B. Tech. Biotechnology

Detailed Syllabus

Programme Code: BTYB

Duration: 4 Years

EFFECTIVE FROM SESSION: 2019-2020

Department of Life Sciences & Biotechnology
Faculty of Science
CHHATRAPATI SHIVAJI MAHARAJ UNIVERSITY PANVEL, NAVI MUMBAI

About the Programme

The B. Tech. Biotechnology programme is aimed at imparting knowledge on the fundamental principles of Biotechnology. This programme is beneficial for the students in the area of higher studies, career opportunities in Multi-national companies, public sector units, academics etc.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOS):

The programme educational objectives of the B. Tech. Biotechnology are:

PEO1 Professional competent in Biotechnology to solve the problems in environmental, food, biochemical and biomedical engineering.

PEO2 Foundation in Chemical engineering and Biological Sciences, to enable them to work on engineering applications in biotechnology as per the requirement of the industries, and also will enable the students to pursue higher studies and research.

PEO3 Enable students to acquire knowledge on the fundamentals of Biochemistry, Cell biology, Microbiology and Molecular biology to enable them to understand basic concept in modern biology and help them to build their carrier in this field.

PEO4 Acquire knowledge in fields such as genetic engineering, protein engineering, and Bioprocess engineering and associated downstream processing enabling their application through Bioprocess technology.

PEO5 Learn the recent developments in the field of Genomics, Proteomics, Cancer Biology and modern drug discovery approaches. It will also empower the students to have advanced focus on the molecular basis of diseases and development of advanced therapeutics.

PEO6 Importance of Bioethics, entrepreneurship, communication and management skills.

PEO7 Demonstrate their proficiency in theory and practice of bio-techniques through life-long learning and provide confidence to perform as an individual and / or member of a team with professional and ethical behavior.

PROGRAMME OUTCOMES (PO):

After completion of the B. Tech. Biotechnology programme students will be able to:

PO1 Have strong background in the interface of modern biology and advanced bioprocess technology and be able to use these tools in industry and/or institutes wherever necessary.

PO2 Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural science, and engineering sciences.

PO3 Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO4 Prepare and engage in independent and life-long learning in the broadest context of technological change

PO5 Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO6 Communicate effectively on complex engineering activities with the engineering community and with the society at large.

PO7 Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering and technology practice.

PO8 Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

SEMESTER I

Course Type	Course Code	Course Name	L	T	P	IA	UE	Total Marks	Credits
BS	MTHG1000	Engineering Mathematics-I	3	1	-	30	70	100	4
BS	PHYG1000	Engineering Physics	3	1	-	30	70	100	4
ES	CSEG1000	Programming for Problem Solving	3	-	-	30	70	100	3
HM	ENGG1000	Professional English	3	-	-	30	70	50	3
BS	PHYG1001	Engineering Physics Lab	-	-	3	15	35	50	2
ES	CSEG1001	Programming for Problem Solving Lab	-	-	4	15	35	50	2
ES	MECG1000	Engineering Mechanics	3	1	-	30	70	100	4
MC		Induction Program*	3 weeks duration						0
		Total	**15**	**3**	**7**	**180**	**420**	**550**	**22**

*Induction program for students to be offered right at the start of the first year.

Engineering Mathematics – I (MTHG1000)

Prerequisites:

Differentiation, Integration, Maxima and Minima, Determinants and Matrices.

Course Objectives:

To make the students familiarize with concepts and techniques in Calculus, Complex number and Matrices. The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power, useful in their disciplines.

Course Outcomes (COs): The students will be able to learn

1. Apply the concepts of complex numbers to the engineering problems.
2. Apply the knowledge of nth order derivatives of standard functions to engineering problems.
3. Apply the principles of basic operations of matrices to the engineering problems.
4. Apply the basic principles of partial differentiation to engineering problems.
5. Apply concepts of partial differentiation (maxima and minima), expansion of functions as an application of successive differentiation.

Course Contents

UNIT-1: Matrices(10 Hrs)

1.1 Review on matrices: Definition of matrix ,types of matrix ,Algebra of matrices ,Adjoint of matrix, inverse of matrix ,Unitary & Orthogonal matrices ,Echelon form ,Rank of a matrix, Normal form , PAQ normal form.
1.2 System of homogeneous & Non homogeneous equations, Conditions of their consistency & Inconsistency & solutions.
1.3 Solution of system of linear algebraic equations, by (1)Gauss Elimination Method (2) Guass Jordan Method (3) Jacobi iteration (4) Gauss Seidal Method

UNIT-2:Complex Numbers(15 Hrs)

2.1 Definition of Complex number ,Algebra of complex number ,Representation of complex number on complex plane ,D'Moivre's Theorem.
2.2 Powers and roots of Exponential & Trigonometric functions.
2.3 Expansion of $sin^n\theta, cos^n\theta$ in terms of sines and cosines of multiples of θ and Expansion of sinnθ, cosnθ in powers of sinθ, cosθ .
2.4 Circular functions of complex number and Hyperbolic functions.Inverse Circular and Inverse Hyperbolic functions. Logarithmic functions.
2.5 Separation of real and Imaginary parts of all types of Functions.

UNIT-3: Numerical Integration (07 Hrs)

3.1 Numerical integration-Different type of operators such as shift, forward, backward difference and their relation. Interpolation, Newton Interpolation,. Integration by (a) Trapezoidal (b) Simpson's 1/3rd (c)Simpson's 3/8th rule.

UNIT-4 : Partial Differential Equation (08 Hrs)

4.1 Partial derivatives of first and higher order, total differentials, differentiation of composite and implicit functions. Euler's Theorem on Homogeneous functions with two and three independent variables (with proof).Deductions from Euler's Theorem.

UNIT-5: Application of Partial Differentiation, Indeterminate forms and curve fitting (08 Hrs)

5.1 Maxima and Minima of a function of two independent variables

5.2 Indeterminate forms, L-Hospital rule,

5.3 Fitting of curves by least square method for line ,parabola &exponential

Recommended Books:

1. A text book of Applied Mathematics, P.N.Wartikar and J.N.Wartikar,Vol – I and –II by Pune Vidyarthi Graha.
2. Higher Engineering Mathematics, Dr.B.S.Grewal, Khanna Publication
3. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley EasternLimited,9thEd.
4. Matrices by Shanti Narayan.
5. Numerical by S.S.Sastry, Prentice Hall

Detailed Syllabus

PHYG1000	**Engineering Physics**	**4L:0T:0P**	**4 Credits**

Course learning objectives:

The objectives of this course are

1. To impart the ideas of Modern physics and Quantum Mechanics
2. To impart the knowledge of Semiconductor Physics and electronic devices
3. To make students learn about the mechanism and devices of Lasers and Optical fibres.
4. To make students learn the basics of crystal structure and Solid State Physic
5. To impart the knowledge of Nan materials and basics of Nanotechnology.

Unit 1: **Modern Physics and Quantum Mechanics:**L:10

Black body radiation spectrum, Assumptions of quantum theory of radiation, Plank's law, Wien's law and Rayleigh Jeans law, for shorter and longer wavelength limits. Wave Particle dualism, deBroglie hypothesis. Compton Effect. Matter waves and their Characteristic properties, Definition of Phase velocity and group velocity, Relation between phase velocity and group velocity, Relation between group velocity and particle velocity.

Heisenberg's uncertainty principle and its application, (Non-existence of electron in the nucleus).Wave function, Properties and physical significance of wave function, Probability density and Normalization of wave function. Setting up of one dimensional time independent Schrodinger wave equation. Eigen values and Eigen functions. Application of Schrodinger wave equation for a particle in a potential well of infinite depth and for free particle.

Unit 2: **Semiconductor Physics:**L:10

Band theory,Direct & indirect band gap semiconductor; Fermi level; Fermi dirac distribution; Fermi energy level in intrinsic & extrinsic semiconductors; effect of impurity concentration and temperature on fermi level; mobility, current density; Hall Effect; Fermi Level diagram for p-n junction (unbiased, forward bias, reverse bias); Basics of Transistors. Applications of semiconductors: LED, Zener diode, Photovoltaic solar cell.

Unit 3: **Lasers and Optical Fibres:**L:10

Einstein's coefficients (expression for energy density). Requisites of a Laser system. Condition for laser action. Principle, Construction and working of CO2 laser and semiconductor Laser. Applications of Laser – Laser welding, cutting and drilling. Measurement of atmospheric pollutants. Holography–Principle of Recording and reconstruction of images.

Propagation mechanism in optical fibres. Angle of acceptance. Numerical aperture. Types of optical fibres and modes of propagation. Attenuation, Block diagram discussion of point to point communication, applications.

Unit 4: **Solid State Physics:**L:10

Space lattice, Bravais lattice–Unit cell, primitive cell. Lattice parameters. Crystal systems. Direction and planes in a crystal. Miller indices. Expression for inter – planar spacing. Co-ordination number. Atomic packing factors (SC,FCC,BCC). Bragg's law, Determination of crystal structure using Bragg's X–ray diffractometer. Polymorphism and Allotropy. Crystal Structure of Diamond, qualitative discussion of Perovskites.

Unit 5: **Nanotechnology:**L:10

Introduction to Nano Science, Density of states in 1D, 2D and 3D structures. Nanomaterials Properties (Optical, electrical, magnetic, structural, mechanical) and applications, Surface to volume ratio; Two main approaches in nanotechnology -Bottom up technique and Top down technique; Tools for characterization of Nanoparticles: Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Atomic Force Microscope (AFM). Methods to synthesize Nanomaterials: Ball milling, Sputtering, Vapour deposition, Sol-gel method

PHYG1001	**Engineering Physics Practical**	**0L:0T:3P**	**1.5 Credits**

LIST OF EXPERIMENTS:

1. MeasurementShow the variation of specific rotation of polarization with the concentration of a sugar solution polarizer.
2. Determine Planck's constant using LED illumination method.
3. Observe the EMF generation of a thermocouple as a function of temperature.
4. Show the temperature dependence of resistivity of given semiconductor using four-probe method.
5. Observe the variation of magnetic field due to a current loop.
6. Find out the diffraction angles of four visible light wavelengths using given diffraction grating.
7. Plot the Hall voltage to ascertain Hall Effect for the given semiconductor.
8. Plot the forward and Reverse Bias of a diode.
9. Characteristics of a transistor (NPN and PNP)
10. Design half-wave, full-wave and bridge rectifiers with diodes and study their characteristics.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Learn and understand more about basic principles and to develop problem solving skills and implementation in technology.

2. Gain Knowledge about Modern physics and quantum mechanics will update the basic concepts to implement the skills.
3. Study of material properties and their applications is the prime role to understand and use in engineering applications and studies.
4. Study Lasers and Optical fibers and its applications are to import knowledge and to develop skills and to use modern instruments in the engineering applications.
5. Understand Basics of Solid State Physics, *viz*, Crystal structure and applications are to boost the technical skills and its applications.
6. Understand basic concepts of nanomaterials and nanotechnology.

Text /Reference Books:

1. Wiley precise Text, Engineering Physics, Wiley India Private Ltd., New Delhi. Book series – 2014, 2. Dr. M.N. Avadhanulu,
2. Dr. P.G.Kshirsagar, Text Book of Engineering Physics, S Chand Publishing, New Delhi – 2012
3. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
4. S.O.Pillai, Solid State Physics, New Age International. Sixth Edition.
5. Chintoo S Kumar ,K Takayana and K P J Reddy, Shock waves made simple, Willey India Pvt. Ltd. New Delhi,2014
6. A Marikani, Engineering Physics, PHI Learning Private Limited, Delhi – 2013

Engineering Physics Lab.

List of Laboratory Experiments (Any eight)

1. To determine of wavelength of monochromatic light using Newton's rings.
2. To determine radius of curvature of plano-convex lens using Newton's rings.
3. To determine position of diffraction minima by studying diffraction at a single slit.
4. To determine unknown wavelength by using plane diffraction grating.
5. To find out Resolving power of Diffraction Grating/Telescope.
6. To verify Malus Law.
7. Any experiment based on Double Refraction (Determination of refractive indices, identification of types of crystal).
8. Any Experiment based on Laser (Thickness of wire, determination of number of lines on grating surface).
9. An experiment based on optic fibers.
10. To study IV characteristics of Solar Cell and determine parameters (fill factor and efficiency).
11. To determine band gap of given semiconductor.
12. To determine Hall coefficient and charge carrier density.
13. Temperature dependence characteristics of semiconductor laser.
14. To find out Magnetic susceptibility of given material.
15. Ultrasonic Interferometer: Determination of velocity of ultrasonic waves in given liquid and find its compressibility.

Programming for Problem Solving (CSEG1000)

Prerequisites:

Differentiation, Integration, Maxima and Minima, Determinants and Matrices.

Course Objectives:

1. To learn the fundamentals of computers and understand the various steps in program development.
2. Learn the syntax and semantics of C programming language.
3. To learn the usage of structured programming approach in solving problems.

Course Outcomes (COs): The students will be able to learn

1. To develop simple algorithms for arithmetic and logical problems.
2. To translate the algorithms to programs & execution (in C language)..
3. To implement conditional branching, iteration and recursion.
4. To decompose a problem into functions and synthesize a complete program using divide and conquer approach.
5. To use arrays, pointers and structures to develop algorithms and programs.

Course Contents

Unit I Introduction to Programming: (08 Hrs)

Introduction to components of a computer system: Memory, processor, I/O Devices, storage, operating system, Concept of assembler, compiler, interpreter, loader and linker. Idea of Algorithm: Representation of Algorithm, Flowchart, Pseudo code with examples, From algorithms to programs, source code. Programming Basics: Structure of C program, writing and executing the first C program, Syntax and logical errors in compilation, object and executable code. Components of C language. Standard I/O in C , Fundamental data types, Variables and memory locations, Storage classes.

Unit II Arithmetic expressions & Conditional Branching: (08 Hrs)

Arithmetic expressions and precedence : Operators and expression using numeric and relational operators, mixed operands, type conversion, logical operators, bit operations, assignment operator, operator precedence and associatively. Conditional Branching: Applying if and switch statements, nesting if and else, use of break and default with switch.

Unit III Loops & Functions: (08 Hrs)

Iteration and loops: use of while, do while and for loops, multiple loop variables, use of break and continue statements. Functions: Introduction, types of functions, functions with array, passing parameters to functions, call by value, call by reference, recursive functions.

Unit IV Arrays & Basic Algorithms: (08 Hrs)

Arrays: Array notation and representation, manipulating array elements, using multi dimensional arrays. Character arrays and strings, Structure, union, enumerated data types, Array of structures, Passing arrays to functions. Basic Algorithms: Searching &Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, Notion of order of complexity. Distributed Database: distributed data storage, concurrency control, directory system

Unit V Pointer & File Handling: (8Hrs.)

Pointers: Introduction, declaration, applications, Introduction to dynamic memory allocation (malloc, calloc, realloc, free), Use of pointers in self-referential structures, notion of linked list (no implementation) File handling: File I/O functions, Standard C preprocessors, defining and calling macros, command-line arguments.

Text Books:

1. Schaum's Outline of Programming with C by Byron Gottfried , McGraw-Hill
2. The C programming by Kernighan Brain W. and Ritchie Dennis M., Pearson Education .
3. Computer Basics and C Programming by V.Rajaraman , PHI Learning Pvt. Limited, 2015.
4. Computer Concepts and Programming in C, E Balaguruswami, McGraw Hill
5. Computer Science- A Structured Programming Approach Using C, by Behrouz A. Forouzan, Richard F. Gilberg, Thomson, Third Edition , Cengage Learning - 2007.
6. Let Us C By Yashwant P. Kanetkar.
7. Problem Solving and Program Design in C, by Jeri R. Hanly, Elliot B. Koffman, Pearson Addison-Wesley, 2006.

