisher - Tropsch and Bergius methods, LPG and CNG – applications, rocket fuels, propellants, classification,

**Lubricants:** Classification, mechanism, properties of lubricating oils, selection of lubricants for engineering applications,

**Polymers and plastics:**

Definition, types of polymerization, mechanism of addition polymerization, effect of polymer structure on properties, plastics – thermoplastic resins and thermosetting resins, compounding of plastics, fabrication of plastics, preparation and properties of cellulose derivatives - Vinyl resins-Nylon(6,6)- bakelites – polycarbonates - epoxy resins, reinforced plastics, conducting polymers, engineering applications of polymers,

**Building Materials:**

**Portland cement:** Manufacture, dry and wet processes, setting and hardening of cement, cement concrete - RCC - decay of concrete - special cements,

**Refractories:** Classifications, properties, engineering applications,

**Ceramics:** Classification, properties, uses.

**Text books:**

1. 'Engineering Chemistry' by P.C. Jain and M. Jain, Dhanapathi Rai & Sons, Delhi
2. 'A Text Book of Engineering Chemistry' by S.S. Dara - S. Chand & Co. New Delhi
3. 'Engineering Chemistry' by B.K. Sharma, Krishna Prakashan, Meerut
4. 'A Text Book of Engineering Chemistry, Allied Publishers Balasubramanian et.al.,
5. 'Material Science and Engineering V. Raghavan - Prentice-Hall India Ltd.,

**1. Historical perspective:**

The Nature of Science and Technology, roots of science and technology in India, science and society, scientists and society, science and faith and the rise of applied sciences,

**2. Policies and plans after independence:**

Nehru's vision of science for independent India, science and technology developments in the new era, science and technology developments during the five year plan periods and science and technology policy resolutions,

**3. Research and Development (R&D) in India:**

Expenditure in R&D, science and technology education, research activities and promotion of technology development, technology mission, programs aimed at technological self reliance, activities of Council of Scientific and Industrial Research (CSIR),

**4. Science and Technological Developments in major areas:**

**Space** – Objectives of space programs, geostationary satellite services – INSAT system and INSAT services remote sensing applications, Launch Vehicle Technology,

**Ocean development** – Objectives of ocean development, biological and mineral resources, marine research and capacity building,

**Defense research-** Spin-off technologies for civilian use,

**Biotechnology**--Applications of biotechnology in - medicine, biocatalysts, agriculture, food, fuel and fodder, development of biosensors and animal husbandry,

**Energy** – Research and development in conservation of energy, India's nuclear energy program, technology spin –offs,

**5. Nexus between technology transfer and development:**

Transfer of technology - Types, methods, mechanisms, process, channels and techniques, appropriate technology, technology assessment, technological forecasting, technological innovations and barriers of technological change.

**Test books:**

1. 'Science and Technology in India' by Kalpana Rajaram, Spectrum Books (P) Ltd., New Delhi,
2. 'Management of Science and Technology' ( Problems & Prospects ) by M.Srinivasan, East West Press ( P ) Ltd., New Delhi,

**Reference books :**

1. 'Science, Technology and Education for Development' K.A.Ramasamy and K.Seshagiri Rao, K., Nayudamma Memorial Science Foundation, Chennai,
2. 'The Role and Impact of Science and Technology in The Development of India' by G.R.Kohili, Surjeet publications,
3. 'Five Year Plans' Government of India, Planning Commission, New Delhi,
4. 'Science, Technology and Development' by K.D. Sharma and M.A.Quresh, Sterling Publications Ltd., New Delhi.

**Objectives:**

To make the student familiar with programming in C and enable the student to implement the numerical methods described in this course using C as Programming language

**Section A****Computer programming in C:**

**Basics:** Variables, constants, expressions, operators and their precedence and associativity, basic input and output statements, control structures, simple programs in C using all the operators and control structure,

**Functions:** Concept of a function, parameters and how they are passed, automatic variables, recursion, scope and extent of variables, writing programs using recursive and non-recursive functions,

**Arrays and strings:** Single and multidimensional arrays, character array as a string, functions on strings, writing C programs using arrays and for string manipulation,

**Structures:** Declaring and using structures, operations on structures, arrays of structures, user defined data types, pointers to using files,

**Files:** Introduction, file structure, file handling functions, file types, files, error handling, C programming examples for using files.

**Section B****Computer oriented numerical methods:**

**Basic concepts:** Preliminary concepts of algorithms, flow charts and their execution traces, a simplified model of a computer,

**Representation for characters and numbers:** Representation for integer and real numbers, effect of finite representation on arithmetic operations for ex. overflow, underflow, associativity and normalization, some elementary methods for overcoming these limitations,

**Numerical methods:** Notation of round-off and truncation errors, numerical methods of finding roots of an algebraic equation of one variable, successive bisection method, false position method, Newton Raphson method and Secant method,

**Solutions of simultaneous algebraic equations;** Gauss elimination method and Gauss Seidal methods,

**Interpolation:** Lagrange's interpolation and difference table methods,

**Numerical integration:** Simpson's rule, Gaussian quadrature formula,

**Numerical solution of differential equation:** Euler's method, Taylor's series method and Runge-Kutta method.

**Text books:**

1. Section A: 'Programming with C' by K.R.Venugopal and Sudeep R. Prasad
2. Section B: 'Introduction to Numerical Methods' by S.S Sastry
3. 'Elementary Numerical Methods' by S.D.Conte

**Reference book:**

1. 'C Programming Language' by Kerningham and Ritchie

**Introduction:**

Drawing instruments and uses, lettering scales in common use,

**Curves:**

Curves used in engineering practice, conic sections, construction of conics by different methods, rectangular-hyperbola, cycloidal curves, trochoids, epi and hypo-cycloids, involutes and Archimedian spiral,

**Orthographic projections:**

Projection of points, projection of straight lines, traces of a line, projection of planes and projection on auxiliary planes,

**Solids and developments:**

Projection of solids in simple positions, projection of solids with axis inclined to one of the reference planes and parallel to the other, projection of solids with axis inclined to both the reference planes, projection of spheres, development of surfaces of solids, development of transition piece connecting a square and circular pipe, helices and screw threads,

**Sections and intersections:**

Sections of different solids and true shape of sections, intersection of surfaces-simple problems with cylinders, prisms and cones,

**Isometric and perspective projections:**

Isometric projection and conversion of orthographic projection into isometric projection, perspective projection, theory of visual ray method and vanishing point method, simple problems involving regular geometrical solids,

**Text book:**

1. 'Elements of Engineering Drawing' by N.D. Bhatt

**Reference book:**

1. 'Engineering Graphics' by K.L. Narayana and P. Kannaiah

**12 of the following experiments must be completed:**

1. Lee's method- determination of coefficient of thermal conductivity of a bad conductor
2. Melde's experiment-determination of the frequency of an electrically maintained tuning fork
3. Newton's rings- determination of radius of curvature of a convex lens
4. Diffraction grating-determination of wavelengths in mercury line spectrum-using spectrometer
5. Determination of Cauchy's constants using spectrometer and mercury light
6. Wedge method-det. of thickness of a paper by forming parallel interference fringes
7. Michelson's interferometer- a) det. of wavelength of light b) Resolution of spectral lines using calcite crystal
8. Det. of
9. Optical Bench – a) Young's double slit, b) Lloyd's mirror, c) biprism, d) diffraction at an edge, and e) thickness of wire
10. Ultrasonic diffraction – Velocity of ultrasonic waves in liquids
11. Variation of magnetic field along the axis of current carrying circular coil – Stewart and Gee's apparatus
12. Calibration of voltmeter using potentiometer
13. Carey Foster's bridge a) laws of resistance and b) temperature coefficient of resistance
14. B-H curves – determination of hysteresis loss
15. Calendar and Barnes method – determination of specific heat of water
16. Hall effect – a) Determination of hall coefficient and b) determination of charge density
17. Photoelectric effect – a) characteristics of photoelectric cell b) det. of Planck's constant
18. Determination of Rydberg constant using hydrogen discharge tube
19. Determination of  $e/m$  of an electron – Thomson's method
20. Determination of band gap of semi conductor

## **BTM -110**

## **Chemistry Laboratory**

### **List of Experiments:**

01. Determination of sodium carbonate
02. Determination of sulfuric acid using a strong base
03. Estimation of iron ( II ) using potassium permanganate
04. Estimation of oxalic acid using potassium permanganate
05. Determination of volume strength of hydrogen peroxide
06. Estimation of calcium in a sample of Portland cement
07. Estimation of chromium (VI) using ferrous ammonium sulphate
08. Estimation of copper (II) using sodium thiosulphate
09. Analysis of bleaching powder for chlorine content
10. Estimation of zinc by EDTA method
11. Determination of hardness of a water sample (EDTA Method)
12. Determination of alkalinity of a water sample

### **Demonstration experiments:**

13. Determination of viscosity of a lubricating oil
14. Preparation of copper pigment
15. Preparation of phenol-formaldehyde resin
16. Digital pH meter
17. Digital potentiometer
18. D.O. Analyzer

## **BTM -111**

## **Workshop Practice**

### **1. Carpentry:**

Bench work, tools used in carpentry,

Jobs for class work – half lap joint, mortise and tenon joint, half –lap dovetail joint, corner dovetail joint, bridle joint,

### **2. Sheet Metal:**

Tools used in sheet metal work, laying developments of sheet metal jobs, soldering,

Jobs for class work – square tray, taper side tray, funnel, elbow pipe,

### **3. Fitting:**

Tools used in fitting work, different files, chisels, hammers and bench vice,

Jobs for class work – hexagon, rectangular, circular and triangular fits, external and internal threads with dies and taps,

### **Reference book;**

1. 'Elements of Workshop technology', Vol.1 by S.K. and H.K. Hajra Choudary

1. Write a program to read x-y coordinates of 3 points and then calculate the area of a triangle formed by them and print the coordinates of the three points and the area of the triangle. What will be the output from your program if the three given points are in a straight line?
2. Write a program, which generates 100 random integers in the range of 1 to 100. Store them in an array and then print the arrays. Write 3 versions of the program using different loop constructs. (e.g. for, while, and do while)
3. Write a set of string manipulation functions e.g. for getting a sub-string from a given position, Copying one string to another, Reversing a string, adding one string to another.
4. Write a program which determines the largest and the smallest number that can be stored in different data types like short, int., long, float and double. What happens when you add 1 to the largest possible integer number that can be stored?
5. Write a program, which generates 100 random real numbers in the range of 10.0 to 20.0, and sort them in descending order.
6. Write a function for transposing a square matrix in place (in place means that you are not allowed to have full temporary matrix).
7. First use an editor to create a file with some integer numbers. Now write a program, which reads these numbers and determines their mean and standard deviation.
8. Given two points on the surface of the sphere, Write a program to determine the smallest arc length between them.
9. Implement bisection method to find the square root of a given number to a given accuracy.
10. Implement Newton Raphson method to det. a root of polynomial equation.
11. Given a table of x and corresponding f(x) values, write a program which will determine f(x) value at an intermediate x value using Lagrange's interpolation.
12. Write a function which will invert a matrix.
13. Implement Simpson's rule for numerical integration.
14. Implement Gaussian quadrature for numerical integration.
15. Write a program to solve a set of linear algebraic equations

**B.Tech. Biotechnology**  
**(Effective from the admitted Batch of 2009-10)**  
**2/4 B.Tech. First semester**

**BTM - 211**

**Mathematics - III**

**Vector Calculus :** Scalar, Vector fields, Gradient, Divergence, Curl, directional derivative, identities, irrotational and solenoidal vector fields, line integral, surface integral and volume integral,

**Complex Analysis:** Differentiability, Cauchy-Riemann equations, analytic functions Cauchy Theorem, Cauchy integral formula, Taylor and Laurent expansions, (without proofs),

**Fourier Transforms:** Fourier integral, Sine and Cosine Integrals, Complex forms of Fourier Integral, Fourier Transforms Fourier and Cosine Transforms, Finite Fourier Sine and Cosine Transforms. Properties of F-Transforms, Convolution Theorem for F-Transforms,

**Partial Differential Equations and Applications:** Introduction, first and second order equations, methods of separation of variables, one-dimensional and two-dimensional heat flow equations, solution of Laplace equation,

**Numerical Analysis:** Solution of non-linear equations of one variable using false position, secant and Newton-Raphson methods, solution of linear algebraic equations using Jacobi, Gauss-Seidel iterative methods, eigen values, eigen vectors using power method, integration using trapezoidal, Simpson's and other quadrature formulae.

**Numerical Solutions of ODE's:** Numerical solutions of ODE's by Picard's method, Euler's method, Runge-Kutta method

**Text book:**

1. "Higher Engineering Mathematics", B.S.Grewal, (34 edition., 1998).

**Reference books:**

1. "Higher Engineering Mathematics", M.K.Venkata Raman
2. "Numerical methods for Scientific and Engineering Computation", M.K.Jain, S.R.K. Iyengar, R.K.Jain, New Age International (p) Ltd, New Delhi.
3. "Numerical methods for Engineers", Santosh K.Gupta, New Age International (p) Ltd, New Delhi.
4. "Numerical Analysis", G.Shankar Rao, New Age International (p) Ltd, New Delhi.

