Amity Institute of Biotechnology

Bachelor of Technology – Biotechnology

FLEXILEARN

-Freedom to design your degree

Programme Structure
Curriculum & Scheme of Examination
2019-20

AMITY UNIVERSITY CHHATTISGARH
RAIPUR

Credit Summary Sheet

Semester	CC	PE	CoC	Total
1	20	-	4	24
2	22	-	4	26
3	20	2	4	26
4	21	-	5	26
5	19	4	3	24
6	21	3	2	24
7	14	8	-	22
8	16	-	-	16
Total	153	17	22	188

Note:- CC - Core Course, PE – Professional Elective-I, CoC – Complementary Course

FIRST SEMESTER

Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Total Credits
Core Courses					**20**
EBT2101/02	Elementary Mathematics – I/ Remedial Biology - I	3	1		4
EBT2103	Applied Physics - I	3	0		3
EBT2104	Basic Concepts in Biotechnology	3	0		3
EBT2105	Introduction to Computers & Programming in C	3	1		4
EBT2106	Basic Electrical Engineering	3	0		3
EBT2107	Applied Physics- I Lab	-	-	2	1
EBT2108	Programming in C Lab			2	1
EBT2109	Basic Electrical Engineering Lab			2	1
Complementary Courses-I					**4**
CSS2101	Developing English Language Skills-I	1	-	-	1
BEH 2151	Understanding Self For Effectiveness	1	-	-	1
LAN2101	Introduction to French as a Foreign Language	2	-	-	2
	TOTAL				**24**

SECOND SEMESTER

Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Total Credits
Core Courses					**22**
EBT2201/02	Elementary Mathematics – II/ Remedial Biology – II	3	1	-	4
EBT2203	Applied Physics-II	3	1	-	4
EBT2204	Object Oriented Programming in C++	3	1	-	4
EBT2205	Applied Chemistry	3	0	-	3
ENV2252	Environmental Studies	4	-	-	4
EBT2206	Applied Physics- II Lab			2	1
EBT2207	Object Oriented Programming in C++ Lab			2	1
EBT2208	Applied Chemistry Lab			2	1
Complementary Courses-II					**4**
CSS2201	Developing English Language Skills-II	1	-	-	1
BEH 2261	Personal and Workplace Excellence	1	-	-	1
LAN2201	French Basic Grammar & Comprehension	2	-	-	2
	TOTAL				**26**

THIRD SEMESTER

Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Total Credits
Core Courses					**20**
EBT2301	Biochemistry	3	1	-	4
EBT2302	Microbiology	3	0		3
EBT2303	Fluid Mechanics for Biotechnology	3	1		4
EBT2304	Database Management System	3	0		3
EBT2305	Bioanalytical Techniques	3	0	-	3
EBT2306	Biochemistry Lab			2	1
EBT2307	Microbiology Lab			2	1
EBT2308	Bioanalytical Techniques Lab			2	1
Professional Electives-I					**2**
EBT2309	Presentation on Innovative Idea & Evaluation	-	-	-	2
EBT2310	MOOCs Certificate /Workshop/ Certificate (Discipline Specific)	-	-	-	2
EBT2311	Thermodymics for Biological System	2	-	-	2
EBT2312	Natural Products from	2	-	-	2

	Medicinal Plants				
Complementary Courses-III					**4**
CSS2301	Fundamentals of Communication	1	-	-	1
BEH2361	Human Values and Ethics	1	-	-	1
LAN2301	French Written Expression	2	-	-	2
	TOTAL				**26**

FOURTH SEMESTER

Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Total Credits
Core Courses					**21**
EBT2401	Genetics and Cell Biology	3	1	-	4
EBT2402	Biostatistics	3	-		3
EBT2403	Enzyme Technology	3	1	-	4
EBT2404	Heat and Mass Transfer	3	1		4
EBT2405	Environmental Biotechnology	3	-	-	3
EBT2406	Genetics and Cell Biology Lab			2	1
EBT2407	Enzyme Technology Lab			2	1
EBT2408	Environmental Biotechnology Lab	-	-	2	1
Complementary Courses-IV					**5**
CSS2401	Technical Writing & Professional Ethics	1	-	-	1
CRC2401	Entrepreneurship	2	-	-	2
LAN2401	Communicative French	2	-		2
	TOTAL				**26**

SUMMER INTERNSHIP-I (6 - 8 Weeks)

FIFTH SEMESTER

Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Total Credits
Core Courses					**17**
EBT2501	Molecular Biology	3	0	-	3
EBT2502	Immunology	3	0	-	3
EBT2503	Bioprocess Technology	3	0	-	3
EBT2504	Bioinformatics	3	0	-	3
EBT2505	Molecular Biology Lab			2	1
EBT2506	Immunology Lab			2	1

EBT2507	Bioprocess Technology Lab			2	1
EBT2508	Bioinformatics Lab	-	-	2	1
EBT2535	Summer Internship I	-	-	-	1
Professional Elective-II					**4**
EBT2509	Applied Bioenergy	3	1	-	4
EBT2510	Biosafety, Bioethics & IPR	3	1	-	4
EBT2511	Applied Clinical Research	3	1	-	4
Complementary Courses-V					**3**
CSS2501	Developing soft skills and personality	1	-	-	1
LAN2501	French Advance Grammar & Comprehensive	2	-	-	2
	TOTAL				**24**

SIXTH SEMESTER

Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Total Credits
Core Courses					**19**
EBT2601	Recombinant DNA Technology	3	0	-	3
EBT2602	Fermentation Technology	3	0	-	3
EBT2603	Plant Biotechnology	3	0	-	3
EBT2604	Nano Biotechnology	3	0	-	3
EBT2605	Recombinant DNA Technology Lab	-	-	2	1
EBT2606	Fermentation Technology Lab	-	-	2	1
EBT2607	Plant Biotechnology Lab	-	-	2	1
EBT2608	Minor Project	-	-	-	4
Professional Elective-III					**3**
EBT2609	Medical Biotechnology	3	-	-	3
EBT2610	Metabolic Engineering	3	-	-	3
EBT2611	Agriculture Biotechnology	3	-	-	3
Complementary Courses-VI					**2**
EBT2612	Aptitude and Reasoning Ability	-	2	-	2
EBT2613	Skill, Training & Placement	-	2	-	2

	Total				**24**

SUMMER INTERNSHIP-II (6 – 8 Weeks)

SEVENTH SEMESTER

Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Total Credits
Core Courses					**16**
EBT2701	Food Biotechnology	3	-	-	3
EBT2702	Animal Biotechnology	3	-	-	3
EBT2703	Genomics & Proteomics	3	-	-	3
EBT2704	Food Biotechnology Lab	-	-	4	2
EBT2735	Summer Internship II	-	-	-	2
EBT2736	MOOCs Certification Course	-	-	-	3
Professional Elective-IV					**3**
EBT2705	Drug Design & Development	3	-	-	3
EBT2706	QA & QC in Biotechnology	3	-	-	3
EBT2707	Molecular Markers & Diagnostics	3	-	-	3
Professional Elective-V					**3**
EBT2708	Biomaterials	3	-	-	3
EBT2709	Bioprocess Plant Designing	3	-	-	3
EBT2710	Stem cell Technology	3	-	-	3
	TOTAL				**22**

EIGHTH SEMESTER

Course Code	Course Title	Lecture (L) Hours Per week	Tutorial (T) Hours Per week	Practical (P) Hours Per week	Total Credits
Core Course					**16**
EBT2801	Dissertation (Industries/Academics/ R&D organizations)	-	-	-	16
	TOTAL				**16**

Syllabus – First Semester

ELEMENTARY METHEMATICS-I

Course Code: EBT2101 **Credit Units: 04**

Course Objective:
The knowledge of Mathematics is necessary for a better understanding of almost all the Engineering and Science subjects. Here our intention is to make the students acquainted with the concept of basic topics from Mathematics, which they need to pursue their Engineering degree in different disciplines.

Course Contents:
Module I: Differential Calculus
Derivative of a function, Derivatives at a point, Fundamental rules for differentiation: Product Rule, Quotient Rule and Chain Rule, Differentiation of Implicit Functions, Parametric forms and Logarithmic Differentiation, Successive differentiation, Leibnitz's theorem (without proof), Mean value theorem, Taylor's and Maclaurin's Theorem,
Asymptote & Curvature, Partial Differentiation, Euler's Theorem, Maxima and Minima

Module II: Integral Calculus
Fundamental Integral Formulae, Methods of Integration: Integration by Substitution, By Parts, Partial Fractions, Definite Integral and its Properties, Reduction Formulae, Application to length, Area and Volume.

Module III: Ordinary Differential Equations
Definition of Order and Degree of differential equation, Formation of ODEs, Solution of Differential Equation of 1stOrder and 1st Degree: Variable Separation, Homogeneous Differential Equations, Linear Differential Equations, Exact Differential Equations, General Linear ODE of Second Order, Solution of Homogeneous Equation, Solution of Simple Simultaneous ODE

Module IV: Coordinate Geometry

Straight Lines: Introduction, Slope of a line and angle between two lines. Various forms of equations of a line: parallel to axes, point-slope form, slope-intercept form, two point form, intercepts form and normal form. General equation of a line. Distance of a point from a line, with numerical examples.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text & References:

- Differential Calculus by Shanti Narain
- Integral Calculus by Shanti Narain
- Differential Equation by A.R.Forsyth
- Higher Engineering Mathematics by H.K. Dass

REMEDIAL BIOLOGY-I

Course Code: EBT2102 **Credit Units: 04**

Unit-I:
The cell theory, structure of prokaryotic and eukaryotic cells, Structure and function of cell membrane, cell organelles. Microscopy, Macro and micro molecules, Basic chemical constituents of living body.

Unit-II:
Morphology, anatomy and functions of different parts of plants:
Root, stem, leaf, inflorescence, flower, fruit and seed, Concepts of botanical garden, herbaria, zoological park and museums.

Unit-III:
Classification of living organisms (Five kingdom classification, major groups and principles of classification in each kingdom), Systematic and binomial system of nomenclature.

Unit-IV:
Concepts of genes and its structure**,** Mendelian genetics, Cell cycle (Elementary Idea), mitosis and meiosis.

Unit-V:
Plant Physiology: Concepts of diffusion, osmosis, imbibitions, Movement of water, food, nutrients and gases, Photosynthesis, plant growth and development.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Recommended Text Book:
1. Biology-Textbook of Class XI, NCERT Publication
2. Biology-Textbook of Class XII, NCERT Publication

Reference Book:
1. Biology by Peter H Raven, George b Johnson, Kenneth A., Mason, Jonathan Losos, Susan Singer (MacGraw Hill Publication)

APPLIED PHYSICS - I

Course Code: EBT2103 **Credit Units: 03**

Course Objective
Aim of this course is to introduce the students to fundamentals of graduate level physics, which form the basis of all applied science and engineering with a focus on biotechnology applications.

Course Outcomes
At the end of the course, the students will be able to correlate between the various facets of interrelationship between matter and energy and develop insights to the basics of Physics which would find implications in analytical as well as molecular processes dealt in biotechnology

Course Contents

Module I: Band Theory of Solids & its bonding

Sommerfeld's free electron theory of metals, Fermi energy, introduction to periodic potential, types of bonding in solids, Estimation of cohesive energy, Madelung constant, Bloch theorem-Kronig-Penney model (qualitative treatment)-Origin of energy band formation in solids - Classification of materials into conductors, semi conductors & insulators-Concept of effective mass of an electron.

Module II: Crystal Structures & X-Ray Diffraction

Introduction, Space lattice, Basis, Unit cell, Lattice parameter, Bravais lattices, Crystal systems, Structure and packing fractions of Simple cubic, Body centered cubic, Face centered cubic crystals, Directions and planes in crystals, Miller indices, Separation between successive [h k l] planes, Diffraction of X-rays by crystal planes, Bragg's law, Laue method, Powder method.

Module III: Dielectric & Magnetic Properties

Introduction, Dielectric constant, Electronic, ionic and orientational polarizations, Internal fields in solids, Clausius, Mossotti equation, Dielectrics in alternating fields, Frequency dependence of the polarizability, Ferro and Piezo electricity, Permeability, Magnetization, Origin of magnetic moment, Classification of magnetic materials, Dia, para and ferron magnetism, Hysteresis curve, Soft and hard magnetic materials.

Module IV: Electron Theory of Metals

Classical free electron theory, Mean free path, Relaxation time and drift velocity, Quantum free electron theory, Fermi, Dirac distribution (analytical) and its dependence on temperature, Fermi energy, Electron scattering and resistance.

Module V: Science & Technology of Nanomaterials

Introduction to Nano materials, Basic principles of Nanoscience & Technology, Fabrication of nano materials, Physical & chemical properties of nanomaterials, Carbon nanotubes, Applications of nanotechnology.

Examination Scheme:

Components	A	CT	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	5	15	10	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

Text book:

1. Introduction to Solid Satate Physics by Charles Kittel Physics – David Halliday, Robert Resnick, Kenneth S Krane, Vol. 1, 5th (e), Willey Student Edition, 2002.
2. Physics – David Halliday, Robert Resnick, Kenneth S Krane, Vol. 2, 5th (e), Willey Student Edition, 2002.
3. Nano: The Essentials – Understanding Nanoscience and nanotechnology by T Pradeep
4. Nanomaterials by A K Bandyopadhyay
5. Introduction to Biophysics by Pranab Kumar Banerjee 10. Introduction to Nanotechnology by Frank Owens Charles Poole

Reference Books:

1. College Physics – Raymond A Serway, Jerry S. Faughn, Chris Vuille, Charles A Bennett, Vol. 1, Thomson Brooks/Cole, 2006.
2. College Physics – Raymond A Serway, Jerry S. Faughn, Chris Vuille, Charles A Bennett, Vol. 2, Thomson Brooks/Cole, 2006.
3. The Feynman Lectures on Physics, Richard P Feynman, Robert B Leighton, Matthew Sands, Vol. 1, Narosa Publishing House, First Reprint, 1986.

BASIC CONCEPTS IN BIOTECHNOLOGY

Course Code: EBT2104 **Credit Units: 03**

Unit-I: Genetics and Molecular Biology
Molecular Basis of life: DNA and RNA. Central Dogma of Life. DNA Structure and Function, Base pairing in DNA Replication. The genetic code, RNA Structure and Function, Protein Synthesis.

Unit-II: Biochemical Engineering
How enzymes work, Michaelis Menten equation, how cells grow, kinetics of growth, batch culture, continuous culture, basic fermentation process – Solid state and submerged state. Concept of Stoichiometry, elemental balance and yield.

Unit-III: Environmental Biotechnology
Air, Soil and Water pollution, Bioremediation, Xenobiotics, Solid waste management, Biosensors, biofilms, Biofuels.

Unit-IV: Industrial Biotechnology
Primary and secondary metabolites, production of industrially important metabolites, Scaleup, Sterilization, Beer production, Single cell protein.

Unit-V: Bioinformatics
Introduction, Biological databases, types of databases, Sequence alignment and tools, Prediction of evolutionary relationships, principle of computational drug designing.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text Books:

1. Introduction to Biotechnology, William J. Thieman and Michael A. Palladino, 3rd Edition, Pearson.
2. Biotechnology, U. Satyanarayana and U. Chakrapani, Books and Allied Limited
3. **"Basic Biotechnology",** Colin Ratledge, Bjorn Kristiansen, Cambridge University Press

INTRODUCTION TO COMPUTERS & PROGRAMMING IN C

Course Code: EBT2105 **Credit Units: 04**

Course Objective:

The objective of this course module is to acquaint the students with the basics of computers system, its components, data representation inside computer and to get them familiar with various important features of procedure oriented programming language i.e. C.

Course Contents:

Module I: Introduction
Introduction to computer, history, Von-Neumann architecture, memory system (hierarchy, characteristics and types), H/W concepts (I/O Devices), S/W concepts (System S/W & Application
S/W, utilities). Data Representation: Number systems and their interconversions. Binary arithmetic, floating point arithmetic, Signed and Unsigned numbers, Memory storage unit.

Module II: Programming in C
Introduction to Algorithms, Complexities and Flowchart, Introduction to Programming, Categories of Programming Languages, Program Design, Programming Paradigms, History of C, Introduction of C, Basic structure of C program, Concept of variables, constants and data types in C, Operators and expressions: Introduction, arithmetic, relational, Logical, Assignment, Increment and decrement operator, Conditional, bitwise operators, ternary operator, Expressions, Operator precedence and associativity. Managing Input and output Operation, formatting I/O.

Module III: Fundamental Features in C
C Statements, conditional executing using if, else, nesting of if, switch and break Concepts of loops,
example of loops in C using for, while and do-while, continue and break. Storage types (automatic,
register etc.), predefined processor, Command Line Argument.

Module IV: Arrays and Functions
One dimensional arrays and example of iterative programs using arrays, 2-D arrays Use in matrix
computations, Concept of Sub-programming, functions Example of user defined functions. Function prototype, Return values and their types, calling function, function argument, function with variable number of argument, recursion.

Module V: Advanced features in C
Pointers, relationship between arrays and pointers Argument passing using pointers, Array of pointers.
Passing arrays as arguments, Strings and C string library, Enumerated, Structure and Union. Defining C structures, Giving values to members, Array of structure, Nested structure, passing strings as arguments, typedef, File Handling, Input and output concept of a file, text files and binary files, Formatted I/O, file I/O operations, example programs.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination;
Att: Attendance

Text & References:

Text:

- "ANSI C" by E Balagurusamy
- Yashwant Kanetkar, "Let us C", BPB Publications, 2nd Edition, 2001.
- Herbert Schildt, "C: The complete reference", Osbourne Mcgraw Hill, 4th Edition, 2002.
- V. Raja Raman, "Computer Programming in C", Prentice Hall of India, 1995.