Reference Books:

1. Programming in C by Kochan Stephen G. Pearson Education – 2015.
2. Computer Concepts and Programming in C by D.S. Yadav and Rajeev Khanna, New Age International Publication .
3. Computer Concepts and Programming by Anami, Angadi and Manvi, PHI Publication
4. Computer Concepts and Programming in C by Vikas Gupta, Wiley India Publication
5. Computer Fundamentals and Programming in C. Reema Thareja, Oxford Publication

Programming for Problem Solving Lab.

List of Laboratory Experiments

1. WAP that accepts the marks of 5 subjects and finds the sum and percentage marks obtained by the student.
2. WAP that calculates the Simple Interest and Compound Interest. The Principal, Amount, Rate of Interest and Time are entered through the keyboard.
3. WAP to calculate the area and circumference of a circle.
4. WAP that accepts the temperature in Centigrade and converts into Fahrenheit using the formula C/5=(F32)/9.
5. WAP that swaps values of two variables using a third variable.

6. WAP that checks whether the two numbers entered by the user are equal or not.
7. WAP to find the greatest of three numbers.
8. WAP that finds whether a given number is even or odd.
9. WAP that tells whether a given year is a leap year or not.
10. WAP that takes two operands and one operator from the user and perform the operation and prints the result by using Switch statement.
11. WAP to print the sum of all numbers up to a given number.
12. WAP to find the factorial of a given number.
13. WAP to print sum of even and odd numbers from 1 to N numbers.
14. WAP to print the Fibonacci series.
15. WAP to check whether the entered number is prime or not.
16. WAP to find the sum of digits of the entered number.
17. WAP to find the reverse of a number.
18. WAP to print Armstrong numbers from 1 to 100.
19. WAP to convert binary number into decimal number and vice versa.
20. WAP that simply takes elements of the array from the user and finds the sum of these elements.
21. WAP that inputs two arrays and saves sum of corresponding elements of these arrays in a third array and prints them.
22. WAP to find the minimum and maximum element of the array.
23. WAP to search an element in a array using Linear Search.
24. WAP to sort the elements of the array in ascending order using Bubble Sort technique.
25. WAP to add and multiply two matrices of order nxn.
26. WAP that finds the sum of diagonal elements of a mxn matrix.
27. WAP to implement strlen (), strcat (),strcpy () using the concept of Functions.
28. WAP to swap two elements using the concept of pointers.
29. WAP to compare the contents of two files and determine whether they are same or not.
30. WAP to check whether a given word exists in a file or not. If yes then find the number of times it occurs

Engineering Graphics

Course Objective:

1. To impart and inculcate proper understanding of the theory of projection.

2. To impart the knowledge of reading a drawing.
3. To improve the visualization skill.
4. To teach basic utility of computer aided drafting (CAD) tool.

Course Outcomes:
Learner will be able to

1. Apply the basic principles of projections in 2D drawings.
2. Apply the basic principles of projections in converting 3D view to 2D drawings.
3. Read a given drawing.
4. Visualize an object from the given two views.
5. Use CAD tool to draw different views of an object

UNIT-1: Drafting Technology and Introduction to Any Drafting Software/Package

Layout of drawing sheets, sizes of drawing sheets, different types of lines used in drawing practice, Dimensioning – linear, angular, aligned system, unidirectional system, parallel dimensioning, chain dimensioning, location dimension and size dimension. Tolerances – methods of representing tolerances, unilateral and bilateral tolerances, tolerance on linear and angular dimensions, geometrical tolerances. Symbols used on drawing, surface finish symbols, welding symbols.

Advantages of using Computer Aided Drafting (CAD) packages, applications of CAD, basic operation of drafting packages, use of various commands for drawing, dimensioning, editing, modifying, saving and printing/plotting the drawings. Introduction to 3D primitives.

UNIT-2: Engineering Curves

Ellipse, Parabola, Hyperbola, normal and tangents to these curves, Involute, Cycloid, Epi-cycloid, Hypo-cycloid, Archimedean Spiral, Helix on cone and cylinder

UNIT-3: Projection of Points and Lines

Lines inclined to both the Reference Planes (Excluding Traces of lines) and simple application based problems on Projection of lines. **Projection of Planes**:- Triangular, Square, Rectangular, Pentagonal, Hexagonal and Circular planes inclined to either HP or VP only. (Exclude composite planes)

UNIT-4 : Orthographic Projections & Isometric Projections

Reference planes, types of orthographic projections – First angle projections, Third angle projections, methods of obtaining orthographic views by First angle method, Sectional orthographic projections – full section, half section, offset section. Isometric view, Isometric scale to draw Isometric projection, Non-Isometric lines, construction of Isometric view from given orthographic views and to construct Isometric view of a Pyramid, Cone, Sphere.

UNIT-5: Auxiliary Projections

Auxiliary planes – Auxiliary Vertical Plane (AVP), Auxiliary Inclined Plane (AIP), symmetrical auxiliary view, unilateral auxiliary view, bilateral auxiliary view.

Free hand sketching -- FV and TV of standard machine parts – Hexagonal headed nut and bolt, foundation bolts, shafts, keys, couplings, springs, screw thread forms, welded joints, riveted joints.

Engineering Graphics Lab

List of Practical:

1. Lines, lettering and dimensioning.
2. Geometrical Constructions.
3. Orthographic projections.
4. Projections of points.
5. Projections of straight lines.
6. Projections of planes.
7. Projections of solids.
8. Section of solids.
9. Isometric Projection

Reference Books:

1. N. D. Bhatt, Engineering Drawing, Charotar Publishing House, 46th Edition, 2003.
2. K. V. Nataraajan, A text book of Engineering Graphic, Dhanalakshmi Publishers, Chennai, 2006.
3. K. Venugopal and V. Prabhu Raja, Engineering Graphics, New Age International (P) Ltd, 2008.
4. Dhananjay A. Jolhe, Engineering Drawing with an Introduction to Autocad, McGraw Hill Education, 2017

Professional English

Course Code	Course Name	Teaching Scheme			Credit Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract	Tut.	Total
BTHU104	Communication Skills	3	2	-	2	2	-	4

Course Code	Course Name	Examination Scheme					
		Theory				Term Work/ Practical/Oral	Total
		Internal Assessment			End Sem Exam		
		Test 1	Test 2	Total			

BTHU104	Communication Skills	15	15	30	70	50	150

Course Objectives.

1. To acquaint the students with appropriate language skills with the purpose of improving the existing ones – LSRW.
2. To make the learners understand the importance and effective use of non-verbal communication.
3. To make the learner proficient in public speaking and presentation skills.
4. To guide and teach the students to utilize the principles of professional business and technical writing for effective communication in the global world.
5. To deploy technology to communicate effectively in various situations.

Course Outcomes.

The students will be able to-

1. Understand and evaluate information they listen to and express their ideas with greater clarity.
2. Speak and respond effectively along the various channels of communication in a business organization.
3. Speak convincingly before an audience with the help of an expanded vocabulary and enhanced digital content.
4. Communicate through result oriented writing both within and outside the organization.
5. Write a set of effective and easy to understand technical description, instructions.

Unit 1: Communication and Communication Process:

Introduction to Communication, Forms and functions of Communication, Barriers to Communication ((linguistic and semantic, psychological, physical, mechanical, cultural), and overcoming them, Types of communication: verbal and non-verbal communication.

Reading: Introduction to Reading, Barriers to Reading, Types of Reading: Skimming, Scanning, Fast Reading, Strategies for Reading, Comprehension.

Listening : Importance of Listening, Types of Listening, Barriers to Listening.

Unit 2: Writing Skills, Reading Skills & Listening Skills:

Features of Good Language, Technical Style of writing, Writing Emails and it's etiquettes, Technical Reports: Report Writing: Types, Format and Structure of reports.

Unit 3: Letter Writing:

Types of letters: Job application letter, complaint letter, enquiry letter, reply to enquiry, sales letter. Essential and non-essential parts of letters, formats of letters.

Unit 4 : Grammar:
Types of sentences, Antonyms and Synonyms, Use of Auxiliaries and Modal Auxiliaries, Synonyms and Antonyms, Pairs of confused words, Common Errors in sentences.

Unit 5: Soft Skills:
Body language, Team work and skills, Decision making ability, Negotiation skills and Interview skills.

Unit 6: Dialogues Writing and Speaking:
Greeting someone and responding to greet, Thanking someone and responding to thanks, Making inquiry and responding to enquiry on telephone, Making request and responding to request.

List of assignments:-

1. Communication and Communication Processes: 02.
2. LSRW- Listening, Speaking, Reading & Writing: 02
3. Letter Writing: 01.
4. Grammar: 01.
5. Soft Skills: 01.
6. Dialogues Writing and Speaking: 01.

References:

1. Communication in Organizations by Dalmar Fisher, Jaico Publishing House
2. Communication Skills by Meenakshi Raman & Sangeeta Sharma, Oxford University Press.
3. Business Correspondence & Report-writing by R.C. Sharma& Krishna Mohan, Tata McGraw-Hill Education.
4. Effective Technical Communication by Ashraf Rizvi, Tata McGraw-Hill.
5. Technical Writing & Professional Communication for non-native speakers of English by
6. Thomas N. Huckin & Leslie A. Olsen, McGraw –Hill.
7. Mastering Communication by Nicky Stanton, Palgrave Master Series
8. www.buisnesscommunicationskills.com
9. www.kcitraing.com
10. www.mindtools.com
11. Journal of Business Communication.

MECG1000	Engineering Mechanics	3L:1T:0P	4 Credits

Course Objective:

The objective of this Course is to provide an introductory treatment of *Engineering Mechanics* to all the students of engineering, with a view to prepare a good foundation for taking up advanced courses in the area in the subsequent semesters. A working knowledge of statics with emphasis on force equilibrium and free body diagrams. Provides an understanding of the kinds of stress and deformation and how to determine them in a wide range of simple, practical structural problems, and an understanding of the mechanical behavior of materials under various load conditions.

Course Outcomes.

The students will be able to:

1. Use scalar and vector analytical techniques for analysing forces in statically determinate structures
2. Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems
3. Apply basic knowledge of maths and physics to solve real-world problems
4. Understand measurement error, and propagation of error in processed data
5. Understand basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts);
6. Understand basic dynamics concepts – force, momentum, work and energy.

Unit 1: **Introduction** (8 lectures)
Transformation of scalars and vectors under Rotation transformation; Forces in Nature; Newton's laws and its completeness in describing particle motion; Form invariance of Newton's Second Law; Solving Newton's equations of motion in polar coordinates; Problems including constraints and friction; Extension to cylindrical and spherical coordinates

Unit 2: (7 lectures)

Potential energy function; F = - Grad V, equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, curl of a force field; Central forces; Conservation of Angular Momentum; Energy equation and energy diagrams; Elliptical, parabolic and hyperbolic orbits; Kepler problem; Application: Satellite manoeuvres;

Unit 3: (5 lectures)
Non-inertial frames of reference; Rotating coordinate system: Five-term acceleration formula. Centripetal and Coriolis accelerations; Applications: Weather systems, Foucault pendulum;

Unit 4: (6 lectures)
Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly-damped oscillators; Forced oscillations and resonance.

Unit 5: (5 lectures)
Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a

rigid body in planar motion; Euler's laws of motion, their independence from Newton's laws, and their necessity in describing rigid body motion; ExamplesIntroduction to three-dimensional rigid body motion — only need to highlight the distinction from two-dimensional motion in terms of (a) Angular velocity vector, and its rate of change and (b) Moment of inertia tensor; Three-dimensional motion of a rigid body wherein all points move in a coplanar manner:

Reference Books

1. Engineering Mechanics, 2nd ed. — MK Harbola
2. Introduction to Mechanics — MK Verma
3. An Introduction to Mechanics — D Kleppner& R Kolenkow
4. Principles of Mechanics — JL Synge & BA Griffiths
5. Mechanics — JP Den Hartog
6. Engineering Mechanics - Dynamics, 7th ed. - JL Meriam
7. Mechanical Vibrations — JP Den Hartog (
8. Theory of Vibrations with Applications — WT Thomson.

SEMESTER II									
Course Type	**Course Code**	**Course Name**	**L**	**T**	**P**	**IA**	**UE**	**Total Marks**	**Credits**
BS	MTHG2000	Engineering Mathematics II	3	1	-	30	70	100	4
BS	CHYG2000	Engineering Chemistry	4	-	-	30	70	100	4
ES	MTEG2001	Engineering Graphics	3	-	-	30	70	100	3
ES	ELEG2000	Basic Electrical Engineering	3	1	-	30	70	100	4
BS	CHYG2001	Engineering Chemistry Lab	-	-	3	15	35	50	2
ES	MTEG2001	Workshop/Manufacturing Practices	1	-	4	30	70	100	3
ES	ELEG2000	Basic Electrical Engineering Lab	-	-	2	15	35	50	1
MC	EVSG2000	Environmental Sciences	2	1		15	35	50	0
		Total	**16**	**3**	**9**	**195**	**455**	**650**	**21**

MTHG2000	Engineering Mathematics- II	4L:0T:0P	4 Credits

Course Objectives:

1. To provide students with sound foundation in applied mathematics to solve real life problems in industry.
2. To understand the concept of Differential equation to the engineering problems.
3. To learn vector algebra and vector calculus.

Course Outcomes:

Learner will be able to:

1. Apply the knowledge of nth order derivatives of standard functions to engineering problems
2. Apply the concepts of First Order and first degree Differential equation to the engineering problems.
3. Apply the concepts of Higher Order Linear Differential equation to the engineering problems.
4. Apply concepts of Beta and Gamma function to the engineering Problems.
5. Apply concepts of Double integral of different coordinate systems to the engineering problems.
6. Apply concepts of triple integral of different coordinate systems to the engineering problems.

Unit 1: Beta and Gamma functions, and exact differential equation:

1.1: Beta function and its properties.

1.2: Gamma functions and its properties.

1.3: Differential Equation of first order and first degree-Exact differential. equations, Equations reducible to exact equations by using integrating factors.

Unit 2: Differential Calculus:-

2.1 Linear differential equations of the type $\frac{dy}{dx} + Py = Q$, equation reduciable to linear form, Bernoulli's equation.

2.2 Higher order Linear Differential Equation with constant coefficient- Complimentary function, particular integrals of differential equation of the type f(D)y = X where X is e^{ax} , sin(ax+b), cos(ax+b), x^n, e^{ax} V, xV.

2.3 Successive differentiation: nth derivative of standard functions. Leibnitz's Thoerem (without proof) and problems.

Unit 3:- Vector Algebra& Vector Calculus

3.1 Definition of vector, Dot product ,Cross product, Vector triple product ,Product of four vectors

3.2 Scalar point function ,Vector point function ,Vector differential operator ∇(del) . Gradient, Divergence, Curl their properties &related problems. Applications- Normal, Directional derivatives, Solenoidal & Irrotational fields

Unit 4 : Double Integration:-

4.1-Definition, Evaluation of Double Integrals, Change of order of integration, Evaluation of double integrals by changing the order of integration and changing to polar form.

UNIT 5: Triple Integration & Application of Double Integration& Triple Integration

5.1 Definition and evaluation (Cartesian, cylindrical and spherical polar coordinates).
5.2 Application to double integrals to compute Area, Mass, Volume. Application of triple integral to compute volume.

Recommended Books:

1. A text book of Applied Mathematics, P. N. Wartikar and J. N. Wartikar, Vol –I and II by Pune Vidyarthi Graha.
2. Higher Engineering Mathematics, Dr.B. S. Grewal, Khanna Publication
3. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited,9th Ed.
4. Numerical Analysis by S.S.Sastry, Prentice Hall
5. Differential Equations, Sheply Ross, Wiley India
6. Vector analysis- Murray R-Spiegal-Scharn series

CHYG2000	Engineering Chemistry	4L:0T:0P	4 Credits

Course Objectives:

To bring adaptability to the concepts of chemistry and to acquire the required skills to become a perfect engineer.