**Cell Biology:** Structure and function of prokaryotic and eukaryotic cell, cell organelles, cell membrane, chloroplast, mitochondria, golgi complex, endoplasmic reticulum, lysosomes, ribosomes and nucleus, chromosome structure, mitosis and meiosis,

**Plant Biology:** Parts of a flowering plant; flower-structure of a typical flower, outline description of floral parts – androecium, gynoecium,

**Embryology:** Structure of anther, microsporogenesis and development of male gametophyte, structure of ovule, megasporogenesis, development of embryo sac. fertilization, process of fertilization and post fertilization changes,

**Anatomy:** Structure and function of xylem and phloem, internal structure of dicot root, stem and leaf, monocot root, stem and leaf, secondary growth of dicot stem,

**Plant Physiology:** Water relations of plants, absorption of water by plants, diffusion, water potential, osmosis, plasmolysis, imbibition, active and passive absorption,

Mineral nutrition: Criteria for essentiality, macro elements (nitrogen, phosphorus and potassium) and microelements,

Photosynthesis: photosynthetic pigments, light reaction-Emerson enhancement effect, photo system I and II, photolysis of water, photophosphorylation, CO<sub>2</sub> fixation – C<sub>3</sub>, C<sub>4</sub> and CAM pathway, photorespiration, factors affecting photosynthesis – Blackman's law of limiting factors,

Nitrogen metabolism: Introduction, nitrogen cycle, biological nitrogen fixation,

**Plant Growth Regulators:** Auxins, gibberellins, cytokinins, abscisic acid and ethylene,

**Plant Breeding:** Methods of plant breeding: selection, hybridization, hybrid vigor and mutational breeding,

**Animal Biology:** General characters of invertebrates, morphology, life cycle and reproduction of *Plasmodium Vivax*, general characters of vertebrates.

**Animal Physiology:** Animal nutrition- modes of nutrition, digestive system of humans and accessory digestive organs, gastrointestinal secretions, digestion, absorption and assimilation of digested products, egestion,

**Respiration:** Respiration in humans – respiratory system, mechanism of respiration,

**Circulatory system:** Blood vascular system in humans, blood and its components, heart, pumping action of heart, heart beat and pulse, important blood vessels and course of blood circulation, lymphatic system-lymph, lymph vessels, lymph nodes and lymphatic ducts and pacemakers,

**Excretion:** Elimination of nitrogenous waste- ammonotelic, ureotelic and uricotelic, structure of human excretory system, structure of urinary system, anatomy of kidney, and structure of nephron,

**Nervous system:** Structure of neuron, nerve impulse and its conduction, synapse, central nervous system- lobes of brain and its meninges, spinal cord, Peripheral nervous system- Cranial nerves and spinal nerves, autonomous nervous system, sympathetic and parasympathetic nervous system, reflex action, reflex arch of humans.

**Text books:**

1. 'Biology Text Book for class XI and XII', NCERT.
2. 'AP Academy Text Book for Botany and Zoology, for intermediate

## **BTM-213 Inorganic & Physical Chemistry**

**Atomic Structure and Periodicity:** Schrodinger wave equation, quantum mechanical model of hydrogen atom,

**Structure and Bonding:** Ionic bond, ion-pair molecules, covalent bond, Lewis theory-valence bond theory, hybridization, VSEPR theory and shape of molecules, molecular orbital treatment for  $H_2$ ,  $He_2$ ,  $N_2$ ,  $O_2$ ,  $O_2^-$ ,  $O_2^{2-}$ ,  $F_2$ ,  $NO$  and  $CO$ ,

**Coordination Compounds:** Werner's theory, effective atomic number, bonding in transition complexes, valence bond and crystal field theory-octahedral, tetrahedral and square planar complexes,

**Representative elements:** General properties and oxidation states of s and p block elements,

Ammonia, nitrites and nitrates, phosphates, phosphites and phosphorothianes, organo silanes, silicones and silicates, fluorocarbons, effect of UV radiation,

**Transition Elements:** Oxidation states, colour, magnetic properties, complexes, comparison of the elements of second and third transition series with the first transition series,

**Solid, Liquid and Gaseous state:** Amorphous and crystalline solids, classification of solids according to bond type – ionic, covalent, metallic, molecular solids, crystal systems, space lattice and unit cell, crystal defects, vapour pressure of liquids, Clapeyron-Claussius equation, surface tension and viscosity, gas laws – ideal gas equation, Dalton's law of partial pressure, Graham's law of diffusion, kinetic theory of gases, molecular velocities, deviation from gas laws – Van der Waal's equation, critical constants,

**Electrochemistry:** Electrochemical series, half-cell potential, EMF, Nernst equation, galvanic cells,

**Colligative properties:** Raoult's law, osmotic pressure, elevation of boiling points, depression in freezing points (no thermodynamic derivations), elementary treatment of vapour pressure-composition diagrams of binary liquid mixtures,

**Phase Rule:** Terms used, phase diagrams-one component system (water and sulphur), two- component system (silver-lead and potassium iodide-water), eutectic point and triple point.

**Text books:**

**Inorganic Chemistry:**

1. Concise Inorganic Chemistry, 5<sup>th</sup> edition- J. D. Lee., Blackwell Science Ltd., London.
2. University General Chemistry, by C. N. R. Rao., Macmillan India Pub. Co.,

**Physical Chemistry:**

1. Physical Chemistry by P. W. Atkins, third edition, Oxford University press.
2. Essentials of Physical Chemistry, Revised edition 2005-B.S.Bahl, Arun Bahl and G.D.Tuli, S. Chand & Company Ltd., India.

**Fundamentals and Stereo Isomerism:** Fundamental analysis – molecular weight, empirical and molecular formula determination, basics of optical and geometrical isomerism, sequence rules, R and S configurations, E, z notation, stereo isomerism of aliphatic hydrocarbons (cyclohexane and its derivatives)

**Aliphatic compounds:** Alkanes - preparation by Wurtz reaction, Kolbe electrolytic method, free radical substitution (mechanism of halogenation), energy of activation and transition state, alkanes - industrial preparation of ethylene, 1,2 elimination reaction (E1 and E2 mechanism), electrophilic and free radical addition reactions (Markonikov's and AntiMarkonikov's rule), isoprene rule, rubber, vulcanization,

Alkynes - industrial method of acetylene, acidity of alkynes, dienes-1,2 and 1,4 addition, diels-Alder reaction,

Cyclo alkanes - preparation and properties of simple cycloalkanes, Bayer's strain theory'

Alkyl halides- SN1 SN2 reactions with mechanisms,

**Aromatic compounds:** Benzene- structure of benzene, aromatic character, electrophilic aromatic substitution ( mechanism of nitration, sulphonation, halogenation, Friedel crafts alkylation and acylation), orientation of disubstituted benzenes -activating and deactivating groups,

Arenes - preparation of arenes, Clemenson and WolfKishner reductions,

Arylhalides - preparation of arylhalides by SandMeyer and Gattermann reaction, nucleophilic aromatic substitution,

**Alcohols and Carbonyl compounds:** Alcohols - industrial method of preparation of ethyl alcohol, differentiation tests for primary, secondary and tertiary alcohols, Grignard synthesis of alcohols,

Ethers - preparation of ethers and epoxides-Williamson synthesis,

Aldehydes and Ketones - nucleophilic addition reactions, carbanion reaction, Cannizzaro reaction, Aldol condensation, Perkin, Reformasky and Wittig reactions,

**Amines and Carboxylic acids:** Amines - industrial method of preparation of aniline and aliphatic amine, reductive amination – Hoffmannelimination, Benzidine rearrangement, effect of substituents on basicity, distinguishing tests, diazonium salts and applications,

Sulpha drugs 0- preparation of sulphanilamide,

Carboxylic acids- preparation and properties of carboxylic acid (acetic acid, benzoic acid), effect of substituents on acidity, HVZ reaction,

Dicarboxylic acids - preparation and properties of oxalic, succinic and adipic acids,

Functional derivatives of carboxylic acids: Hoffmannbromamide reaction, Claisen condensation,

Preparation and properties of malonic ester and acetoacetic ester, Keto-enol Tautomerism,

**Carbohydrates:** Classification, stereochemistry, reactions of glucose and fructose and their inter conversions – Killiani-Fischer synthesis, Ruff degradation and Wohl's degradation.

**Text book:**

1. "Text Book of Organic Chemistry", R. T. Morrison and R. N. Boyd.

**Reference books;**

1. 'A Text Book of Organic Chemistry' by I. L. Finar (Vol. I), Longman group
2. 'A Text Book of Organic Chemistry' by L.G.Wade, Jr., Pearson Education
3. 'A Text Book of Organic Chemistry' by Francis A . Carey, Tata Mc-Graw Hill

**History and Development of Microbiology:** Contributions of van Leeuwenhock, Joseph Lister, Pasteur, Koch, Jenner, Winogradsky, Beijerinck, further developments of microbiology,

**Microbial Taxonomy:** Bacteria, archea and their broad classification. molecular approaches to microbial taxanomy, physiology of extremophiles,

**Morphology and Functions of Viruses, Yeast, Molds and Bacteria:**

**Viruses-** Morphology of viruses- size, shape and symmetry, replication of viruses- Lytic and Lysogenic cycle,

**Yeast and Molds:** Morphology, life cycle, economic importance of yeast and *Aspergillus*,

**Bacteria :** Ultra structure of bacteria, cell wall, cell membrane, flagella, pili, capsule, endospore, and cell inclusions, differences between prokaryotic and eukaryotic cell,

**Microbial growth:** Definition of growth- growth curve, measurement of bacterial growth (cell number and cell mass ) growth yield, continuous culture- chemostat, turbidostat, synchronous growth, effect of environmental factors on growth,

**Microbial Nutrition and Control of Microorganisms:** Nutritional requirements, nutritional types of bacteria, up-take of nutrients by cell, sterilization, and disinfection, effect of physical (moist and dry heat, radiation and filtration) and chemical agents, antibiotics- mode of action and resistance,

**Methods in Microbiology:** Culture media, synthetic and complex media, solidifying agents, types of media, isolation of pure cultures- spread plate, pour plate and streak plate, preservation of microorganisms, light (bright field only) and electron microscopy,

**Applied Microbiology:** Water, food and milk born contamination and remedy; basic microbial genetics- transformation, conjugation, transduction, strain improvement of industrially important micro-organisms.

**Text book:**

1. 'Microbiology', by Prescott L.M., Herley J.P., Klein D.A., McGraw- Hill

**Reference books:**

1. "Microbiology", Pelzar, M.J., Chan, E.C.S., Kreig N.R., Tata McGraw-Hill
2. "Brock biology of Microorganisms", Madigan M.T., Martinco J.M. and Parker J., Prentice Hall

**BTM -216 Basic Electrical and Electronics Engineering**  
(**Five** questions to be set from **Section A** and **Three** questions from **Section B**)

**Section-A**

**Fundamentals Laws and Theorems:** KVL, KCL, ohm's law, superposition theorem, Thevenin's theorem, Norton's theorem, reciprocity theorem,

**D.C. and A.C. Circuits:** Mesh analysis, nodal analysis, star-delta transformation, sinusoidal steady state analysis of 1- $\phi$  circuits, series and parallel circuits, 3- $\phi$  circuits, Star-Delta circuits,

**D.C. Machines :** Construction and working of D.C. generators, EMF equation, classification, characteristics, armature reaction, construction and working of D.C. motors, torque equation, characteristics, speed control methods and 3-point starter, efficiency calculation,

**Single phase Transformers:** Construction and working of single phase transformers, equivalent circuits, efficiency, regulation, O.C and S.C tests,

**A.C. Machines:** Construction and working of 3 -  $\phi$  Induction motor, slip, torque equation, efficiency, calculation, construction and working of synchronous generator (alternator), EMF equation, regulation-synchronous impedance method, synchronous motor, torque equation, starting methods.

**Section-B**

**Electronics:** Characteristics of semiconductor diodes, transistors, characteristics of CB, CE, CC transistor configurations, oscillators, cathode ray oscilloscope, construction, working, applications, mechanical transducers, electrical transducers, pressure gauges, LVDT.

**Text books:**

1. 'Elements of Electrical Engineering and Electronics' by V.K. Mehta, S.Chand & Co.
2. 'Fundamentals of Electrical Engineering and Electronics' by B.L. Thereja
3. 'Electronic Devices and Circuits' by Allen Mottorshad, Prentice Hall of India
4. 'Basic Electrical Engineering' by V.N. Mitthal, Tata Mc-Graw Hill

## BTM -217 Chemistry Laboratory – II (Organic Chemistry)

### 1. Preparation of simple organic compounds involving the following reactions:

- a) Acetylation : Acetanilide from Aniline and Aspirin from Salicylic acid
- b). Benzoylation: Benzanilide from Aniline
- c).Nitration: p-nitroacetanilide from acetanilide
- d).Methylation:  $\beta$ -naphthyl methyl ether from  $\beta$ -naphthol
- e).Sulphonation: Sulphanilic acid from Aniline
- f).Oxidation: p-benzoquinone from Hydroquinone

### 2. Qualitative analysis: Identification of the following functional groups in at least SIX organic compounds by adopting a systematic qualitative procedure:

- a) Carboxylic acids
- b) Phenols
- c) Aldehydes and Ketones
- d) Esters
- e) Carbohydrates
- f) Hydrocarbons and Ethers
- g) Primary, Secondary and Tertiary amines
- h) Amides and Imides
- i) Nitro groups

#### Text book:

1. 'A Text book of Qualitative Organic Analysis' by A.I. Vogel, Orient Longmans Ltd

## BTM -218

## Microbiology Laboratory

### List of Experiments:

1. Preparation of Nutrient broth and inoculation of Bacteria.
2. Preparation of Nutrient agar and inoculation of Bacteria
3. Isolation of pure cultures
4. Staining of Microbes- Simple staining, Gram staining, Negative staining, Capsule staining and spore staining.
5. Motility of Microbes.
6. Morphology of Fungi-( *Aspergillus niger* )
7. Morphology of Yeast-( *Saccharomyces cerevisiae* )
8. Bio-chemical tests- IMViC test, Amylase test, Hydrogen Sulphide production test
9. Testing of Microbiological quality of milk.
10. Testing of Microbiological quality of water.
11. Microbial assay of antibiotics.
12. Evaluation of disinfectant.