References:

- Kernighan & Ritchie, "C Programming Language", The (Ansi C Version), PHI, 2nd Edition.
- J. B Dixit, "Fundamentals of Computers and Programming in „C".
- P.K. Sinha and Priti Sinha, "Computer Fundamentals", BPB publication.

BASIC ELECTRICAL ENGINEERING

Course Code: EBT2106 **Credit Units: 03**

Course Objective:

The objective of the course is to provide a brief knowledge of Electrical Engineering to students of all disciplines. This Course includes some theorems related to electrical, some law‟s related to flow of current, voltages, basic knowledge of Transformer, basic knowledge of electromagnetism, basic knowledge of electrical network.

Course Contents:

Module I: Electrical Quantities

Definitions: Force, Energy, Power, Charge, Current, Voltage, Electric Field Strength, Magnetic Flux Density, Magnetic Flux, Electrical Power and Energy. Circuit Components: Resistance, Inductance and Capacitance. Energy Sources: Ideal Source, Independent Source and Controlled Source.

Module II: Network Analysis Techniques

Circuit Principles: Ohm‟s Law, Kirchoff‟s Current Law, Kirchoff‟s Voltage Law Network Reduction:
Star–Delta Transformation, Source Transformation, Nodal Analysis, Loop analysis.

Module III: Alternating Current Circuits

Peak, Average and RMS values for alternating currents, Power calculation: reactive power, active power, Complex power, power factor, impedance, reactance, conductance, susceptance Resonance: series Resonance, parallel resonance, basic definition of Q factor & Band-width.

Module IV: Network Theorems & Electromagnetism

Superposition theorem, Thevenin‟s Theorem, Norton‟s theorem and Reciprocity theorem. Magnetic Induction: Faraday‟s law, Lenz‟s law, Hysteresis, magnetic Circuits, Excitation of magnetic circuits, Energy stored in magnetic circuits

Module V: Transformers

Transformer Operation: Construction, Voltage relations, Exciting current, current relations, Linear circuit models, Transformer as two port network, open circuit test, short circuit test, Transformer performance: Efficiency and voltage regulation.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text:

- R.J. Smith, R.C. Dorf: Circuits, devices and Systems
- B.L. Thareja: Electrical Technology: Part -1 & 2

References:

- V.Deltoro: Electrical Engineering fundamentals
- Schaum‟s Series: Electrical Circuits

APPLIED PHYSICS – I LAB

Course Code: EBT2107 **Credit Units: 01**

1. To determine the wavelength of sodium light by Newton's rings method.
2. To determine the dispersive power of the material of prism with the help of a spectrometer.
3. To determine the specific rotation of sugar by Bi-quartz or Laurent half shade polarimeter.
4. To determine the wavelength of laser using diffraction grating.
5. To determine the energy band-gap of Germanium crystal using four probes method.
6. To draw V – I characteristics of a photocell
7. To study the characteristics of photo voltaic cell (solar cell).
8. To determine the wavelengths of Yellow I and Yellow II lines of a sodium spectra using diffraction grating
9. To draw the V – I characteristics of a forward and reverse bias PN junction diode

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, A-Attendance, PR- Performance, LR – Lab Record, V – Viva.

PROGRAMMING IN C LAB

Course Code: EBT2108 **Credit Units: 01**

Software Required: Turbo C/C++

Course Contents:

1. WAP to print ASCII values of entered character.
2. WAP to print larger among 2 numbers using-
   a. If-else
   b. Ternary operator
3. WAP to print larger among 3 numbers using-
   a. Nested if
   b. Laddered if
4. WAP to swap two variables-
   a. With temporary variable
   b. Without temporary variable
5. WAP to perform bitwise AND, OR and shift operations.
6. WAP to find factorial of a number
   a. Using while loop.
   b. Using function
   c. Using recursion
7. WAP for number system inter-conversion
   a. From decimal to binary conversion.
   b. From binary to decimal conversion.
8. WAP to find out whether a number is
   a. palindrome or not.
   b. Armstrong or not
   c. prime or not.
9. WAP to print –

*
**
***

10. WAP to print-

```
      *
*     *
*     *     *
```

11. WAP to find sum of seriesupto n terms
    a. 1 2 4 8----------
    b. 1^2 2^2 3^2 4^2------ upto n terms
    c. Fibonacci series
    d. Sine series
    e. Cosine series

12. WAP to enter the roll no, marks of physics, chemistry and maths. Calculate his percentage and print all details.

13. WAP to find area of rectangle, circle, square and triangle using switch case and named variables.

14. WAP to perform following operations on 3 X 3 matrix
    a. find largest element of an integer array.
    b. search a given element in an integer array.
    c. sort a given integer array.
    d. find transpose

15. WAP to find product of two 3 X 3 matrices.

16. WAP to find number of vowels and consonants in a given string.

17. WAP to find whether the string is palindrome or not.

18. WAP to find the sum of n terms of Fibonacci series using recursion

19. WAP to swap two variables
    a. Using temporary variable
    b. Without using temporary variable
    c. Using call by reference.

20. WAP to perform searching and sorting in an array using functions.

21. WAP to sort array of strings take input from command line argument.

22. WAP to read the contents of a file.

23. WAP to print the contents of your own file as output.

24. WAP to create a structure named STUDENT with name, rollno and branch. Also print details of 3 students using structure.

25. WAP to create a structure POINT with xvalue and yvalue. Print details of 5 such points.

26. Create a structure to specify data on students given below:

Roll number, Name, Department, Course, Year of joining
Assume that there are not more than 450 students in the college.
(a) Write a function to print names of all students who joined in a particular year.
(b) Write a function to print the data of a student whose roll number is given.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	**10**	**10**	**5**	**50**	**20**

IA = Internal Assessment, EE = End Semester Examination, a = attendance, PR = Practical Performance, LR = Lab Record, V = Viva

BASIC ELECTRICAL ENGINEERING LAB

Course Code: EBT2109 **Credit Units: 01**

Course Contents:

List of Experiments:

1. To verify KVL & KCL in the given network.
2. To verify Superposition Theorem.
3. To verify Maximum Power Transfer Theorem.
4. To verify Reciprocity Theorem.
5. To verify Thevenin‟s Theorem.
6. To verify Norton‟s Theorem.
7. To perform OC & SC Test on I phase transformer.
8. Transient response of RLC Ckt.
9. To perform ratio & polarity test on I phase transformer.
10. Power & Power Factor measurement by 2- wattmeter method.

Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

Note: Minor variation could be there depending on the examiner

DEVELOPING ENGLISH LANGUAGE SKILLS-I

Course Code: CSS2101 **Credit Units: 1**

Course Objective:
The course is intended to give a foundation of English Language. The literary texts are indented to help students to inculcate creative and aesthetic sensitivity and critical faculty through comprehension, appreciation and analysis of the prescribed literary texts. It will also help them to respond form different perspectives.

Course Outcome: At the end of the semester, students should be able to:

- demonstrate a significant increase in word knowledge.
- expand the learner's use of grammatically correct and situationally and culturally appropriate language in speaking and writing for effective communication in a variety of interpersonal and academic situations.
- Support interpretive claims about a variety of texts.

Course Contents:

Module I: Essentials of Grammar
Parts of Speech
Types of Sentence: Based on sense and Based on structure

Module II: Basics of Phonetics
Organs of speech
Consonant sound
Vowel sound

Module III: Building Advanced Vocabulary
Homonyms and Homophones
Synonyms and antonyms
One word substitution

Module IV: Short Stories
Last Leaf by O' Henry
A Letter to God-Gregario Lapex Y-Fuentes
The Portrait of the Lady, by Khuswant Singh

Examination Scheme:

Components	Written Test	CAF	CT	V/P	GD/Extempore	A
Weightage (%)	50	10	10	15	10	5

CAF- Communication Assessment File, **V/P**- Viva/Presentation, **GD**- Group Discussion, **A**- Attendance

UNDERSTANDING SELF FOR EFFECTIVENESS

Course Code: BEH2161 **Credit Units: 01**

Course Objective:
This course aims at imparting**:**

- Understanding self & process of self exploration
- Learning strategies for development of a healthy self esteem
- Importance of attitudes and its effective on personality
- Building Emotional Competence

Course Outcomes:

At the end of the course, insights attained from this course would enable students to know about themselves fully. Attaining this insight of about them, students can maximize outcomes by changing their negative behaviour and maintaining self control. They will be aware of their strengths, weaknesses, and habits. Present course will improve the students' attitude in areas of self expression, self-acceptance, acceptance of others and self-awareness. It will also enable the students to become more accepting of others' ideas and feelings and increase their awareness of their own feelings and motivations. Students will be able to list out the components of attitude and benefits of positive attitudes. In the end after learning these skills students will be able to adapt positive behaviour and deal effectively with the challenges and threats of everyday life.

Course Contents:
Module I: Self: Core Competency
Understanding of Self, Components of Self – Self identity, Self concept, Self confidence, Self image

Module II: Techniques of Self Awareness
Exploration through Johari Window, Mapping the key characteristics of self, Framing a charter for self Stages – self awareness, self acceptance and self realization

Module III: Self Esteem & Effectiveness
Meaning and Importance, Components of self esteem, High and low self esteem, Measuring your self esteem

Module IV: Building Positive Attitude
Meaning and nature of attitude, Components and Types of attitude, Importance and relevance of attitude

Module V: Building Emotional Competence
Emotional Intelligence – Meaning, components, Importance and Relevance
Positive and Negative emotions, Healthy and Unhealthy expression of emotions

Module VI: End-of-Semester Appraisal Viva based on personal journal Assessment of Behavioural change as a result of training
Exit Level Rating by Self and Observer

Examination Scheme:

Components	Social Awareness Project (SAP)	Journal For Success (JoS)	A	Mid Term/Class Test	Viva/ Presentation	End term Examination
Weightage	15	10	5	10	10	50

Text & References:

1. Organizational Behaviour, Davis, K.
2. Hoover, Judhith D. Effective Small Group and Team Communication, 2002,HarcourtCollege Publishers
3. Dick, McCann&Margerison, Charles: Team Management, 1992 Edition, viva books
4. Bates, A. P. and Julian, J.: Sociology - Understanding Social Behaviour
5. Dressler, David and Cans, Donald: The Study of Human Interaction
6. Lapiere, Richard. T – Social Change
7. Lindzey, G. and Borgatta, E: Sociometric Measurement in the Handbook of Social Psychology, Addison – Welsley, US.
8. Rose, G.: Oxford Textbook of Public Health, Vol.4, 1985.
9. LaFasto and Larson: When Teams Work Best, 2001, Response Books (Sage), New Delhi
10. J William Pfeiffer (ed.) Theories and Models in Applied Behavioural Science, Vol 2, Group (1996); Pfeiffer & Company
11. Smither Robert D.; The Psychology of Work and Human Performance, 1994, Harper Collins College Publishers

INTRODUCTION TO FRENCH AS A FOREIGN LANGUAGE

Course Code: LAN2101 **Credit Units: 02**

Course Objective: This course teaches the students to understand French as a foreign language, to express themselves in basic French and familiarizes them with the Present tense. Students will be able to engage in basic conversation in French and will be able to frame sentences using negation, interrogation, etc.

Course Outcome: After completion of this course, the students will be able to:
Understand the use of French and difference between foreign and mother language.
Greet and using simple sentences in French.
Ask questions and respond in positive and negative sentences.

Course Contents:

Module I : Introduction to French Language	
• Française Langue Etranger. • Les alphabets français • Nommer des objets, s'adresser poliment à quelqu'un • Se présenter, présenter quelqu'un • Dire où on travaille, ce qu'on fait	• French as a foreign language • French Alphabets • Name objects, politely address someone • Introduce yourself, introduce someone • Tell where we work, what we do
Module II : Regions of France	
• Régions française et ses territoires de l'outre mer. • À propos de la France • Identifier des objets, expliquer leur usage • dire l'heure et la date, faire un achat, discuter le prix.	• French Regions and its overseas territories. • About France • Identify objects, explain their use • Say time and date, make a purchase, discuss the price.
Module III: Grammar	
• Articles définis et indéfinis, masculin et féminin des noms, pluriel des noms • Je, il, elle sujets, verbes parler, habiter, s'appeler, être, avoir, masculin et féminin des adjectifs de nationalité • Tu, vous sujets, verbes parler, aller, être, c'est moi/c'est toi • Démonstratif adjectif (ce, cet, cette, and ces)	• Definite and Indefinite Articles, masculine and feminine nouns, plural nouns • I, he, she subjects, verbs to speak, to live, to call, to be, to have, masculine and feminine adjectives of nationality • You, you(formal) subjects, verbs to speak, to go, to be, it's me / it's you • Demonstrative adjective adjectif (ce, cet, cette, and ces)

Examination Scheme:

Components	Mid-Term	Home Assign.	Viva-voce	Attendance	End - Term
Weightage (%)	10	15	20	5	50

Text & References:

1. Andant, Christine et al. A propos A1 Livre de l'élève and Cahier d'exercices. Grenoble: Presses universitaires de Grenoble, 2010.
2. Girardeau, Bruno et Nelly Mous. Réussir le DELF A1. Paris: Didier, 2010.

References:

1. Modern French course by Mathurin Dondo, Oxford
2. 450 exercices de grammaire, Clé International
3. 3-in-1 French Grammar, Vocabulary & Verbs, Collins
4. French-English-French dictionary, Larousse

Syllabus – Second Semester

ELEMENTARY MATHEMATICS – II

Course Code: EBT2201 **Credit Units: 04**

Course Objective:

The knowledge of Mathematics is necessary for a better understanding of almost all the Engineering and Science subjects. Here our intention is to make the students acquainted with the concept of basic topics from mathematics, which they need to pursue their Engineering degree in different disciplines.

Course Contents:

Module I: Linear Algebra

Definition of a Matrix, Operations on Matrices Determinants, Elementary Operations, Reduction of a Matrix to Row Echelon Form, Rank of a Matrix, Consistency of Linear Simultaneous Equations, Gauss Elimination and Gauss Jordan – Method, Eigen values and Eigen Vectors of Matrix, Caley-Hamilton theorem, Diagonalization of a matrix.

Module II: Complex Number

Definition of Complex Number, Equality, Conjugate and Modulus of a Complex Number, Polar form of a Complex Number, De-Moivre‟s Theorem, Roots of a Complex Number, Exponential and Circular function of a Complex Number, Hyperbolic Functions and their inverses.

Module III: Vector Calculus

Scalar and vector field, Gradient, Divergence and Curl, Directional Derivative, Evaluation of a Line Integral, Green‟s theorem in plain (without proof), Stoke‟s theorem (without proof) and Gauss Divergence theorem (without proof)

Module IV: Probability and Statistics

Frequency Distribution, Arithmetic Mean, Median, Partition Values, Mode, Variance and Standard Deviation, Curve Fitting, Principle of least squares, Linear regression. Introduction to Probability, Addition and Multiplication theorem of Probability, Random variables and Probability Distribution, Expected values, Binomial distribution, Poisson distribution and Normal. Distribution and their Applications.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text books

1. Biological Physics: Energy, Information, Life by Philip Nelson
2. Rodney M.J. Cotterill, Biophysics: An Introduction, Wiley, Ist Edition (2002)

Reference Books

1. R. Glaser, Biophysics: An introduction, Springer, 2nd Edition (2012)
2. Mae-Wan Ho, The rainbow and the worm: The physics of organisms, World scientific publishing, 3rd edition (2008)
3. Biological Thermodynamics by Donald T. Haynie
4. Introductory Biophysics by J. R. Claycomb and J.Q.P. Tran

Molecular and Cellular Biophysics by Meyer B. Jackson

REMEDIAL BIOLOGY-II

Course Code: EBT2202 **Credit Units: 04**

Unit-I:

Brief history of microbiology, Types of microorganisms, Basic idea of domain bacteria, proteobacteria, non proteobacteria Gram –ve and Gram +ve bacteria, lichens, algae, protozoa, helminthes, viral structures, viral multiplication, Role of microorganisms in the production of industrial chemicals and pharmaceuticals.

Unit-II:

Functional Anatomy of Prokaryotic and Eukaryotic Cells: Size, shape, and arrangement of bacterial cells. Structure and function of cells.

Unit-III:

Catabolic & anabolic reactions: enzymes, energy production and carbohydrate metabolism. Lipid & protein catabolism, Energy production mechanism, metabolic diversity & pathways of energy use. Integration of metabolism.

Unit-IV:

Energy Utilization: Structure of mitochondria, cellular respiration, relationship of carbohydrate metabolism to other compounds, Glycolysis, formation of acetyl co-A, Kreb cycle, Electron Transport System and Oxidative Phosphorylation, ATP, factors affecting respiration.

Unit-V:

Reproductive health and human welfare: Population and birth control, sexually transmitted diseases, infertility, Cancer and AIDS, Basic concepts of immunology, vaccines.

Recommended Text Book:

1. Biology-Textbook of Class XI, NCERT Publication
2. Biology-Textbook of Class XII, NCERT Publication
3. Microbiology- Pelzar, Tata Mcgraw- Hill Publishing Com. Ltd., 2002
4. An introduction to immunology by C.V. Rao, Narosa publishing house

Reference Book:

Biology by Peter H Raven, George b Johnson, Kenneth A., Mason, Jonathan Losos, Susan Singer (MacGraw Hill Publication)

General Microbiology: Stainier, Adelberq and Ingraham.

APPLIED PHYSICS - II

Course Code: EBT2203 **Credit Units: 04**

Course Objective
Aim of this course is to introduce the students to fundamentals of physics, which form the basis of all bio-molecular processes.

Course Outcomes
At the end of the course, the students will be able to correlate between the physical aspects of bio-molecular processes and analytical tools used for deciphering biological progressions.

Course Contents

Module I:
Physical Techniques: Diffusion, Sedimentation, Osmosis, Viscosity, factors influencing the various processes and their application in biology.