1. To impart the basic knowledge of atomic, molecular and electronic modifications which makes the student to understand the technology based on them.
2. To acquire the knowledge of electrochemistry, corrosion and water treatment which are essential for the Engineers and in industry.
3. To acquire the skills pertaining to spectroscopy and to apply them for medical field etc.
4. To impart then knowledge of stereochemistry and synthetic aspects useful for understanding reaction pathways

Course Outcomes:

The basic concepts included in this course will help the student to gain:

1. The knowledge of atomic, molecular and electronic changes, band theory related to conductivity.
2. The required principles and concepts of electrochemistry, corrosion and in understanding the problem of water and its treatments.
3. The required skills to get clear concepts on basic spectroscopy and application to

medical field etc.

4. The knowledge and configurational and conformational analysis of molecules and reaction mechanisms.

Unit 1: Water and its treatment: (9L)

Introduction – Chemistry of Water Molecule. hardness of water. Types of hardness: temporary and permanent.(Numericals Based on Hardness). units of hardness. Estimation of hardness of water by complexometric method.Methods of softening of water: Lime Soda Process(Numericals), Zeolite Process & ion exchange process (Numericals). Softening of Water Potable water and its specifications. Steps involved in treatment of water – Disinfection of water by chlorination and ozonization. Desalination of water – Reverse osmosis. Numerical problems.

Unit 2: Energy Sourses: (9L)

Fuels- Definition, classification (solid, liquid & gaseous fuels) - characteristics of a good fuel; Coal - analysis of coal - proximate and ultimate analysis and their significance; Petroleum - refining, knocking - octane and cetane number, cracking - fluid bed catalytic cracking; Natural gas, LPG, CNG - constituents, characteristics and uses. Numericals.

Unit 3: Molecular structure and Theories of Bonding: (8L)

Atomic and Molecular orbitals. Linear Combination of Atomic Orbitals (LCAO), molecular orbitals of diatomic molecules, molecular orbital energy level diagrams of N2, O2 and F2 molecules. π Molecular orbitals of butadiene and benzene.

Crystal Field Theory (CFT): Salient Features of CFT – Crystal Field Splitting of transition metal ion d- orbitals in Tetrahedral, Octahedral and square planar geometries.

Unit 4: Corrosion: (9L)

Corrosion:Causes and effects of corrosion – theories of chemical and electrochemical corrosion – mechanism of electrochemical corrosion. Types of corrosion: Galvanic, water-line and pitting corrosion. Factors affecting rate of corrosion, Corrosion control methods- Cathodic protection – Sacrificial anode and impressed current cathodic methods. Surface coatings – metallic coatings – Methods of coating- Hot dipping, cementation – methods of application. Electro plating and Electro plating of Copper.

Unit 5: Stereochemistry, Reaction Mechanism and synthesis of drug molecules: (10L)

Introduction to representation of 3-dimensional structures, Structural and stereoisomers, configurations, symmetry and chirality. Enantiomers, diastereomers, optical activity and Absolute configuration. Conformation alanalysis of n- butane.

Substitution reactions: Nucleophilic substitution reactions: Mechanism of SN1, SN2 reactions. Electrophilic and nucleophilic addition reactions: Addition of HBr to propene. Markownikoff and anti Markownikoff's additions. Grignard additions on carbonyl compounds. Elimination reactions: Dehydro halogenation of alkylhalides. Saytzeff rule. Oxidation reactions: Oxidation of alcohols using $KMnO_4$ and chromic acid.

Reduction reactions: reduction of carbonyl compounds using $LiAlH_4$ & $NaBH_4$. Hydroboration of olefins. Structure, synthesis and pharmaceutical applications of Paracetamol and Aspirin.

Reference Books:

1. Physical Chemistry, by P.W. Atkins
2. Engineering Chemistry (NPTEL Web-book), by B.L. Tembe, Kamaluddin and M.S.

Krishnan
3. University Chemistry, by B.H. Mahan
4. Fundamentals of Molecular Spectroscopy, by C.N. Banwell
5. Organic Chemistry: Structure and Function by K.P.C. Volhardt and N.E.Schore, 5th Edition.

CHYG2001	Engineering Chemistry Lab	0L:0T:4P	2 Credits

Objectives:

The chemistry laboratory course consists of experiments related to the principles of chemistry required to the engineering student. The course will make the student to learn:

1. Estimation of hardness and chloride content in water to check its suitability for drinking purpose.
2. To determine the rate constant of reactions from concentrations as an function of time.
3. The measurement of physical properties like adsorption and viscosity.
4. To synthesize the drug molecules and check the purity of organic molecules by thin layer chromatographic (TLC) technique.

Laboratory Outcomes

The experiments included in the chemistry laboratory will make the student to gain the skills on

1. Determination of parameters like hardness and chloride content in water.
2. Estimation of rate constant of a reaction from concentration – time relationships.
3. Determination of physical properties like adsorption and viscosity.
4. Calculation of Rf values of some organic molecules by TLC technique

List of Experiments

1. Determination of total hardness of water by complexometric method using EDTA
2. Determination of chloride content of water by Argentometry
3. Estimation of an HCl by Conductometric titrations
4. Estimation of Acetic acid by Conductometric titrations
5. Estimation of HCl by Potentiometric titrations
6. Estimation of Fe^{2+} by Potentiometry using $KMnO_4$
7. Determination of rate constant of acid catalysed hydrolysis of methyl acetate
8. Synthesis of Aspirin and Paracetamol
9. Thin layer chromatography calculation of R_f values. eg ortho and para nitro phenols
10. Determination of acid value of coconut oil
11. Verification of freundlich adsorption isotherm-adsorption of acetic acid on charcoal
12. Determination of viscosity of castor oil and ground nut oil by using Ostwald's viscometer.
13. Determination of partition coefficient of acetic acid between n-butanol and water.
14. Determination of surface tension of a give liquid using stalagmometer.

References

1. Senior practical physical chemistry, B.D. Khosla, A. Gulati and V. Garg (R. Chand & Co., Delhi)
2. An introduction to practical chemistry, K.K. Sharma and D. S. Sharma (Vikas publishing, N. Delhi)
3. Vogel's text book of practical organic chemistry 5th edition
4. Text book on Experiments and calculations in Engineering chemistry – S.S. Dara

ELEG2000	Basic Electrical Engineering	4L:0T:0P	4 Credits

Course Objectives:

The course objectives are:

1. Impart a basic knowledge of electrical quantities such as current, voltage, power, energy and frequency to understand the impact of technology in a global and societal context.
2. Provide working knowledge for the analysis of basic DC and AC circuits used in electrical and electronic devices.
3. To explain the working principle, construction, applications of DC machines, AC machines & measuring instruments.
4. Highlight the importance of transformers in transmission and distribution of electric power.

Course Outcomes:

CO 1. To understand and analyze basic electric and magnetic circuits

Co 2. To study the working principles of electrical machines and power converters.

CO 3. To introduce the components of low voltage electrical installations

Unit 1: DC Circuits (8 hours)

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

Unit 2: AC Circuits (8 hours)

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

Unit 3: Transformers (6 hours)

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Unit 4: Electrical Machines (8 hours)

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

Unit 5: Power Converters (7 hours)

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

Unit 6: Electrical Installations (8 hours)

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Text / Reference Books

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. Ashfaq Hussain, Basic Electrical Engineering, S. Chand Publication.
3. V. Mittle & Arvind Mittal, Basic Electrical Engineering, TMH.
4. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
5. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
6. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
7. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.
8. J.B. Gupta, Basic Electrical Engineering, Kataria & Sons .

ELEG2000	**Basic Electrical Engineering Lab**	**0L:0T:2P**	**1 Credits**

Objectives:

1. To Design Electrical Systems.
2. To Analyze A Given Network By Applying Various Network Theorems.
3. To Expose The Students To The Operation Of DC Generator
4. To Expose The Students To The Operation Of DC Motor and Transformer.
5. To Examine The Self Excitation In DC Generators.

List of experiments/demonstrations:

1. Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Verification of KVL and KCL.
3. Verification of Thevenin's theorem.
4. Verification of Norton's theorem.
5. Verification of Superposition theorem.

6. Verification of Maximum power transfer theorem.
7. Verification of Reciprocity theorem.
8. Magnetization characteristics of DC shunt generator.
9. Swinburne's test on DC shunt machine.
10. Brake test on DC shunt motor.
11. OC & SC tests on single phase transformer.
12. Load test on single phase transformer.
13. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

Laboratory Outcomes

After successfully studying this course, students will:

1. Explain the concept of circuit laws and network theorems and apply them to laboratory measurements.
2. Be able to systematically obtain the equations that characterize the performance of an electric circuit as well as solving both single phase and DC Machines
3. Acknowledge the principles of operation and the main features of electric machines and their applications.
4. Acquire skills in using electrical measuring devices.

MTEG2001	Engineering Graphics	4L:0T:0P	4 Credits

Course Objective:

1.To impart and inculcate proper understanding of the theory of projection.
2. To impart the knowledge of reading a drawing.
3.To improve the visualization skill.
4.To teach basic utility of computer aided drafting (CAD) tool.

Course Outcomes:

Learner will be able to,

1. Apply the basic principles of projections in 2D drawings.
2. Apply the basic principles of projections in converting 3D view to 2D drawings.
3. Read a given drawing.
4. Visualize an object from the given two views.
5. Use CAD tool to draw different views of an object

UNIT-1: Drafting Technology and Introduction to Any Drafting Software/Package

Layout of drawing sheets, sizes of drawing sheets, different types of lines used in drawing practice, Dimensioning – linear, angular, aligned system, unidirectional system, parallel dimensioning, chain dimensioning, location dimension and size dimension. Tolerances –

methods of representing tolerances, unilateral and bilateral tolerances, tolerance on linear and angular dimensions, geometrical tolerances. Symbols used on drawing, surface finish symbols, welding symbols.

Advantages of using Computer Aided Drafting (CAD) packages, applications of CAD, basic operation of drafting packages, use of various commands for drawing, dimensioning, editing, modifying, saving and printing/plotting the drawings. Introduction to 3D primitives.

UNIT-2: Projection of Points and Lines

Lines inclined to both the Reference Planes (Excluding Traces of lines) and simple application based problems on Projection of lines. **Projection of Planes**:- Triangular, Square, Rectangular, Pentagonal, Hexagonal and Circular planes inclined to either HP or VP only. (Exclude composite planes)

UNIT-3: Engineering Curves

Ellipse, Parabola, Hyperbola, normal and tangents to these curves, Involute, Cycloid, Epi-cycloid, Hypo-cycloid, Archimedean Spiral, Helix on cone and cylinder

UNIT-4 : Orthographic Projections & Isometric Projections

Reference planes, types of orthographic projections – First angle projections, Third angle projections, methods of obtaining orthographic views by First angle method, Sectional orthographic projections – full section, half section, offset section. Isometric view, Isometric scale to draw Isometric projection, Non-Isometric lines, construction of Isometric view from given orthographic views and to construct Isometric view of a Pyramid, Cone, Sphere.

UNIT-5: Auxiliary Projections

Auxiliary planes – Auxiliary Vertical Plane (AVP), Auxiliary Inclined Plane (AIP), symmetrical auxiliary view, unilateral auxiliary view, bilateral auxiliary view.

Free hand sketching -- FV and TV of standard machine parts – Hexagonal headed nut and bolt, foundation bolts, shafts, keys, couplings, springs, screw thread forms, welded joints, riveted joints.

PART I: Drawing sheet

Five drawing sheets to be prepared on half imperial drawing sheet: (TO be completed in 30 Hrs.)

Sheet No.1: Curves (2 problems) & projections of lines (2 problems)
Sheet No. 2: Projections of solids (2 problems) & section of solids (1 problem)
Sheet No.3: Orthographic projections (1 problem) & sect. ortho. Projections (1 problem)
Sheet No.4: Reading of orthographic projections (2 problems)
Sheet No.5: Isometric view (2 problems) & free hand sketches of fasteners.
Home –Work: one sketch book, A-3 consisting of minimum 3 problems from each module. Duly signed sketch book is part of term –work.

PART II: Computer Aided Drawing (Auto –CAD)

Practice on Auto –cad: Theory and practice to be completed during practical sessions.

1 Introduction to Auto –Cad.
2 Fundamental of 2 –D Constructions.
3 Orthographic projections.
4 Sectional orthographic projections.
5 Reading of Orthographic projections.
6 Fundamental of 3 –D drawing Isometric view.

EVSG2000	Environmental Studies	3L:0T:0P	0 Credits

Unit 1 : Multidisciplinary nature of environmental studies (2 lectures)
Definition, scope and importance, Need for public awareness.

Unit 2 : Natural Resources : (8 lectures)
Renewable and non-renewable resources :
Natural resources and associated problems.
a) Forest resources : Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.
b) Water resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
c) Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
d) Food resources : World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
e) Energy resources : Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.
f) Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.
• Role of an individual in conservation of natural resources.
• Equitable use of resources for sustainable lifestyles.

Unit 3 : Ecosystems (6 lecture)
• Concept of an ecosystem.
• Structure and function of an ecosystem.
• Producers, consumers and decomposers.
• Energy flow in the ecosystem.
• Ecological succession.
• Food chains, food webs and ecological pyramids.
• Introduction, types, characteristic features, structure and function of the following ecosystem :-
a. Forest ecosystem
b. Grassland ecosystem
c. Desert ecosystem
d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit 4 : Biodiversity and its conservation (8 lectures)

• Introduction – Definition : genetic, species and ecosystem diversity.
• Biogeographical classification of India
• Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values
• Biodiversity at global, National and local levels.
• India as a mega-diversity nation
• Hot-sports of biodiversity.
• Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts.
• Endangered and endemic species of India
• Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity.

Unit 5 : Environmental Pollution (8 lectures)

Cause, effects and control measures of :-
a. Air pollution
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards
• Solid waste Management : Causes, effects and control measures of urban and industrial wastes.
• Role of an individual in prevention of pollution.
• Pollution case studies.
• Disaster management : floods, earthquake, cyclone and landslides.

Unit 6 : Social Issues and the Environment (7 lectures)

• From Unsustainable to Sustainable development
• Urban problems related to energy
• Water conservation, rain water harvesting, watershed management
• Resettlement and rehabilitation of people; its problems and concerns. Case Studies
• Environmental ethics : Issues and possible solutions.
• Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies.
• Wasteland reclamation.
• Consumerism and waste products.
• Environment Protection Act.
• Air (Prevention and Control of Pollution) Act.
• Water (Prevention and control of Pollution) Act
• Wildlife Protection Act
• Forest Conservation Act
• Issues involved in enforcement of environmental legislation.
• Public awareness.

Unit 7 : Human Population and the Environment (6 lectures)

• Population growth, variation among nations.
• Population explosion – Family Welfare Programme.

• Environment and human health.
• Human Rights.
• Value Education.
• HIV/AIDS.
• Women and Child Welfare.
• Role of Information Technology in Environment and human health.
• Case Studies.

Unit 8 : Field work (Field work Equal to 5 lecture hours)

• Visit to a local area to document environmental assets: river/ forest/grassland/hill/mountain
• Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
• Study of common plants, insects, birds.
• Study of simple ecosystems-pond, river, hill slopes, etc.

Textbook:

Textbook for Environmental Studies for undergraduate courses of all branches of Higher Education, Erach Bharucha, Published by University Grants Commission.
E-copy: https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf

SEMESTER III

Course Type	Course Code	Course Name	L	T	P	IA	UE	Total Marks	Credits
BS	MTHG3000	Engineering Mathematics	3	1	-	30	70	100	4
DC	BTYB3010	Biochemistry	3	-	-	30	70	100	3
DC	BTYB3020	Microbiology	3	-	-	30	70	100	3
DC	BTYB3030	Genetics	3	-	-	30	70	100	3
DC	BTYB3040	Immunology	3		0	30	70	100	3
DC	BTYB3011	Biochemistry Lab	-	-	2	15	35	50	2
DC	BTYB3021	Microbiology Lab	-	-	2	15	35	50	2
DC	BTYB3031	Genetics lab	-	-	2	15	35	50	2
DC	BTYB3041	Immunology lab	-	-	2	15	35	50	2
MC	LLLB3000	Constitution of India	2	-	-	30	70	100	0
		Total	**21**	**1**	**4**	**240**	**560**	**800**	**24**

MTHG3000 ENGINEERING MATHEMATICS III

Objectives:

1. To provide sound foundation in the mathematical fundamentals necessary to formulate, solve and analyze engineering problems.