#### Text book:

'Microbiology- a Laboratory Manual' by Cappuccino T.G., Sherman N, Addison Wesley.

**B.Tech. Biotechnology**  
**(Effective from the admitted Batch of 2009-10)**  
**2/4 B.Tech. Second semester**

BTM -221

Biochemistry

Scope and importance of Biochemistry.

**Carbohydrates:** Classification, chemistry and properties of monosaccharides (Ribose, Glucose, and Fructose), disaccharides (maltose, lactose, sucrose) and polysaccharides (homopolysaccharides and heteropolysaccharides), metabolism of carbohydrates - glycolysis, TCA cycle, electron transport and oxidative phosphorylation, HMP shunt pathway, glycogenesis and glycogenolysis,

**Proteins and amino acids:** Classification and properties of amino acids and proteins, peptide bond, chemical synthesis of peptides and solid-phase peptide synthesis, structural organization of proteins- primary, secondary, tertiary and quaternary structure of proteins, denaturation of proteins,

**Lipids:** Classification, structure and physiological functions of triglycerides, fatty acids, phospholipids, cerebrosides, gangliosides and cholesterol, digestion and absorption of fats, biosynthesis and degradation of fatty acids and triglycerides,

**Nucleic acids:** Structure and properties of purines and pyrimidine bases, nucleosides, nucleotides, cellular localization, isolation and estimation of nucleic acids, types of nucleic acids, double helical structure of DNA, types of RNA, biosynthesis and catabolism of purines and pyrimidines,

**Enzymes:** Introduction, nomenclature and classification of enzymes, kinetic properties of enzymes, factors affecting enzyme action, coenzymes, enzyme inhibition- competitive, non-competitive and uncompetitive inhibitions,

**Porphyrins:** Chemistry of hemoglobin and chlorophyll, synthesis of heme and chlorophyll and heme catabolism,

**Vitamins and hormones:** Definition, classification, chemistry, source, functions and deficiency of vitamins, outlines of hormones and their functions,

**Text books:**

1. "Fundamentals of Biochemistry" by J.L.Jain, S.Chand & Company Ltd, New Delhi
2. "Principles of Biochemistry" by Lehninger, Nelson and Cox, CBS Publications.

**Mendel's law of Inheritance:** Mendel's experiments–Mendel's materials, crossing technique, results of Mendel's experiments, phenomenon of dominance, variation in dominance relation, incomplete dominance, co-dominance, principle of segregation-monoybrid cross, mechanism of segregation, monoybrid ratio, principle of independent assortment, Mendel's dihybrid cross, mechanism of independent assortment, dihybrid ratio, back cross and test cross, deviations from dihybrid phenotypic ratio,

**Interaction of Genes:** Interaction of genes-combs in fowls, Epistasis, complementary genes, duplicate genes, additional interactions involving two gene pairs, interaction between more than two gene pairs,

**Quantitative / Multiple factor inheritance:** Multiple factors, quantitative and quantitative traits, examples of quantitative inheritance, Kernel color in wheat, skin color in man, corolla length in tobacco, continuous variations,

**Multiple alleles :** (Based on classical concept of Allelomorphism): Multiple alleles and isoalleles, skin color in rodents, eye color in *Drosophila*, self sterility in *Nicotiana*, blood groups in humans, complementation test or cis-trans test,

**Linkage, crossing over and mapping:**

**Linkage** – coupling and repulsion hypothesis, Morgan's view on linkage, chromosome theory of linkage, kinds of linkage-complete linkage, incomplete linkage, linkage groups, significance of linkage,

**Crossing over** – Types of crossing over - mitotic and meiotic crossing over, mechanism - synapsis, duplication of chromosomes, crossing over by breakage and union, terminalization,

Molecular mechanism of recombination- Holiday model, cytological basis of crossing over; significance of crossing over,

**Construction of a genetic mapping:** Two point and three point test crosses and gene mapping, interference and coincidence,

**Sex Determination :** Genetically controlled sex determining mechanisms, sex chromosomal mechanism of sex determination, types-heterogenetic males, heterogenetic females, genic balance mechanism ( $X/A$  ratio in *Drosophila*), sex determination in man (TDF and SRY genes), sex determination in plants; Single gene control of sex; haploid males in hymenoptera; hormonal control of sex, environmental control of sex, dosage compensation (in man and *Drosophila*),

**Sex Linkage:** Inheritance of sex linked (X-linked) traits-eye color in *Drosophila*, haemophilia and color blindness in human and barred plumage in poultry, inheritance of Y-linked genes, inheritance of XY-linked genes, primary

and secondary non-disjunction of sex chromosomes, sex influenced and sex limited traits, sex linked disorders in human beings,

**Cytoplasmic Inheritance :** Maternal effects-shell coiling in snails, pigment in flour moth, cytoplasmic inheritance involving dispensable heredity units, kappa particles in *Paramecium*, cytoplasmic inheritance by cellular organelles, plastid inheritance in variegated four-o'clock plant, mitochondrial inheritance, male sterility in plants, uniparental inheritance in chlamydomonas,

**Chromosomal variations:** Origin, types and cytogenetic effects,  
**Structural changes in chromosomes:** Duplications, translocations, inversions (paracentric and pericentric cross over suppressors),

**Numerical changes in chromosomes:** Aneuploidy (monosomy, nullisomy, trisomy, tetrasomy), euploidy (monoploidy, haploidy, polyploidy-autopolyploids and allopolyploids).

**Text books:**

1. "Genetics", by P.K.Gupta, Rastogi Publications
2. "Cell Biology, Genetics, Molecular Biology, Evolution and Ecology", by P.S. Verma & V.K. Agarwal, S. Chand & Company

**Reference book:**

1. "Principles of Genetics", by E.J. Gardner, M.J.Simmons & D.Peter Snustard, John Wiley & Sons, INC.

**Stoichiometry and composition relationships :** The gram-mole and pound-mole – Limiting reactant – Excess reactant – Degree of completion – Basis of Calculation – Weight percent, Volume percent and mole percent – Density and Specific Gravity.

**Behavior of Ideal gases:** Application of the Ideal-gas law – Dalton and Amagat laws to gaseous mixtures – Composition of gases on dry basis and on wet basis.

**Vapor pressure :** Vaporization – Condensation – Vapor pressure – Effect of temperature on vapor pressure – Antoine equation – Reference substance vapor pressure plots – Vapor pressure of immiscible liquids – Ideal solutions and Raoult's law – Non-volatile solutes.

**Humidity :** Molal Humidity – Percentage Saturation – Relative saturation or Relative Humidity – Dew point – Dry-bulb temperature – Wet-bulb temperature

**Material Balance:** Tie substance – Yield – Conversion – Processes involving chemical reactions – Material balance calculations involving drying – Dissolutions and Crystallization – Processes involving Recycle, Bypass and Purge.

**Heat Capacities of gases and gaseous mixtures:** Effect of temperature on heat capacity of gas – Mean heat capacity of gases – Latent heats – Heat of fusion – Heat of vaporization – Estimation of latent heat of vaporization using Clausius – Clapeyron equation – Enthalpy of humid air and humid heat capacity.

**Standard heat of reaction** – Standard heat of formation – Laws of thermochemistry – Standard heat of combustion – Calculation of heat of formation from heats of combustion – Calculation of Standard heat of reaction from heats of formation and from heats of combustion – Effect of temperature on heat of reaction – Adiabatic and non-adiabatic reactions.

**Text book:**

1. 'Chemical Process Principles – Part I, Material and Energy Balances' by Olaf A Hougen, Kenneth M. Watson, and Roland A Ragatz, CBS Publishers and Distributors, 1995.

**Reference books:**

1. Stoichiometry(SI Units) by B.I.Bhatt and S.M.Vora, Tata McGraw Hill Publishing Company Ltd.,
2. Basic Principles and Calculations in Chemical Engineering by David M.Himmelblau, 3<sup>rd</sup>Prentice Hall of India Pvt.Ltd., 1995
3. Stoichiometry and Process Calculations, by K.V.Narayanan and B.Lakshmikutty, Prentice Hall of India Pvt.Ltd., New Delhi, 2006.

**Chromatography:** Chromatography, distribution coefficient, modes of chromatography, paper, thin layer, ion-exchange and affinity chromatography, GLC- Principle, sample preparation, apparatus, detectors, types and applications, HPLC- principle, components and applications,

**Electrophoresis:** Electrophoresis, general principles, support media and applications, SDS-PAGE, isoelectric focusing, Agarose gel electrophoresis, capillary electrophoresis, centrifugation, principle of sedimentation, sedimentation coefficient, preparative and analytical centrifuges, ultracentrifuge, differential centrifugation, density gradient centrifugation, applications in determination of molecular mass, purity and conformation of macromolecules,

**Radioisotopy:** Radioisotope techniques, detection and measurement of radioactivity, gas ionization, excitation of solids and solutions, autoradiography, application in biological sciences, metabolic pathways, turn over time determination, isotope dilution analysis, radiodating, clinical diagnosis and sterilization and tracer techniques,

**Spectroscopy:** UV Visible Spectroscopy - principle, Beer-Lambert's law, instrumentation of single and double beam spectrophotometers, Bathochromic and hypsochromic shifts and applications, turbidometry and nephelometry- principles and applications, infra red and Raman Spectroscopy- principles and applications, spectrofluorimetry- principle and applications,

**Advanced methods:** ESR Spectroscopy- principle, hyperfine splitting, instrumentation and applications, NMR Spectroscopy- principle, theory of proton magnetic resonance and instrumentation, NMR parameters, chemical shifts, spin-spin splitting, intensity and line width and applications, magnetic resonance imaging, mass spectroscopy- principle, instrumentation, ionization techniques, electron impact and chemical ionization, ion desorption and evaporation methods, magnetic and electric sector analyzers, detectors (Faraday cup), X-ray crystallography - principle, Bragg's equation, determination of crystal structure- rotating crystal method and powder method, and applications.

**Text books:**

1. "Practical Biochemistry- Principles and techniques", by Keith Wilson and John Walker- Cambridge
2. "Biophysical techniques", by K.Upadhyay, A. Upadhyaya and N.Nath. Himalaya Publishing House

**Dimensional analysis:** Buckingham  $\pi$  theorem

**Types of fluids:** Hydrostatic Pressure, pressure measuring devices

**Introduction to fluids in motion:** Concept of stream lines, stream tubes, viscosity, types of fluids, flow in boundary layers its formation and growth in tubes and a plates, basic equations of fluid flow – continuity, momentum, Bernoulli's equation and Navier – Stoke's equation, Hagen-Poiseuille equation, friction factor and its significance,

**Transportation and metering of fluids:** Pumps and blowers, reciprocating, rotary and centrifugal pumps, flow measuring devices - venturi meter, orifice meter, pitot tube, rotameter, notches and weirs.

**Modes of heat transfer:** Basic laws of heat transfer, analogy between heat flow and electrical flow,

**Conduction:** Fourier law of heat conduction, steady state one dimensional heat conduction through plane wall, cylinder wall and spherical shell,

**Convection:** The convective heat transfer coefficient, introduction to thermal boundary layer, dimensionless numbers in heat transfer and their significance, heat transfer by forced convection inside tubes and ducts, in laminar, transition and turbulent flow, analogies between momentum and heat transfer - Reynolds Colburns and Prandtl analogies,

**Heat transfer by radiation:** Thermal radiation, black body radiation' Kirchoff's law, emissivity, combined heat transfer by conduction convection and radiation,

**Text books:**

1. "Unit Operations of Chemical Operations" 6<sup>th</sup> Ed., by W. L . Mc-Cabe, J.C.Smith and P.Harriot

**Reference books:**

1. "Heat Transfer", by Holman J.P. ,Mc Graw Hill, Newyork 6<sup>th</sup> Ed 1997.
2. "Heat Transfer", by Y.V.C Rao.
3. "Transport Processes and Unit Operations", Christie j. Geankopolis prentice. Hall of India limited. New Delhi.

**Introduction:** Definition, scope and importance, measuring and defining environmental development – indicators,

**Ecosystems:** Introduction, types, characteristic features, structure and functions of ecosystems – forest, grassland, desert, aquatic (lakes, rivers and estuaries),

**Environmental and natural resources management:** Land resources- land as a resource, common property resources, land degradation, soil erosion and desertification, effects of modern agriculture, fertilizer-pesticide problems,

Forest resources- use and over-exploitation, mining and dams –their effects on forest and tribal people,

Water resources – use and over utilization of surface and ground water, floods, droughts, water logging and salinity, dams-benefits and costs, conflicts over water,

Energy resources- Energy needs, renewable and non-renewable energy sources, use of alternate energy sources, impact of energy use on environment,

**Bio-diversity and its conservation:** Value of bio-diversity- consumptive and productive use, social, ethical, aesthetic and option values, bio-geographical classification of India - India as a mega diversity nation, threats to biodiversity, hot spots, habitat loss, poaching of wild life, loss of species, seeds etc., conservation of biodiversity - in-situ and ex-situ conservation,

**Environmental pollution- local and global issues:** Causes, effects and control measures of air pollution, indoor air pollution, water pollution, soil pollution, marine pollution, noise pollution, solid waste management, composting, vermiculture, urban and industrial wastes, recycling and re-use, nature of thermal pollution and nuclear hazards, global warming, acid rain , ozone depletion,

**Environmental problems in India:** Drinking water, sanitation and public health, effects of activities on the quality of environment, urbanization, transportation, industrialization, green revolution, water scarcity and ground water depletion, controversies on major dams – resettlement and rehabilitation of people: problems and concerns, rain water harvesting, cloud seeding and watershed management,

**Economy and environment:** The economy and environment interaction, economics of development, preservation and conservation, sustainability: theory and practice, limits to growth, equitable use of resources for sustainable lifestyles, environmental impact assessment,

**Social issues and the environment:** Population growth and environment, environmental education, environment movements, environment versus development,

**Institutions and governance:** Regulation by Government, monitoring and enforcement of environmental regulation, environmental Acts, water (prevention and control of pollution) act, air (prevention and control of pollution) act, environment protection act, wild life protection act, forest conservation act, coastal zone regulations, institutions and policies relating to India, environmental governance,

**International conventions:** Stockholm conference-1972, Earth summit-1992, World commission for environmental development (WCED),

**Case studies:** Chipko movement, Narmada bachao andolan, Silent valley project, Madhura refinery and Taj mahal, Industrialization of Pattancheru, Nuclear reactor at Nagarjuna sagar, Tehri dam, Ralegaon siddhi (Anna Hazare), Kolleru lake-aquaculture, Fluorosis in Andhra Pradesh,

**Field work:** Visit to a local area to document and mapping environmental assets – river/forest/grass land / hill/ mountain, study of local environment-common plants, insects, birds, study of simple ecosystems – pond, river hill, slopes etc, visits to industries- water treatment plants, effluent treatment plants.