Module II
Dynamics of biomolecules: Diffusion, Laws of diffusion, Active transport, Facilitated diffusion, Osmosis, Osmotic pressure, Osmoregulation, Viscosity and biological importance, Surface tension, Factors influencing surface tension, Biological importance. Transport at low Reynold numbers: Friction in fluids, Reynold number, significance of low Reynolds numbers, The time reversal properties of a dynamical law, Applications: Swimming and pumping - Bacterial motion, vascular networks.

Module III
Dual nature of electron, de Broglie's wavelength, electron motion in electric and magnetic fields, electron lens formation, Electron Microscope: construction, working and applications. Atomic Force microscope, Scanning Tunneling Microscope, Scanning Near field optical Microscope – an introduction.

Module IV
Thermodynamics and entropy in biology: Heat, temperature, chemical equilibrium, thermodynamic equilibrium, types of energies and laws of thermodynamics, Applications: Brownian motion, chemical kinetics and catalysis, protein folding and unfolding, metabolism in animals. Entropy, Entropic forces, Applications: Electrostatics in water, melting of DNA, phase transitions in membranes, Diffusion and its applications in biological systems.

Module V
Molecular motors and nerve impulses: Electro-osmotic effects, ion pumping, mitochondria, nerve impulses and their electrical network equivalence, mechanism of the action potential, Applications: synapses in nerves and muscles, neuromuscular junctions.

Examination Scheme:

Components	A	CT	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	5	15	10	70

CT: Class Test, EE: End Semester Examination; A: Attendance

Text books

1. Biological Physics: Energy, Information, Life by Philip Nelson
2. Rodney M.J. Cotterill, Biophysics: An Introduction, Wiley, Ist Edition (2002)

Reference Books

5. R. Glaser, Biophysics: An introduction, Springer, 2nd Edition (2012)
6. Mae-Wan Ho, The rainbow and the worm: The physics of organisms, World scientific publishing, 3rd edition (2008)
7. Biological Thermodynamics by Donald T. Haynie
8. Introductory Biophysics by J. R. Claycomb and J.Q.P. Tran
9. Molecular and Cellular Biophysics by Meyer B. Jackson

OBJECT ORIENTED PROGRAMMING IN C++

Course Code: EBT2204 **Credit Units: 04**

Course Objective:

This course is designed to help students developing the basic understanding of object oriented paradigm and its advantages. By the end of this course, students will be able to understand the Object Oriented Programming and able to write C++ programs using the Object oriented design, and use the standard C++ library. The programming skills thus acquired using C++ language can be used in developing programs for the scientific and business purposes. This course may also act as backbone to all other courses that are based on Object Oriented concept. The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency: Design and Develop program following Object Oriented concept in C++ to solve given problem.

COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes. i. Explain Object Oriented Programming concepts. ii. Use the basic programming constructs of C++ iii. Apply object-oriented approaches to software problems in C++ iv. Develop small scale programs in 'C++'. v. Debug and fix common errors in C++ programs.

COURSE CONTENTS:

Module I: Introduction

Procedure Oriented Programming VS object-oriented Programming, Characteristics and Concepts of OOP, Introduction to C++ Programming Language, Character Set, Tokens, Precedence and Associativity, Program Structure, Data Types, Variables, Operators, Expressions, I/O operations, Statements and control structures.

Module II: Classes and Objects

Array, Functions, Encapsulation and Data Abstraction, Concept of Objects, State, Behavior & Identity of an object, Classes, Scope Resolution Operator, Access modifiers, Static members of a Class, Array of Objects, Instances, Message passing, Constructors & Destructors, Friend Functions.

Module III: Inheritance

Inheritance, Single Inheritance, Multiple Inheritance, Multilevel Inheritance, Hybrid Inheritance, Ambiguity resolution using scope resolution operator and Virtual base class, Aggregation, composition vs classification hierarchies, Abstract Classes, Overriding inheritance methods, Constructors in derived classes, Nesting of Classes.

Module IV: Polymorphism and File Handling

Polymorphism, Compile time and runtime Polymorphism, Function Overloading, Operator Overloading (Unary and Binary), Polymorphism by parameter, Pointer to objects, this pointer, Virtual Functions, pure virtual functions. Character and String input and output to files, Command Line Arguments and Printer Output. Reading a File, Managing I/O Streams, Opening a File, Checking for Failure with File Commands, Checking the I/O Status Flags, Dealing with Binary Files.

Module V: Standard Template Library
Implementing a class template, Implementation of class template member functions, Using a class template, Function templates, Implementing function templates, Using template functions, Template instantiation, Class template specialization, Throwing an exception, catching an exception: The try block, Exception handlers.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	**5**	**10**	**8**	**7**	**70**

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A: Attendance

LEARNING RESOURCES:

Text:

- A.R. Venugopal, Rajkumar, T. Ravishanker "Mastering C++", TMH, 1997.
- R. Lafore, "Object Oriented Programming using C++", BPB Publications, 2004.
- "Object Oriented Programming with C++" By E. Balagurusamy.
- Schildt Herbert, "C++: The Complete Reference", Wiley DreamTech, 2005.

References:

- Parasons, "Object Oriented Programming with C++", BPB Publication, 1999.
- Steven C. Lawlor, "The Art of Programming Computer Science with C++", Vikas Publication,2002.
- Yashwant Kanethkar, "Object Oriented Programming using C++", BPB, 2004.
- Timothy Budd, "An Introduction to Object-Oriented Programming", Addison-Wesley Publication, 3rd Edition.

APPLIED CHEMISTRY

Course Code: EBT2205 **Credit Units: 03**

Course Objective:
Chemistry is essential to develop analytical capabilities of students, so that they can characterize, transform and use materials in engineering and apply knowledge in their field. All engineering fields have unique bonds with chemistry whether it is Aerospace, Mechanical, Environmental and other fields the makeup of substances is always a key factor, which must be known. The upcoming field of technology like Nanotechnology and Biotechnology depends fully on the knowledge of basic chemistry. With this versatile need in view, course has been designed in such a way so that the student should get an overview of the whole subject starting from the very basic bonding mechanism to the application of materials.

Course Contents:

Module I: Chemical Bonding
Types of bond: Ionic, Covalent and Co-ordinate bond; Fajan's rule; Hybridisation; H- bonding ; Valence bond and Molecular orbital theory for diatomic molecule.

Module II: Organic Mechanism
Electronegativity and dipole moment; Electron Displacement Effects: Inductive Effect; Mesomeric Effect; Electromeric Effects; Fission of covalent bonds; Intermediates of Organic reactions; Carbonium, Carbanion, Free Radical and Carbene; Types of organic reactions; Substitution, Elimination, Addition.

Module III: **Radioactivity**
Natural and artificial, Radioactive Decay Processes, group displacement law, half life period, binding energy, nuclear reaction equations, Radioisotopes and their application, tracers, Application of radioactivity, Medicinal and agriculture use of isotopes Fission and Fusion

Module IV: Thermodynamics
Introduction; Terminology; First Law; Adiabatic and Isothermal Process; Reversible and Irreversible Process; Second law of Thermodynamics; Standard State; Entropy, Gilbb's Helmholtz equation; VantHoff Isotherm and Isochore; Third law of Thermodynamics; Chemical Potential; Activity and Activity Coefficient; Coupled Reactions.

Module V: Chemical Equilibrium
Introduction ; Le Chatelier's Principle; Equilibrium constant from Thermodynamic Constants; Acid-Base Concept; Weak acid and Weak base and their salts; Solubility Product; pH and pOH, Buffer Solution, Buffer Action.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text & References:

Text:

- Engineering Chemistry, Jain & Jain
- Engineering Chemistry, Shashi Chawla
- Nuclear Chemistry- G.R. Choppin and J. Rydbergy, Pergamon publications

References:

- Organic Mechanism, Morrison and Boyd
- Physical Chemistry, Puri Sharma and Pathania
- Organic Chemistry Vol-I, IL Finar
- Organic Chemistry Vol-II, IL Finar
- Physical Chemistry, Atkins Peter, Paula Julio
- A guide to mechanism in organic chemistry, Peter Sykes.
- Introduction to practical chemistry, K.K.Sharma
- Concise Inorganic chemistry, J.D. Lee

ENVIRONMENTAL STUDIES

Course Code: ENV2252 **Credit Units: 04**

Module I: The multidisciplinary nature of environmental studies
Definition, scope and importance, Need for public awareness

Module II: Natural Resources
Renewable and non-renewable resources:
Natural resources and associated problems, Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies. 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.

Module III: Ecosystems
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:
- Forest ecosystem
- Grassland ecosystem
- Desert ecosystem
- Aquatic ecosystems (ponds, streams, lakes, rivers, ocean estuaries)

Module IV: Biodiversity and its conservation
Introduction-Definition: genetic, species and ecosystem diversity, Bio-geographical 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-spots 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

Module V: Environmental Pollution
Definition, Causes, effects and control measures of:
- Air pollution
- Water pollution
- Soil pollution
- Marine pollution
- Noise pollution

 Thermal pollution
 Nuclear pollution
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.

Module VI: Social Issues and the Environment
From unsustainable to sustainable development, Urban problems and 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.
Environmental 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

Module VII: Human Population and the Environment
Population growth, variation among nations, Population explosion – Family Welfare Programmes, 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

Module VIII: Field Work
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.

Examination Scheme:

Components	CT	HA	S/V/Q	A	EE
Weightage (%)	15	5	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, A: Attendance, EE: End Semester Examination

Text &References:

 Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
 BharuchaErach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad 380 013, India, Email:mapin@icenet.net (R)
 Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)

APPLIED PHYSICS LAB - II

Course Code: EBT2206 **Credit Units: 01**

Course Contents:

1. To determine the frequency of an electrically maintained tuning fork by Melde‟s method.
2. To determine the acceleration due to gravity (g) by Kater‟s reversible pendulum.
3. To find the wavelength of the prominent lines of mercury spectrum using plane transmission grating.
4. To find the energy band gap of semiconductor (Ge) crystal using four-probe method.
5. To determine the frequency of A.C. mains using sonometer and electromagnet.
6. To determine the thickness of the given wire using wedge method.
7. To study the V-I characteristics of forward and reversed biased p-n junction diode.
8. To study the characteristics of a solar cell and find the fill factor.
9. To study the characteristics of a photo-cell and verify the inverse law of radiation.

Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

OBJECT ORIENTED PROGRAMMING IN C++ LAB

Course Code: EBT2207 **Credit Units: 01**

Software Required: Turbo C++ and AUTOCAD 2001

1. Develop programs using Input/Output operators
2. Develop programs using Control structure.
3. Develop programs using array of object.
4. Develop programs using call by value, call by reference
5. Develop programs on default arguments, constant arguments
6. Develop programs on function overloading
7. Develop programs using different classes such as student, distance, shape, employee, feet, time, data etc. with data member & member functions.
8. Develop Programs using array of objects and static member functions.
9. Develop programs using Friend function.
10. Develop programs using single, multilevel, multiple Inheritance.
11. Develop programs using various types of constructors and destructor.
12. Develop programs using inheritance and constructors.
13. Develop programs using Virtual base class.
14. Develop programs using 'this' key word.
15. Develop programs using virtual function.
16. Develop programs using unformatted input/output functions.
17. Develop programs using formatted input/output functions.

Examination Scheme:

IA				EE	
A	**PR**	**LR**	**V**	**PR**	**V**
5	**10**	**10**	**5**	**50**	**20**

IA = Internal Assessment, EE = End Semester Examination, a = attendance, PR = Practical Performance,
LR = Lab Record, V = Viva

APPLIED CHEMISTRY LAB

Course Code: EBT2108 **Credit Units: 01**

Course Objective: The main objective of Applied Chemistry experimental practices for B Tech Biotechnology students are to aware about quality of water, contamination of different water samples, to know the pH importance of different biological samples, and to develop skill in apparatus handling and accuracy in biotechnological laboratory work.

List of Experiments (Perform any 10)

1. Determination of typr and extent of alkalinity in given water sample.
2. Determination of acidity of the given industrial effluent water titrimetrically.
3. To determine the ferrous content in the supplied sample of iron ore by volumetric analysis against standard K2Cr2O7 solution
4. To determine the surface tension of a given liquid by drop number method.
5. To determine the composition of a liquid mixture A and B (acetic acid and water) by surface tension method.
6. To determine the temporary, permanent & total hardness of a sample of water by complexometric titration method.
7. To determine the number of water molecules of crystallization in Mohr's salt (ferrous ammonium sulphate) provided standard potassium dichromate solution
8. Determination of Dissolved oxygen in the given water sample.
9. To determine the total residual chlorine in water.
10. Determination of viscosity of given oil by means of Ostwald viscometer.
11. To determine flash point & fire point of an oil by Pensky Martin‟s Apparatus
12. Analysis of iron in water sample by UV Spectrophotometer
13. To determine the Rf Value of plant pigments using paper chromatography.

Examination Scheme:

IA				EE	
Teacher Assessment	**Lab Record**	**Viva**	**Attendance**	**Major Experiment**	**Viva**
08	07	10	05	50	20

Texts & References:

1) Theory and Practices in Chemistry- Narula & Virmani
2) Experiments in Applied Chemistry- Sunita Rattan, Kataria & Sons
3) Experimental Chemistry-Shashi Chawla, Dhanpat Rai Publications
4) Comprehensive Experimental Chemistry, V. K. Ahluwalia, New Age Publication, Delhi

DEVELOPING ENGLISH LANGUAGE SKILLS-II

Course Code: CSS2201 **Credit Units: 1**

Course Objective:
The course is intended to give a foundation of English Language. The literary texts are indented to help students to inculcate creative & aesthetic sensitivity and critical faculty through comprehension, appreciation and analysis of the prescribed literary texts. It will also help them to respond form different perspectives.

Course Outcome:

At the end of the semester, the students should be able to:

- demonstrate a significant increase in word knowledge.
- expand the learner's use of grammatically correct and situationally and culturally appropriate language in speaking and writing for effective communication in a variety of interpersonal and academic situations.
- Support interpretive claims about a variety of texts.

Course Contents:

Module I: Applied Grammar and Uses
Subject Verb Concord
Tenses
Voice
Narration

Module II: Phonetics and Phonology
The syllable
Stress & Intonation
Aspects of Connected Speech: Rhythm & Assimilation

Module III: Vocabulary
Word Formation: Root, Prefix, Suffix
Phrasal Verbs
Idiomatic Expression

Module IV: Poems
Futility by Wilfred Owen
Our Casuarina Tree by Taru Dutt
Night of the Scorpion by Nissim Ezekiel

Examination Scheme:

Components	Written Test	CAF	CT	V/P	GD/Extempore	A
Weightage (%)	50	10	10	15	10	5

CAF- Communication Assessment File, **V/P**- Viva/Presentation, **GD**- Group Discussion, **A**- Attendance

PERSONAL AND WORK PLACE EXCELLENCE

Course Code: BEH2261 **Credit Units: 01**

Course Objective:

Importance of Personal and Professional excellence,
Inculcating the components of excellence

Course Outcomes:

Insights attained from this course will enhance the understanding of students in building and leverage their professional reputation and students will learn to make a balanced choice between professional and personal commitments

Course Contents:

Module I: Components of Excellence
Personal Excellence:
Identifying long-term choices and goals Uncovering the talent, strength & style
Analyzing choke points in your personal processes by analysis in area of placements, events, seminars, conference, extracurricular activities, projects etc.

Module II: Managing Personal Effectiveness
Setting goals to maintain focus
Dimensions of personal effectiveness (self disclosure, openness to feedback and perceptiveness)
Integration of personal and organizational vision for effectiveness A healthy balance of work and play
Managing Stress creatively and productively

Module III: Personal Success Strategy
Time management
Handling criticism and interruptions
Dealing with difficult people
Mapping and evaluating the situations
Identifying long-term goals

Module IV: Positive Personal Growth
Understanding & Developing positive emotions
Positive approach towards future
Resilience during loss and challenge

Module V: Professional Success
Building independence & interdependence
Reducing resistance to change
Continued reflection (Placements, events, seminars, conferences, projects extracurricular Activities etc.)

FRENCH BASIC GRAMMAR AND COMPREHENSION

Course Code: LAN2201 **Credit Units : 02**

Course Objective: This course enables the students to apply their knowledge of possessive and demonstrative adjectives in the present and near future tense, in conversation- using different groups of verbs, and to conjugate the French -ER regular and irregular verbs.

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

· Demonstrate their belonging and others things using French sentences.
· Speak the incidents of near future and recent past.
· Understand the French verbs and its categories.

Course Content:

Module I : About oneself	
L'arbre généalogique	Family tree
La salle de classe	The classroom
Ma vie quotidienne	My daily life
À la maison	At home
À l'université	At the university
Module II: Personal activities	
Préparatifs pour assister à une fête	Preparations to attend a party
À l'arrêt de bus	At the bus-stop
Lettre à un ami	Letter to a friend
Module III : Grammar	
Les articles contractés, les quantités indéterminées et déterminées	Articles contracted, indeterminate and determined quantities
Les adverbes de fréquences	Frequency adverbs
Verbes- Parler, Manger, Essayer, Préférer, faire, prendre, venir, pouvoir, vouloir, les verbes pronominaux	Verbs - to speak, to eat, to try, to prefer, to make, to take, to come, to be able, to want, the pronominal verbs
La comparaison de l'adjectif	The comparison of the adjective
La négation	The negation
La future proche	The near future

Examination Scheme:

Components	Mid-Term	Home Assign.	Viva-voce	Attendance	End -Term
Weightage (%)	10	15	20	5	50

Text & References:

1. Andant, Christine et al. A propos A1 Livre de l'élève and Cahier d'exercices. Grenoble: Presses universitaires de Grenoble, 2010.
2. Girardeau, Bruno et Nelly Mous. Réussir le DELF A1. Paris: Didier, 2010.