2. To understand the concept of Fourier Series, its complex form and enhance the problem solving skill.
3. To learn the Laplace Transform, Inverse Laplace Transform of various functions, application
4. To understand the concept of Correlation and Regression to the engineering problems
5. To understand the concept of Z - transformation.
6. To understand the concept of probability.

UNIT I: Laplace Transform

1.1 Introduction, Definition of Laplace transform, Laplace transform of constant, trigonometrical, exponential functions

1.2 Important properties of Laplace transform: Change of scale property, First shifting theorem, Laplace transform of L{t^n f(t)}, L{ f(t)/t},Laplace transform of integral0tfudu or0tftdt, Laplace transform of derivatives.

1.3 Inverse Laplace transform of standard functions, related problems , Inverse Laplace transform with Partial fraction and Convolution theorem

1.4 Application to solve initial and boundary value problem involving ordinary differential equations with one dependent variable and constant coefficients.

UNIT 2: **Fourier series**

2.1 Dirichlet's conditions, Fourier series of periodic functions with period 2π and 2L.

2.2 Fourier series for even and odd functions.

2.3 Half range sine and cosine Fourier series, Parseval's identities.

UNIT 3: Matrices

3.1 Eigen values and Eigen vectors.

3.2 Cayley-Hamilton theorem(without proof).

3.3 Similar matrices, Diagonalizable of matrix.

3.4 Derogatory and non-derogatory matrices .

UNIT 4: Correlation &Regression

4.1 Karl Pearson's coefficient of correlation, covariance, Spearman's Rank correlation .

4.2 Lines of Regression.

UNIT 5: Probability and Probability Distribution

5.1 Concepts of Probability - Additive and Multiplicative Laws- Bayes' Decision Rule

5.2 Random variable, discrete& continuous random variables, Expectation

5.3 Probability Distributions: Binomial, Poisson and Normal Distribution.

UNIT 6: Z TRANSFORM

6.1 Z-transform of standard functions such as Z(a^n)

6.2 Properties of Z-transform :Linearity, Change of scale, Shifting property, Multiplication of K. Convolution theorem

6.3 Inverse Z transform: Binomial Expansion and Method of Partial fraction.

Recommended Books:

1. A text book of Applied Mathematics, P.N.Wartikar and J.N.Wartikar, Vol – I and –II by Pune Vidyarthi
Graha.
2. Higher Engineering Mathematics, Dr.B.S.Grewal, Khanna Publication
3. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley EasternLimited,9thEd.
4. Matrices by Shanti Narayan.
5. Numerical by S.S.Sastry, Prentice Hall
6.Dass, H.K., and Er. Rajnish Verma," Higher Engineering Mathematics", S. Chand Private Ltd.,

Outcomes: Learner should be able to ….
1. Demonstrate the ability of using Laplace Transform and Fourier Series in solving the Ordinary Differential Equations and Partial Differential Equations.
2. Use matrix algebra with its specific rules to solve the system of linear equations.
3.Apply the concept of Correlation and Regression to the engineering problems.
4. Apply the concept of Z- transformation and its inverse of the given sequence
5. Expand the periodic function by using Fourier series.
6. Apply the concept of probability and probability distribution in engineering problems.

BIOCHEMISTRY (BTYB3010)

Course learning objectives:
The objectives of this course are
1. To understand the properties of carbohydrates, proteins, lipids, cholesterol, DNA, RNA, glycoproteins and glycolipids and their importance in biological systems. .
2. To develop skills to determine amino acid and nucleotide sequences of proteins and DNA respectively
3. To Understand the importance of high energy compounds, electron transport chain, synthesis of ATP under aerobic and anaerobic conditions.

UNIT 1: Chemical constituents of Life I: (12 Lectures)
1.1. Amino acids: Structure & Function. Structure and properties of Amino acids
1.2. Proteins**:** Types of proteins and their classification, Forces stabilizing protein structure and shape. Different Level of structural organization of proteins, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins.
1.3.Carbohydrates: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoprotein's and their biological functions

UNIT 2: Chemical constituents of Life II 12 lectures
2.1. Lipids: Structure and functions –Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol.
2.2. Nucleic acids: Structure and functions: Physical & chemical properties of Nucleic acids,

2.3. Nucleosides & Nucleotides, purines & pyrimidines,. Biologically important nucleotides,
2.4. Double helical model of DNA structure and forces responsible for A, B & Z – DNA, denaturation and renaturation of DNA

UNIT 3 : Bioenergenetics (12 lectures)

3.1. Laws of thermodynamics,
3.2. concept of free energy, endergonic and exergonic reactions, coupled reactions,
3.3. Redox reactions.
3.4. ATP: structure, its role as a energy currency molecule.

UNIT 4: Enzymes (12 lectures)

4.1. Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group;
4.2. Classification of enzymes
4.3. Features of active site, substrate specificity,
4.4. Mechanism of action (activation energy, lock and key hypothesis, induced - fit theroy), Michaelis – Menten equation, enzyme inhibition and factors affecting enzyme activity.

UNIT 5: Carbohydrates Metabolism 12 lectures

5.1. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions.
5.2. Pentose phosphate pathway and its significance,
5.3. Gluconeogenesis Glycogenolysis and glycogen synthesis.
5.4. TCA cycle, Electron Transport Chain, Oxidative phosphorylation

Text /Reference Books:

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman
2. and Co.
3. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of
4. Plants. American Society of Plant Biologists.
5. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH
6. Freeman and Company, New York, USA.
7. Hopkins, W.G. and Huner, P.A. (2008) Introduction to Plant Physiology. John Wiley and Sons.
8. Salisbury, F.B. and Ross, C.W. (1991) Plant Physiology, Wadsworth Publishing Co. Ltd.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Develop an understanding of fundamental biochemical principles, such as the structure/function of biomolecules, metabolic pathways, and the regulation of biological/biochemical processes.
2. Gain proficiency in basic laboratory techniques in both chemistry and biology, and be able to apply the scientific method to the processes of experimentation and hypothesis testing

BTYB3011 BIOCHEMISTRY LAB

LIST OF EXPERIMENTS:

1. Quantitative estimation of RNA by orcinol reagent.
2. Quantitative estimation of DNA by DPA method.
3. Principles of Colorimetry**: (i)** Verification of Beer's law, (**ii)** To study relation between absorbance and % transmission.
4. Preparation of buffers.
5. Isolation of casein from milk.
6. Separation of sugars/amino acids by paper chromatography.
7. Qualitative tests for Carbohydrates, lipids and proteins
8. Determination of acid number of fats.

MICROBIOLOGY (BTYB3020)

Course learning objectives:

The objectives of this course are

1. To become aware with the contributions of Louis Pasteur, Edward Jenner and Robert Koch in microbiology and immunology.
2. To get acquainted with the discovery of antibiotics and their targets, drug/antibiotic resistance, preventive and therapeutic approaches of infectious diseases, hospital acquired infections.
3. To Understand the importance of microorganisms as model systems in genetics and biochemistry.
4. To know the contribution of gut microbiome in human health.
5. To understand the concepts of fight against major killer diseases – tuberculosis, HIV and malaria.

Unit 1: Introduction to Microbiology(12 lectures)

1.1. History , application and Status of Microbiology in India.
1.2. Classification of Micro-organisms.
1.3. General features.
1.4. Microbial taxonomy- Bergey manual.

Unit 2: Structure and Diversity of Microorganisms. (12 lectures)

2.1. bacteriology- morphology and structure of Archaebacteria.
2.2. Structure and function of cell organelles of bacteria.
2.3. Structure of viruses.

Unit 3: Staining methods(12 lectures)

1.1. Stains and Dyes
1.2. Simple staining
1.3. Differential staining
1.4. Special staining

Unit 4: Microbial growth(12 lectures)

4.1. Growth curve-mathematical expression of growth.
4.2. Factors affecting microbial growth.

4.3. Batch, continuous, synchronous and diauxic growth
4.4. Quantification of growth.

Unit 5: Microbial Nutrition and metabolism. (12 lectures)

5.1. Nutritional classification of Microorganisms.
5.2. Concept of anabolism and catabolism process.
5.3. Nitrogen fixation- types and mechanism.
5.4. Microbial diseases in plants and animals.

Text /Reference Books:

1. Microbiology:Pelczar M J
2. Microbiology:Presscott L M,Harley J P and Klein D A
3. Textbook of Micrbiology-Ananthanarayan
4. General microbiology - Powar & Daginawala

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Usage of scientific terminologies to describe & express fundamental concepts in Microbiology.
2. Able to apply basic principles to understand host-microbe relationship in different Infectious diseases.
3. Able to connect and integrate the knowledge obtained for applications related to Microbes, their tools and database.
4. Able to connect and integrate the knowledge of microbiology and immunology from the perspective of a bioinformatician with special emphasis on microbe-immune interface

BTYB 3021 MICROBIOLOGY LAB

LIST OF EXPERIMENTS:

1. Monochrome Staining, Differential Staining, Gram Staining, and Acid Fast Staining and Romonowsky Staining
2. Special Staining Technique for Cell Wall, Capsule and Endospores and Fungal Staining, Lipid granules, metachromatic, flagella, spirochetes
3. Motility test
4. Sterilization of Laboratory Glassware and Media using Autoclave
5. Preparation of Media- Nutrient broth and Agar, MacConkey Agar, Sabourauds Agar
6. Isolation of Organisms , Macroscopic and microscopic studies: T-streak, Polygon method, Colony characteristics of microorganisms
7. Enumeration of microorganisms: Serial Dilution, Pour Plate, Spread Plate Method, Nephlometry, Haemocytometry, Breeds count
8. Growth Curve of E.coli
9. Effect of pH and temperature on growth of organisms

GENETICS (BTYB3030)

Course learning objectives:

The objectives of this course are

1. To acquaint students with concepts in Genetics
2. To impart skills in Techniques in Genetic Analysis and Population Genetics

Detailed Syllabus

Unit 1: Mendels Law (12 lectures)

1.1.Mendel's Laws of HeredityMonohybrid Cross: Principleof Dominance and Segregation. Dihybrid Cross: Principle ofIndependent Assortment.

1.2 Application of Mendel's Principles Punnett Square.

1.3. Mendel's Principle in HumanGenetics. Incomplete Dominance and Co-dominance. Multiple Alleles.Allelic series.Variations among the effect of the Mutation.Genotype and Phenotype.

1.1.Environmental effect on the expression of the Human Genes. Gene Interaction.Epistasis.

Unit 2: Genetic analysis (12 lectures)

2.1. Genetic analysis in Bacteria- Prototrophs, Auxotrophs.

2.2. Bacteriophages: Lytic and Lysogenic Development of Phage. Mechanism of Genetic Exchange in Bacteria:

2.3. Conjugation; Transformation; Transduction; (Generalized Transduction, Specialized Transduction)

2.4. Bacterial Transposable Elements

Unit 3: Prokaryotic and Eukaryotic transcription (12 lectures)

3.1. Transcription Process in Prokaryotes :RNA Synthesis; Promoters and Enhancers;

3.2. Initiation of Transcription at Promoters; Elongation and Termination of an RNA Chain.

3.3. Transcription in Eukaryotes Transcription of Protein Coding Genes by RNA Polymerase.

Unit 4: Genetic code (12 lectures)

4.1. Nature of Genetic Code.

4.2. Wobble Hypothesis.

4.3.Translation: Process of Protein Synthesis (Initiation, Elongation, Translocation, Termination)

Unit 5: Regulation in prokaryotes and eukaryotes (12 lectures)

5.1. Gene regulation In prokaryotes: In Bacteria: *Lac* operon of *E.coli, trp* Operon of *E.coli.*

5.2. In Eukaryotes: Operons in Eukaryotes; Control of Transcriptional Initiation

5.3. Jumping genes in maize

Text /Reference Books:

1. General Principles of Microbiology- Stanier
2. Fundamental Principles of Bacteriology - A. J. Salle McGraw Hill
3. Genetics, (2006) Strickberger MW - (Prentice Hall, India)
4. Human Genetics- A. M. Winchester – MacMillan Press
5. iGenetics- Peter Russell -Pearson Education
6. Microbial Genetics- Freifelder –Narosa Publishing House

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Define and explain the three laws of Heredity
2. Explain the patterns of breeding and cross breeding
3. Explain the concept of alleles, their dominant and recessive nature
4. Explain unusual patterns of inheritance and deviations from the normal laws

BTYB3031 GENETICS LAB

LIST OF EXPERIMENTS:

1. Isolation, Quantitative Analysis and AGE of Genomic DNA from Bacteria and Yeast.
2. Mutations by UV rays
3. Mutations by chemical agents such as; base analogue, intercalating agents or Alkylating agents.
4. Bacterial transformation
5. Bacterial conjugation
6. Bacterial transduction
7. Karyotyping with the help of photographs

IMMUNOLOGY(BTYB3040)

. Course learning objectives:

The objectives of this course are

1. To Understand of the overview of immune system including cells, organs and receptors.
2. To learn structure and functions of different classes of immunoglobulins, the genetic basis of antibody diversity and the importance of humoral, cell-mediated and innate immune responses in combating pathogens.
3. To understand mechanisms involved in different types of hypersensitivity, and the importance of conventional vs.recombinant vaccines.
4. To get acquainted with the importance of antigen-antibody interaction in disease diagnosis.
5. To understand the principles of tolerance, autoimmunity and the role of immunity in protection against pathogens.

Unit 1 Introduction to Immunology (12 lectures)

Immune Response - An overview, components of mammalian immune system Molecular structure of Immuno-globulins or Antibodies, Humoral & Cellular immune responses, T-lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells), T-cell receptors, genome rearrangements during B-lymphocyte differentiation, Antibody affinity maturation class switching, assembly of T-cell receptor genes by somatic recombination.

Unit 2 Immunoglobulin regulation (12 lectures)

Regulation of immunoglobulin gene expression – clonal selection theory, Allotypes & idiotypes, allelic exclusion immunologic memory, Heavy chain gene transcription, genetic basis of antibody diversity, Hypotheses (germ line & somatic mutation), antibody diversity.

Unit 3. MHC(12 lectures)

Major Histocompatibility complexes – class I & class II MHC antigens, Antigen processing.

Immunity to infection – immunity to different organisms, pathogen defense strategies, avoidance of recognition. Autoimmune diseases, Immunodeficiency-AIDS.

Unit 4. Immunotechniques (12 lectures)

Antigen antibody interaction techniques- Precipitation Reactions: Immunoprecipitation, Immunoelectrophoresis, CIEP, Rocket Electrophoresis and 2-D Immunoelectrophoresis

Agglutination Reactions: Passive, Reverse Passive, Agglutination Inhibition. Coomb's Test; Complement Fixation Tests. Synthesis of Monoclonal antibodies & Applications.

Unit 5 DNA Vaccines (12 lectures)

Vaccines & Vaccination – adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents,Passive & active immunization. Introduction to immunodiagnostics – RIA, ELISA

Text /Reference Books:

1. Kuby immunology, Judy Owen, Jenni Punt, Sharon Stranford., 7th edition (2012), Freeman and Co., NY
2. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6 th edition Saunders Publication, Philadelphia.
3. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication, Oxford.
4. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
5. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.
6. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg.
7. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publications.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Students will be able to understand and apply basic microbiological techniques and correlate them with their fundamental concepts in the subject.
2. Students will be able to understand and apply basic immunological techniques and correlate them with their fundamental concepts in the subject.