## **BTM -227      Biochemistry and Bioanalytical Laboratory**

1. Estimation of total Carbohydrates
2. Estimation of Proteins
3. Estimation of Lipids and of Cholesterol
4. Assay of Enzymes- Amylase. Determination of its  $K_m$  value
5. Estimation of DNA, Determination of  $T_m$  of DNA
6. Paper chromatography of sugar
7. Thin layer chromatography of lipids
8. Ion exchange chromatography for biomolecules separation
9. Electrophoresis of proteins and determination of their molecular weight by SDS-PAGE
10. Estimation of turbidity by Nephelometer
11. Separation of biomolecules by GLC

### **Text books:**

1. 'Introduction to Practical Biochemistry', by Plummer, Tata Mc-Graw Hill
2. 'Practical Biochemistry', by Sawhney
3. 'Laboratory Manual in Biochemistry' by J.Jayaraman, New Age International

## **BTM - 228              Fluid Mechanics Laboratory**

1. Discharge through an open orifice
2. Venturi meter
3. Orifice meter
4. V- Notch
5. Rotameter
6. Bernoulli's theorem
7. Friction factor
8. Centrifugal pump
9. Reciprocating pump
10. Reynolds apparatus

**B.Tech. Biotechnology**  
**(Effective from the admitted Batch of 2009-10)**  
**3/4 B.Tech. First semester**

**BTM -311                      Thermodynamics**

**The first law and other basic concepts :** Joule's experiments, internal energy, the first law of thermodynamics, thermodynamics state and state functions, equilibrium, phase rule, the reversible process- constant 'V' and constant 'P' processes, enthalpy, heat capacity, mass and energy balance for open system, energy balance for steady state flow process,

**The second law of Thermodynamics:** Statements of the second law, heat engines, Carnot's theorem, thermodynamic temperature scales, ideal gas temperature scale, Carnot's equations,

**Entropy:** Entropy changes of an ideal gas, mathematical statement of the second law, the third law of thermodynamics, entropy from the microscopic view point,

**Chemical Reaction Equilibria:** The reaction coordinate, application of equilibrium criteria to chemical reactions, the standard Gibbs energy change and the equilibrium constant, effect of temperature on the equilibrium constant, relation of equilibrium constants to composition, phase rule and Duhem's theorem for reacting systems.

**Text books:**

1. "Introduction to Chemical Engineering Thermodynamics" by J.M. Smith, H.C. Vanness & M.M. Abbott, 6<sup>th</sup> Ed. McGraw Hill Book Co., New York
2. "Chemical and Engineering Thermodynamics", by Stanley I. Sandler

**Immunity, Lymphoid organs and cells:** Introduction to Immunology and its origin in vertebrates and invertebrates, immunity-innate immunity and acquired immunity and the various lines of defence, organs of immune system, Thymus, bone marrow, bursa of fabricius, spleen, lymphnode and MALT, cells of immune system- B-cells, T-cells, antigen presenting cells, monocytes, NK cells and langerhan cells,

**Antigens, Antibodies and Ag-Ab reactions:** Antigens- properties of antigens, haptens, epitopes, T-dependent and T-independent antigens, adjuvants and their clinical importance, immunoglobulins- classification, structure and functions of immunoglobulins, antigenic determinants on antibodies, antigen – antibody reactions, and tests involving them - precipitation tests, agglutination tests, complement fixation tests, immunofluorescence, RIA, ELISA, Western blotting and ELISPOT,

**Complement, MHC and Immune response:** Complement system- its components, complement fixation pathways and consequences, MHC- In mice and human, structure of MHC molecules and their role in antigen presentation, immune response- humoral and cell, mediated immune response, IR curve, role of cytokines in immunity, interferons and interleukins, immune suppression, immune tolerance,

**Hypersensitivity, Transplantation, Autoimmune disease:** Hypersensitive reactions- Type I, II, III and IV reactions and their role in graft rejection, transplantation immunology- classification of grafts and immunology of graft rejection, agents used for preventing graft rejection, autoimmune diseases- definition and few examples,

**Hybridoma and Vaccination:** Hybridoma technology- production of monoclonal antibodies and their applications, vaccines and vaccination, methods of attenuation of live forms, types of vaccines- whole organisms as vaccines, attenuated forms, purified molecules as vaccines, recombinant organisms, DNA vaccines and synthetic peptides.

**Text book:**

1. 'Immunology' by A.Goldsby, Thomas J.Kindt, Barbara A.Osborne and Janis Kuby
2. 'A Text book of Microbiology' by R.Ananthanarayan and C.K.J.Pandey.

**Introduction:** Mass transfer Operations.

**Molecular diffusion in fluids:** Binary solutions, Fick's law, equation of continuity, Steady state equimolar counter current diffusion, Stefan's diffusion, estimation of diffusivity of gases and liquids, application of molecular diffusion.

**Mass transfer coefficients:** Mass transfer coefficients in turbulent flow, theories of mass transfer, analogy between momentum, heat and mass transfer in laminar and turbulent flow, correlations for mass transfer coefficients in simple situations, diffusion in solids.

**Interphase mass transfer:** Concept of equilibrium, diffusion between phases, two resistance theory, material balances in steady state co-current and counter-current stage processes, Murphy stage efficiency.

**Equipment for gas-liquid operations:** Sparged vessels, mechanically agitated vessels for single phase liquids and gas-liquid mixtures, tray towers, sieve tray for absorption and distillation, venturi scrubbers, spray towers and spray chambers, packed towers for absorption and distillation, tray towers versus packed towers.

**Absorption:** Solubility's of gases in liquids, two component systems, multi-component systems, ideal and non-ideal solutions, choice of solvent for absorption, single component absorption material balances, counter current multistage operations, dilute gas mixtures, on-isothermal operation, tray efficiency, continuous contact equipment, HETP, HTU, NTU concepts for single operation absorption with chemical reaction.

**Distillation:** Principles of VLE for binary systems, phase diagrams, relative volatility, ideal solutions, azeotropes, enthalpy concentration diagrams, flash vaporization, partial condensation, differential distillation, steam distillation, continuous distillation, McCabe-Thiele method, Ponchon-Savarit method, tray efficiencies, introduction to multi-component distillation, azeotropic and extractive distillations.

**Text book:**

1. Mass transfer Operations, Robert E. Treybal, 3rd edition, McGraw-Hill Book Co.,

**Reference books:**

1. "Unit Operations in Chemical Engineering" by McCabe, W.L., Smith, J.C. and Harriot, P., 5<sup>th</sup> Edition, McGraw-Hill Book Co.,
2. "Chemical Engineering Hand Book" by J.H. Perry.

**The nucleus, chromatin and the chromosome:** structure and function of nucleus; organization of genetic material – Packing of DNA into chromatin, Nucleosome organization; Chromosome structure; Cell cycle – Check points, Cdks and regulation.

**The biochemical basis of Inheritance:** DNA as the genetic material, DNA structure and replication in prokaryotes and eukaryotes – Enzymes involved and mechanism including replication at telomere.

**Genome organization in Eukaryotes-** DNA Kinetics and cot curves, Nucleotide composition – Unique, Middle and highly repetitive DNA, Mitochondrial and plastid genomes.

**Genetic code:** properties of genetic code, Wobble hypothesis.

**Gene Expression: Transcription** in prokaryotic and eukaryotic systems – enzymes and factors involved and mechanism; RNA processing in eukaryotes – capping, addition of poly(A) and removal of introns; **Translation** in prokaryotes and eukaryotes – machinery involved and mechanism;

**Regulation of gene expression** in prokaryotes – Lac operon concept in *E.coli* ; regulation of gene expression in eukaryotes by promoters, enhancers, silencers and transcription factors.

**Mutations** – Terminology, types of mutations, Biochemical basis of mutants, Mutagenesis, Chemical mutagens - base analogues, Intercalating substances, Physical mutagens- U.V radiation and ionization radiation, AMES test, Repair of DNA damage.

#### TEXT BOOKS:

1. “The world of the cell”, Becker, Klein Smith and Hordin, Pearson education.

#### REFERENCE:

1. “Molecular cell biology” by Lodish et.al., Freeman Publications
2. “Cell & Molecular Biology” by De.Robertis. E.D.P., International Edition
3. “Molecular Biology” by Friefelder, D., Narosa publications
4. “Molecular Biology of the Gene” by J.D.Watson et.al, Benjamin

**Conventional energy sources:** The present and scope for future development, utilization of coal, formation, analysis, classification, storage and carbonization, byproduct recovery,

**Petroleum:** Origin, classification, single and multi-stage fractionation, reforming, catalytic cracking, specification of kerosene, motor gasoline and fuel oils, liquified petroleum gas and nature gas, composition, properties and uses,

**Non-conventional energy sources:** Solar radiation, principles of heating, cooling and photo-voltaic cells,

**Biogas production:** Biomass, wind energy, tidal and wave energy, geothermal energy, nuclear energy, ocean thermal energy, hydrogen energy,

**Fuel cells:** Storage of energy, types - water storage, packed bed storage, solar storage, chemical storage, phase change storage, mechanical energy storage and windmill storage.

**Text books:**

1. "Fuels and Combustion", by S. Sirkar, Orient Longmans, 2nd Ed.
2. "Solar Energy, Thermal Storage", by S.P. Sukhatme, TMH
3. "Non-conventional Energy Sources", by G. D. Rai, Khanna Publications.

**Food processing and preservation:** Biotechnology in relation to the food industry, nutritive value of the food, types of microorganisms associated with the food, food colors and flavors, enzymes and chemicals used in food processing, food preservation,

**Fermented food products:** Microbial culture used in food industry, fermentation technology for food industry & waste utilization. Bioprocessing and fermentation of meat, vegetables, fruits, dairy products, non-beverage plant products, beverages and related products of baking,

**Food spoilage and Food Microbiology:** Food spoilage, food borne illness, food quality and quality control, HFCS (High Fructose Corn Syrup), single cell protein production,

**Food processing operations:** Food engineering operations: characteristics, cleaning, sorting and grading of food raw materials, food conversion operations, size reduction, mixing, emulsification, filtration, membrane separation, centrifugation, extraction, and crystallization, microwave heating, thermal inactivation of microorganisms, freezing and thawing of foods,

**Text books:**

1. "Biotechnology: Food fermentation", by V.K. Joshi & Ashok pandey.
2. "Food processing and preservation", by B. Sivasankar

**Reference books:**

1. "Food Biotechnology", by Roger Angold, Gordon Beech & Taggart
2. "Basic Food Microbiology", by George J Banward, CBS publishers
3. "Modern Food Microbiology", by James M Jay, CBS publishers.

**Basic Concepts of Optimization:** Introduction to process optimization; continuity of functions, unimodal versus multimodal functions, convex and concave functions, convex region, necessary and sufficient conditions for an extremum of unconstrained function, interpretation of the objective function in terms of its quadratic approximation,

**Optimization of unconstrained Functions - One-dimensional Search:** Numerical methods for optimizing a function of one variable, scanning and bracketing procedures; Newton, quasi-Newton and secant methods of unidimensional search, Newton's method, quasi-Newton method, secant method,

**Region Elimination Methods,** polynomial approximation methods - quadratic interpolation, cubic interpolation, how the one-dimensional search is applied in a multidimensional problem, evaluation of unidimensional search methods,

**Unconstrained Multivariable Optimization:** Direct methods- random search, grid search, univariate search, simplex method, conjugate search directions, Powell's method, indirect methods first order - gradient method and conjugate gradient method, indirect method second order – Newton's method,

**Linear Programming and its Applications:** Basic concepts in linear programming, degenerate LP's – graphical solution, natural occurrence of linear constraints; the Simplex method of solving linear programming problems,

**Nonlinear Programming with Constraints:** Lagrange multiplier method, necessary and sufficient conditions for a local minimum, generalized reduced-gradient method, random search methods, and comparative evaluation of different methods,

**Global Optimization:** Overview of genetic algorithm, simulated annealing and other global optimization methods, heuristic search methods.

**Text book:**

1. "Optimization of Chemical Processes", 2<sup>nd</sup> Edition, by T.F. Edgar, D.M. Himmelblau and L.S. Lasdon McGraw-Hill, 2001.