References:

1. Modern French course by Mathurin Dondo, Oxford
2. 450 exercices de grammaire, Clé International
3. 3-in-1 French Grammar, Vocabulary & Verbs, Collins
4. French-English-French dictionary, Larousse

Syllabus – Third Semester

BIOCHEMISTRY

Course Code: EBT2301 **Credit Units: 04**

Course Objective:

The main objective of the course will be to build the basic foundation for studying biochemistry. This course will be help to understand about the composition of living cells and biomolecules present in cells and their metabolism.

Course Contents:

Module I: Chemical basis of Life

Chemical foundations of biology – pH – pK – acids & bases - ionization of water - properties of biomolecules in aqueous environment - buffers - buffering in biological systems - chemical bonding – various forces and interactions in biological systems - bioenergetics.

Module II: Carbohydrates

Basic structure, classification and functions of carbohydrates - carbohydrate metabolism: glycolysis - Kreb's cycle - phosphogluconate pathway - glyoxylate pathway - pentose phosphate pathway - Cori cycle - Gluconeogenesis and glycogenolysis - Oxidative phosphorylation.

Module III: Amino acids and Proteins

Classification of amino acids and properties: isoelectric pH, zwitterions, and precipitation reactions. - biosynthesis and breakdown of amino acids - Peptide bond - Structure of protein - primary, secondary, tertiary and quaternary structures - Ramachandran plot.

Module IV: Lipid chemistry

Structure and functions of lipids and derivative lipids - glycerol, fatty acids, waxes, phospholipids, sphingolipids, lipoproteins - Biosynthesis and oxidation of fatty acids – Steroids - Cholesterol synthesis - formation of ketone bodies - Structure and functions of vitamins & its derivatives - co-factors.

Module V: Nucleic acids

Structure and functions of nucleic acids: types of DNA and RNA - De novo and salvage pathways for synthesis of pyrimidine and purine nucleotides - purine and pyrimidine breakdown - Major metabolic disorders of nucleotide metabolism; Gout, Lesch-Nyhan syndrome – immunodeficiency.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

References:

1. Garrett, Reginald H., Grisham, Charles M (2012) Biochemistry, 5th Edition.
2. Biochemistry, 3rd Edition. Matthews, van Holde, and Ahern
3. Biochemistry, 6th Edition. Berg, Tymoczko and Stryer
4. Molecular Cell Biology, 7th Edition. Lodish, et. al.
5. Textbook of Biochemistry with Clinical Correlations, 7th Edition by T. Devlin
6. Biochemistry, 4th edition. Donald Voet and Voet Judith
7. Harpers Review of Biochemistry, 25th Edition. Murray RK, Rodwell VW.
8. Lehninger's Principles of Biochemistry, 5th Edition. Nelson DL and Cox MM
9. Concepts in Biochemistry, 3rd Edition. Rodney Boyer .

MICROBIOLOGY

Course Code: EBT2302 **Credit Units: 03**

Course Objective:
The course imparts the knowledge of different types of microorganisms that are invisible to our naked eyes. Discovery origin and evaluation of different forms of bacteria, fungi, protozoa and viruses constitute the basics of biotechnology.

Course Contents:

Module I
Introduction and historical perspective - History and Discovery of the microbial world, Methods in Microbiology, Culture media, Theory and practice of sterilization, pure culture techniques.

Module II
Prokaryotic structure and function - functional anatomy of bacteria: cell envelope, cell wall, cytoplasmic membrane, capsule, surface appendages, cytoplasm and cytoplasmic inclusions. Growth - The definition of growth, mathematical expression of growth, growth curve, measurement of growth, synchronous growth, continuous culture, culture collection and maintenance of cultures.

Module III
Metabolic Diversity among microorganisms - photosynthesis in microorganisms, role of bacteriochlorophylls, carotenoids and phycobilins, Chemolithotrophy, hydrogrn-iron-nitrite-oxidizing bacteria, nitrate and sulphate reduction, methanogenesis and acetogenesis, Fermentations, nitrogen fixation, plant microbe interactions (mycorrhizae).

Module IV
Viruses: Bacterial, animal; structure of viruses; Reproduction and life cycle of RNA and DNA viruses; Viroids and prions. Algae and Fungi: Introduction, Classification and Reproduction.

Module V
Host-parasite relationship - Normal micro flora of skin, oral cavity, gastrointestinal tract, Respiratory infections; entry of pathogens into the host, types of toxins (Exo, endo, entro) and their mode of actions, Sexually transmitted disease including AIDS, Food and water- borne diseases; pathogenic fungi.

Module VI
Chemotherapy/antibiotics-Antimicrobial agents, sulfa drugs, antibiotics - penicillin and cephalosporins, broad spectrum antibiotics, antifungal antibiotics; mode of action.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text & References:

Text:

- General Microbiology, R.Y. Stanier, J.L. Ingraham, M.L.Wheelis and P.R. Painter, Macmillian
- Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill Microbiology by Prescott
- The microbes – An Introduction to their Nature and Importance, P.V. Vandenmark and B.L. Batzing, Benjamin Cummings.

References:

- The Microbial World, Roger Y. Stanier, Prentice Hall
- Microbiology, Tortora, Funke and Chase, Benzamin & Cummings
- Principles of Fermentation Technology, Salisbury, Whitaker and Hall, Aditya Books Pvt. Ltd.
- Industrial Microbiology, Casida, New Age International
- Industrial Microbiology, Prescott and Dunn, C.B.S. Publishers Principles of Microbiology, R.M. Atlas, WMC. Brown Publisher.

FLUID MECHANICS FOR BIOTECHNOLOGY

Course Code: EBT2303 **Credit Units: 04**

Module I:
Properties and nature of fluids - ideal fluid - real fluid - density - specific weight - specific volume, surface tension, compressibility, capillarity - absolute and gauge pressures. Viscosity, Newton's Law of viscosity, Kinematic Viscosity, Rheological Diagram, Euler Equation and its application, Derivation of Bernoulli Equation from Euler Equation, Applications of Bernoulli's Theorem, Pascal's Law, Hydrostatic Law.

Module II:
Flow of incompressible fluid - classification of flow - steady and unsteady state flow, uniform and non-uniform flow - Three, two and one directional flow - streamline, streak line, path line, stream tube, velocity potential, laminar flow.

Module III:
Measurement of Pressure: Definition of Gauge and & Absolute Pressure, Barometer, Various Manometers (Peizometer, U-tube manometer, Single column manometers, U-tube & Inverted U-tube differential manometers) & their industrial applications.

Module IV:
Flow Measuring Equipment: Head Flow Meters, Nozzel Meter, Orifice Meter, Venturi Meter, Area Flow Meters, Rotameter, Pitot Tube & Applications of these equipments.

Module V:
Pipe fittings, major and minor losses in pipe flow, Calculation of Pressure Drop in a Pipe, Equivalent Length & 'K' factor, Methods of finding dimensional numbers - methods of governing equations, Method of force ratios and Buckingham's π method, Outline of procedure for Buckingham Pi method, Physical significance of dimensionless numbers. Reciprocating Pumps and its working, Centrifugal Pumps, Characteristic Curves of Centrifugal Pumps, Advantages and Disadvantages of Centrifugal Pumps, applications of centrifugal pumps.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text Books and Reference Books

1. Fluid Mechanics & Hydraulic Machines by Dr. RK Bansal.
2. McCabe Smith: Unit Operations in Chemical Engineering, McGraw Hill.
3. Fox, RA & McDonald, AT, "Introduction to Fluid Mechanics", 5th ed: John Wiley (1998).
4. Kumar, DS, "Fluid Mechanics", SK Katria and Sons, Delhi (1998.)
5. Rajput RK, Text book of Fluid Mechanics", S. Chand and Co., New Delhi, (1998).
6. Gupta, Vijay and SK Gupta, "Fluid Mechanics and its Applications", Wiley Eastern, New Delhi.

DATABASE MANAGEMENT SYSTEM

Course Code: EBT2304 **Credit Units: 03**

Course Objective:
It enables the students to access biological information networks and databases in order to understand the different techniques of biotechnology to build detection systems especially in the prevention and reatment of human diseases.

Course Contents:

Module I: Introduction
Concept and goals of DBMS, DBMS Architecture, Database Languages, Database Users, Database Abstraction. Basic Concepts of ER Model: Entity Type, Entity Set, Relationship type, Relationship sets, Keys,Design of ER Model.

Module II: Hierarchical model & Network Model
Hierarchical data model: Concepts, Data definition, Data manipulation and implementation. Network Data Model: architecture, working, application and advantages.

Module III: Relational Model
Relational database, Relational Algebra, Relational Calculus, Tuple Calculus.

Module IV: Relational Database Design and Query Language
SQL,Normalization using Functional Dependency, 1NF, 2NF, 3NF, BCNF, Multivalued dependency and Join dependency.

Module V: Concurrency Control and Current trends
Transaction basics: ACID property, Life cycle of Transaction, Why Concurrency Control, Schedule, Serializability, Lock Based Protocols, Deadlock Handling, Crash Recovery. Distributed Database, Objective Oriented Database, Multimedia Database, Data Mining.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text & References:
Text:
- Korth, Silberschatz, "Database System Concepts", 4th Ed., TMH, 2000.
- Steve Bobrowski, "Oracle & Architecture", TMH, 2000
- Data Mining: Concept and techniques, J. Han and M. Kamber, Morgan Kaufman

References:
- Date C. J., "An Introduction to Database Systems", 7th Ed., Narosa Publishing, 2004
- Elmsari and Navathe, "Fundamentals of Database Systems", 4th Ed., A. Wesley, 2004
- Ullman J. D., "Principles of Database Systems", 2nd Ed., Galgotia Publications, 1999.

BIOANALYTICAL TECHNIQUES

Course Code: EBT2305 **Credit Units: 03**

Course Objective:
The students will be exposed to techniques and instruments that are used in biotech industries.

Course Contents:

Module I: Microscopy
Light microscopy, Bright & Dark Field microscopy, Phase Contrast microscopy, TEM, SEM

Module II: Chromatography
Paper, TLC, gel filtration, ion-exchange chromatography, affinity chromatography, HPLC and GLC

Module III: Electrophoresis
Gel electrophoresis, SDS-PAGE, isoelectric focusing, two-dimensional electrophoresis, capillary electrophoresis

Module IV: **Spectroscopy**
UV and visible spectroscopy, Atomic absorption spectroscopy, Mass Spectrometry, MALDITOF, Nuclear Magnetic Resonance

Module V: Crystallography
Bragg's Law, X-ray Diffraction, X-ray crystallography

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text & References:

- Wilson, K, Walker, J., Principles and Techniques of Practical Biochemistry. 5th Ed. - Cambridge University Press, Cambridge 1999.
- Biophysical Chemistry (Principles and Techniques) Nath and Upadhyay, Himalaya Publishing House

BIOCHEMISTRY LAB

Course Code: EBT2306 **Credit Units: 01**

Course Contents:

1. Qualitative analysis of carbohydrates, proteins, steroids, alkaloids and flavonoids.
2. Determination of reducing sugar by dinitro-salicylic (DNS) method.
3. Determination of amino acid by Ninhydrin method.
4. Colorimetric estimation of proteins by Bradford/ Lowry's methods.
5. Determination of isoelectric point of casein.
6. Separation by amino acids by TLC.
7. Extraction of total lipids by Folch's Method.
8. Determination of acid, iodine and saponification values of fats.
9. Estimation of DNA by diphenylamine reagent method.
10. Determination of pKa values.
11. Experimental analysis of biochemical compounds by TLC.

Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

MICROBIOLOGY LAB

Course Code: EBT2307 **Credit Units: 01**

Course Contents:

1. Preparation of solid and liquid media.
2. Isolation and maintenance of organisms by plating, streaking and serial dilution.
3. Preparation of slant cultures.
4. Growth curve measurement.
5. Measurement of bacterial population by dilution method.
6. Effect of temperature, pH, carbon and nitrogen sources on growth of bacteria.
7. Microscopic examination of bacteria by gram staining.
8. Endospore staining.
9. Capsule staining.
10. Isolation and identification of Rhizobium from root nodules.

Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

BIOANALYTICAL TECHNIQUES LAB

Course Code: EBT2308 **Credit Units: 01**

Course Objective:
The students will be exposed to techniques and instruments that are used in biotech industries.

Course Contents:

Module I
Principle and working of basic analytical instruments – Autoclave, Laminar air flow, Sonicator, Bioreactor,

Module II
Centrifugation – low speed and high speed.

Module III
Spectrophotometer techniques

Module IV
Chromatography –Paper Chromatography and Thin Layer Chromatography

Module V
Electrophoresis –SDS Page and Agarose gel electrophoresis.

Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

PRESENTATION ON INNOVATIVE IDEA & EVALUATION

Course Code: EBT2309 **Credit Units: 02**

Course Description and Outcomes

Students will learn techniques for improving the flexibility and originality of their thinking and will explore approaches used by managers and organizations to create and sustain high levels of innovation. Topics include: personal thinking preferences, everyday creativity and eliminating mental blocks, creative thinking techniques, idea selection approaches, teaming techniques for creativity, conditions that promote creativity, design for interaction, disruptive technologies, and intellectual property. The course uses fun and hands-on activities to stimulate innovation.

At the end of this course, students will:

- Understand building blocks of innovation
- Be familiar with processes and methods of creative problem solving: observation, definition, representation, ideation, evaluation and decision making
- Enhance their creative and innovative thinking skills
- Be familiar with creative and innovative thinking styles
- Practice and value teaming, communication, and diversity
- Understand risk taking, paradigm shift, and paradigm paralysis

Course Assignments

Assignments include:

- Brain teasers (aka Puzzle Busters, to be solved individually)
- Cartoon captions (small teams)
- TRIZ, a systematic ideation method, reading (individual)
- Book readings and discussions (small teams)
- Small teams presentations on innovation: (1) innovative individual, (2) innovative company, (3) innovative movie/game, (4) sustainable innovation, (5) innovation in business, (6) innovation in art, (7) innovation in architecture, (8) innovative nation, (9) innovation in science, and (10) innovation in engineering.
- Large groups hands-on projects
- Eight-dimensional (8D) ideation method examples
- Large teams videos

In addition, students are required to keep a log book.

Assessment Scheme:

Internal Assessment	**External Assessment**	
Report (50 marks)	Viva	Presentation
50	25	25
Total Marks	100	

MOOCs CERTIFICATE/WORKSHOP/CERTIFICATE (DISCIPLINE SPECIFIC)

Course Code: EBT2310 **Credit Units: 02**

Course Objective

A workshop is a series of educational and practical sessions. In the workshop, simulation exercise take place related to the topic which is conducted by speaker, which essentially means learning while practicing. This often involves students practicing their new skills during the event under the watchful eye of the instructor. The student will choose the option of workshop from amongst their concentration electives. The evaluation will be made by Board of examiners comprising of the faculties.

One Credit will be given to student after successful completion of MOOCs CERTIFICATE /CERTIFICATE/ (DISCIPLINE SPECIFIC) from sources like IITs, NITs, COURSERA, University of Michigan, University of California, San Diego, Yonsei University, Udemy, EDUONIX, Microsoft, EDX etc.

Workshop/ Certification Course/ MOOCs Certificate Outputs
Experience in **planning and preparing** a technical idea and concept
Techniques and skills for a lively and **positive atmosphere** during the workshop
Hands on experience in the processes of providing a training session (e.g. **lecturing and facilitating**)

Guidelines for Workshop/ Certification Course/ MOOCs Certificate
The procedure for earning credits from workshop consists of the following steps:
There will be one credit per workshop/ Certification Course/ MOOCs Certificate attended.
The student has to submit a certificate of participation for each workshop.
The student has to submit a report of at least 500 words about the learning outcome from the workshop.

Evaluation Scheme:

Internal Assessment	**External Assessment**	
Workshop attendance and certificate	**Performance during Training**	**Report of learning outcomes**
50	25	25
Total Marks	100	

THERMODYNAMICS FOR BIOLOGICAL SYSTEM

Course Code: EBT2311 **Credit Units: 02**

Course Objective: Thermodynamics is one of the essential tools to analyze biological systems. Thus, it is essential that an undergraduate in biotechnology knows the relevant thermodynamics principles. This course will give an insight about the reactions that occur in living systems, how they interact with their environment and application of thermodynamics to living systems.

Module 1: **Basic Concepts & Laws of Thermodynamics**
System, Surrounding & Processes, Closed and Open systems, State Properties, Intensive & Extensive Properties, State and Path functions, Equilibrium state, enthalpy, specific heat, Reversible and Irreversible processes.

Module 2: **Laws of Thermodynamics**
Zeroth law of Thermodynamics, General statement of First law of Thermodynamics, Heat capacity, Heat reservoir and Heat engines. General statements of the second law, Concept of entropy, Carnot principle, Calculation of entropy changes, Clausius inequality, Entropy and Irreversibility, Third law of Thermodynamics. Basic energy concepts, Enthalpy change, energy balance equations, Steam tables.

Module 3: **Thermodynamics Theories**
Chemical potential, fugacity, activity, activity coefficient, chemical reaction equilibria, standard free energy change, equilibrium conversion, thermodynamic equations. Application of thermodynamics on Bimolecular.

Module 4: **Introduction to Chemical Reaction Engineering**
Homogenous reactions, Effect of Temperature on Rate Constant, Arrehnius equation, Collision Theory, Transition State Theory, Law of Conservation of mass, stoichiometry, basics of Material Balance.