IMMUNOLOGY LAB (BTYB3041)

LIST OF EXPERIMENTS:

1. Differential leucocytes count
2. Total leucocytes count
3. Total RBC count
4. Haemagglutination assay
5. Haemagglutination inhibition assay
6. Separation of serum from blood
7. Passive Agglutination- RA Factor Test.
8. ELISA (Kit based).
9. Dot ELISA
10. Single radial immunodiffusion
11. Ouchterlony double immunodiffusion

LLLB3000 Constitution of India

Course learning objectives:

The objective of the course is how to deal and adjust in the society under government regulations. Constitution is the highest law of the land and every department owes its origin to its

laws. To make governance better an engineer must conduce to E-governance through computers and knowledge of cyber laws. An engineer must know the limits of state action

and regulations by acquainting himself with the laws that applied by the bureaucrats. Since an engineer works at different places and sights, he must have the basic knowledge of centre – state relations with reference to policy of financing the key projects. The knowledge of Constitution is necessary for him in order to ensure that the rules and regulations under which public and private sector works, do not violate the provisions of the Constitution. Knowledge of corporate culture is necessary for him. He must understand the compulsions of the public private partnership and philosophy of state ownership of key industries.

UNIT-1

Introduction to Constitution of India, Role of Public Sector Undertakings in economic development, Public policy making in India and influence of new globalised world order

UNIT-2

I.T.Law in India - Section 4-10 of I.T Act: Cyber laws in India - Section 43-47 of I.T Act- Section 65-78 of I.T Act, E-Governance and role of engineers in E-Governance.

UNIT-3

Socialist policy of India and its relevance, Role of Planning Commission in economic development, Finance Commission and centre-State relations

UNIT-4

Fundamental Rights and Fundamental Duties, Directive Principles of State Policy, Politics of Industrialization in India and the policy of Liberalization Privatization and Globalization (LPG)

UNIT-5

Need for reformed engineering serving at the Union and State level, Role of I.T. professionals in Judiciary, Problem of Alienation and Secessionism in few states creating hurdles in Industrial development

Recommended Books & References:

1. An Introduction to the Constitution of India by: Brij Kishore Sharma

2. Relevant document related Government of India Policy.

3. Cyber Law by Dr. Gupta and Agarwal.

4. www.indiancourts.nic.in

5. Public Administration by Awasthi and Maheshwari

Course Outcomes:

On completion of this course, the students will be able to

1. Understand the basics of Constitution of India.

2. Understand the role of Public Sector Undertakings in economic development

3. Understand the Public policy making in India and influence of new globalized world

4. Understand E-Governance and role of engineers in E-Governance.

5. Understand the Socialist policy of India

6. Understand the role of Planning Commission in economic development

7. Understand the Finance Commission and centre-State relations

8. Understand the Fundamental Rights and Fundamental Duties

SEMESTER IV

Course Type	Course Code	Course Name	L	T	P	IA	UE	Total Marks	Credits
DC	BTYB 4010	Molecular Biology	3	-	-	30	70	100	3
DC	BTYB 4020	Bioprocess technology	3	-	-	30	70	100	3
DC	BTYB4030	Food and Diary microbiology	3	-	-	30	70	100	3
DC	BTYB4040	Introduction to Biotechnology	3	-	-	30	70	100	3
DC	BTYB1041	Introduction to Biotechnology lab	3	1	-	30	70	100	4
DC	BTYB 4050	Molecular Biology lab	3	-	-	30	70	100	3
DC	BTYB 4011	Bioprocess technology lab	-	-	2	15	35	50	1
DC	BTYB4031	Food and Diary microbiology lab	-	-	2	15	35	50	1
		Total	**18**	**1**	**4**	**210**	**490**	**700**	**21**

BTEB4030	MOLECULAR BIOLOGY	4L:0T:0P	4 Credits

Course learning objectives:

The objectives of this course are

1. To acquaint students with DNA Replication, Repair and Genetic Engineering.
2. Impart the knowledge of molecular Biology Techniques.

Detailed Syllabus:

Unit 1 Hereditary material- DNA (12 lectures)

1.1 DNA as the vehicle of inheritance- Experimental evidence -Griffith, McLeod, McCarty and Avery, HerscheyChase experiments.

1.2.Definition of Gene, organization of genes and non-coding

1.3.DNA in prokaryotes and Eukaryotes - unique, moderately repetitive and highly repetitive DNA sequence, Satellite DNA.

1.4. Cot value.

Unit 2 DNA replication in prokaryotes (12 lectures)

2.1. DNA Replication in Prokaryotes - Semi-conservative DNA replication,
2.2. DNA Polymerases and its role, E.coli Chromosome Replication,
2.3.Bidirectional Replication of Circular DNA molecules.
2.4. Rolling Circle Replication, DNA

Unit 3 DNA replication (12 lectures)

3.1. Replication in Eukaryotes
3.2. DNA Recombination –Holliday Model for Recombination
3.3. Transformation

Unit 4 Mutations(12 lectures

4.1. Definition and Types of Mutations.
4.2. Mutagenesis and Mutagens.(Examples of Physical, Chemical and Biological Mutagens)
4.3. Types of Point Mutations,
1.1. DNA REPAIR Photoreversal, Base Excision Repair, Nucleotide Excision Repair, Mismatch Repair, SOS Repair and Recombination Repair**.**

Unit 5 Genetic and Chromosomal variation (12 lectures)

5.1. Genetic variation and chromosomal basis of inheritance Types: Discontinuous and continuous
5.2. Molecular basis of allelic variation.
5.3. Historical development of chromosomal theory, nature of chromosome, chromosomal behaviour 5.4. Inheritance in eukaryotes

Text /Reference Books:

1. Upadhya- Molecular Biology- Himalaya pub.
2. Watson – Molecular biology of gene- Pearson pub.
3. David Freifelder- Microbial Genetics – Narosa Pub.
4. David Freifelder– Molecular Biology – Narosa pub.
5. Gardner – Principals of Genetics – Wiley international pub.
6. Albert Bruce- Molecular biology of the cell- garland science.
7. Loddish - Molecular cell biology – W-H. freeman
8. Lewin – Genes X- Oxford
9. Fundamentals of Cell and Molecular biology-Baig, Telang and Ingle-Amruta

Genome- T.A. Brown- John Wiley

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Understand basic molecular biology terms and definitions
2. Understand the molecular model of DNA and its replication in various ways
3. Define mutations and predict their outcomes
4. Enlist various possibilities and probable reasons which may lead to mutations
5. Explain certain medical conditions related to one's genetics
6. Elucidate the concept of heredity and passing of information from generation to other

BTEB4031	**MOLECULAR BIOLOGY LAB**	**0L:0T:4P**	**2 CREDITS**

LIST OF EXPERIMENTS:

1. Isolation and purification of DNA from plant sources (genomic)
2. Agarose Gel Electrophoresis of the genomic DNA
3. Quantitative analysis of DNA by DPA
4. Quantitative analysis of RNA by Orcinol method
5. Study of DNA repair mechanism by photo reactivation

Determination of Tm value of DNA

BTEB4020	**BIOPROCESS TECHNOLOGY**	**4L:0T:0P**	**4 Credits**

Course learning objectives:

The objectives of this course are

- To Learn various bioprocess related terms and principles
- To Learn about microbial growth kinetics in various mode of fermentation
- To Learn about the principles and application of Mass transfer and Sterilization
- To Develop an understanding of important concepts and design aspects of bioreactors
- To Learn about the functioning of various bioreactors
- To Learn about the principle of scaling up and scaling down of bioprocesses

Unit 1 Fermentor design (12 lectures)

Design of a fermentor**:** - Basic Design; Parts of a Typical Industrial Fermentor. Types of fermenter- Stirred Tank Fermentor, Air lift, Pneumatic, Bubble column, Tower fermentor, Process Parameters : *pH*, Temperature, Aeration, Agitation, Foam, Pressure, Inlet and exit gas analysis, Dissolved oxygen. Carbon dioxide electrodes, microbial biomass, Safety valves.

Unit 2 Industrial Fermentation (12 lectures)

Production of industrial chemicals, biochemicals and chemotherapeutic products. Propionic acid, butyric acid, 2-3 butanediol, gluconic acid, itaconic acid, Biofuels: Biogas, Ethanol, butanol, hydrogen, biodiesel, microbial electricity, starch conversion processes; Microbial

polysaccharides; Microbial insecticides; microbial flavours and fragrances, newer antibiotics, anti cancer agents, amino acids.

Unit 3 Microbial metabolites(12 lectures)

Microbial products of pharmacological interest, steriod fermentations and transformations. Over production of microbial metabolite, Secondary metabolism – its significance and products. Metabolic engineering of secondary metabolism for highest productivity. Enzyme and cell immobilization techniques in industrial processing, enzymes in organic synthesis, proteolytic enzymes, hydrolytic enzymes, glucose isomerase, enzymes in food technology/organic synthesis.

Unit 4 Purification of protein (12 lectures)

Purification & characterization of proteins, Upstream and downstream processing, solids and liquid handling. Distribution of microbial cells, centrifugation, filtration of fermentation broth, ultra centrifugation, liquid extraction, ion-exchange recovery of biological products. Experimental model for design of fermentation systems, Anaerobic fermentations.

Text /Reference Books:

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology.
3. 2nd edition. Panima Publishing Co. New Delhi.
4. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
5. 4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
6. Salisbury, Whitaker and Hall. Principles of fermentation Technology,

Course Outcomes:

At the end of this course students will demonstrate the ability to:

- Able to use correct biological terms to describe & analyze phenomena/ problems in bioprocesses
- Able to apply engineering principles to address issues in various bioprocesses
- Able to analyze bacterial growth kinetics (homogeneous reaction) in batch /continuous/ Fed-batch reactor and sterilization
- Able to understand and to solve problems related to bioprocess phenomena including mixing, Mass transfer and sterilization
- To develop a strong foundation about bioreactor designs and their applications
- Able to understand the basis of bioprocess scale up and the related basic design calculations

BTEB4021	**BIOPROCESS TECHNOLOGY LAB**	**0L:0T:4P**	**2 Credits**

LIST OF EXPERIMENTS:

1. Comparative analysis of design of a batch and continuous fermenter.
2. Calculation of Mathematical derivation of growth kinetics.
3. Solvent extraction & analysis of a metabolite from a bacterial culture.
4. Perform an enzyme assay demonstrating its hydrolytic activity (protease/peptidase/glucosidase etc.)

BTYB4030	Food and Diary microbiology

Course learning objectives:

The objectives of this course are

1. to acquaint students with the role of microorganisms in association with foods, highlighting both their beneficial and harmful activities and their applications in the food industry
2. to understand the concept of quality control of food.

Detailed Syllabus:

Unit 1 Foods as a substrate for microorganisms Lectures: 8

Intrinsic and extrinsic factors that affect growth and survival of microbes in foods, natural flora and source of contamination of foods in general.

Unit 2 Microbial spoilage of various foods Lectures: 10

Principles, Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods

Unit 3 Principles and methods of food preservation Lectures: 12

Principles, physical methods of food preservation: temperature (low, high, canning, drying), irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging, chemical methods of food preservation: salt, sugar, organic acids, SO2, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins

Unit 4 Fermented foods Lectures: 10

Dairy starter cultures, fermented dairy products: yogurt, acidophilus milk, kumiss, kefir, dahi and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tampeh, Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market.

Unit 5 Food borne diseases (causative agents, foods involved, symptoms and preventive measures) Lectures: 10

Food intoxications: Staphylococcus aureus, Clostridium botulinum and mycotoxins; Food infections: Bacillus cereus, Vibrio parahaemolyticus, Escherichia coli, Salmonellosis, Shigellosis, Yersinia enterocolitica, Listeria monocytogenes and Campylobacter jejuni

Text /Reference Books:

1. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.

2. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.
3. Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York.
4. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.
5. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.
6. Gould GW. (1995). New Methods of Food Preservation. Blackie Academic and Professional, London.
7. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7th edition, CBS Publishers and Distributors, Delhi, India.
8. Lund BM, Baird Parker AC, and Gould GW. (2000). The Microbiological Safety and Quality of Foods. Vol. 1-2, ASPEN Publication, Gaithersberg, MD.
9. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Will be aware of the possible sources of contamination of foods and the parameters affecting microbial growth in foods.
2. Will gain insight into the microbial spoilage of some foods
3. Will acquire an in-depth knowledge of various physical and chemical methods used for food preservation.
4. Will be acquainted with microbial production of fermented dairy and non-dairy food products.
5. Will also be able to understand the health benefits of prebiotics, probiotics and synbiotics.
6. Will be conversant with some food-borne diseases and will be able to explain methods for detection of food borne pathogens.

MCRB4021	**FOOD AND DAIRY MICROBIOLOGY LAB**	**0L:0T:4P**	**2 Credits**

LIST OF EXPERIMENTS:

1. MBRT of milk samples and their standard plate count.
2. Alkaline phosphatase test to check the efficiency of pasteurization of milk.

3. Isolation of any food borne bacteria from food products.
4. Isolation of spoilage microorganisms from spoiled vegetables/fruits.
5. Isolation of spoilage microorganisms from bread.
6. Preparation of Yogurt/Dahi.

SEMESTER V

Course Type	Course Code	Course Name	L	T	P	IA	UE	Total Marks	Credits
DC	BTYB5010	Genetics	3	-	-	30	70	100	3
DC	BTYB5020	rDNA technology	3	-	-	30	70	100	3
DC	BTYB5030	Plant biotechnology	3	-	-	30	70	100	3
BS	BINB5320	IPR, Biosafety & Entrepreneurship	**3**	**-**	**-**	**30**	**70**	100	**3**
DE	**	Principles of Genetics lab	2	1	-	30	70	100	3
GE	**	rDNA technology lab	2	-	-	15	35	50	1
DC	BTYB5021	Plant biotech lab	-	-	2	15	35	50	1.3+
		Total	**17**	**1**	**4**	**210**	**490**	**700**	**20**

BTEB5010	**GENETICS**	**4L:0T:0P**	**4 Credits**

Course learning objectives:

The objectives of this course are

3. To acquaint students with concepts in Genetics
4. To impart skills in Techniques in Genetic Analysis and Population Genetics

Detailed Syllabus

Unit 1: Mendels Law (12 lectures)

1.2.Mendel‘s Laws of HeredityMonohybrid Cross: Principleof Dominance and Segregation. Dihybrid Cross: Principle ofIndependent Assortment.

1.2 Application of Mendel‘s Principles Punnett Square.

1.3. Mendel‘s Principle in HumanGenetics. Incomplete Dominance and Co-dominance. Multiple Alleles.Allelic series.Variations among the effect of the Mutation.Genotype and Phenotype.

1.2.Environmental effect on the expression of the Human Genes. Gene Interaction.Epistasis.