**Reference books:**

1. "Applied Optimization with MATLAB" by P. Venkataraman, John Wiley
2. 'Optimization for Engineering Design' by K. Deb, Prentice Hall of India Private Limited, New Delhi, 2003
3. 'Engineering Optimization', 3<sup>rd</sup> Edition, by S.S. Rao Wiley, 1996.

**Introduction:** Basic principles of systems biology, experimental techniques,

**Standard models and approaches:** Metabolism- enzyme kinetics and thermodynamics, metabolic networks, metabolic control analysis,

**Biological processes:** Signal transduction- introduction, function and structures, interactions, structural components, signaling selected biological processes,

**Evolution:** Introduction, mathematical models, prediction of biological systems, data integration,

**Applications:** Systems biology in various fields, databases and tools, modeling tools.

**Text books:**

1. "Systems Biology in Practice-Concepts, Implementation and Application" by Edda Klipp and Ralf Herwig, Wiley VCH, I Edition
2. "Systems Biology: Definitions and Perspectives" by Lilia Alberghina and Hans V. Westerhoff, Springer, 2005.

**Reference books:**

1. "Systems Biology: Principles, Methods, and Concepts" by Andrzej K. Konopka, CRC Press, 2006
2. "Stochastic Modelling for Systems Biology" by Darren James Wilkinson, CRC Press, 2006.

## **FE -01      Basic Biotechnology (Free Elective I)**

**Introduction to Biotechnology:** Definitions, historical perspectives, scope and importance, classical vs. modern concepts, biotechnology in India and global trends,

**Fundamentals of Biochemical Engineering:** Concept of pH, buffer, physical variables, dimensions and units, measurement conventions, physical and chemical property data,

**Protein Structure and Engineering:** Introduction to the world of proteins, 3-D shape of proteins, structure and function relationship in proteins, purification of proteins, characterization of proteins, protein based products,

**Recombinant DNA Technology:** Introduction, tools of rDNA technology, making recombinant DNA, DNA library, introduction of recombinant DNA into host cells, polymerase chain reaction (PCR),

**Plant Cell Culture and Application:** Introduction, cell and tissue culture techniques, applications of cell and tissue culture, transgenic plants with beneficial traits, diagnostics in agriculture and molecular breeding, bioethics in plant genetic engineering,

**Animal Cell Culture and Applications:** Introduction, animal cell culture techniques, characterization of cell lines, applications of animal cell culture, stem cell technology, bioethics in animal genetic engineering,

**Biotechnology and Society:** Good laboratory practices, quality assurance, quality control, patents, intellectual property rights, marketing; ethical issues in agriculture and health care.

### **Text books:**

1. 'A textbook of Biotechnology for Class XI and XII', CBSE
2. 'Biotechnology ' by Smith, Cambridge Press.

## **FE -01      Biosensors and Bioelectronics (Free Elective I)**

**Introduction and their types:** What are biosensors? advantages and limitations, biocatalysis based biosensors, bioaffinity based biosensors and microorganisms based biosensors, biologically active material and analyte,

**Basic design and considerations:** Various components of biosensors, calibration, dynamic Range, signal to- noise ratio, sensitivity, selectivity, interference. Types of membranes used in biosensor constructions, immobilization: adsorption, encapsulation -(hydro-gel, sol-gel glass, etc.), covalent attachment, diffusion issues,

**Transducers in biosensors:** Various types of transducers; principles and - calorimetric, optical, potentiometric / amperometric conductrometric / resistormetric, piezoelectric, semiconductor, impedimetric, mechanical and molecular electronics based transducers, chemiluminiscene - based biosensors,

**Application and uses of biosensors;** Biosensors in clinical chemistry, medicine and health care, biosensors for veterinary, agriculture and food, low cost-biosensor for industrial processes for online monitoring, biosensors for environmental monitoring.

### **Text books:**

1. "Biosensors for Environmental Monitoring" by Bilitewski, U. Turner, A.P.F., Harwood, Amsterdam
2. "Biosensors and Their Applications" by Yang V.C. and T.T. Ngo, Kluwer Academic/Plenum Publishers, New York, NY. ISBN: 0-306-46087-4

### **Reference book:**

1. 'Optical Biosensors: Present & Future' by Ligler, F.S. and Rowe Taitt, C.A., Elsevier, The Netherlands, ISBN: 0-444-50974-7.

## **BTM-316**

## **Unit Operations laboratory**

1. Emissivity measurement apparatus
2. Natural Convection
3. Forced Convection
4. Pin Fin Apparatus (Natural Convection)
5. Pin Fin Apparatus (Forced Convection)
6. Liquid-Liquid Extraction
7. Solid –Liquid Equilibrium
8. Hydrodynamic Studies in Sieve tray tower
9. Ternary – Liquid Equilibrium
10. Single drop Liquid – Liquid equilibrium

## **BTM - 313**

## **Cell and Molecular Biology Laboratory**

### **Cell biology:**

Study of mitosis, meiosis, differential staining of euchromatin and heterochromatin, fluorescent *in situ* hybridisation - FISH (principle & photographs),

### **Molecular biology:**

Isolation of genomic DNA, quantification of DNA, Agarose gel electrophoresis, isolation of plasmid DNA, restriction digestion, ligation, transformation, southern blotting, isolation and analysis of RNA.

### **Text books:**

1. "A Guide to Molecular Cloning", Vol. 1,2 & 3, Sambrook, J. et al., Cold Spring Harbor Laboratory Publications
2. 'Chromosome Techniques' by Sharma & Sharma

**Communication:**

Importance of communication

Non verbal communication

Personal appearance

Posture

Gestures

Facial expressions

Eye contact

Space distancing

**Goal setting:**

Immediate, short term, long term,

Smart goals, strategies to achieve goals

**Time management:**

Types of time

Identifying time wasters

Time management skills

**Leadership and team management:**

Qualities of a good leader

Leadership styles

Decision making

*Problem solving*

Negotiation skills

**Group discussions:**

Purpose (Intellectual ability, creativity, approach to a problem, solving, tolerance, qualities of a leader)

Group behaviour, Analysing performance

**Job interviews:**

Identifying job openings

Preparing resumes & CV

Covering letter

Interview (Opening, body-answer Q, close-ask Q),

Types of questions

**Reference books:**

1. 'Effective Technical Communications' by Rizvi M. Ashraf, McGraw–Hill Publication
2. 'Developing Communication Skills' by Mohan Krishna & Meera Banerji, Macmillan
3. 'Creative English for Communication' by N.Krishnaswami & T.Sriraman, Macmillan
4. 'Professional Communication Skills' by Jain Alok, Pravin S.R. Bhatia & A.M. Sheikh, S.Chand & Co.

**B.Tech. Biotechnology**  
**3/4 B.Tech. Second semester**

**BTM- 321**

**Biostatistics**

**Introduction**, collection and classification of data, graphical representation, histogram, frequency polygon and cumulative frequency curve, comparison of frequency distributions, measures of central tendency, mean, median and mode, an empirical relation between mean, median and mode, geometric mean and harmonic mean, measures of dispersion – range, quartile deviation or semi-inter quartile range, mean deviation, root mean square deviation, standard deviation, variance, coefficient of variation, empirical relation between measures of dispersion, standard deviation of combined samples

**Moments**, skewness and kurtosis, correlation, scatter diagram, coefficient of correlation both for ungrouped and grouped data, lines of regression, standard error of estimate, rank correlation

**Probability distribution and sampling theory:** Random variable both discrete and continuous, probability distribution both discrete and continuous, cumulative distribution, expectation, variance, standard deviation, moment generating function, binomial distribution, constants of binomial distribution, mean, standard deviation, skewness and kurtosis, fitness of a binomial distribution, Poisson distribution, constant of poisson distribution, mean, standard deviation, skewness and kurtosis – fitting of a poisson distribution, normal distribution, standard normal distribution, propertive normal distribution, probability error, fitting of normal distribution,

**Sampling Theory:** sampling, random sampling, parameters and statistic, objectives of sampling, sampling distribution, standard error, testing of hypothesis, errors, null hypothesis, level of significance, testing significance, confidence limits, simple sampling of attributes, test of significance for large samples, comparison of large samples, test of significance for means of two large samples, sampling of variables, small samples, number of degrees of student t-distribution, significance test of difference between sample means, f-distribution, Fisher's z-distribution, Chi-square distribution

**Numerical solutions of PDEs** – Elliptic (Liebmann iteration process), parabolic (Schmidt explicit formula), hyperbolic and Poisson's equations (Gauss – siedel method)

**Text book:**

1. "Higher Engineering Mathematics" by B.S.Grewal

**Reference books:**

1. 'Numerical Methods for Scientific and Engineering Computation' by M.K.Jain, S.R.K.Iyengar and R.K.Jain, New Age International (P) Ltd., New Delhi
2. 'Probability, Statistics and Random Process' by T. Veerarajan, Tata Mc-Graw Hill
3. 'Probability, Statistics with Reliability, Queing and Computer Science Application' by Kishore S. Trivedi

**BTM-322 Chemical Reaction Engineering**

**Introduction** and overview of the subject, kinetics of homogeneous reactions, non elementary reactions, Arrhenius relation, Collision theory and Transition-state theory, various methods of analyses of batch reactor data obtained for various types of reactions including variable volume and variable pressure data .

**Isothermal batch reactor design, Homogeneous flow reactors:** Design equation for plug flow reactor (PFR) and continuous stirred tank reactor (CSTR), data analysis in flow reactors, space time, space velocity, recycle reactor, cascade of CSTRs and combination for PFR and CSTR.

**Multiple reactions:** Design for multiple reactions, parallel reactions, series reactions.

**Non-isothermal design:** Energy balance equations for batch, PFR and CSTR under non-isothermal conditions, Equilibrium conversion under adiabatic conditions, Design of the homogeneous reactors under adiabatic conditions.

**Non-ideal flow:** Residence time distribution curves, C, E and F curves; Interpretation of the response data for the "Dispersion" and "Tanks-in-series" models, calculation of conversion using E data and tanks- in -series model.

**Heterogeneous Catalysis:** Catalyst-properties, calculation of surface area, porosity and pore volume, catalyst preparation methods, promoters, inhibitors and catalyst poisons, physical adsorption & chemisorption, adsorption isotherms, Derivation of rate equations for various mechanisms (Adsorption, surface reaction and desorption controlling etc.,) Data analysis for heterogeneous laboratory catalytic reactors. Isothermal packed bed (PFR) reactor design, effectiveness factor and internal pore diffusion, Criteria for internal pore diffusion limitation.

**Text book:**

1. 'Chemical Reaction Engineering' by Octave Levenspiel, 3<sup>rd</sup> Edition, John Wiley & Sons, 1999

**Reference books:**

1. 'Elements of Chemical Reaction Engineering' by H.S.Fogler, 3<sup>rd</sup> Edition, Printice Hall International, 2000
2. 'Chemical Engineering Kinetics' by J.M.Smith, 3<sup>rd</sup> Edition, McGraw Hill, 1981

**BTM -323**

## **Bioprocess Engineering**

**Introduction** to biotechnology and bioprocess engineering, regulatory constraints in bioprocess,

**Stoichiometry of microbial growth and product formation:** Elemental balances, degree of reduction, prediction of yield coefficients,

**Enzyme Kinetics** – Michaeli's- Menten equation and determination of kinetic coefficients, effect of pH and temperature,

**Principles and mechanisms of media and air sterilization:** Batch and continuous sterilization of media,

**Cell kinetics and Fermentor design:** Batch growth cultivation, batch, continuous and plug flow fermentors, Monod growth kinetics in continuous culture and evaluation of coefficients, fed batch operation, chemostat with cell recycle, multistage chemostat systems,

Nonconventional bioreactors, bioreactor instrumentation and control.

### **Text books:**

1. "Bioprocess Engineering" 2<sup>nd</sup> edition, by M.L.Shuler and F.Kargi, Prantice Hall India, New Delhi.
2. "Biochemical Engineering" by JU.M.Lee, Practice–Hall 1992.

### **Reference books:**

1. "Text Book of Biochemical Engineering" by D.G. Rao, Tata McGraw Hill, New Delhi, 2004.
2. "Biochemical Engineering Fundamentals", 2<sup>nd</sup> edition, by E.Bailey and D.F.Ollis, McGraw Hill, 1986.

**Separation of insoluble products:** Filtration, centrifugation (batch, continuous, basket), coagulation and flocculation, sedimentation, decanting,

**Cell disruption:** Physical methods (osmotic shock, grinding with abrasives, solid shear, liquid shear), chemical methods (alkali, detergents), enzymatic methods,

**Separation of Soluble Products:** Extraction, precipitation, adsorption, dialysis, reverse osmosis, ultra filtration and micro filtration, cross- flow ultra filtration and micro filtration, electrophoresis, gel exclusion chromatography, ion exchange chromatography and electro dialysis,

**Products Purification & Polishing:** Crystallization, drying and pervaporation,

**Adsorption:** Theory of adsorption, industrial adsorbents, adsorption equilibria, Freundlich equation, single and multistage operations, unsteady state adsorption, equipment for single stage and continuous contact, ion-exchange.

**Text books:**

1. "Bioprocess Engineering" by Michael L. Shuler Fikret Kargi, Prentice Hall of India
2. "Bioseparations- Downstream Processing for Biotechnology", by Paul A. Belter and E. L. Cussler

**Reference books:**

1. "Biochemical engineering fundamentals", 2nd ed. by J.E. Bailey and D. Ollis, McGraw-Hill (1986)
2. " Bioseparations-Principles & Techniques" by B. Sivasankar.
3. ."Principles of Fermentation Technology" by P.F. Stanbury and A. Whitaker, Pergamon press (1984).