Module 5: **Kinetics of Chemical Reaction**
Basic reaction theory, Kinetics of homogenous reactions, and reactions in biological systems, Order and Molecularity of a Chemical reaction, Elementary Reactions, First, Second and Third order reactions, Non Elementary Reactions, Pseudo-first order reaction, Determination of rate constant and order of reaction and reaction yield.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text & References:
***Text*:**
- Heat Transfer by K.A. Gavhane
- Mass Transfer by Trebol
- Heat and Mass transfer by McCabe Smith

***References*:**
- Chemical Engineering by Coulson and Richardson,Vol I & II. Pergamon Press, New York.
- Heat and Mass Transfer by P K Nag, third edition. Tata McGraw Hill publishing, New Delhi, India

NATURAL PRODUCTS FROM MEDICINAL PLANTS

Course Code: EBT2312 **Credit Units: 02**

Course Objective:
The main objective are to cover the representative herbal dosage form and general issues of formulation , production, quality requirement and uses to gain an understanding of challenges associated with quality herbal formulation manufacturing

Module I
Medicinal plants: Important medicinal of India; Non-angiosperm medicinal (Algae, lichens, bryophytes and gymnosperms); Rare and endangered species of medicinal, Policies for their conservation, regeneration and sustainable use; Medicinal Plant Specialist Group of Species Survival Commission (IUCN).

Module II: Herbs as raw materials:
Definition of herb, herbal medicines, herbal medicinal product and herbal drug preparations. Source,selection,identification and authentification of herbal materials., Drying and processing of herbal raw materials., Packing and labeling of finished products.

Module III- Fundamentals of cultivation and Herbal Extracts
Cultivation of medicinal plants: season and time, selection and preparation of land for cultivation, tillage (different types), planting density, planting patterns; Physical, chemical, standardization, qualitative and quantitative, estimations exemplified by the methods of preparation of at least two standardized extracts. Stability studies for extracts. W.H.O Policy on herbal medicines.

Module IV
Herbal Based industry: Scope, study of infrastructure, staff requirements, project, profiles, equipments, processing, research and development & Regulatory requirements. Role of natural products in herbal medicines, General status and importance of herbal medicines.

Module V- Herbal Product Development:
Preparation of liquid orals, tablets, capsules,ointments ,creams and cosmatics, Methods involved in monoherbal and polyherbal formulation with their merits and demerits. Quality Control of finished herbal medicinals products .

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

References

- Pharmacognosy by G.E. Trease, W.C.Evans, ELBS.
- Pharmacognosy by Verno E. Taylor, Linn. R.Braddy, James E.Robberts, K.M.Varghese Co. Mumbai.

Text:

- Phytochemical methods of chemical analysis by Harborne
- Quantitative Thin layer chromatography and its industrial application by Trieber L.R. 8. HPTLC- Quantitative analysis of Pharmaceutical Formulation by P.D.Sethi
- Indian Herbal Pharmacopoeia Vol. I and II
- British Herbal Pharmacopoeia

- Herbal drug industry by R.D.Chaudhari
- General Pharmacy by J.W. Cooper and Coline Gunn
- Tutorial Pharmacy by S.J.Carter 19. Cosmeceuticals- Drugs Vs Cosmetics by Peter Elsnerand Hovard. D. Maibach

FUNDAMENTALS OF COMMUNICATION

Course Code: CSS2301 **Credit Units: 01**

Course Objective:

The course is intended to develop a deep understanding of the fundamentals of communication, and to improve communication skills by appreciating the importance of non-verbal communication. Effective communication facilitates efficient information sharing between company employees and can substantially contribute to its commercial success.

Course Outcome:

Intended outcome of the course is to enable the students to find, use, and evaluate primary academic writing associated with the communication discipline and they will develop knowledge, various professional skills and judgment around human communication that facilitate their ability to work collaboratively with others.

Course Contents:

Module I: Fundamentals of Communication

Communication: Definition, Process, Importance of Communication, Principles of Communication: 7C's, Role of Critical and Creative Thinking in Effective Communication.

Module II: Forms of Communication

Verbal Communication, Non-verbal Communication, Intrapersonal Communication, Interpersonal Communication, Mass Communication, Media Communication, Formal and Informal Communication

Module III: Barriers to Communication

Verbal Barriers, Non-Verbal Barriers, Semantic Listening Barriers, Physical and Mechanical Barriers, Psychological Barriers

Examination Scheme:

Components	Written Test	CAF	CT	V/P	GD/Extempore	A
Weightage (%)	50	10	10	15	10	5

CAF- Communication Assessment File, **V/P**- Viva/Presentation, **GD**- Group Discussion, **A**- Attendance

Text & References:

1. Ramon & Prakash, Business Communication, Oxford.
2. Sydney Greenbaum Oxford English Grammar, Oxford.
3. Successful Communications, MalraTreece (Allyn and Bacon)
4. Effective Technical Communication, M. Ashraf Rizvi.
5. Anjanee Sethi & Bhavana Adhikari, Business Communication, Tata McGraw Hill

HUMAN VALUES AND ETHICS

Course Code: BEH2361 **Credit Units: 01**

Course Objective:
To help students distinguish between values and skills, and understand the need, basic guidelines, content and process of value education. Also to help students understand the meaning of happiness and prosperity for a human being and to facilitate the students to understand harmony at all the levels of human living, and live accordingly.

Course Contents:
Module-I Course Introduction - Need, Basic Guidelines, Content and Process for Value Education
Understanding the need,–what is it?, Happiness and Prosperity, Basic requirements for, fulfillment of aspirations, Understanding and living in harmony at various levels.

Module II: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship
Understanding harmony in the Family- the basic unit of human interaction, Understanding values in human-human relationship, Trust and Respect as the foundational value of relationship, Understanding the harmony in the society

Module III: Understanding Harmony in the Nature
Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature Holistic perception of harmony at all levels of existence.

Module IV: Implications of Holistic Understanding of Harmony on Professional Ethics
Natural acceptance of human values, Ethical Human Conduct, basis for Humanistic Education Competence in Professional Ethics, Level of individual: as socially and ecologically responsible engineers, technologists and managers, and at the level of society: as mutually enriching institutions and organizations.

Module V:
End-of-Semester Appraisal, Viva based on personal journal, Assessment of Behavioural, change as a result of training, Exit Level Rating by Self and Observer

Examination Scheme: Total Internal (50)

Components	SAP	Journal for Success (JOS)	A	Mid Term Test / CT / Assignment	VIVA / Presentation
Weightage (%)	15	10	5	10	10

Reference Books:

1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991

4. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
5. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
6. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
7. A N Tripathy, 2003, Human Values, New Age International Publishers.
8. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati.

Text & References:

1. Blonna, Richard; Coping with Stress in a Changing World: Second edition
2. Pestonjee, D.M, Pareek, Udai, Agarwal Rita; Studies in Stress And its Management
3. Pestonjee, D.M.; Stress and Coping: The Indian Experience
4. Clegg, Brian; Instant Stress Management – Bring calm to your life now

FRENCH WRITTEN EXPRESSION

Course Code: LAN2301 **Credit Units: 02**

Course Objective: This course enables the students to strengthen their current communication skills in oral and written, to enrich their vocabulary and formulations using tenses and situation-related glossary and to provide them with a basic knowledge of French cuisine.

Course Content:

Module I : A visit to France	
• Visiter différents villes • Le printemps!	• Visiting different places • Spring time!
Module II: Reunion of old friends	
• Ça fait longtemps… (utiliser le passé composé) • Activités récentes ... (en utilisant le passé récent)	• It's been a long time… (using passé composé) • Recent activities ... (using passé récent)
Module III : Grammar	
• Les verbes : 'ir groupe' devoir, falloir • Les prépositions de lieu, de pays • l'impératif, le passé composé, forme et accord du participe passé, la négation au passé composé • Passé composé avec être, avoir et les verbes pronominaux • Les indicateurs de temps (il y a, depuis)	• Verbs: 'ir group', must • Prepositions, with country name • The imperative, the present perfect, the negation and the past participle • Passé compose with être, avoir and the pronominal verbs • Time indicators (since, then)

Examination Scheme:

Components	Mid-Term	Home Assign.	Viva-voce	Attendance	End -Term
Weightage (%)	10	15	20	5	50

Text & References:

- Andant, Christine et al. A propos A1 Livre de l'élève and Cahier d'exercices. Grenoble: Presses universitaires de Grenoble, 2010.
- Girardeau, Bruno et Nelly Mous. Réussir le DELF A1. Paris: Didier, 2010.

References:

- Modern French course by Mathurin Dondo, Oxford
- 450 exercices de grammaire, Clé International
- 3-in-1 French Grammar, Vocabulary & Verbs, Collins
- French-English-French dictionary, Larousse

Syllabus – Fourth Semester

GENETICS AND CELL BIOLOGY

Course Code: EBT2401 **Credit Units: 04**

Course objective
The course objective is to provide the comprehensive knowledge on the how the cell system works and how the progeny cells will be generated via cell division. This course also provides the genetics of cell maintenance and cell division, how the genetic information is transferred from one generation to next generation. Compiled information will be provided how the cell biology works in genetics level and molecular level.

Module I
Cell theory, pre-cellular evolution, prokaryotic and eukaryotic cells Origen and diversion. Cell structure of prokaryotes and eukaryotes. Differences between prokaryotic and eukaryotic cells. Cell cycle: molecular events, cell division, mitosis and meiosis.

Module II
Cellular organelles - structure and function of cell wall, plasma membrane nucleus, Mitochondria, Chloroplast, Nucleus, lysosomes, peroxisomes, golgi bodies, and transport across membranes. Cell locomotion- cytoskeleton, structure and function of cilia and flagella.

Module III

Cellular signalling –general mechanism of signal transduction and structures of the various types of receptors and traducing mediators (G-proteins and 2° and 3° mediators participate in signal transduction). Types of cancer and etiology of cancer, metastasis, cytological role of p53 and p21 genes in cancer development, Apoptosis.

Module IV
Genetics: classical and molecular genetics, Mendelian principles of inheritance. Extension of Mendelism: Allelic variations, influence of environment on expression, penetrance and expressivity, epistasis, pleiotropy. Chromosomal basis of inheritance; genetic linkage, crossing over and genetic variations and karyotyping and chromosome mapping.

Module V
Mutation and mutagenic agents, types of mutations. Numerical and structural changes in chromosomes with emphasis on human syndromes. plant breeding, genetic linkage of phenotype via QTLs. Evolutionary and Economic importance of mutations.

Module VI
Classical and modern concept of gene, pseudoallelism, position effect, intragenic crossing over & complementation (cistron, recon & nutron) Benzer‟s work on rII locus in T_2 bacteriophage. Genetics of Population: Hardy- Weinburg Law and its deviations.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text & References:

Text:

- Cell and Molecular Biology, Gerald Karp, John Wiley and Sons Inc.
- Cell and Molecular Biology, DeRobertis, B.I. Publication Pvt. Ltd.
- Genetics, P.K. Gupta, Rastogi Publication
- Concepts of Genetics (Sixth Edition), William S. Klug and Michael R, Cummings, Pearson Education

References:

- Cell in Development and Inheritance, E.B. Wilson, Macmilian
- Developmental Biology, S.F. Gilbert, Sinauer Associates Inc.
- Essential Cell Biology : An Introduction to the Molecular Biology of the Cell, B. Alberts, D. Bray, A. Johnson, J. Lewis, M. Roff, K. Robert, P. Walter and K. Roberts, Garland Publishing Company
- Molecular Cell Biology, H.Lodish, A.Berk, S.L. Zipursky, P. Matsudaura, D. Baltimore and J. Danell, W.H. Preeman and Company.
- Genetics, M.W. Strickberger, Prentice Hall College Division
- Genetics, P.J.Russell, Benjamin/Cummings
- Principles of Genetics, E J Gardner, John Wiley & Sons Inc.
- Genetics, R. Goodenough, International Thomson Publishing
- Introduction to Genetic Analysis, A.J. F. Griffiths, W.H. Freeman and Company
- Principles of Genetics, D.P. Snustad& M.J. Simmons, John Wiley and Sons Inc.
- Molecular Biology of the Gene (Fifth Edition), J.D. Watson, A.M. Weiner and N.H. Hopkins, Addison – Wiesley Publishing

BIOSTATISTICS

Course Code: EBT2402 **Credit Units: 03**

Course Objective:
The course aims to develop competency and expertise in the application of statistical methods applied to biological data obtained in experimental techniques, methodology and the safe laboratory practice.

Course Contents:
Module I
Statistics and Biostatistics: Preliminary concepts; Measures of Central Tendency: Mean, Median, Mode Measures of Dispersion: Range, Standard deviation, Variance

Module II: Probability
Random Experiments, Trial and Event, Sample Space, Mutually Exclusive or Disjoint Events, Mutually Exhaustive Events, Equally Probable Events, Complementary Event, Classical definition of Probability, Statistical definition of Probability, Axiomatic definition of Probability, Addition theorem, Multiplication theorem, Conditional Probability, Baye's Theorem.

Module III: Continuous Distribution
Normal Distribution, Properties of Normal distribution

Module IV: Correlation
Bivariate distribution Correlation, Types of Correlation, Simple Correlation Coefficient for ungrouped data, Properties and Interpretation of Correlation Coefficient, Scatter diagram, Probable error of Correlation Coefficient. Rank correlation, Some examples.

Module V: Regression
Definition, Regression lines and Regression Coefficients, Properties of Regression Coefficients, Some examples. Method of least square: Fitting of straight line.

Module VI: Introduction to the following Statistical terms
Parameter, Statistic, Null hypothesis, Alternative hypothesis, Critical region, Type1 Error, Type 11 Error, Level of significance.
Test of Significance for Small samples: One sample t-test, Paired t-test, Degrees of freedom for t-test.
Test of Significance for Large samples: Normal test for sample mean and population mean, Normal test for two sample means.
Chi-square Test: Test of goodness of fit.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project	Seminar/Quiz	EE
Weightage (%)	10	5	10	5	70

Text & References:
Text:
- Introduction to Biostatistics, Ronald N. Forthfer and Eun Sun Lee, Publisher: Elsevier.
- Statistical Methodology, S.P. Gupta, Publisher: S. Chand & Co.
- Fundamentals of Statistics, S.C. Gupta. Publisher: S.Chand & Co.

References:
- Biostatistics: A manual of Statistical Methodology for use in Health, Nutrition and Anthropology, K. Visweswara Rao. Publisher: Jaypee Brothers Biostatistics: A foundation for analysis in the Health Sciences, W.W. Daniel, Publisher: John Wiley and Sons
- Fundamentals of Mathematical Statistics, S.C. Gupta and V.K. Kapoor, Publisher: S.Chand & Co.
- Statistical Analysis, Kaushal, T.L. Publisher: Kalyani Publishers

- Statistical Methods, Potri, D. Kalyani Publishers.
- Mathematical Statistics, H.C. Saxena, and V.K. Kapoor: S. Chand & Company
- Biostatistics, P.N. Arora and P.K. Malhan, Publisher: Himalaya Publishing House

ENZYME TECHNOLOGY

Course Code: EBT2403 **Credit Units: 04**

OBJECTIVE:
The objective of the course is to familiarize the student with enzymes, their kinetics, purification and applications in different fields. At the end of the course, the students will have sufficient scientific understanding of the Enzymology. This knowledge would be applicable in different industries

Module I- Introduction to Enzymes:
Classification: Trivial & EC system, Properties of enzymes, Enzyme substrate interactions, enzyme substrate complex, concept of active site, transition state theory, Effect of pH, temperature & substrate concentration on reaction rate, Factors affecting catalytic efficiency - proximity and orientation effects, Chemical modification of enzymes.

Module II- Enzyme Kinetics & Regulation of Enzyme Action:
Enzyme substrate complex: concept of E-S complex, binding sites, active site, specificity, Kinetics of enzyme activity, Michaelis-Menten equation and its derivation, Different plots for the determination of Km and Vmax and their physiological significance, Structure-Function Relations: chymotrypsin, lysozyme, metalloenzyme and the role of metals in catalysis with reference, to carboxypeptidases. Ribozymes, Kinetics of Allosteric enzymes.

Module III- Immobilization of Enzyme & its applications:
Various methods of immobilization - ionic bonding, adsorption, covalent bonding (based on R groups of amino acids), microencapsulation and gel entrapment, kinetics of immobilized, enzyme. Applications of enzymes: Food processing, Medicine, Diagnostics, Production of new compounds, research tools (ELISA method), Leather Industry & Textile Industry.

Module IV- Enzyme Reactors:
Reactors for batch/continuous enzymatic processing, choice of reactor type, idealized enzyme reactor systems, Mass transfer in enzyme reactors, steady state analysis of mass transfer.

Module V- Challenges and Future trends:
Recent advances in enzyme technology, Use of unnatural substrates, Enzyme engineering, Artificial enzymes, Coenzymes-regenerating systems.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text and Reference Books:

1. Fundamentals of Enzymology. Nicolas C. Price and Lewis Stevens. Oxford University press. 2000.
2. Biochemistry by Stryer (4th edn) Fundamentals of Biochemistry by A. C. Deb. Biochemistry by Zubay.
3. Biotechnological Innovations in Chemical Synthesis by R.C. B. Currell, V. D. Mieras, Biotol Partners Staff Publisher: Butterworth Heinenmann
4. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry by Trevor Palmer and Philip L. Bonner, East-West Press Private Limited
5. Industrial Enzymes and their Application by H. Uhlig. Publisher: John Wiley and Sons Inc
6. Enzyme kinetics: Behavior and Analysis of Rapid Equilibrium and Steady –State Enzyme Systems by I.H. Segel Publisher: Wiley-Interscience
7. Enzyme Technology by M. F. Chaplin and C. Bucke. Publisher: Cambridge University Press
8. Principles of Biochemistry by Lehninger, A.L., Worth Publishers, New York (2007)

HEAT AND MASS TRANSFER

Course Code: EBT2404 **Credit Units: 04**

Course Objective: This course is designed to introduce a basic study of the phenomena of heat and mass transfer, to develop methodologies for solving a wide variety of practical problems in biochemical engineering, and to provide useful information concerning the performance and design of particular systems and processes.

Module 1: **Introduction of Heat Transfer**

Introduction to various modes of heat transfer, Fourier's law of heat conduction, Effect of temperature on thermal conductivity, Steady and unsteady state conduction, Thermal resistances, Heat flow through a cylinder, sphere, critical radius of insulation, Thermal diffusivity.