Unit 2: Genetic analysis (12 lectures)

2.1. Genetic analysis in Bacteria- Prototrophs, Auxotrophs.

2.2. Bacteriophages: Lytic and Lysogenic Development of Phage. Mechanism of Genetic Exchange in Bacteria:

2.3. Conjugation; Transformation; Transduction; (Generalized Transduction, Specialized Transduction)

2.4. Bacterial Transposable Elements

Unit 3: Prokaryotic and Eukaryotic transcription (12 lectures)

3.1. Transcription Process in Prokaryotes :RNA Synthesis; Promoters and Enhancers;

3.2. Initiation of Transcription at Promoters; Elongation and Termination of an RNA Chain.

3.3. Transcription in Eukaryotes Transcription of Protein Coding Genes by RNA Polymerase.

Unit 4: Genetic code (12 lectures)

4.1. Nature of Genetic Code.

4.2. Wobble Hypothesis.

4.3.Translation: Process of Protein Synthesis (Initiation, Elongation, Translocation, Termination)

Unit 5: Regulation in prokaryotes and eukaryotes (12 lectures)

5.1. Gene regulation In prokaryotes: In Bacteria: *Lac* operon of *E.coli, trp* Operon of *E.coli.*

5.2. In Eukaryotes: Operons in Eukaryotes; Control of Transcriptional Initiation

5.3. Jumping genes in maize

Text /Reference Books:

7. General Principles of Microbiology- Stanier
8. Fundamental Principles of Bacteriology - A. J. Salle McGraw Hill
9. Genetics, (2006) Strickberger MW - (Prentice Hall, India)
10. Human Genetics- A. M. Winchester – MacMillan Press
11. iGenetics- Peter Russell -Pearson Education
12. Microbial Genetics- Freifelder –Narosa Publishing House

Course Outcomes:

At the end of this course students will demonstrate the ability to:

5. Define and explain the three laws of Heredity
6. Explain the patterns of breeding and cross breeding
7. Explain the concept of alleles, their dominant and recessive nature
8. Explain unusual patterns of inheritance and deviations from the normal laws

BTEB5011	**GENETICS LAB**	**0L:0T:2P**	**4 Credits**

LIST OF EXPERIMENTS:

8. Isolation, Quantitative Analysis and AGE of Genomic DNA from Bacteria and Yeast.
9. Mutations by UV rays
10. Mutations by chemical agents such as; base analogue, intercalating agents or Alkylating agents.

11. Bacterial transformation
12. Bacterial conjugation
13. Bacterial transduction
14. Karyotyping with the help of photographs

BTEB5030	RECOMBINANT TECHNOLOGY	4L:0T:0P	4 Credits

1. Course learning objectives:

The objectives of this course are

1. To chose a career in molecular biology and genetic engineering
2. To Exploit the basic understanding of the subject to create something that can help society
3. To Equip oneself with skills to grow in the biotech sector
4. To Work in biotechnology industries in Research and Development/Production/ Quality Assurance
5. To Carry out basic research in understanding many more molecular mechanisms inside a cell

2. Detailed Syllabus

Unit I: Basic Concepts and Tools of Gene cloning

What is gene cloning and why do we need to clone a gene?; Introduction to recombinant DNA technology: Introduction to vehicles of gene cloning, Handling of DNA, RNA, cDNA and Restriction enzymes, Laboratory requirements, Safety measures and regulations for rDNA work, Choice and selection of the tools and techniques; Purification of DNA from bacterial, plant and animal cells; Manipulation of purified DNA; Introduction of DNA into living cells; Different methods of horizontal gene transfer: Transformation, Conjugation and Transduction.

Unit II: Cloning Vectors and Identification of a clone

Vehicles: Plasmids, Bacteriophages and viruses, Phagemids and Cosmids; Bacterial Artificial Chromosomes; Vectors for yeast and other fungi: 2µ plasmid, YEPs, YIPs, YRPs, and YACs;

To obtain a clone of a specific gene: Direct selection, Selection using hybridization from Genomic DNA library, cDNA library; Probe designing and labeling; Identification of clones using alternative methods

Unit III: Studying gene location and structure

Gene location: Hybridization techniques – Southern blotting; In situ hybridization, FISH, OFAGE.

Studying gene structure; DNA sequencing: Sanger's method of chain termination and Maxam Gilbert's method of chemical degradation; Automated sequencing; Polymerase Chain Reaction and its types; Chemical synthesis of oligonucleotides.

Unit IV: Gene Expression and Regulation

Transcript analysis; Studying gene expression; Regulation of gene expression; Studying translated product of the gene; Studying protein – protein interactions; Expression vectors; Promoters used in expression vectors; Cassettes and gene fusions; Problems associated with production of recombinant protein in E.*coli;* Production of recombinant protein by eukaryotic cells like yeast and fungi; Study of protein functions by *in vitro* mutagenesis

Text /Reference Books:

1) Molecular Biology of the Gene (2008) 6th ed., Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R., Cold Spring Harbor Laboratory Press, Cold Spring

Harbor (New York).
2) Gene Cloning and DNA Analysis (2010) 6th ed., Brown, T.A., Wiley-Blackwell Publishing (Oxford, UK)
3) Principles of Gene Manipulation and Genomics (2006) 7th ed., Primrose, S. B., and Tawyman, R. M., Blackwell publishing (Oxford)
4) Molecular Biotechnology: Principles and Applications of Recombinant DNA (2010) 4th ed., Glick B.R., Pasternak, J.J. and Patten, C.L., ASM Press (Washington DC)

3. Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Understand the basic tools required in recombinant DNA technology
2. Explore the methods used to study gene location and structure
3. Know the various techniques used to study the gene expression and regulation
4. Understand the techniques used in analyzing transcripts and proteins
5. Understand problems associated with production of recombinant molecules
6. Explore the use of recombinant DNA technology in betterment of the society
7. Appreciate experiments carried out by scientists to enable understand various molecular mechanisms

BTEB5031	**RECOMBINANT TECHNOLOGY LAB**	**0L:0T:4P**	**2 Credits**

LIST OF EXPERIMENTS:

1) Genomic DNA isolation from bacteria
2) Plasmid DNA isolation
3) Assessment of quality and quantity of DNA
4) Agarose gel electrophoresis to visualize DNA
5) Restriction digestion
6) DNA ligation
7) DNA transformation

Course Learning Objective:

The objectives of this course are:

1. To Understand the concept of *in vitro* micropropagation and its various techniques
2. To Understand the various mechanisms of transfer of desired DNA into plant cells
3. To Appreciate the benefits of protoplast isolation and fusion
4. To Understand the benefits of somaclonal variations in crop improvement
5. To Know the basic experimental designs required for a successful transfer of plantlets from labs to farms
6. To Understand the importance of secondary metabolites and their production for commercial use

Detailed Syllabus

UNIT I Micropropagation **15 Lectures)**

Introduction, Cryo and organogenic differentiation, Types of culture: Seed , Embryo, Callus,

Organs, Cell and Protoplast culture. Micropopagation Axillary bud proliferation, Meristem andshoot tip culture, cud culture, organogenesis, embryogenesis, advantages and disadvantages of micropropagation.

UNIT- II In vitro techniques (20 Lectures)

In vitro haploid production Androgenic methods: Anther culture, Microspore culture andogenesis Sgnificance and use of haploids, Ploidy level and chromosome doubling, diplodization, Gynogenic haploids, factors effecting gynogenesis, chromosome elimination techniques for production of haploids in cereals.

UNIT - III. Proptoplast culture(15 Lectures)

Protoplast Isolation and fusion Methods of protoplast isolation, Protop last development, Somatichybridization, identifiation and selection of hybrid cells, Cybrids, Potential of somatichybridization limitations.Somaclonal variationNomenclautre, methods, applications basis and disadvantages)

UNIT – IV PGPB (10 Lectures)

Plant Growth Promoting bacteria. Nitrogen fixation, Nitrogenase, Hydrogenase, Nodulation, Biocontrol of pathogens, Growth promotion by free-living bacteria.

Text /Reference Books:

1. Bhojwani, S.S. and Razdan 2004 Plant Tissue Culture and Practice.
2. Brown, T. A. Gene cloning and DNA analysis: An Introduction. Blackwell Publication.
3. Gardner, E.J. Simmonns, M.J. Snustad, D.P. 2008 8th edition Principles of Genetics. Wiley India.
4. Raven, P.H., Johnson, GB., Losos, J.B. and Singer, S.R. 2005 Biology. Tata MC Graw Hill.
5. Reinert, J. and Bajaj, Y.P.S. 1997 Applied and Fundamental Aspects of Plant Cell, Tissue and
6. Organ Culture. Narosa Publishing House.
7. Russell, P.J. 2009 Genetics – A Molecular Approach. 3rdedition. Benjamin Co.
8. Sambrook & Russel. Molecular Cloning: A laboratory manual. (3rd edition)

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Contributing towards developing high yielding and good quality crops to meet demands of the farmers and population
2. Contributing towards developing plants for bioremediation and sustaining in stressed climatic conditions
3. Start small scale companies with products that can cater to the agricultural sector
4. Carry out basic research in developing new products
5. Work in institutions and industries contributing to agribiotech sector

PHYB5311	PLANT BIOTECHNOLOGY LAB	0L:0T:4P	2 Credits

LIST OF EXPERIMENTS:

1. Preparation of simple growth nutrient (knop's medium), full strength, half strength, solid and liquid.
2. Preparation of complex nutrient medium (Murashige & Skoog's medium)
3. To selection, Prune, sterilize and prepare an explant for culture.
4. Significance of growth hormones in culture medium.

5. To demonstrate various steps of Micropropagation.

CIVB5040 Environmental Engineering 3L:0T:0P 3 Credits

Course learning objectives:

1. To make the students conversant about the environmental pollution problems related to land, air and water.
2. To make the students conversant about the principles of water treatment processes including the problems involved in handling the different sources of water supply.
3. To impart basic knowhow of the process of collection and distribution of domestic wastewater and to make them learn about the different techniques of onsite treatment of sewage.
4. To impart a comprehensive knowledge of the different wastewater treatment processes including the latest state of the art technologies.
5. To get a brief idea of solid waste collection, its sources and characteristics and the different methods of disposal of solid waste.

UNIT-1

Sources, Quality and Quantity Perspectives of Water: Surface sources, subsurface sources, physical characteristics, chemical characteristics, biological characteristics, water quantity estimation, water consumption rate, fluctuations in rate of demand, design periods, population forecasting methods. Collection and Conveyance of Water: Intakes, types of Intakes, factors governing location of intakes, pumps, types of conduits, types of pipes, pipe appurtenances

UNIT-2

Purification of Water – Water Treatment: Operations involved in water treatment, screening, plain sedimentation, sedimentation aided with coagulation, filtration, disinfection, water softening, miscellaneous treatments.

UNIT-3

Distribution System: Requirements of a good distribution system, methods of distribution, systems of supply of water, Distribution reservoirs, layout of distribution system, design of distribution system, analysis of pipe networks of distribution system, appurtenances in distribution system, detection and prevention of wastage of water in a distribution system.

UNIT-4

Sewers and sewer appurtenances: Hydraulic design of sewers: hydraulic formulae for design of sewers, minimum velocity of flow in sewers, maximum velocity of flow in

sewers, effect of variation in flow of sewage on velocity of flow in sewers, forms of sewers, design of storm water drains. Construction of sewers: factors affecting the selection of material for sewer construction, materials for sewers, joints in sewers, shapes of sewers, maintenance, cleaning & ventilation of sewers. Sewer appurtenances.

UNIT-5

Quality and Quantity Perspectives of Sewage: Physical, chemical and biological characteristics of sewage, analysis of sewage, estimation of dry weather flow, estimation of storm water flow. Treatment of sewage: Preliminary & primary treatment of sewage: screening, grit removal basins, tanks for removal of oil and grease, sedimentation, sedimentation aided with coagulation. Secondary treatment of sewage: activated sludge process, sewage filtration, miscellaneous methods such as oxidation ditch, oxidation ponds, aerated lagoons, rotating biological contractors. Treatment and disposal of sludge, on-site disposal methods, advanced sewage treatment, treated effluent disposal & reuse.

Recommended Books & References:

1. Environmental Engineering, by Peavy, H.S, Rowe, D.R., and G. Tchobanoglous, McGraw Hill Inc., New York, 1985

2. Water supply Engineering – Environmental Engineering (Vol. I), by P.N. Modi, Standard Book House, 2006

3. Water supply Engineering – Environmental Engineering (Vol. 3), by S.K. Garg, Khanna Publishers, 1999

4. Sewage treatment & Disposal and waste water Engineering – Environmental Engineering (Vol. II) by P.N. Modi, Standard Book House, 2008

5. Sewage Disposal and Air Pollution Engineering – Environmental Engineering (Vol. II) by S.K. Garg, Khanna Publishers, 1999

Course Outcomes:

On completion of this course, the students will be able to

1. Serve the community by making people aware with the different pollution related problems.

2. Gain knowledge of the different processes of water treatment and would be able to assist

in the design of the water treatment plants.

3. Design a sewerage system for the town and would assist in the design of wastewater treatment plants.

4. Recognize the importance of management of solid waste and thus would assist in maintaining proper hygienic conditions.

6. **Help in the prevention of water borne disease thus improving the health conditions of the people.**

CIVB5041 Environmental Engineering Lab 0L:0T:2P 1 Credit

List of Experiments

1. Determination of pH.

2. Determination of Conductivity.

3. Determination of Acidity of water.

4. Determination of Alkalinity of Water.

5. Determination of Chlorides.

6. Determination of Hardness of water.

7. Determination of Fluorides.

8. Determination of Available Chlorine in bleaching powder.

9. Conducting Break Point Chlorination Test.

10. Determination of Residual Chlorine.

11. Determination of Dissolved Oxygen.

12. Determination of Chemical Oxygen Demand.

13. Determination of Biochemical Oxygen Demand.

14. Conducting Jar test for determining optimum dosage of coagulant.

15. Determination of Total Solids, Total Dissolved Solids & Settelable Solids.

SEMESTER VI

Course Code	Course Code	Course Name	L	T	P	IA	UE	Total Marks	Credits
DC	BTYB6010	**Bioanalytical tools**	3	-	-	30	70	100	3
DC	BTYB6020	**Genomics and proteomics**	3	-	-	30	70	100	3
DE	**	Animal biotechnology	3	-	-	30	70	100	3
OE	**	IPR ,Biosafety	3	-	-	30	70	100	3
DC	BTYB6030	**Bioanalytical tools lab**	3	-	-	30	70	100	3
DC	BTYB6011	**Genomics and proteomics lab**	-	-	2	30	70	100	1
DC	BTYB6021	Animal biotechnology lab	-	-	2	15	35	50	1
DC	BTYB6031	IPR ,Biosafety lab	-	-	2	15	35	50	1
		Total	**15**	**0**	**10**	**210**	**490**	**700**	**20**

BTEB6010	**BIOANALYTICAL TOOLS**	**4L:0T:0P**	**4 Credits**

1. Course learning objectives:

The objectives of this course are

- To develop the skills to understand the theory and practice of bio analytical techniques.
- To provide scientific understanding of analytical techniques and detail interpretation of results.

UNIT I Microscopy

Simple microscopy, phase contrast microscopy, florescence and electron microscopy (TEM and SEM), pH meter, absorption and emission spectroscopy

UNIT II Centrifugation (15 Lectures)

Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infrared), centrifugation, cell fractionation techniques, isolation of sub-cellular organelles and particles.

UNIT III Chromatography (15 Lectures)

Introduction to the principle of chromatography. Paper chromatography, thin layer chromatography, column chromatography: silica and gel filtration, affinity and ion exchange chromatography, gas chromatography, HPLC.

UNIT IV Electrophoresis (20 Lectures)

Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse field gel electrophoresis, immuno- electrophoresis, isoelectric focusing, Western blotting. Introduction to Biosensors and Nanotechnology and their applications.

Text /Reference Books:

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John
   Wiley& Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition.
   Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM
   Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 The World of the Cell.7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

3. Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Apprehend the functioning, maintenance and safety aspects of the basic apparatus used in a Biotechnology lab.
2. Assimilate the principles and applications of centrifuge, electrophoresis and chromatography in research and related experiments.
3. Employ the knowledge for the separation of proteins/peptides by selecting appropriate separation techniques.
4. Characterize certain functionalities of biomolecules by using spectroscopic techniques.

BTEB6011	**BIOANALYTICAL TOOLS LAB**	**0L:0T:4P**	**2 Credits**

LIST OF EXPERIMENTS:

1. Native gel electrophoresis of proteins
2. SDS-polyacrylamide slab gel electrophoresis of proteins under reducing conditions.
3. Preparation of the sub-cellular fractions of rat liver cells.
4. Preparation of protoplasts from leaves.
5. Separation of amino acids by paper chromatography.
6. To identify lipids in a given sample by TLC.
7. To verify the validity of Beer's law and determine the molar extinction coefficient of NADH.