**Biological Waste Water Treatment:** Biological processes for domestic and industrial waste water treatment, aerobic systems- activated sludge process, trickling filters, biological filters, rotating biological contractors (RBC), fluidized bed reactor (FBR), expanded bed reactor, inverse fluidized bed biofilm reactor (IFBBR), packed bed reactors, air sparged reactors, anaerobic biological treatment- contact digesters, packed column reactors, UASB,

**Bioremediation:** Introduction, constraints and priorities of bioremediation, biostimulation of naturally occurring microbial activities, bioaugmentation, insitu, exsitu, intrinsic and engineered bioremediation, solid phase bioremediation- land farming, prepared beds, soil pipes, phytoremediation, composting, bioventing and biosparging, liquid phase bioremediation- suspended bioreactors, fixed biofilm reactors,

**Metal Biotechnology and Biofuels:** Mining and metal biotechnology, microbial transformation, accumulation and concentration of metals, metal leaching, extraction and future prospects, microorganisms and energy requirements of mankind, production of non-conventional fuels- methane (biogas), hydrogen alcohols and algal hydrocarbons, use of microorganism in augmentation of petroleum recovery,

**Hazardous Waste Management:** Introduction, xenobiotic compounds, recalcitrants, hazardous wastes, biodegradation of xenobiotics, biological detoxification, market for hazardous wastes management, biotechnology application to hazardous waste management, examples of biotechnological applications to hazardous waste management, cyanide detoxification, detoxification of oxalate, urea, etc.; toxic organics, phenols.

**Text books:**

1. "General Microbiology", by Stanier R Y, Ingraham J L, Wheelis ML & Painter RR, McMillan publications.
2. "Environmental Pollution Control Engineering", by C. S. Rao, New Age International Pvt Ltd.

**Reference books:**

1. 'Biotechnology and Biodegradation, Advances in Applied Biotechnology', Vol-4, by Karnely, D., Chakrabarthy, Omen, G.S., Gulf Publications Co., London.
2. 'Bioremediation Engineering: Design and Application', by John T, Cookson, Jr., McGraw Hill, Inc.

## BTM -326      Pharmaceutical Biotechnology (Elective II)

**Introduction:** Introduction, development of drug and pharmaceutical industry, therapeutic agents, their uses and economics, regulatory aspects,

**Drug metabolism:** Drug metabolism and pharmacokinetics, metabolism, physico-chemical principles, radioactivity, pharmacokinetics- action of drugs on human bodies,

**Bulk drug manufacture:** Important unit processes and their applications, bulk drug manufacturing, types of reactions in bulk drug manufacturing and processes, special requirements for bulk drug manufacture,

**Dosage forms and manufacture:** Manufacturing principles: wet granulation, dry granulation or slugging, direct compression, tablet presses, coating of tablets, capsules, sustained action dosage, forms- parental solutions, oral liquids, injections, ointments, various topical drugs and pharmaceuticals, packaging, packaging techniques, quality management and GMP.

**Other dosage forms and control:** Pharmaceutical products and their control, therapeutical categories such as laxatives, vitamins, analgesics, non-steroid contraceptives; antibodies and biologicals, hormones.

### **Text books:**

1. "Theory and Practice of Industrial Pharmacy". 2nd Ed. Edited by L. Lachman.*et al*, Lea and Febiger, Philadelphia,
2. "Dispensing for Pharmaceutical Students" by John William Cooper, Colin Gunn, S.J.Carter, Sir I. Pitman & Sons

## **BTM -326 Cancer Biology (Elective II)**

**Fundamentals of Cancer Biology:** Introduction, regulation of cell cycle, mutations that cause changes in signal molecules, effects on receptor, signal switches, classification of cancer, modulation of cell cycle in cancer. Carcinogenesis, cancer initiation, promotion and progression,

**Causes for Carcinogenesis:** Chemical carcinogenesis, metabolism of carcinogenesis, natural history of carcinogenesis, targets of chemical carcinogenesis, principles of physical carcinogenesis, X - ray radiation, mechanism of radiation carcinogenesis,

**Molecular Cell Biology of Cancer:** Oncogenes, identification of oncogenes, retroviruses and oncogenes, detection of oncogenes, growth factor and growth factor receptors that are oncogenes, oncogenes / proto oncogene activity, growth factors related to transformations, tumor suppression, tumor suppressor genes,

**Principles of Cancer Metastasis:** Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three-step theory of invasion, proteinases and tumor cell invasion,

**Detection of Cancer;** Detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection, different forms of therapy, chemotherapy, radiation therapy and immuno therapy, advantages and limitations.

### **Text books:**

1. "Cancer Biology" by Raymond W. Ruddon, Oxford University Press Inc., 2007 Ed., NY.
2. "The Basic Science of Oncology" by Ian F.Tannock et al, 4<sup>th</sup> edition, 2007. Mc Graw Hill Company.

## **BTM-326 Animal Cell Culture and Hybridoma Technology (Elective II)**

**Cell culture:** Laboratory design and equipments planning, construction and services and equipment, cryopreservation equipment and principle, water purification system, washing, packing and sterilization of different materials used in animal cell culture, aseptic concepts, maintenance of sterility in cell culture vessels,

**Media and Reagents:** Types of cell culture media, ingredients of media; physiochemical properties, CO<sub>2</sub> and bicarbonates, buffering, oxygen, osmolarity, temperature, surface tension and foaming, balance salt solutions, antibiotics and growth supplements, foetal bovine serum, serum free media, selection of medium and serum, conditioned media, other cell culture reagents, preparation and sterilization of cell culture media, serum and other reagents.

**Different types of cell cultures:** Primary culture and its preparation, establishment of primary culture, subculture –passage number, split ratio, seeding efficiency and criteria for subculture, continuous cell lines, suspension culture, behavior of cells in culture conditions: division, growth pattern, estimation of cell number, development of cell lines, characterization and maintenance of cell lines, common cell culture contaminants, cell transformation, normal Vs transformed cell and agents that cause transformation.

**Scale-up:** Cell culture reactors, scale-up in suspension, scale and complexity, mixing and aeration, rotating chambers, perfused suspension cultures, fluidized bed reactors for suspension culture, scale-up in monolayers, multisurface propagators, multiarray disks, spirals and tubes, roller culture, microcarriers, perfused monolayer cultures, membrane perfusion, hollow fiber perfusion, matrix perfusion, microencapsulation, growth monitoring,

**Applications:** Cell cloning and selection, transfection and transformation of cells, commercial scale production of animal cells, stem cells and their application, application of animal cell culture in pharmaceuticals, production of vaccines, growth hormones and interferons, hybridoma technology, production of hybridoma, screening and applications of monoclonal antibodies in various fields.

### **Text books:**

1. "Culture of Animal Cells", (3rd Edition) by F1. Ian Freshney, Wiley-Liss,
2. "Animal Biotechnology" by M.M.Ranga, 2002 Edition.

## **BTM -326      Stem Cells in Health Care (Elective II)**

**Stem cell basics:** Unique properties of stem cells, embryonic stem cells, adult stem cells, umbilical cord stem cells, similarities and differences between embryonic and adult stem cells, properties of stem cells – pluripotency, totipotency, multipotency,

**Embryonic stemcells:** Invitro fertilization, human embryonic stem cells, *blastocyst, inner cellmass, growing ES cells in laboratory, laboratory tests to identify ES cells, stimulating ES cells for differentiation, properties of ES cells, human ES cells, monkey and mouse ES cells,*

**Adult stem cells:** Somatic stem cells, test for identification of adult stem cells, adult stem cell differentiation, trans-differentiation, plasticity, different types of adult stem cells,

**Stem cell in drug discovery and tissue engineering:** Target identification, manipulating differentiation pathways, stem cell therapy Vs cell protection, stem cell in cellular assays for screening, stem cell based drug discovery platforms, drug screening and toxicology,

**Genetic engineering and therapeutic application of stem cells:** Gene therapy, genetically engineered stem cells and animal cloning (transgenic animals), biomarkers in cancer, therapeutic applications in parkinson's disease, neurological disorder, limb amputation, heart disease, spinal cord injuries, diabetes, matching the stem cell with transplant recipient, HLA typing, Alzheimers disease, spinal cord injuries, tissue engineering application, production of complete organs – kidney, eyes, heart, brain.

### **Text books:**

1. “Stem Cells, Human Embryos and Ethics: Interdisciplinary Perspectives” by Larstnor, Springer, 2008
2. ‘Handbook of Stem Cells’, Volume-1, by Robert Paul Lanza, Gulf Professional Publishing, 2004

### **Reference books:**

1. “Embryonic Stem cells”by Kursad and Turksen. 2002, Humana Press.
2. “Stem Cell and Future of Regenerative medicine by Committee on the Biological and Biomedical Applications of Stem cell Research”, 2002, National Academic Press.

1. Cell Disruption by Sonication
- 2. Cell Disruption by Enzymatic Reaction
3. Centrifugal Separation- Ultra Centrifugation, Gel Filtration
4. Micro filtration
5. Ultra filtration
6. Aqueous Two-phase Extraction
7. Dialysis
- 8. Ammonium Sulphate Precipitation
9. Isoelectric Precipitation
10. Affinity Chromatography
11. Ion Exchange Chromatography •
- 12. Gas Chromatography
13. Adsorption Chromatography.
14. Gel Exclusion Chromatography
15. Crystallization
16. Freeze Drying.

## **BTM -328 Bioprocess and Reaction Engineering Laboratory**

### **Bioprocess Engineering**

1. Isolation and characterization of industrial cultures for use as biocatalysts in bioprocesses and Analysis of raw materials used in common industrial bioprocesses
2. Production Ethanol & Protease
3. Parameter optimization studies in bioprocesses eg. Ethyl alcohol, amino acid production etc.
4. Product purification in bioprocess studies. Eg. Enzyme production (amylase, protease etc).
5. Measurement of Volumetric Oxygen transfer coefficient
6. Cell immobilization protocols
7. Immobilized bioprocess with cells and enzymes
8. Filter efficiency of common air filters
9. Heat inactivation of microbial cells, thermal death rate

### **Reaction Engineering**

1. Batch Reactor (Order)
2. Batch Reactor (Rate Constant)
3. CSTR (Rate Constant)
4. PFR (Rate Constant)
5. CFR (CSTR to PFR)
6. CFR (PFR to CSTR)
7. RTD studies in a packed bed Reactor
8. RTD studies in a Plug flow reactor

**B.Tech. Biotechnology**  
**(Effective from the admitted Batch of 2009-10)**  
**4/4 B.Tech. First semester**

**BTM -411                      Enzyme Engineering**

**Introduction:** Catalysis and biocatalysis, enzyme structure functionality and relationship, enzyme activity, classification of enzymes, enzymes as process catalysts,

**Enzyme Production:** Enzyme sources, synthesis, recovery, purification, and formulation of enzymes,

**Homogeneous Enzyme Kinetics:** Hypothesis of enzyme kinetics, rapid equilibrium and steady-state hypothesis, determination of kinetic parameters, various types of kinetic inhibition, reactions with more than one substrate, effect of environmental variables- pH, temperature, and ionic strength,

**Heterogeneous Enzyme Kinetics:** Various methods of enzyme immobilization, mass transfer effects in heterogeneous biocatalysis, partition effects, external (film) diffusion, internal (pore) diffusion,

**Enzyme Reactors:** Design of ideal reactors with enzymes (Batch, CSTR, PFR), effect of diffusion on enzyme reactor design, effectiveness factor, effect of thermal inactivation and mass transfer limitation on design and performance of enzyme reactors,

**Application of Enzymes:** Application in biosensors, Food processing applications, Medical and pharmaceutical applications.

**Text books:**

1. "Enzyme Biocatalysis: Principles and Applications' by A.Illanes, Springer
2. "Enzyme Technology" by M.F.Chaplin and C.Bucke, Cambridge University press, 1990. (Website for the book, [www:lsbu.ac.uk/biology/enztech/](http://www.lsbu.ac.uk/biology/enztech/))

**Reference books:**

1. "Biocatalysts and Enzyme Technology" by K. Buchholz, V. Kasche and U.T. Bornscheur, Wiley, 2005
2. "Enzyme Technology", by Shanmugam, S. and Satish Kumar, T., IK International Pvt. Ltd, New Delhi, 2008
3. "Biochemical Engineering Fundamentals' by Bailey, J.E., and Ollis, D.F., McGraw-Hill, 1986.
4. "Bioprocess Engineering", 2<sup>nd</sup> edition, by Shuler and Kargi, Prentice-Hall

**Introduction to Bioinformatics:** Need of computers in Biotechnology research, File Transfer Protocol (FTP), TELNET, HTTP, bioinformatics- introduction, scope, applications, various file formats for bio-molecular sequences, genbank, fasta, gcg, msf, nbrf-pir etc.

**Biological Databases:** Introduction to databases, classification of biological databases, information retrieval from databases, nucleic acid sequence databases, GenBank, EMBL, DDBJ, protein sequence databases, SWISS-PROT, TrEMBL, PIR\_PSD, genome databases, sequence based database searches, BLAST and FASTA,

**Sequencing:** Basic concepts of sequence similarity, identity and homology, definitions of homologues, orthologues, paralogues, scoring matrices- PAM and BLOSUM series, differences between distance and similarity matrix, Sequence Alignment: Strings, edit distance, string similarity- methods, pair wise alignment- local and global alignment, gap- gap penalty,

**Pairwise sequence alignments (PSA):** Needleman and Wuncsh, Smith and Waterman algorithms for pairwise alignments, use of PSA for analysis of nucleic acid and protein sequences and interpretation of results, **Multiple sequence alignments (MSA):** The need for MSA, basic concepts of various approaches for MSA, algorithm of CLUSTALW and pileup and their application for sequence analysis, use of HMM method,

**Phylogenetic Analysis and gene prediction:** Understanding evolutionary process, origins of molecular phylogenetics, phylogenetic analysis methods- maximum parsimony, UPGMA, neighbor-joining, maximum likelihood, basis of gene prediction, gene prediction Methods, other gene prediction tools, gene annotation, human genome mapping (HGP),

**Structural Bioinformatics:** Prediction of protein structure, secondary structure, algorithms of Chou Fasman, GOR methods, tertiary structure prediction approach, basic principles and protocol of homology modeling, basic principles of *ab initio* structure prediction.