Module2: **Convective heat transfer**

Heat flux, Average temperature of fluid stream, Overall heat transfer coefficient, LMTD, Individual heat transfer coefficient, Relationship between individual and overall heat transfer coefficient, concept of heat transfer by convection, Application of dimensional analysis for convection, Heat exchange equipments, Single pass, 1-1 double pipe exchanger, 1-2 parallel counter flow exchanger, Enthalpy balance in heat exchange equipments, Evaporation, Condensation.

Module 3: **Introduction to mass transfer**

Molecular diffusion in fluids, Diffusivity, Film Theory, Mass transfer coefficients, Interphase mass transfer, Gas absorption, counter current multistage operation, Calculation of NTU, HTU and number of stages, HETP.

Module 4: Distillation

Vapour liquid equilibrium, Rayleigh's equation, Flash distillation and differential distillation for two component mixture, McCabe-Thiele method, Bubble cap and sieve distillation column, Azeotropic and extractive distillation.

Module 5: **Mass Transfer Processes**

Extraction, Drying and Crystallization, Liquid-liquid equilibrium, Liquid extraction, Leaching, Batch drying, Principle and operation of a spray drier, Preliminary idea of crystallization.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text & References:

***Text*:**

- Heat Transfer by K.A. Gavhane
- Mass Transfer by Trebol
- Heat and Mass transfer by McCabe Smith

***References*:**

- Chemical Engineering by Coulson and Richardson, Vol I & II. Pergamon Press, New York.
- Heat and Mass Transfer by P K Nag, third edition. Tata McGraw Hill publishing, New Delhi, India

ENVIRONMENTAL BIOTECHNOLOGY

Course Code: EBT2405 **Credit Units: 03**

Course Objective:
The objective of this course is to familiarize the students with the processes and micro organism that can be employed for a cleaner environment. The students will be applying basic knowledge of microbiology for developing the practices for a cleaner environment, water, fuel, fertilizer, pesticides etc. The course also aims to make the students aware of legislation and acts prevalent to control the degradation of our eco system.

Course Contents:

Module I
Treatment of municipal wastes and industrial effluents (Physico-Chemical, biological analysis of waste water), Rr. Sec and test waste water treatment sludge treatment and disposal treatment of wastes from paper, textile, dairy, petrochemical and pharmaceutical industry .

Module II
Bioremediation and phytoremediation of toxic compounds like pesticides, hydrocarbons, polymers, surfactants, biotransformation and bioaccumulation

Module III
Renewable and non-renewable energy resources, clean fuel technology, biofuels.

Module IV
Biofertilizers and biopesticides – a cleaner agricultural practice, concept of N_2 - fixation, azolla, cyanobacteria, Rhizobium and VAM as biofertilizers.

Module V
Biomining – microbe assisted microbial leaching, bioaccumulation and biosorption, Biosensors and biomarkers for ecotoxicity measurement, EIA and Environmental audit.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text & References:

***Text*:**

- Environmental Biotechnology – Concepts and Applications, Hans-Joachim Jordening and Jesef Winter
- Introduction to Environmental Biotechnology, Milton Wainwright

***References*:**

- Waste Water Engineering, Metcalf and Eddy. Publisher: Tata McGraw hill
- Agricultural Biotechnology, S.S. Purohit
- Environmental Microbiology: Methods and Protocols, Alicia L. Ragout De Spencer, Jonh F.T. Spencer.
- Principles of Environmental Engineering, Gilbert Masters

GENETICS AND CELL BIOLOGY LAB

Course Code: EBT2406 **Credit Units: 01**

Course Contents

Module I
Microscopy: Light microscopy, Bright field, Phase contrast.

Module II
Study of chromoplasts, chloroplast in plant cell; Mitosis and Meiosis

Module III
Study of permanent slides of types of cancer; Study of apoptosis

Module IV
Protoplast Isolation from plant source

Module V
Study of bacterial transformation, conjugation and bacterial transduction.

Module IV
Study of physical and chemical mutagens on growth of *E. coli*; PTC test.

Examination Scheme:

IA			**EE**			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

ENZYME TECHNOLOGY LAB

Course Code: EBT2407 **Credit Units: 01**

Course Contents:

1. Isolation of amylase from bacteria/ protease from pulse/ cellulase from fungi.
2. Partial purification of enzyme by ammonium sulphate fractionation.
3. Assay of enzymes and specific activity of amylase, cellulose & protease.
4. Substrate specificity of enzymes.
5. Kinetics of enzyme catalysed reactions: Effect of varying substrate concentration on enzyme activity, determination of Michaelis-Menten constant (Km) and Maximum Velocity (Vmax.) using Lineweaver-Burk plot.
6. Effect of temperature and pH on enzyme activity.
7. Immobilisation of enzymes.
8. Micro environmental effects on immobilised enzymes.

Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

ENVIRONMENTAL BIOTECHNOLOGY LAB

Course Code: EBT2408 **Credit Units: 01**

Course Contents:

1. Investigation of biochemical oxygen demand in waste water
2. Investigation of chemical oxygen demand in waste water
3. Investigation of hexavalent chromium in waste water
4. Investigation of sulphate in waste water
5. Estimation of optimum dosage of ferric chloride for removal of suspended matter
6. Nitrogen estimation by Kjeldahl method
7. MPN (most probable number) technique for water quality testing
8. Biodegradation of pesticides by microbes
9. Bioaccumulation of heavy metals

Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

TECHNICAL WRITING & PROFESSIONAL ETHICS

Course Code: CSS2401 **Credit Units: 01**

Course Objective:

The course is intended to develop efficient technical writing skills for official correspondence; students will be able to exhibit a high degree of professional conduct in the course of their practice of the profession and in their relationship with the society in general.

Course Outcome:

Intended outcome of the course is to enable the students to participate actively in writing activities (individually and in collaboration) that model effective scientific and technical communication in the workplace and to apply technical information and knowledge in practical documents for a variety of professional audiences (including peers and colleagues or management) and public audiences.

Course Contents:

Module I: Official Correspondence

Memo, Notice and Circulars, Agenda and Minutes, Business Letters and Resume, Business Reports- Features, Structure, Style

Module II: Dynamics of Professional Presentations

Audience Analysis, Presentation Skills, Effective PowerPoint Presentation, Individual and Group Presentations, The Art of Negotiation, Telephonic Skills

Module III: Professional Ethics

Ethics-Definition and Importance, Human Values, Professional ethics and codes of conduct

Examination Scheme:

Components	Written Test	CAF	CT	V/P	GD/Extempore	A
Weightage (%)	50	10	10	15	10	5

CAF- Communication Assessment File, **V/P**- Viva/Presentation, **GD**- Group Discussion, **A**- Attendance

Text & References:

1. Christopher Preece, Ross Dixon, and Simon Robinson, Engineering, Business and Professional Ethics, Elsevier, London
2. A. Alavudeen, M. Jayakumaran, and R. Kalil Rahman, Professional Ethics and Human Values, Laxmi Pub, New Delhi.
3. Successful Communications, Malra Treece (Allyn and Bacon)
4. Effective Technical Communication, M. Ashraf Rizvi.
5. AnjaneeSethi & Bhavana Adhikari, Business Communication, Tata McGraw Hill

ENTREPRENEURSHIP

Course Code: CRC2401 **Credit Units: 02**

Course Objective:
The aim of this course is to have a comprehensive perspective of inclusive learning, ability to learn and implement the Fundamentals of Entrepreneurship. It enables students to learn the basics of Entrepreneurship and entrepreneurial development which will help them to provide vision for their own Start-up.

Course Contents:

Module I: Entrepreneurial Perspectives:
Evolution, Concept of Entrepreneurship, Types of Entrepreneurs, Entrepreneurial Competencies, Capacity Building for Entrepreneurs. Entrepreneurial Training Methods; Entrepreneurial Motivations; Models for Entrepreneurial Development, The process of Entrepreneurial Development.

Module II: Regulations
Role of Regulatory Institutions; Role of Development Organizations; Self Employment Oriented Schemes; Various grant schemes

Module III: Management of MSMEs and Sick Enterprises Challenges of MSMEs, Preventing Sickness in Enterprises – Specific Management Problems; Industrial Sickness; Industrial Sickness in India – Symptoms, process and Rehabilitation of Sick Units.

Module IV: New Venture Creation
Introduction, Mobility of Entrepreneurs, Models for Opportunity Evaluation; Business plans – Purpose, Contents, Presenting Business Plan, Procedure for setting up Enterprises, Central level – Startup and State level – Incubators, Other Institutions initiatives.

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage(%)	5	10	8	7	70

CT: ClassTest, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; A:Attendance

Text & References:
Text:
- Entrepreneurship Development and Small Business Enterprises, Poornima M. Charantimath, 2e, Pearson, 2014.
- Entrepreneurship, A South – Asian Perspective, D. F. Kuratko and T.V. Rao, 3e, Cengage, 2012.

References:
- Entrepreneurship, Arya Kumar, 4 e, Pearson 2015.
- The Dynamics of Entrepreneurial Development and Management, Vasant Desai, Himalaya Publishing House, 2015.

COMMUNICATION FRENCH

Course Code: LAN2401 **Credit Units: 02**

Course Objective: This course enables the students to acquire more vocabulary, to use all negative expressions, adjectives, new tenses, to understand more advanced texts and start describing any situation using Past Tense, Imperfect, present progressive, and future tenses and also to enable them to identify and talk about famous monuments of France.

Course Content:

Module I: Childhood memories	
• Souvenirs d'enfance: un texte imparfait. • Une célébration mémorable - différence entre le passé composé et imparfait	• Childhood memories: a text using imperfect. • A memorable celebration - difference between passé composé and imperfect
Module II: Planning for a vacation	
• S'exprimer en utilisant le futur. • Plans futurs: conjugaison et utilisation du futur simple (verbes exceptionnels). • Décrire les actions continues dans le présent utilisant « Etre en train de, sur le point de »	• Expressing oneself using future tense. • Future plans: conjugation and usage of simple future tense (exceptional verbs). • Describing continuous actions in present by using « Etre en train de, sur le point de »
Module III: Grammar	
• L'imparfait, • La comparaison du verbe/du nom ; mieux/meilleur • Les pronoms relatives	• The imperfect, • The comparison of the verb / the name; better • The pronouns parents

Examination Scheme:					
Components	Mid-Term	Home Assign.	Viva-voce	Attendance	End -Term
Weightage (%)	10	15	20	5	50

Text & References:

- Andant, Christine et al. A propos A1 Livre de l'élève and Cahier d'exercices. Grenoble: Presses universitaires de Grenoble, 2010.
- Girardeau, Bruno et Nelly Mous. Réussir le DELF A1. Paris: Didier, 2010.

References:

- Modern French course by Mathurin Dondo, Oxford
- 450 exercices de grammaire, Clé International
- 3-in-1 French Grammar, Vocabulary & Verbs, Collins
- French-English-French dictionary, Larousse

Syllabus – Fifth Semester

MOLECULAR BIOLOGY

Course Code: EBT2501 **Credit: 03**

Course Objective: The objective of the course is to provide a clear understanding of basic concepts of molecular events operational inside the cell. The student would be expected to understand the complete structure of central dogma of life and understand the process governing the gene expression. Strong foundation in molecular biology enables the students to familiarize themselves with genetic engineering and recombinant DNA technology.

Course Contents:

Module I: DNA Structure and Replication
Structure of DNA, Models of DNA Replication, DNA polymerases, mechanism of DNA replication in prokaryotes and Eukaryotes, Mechanism of DNA damage & repair.

Module II: Transcription
Transcription of DNA, RNA Polymerases and the transcription cycle, Transcription mechanism in Prokaryotes and Eukaryotes. Inhibitors of RNA synthesis.

Module III: Post-transcriptional Processing of RNA
Processing of RNA Processing of mRNA-5'cap formation; 3' polyadenylation, RNA splicing mechanism, Exon shuffling, RNA editing, mRNA transport.

Module IV: Translation
Genetic code, mRNA, tRNA, and Ribosome, charging of t-RNA, Mechanism of protein synthesis. Inhibitors of protein synthesis. Post translational modifications.

Module V: Regulation of gene expression
Regulation in prokaryotes – repressors and negative control, positive control, role of cAMP, AMP receptor protein, *lac* operon and *ara* operons, Catabolite repression, Regulation in Eukaryotes promoters and enhancers, transcriptional regulatory protein, transcriptional activators and factors.

Module VI: Gene Silencing
Basic concepts of gene silencing, siRNA, miRNA, RNA Interference, Ribozymes, Antisense technology, Applications of antisense technology.

Examination Scheme:

Components	CT	Attendance	Assignment Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text book:

1. Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox Publisher: W. H. Freeman.
2. Molecular Biology of the Cell, Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, and James D Watson. Publisher New York: Garland Science

3. Molecular Biology of the gene by Watson
4. Molecular Cell Biology by Harvey Lodish, David Baltimore, W. H. Freeman Publisher.
5. Molecular Biology by D Friefelder

Reference Book

Concepts of Genetics, W.S. Klug, and M.R. Cummings 2004, Pearson Education

IMMUNOLOGY

Course Code: EBT2502 **Credit: 03**

Course Objective:

Role of antibody engineering in biomedical applications and the importance of immuno genetics in disease processes, tissue transplantation and immune regulation are some of the areas of attributes of this course which can help the students to understand the biotechnology related to human kind.

Course Contents:

Module I
Historical perspective of immune system and immunity; Innate and specific immunity, Humoral immunity, Cell-mediated immunity.

Module II
Cells of the immune system, Hematopoiesis, organs of the immune system, central and peripheral immune system, mode of antigen presentation

Module III
B cell receptor, Types of antibodies and their structures, isotypes, allotypes, idiotypes, Genetic basis of antibody diversity. T Cell receptor, Histocompatibility: structure of MHC class I & II, MHC restriction, Self-tolerance in relation to MHC.

Module IV
Complement system, Autoimmunity, Hypersensitivity, Transplantation immunology, Cancer immunology and checkpoint therapy, immunity against infectious disease.

Module V
Measurement of antigen – antibody interaction: agglutination, immunodiffusion, immune electrophoresis, ELISA, RIA, production of monoclonal antibodies, Hybridoma Technology.

Examination Scheme:

Components	**CT**	**Attendance**	**Assignment/ Project/Seminar/Quiz**	**EE**
Weightage (%)	15	5	10	70

Text & References:

Text:

- Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company
- Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company

References:

- Fundamentals of Immunology, W. Paul, Lippincott Williams and Wilkins
- Immunology, W.L. Anderson, Fence Creek Publishing (Blackwell).
- Immunology: A Short Course, E. Benjamin, R. Coico and G. Sunshine, Wiley-Leiss Inc.
- Immunology, Roitt, Mosby – Yearbook Inc.
- Kuby Immunology, R.A. Goldsby, T.J. Kindt, and B.A. Osborne, Free

BIOPROCESS TECHNOLOGY

Course Code: EBT2503 **Credit: 03**

Course Objective:
Bioprocess Technology deals with the study of the engineering concepts for biological conversion of raw materials to food, pharmaceuticals, fuels, and chemicals. In this course, the emphasis is placed on enzyme kinetics and technology, bioreaction kinetics, and downstream processing of bioreaction products.

Course Contents:

Module I: Introduction to Bioprocess
Introduction to Bioprocess, Steps of a bioprocess development. Bioreactor / Fermenter – types & operation of Bioreactors. stages of fermentation processes. Submerged and Solid state fermentation. Advantages & disadvantages of Submerged and Solid state fermentation.

Module II: Media, sterilization and inoculum
Development of media for industrial fermentations, carbon sources, nitrogen sources, buffers, oxygen, antifoams, medium optimization, Sterilization of fermenter, sterilization of feed. Inoculum transfer criteria, development of inocula for yeast processes, bacterial processes and fungal processes

Module III: Kinetics of Microbial growth
Batch growth, cell growth kinetics in batch culture, production kinetics in cell culture, kinetics of substrate uptake, effect of culture conditions on cell kinetics, determining cell kinetic parameters from batch data, maintenance effect and kinetics of cell death

Module IV: Recovery and Purification of products
Strategy to recover and purify products, separation of insoluble products (filtration, centrifugation, coagulation and flocculation), Cell disruption (mechanical and non-mechanical methods), Separation of soluble products (liquid-liquid extraction, aqueous two-phase extraction)

Module V: Traditional industrial bioprocesses
Anaerobic bioprocesses – Ethanol production, lactic acid production, acetone-butanol production, Aerobic processes – citric acid production, penicillin production

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text and Reference:

1) Bioprocess Engineering Basic Concepts, M.L. Shuler and F. Kargi, Prentice Hall
2) Bioprocess Engineering Principles, P Doran, Academic Press
3) Principles of Fermentation Technology, Stanbury and Whittaker

BIOINFORMATICS

Course Code: EBT2504 **Credit: 03**

Course Objective:
The course involves a basic understanding of computer and bioinformatics tools and skills in the field of biology.