BINB6020	GENOMICS AND PROTEOMICS	4L:0T:0P	4 Credits

1. Course learning objectives:

The objectives of this course are

1. The course is intended to provide thorough understanding of the genomics i.e. modern technologies in whole genome sequencing, genome mining, comparative genomics, global gene function technologies, protein structure & function technologies at the genome level, etc.
2. The course will explore that how technological innovations fostered by the Human Genome Project, will lead to significant advances in our understanding of diseases that have a genetic basis and, more importantly, how health care will be delivered from this point forward

2. Detailed Syllabus

Unit 1: Genomics (12 lectures)

1.1. Introduction to Genomics

1.2. DNA sequencing methods – manual & automated: Maxam & Gilbert and Sangers method. Pyrosequencing,

1.3. Genome Sequencing: Shotgun & Hierarchical (clone contig) methods,

1.4. Computer tools for sequencing projects: Genome sequence assembly software.

Unit 2: Genome data(12 lectures)

2.1.Managing and Distributing Genome Data: Web based servers

2.2. Softwares for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome.

2.3. Selected Model Organisms' Genomes and Databases.

Unit 3: protein structure (12 lectures)

3.1.Introduction to protein structure,

3.2. Chemical properties of proteins. Physical interactions that determine the property of proteins. Short-range interactions, electrostatic forces, van der waal interactions, hydrogen bonds, Hydrophobic interactions.

3.3. Determination of sizes (Sedimentation analysis, gel filteration, SDS-PAGE); Native PAGE,

3.4.Determination of covalent structures – Edman degradation.

Unit 4: Proteomics (12 lectures)

4.1. Introduction to Proteomics, Analysis of proteomes.

4.2. 2D-PAGE. Sample preparation, solubilization, reduction, resolution. Reproducibility of 2D-PAGE.

4.3. Mass spectrometry based methods for protein identification.

4.4. De novo sequencing using mass spectrometric data.

Unit 5. Molecular Markers (12 lectures)

5.1. Dominant and codominant markers,

5.2. Homoplasy concept, Identical by state Vs Identical by descent markers,

5.3. Hybridization based marker system – RFLP, PCR based marker systems – RAPD, AFLP, CAPS, SCAR, SSRs,

5.4.Microarray based SNP detection techniques, Applications of DNA markers

Text /Reference Books:

1. Genes IX by Benjamin Lewin, Johns and Bartlett Publisher, 2006.
2. Modern Biotechnology, 2nd Edition, S.B. Primrose, Blackwell Publishing, 1987.
3. Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition, B.R. Glick, J.J. Pasternak and C.L. Patten, 2010.
4. Molecular Cloning: A Laboratory Manual (3rd Edition) Sambrook and Russell Vol. I to III, 1989.
5. Principles of Gene Manipulation 6th Edition, S.B.Primrose, R.M.Twyman and R.W. Old. Blackwell Science, 2001.
6. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
7. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.
8. Russell, P. J. (2009). iGenetics- A Molecular Approach. III Edition. Benjamin Cummings.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Students will have a thorough understanding of various genomic technologies such as whole genome mapping & sequencing, genome annotation, global gene cloning and gene expression technologies, comparative genomics, introduction to pharmacogenomics
2. The students will know the vast amount of genome information in publically available databases and how to access and best utilize for practical purposes.
3. Able to analyze the gene expression data sets to derive the biologically meaning information Assessment
4. Able to apply the knowledge of function genomics in public health

BTEB4221	ANIMAL BIOTECHNOLOGY THEORY	2L:0T:0P	2 Credits

Course Objective:

1. To provides a toolkit in the form of a number of various techniques and processes developed over time to solve problems involving primarily human welfare with focus on health and medicine.
2. To Equips students with basic tools of biotechnology which are a must for everyone interested in pursuing a career in biotechnology.
3. To makes one aware of the scope of this field which encompasses almost every field of science like engineering, research, commercialization and academics

Detailed Syllabus:

Unit 1. Introduction

Concept and scope of biotechnology

Unit 2. Molecular Techniques in Gene manipulation

2.1.Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, M13, BAC, YAC, MAC and Expression vectors (characteristics).
2.2. Restriction enzymes: Nomenclature, detailed study of Type II.
2.3. Transformation techniques: Calcium chloride method and electroporation.
2.4. Construction of genomic and cDNA libraries and screening by colony and plaque hybridization
2.5. Southern, Northern and Western blotting DNA sequencing: Sanger method Polymerase Chain Reaction, DNA Finger Printing and DNA micro array

Unit 3. Genetically Modified Organisms

3.1. Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection
3.2. Applications of transgenic animals: Production of pharmaceuticals, production of donor organs, knock out mice.
3.3. Production of transgenic plants: Agrobacterium mediated transformation.
3.4. Applications of transgenic plants: insect and herbicide resistant plants.

Unit 4. Culture Techniques and Applications

4.1. Animal cell culture, Expressing cloned genes in mammalian cells,
4.2. Molecular diagnosis of genetic diseases (Cystic fibrosis, Sickle cell anemia)
4.3. Recombinant DNA in medicines: Recombinant insulin and human growth hormone, Gene therapy.

Unit 5 Transgenesis

5.1. Introduction to transgenesis.
5.2. Transgenic Animals – Mice, Cow, Pig, Sheep, Goat, Bird, Insect.
5.3. Animal diseases need help of Biotechnology – Foot-and mouth disease, Coccidiosis, Trypanosomiasis, Theileriosis.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. It gives insight into various cell/tissues culture techniques
2. Understanding of in vitro culturing of organisms and production of transgenic animals.
3. Understanding of cloning of mammals, large scale culture and production from recombinant microorganisms
4. Gains skills in medical, environmental biotechnology, biopesticides, Biotechnology of aquaculture and use of animals as bioreactors
5. This insight allows students to take into consideration about ethical issues involved in production transgenic animals and BT products.

Reference Books:

1. Brown, T.A. (1998). Molecular Biology Labfax II: Gene Cloning and DNA Analysis. II Edition, Academic Press, California, USA.
2. Glick, B.R. and Pasternak, J.J. (2009). Molecular Biotechnology - Principles and Applications of Recombinant DNA. IV Edition, ASM press, Washington, USA.

3. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An Introduction to Genetic Analysis. IX Edition. Freeman and Co., N.Y., USA.

Snustad, D.P. and Simmons, M.J. (2009). Principles of Genetics. V Edition, John Wiley and Sons Inc.

BINB5320	I.P.R. ENTREPRENEURSHIP BIOETIHCS& BIOSAFETY	4L:0T:0P	4 Credits

Course Learning Objective:

The objectives of this course are:

1. To provide an insight and understanding about different aspects of protection of inventions and research developments
2. Learn about procedures for filling protection through Intellectual Property Rights.
3. To provide scopes of protection of diverse intellectual properties and its commercialization forsocio-economic improvement.

Detailed Syllabus

Unit 1. Introduction (12 lectures)

1.1.Introduction to Indian Patent Law.

1.2.World Trade Organization and its related intellectual property provisions.

1.3.Intellectual/Industrial property and its legal protection in research, design anddevelopment.

1.4. Patenting in Biotechnology, economic, ethical and depository considerations.

Unit 2. Entrepreneurship (12 lectures)

2.1. Entrepreneurship: Selection of a product, line, design and development processes

2.2. economics on basic regulations of excise:

2.3. Demand for a given product, feasibility of its production under given constraints of raw material, energy input, financial situations export potential etc.

Unit 3 . Bioethics (12 lectures)

3.1. Bioethics – Necessity of Bioethics

3.2. Different paradigms of Bioethics – National & International.

3.3. Ethical issues against the molecular technologies.

Unit 4. Biosafety (12 lectures)

4.1. Biosafety– Introduction to biosafety and health hazards concerning biotechnology.

4.2. Introduction to the concept of containment level

4.3. Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. To enable students with basic concepts and knowledge of intellectual property rights.
2. To apply and execute different types of IP protection in research and academics.
3. Able to understand about the mechanisms of different IP protections, registrations and applications Technical
4. To be capable of tackling issues related to IP and its commercialization
5. To learn the strategies for effective IP management and commercialization Analytical skills

Reference Books:

1. Entrepreneurship: New Venture Creation : David H. Holt
2. Patterns of Entrepreneurship : Jack M. Kaplan

3. 3Entrepreneurship and Small Business Management: C.B. Gupta, S.S. Khanka, Sultan Chand & Sons.
4. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.
5. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international

BINB5321	**I.P.R. ENTREPRENEURSHIP BIOETIHCS& BIOSAFETY LAB**	**0L:0T:4P**	**2 Credits**

LIST OF EXPERIMENTS:

1. Proxy filing of Indian Product patent
2. Proxy filing of Indian Process patent
3. Planning of establishing a hypothetical biotechnology industry in India
4. A case study on clinical trials of drugs in India with emphasis on ethical issues.
5. Case study on women health ethics.
6. Case study on medical errors and negligence.
7. Case study on handling and disposal of radioactive waste

SEMESTER VII

Course Code	Course Code	Course Name	L	T	P	IA	UE	Total Marks	Credits
DC	BTYB7010	Concepts in Bioinformatics	2	1	-	30	70	100	3
DE	**	Agriculture Biotechnology	3	-	-	30	70	100	3
DE	**	Bioenergy and Biofuels	3	-	-	30	70	100	3
OE	**	Microbial Biotechnology	3	-	-	30	70	100	3
		Concepts in Bioinformatics lab	2	1	-	30	70	100	3
DC		Microbial Biotechnology lab	-	-	2	15	35	50	2
DC	BTYB7001	Project Stage-I	-	-	10	30	70	100	5
		Total	**14**	**2**	**10**	**210**	**490**	**600**	**22**

BINB3010	**CONCEPTS IN BIOINFORMATICS**	**4L:0T:0P**	**4 Credits**

1. Course learning objectives:

The objectives of this course are

1. List the concepts and applications of sequence searching

2. Define the concepts of homology, identity, orthologues, paralogues
3. Provide examples of basic sequence alignment, introducing concepts of point mutations, deletions, insertions etc.
4. Provide an outline of the different approaches to sequence alignment - exhaustive vs. heuristic

Detailed Syllabus:

Unit 1: Introduction (12 lectures)

1. Introduction, Sequence alignment
2. Scoring Matrix- PAM and BLOSUM
3. Gaps and Gap penalties
4. Different types of Gap weights and Application of Gaps.

Unit 2: Alignments (12 lectures)

2.1. Pairwise alignment: DotPlot analysis.
2.2. Dynamic programming- Needleman- Wunch Algorithm, Smith- Waterman algorithm, Edit distance dynamic program ming.
2.3. Clusrtal W, TCOFFEE, Profile methods- Gribskov profile, PSI_BLAST
2.4. Multiple segment alignment- sum of pairs, Divide and conquer, Progressive and Iterative alignment

Unit 3: Cluster detection (12 lectures)

3.1. Phylogenetic relationships, Clustering and Phylogeny
3.2. Phylogenetic analysis- concept of Phylogenetic tree, Methods of Phylogeny analysis- Diastance and character based methods.
3.3. Motif detection
3.4. Protein family databases.

Unit 4: Data Mining(12 lectures)

1. Data Mining- introduction and definition.
2. Data Mining problem and Data Mining Techniques, Tools and Methods.
3. Management of databases.
4. DBMS. Difference between DBMS and file system.

Unit 5 Metabolomics (12 lectures)

5.1. metabolic pathway database (KEGG pathway database)
5.2. Concept of Metablome and Metabolomics
5.3. Drug discovery and Design- target identification, target validation, lead identification, lead optimization, Priclinical Pharmacology and Toxicology.
5.4. Chemoinformatics tools for drug discovery- Chemical structure representation(SMILE & SMART), Chemical datatbases (CSD,ACD,WDI, PUBCHEM and Chembank)

Text /Reference Books:

1. Orpita basu & Sinninder kaur, Thakural ,"Bioinformatics databases tools, Alogrithm, 2007, Oxford University Press.
2. Higgins D, Willie Taylor " Bioinformatics, Sequence, Structure and data bank, A practical approach, 2000, First edition, Oxford University Press.
3. Allwood T, david Parry Smith; Introduction to bioinformatics, 2008, Pearson education, Singapore.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Extract and generate pairwise sequence alignments for a protein sequence of interest
2. Describe and interpret the metrics used to assess the quality of a pairwise sequence alignment, identity versus similarity
3. Describe the differences between homologues, paralogues and orthologues
4. Use a pairwise sequence approach to identify mutations between two sequences

BINB3011	**CONCEPTS IN BIOINFORMATICS LAB**	**0L:0T:4P**	**2 Credits**

LIST OF EXPERIMENTS:

1. To perform sequence alignemt using clustal W.
2. To study phylogenetic relationship using PHYLIP/MEGA.
3. To find motif using motif search.
4. To explore pathway database: KEGG database.

BTEB5310	**AGRICULTURE BIOTECHNOLOGY**	**4L:0T:0P**	**4 Credits**

Course Learning Objective:

The objectives of this course are:

1. To acquire knowledge about the range of approaches to manipulate and improve plants. Students will demonstrate the ability to develop, interpret, and critically evaluate modern approaches to scientific investigation in field of agriculture.
2. To provide information as how to develop and use biofertilizers in agriculture alongwith utilization of microbes as PGPR.

Detailed Syllabus

Unit1 Introduction to Agricultural biotechnology. 13 Hrs

Crop improvement hybridization and plant breeding techniques. Micropropagation and plant tissue culture technique and its application in agriculture. Somatic hybridization, haploid production and cryopreservation. Study of biopesticides used in agriculture (neem as example). integrated pest management.

Unit2 Mechanism of biological nitrogen fixation process.

study of NIF, NOD and HUP genes in nitrogen fixation process. Production of biofertilizers and applications of rhizobium, azotobacter, azolla and mycorrhiza. Use of plant growth regulators in agriculture and horticulture.

Unit 3 Green House technology

Green house Technology-- Types of green house, importance, functions and features of green house, Design criteria and calculation Construction material, covering material and its characteristics, growing media, green house irrigation system. Nutrient management Greenhouse heating, cooling and shedding and ventilation system, Computer controlled environment, Phytotrons, fertigation and roof system **,** Precision Cultivation- tools, sensors for information acquisition

Unit 4 Plant stress biology

Abiotic stress –Physiological and molecular responses of plants to water stress, salinity stress, temperature stress – heat and cold, Photooxidative stress, stress perception and stress signalling pathways, Ionic and osmotic homeostasis, reactive oxygen species scavenging,
Biotic stress - plant interaction with biology bacterial, viral and fungal pathogens, plant responses to pathogen–biochemical and molecular basis of host-plant resistance , toxins of fungi and bacteria , systemic and induced resistance –pathogen derived resistance, signaling

Unit 5 Molecular markers in Plant Breeding

Genetic markers in plant breeding—Classical markers DNA markers(RFLP, RAPD, AFLP, SSR, SNP) Applications of molecular markers to plant breeding [quantitative trait locus (QTL) mapping] Plant DNA Barcoding- BarcodingMarkers (matK, rbcl, ITS, tmH-psbA), steps, recent advances, Benefits, Limitations

Text Books/ Reference Books

COURSE OUTCOME

1. Acquire knowledge about the range of approaches to manipulate and improve plants, animals and microorganisms.
2. Demonstrate the ability to develop, interpret, and critically evaluate modern approaches to scientific investigation.
3. understand the relationship between society and science and the justification for biotechnological manipulation of plants, animals, and microorganisms.

BTEB5311	**AGRICULTURE BIOTECHNOLOGY Lab**	**0L:0T:4P**	**2 Credits**

LIST OF EXPERIMENTS:

1. RAPD analysis demonstration experiment
2. Isolation of Rhizobium
3. Isolation of Azotobacter
4. Isolation of Phosphate solubilising bacteria
5. Study of effect of abiotic stress on plants.
6. Rapid screening tests for abiotic stress tolerance (drought, - PEG, Mannitol &salinity NaCl)
7. Estimation of antioxidants and antioxidant enzymes - Ascorbate, Catalase, and Peroxidase
8. Visit to green house facility and submission of field visit report.