**Text books:**

1. "Essential Bioinformatics" by Jin Xiong, Cambridge University Press, 2006.
2. "Bioinformatics Method and Applications-Genomics, Proteomics and Drug Discovery", S.C. Rastogi, N. Mendiratta and P. Rastogi, Prentice Hall, India

**Reference books:**

1. "Bioinformatics- Sequence and Genome Analysis" by David W Mount, Cold Spring Harbor Laboratory Press, second edition, 2004
2. "Bioinformatics: A Beginners Guide" by Claverie & Notredame, Wiley India

**Introduction, Purification and manipulation of DNA:** History and scope of gene manipulation, isolation and purification of total cell DNA and plasmid DNA, DNA manipulative enzymes, restriction endonucleases- types, nomenclature, recognition sequence, cleavage pattern, restriction digestion and its analysis, Ligases – mode of action, strategies of ligation, linkers, adaptors and homopolymer tailing, DNA modifying enzymes,

**Cloning Vectors and Libraries:** *E. coli* vectors – construction and features of plasmids – p<sup>BR322</sup>, p<sup>UC8</sup>, p<sup>UC18</sup>, p<sup>GEM3Z</sup>, bacteriophage vectors – Lambda phage & M-13 phage vectors, cosmids, phasmids, shuttle vectors, yeast vectors - 2µm plasmid, yeast episomal plasmid and YACs, transfer and cloning of recombinant vectors, construction of genomic DNA libraries, cDNA libraries and their screening, gene cloning strategies,

**PCR, Blotting and Fingerprinting techniques:** Preparation of labeled probes and primers, DNA sequencing methods – Maxam & Gilbert method, Sangers and Automated sequencing method, PCR and its applications, southern blotting, northern blotting, DNA finger printing technique- RFLP and RAPD and its applications,

**Gene transfer methods and mutagenesis:** Gene transfer techniques – transformation, transfection, electroporation, lipofection and gene gun methods, cause of the mutagenesis, site specific mutagenesis, transposon mutagenesis, gene knockout technologies,

**Applications, achievements and limitations:** Application of genetic engineering in agriculture, animal husbandry, medicine, environmental management and in industry, achievements, limitations and negative aspects of genetic engineering.

#### **Text books:**

1. “Gene cloning and DNA analysis” – An Introduction, T. A. Brown, Blackwell Publishing, 2006.
2. “Biotechnology” – B.D.Singh, Kalyani Publishers, New Delhi, 2006.

#### **Reference books:**

1. “Principles of Gene Manipulation and Genomics”, S. B. Primrose and R. M. Twyman, Blackwell Publishing, 2006.
2. “From Genes to Clones- Introduction to Gene Technology”, Winnacker, Panima Publishing Corporation, New Delhi.

**Linear Open loop systems:** Simple first order and second order systems, physical examples of first and second order systems, response of first order systems in series, transportation lag,

**Linear closed loop systems :** The control systems, controllers , final control element, block diagram of chemical reactor control systems, closed loop transfer functions , transient response of simple control systems,

**Stability:** Stability, root locus, frequency response, control system design by frequency response, Bode diagram, Bode stability criteria,

**Analysis and design of feed –back control systems :** Concept of feed back control, types of feed- back controllers, measuring devices, final control elements, dynamic behavior of feed-back control process, block diagram and closed loop response, effect of P.I. & D control action on the response of a controlled process,

**Analysis and design of control systems:** Cascade control, feed forward control, ratio control,

**Introduction to process applications:** Controller tunings, controller mechanisms, control valves,

**Text book:**

1. ‘Process Analysis and Control’ 2<sup>nd</sup> edition by Donald R.Coughnowr, McGraw Hills

**Reference books:**

1. ‘Chemical Process Control- An Introduction to Theory and Practice’ by G.Stephanopoulos, Prentice Hall of India Pvt. Ltd., New Delhi
2. ‘Computer Control of Industrial Processes’ by E.S.Savas, McGraw Hill,London
3. ‘Handbook of Instrumentation and Control’ by Considine
4. ‘Process Modeling Simulation and Control for Chemical Engineers’ by Lubin
5. ‘Industrial Instrumentation’ by Donald P. Eckmen, Wiley Eastern Limited.

## **BTM -415 Industrial Biotech Products**

**Microbial Processes:** Introduction, types of fermentations, components of industrial microbial process, source of industrial cultures, maintenance and improvement of culture for better production,

**Alcohol fermentation:** Production of industrial alcohol, biosynthetic mechanism, recovery of latest developments, wine manufacture, glycerol fermentation, production of acetone and butanol,

**Organic acid production-** Biochemistry of acetic acid production, vinegar manufacture, production of citric acid and lactic acid,

**Microbial foods:** Mushrooms, cheese, Baker's yeast

Amino acids – L-Glutamic acid, Lysine

Vitamins – Vitamin B<sub>12</sub>

Antibiotics – Penicilin and streptomycin.

Industrial enzymes: production of amylase, protease and lipase

Miscellaneous-Biopolymers (Xanthan gum, dextran etc), vaccines.

### **Text books:**

1. "Industrial Microbiology" by Cruger & cruger
2. "Industrial Microbiology" by Cassida
3. "Industrial Microbiology" by A.H.Patel

### **Reference books:**

- 1 'Industrial Microbiology' by Prescott & Dunn
1. "Biotechnology" by U. Satyanarayana.

## **BTM -416      Biomedical Engineering (Elective-III)**

**Instrumentation and Bioelectric potentials:** General introduction to biomedical engineering, man instrumentation system and factors to be considered in the designing of biomedical instrumentation, applications of biomedical engineering, bioelectric potentials in the human body,

**Neuromuscular system:** Nervous system: central nervous system and physiology, structure of neuron and nerve impulse transmission, neuromuscular system: neurons, synapses and muscles, electrical properties of nerves and muscles, problems and diagnostics,

**Cardiovascular system:** Anatomy and physiology of heart, ECG and the cardiac cycle, problems and solutions to electrical problems in the heart, blood and vascular modeling, haemodynamics, vascular disease management,

**Skeletal system, Biomaterials and Implantable Biosensors:** Skeletal System-axial and appendicular skeleton and their prosthetics, biomaterials and implantable sensors, testing of biomaterials *in vitro* and *invivo*

**Renal system:** Excretory, system (including Dialysis): renal anatomy and physiology, the nephron, dialysis machines and mass transport,

**Medical Imaging methods:** Design considerations of X-ray tubes and X-ray machine, construction and working of CT-scanning, MRI, PET and SPECT, ethical consideration in medical research.

### **Text books:**

1. "Introduction to Biomedical Instrumentation" Cromwell et al., Prentice-Hall
2. "A short introduction to biomedical engineering" by Suptendra Nath Sarbadhikari, Universities Press, 2007

## **BTM -416 Metabolic Engineering (Elective-III)**

**Models for Cellular Reactions:** Stoichiometry of cellular reactions, reaction rates, dynamic mass balances, yield coefficients and linear rate equations,

**Material Balances and Data Consistency:** Black box model, elemental balances, heat balance, analysis of over-determined systems, identification of gross measurement errors,

**Regulation of Metabolic Pathways:** Regulation of enzyme activity, regulation of enzyme concentration, regulation at whole cell level, regulation of metabolic networks,

**Examples of Pathway Manipulations:** Enhancement of product yield and productivity, extension of substrate range, extension of product spectrum and novel products, improvement of cellular properties, xenophobic degradation,

**Metabolic Pathway Synthesis:** Metabolic pathway synthesis algorithm, overview of the algorithm, case study of lysine biosynthesis, discussion of the algorithm,

**Metabolic Flux Analysis:** Theory of over-determined systems, underdetermined systems, linear programming, sensitivity analysis,

**Methods for the Experimental Determination of Metabolic Fluxes by Isotope Labeling:** Direct flux determination from fractional label enrichment, applications involving complete enumeration of metabolite, stopovers, carbon metabolite balances,

**Applications of Metabolic Flux Analysis:** Amino acid production by glutamic acid bacteria, metabolic fluxes in mammalian cell cultures,

**Metabolic Control Analysis (MCA):** Fundamentals of metabolic control analysis, determination of flux control coefficients, MCA of linear pathways, MCA of branched pathways, theory of large deviations,

### **Text book:**

“Metabolic Engineering: Principles and Methodologies”, G.N.Stephanopoulos, A. A. Aristidou, and J. Nielsen, Academic Press, 1998.

### **References books:**

1. 'Bioreaction Engineering Principles.' 2<sup>nd</sup> edition, by Nielsen, J. and Villadsen, J., and Linden, G., Plenum Press, 2003
2. 'Computational Modeling and Genetic and Biochemical Networks', by J.M.Brower and H.Bolouri, MIT Press, 2001

## **BTM -416      Agricultural Biotechnology (Elective-III)**

**Introduction** - Definition, classical vs modern approach, demand for biological resources, achievements,

**Nitrogen Fixation**- Basic concepts, nif genes and their regulation, potential scope in crop improvement,

**Genetic engineering** - aims of genetic engineering, techniques of gene manipulation, **Transformation Techniques** -Physical methods, *agrobacterium*, mediated transformation. **Transgenics** - Basic concept and essential steps of the process, some examples of transgenic plants, use of suitable promoters, gene silencing and measures to overcome it, commercial aspects of the technology. **Molecular Markers** - concept, SNPs, RAPD, RFLP, role in crop improvement and genome mapping,

**Molecular and biochemical basis**, signalling pathways in the production of transgenic plants for fungal, bacterial and viral disease resistance; herbicide resistance, pest resistance, drought and other abiotic stress resistance,

**Plant as Biofactories** - Concept, production of chemicals, pigments, perfume, flavors, insecticides, anticancer agents and other important compounds, molecular farming, use of plants for production of nutraceuticals, edible vaccines and other desired products,

**SCP** - micro organisms, nutritional value, production of algal biomass, bio fertilizers and bio pesticides, mass cultivation of *Rhizobium*, *Azotobacter*, *Azospirillum*, *Mycorrhiza*, bluegreen algae and *Azolla*.

### **Text books:**

1. "Agricultural Biotechnology" by Arie Altman, Marcel Dekker, Inc. (2001)
2. "Agricultural Biotechnology", by S.S.Purohit, Agro Bios (India)

### **Reference book:**

1. "Molecular Biotechnology Principles and Applications of Recombinant DNA", by Bernard R. Glick and Jack J. Pasternak,. ASM Press

**BTM -416 Industrial management and Entrepreneurship  
(Elective-III)**

**Entrepreneurship:** Concept, need, its existence in India and abroad, traits of an entrepreneur, development of entrepreneurial talents, motivation. achievement, risk taking, goal setting. creativity obligation, pitfalls and steps for successful entrepreneurship,

**Entrepreneurship education** and role of institutions, entrepreneurship development through promotional organization, concept and growth of such organizations specially with respect to state, procedure for starting small scale industry, incentives for their promotions,

**Product development** and research preparation of project report, decision making, forms of ownership, organization structure, production planning and control, marketing,

**Working capital management,** operation and control through budget, inventory control, motion and time study, job evaluation,

**Industrial psychology,** industrial safety, labor disputes, labor welfare and morale, leadership - development and training of managers.

**Text books:**

1. 'Industrial Engineering and Management' by O.P. Khanna, Reprint ed., 1988
2. 'Management of Small Scale Industry' by Vasant Desai, 3rd ed. 1986, Himalaya Publishing House, Bombay
3. 'Industrial Organization and Management' by S A Sherlekar, 1979.

**Reference books:**

1. 'Essential of Management' by Kootz and O Donnel, TMH 1975
2. 'Handbook of Industrial Engineering and Management' by Grant and Grant,
3. 'Personnel Administration' by C A Myers, 8th ed. 1977

## **BTM -417      Bioinformatics Laboratory**

1. Sequence retrieval from DNA & Protein databases.
2. Sequence alignment /Annotation-Dot Plot
3. BLAST
4. Multiple Sequence Alignment (CLUSTALW).
5. Phylogenetic Analysis.
6. Structure Visualization of Proteins
7. Restriction Mapping.
8. Identification of Genes in Genomes.
9. Primer Design.
10. Molecular Docking

## **BTM -418      Process Control Laboratory**

1. Response of Bare Thermometer for a step input
2. Response of Bare Thermometer for a impulse input
3. Response of first order system for a step input
4. Response of Non – Interacting system for a step change
5. Response of Non – Interacting system for a impulse input
6. Response of a Interacting system for a step change
7. Response of Interacting system for a impulse change
8. study of Control Valve Coefficient
9. Study of inherent characteristics of Control Valve
10. Temperature Control trainer
- 11.

## **BTM -419      Seminar**

## **BTM -420      Training Report**

Summer Industrial Training is Compulsory at the end of III year second semester and assessment will be done at the end of IV year first semester.

**B.Tech. Biotechnology**  
**4/4 B.Tech. Second semester**

**BTM-421 Engineering Economics & Bioprocess Design**

**Engineering Economics:**

**Value of money equivalence:** Value of money, equations for economic studies, equivalence, types of interest, discrete, continuous, annuities: relation between ordinary annuity and the periodic payments, continuous cash flow and interest compounding, present worth of an annuity, perpetuities and capitalised costs, bonds and debentures: value of a bond and yield rate,

**Depreciation:** Types and various methods of calculating depreciations, depreciation accounting, cost accounting- basic relationship in accounting, balance sheet and income statements.