Course Contents:

Module I: Introduction and overview
Introduction to Bioinformatics and computational Biology; Biological Databases, sequence databases, sequence retrieval, sequence file formats, submitting DNA and protein sequences; classification of biological databases

Module II: Biological Databases
Sequence databases, Nucleotide and Protein databases, Protein family/domain databases, Cluster databases-An Introduction, Specialised databases, Structural databases

Module III: Sequence alignment
Global and local alignments, statistical significance of alignments, scoring matrices and gap penalties, position specific scoring matrices, programs and methods for Pairwise and multiple alignment, family and superfamily representation, Hidden Markov Model

Module IV: Phylogenetic prediction
Phylogenetic analysis, Types of phylogenetics trees, Evolutionary Models, Character and distance based Tree building methods; tree evaluation, phylogenetic analysis, parsimony, maximum likelihood trees; Trees-splits and metrices on trees, tree interpretation,

Module V: Predictive methods using DNA and protein sequences
ESTs: construction, databases, clustering, gene discovery and identification, and functional classification. Protein identification tools, physical properties, motifs and patterns, structure, folding classes, structure classification databases – Scop and Cath;

Module VI: Structure databases
Structural databases - PDB and MMDB, structure file formats, Secondary and tertiary structure prediction methods in proteins, software to visualize secondary and tertiary structural information in protein. Reconstruction of metabolic pathways, gene identification, Introduction to Python and application of Machine learning in bioinformatics.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text & References:

Text:

- Introduction to Bioinformation – T.Attawood
- Essentials of Genomics and Bioinformatics, C.W. Sensen, John Wiley and Sons
- Bioinformatics: Sequence and Genome Analysis, D.W. Mount, Cold Spring Harbor Laboratory Press

MOLECULAR BIOLOGY LAB

Course Code: EBT2505 **Credit: 01**

Course Contents:

1. Isolation of genomic DNA.
2. Isolation of plasmid DNA.
3. Isolation of eukaryotic total RNA.
4. Visualization of isolated DNA by agarose gel electrophoresis.
5. Separation of protein samples by SDS-PAGE.
6. Study of Lac induction via β-gal assay.

Examination Scheme:

Internal Assessment			**External Examination**			
Class test (Practical Based)	Mid Term Viva	Attendance	Major Experiment	Minor Experiment	Practical Record	Viva
15	10	05	35	15	10	10

IMMUNOLOGY LAB

Course Code: EBT2506 **Credit: 01**

Course Contents:

Module I
Blood film preparation and identification of cells.

Module II
Isolation of serum, Purification of lgG through affinity chromatography

Module III
Lymphoid organs and their microscopic organization.

Module IV
ELISA Techniques, WIDAL Test, Blotting Techniques.

Module V
Radial Immuno Diffusion Test; Ouchterlony Double diffusion Test

Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

BIOPROCESS TECHNOLOGY LAB

Course Code: EBT2507 **Credit: 01**

Course Objective:

To train on methods to investigate the growth of microorganisms in different systems under different conditions.
To gain useful skill and knowledge by analogy when solving problems typical for the bio industry or for research

Module I:
Understanding the parts and basic operating principles of a fermenter, Design of fermenter**.**

Module II:
Isolation and screening of microorganism from environment samples.

Module III:
Determination of Thermal Death Point and Thermal death time of micro-organisms for design of a sterilizer.

Module IV:
Study of growth kinetics of micro-organism, determination substrate utilization rate and to compute specific growth rate and growth yield from the data obtained.

Module V:
Comparative studies of ethanol production using different substrates.

Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

BIOINFORMATICS LAB

Course Code: EBT2508 **Credit: 01**

List of Experiments/Exercises

1. Assessing database from NCBI and similarity searching using BLAST and FASTA.
2. Basics of sequence analysis Retrieving a sequence-nucleic acid/Protein
3. Local and Global Alignment- concepts Pair wise sequence alignment, Smith Watermann Algorithm Needleman Wunsch Algorithm
4. Multiple sequence alignment
5. Phylogenetic Analysis of sequences
6. Homology Modelling
7. ORF Finding
8. Molecular modeling/Docking.
9. Basic machine learning using WEKA tool.

Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

SUMMER INTERNSHIP – I

Course Code: EBT2535 **Credit: 01**

GUIDELINES FOR SUMMER INTERNSHIP REPORT FILE

Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation.

Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critiqued by the faculty guide and corrected by the student at each stage.

The File is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation.

Methodology

The students will be sent to various industries and institutes where they will undergo short term training. After the completion of the training the students will be required to submit project report which shall then be evaluated by two internal examiners. The students will then have to appear for a Viva Voce examination to be conducted by an external evaluator at the end of the semester.

In general, the File should be comprehensive and include

- A short account of the activities that were undertaken as part of the project
- A statement about the extent to which the project has achieved its stated goals
- A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project
- Any activities planned but not yet completed as part of the project, or as a future initiative directly resulting from the project
- Any problems that have arisen that may be useful to document for future reference.

Report Layout

The report should contain the following components:

Title or Cover Page

The title page should contain the following information: Project Title; Student‟s Name; Course; Year; Supervisor‟s Name.

Acknowledgements (optional)

Acknowledgment to any advisory or financial assistance received in the course of work may be given.

Abstract

A good "Abstract" should be straight to the point; not too descriptive but fully informative. First paragraph should state what was accomplished with regard to the objectives. The abstract does not have to be an entire summary of the project, but rather a concise summary of the scope and results of the project

Table of Contents

Titles and subtitles are to correspond exactly with those in the text.

Introduction

Here a brief introduction to the problem that is central to the project and an outline of the structure of the rest of the report should be provided. The introduction should aim to catch the imagination of the reader, so excessive details should be avoided.

Materials and Methods

This section should aim at experimental designs, materials used. Methodology should be mentioned in details including modifications if any.

Results and Discussion

Present results, discuss and compare these with those from other workers, etc. In writing these section, emphasis should be given on what has been performed and achieved in the course of the work, rather than discuss in detail what is readily available in text books. Avoid abrupt changes in contents from section to section and maintain a lucid flow throughout the thesis. An opening and closing paragraph in every chapter could be included to aid in smooth flow.

Note that in writing the various secions, all figures and tables should as far as possible be next to the associated text, in the same orientation as the main text, numbered, and given appropriate titles or captions. All major equations should also be numbered and unless it is really necessary never write in "point" form.

Conclusion

A conclusion should be the final section in which the outcome of the work is mentioned briefly.

Future prospects

Appendices

The Appendix contains material which is of interest to the reader but not an integral part of the thesis and any problem that have arisen that may be useful to document for future reference.

References / Bibliography

This should include papers and books referred to in the body of the report. These should be ordered alphabetically on the author's surname. The titles of journals preferably should not be abbreviated; if they are, abbreviations must comply with an internationally recognised system.

Examples

For research article

Voravuthikunchai SP, Lortheeranuwat A, Ninrprom T, Popaya W, Pongpaichit S, Supawita T. (2002) Antibacterial activity of Thai medicinal plants against enterohaemorrhagic *Escherichia coli* O157: H7. *Clin Microbiol Infec*, **8** (suppl 1): 116–117.

For book

Kowalski, M. (1976) Transduction of effectiveness in *Rhizobium meliloti*. SYMBIOTIC NITROGEN FIXATION PLANTS (editor P.S. Nutman IBP), **7**: 63-67

ASSESSMENT OF THE PROJECT FILE

Essentially, marking will be based on the following criteria: the quality of the report, the technical merit of the project and the project execution.

Technical merit attempts to assess the quality and depth of the intellectual efforts put into the project. Project execution is concerned with assessing how much work has been put in. The File should fulfill the following ***assessment objectives:***

Range of Research Methods used to obtain information

Execution of Research

Data Analysis
Analyse Quantitative/ Qualitative information, Control Quality

Draw Conclusions

Examination Scheme:

Internal Assessment	External Assessment
Project Report	Viva Voce
60	40
Total	**100**

APPLIED BIOENERGY

Course Code: EBT2509 **Credit: 04**

Course Objective:

The Course objective is to facilitate the students to achieve a clear conceptual understanding of technical and commercial aspects of Bioenergy. The course is believed to make the students have a basic and conceptual knowledge of the technology, economics and regulation related issues associated with Bioenergy.

Course Contents:

Module I – Introduction to Bioenergy
Bioenergy Concepts- Introduction, Biopower, bioheat. Biofuels, advanced liquid fuels, drop-in fuels. - Biobased products

Module II: Biomass as feedstocks for renewable energy
First generation feedstocks – sugar crops, grains, oilseeds. Second generation – Agri-residues, forestry residues. Municipal solid waste. Third generation – micro algae and macro algae.

Module III: Biochemical conversions for biofuel and bioenergy production
Trans-esterification for biodiesel production, Fermentation for bioethanol and biobutanol production, Anaerobic digestion for biogas/biomethane production, Biohydrogen production, Bioelectrochemical systems for bioenergy and chemical production, Biorefinery.

Module IV: Thermochemical conversions for biofuel and bioenergy production
Torrefaction, Slow and fast pyrolysis, Gasification, Combustion. Co-firing – Biomass choices, principles of bioprocesses, reactor types, state-of-the-art of the application of technologies**.**

Module V: Life cycle assessment
Life cycle assessment of biofuels, steps, definition, scope and Objectives, Sustainability and impact assessment. Case studies of LCA assessment.

Examination Scheme:

Components	CT	Attendance	Assignment Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text books

1. G. N. Tiwari and M. K. Ghosal,, *Fundamentals of Renewable Energy Sources*, Narosa Publishing House, , 2007
2. Kishore V V N, *Renewable Energy Engineering and Technology, Principles and Practice*, The Energy and Resources Institute (TERI) , 2009

Reference Books

1. Nijaguna, B.T.,, *Biogas Technology*, New Age International publishers (P) Ltd., , 2002
2. Samir Kumar Khana,, *Bioenergy and Biofuel from Biowastes and Biomass*, ASCE Publications , 2010

BIOSAFETY, BIOETHICS & IPR

Course Code: EBT2510 **Credit: 04**

Course objectives:

To discuss about various aspects of biosafety regulations, IPR and bioethics concerns arising from the commercialization of biotech products. To understand balanced integration of scientific and social knowledge in sustainable development.

Course Contents:

Module-I: Biosafety
History, evolution and concept of biosafety; need and application of biosafety in laboratories and industries; biosafety guidelines, regulations and norms, Implementation of biosafety guidelines; Classification and Description of Biosafety levels.

Module-II: Biosafety Assessment
Risk assessment and containment levels; biohazard, bio-medical and hazardous wastes, handling and disposal; transportation of biological materials; bio-terrorism; biosafety protocol regulations to protect nature; Good laboratory practice (GLP) and Good manufacturing practice (GMP), Use of GMO's and their release.

Module-III: Bioethics
Introduction and need of bioethics, its relation with other branches, types of risk associated with GMOs, Ethical Issues involving GMOs; ethics related to human cloning, human genome project, Socio-economic impact of biotechnology

Module-IV: Ethical issues and case study
Agriculture and animal rights, data privacy of citizens health; ethical issues in India and abroad through case studies.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

REFERENCES

- Beier, F.K., Crespi, R.S. and Straus, T. Biotechnology and Patent protection-Oxford and IBH Publishing Co. New Delhi.
- Cartagena Protocol on Biosafety (2006) Ministry of Environment and Forest, Government of India, New Delhi.
- Encyclopedia of Ethical, Legal and Policy issues in Biotechnology, John Wiley & Sons Inc. (2005).
- Intellectual property rights and Biotechnology (Biosafety and Bioethics), Anupam Singh, Ashwani Singh, NPH, New Delhi

- Jonathan, Y.R., Anthology of Biosafety (Vols. 1-4), American Biological Safety Association (2005).
- Regulatory Framework for GMOs in India (2006) Ministry of Environment and Forest, Government of India, New Delhi
- Sasson A, Biotechnologies and Development, UNESCO Publications.
- Sateesh, M.K., Bioethics and Biosafety, IK International Publishers (2008)
- Singh I. and Kaur, B., Patent law and Entrepreneurship, Kalyani Publishers (2006).
- Singh K, Intellectual Property rights on Biotechnology, BCIL, New Delhi

APPLIED CLINICAL RESEARCH

Course code: EBT2511 **Credits: 04**

Course objective:
Clinical Research is a higher stratum of the biotechnology application in healthcare sector. This is the direct application of the biotechnology product like drugs for various pathology and healthcare issues. Programme deals with clinical experiment and research on drug testing and evaluation in living organisms. The course also included with aspects of research on the various drugs/vaccines design and testing for going with commercialization. It includes the biosafety, ethical safety and productiveness before commercialization.

Course Contents:

Module I: Drug discovery and development
Drug discovery and development, stages of drug development and commercialization, combinatorial synthesis of drugs, Natural products and their clinical tests procedures.

Module II: Pharmacokinetics and clinical research
Introduction to pharmacogenetics, Genetical influence on drug kinetics, Drug metabolic enzymes- Phase I and Phase II enzymes, Drug transporters, classification and their influence in drug efficacy, role of drug metabolizing enzymes in drug dosage.

Module III: Drug Regulation
Drug regulatory systems in India, Clinical postulation in drug testing in animals. Steps in human trails and its ethical regulation. Experimental animals/cell lines for preclinical trials, drug toxicity studies, assessment of preclinical data, assessment of drug risk ratio.

Module IV: Ethical regulations of Clinical research
Good Clinical Laboratory practices, ICMR-guidelines for clinical trials, Ethical regulations in clinical trials, Quality assurance in drug certification, Role of institutional Ethical Committees, Institutional Review Board and its role in clinical tests.

Module V: Regulatory authorities of clinical research
Regulations of preclinical and clinical trials in India, Regulatory authorities of India: India Indian FDA, ICMR, DGFT, DBT; National regulatory authorise and their role in regulation of clinical research, Indian regulatory approval procedures, Quality assurance certification by FDA.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

References:

1. Basic Principles of Clinical Research and Methodology by S.K.Gupta
2. Drug Discovery and Development by Raymond G Hill
3. A guide book for regulatory submission: Sandy Weinberg
4. Introduction to regulatory affairs: Vedjignesh.
5. Essentials of Medical Pharmacology: K. D Tripathi.

DEVELOPING SOFT SKILLS AND PERSONALITY

Course Code: CSS2501 **Credit: 01**

Course Objective:
The course will help the students to boost overall personality, thereby enhancing their career prospects. It will provide a strong conceptual and practical framework to build, develop, manage teams; it will provide strong practical orientation to the students and help them in building and improving their skills in communication, the effective use of English, business correspondence, presentations, team building, leadership, time management, group discussions, interviews, and inter-personal skills. Students will compete successfully in the business environment.

Course Contents:
Module I: Soft Skills for Personality Development
Definition and Objective
Difference between Hard Skills and Soft Skills
Skills for Enhancing Personality

Module II Types of Soft Skills
Communication, Adaptability, Teamwork, Problem Solving
Creative Thinking
Work Ethics
Time Management
Leadership
Interpersonal Skills

Module III: Employability Skills
GD Skills
Interview Skills
Meeting Skills
Telephonic Skills
Activity
Examination Scheme:

Components	Written Test	CAF	CT	V/P	GD/Extempore	A
Weightage (%)	50	10	10	15	10	5

CAF- Communication Assessment File, **V/P**- Viva/Presentation, **GD**- Group Discussion, **A**- Attendance

Text Book:
- Personality Development and Soft Skills by Barun Mitra (Oxford Publication)
- Personality Development and Soft Skills by Smita Rajan (Book Enclave Publisher)
- Soft Skills: Key to Success in Workplace and Life by Meenakshi Raman and Shalini Upadhyay (Cengage Publisher)
- Sizzling Soft Skills for Spectacular Success - A Practical Guide on Personality Development by P. Ameer Ali (Notion Press)

FRENCH ADVANCE GRAMMAR AND COMPREHENSION

Course Code: LAN2501 **Credit: 02**

Course Objective:
This course enables the students to learn the pronunciation, build the new and various vocabularies through French cinema and drama, and to understand the French literature.

Course Content:

Module I: Comparing two people/objects	
• Parler de personnes / objets / lieux • Comparer les biens et les vêtements • Décrire les événements et les personnes; le plus / le moins ... • Description des actions - Formation et utilisation des adverbes	• Talking about people/objects/places • Comparing possessions and habits • Describing events & people; the most / least… • Describing Actions- Formation & usage of adverbs
Module II: Shopping in France	
• Culture et civilisation: Shopping en France • Culture et civilisation: Boutiques - vocabulaire et dialogues	• Culture & civilization : Shopping in France • Culture & civilization : Shops- vocabulary & dialogues
Module III: Grammar	
• Les pronoms compléments directs, les pronoms compléments indirects • Pronom « Y » • Pronom « en »	• Pronouns direct complements, pronouns indirect complements • Pronoun "Y" • Pronoun "en"

Examination Scheme:					
Components	Mid-Term	Home Assign.	Viva-voce	Attendance	End - Term
Weightage (%)	10	15	20	5	50

Text & References:

• Andant, Christine et al. A propos A2 Livre de l'élève and Cahier d'exercices. Grenoble: Presses universitaires de Grenoble, 2010.
• Girardeau, Bruno et Nelly Mous. Réussir le DELF A2. Paris: Didier, 2010.

References:

• Modern French course by Mathurin Dondo, Oxford
• 450 exercices de grammaire, Clé International
• 3-in-1 French Grammar, Vocabulary & Verbs, Collins
• French-English-French dictionary, Larousse

Syllabus – Sixth Semester

RECOMBINANT DNA TECHNOLOGY

Course Code: EBT2601 **Credit: 03**

Course Objective:
A complete understanding of molecular techniques can be obtained through the course. The successful application of biotechnology largely depends on these advanced molecular techniques.

Course Contents:

Module I: Introduction to RDT
Definition and introduction to recombinant DNA Technology (RDT). Concept of cloning, Enzyme used in RDT: Restriction endonuclease, methyltransferase, ligase, polymerase, kinase, phosphatase, nuclease, transferase, reverse transcriptase.

Module II: Cloning vectors/cloning strategies
Plasmids, bacteriophages vectors (insertional and replacement vectors), phagemids, cosmids, artificial chromosomes (YAC, BAC). expression vectors (Bacteria and yeast), Antibiotic markers used in vector, fusion tags, Codon bias and codon optimization, Recombinant screening, Blue white selection (Alpha-comlimentation, Ex. pUC19/DH5α), colony hybridization, Colony PCR, Immunoscreening.

Module III: Blotting techniques and hybridization
Southern, Northern and Western blotting techniques, Radioactive and non-radioactive probes.

Module IV: Polymerase Chain Reaction and its applications
Principles of PCR, PCR components, designing of primers, Types of PCR: Gradient PCR, Hot-start PCR, Touch down PCR, multiplex PCR, Reverse Transcriptase PCR, RT-PCR. Purpose of constructing DNA libraries. Construction of cDNA and genomic libraries.