MCRB5310	**Microbial Biotechnology**	**4L:0T:0P**	**4 Credits**

Course Learning Objective:

The objectives of this course are:

1. To understand the role of microorganisms in the advent of biotechnology, both traditional as well as modern.

2. To become aware of the benefits and concerns of using microbe-based procedures/tools such as biosensors, biopesticides, bioplastics, bioleaching as well as genetically modified organisms.
3. To learn about Non-traditional vaccines and the promise they hold will be discussed.
4. To learn about IPR and its main components would empower the students to protect their innovative research work in the future, and yet be able to fruitfully share with the deserving fellow users.

Detailed Syllabus

Unit 1 Microbial Biotechnology and its Applications Lectures: 10

Microbial biotechnology: Scope and its applications in human therapeutics, agriculture (Biofertilizers, PGPR, Mycorrhizae), environmental, and food technology Use of prokaryotic and eukaryotic microorganisms in biotechnological applications Genetically engineered microbes for industrial application: Bacteria and yeast

Unit 2 Therapeutic and Industrial Biotechnology Lectures: 10

Recombinant microbial production processes in pharmaceutical industries - Streptokinase, recombinant vaccines (Hepatitis B vaccine) Microbial polysaccharides and polyesters, Microbial production of bio-pesticides, bioplastics Microbial biosensors

Unit 3 Applications of Microbes in Biotransformations Lectures: 8

Microbial based transformation of steroids and sterols Bio-catalytic processes and their industrial applications: Production of high fructose syrup and production of cocoa butter substitute

Unit 4 Microbial Products and their Recovery Lectures: 10

Microbial product purification: filtration, ion exchange & affinity chromatography techniques Immobilization methods and their application: Whole cell immobilization

Unit 5 Microbes for Bio-energy and Environment Lectures: 12

Bio-ethanol and bio-diesel production: commercial production from lignocellulosic waste and algal biomass, Biogas production: Methane and hydrogen production using microbial culture. Microorganisms in bioremediation: Degradation of xenobiotics, mineral recovery, removal of heavy metals from aqueous effluents

Text /Reference Books:

1. Ratledge, C and Kristiansen, B. (2001). Basic Biotechnology, 2nd Edition, Cambridge University Press.
2. Demain, A. L and Davies, J. E. (1999). Manual of Industrial Microbiology and Biotechnology, 2nd Edition, ASM Press.
3. Swartz, J. R. (2001). Advances in Escherichia coli production of therapeutic proteins. Current Opinion in Biotechnology, 12, 195–201.
4. Prescott, Harley and Klein's Microbiology by Willey JM, Sherwood LM, Woolverton CJ (2014), 9th edition, Mc Graw Hill Publishers.
5. Gupta PK (2009) Elements of Biotechnology 2nd edition, Rastogi Publications,
6. Glazer AN and Nikaido H (2007) Microbial Biotechnology, 2nd edition, Cambridge University Press
7. Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4th edition, ASM Press,
8. Stanbury PF, Whitaker A, Hall SJ (1995) Principles of Fermentation Technology 2nd edition., Elsevier Science

9. Crueger W, Crueger A (1990) Biotechnology: A text Book of Industrial Microbiology 2nd edition Sinauer associates, Inc.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Will get an overview of the possibility of using microbes in a number of technologies and fields for the direct/indirect benefit of mankind and the environment.
2. Will get familiarized with how manipulated producer microbes and/or procedures may yield products of medical/therapeutic value, hence contributing to human longevity.
3. Will learn how microorganisms are the mightiest candidates in fighting environmental pollution and minimizing xenobiotics, thereby elevating human living conditions. Biosensors and whole cell/enzyme immobilization would be appealing illustrations to the students as some of the strategies towards this goal.
4. Will delve deep into the role of microorganisms in maintaining environmental homeostasis, combating pollution, eliminating xenobiotics and inexpensive energy production from waste natural lignocellulosics.
5. Will become familiar with the contribution of specific microorganisms in traditional agriculture practices, and will become acquainted with GM crops, RNA interference and edible vaccines.

MCRB5311	**Microbial Biotechnology lab**	**0L:0T:4P**	**2 Credits**

LIST OF EXPERIMENTS:

1. Study yeast cell immobilization in calcium alginate gels
2. Study enzyme immobilization by sodium alginate method
3. Pigment production from fungi (Trichoderma / Aspergillus / Penicillium)
4. Isolation of xylanase or lipase producing bacteria
5. Study of algal Single Cell Proteins

BTEB6320	**Bioenergy And Biofuels**	**5L:1T:0P**	**4 Credits**

Course Learning Objective:

The objectives of this course are:

1. Introduction of existing and possible Bioenergy and Biofuels technoloies
2. Discussion of technical, process and economic issues related to first, second and third generation biofuels along with Physico chemical techniques

Detailed Syllabus

Unit 1 Introduction to Biofuels and Bioenergy

1.1 Definition, Global Energy Outlook, Sustainability, Biomass Feedstocks, Processes and 1.2. Technologies, Environment and Ecology

Unit 2 Ethanol from Corn and Lignocellulosics:

2.1. Fuel Ethanol from Corn, Corn Ethanol as Oxygenated Fuel,

2.2. Chemistry of Ethanol Fermentation, Corn-to-Ethanol Process Technology, By-Products/Coproducts of Corn Ethanol, Ethanol as Oxygenated and Renewable Fuel, Ethanol Vehicles,

2.3. Lignocellulose and Its Utilization, Lignocellulose Conversion, Agricultural Lignocellulosic Feedstock, Cellulosic

2.4. Ethanol Technology; Energy Balance for Ethanol Production from Biomass, Process Economics and Strategic Direction.

Unit 3 Fast Pyrolysis and Gasification of Biomass:

3.1. Biomass and Its Utilization, Analysis and Composition of Biomass,

3.2. Chemistry of Biomass Gasification, Fast Pyrolysis of Biomass, Biomass Gasification Processes, 3.3. Utilization of Biomass Synthesis Gas

Unit 4 Conversion of Waste to Biofuels, Bioproducts, and Bioenergy & Mixed Feedstock:

4.1.Types of Waste and Their Distributions, Strategies for Waste Management, Waste Preparation and Pretreatment for Conversion, Technologies for Conversion of 4.2. Waste to Energy and Products, Economic and Environmental Issues Related to Waste Conversion, Future of the Waste Industry, Advantages and Disadvantages of Mixed Feedstock, Transportation, Storage, and Pretreatment,

4.3. Gasification Technologies, Liquefaction Technologies, Future of Mixed Feedstock.

Unit 5 Biomass sources:

5.1. Waste sources, liquid, solid, Agrobased sources, Energy scenarios,Biogas technology-biogas plant & types, biodigester.

5.2. Biogas- composition, production and factors affecting production, uses

5.3. Biofuels – ethanol production. Microbial hydrogen production Biodiesel, Case studies on Biogas and biofuels, Advanced biofuels

Course Outcomes:

At the end of this course students will demonstrate the ability to:

- Advantages and disadvantages of Bioenergy and Biofuels over fossil fuels
- Technical barriers in Bioenergy and Biofuel Technology
- Whole biorefinery approaches for economical implementation into the market
- Conversion technologies of waste to Biofuels, Bioproducts, and Bioenergy
- Conversion of waste and Mixed feedstock to Biofuels, Bioenergy and Bioproducts.

Reference Books:

1. Biofuels and Bioenergy: Processes and Technologies by Sunggyu Lee and Y. T. Shah, CRC Press
2. Bioenergy and Biofuel from Biowastes and Biomass by Samir K. Khanal, Rao Y. Surampalli, Tian C.Zhang, Buddhi P. Lamsal, R. D. Tyagi and C.M. Kao, ASCE Publishers .
3. Review and research articles from Science Direct, Springer, Wiley and PubMed Publishers

SEMESTER VIII

Course Code	Course Code	Course Name	L	T	P	IA	UE	Total Marks	Credits
DC	BTYB8010	Nanobiotechnology	3	-	-	30	70	100	3
DE	BTYB8020	Genome editing	3	-	-	30	70	100	3
DE	BTYB8030	Bioterrorism	3	-	-	30	70	100	3
OE	**	Nanobiotechnology lab	3	-	-	30	70	100	3
DC	BTYB8015	Seminar- I	-	-	2	30	70	100	1

DC	BTYB8023	Project Stage-II			18	30	70	100	9
		Total	**12**	**-**	**20**	**180**	**420**	**600**	**22**

BTYB8030	**BIOTERRORISM & NATIONAL SECURITY**	**4L:0T:0P**	**4Credits**

Course Objective(s):

1. Familiarization of issues involved and threats facing society due to bioterrorism and approaches to tackle it effectively.

Course Content:

Unit 1 Terrorism and Bioterrorism Definition-Traditional Terrorists-New Terrorists-Nuclear, chemical, and radiological weapons-The psychology of Bioterrorism-Historical perspective.

Unit 2 Microbes and Immune System Primary classes of Microbes-bacteria, virus, and other Agents-Immune systemInteraction between microbes and the immune system.

Unit 3 Bioterrorism Weapons and Techniques Characteristics of microbes and the reasons for their Use-Symptoms-PathogenicityEpidemiology-natural and targeted release-The biological, techniques of dispersal, and case studies of Anthrax, Plague-Botulism, Smallpox, and Tularemia and VHF.

Unit 4 Prevention and Control of Bioterrorism Surveillance and detection- Detection equipment and sensors –Diagnosis-TreatmentVaccinations-Supplies- Effectiveness-Liability-Public Resistance-Response-First Responders-Infectious Control-Hospital-Prevention-Protection-DecontaminationNotification-Role of Law Enforcement-Economic impact.

Unit 5 Bioterrorism Management Ethical issues: personal, national, the need to inform the public without creating fear, cost-benefit Rations-Information Management-Government control and industry Support-Microbial forensics.

Text Books:

2. Bioterrorism: Guidelines for Medical and Public Health Management, Henderson, Donald, American Medical Association, 1st Edition, 2002.
3. Biological Weapons: Limiting the Threat (BCSIA Studies in International Security), Lederberg, Joshua (Editor), MIT Press ,1999.

4. Bioterrorism and Infectious Agents: A New Dilemma for the 21st Century (Emerging Infectious Diseases of the 21st Century), I.W. Fong and Kenneth Alibek, Springer, 2005.
5. The Demon in the Freezer: A True Story, Preston, Richard, Fawcett Books, 2003.
6. The Anthrax Letters: A Medical Detective Story, Cole, Leonard A., Joseph Henry Press, 2003.
7. Biotechnology research in an age of terrorism: confronting the dual use dilemma, National Academies of Science, 2003.
8. http://www.centerforhealthsecurity.org/our-work/pubs_archive/pubspdfs/2012/sloan_book/Preparing%20for%20Bioterrorism_Gigi%20Kwik%20Gron vall_December%202012.pdf

Course Outcomes:

1. Exposure to threats for national security, methods to tackle them and support law enforcement & health agencies to handle th

BTYB8020	**GENOME EDITING**	**4L:0T:0P**	**4Credits**

Course Objective(s):

2. To provide the technical details and applications of modern tools for precision gene targeting and editing.
3. To provide information about targeted gene silencing.

Course Content:

Unit 1 Overview of traditional methods: homologues recombination for gene knockout. RNAi system, Cre-LoxP and Flp-FRT systems.

Unit 2 Engineered enzyme systems: Zinc finger nucleases (ZFNs), transcription-activator like effector nucleases (TALEN), meganucleases and the clustered regularly interspaced short palindromic repeats (CRISPR/Cas9) system. Design of sgRNA.

Unit 3 Multiplex Automated Genomic Engineering (MAGE). Applications in Targeted gene mutation, Gene therapy, creating chromosome rearrangement, Study gene function with stem cells,

Unit 4 Transgenic animals, Endogenous gene labeling, targeted transgene addition, GM plants, application is biofuel production and in bioremediation. Ethics, safety and risk of targeted gene editing.

Text Books/References:

1. CRISPR Gene Editing, Methods and Protocols, Editors: Luo, Yonglun (Ed.)
2. Genome Editing and Engineering, From TALENs, ZFNs and CRISPRs to Molecular Surgery. Edited by Krishnarao Appasani.

3. Progress in Molecular Biology and Translational Science Vol 149-Genome Editing in Plants. Edited by Donald P. Weeks and Bing Yang. Academic Press.
4. Precision Medicine, CRISPR, and Genome Engineering, Moving from Association to Biology and Therapeutics, Editors: Tsang, Stephen H. (Ed.). Springer.

Course Outcomes: At the end of this course, the students will

1. learn and systematically analyze technical details of precise gene-editing tools.
2. appreciate the vast applications of gene editing in the field of medicine, agriculture, and the environment.
3. learn the risk, safety, and ethics of gene editing tools

BTYB8010	**NANOBIOTECHNOLOGY**	**4L:0T:0P**	**4Credits**

Course Learning Objective:

The objectives of this course are:

1. Introduction to Nanomaterial and various material used for obtaining nano-materials
2. Learn various approaches or methods used for nanomaterial synthesis.
3. To learn various analytical techniques used for nanomaterial characterization.
4. Learn various applications of nanomaterial in health care, agriculture and environmental monitoring

Detailed Syllabus

Unit 1 Introduction, History &Applications:

1.1. Various definitions and Concept of Nano-biotechnology & Historical background. Fundamental sciences and broad areas of Nano-biotechnology.

1.2.Va rious applications of Nanobiotechnology, Cell – Nanostructure interactions

Unit 2 Synthetic methodologies:

2.1. Introduction to the two approaches (bottom up and top down) followed for the synthesis of nanomaterials:

2.2. Lithography method, Electrochemical method, Mechanical Method, Chemical Synthesis, Chemical vapour deposition, Molecular self-assembly, Laser Induced assembly.

Unit 3 Techniques used for the characterization of nanoparticles:

3.1. Principles of microscopy-light, electron, fluorescent confocal, scanning and transmission microscopes, different fixation and staining techniques for EM.

3.2. Principles of spectroscopy-UV, visible, CD, FTIR, NMR, and ESR spectroscopy, structure determination using X-ray diffraction, analysis using light scattering

Unit 4 Nano-biotechnologicalapplications in health and disease:

4.1. Properties of different types of nanoparticles normally used in health and disease. Diagnostics and theranostics application of nanomaterials in health Sciences

Unit 5 Nanobiotechnological applications in Environment and food - detection and mitigation:

5.1. Properties of different types of nanoparticles normally used in environmental and food sciences. 5.2 Detection and removal of toxic metal ion from polluted sample and detection and removal of pathogen form food sample.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Introduction to Nano (Basics to Nanoscience and Nanotechnology)
2. Introduction to the two approaches (bottom up and top down) followed for the synthesis of nanomaterial and fundamental properties of Nano-materials(Nano-effect)
3. Introduction to various technique used for the characterization of nanostructures and nanomaterial.
4. Fundamental understanding of nanomaterial/nanobiotechnological application in health and disease.
5. Fundamental understanding of nanomaterial/nanobiotechnological application in Environment and food – detection and mitigation

Reference Books:

1. C. A. Mirkin and C. M. Niemeyer. Nanobiotechnology - II more concepts and applications. (2007) - Wiley VCH.
2. P. Boisseau, P. Houdy, M. Lahmani, Nanoscience: Nanobiotechnology and Nanobiology

BTEB6331	**NANOBIOTECHNOLOGY LAB**	**0L:0T:4P**	**2 Credits**

LIST OF EXPERIMENTS:

1. Synthesis of Al2O3 nanoparticles using Sol Gel method.
2. Synthesis of semiconductor (ZnS, CdS etc.) nanoparticles by Chemical method
3. Synthesis of nanoparticles using Biological process
4. Detection of nanoparticles in colloidal solutions using UV-Vis absorption technique.
5. Analysis of AFM, SEM and TEM pictures.

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