**Bioprocess Design:**

**Basic function of a Bioreactor** for plant and microbial or animal cell culture, factors involved in bioreactor design and principal operating characteristics of bioreactors.

**Body construction:** construction material, temperature control,

**Aeration and agitation:** Agitators (impellers), stirrer glands and bearings, baffles, aeration system (spargers), valves and steam traps used in fermentation industries,

**Scale up:** Basic concepts, problems related to the scale up of the microbial processes, designing of other fermentation vessels,

**Text books:**

1. 'Plant Design and Economics for Chemical Engineers' fourth edition, by Max S Peters and Klaus D Timmerhans, Mc Graw Hill Book Company
2. 'Fermentation and Biochemical Engineering Handbook' 2<sup>nd</sup> Edition by Henry C. Vogel and Celeste L. Todaro, Noyes Publications, 1997.

**Reference books:**

1. 'Biochemical Engineering Fundamentals', 2<sup>nd</sup> edition, E.Bailey and D.F.Ollis, McGraw Hill, 1986
2. 'Bioprocess Engineering' 2<sup>nd</sup> edition, M.L.Shuler and F.Kargi, Prantice Hall India, New Delhi
3. 'Principles of Fermentation Technology' by Stanbury, Pergamon
4. 'Text Book of Biochemical Engineering', by D.G. Rao, Tata McGraw Hill

**Fundamentals of plant tissue culture:** laboratory organization, sterilization methods, culture medium and growth regulators, **Totipotency, callus culture and organogenesis:** Expression of totipotency in cell culture and importance, principle of callus culture, characteristics of callus culture and importance, principle of organogenesis, factors effecting organogenesis and applications,

**Cell culture:** Single cell culture-isolation, methods of single cell culture and importance, cell suspension culture, types of suspension culture, growth pattern, synchronization, assessment of growth and viability of cultured cells, significance of suspension cultures,

**Somatic embryogenesis and synthetic seeds:** Principle, induction of embryogenesis, embryo development and maturation, factors effecting somatic embryogenesis, synchronization, large scale production and importance of Somatic embryogenesis, synthetic seeds- methods of making synthetic seeds and applications, germplasm conservation,

**Somoclonal variations:** its genetic basis and application in crop improvement, cell line selection for resistance to herbicides, stress and diseases, **Haploid production and its advantages-** androgenesis, principle, pollen culture, advantages of pollen culture over anther culture, homozygous diploids, importance of anther and pollen culture,

**Clonal propagation:** Technique, multiplication by axillary and apical shoots, adventitious buds/ bulbs/ protocorms, by callus culture, transplantation, acclimatization, production of disease free plants- meristem tip culture, virus indexing,

**Protoplast technology:** Isolation, culture and plant regeneration, protoplast fusion, methods, identification and characterization of somatic hybrids, cybrids and importance of somatic hybridization,

**Genetic transformation:** Plant vectors, Ti plasmids, Ri plasmids - indirect and direct methods, current status and limitations, automation and economics of tissue culture.

**Text book:**

1. "Plant tissue culture" by Kalyan Kumar De, New Central Book Agency

**Reference books:**

1. 'An Introduction to Plant tissue culture' by Razdan, M.K., Oxford & LBH.
2. 'Plant Tissue Culture- Theory and Practice' by Bhojwani, S.S. & Razdan, M.K., Elsevier
3. "Plant tissue and Cell culture" by Street, H.E. Blackwell

**Section I**

**EC structure and tools**, directives decision on regulation (and how to find them), biotechnology and the law: Cartagena protocol, good laboratory practice, guidelines for microbial and animal cell cultivation, safety and the genetic manipulation of organisms, scientific procedure using animals, Radiation health and safety.

**Section II**

**Patents and biotechnology**, Applying for marked authorization for medical products, manufacture and evaluation of medicinal products produced, regulation of biotechnology in the food industry, a general comment on the biotechnological production of chemicals other than medicines and food ingredients.

**Reference books:**

1. 'Compendium of Good Practices in Biotechnology', BIOTOL series
2. 'Patent Strategy for Researchers and Research Managers, by Knight, Wiley Publications
3. 'Role of Patent and Patent Information in Biotechnology Inventions', Document of The International Bureau of World Intellectual Prosperity Organization -1994
4. 'Safety in Microbiology' by D.A. Shapton and R.G. Board, Academic Press, London 1972
5. 'Biopharmaceuticals' by Gary Walsh

**Intellectual property Rights:** Patents and intellectual property rights (IPR): definition, scope, objectives, sources of patent information, patent processing, copy rights, trade marks,

**Plant biotechnology:** Indian patents and foreign patents, plant variety protection act, the strategy of protecting plants, patent litigation, role of patent in pharmaceutical industry,

**Why there is a need to commercialize biotechnology?** Creating and marketing the image of the biotechnology company, art of negotiation and effective communication, role of venture capitalism, business plan, selection of CEO and personnel, real estate for a biotech start-up,

**Role of a biotechnology manager,** role of research and development, university-industry technology transfer arrangements, how and why a biotech company can benefit.

**Text / Reference books:**

1. 'The Law and Strategy of Biotechnological Patents' by Sibley, Butterworth publications.
2. 'Good Manufacturing Practices for Pharmaceuticals' by S.H. Willing
3. 'Intellectual Property Rights' by Ganguli, Tat Mc-Graw Hill
4. 'Intellectual Property Right' by Wattal, Oxford Publishing House
5. 'Positioning' by All Rise and Jack Trout (1986), Warner Books
6. 'Protection of Industrial Property Rights' by P. Das and Gokul Das
7. 'Biotechnology: The Science & The Business' by V. Moser and R.E. Cape, (1999) Harwood.
8. Latest review articles and papers on the subject.

**Empirical Force Fields and Molecular Mechanisms:** Bond stretching, angle bending, torsional I terms, out of plane, bonding motions, electrostatic interactions, Vander Walls interactions, effective pair potentials, hydrogen bonding, simulation of liquid water,

**Computer Simulation Methods:** Calculation of thermodynamic properties, phase space, practical aspects of computer simulation, boundaries monitoring equilibrium, long range process, analyzing results of simulation and estimating errors,

**Molecular Dynamics Simulation Methods:** Molecular dynamics using simple modules, molecular dynamics with continuous potentials, running molecular dynamics simulation, constant dynamics, time dependent properties, molecular dynamics at constant temperature and pressure,

**Monte Carlo Simulation Methods:** Metropolis methods; simulation of molecules – Polymers, calculating chemical potentials, molecular dynamics.

**Text books:**

1. 'Molecular Modeling Principles and Applications' by A.R. Leach, Longman, 1996
2. 'Molecular Dynamics Simulation- Elementary Methods', John Wiley and Sons, 1997.

**Biotechnology in marine science:** History of marine biotechnology application in aquaculture, pharmaceutical, environment remediation, biofouling and biocorrosion,

**Developmental biotechnology:** Induced breeding, in-vitro fertilization, cryopreservation, biotechnological tools - ELISA, FISH, PCR gene probes, dot immunobinding activity, monoclonal antibodies, biosafety ethics,

**Bioactive marine natural products,** membrane receptors, antitumor compounds, antiinflammatory, analgesic compounds, antiviral agents, isolation and identification of marine bioactive compounds such as labile proteins, toxins, carotenoids, commercial development of marine natural products- chitosan, chitin,

**Algal biotechnology single cell protein,** hydrocolloids, agarose, carrageen alginates and other by products, marine enzymes sources and their applications, marine lipids sources and their applications,

**Bioinformatics:** Introduction to computers, internet and bioinformatics, bioinformatics servers- (European Bioinformatics Institute, National Centre for Biotechnological Information, DNA data bank of Japan), DNA sequence and structural analyses, basic logical alignment tool, DNA sequence alignment and phylogeny, protein structural analysis, 3D molecular visualiser, drug designing.

**Text books:**

1. 'New Developments in Marine Biotechnology' by Italy, E (Eds), Plenum Pub.Corporation
2. 'Molecular Genetics of Marine Organisms' by Milton Fingerman and Rachakonda Nagabhushanam, Science Pub Inc.
3. 'New Developments in Marine Biotechnology' by Y. Le Gal and H.O.Halvorson, Springer.

**Reference books:**

1. 'Marine Biotechnology', Volume-1, by David H. Attaway, Pharmaceutical and Bioactive Natural Products
2. 'Biotechnology in the Marine Sciences (Advances in Marine Science & Biotechnology)' by Rita R. Colwell, Wiley Interscience
3. 'Chemistry of Marine Natural Products, Chemical and Biological Perspectives' vols.- I & III, by Scheupr, P.J.(Ed.), Academic Press, New York.

**General Introduction:** Basics of quantum mechanics, harmonic oscillator, magnetic phenomena, band structure in solids, Mossbauer and Spectroscopy, optical phenomena bonding in solids, anisotropy,

**Silicon Carbide:** Application of silicon carbide, nano materials preparation, sintering of SiC, X-ray diffraction data, electron microscopy sintering of nano particles, nano particles of alumina and zirconia, nano materials preparation, characterization, wear materials and nano composites,

**Mechanical properties:** Strength of nano crystalline SiC, preparation for strength measurements, mechanical properties, magnetic properties,

**Electrical properties:** Switching glasses with nanoparticles, electronic conduction with nano particles,

**Optical properties:** Optical properties, special properties and the coloured glasses

**Process of synthesis of nano powders,** electro deposition, important nano materials,

**Investigating and manipulating materials in the nanoscale:** Electron microscopies, scanning probe microscopies, optical microscopies for nano science and technology, X-ray diffraction,

**Nanobiology:** Interaction between biomolecules and nanoparticle surface, different types of inorganic materials used for the synthesis of hybrid nano-bio assemblies, application of nano in biology, nanoprobe for analytical applications - a new methodology in medical diagnostics and biotechnology, current status of nano biotechnology, future perspectives of nanobiology, nanosensors,

**NanoMedicines:** Developing of nanomedicines, nanosystems in use, protocols for nanodrug administration, nanotechnology in diagnostics applications, materials for used in diagnostics and therapeutic applications, molecular nanomechanics, molecular devices, nanotribology, studying tribology at nanoscale, nanotribology applications.

**Text books:**

1. 'Nano Materials' by A.K.Bandyopadhyay, New Age Publishers
2. 'Nano Essentials' by T.Pradeep, TMH.

**History, scope and importance:** Important contributions, sequencing development, aims and tasks of bioinformatics, applications of bioinformatics, challenges and opportunities, computers and programs, internet, world wide web browsers, EMB net, NCBI,

**Basic concepts of biology:** The nature of chemical bonds, introduction to genes and proteins, nucleotides, orientation, base pairing, the central dogma, promoter sequences, genetic code, ORFs, introns and exons, splice variants, protein structure -primary, secondary, tertiary and quaternary, the notation of homology, introduction to data generating techniques: restriction enzymes, gel electrophoresis, blotting and hybridization, cloning, PCR, biological databases, search engines, public databases: PubMed, EMBL, GenBank, PDB, Swiss-Port,

**Genomes and their organization:** Genomics and proteomics: prokaryotic genomes, eukaryotic genomes, gene structure, GC content in eukaryotic genomes, gene expression, protein classification, 2D-electrophoresis, mass spectrometry, microarray technology, X-ray crystallography, NMR, sequence and phylogeny analysis, detecting ORFs, outline of sequence alignment, introduction to BLAST, multiple sequence alignment, phylogenetic analysis, .

**Data mining in bioinformatics:** Introduction - data cleaning, data preprocessing, data integration, classification methods - cluster analysis methods, data visualization and visual data mining, computational mining of biological processes.

**Text books:**

1. 'Fundamental Concepts of Bioinformatics' by D.E. Krane and M.L. Raymer, Pearson Education, 2003
2. 'Bioinformatics Computing' by Baryan Bergeron, Prentice-Hall of India Pvt Ltd., New Delhi

**Reference books:**

1. 'Bioinformatics- Sequence and genome analysis' by David W Mount, Cold Spring Harbor Laboratory Press, 2<sup>nd</sup> edition, 2004
2. 'Bioinformatics Methods and Applications- Genomics, Proteomics and Drug Discovery' by S. C. Rastogi, N. Mendiretta, P. Rastogi (3<sup>rd</sup> edition).

## **BTM – 424      Plant Cell and Tissue Culture Laboratory**

1. Sterilization methods
2. Preparation of stock solutions
3. Preparation of medium
4. Establishment of callus cultures from carrot cambial explants
5. Establishment of cell culture
6. Establishment of growth and preparation of growth curve
7. Embryo culture of maize or any suitable crop, root/shoot initiation (organogenesis) from different explants
8. Micro propagation and plant regeneration
9. Isolation, culture and fusion of plant protoplasts
10. Anther and pollen culture

### **Text books:**

1. 'Plant Cell Culture: A Practical Approach' by R.A.Dixon
2. 'Plant Cell and Tissue Culture – a Laboratory Manual' by J.Rienert and M.M.Yeoman, Springer Verlag
3. 'Plant Tissue Culture: Theory and Practice' by S.S. Bhojwani. .

## **BTM – 425      Project**

The project work should consist of a comprehensive design of a chemical plant in the form of a report with the following chapters.

1. Introduction
2. Physical and chemical properties and uses
3. Literature survey for different processes
4. Selection of the process
5. Material and energy balances
6. Specific equipment design (Process as well as mechanical design with drawings)
7. General equipment specifications
8. Plant location and layout
9. Materials of construction
10. Health and safety factors
11. Preliminary cost estimation
12. References