Module V: DNA sequencing and analysis
DNA sequencing (Maxam Gilbert, Sangers and automated), Next Generation Sequencing.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text Book:

- Principles of Gene Manipulation: An Introduction to Genetic Engineering, R.W. Old and S. B Primrose, Blackwell Science Inc.
- Recombinant DNA, J.D. Watson et al, W.H. Freeman and Company.

FERMENTATION TECHNOLOGY

Course Code: EBT2602 **Credit: 03**

Course Objective:
This course introduces various aspects of applied and industrial microbiology. The course helps the students to learn every important upstream and downstream components of fermentation process including Fermenter designing, operation and control. Additionally, the course can educate the students about different types of fermentation processes and process economics. and helps in the student's exposure on industrial applications of bioprocess Technology.

Course Contents:

Module I: Introduction to Fermentation Technology
The range of fermentation process, microbial biomass, enzymes, metabolites, recombinant products. Chronological development of fermentation industry, components of a typical fermentation process.

Module II: Industrially important microorganism.
Isolation of industrially important microorganisms, screening and preservation methods, improvement of industrial microorganisms. Isolation and improvement of auxotrophic and resistant mutant strains, selection of stable strains, non-stable strains, infection resistant strains.

Module III: Design of a fermenter
Basic functions of a fermenter, aseptic operations and environment, body construction, agitation, aeration, achievement and maintenance of aseptic conditions, valves and steam traps, specialized bioreactors; membrane bioreactors; tower bioreactors; fluidized bed bioreactors; Immobilized system and packed bed reactors and Photobioreactor.

Module IV: Aeration and Agitation
Oxygen requirements of industrial fermentation, determination of K_La values, fluid rheology, factors affecting K_La – air flow rate, degree of agitation, medium and culture rheology, scale-up and scale-down of aeration/agitation regimes in stirred tank reactors.

Module V: Fermentation Economics
Market potential, cost regulators – plant, equipment, media, sterilization, strain improvement, operational parameters. Recovery costs of products, water usage and recycling, effluent treatment.

Examination Scheme:

Components	CT	Attendance	Assignment Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text and Reference books:

- Principles of Fermentation Technology, 3rd Edition, PF Stanbery, A. Whitaker and Steve Hall, Elesvier (2016).
- Bioprocess Engineering Basic Concepts, by M Shuler and F. Kargi, Prentice Hall Press (2015)
- Bioprocess Engineering Principles, P Doran, Academic Press
- Fermentation and Biochemical Engineering Handbook, 2nd Edition., H C. Vogel and C M. Todaro, Elesvier (2014).

PLANT BIOTECHNOLOGY

Course Code: EBT2603 **Credit: 03**

Course Objective:
This course is designed to introduce a basic study of the various tools and techniques in the field of plant biotechnology and tissue culture lab. This course will also provide the clear concepts of different techniques for tissue culture and also various methods for the crop improvement and gene transfer.

Module I: **Introduction**
Definition, scope & history of plant tissue culture, Important of plant tissue culture and biotechnology, Establishment of plant tissue culture labs, equipment's require for plant tissue culture, Green house, and poly house establishment.

Module II: **Sterilization and Culture Media**
Physical and chemical sterilization methods, culture media-composition, types of media and role of hormones in *in-vitro* culture. Inoculation, Incubation, and acclimatization. Surface sterilization of explant. Subculture and transfer of explant and culture.

Module III: Tissue Culture Techquies
Organ culture, Anther, Embryo and meristem culture, organogenesis, somatic embryogenesis, and artificial seeds. Somatic hybridization; Isolation, Fusion and Protoplast culture. Somaclonal variation and cryopreservation.

Module IV: **Crop Improvement**
Organization and function of plant nuclear genome (*Arabidopsis thaliana*), Genetic transformation of plants by Agrobacterium: Genetic organization of Ti plasmid Functions encoded by integrated T-DNA. Molecular mechanism involved in transformation of genetic material in plants by *Agrobacterium tumefaciens*, Transgenic plants resistant to insect, Biosafety and bioethics

Module V: **Application of Plant Biotechnology**
Transgenic plants, herbicide and pest resistant plants, molecular pharming, therapeutic products, Application of Hairy root culture for secondary metabolites.

Examination Scheme:

Components	Class Test	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

TEXT BOOKS:

1. Gupta, P. K. 1994. Elements of Biotechnology. Rastogi Publications. Meerut.
2. Ignacimuthu , S., 2003. Plant Biotechnology. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
3. Kalyan Kumar De., 1997. Plant Tissue Culture – New Central Book Agency (P) Ltd., Calcutta.
4. Mascarenhas A.F., 1991. Hand book of Plant Tissue Culture. Indian Council of Agricultural

Research. New Delhi.

REFERENCE:

1. Grierson, D and Convey, S.N., 1988 . Plant Molecular Biology Published in the USA by Chapman and Hall, New York.
2. Dubey, R.C.1993. Text Book of Biotechnology. S. Chand & Company Ltd., New Delhi.
3. Ignacimuthu, S.1997. Plant Biotechnology . Oxford Publishing Co. Pvt. Ltd., New Delhi. 4. Trivedi P.C. 2001. Algal Biotechnology .
5. Rashid, A. 2009. Molecular physiology and Biotechnology of Flowering plants. Narosa Publishing House Pvt. Ltd., New Delhi.

NANO-BIOTECHNOLOGY

Course Code: EBT2604 **Credit: 03**

Course Objective: To gain the understanding of the principles of Nanobiotechnology, characterization of nanostructured materials and equipment towards the cutting edge areas of nanotechnology. This course will foster innovations and promote translational research to address various issues in the areas of heath, agriculture, food and environment.

Module 1: **Introduction**

Introduction to Concept of Nanotechnology and overview of nanoscale materials. Properties at nanoscale (optical, mechanical, electronic and magnetic). Fundamental sciences and broad areas of Nanobiotechnology. Various applications of Nano-biotechnology

Module 2: - **Synthesis and Characterisation of Nanomaterials**

Types of nanomaterials. Classification of nanomaterials on the basis of size, dimensions and material. Methods: Chemical Reduction, solvothermal methods, photochemical, CVD, metal oxide Chemical Vapour deposition. Physical Methods: ball milling, electrodeposition, pyrolysis, sputtering. Characterization methods: Optical (UV-Vis and Fluorescence Spectroscopy), X-Ray Diffraction, TEM, SEM, EDX, FTIR, RAMAN Spectroscopy.

Module 3: - **Protein and DNA based Nanostructures**

Protein based nanostructures building blocks and templates. Nanobioelectronic devices and polymer nanocontainers-Microbial production of inorganic nanoparticles- Magnetosomes. DNA based nanostructures. Hybrid conjugates of gold nanoparticles - DNA oligomers.

Module 4:- Biomaterials & Bio-electronics

Biomaterials- types, properties and applications, Biomaterial nano-particle systems for bio-electronic & biosensing applications, Biomaterial-based Nano-circuitry, Protein-based Nano-circuitry, DNA as functional template for Nano-circuitry.

Module 5:- Nanotechnology in Agriculture and Food Technology

Insecticides development using nanotechnology and Nanofertilizers. Nanotechnology in food processing, food safety and biosecurity, toxin and contaminant detection, Smart packaging. Nanotoxicology.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text & References Book:

- Nanobiotechnology: Concepts, Appplications and Perspectives by CM Niemeyer and CA Mirkin
- Bionanotechnology by David S Goodsell
- Nanosystems: Molecular Machinery, Manufacturing and Computation by K E Dreler

RECOMBINANT DNA TECHNOLOGY LAB

Course Code: EBT2605 **Credit: 01**

Course Contents:

Experiment 1: Preparation of competent cells
Experiment 2: Isolation of plasmid DNA
Experiment 3: Isolation of RNA
Experiment 4: Primer designing
Experiment 5: PCR amplification of GFP gene
Experiment 6: Restriction digestion of plasmid DNA and gene
Experiment 7: Ligation of plasmid and GFP gene
Experiment 8: Transformation of ligation mixture
Experiment 9: Selection of recombinants

Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

FERMENTATION TECHNOLOGY LAB

Course Code: EBT2606 **Credit: 01**

Course Contents:

1. To study the anatomy of a fermenter and the functions of different parts of it.
2. To perform the Sterilization-in-place of a reactor vessel.
3. To estimate the Oxygen transfer co-efficient (K_La) and growth kinetic parameters.
4. To produce Ethanol and estimate the yield and other kinetic parameters using a fermenter.
5. To immobilize microbial cells for production of α-amylase.
6. Heat removal capacity estimation of fermenter.

Examination Scheme:

Internal Assessment			External Examination			
Class test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment**	**Practical Record**	**Viva**
15	**10**	**05**	**35**	**15**	**10**	**10**

PLANT BIOTECHNOLOGY LAB

Course Code: EBT2607 **Credit: 01**

Course Contents:

1. Organizing Plant tissue culture Laboratory (Lab layout)
2. Preparation of Tissue Culture Media
3. To induce callus from the explants of carrot root
4. To perform regeneration of the plant from shoot tip of *Bougainvillea*
5. To isolate protoplast by mechanical method
6. To isolate protoplasts by enzymatic method
7. To isolate and inoculate anthers for haploid production.
8. To prepare hydrated synthetic seeds in vitro.

Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	**10**	**05**	**35**	**15**	**10**	**10**

MINOR PROJECT

Course Code: EBT2608 **Credit: 04**

GUIDELINES FOR MINOR PROJECT FILE

Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation.

Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critiqued by the faculty guide and corrected by the student at each stage.

The File is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation.

Methodology

The students will be sent to various industries and institutes where they will undergo short term training. After the completion of the training the students will be required to submit project report which shall then be evaluated by two internal examiners. The students will then have to appear for a Viva Voce examination to be conducted by an external evaluator at the end of the semester.

In general, the File should be comprehensive and include

- A short account of the activities that were undertaken as part of the project
- A statement about the extent to which the project has achieved its stated goals
- A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project
- Any activities planned but not yet completed as part of the project, or as a future initiative directly resulting from the project
- Any problems that have arisen that may be useful to document for future reference.

Report Layout

The report should contain the following components:

Title or Cover Page

The title page should contain the following information: Project Title; Student‟s Name; Course; Year; Supervisor‟s Name.

Acknowledgements (optional)

Acknowledgment to any advisory or financial assistance received in the course of work may be given.

Abstract

A good "Abstract" should be straight to the point; not too descriptive but fully informative. First paragraph should state what was accomplished with regard to the objectives. The abstract does not have to be an entire summary of the project, but rather a concise summary of the scope and results of the project

Table of Contents

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Results and Discussion
Present results, discuss and compare these with those from other workers, etc. In writing these section, emphasis should be given on what has been performed and achieved in the course of the work, rather than discuss in detail what is readily available in text books. Avoid abrupt changes in contents from section to section and maintain a lucid flow throughout the thesis. An opening and closing paragraph in every chapter could be included to aid in smooth flow.
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Conclusion
A conclusion should be the final section in which the outcome of the work is mentioned briefly.

Future prospects

Appendices
The Appendix contains material which is of interest to the reader but not an integral part of the thesis and any problem that have arisen that may be useful to document for future reference.

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This should include papers and books referred to in the body of the report. These should be ordered alphabetically on the author's surname. The titles of journals preferably should not be abbreviated; if they are, abbreviations must comply with an internationally recognised system.

Examples
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For book
Kowalski, M. (1976) Transduction of effectiveness in *Rhizobium meliloti*. SYMBIOTIC NITROGEN FIXATION PLANTS (editor P.S. Nutman IBP), **7**: 63-67

ASSESSMENT OF THE PROJECT FILE
Essentially, marking will be based on the following criteria: the quality of the report, the technical merit of the project and the project execution.

Technical merit attempts to assess the quality and depth of the intellectual efforts put into the project. Project execution is concerned with assessing how much work has been put in. The File should fulfill the following ***assessment objectives:***

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Analyse Quantitative/ Qualitative information, Control Quality

Draw Conclusions

Examination Scheme:

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Project Report	Viva Voce
60	40
Total	**100**

MEDICAL BIOTECHNOLOGY

Course Code: EBT2609 **Credit: 03**

Course Objectives:
To enlighten the knowledge of the Students on different areas of Medical Biotechnology. To train the Students in a hospital based setup and familiarize them with the clinical diagnostics of diseases.

Module I:
Introduction: History and scope of medical biotechnology, current status and future prospects. Classification of genetic diseases.

Module II:
Chromosomal disorders, Gene disorders, Gene controlled diseases, Mitochondrial disorders.

Module III:
Introduction to different types of cancer therapy; Hormonal therapy; Targeted therapy against surface molecules; Microtubule targeting plant based drugs; p53 protein as a target; Targeting angiogenesis; Introduction to oncogenomics.

Module IV:
Strategies of gene therapy: gene augmentation, Vectors used in gene therapy, Biological vectors and Synthetic vectors mediated gene transfer. Gene therapy trials: Familial Hypercholesterolemia, ADA, AIDS, Cystic Fibrosis, Solid tumors.

Module V:
Biophysical concepts of Ultrasound Imaging techniques; CT Scan; PET Scan; Electro-Cardiogram; Electro encephalogram; Endoscopy.

Examination Scheme :

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text books:
- Diagnostic and Therapeutic Antibodies (Methods in Molecular Medicine by Andrew J.T. George (Editor), Catherine E. Urch (Editor) Publisher: Humana Press; edition (2000)
- Molecular Diagnosis of Infectious Diseases (Methods in Molecular Medicine) by Jochen Decker, U. Reischl

Reference Books:
- Human Molecular Genetics by T. Strachan, Andrew

METABOLIC ENGINEERING

Course Code: EBT2610 **Credit: 03**

Course Objective:
The course will provide an overview of the basic concepts and experimental techniques used in metabolic engineering and its applications in production of useful compounds of industrial importance. The students will also learn that how complex regulatory mechanisms at multiple levels control the dynamics of the cellular metabolism. The course will also cover examples of successful engineering strategies used for the production of commercially important primary and secondary metabolites or recombinant proteins.

Module 1: Introduction to Metabolic Engineering
Introduction to metabolism, catabolism, anabolism. Key differences between metabolic controls of prokaryotes and eukaryotes. Different models organism for metabolic engineering study.

Module 2: Metabolic Flux Analysis
Building stoichiometric matrix; Steady state and pseudo steady state assumptions; Using different optimizing functions to solve linear programming problem; understanding flux cone and constraints; Introducing additional constraints from thermodynamics.

Module 3:
Experimental determination of metabolic fluxes C13 labeling, NMR and GC-MS based methods for flux determination.

Module 4: Computational Modeling of Biological Networks
Introduction to MATLAB. Synthetic circuit design, metabolic flux analysis. MOMA (Minimization of Metabolic Adjustment), iFBA (Integrated Flux Balance Analysis), dFBA; Enhancement of product yield and productivity.

Module 5: Industrial application
Industrial applications pathway engineering strategies for overproduction of some commercially important primary and secondary metabolites such as amino acids, organic acids, alcohols, PHA, PHB, dyes (melanin, Indigo) and therapeutic compounds, Case studies.

Examination Scheme:

Components	Class Test	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

TEXT BOOKS:

- Gregory N. Stephanopoulos, Aristos A. Aristidou, Jens Nielsen, Metabolic Engineering: Principles and Methodologies ,Academic Press 1998.
- Sang Yup Lee E. Terry Papoutsakis Marcel Dekker, Metabolic Engineering.inc 1998
- Nielsen J and Villadsen J. (1994) Bioreaction Engineering Principles. New york: Plenum Press

REFERENCES:

- Computational Analysis of Biochemical Systems: A Practical Guide for Biochemists and Molecular Biologists by Eberhard O. Voit Cambridge University Press 2000
- Applications of Plant Metabolic Engineering. R. Verpoorte, A. W. Alfermann and T. S. Johnson (eds). Springer, P.O. Box 17, 3300 AA Dordrecht, The Netherlands. 2007.
- Systems Modeling in Cellular Biology: From Concepts to Nuts and Bolts Edited by Zoltan Szallasi, JorgStelling and VipulPeriwal MIT Press Cambridge 2006

AGRICULTURE BIOTECHNOLOGY

Course Code: EBT2611 **Credit: 03**

Course Contents:

Module I:
Agriculture and Agricultural Biotechnology, Clonal Germplasm: Micro propagation, In vitro production of pathogen and contaminant free plants .

Module II:
Biotechnology- Methods of Crop Improvement: Genetic Engineering of Crop Plants, Transgenic Plants, Molecular Markers, QTL Mapping

Module III:
Microbes in Agriculture and Food: Applied Microbiology in the future of mankind, moving frontiers of applied microbiology, microbial enzymes and their applications in food processing and agrochemical industries, agro-waste utilization, biodegradable polymers and their applications, microbial polysaccharides; Production and utilization of essential amino-acids, chemicals from micro-algae.

Module IV
Metabolite Production: Production of Secondary Metabolites, Production of foreign compounds in transgenic plant, Achievements and recent developments of genetic engineering in agriculture

Module V:
Biofertilizers and Bioremediation: Microbial Biopesticides, Biofungicides, Herbicides, and Agricultural antibiotic Biotechnology in Agriculture: Ethical Aspects and Public Acceptance, Animal farming.

Examination Scheme :

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text & References:

- Biotechnology by B.D.Singh, Kalyani Publication
- Biotechnology – Fundamentals and applications by S.S.Purohit, Student Edition
- Agricultural Biotechnology-Arie Altman, CRCPress
- Biotechnology- An Introduction by Susan R. Barnum, Vikas Publishing House

APTITUDE AND REASONING ABILITY

Course Code: EBT2612 **Credit: 02**

Course Contents:

Module 1: Quantitative Aptitude
Data interpretation: data graphs (bar graphs, pie charts, and other graphs representing data), 2- and 3-dimensional plots, maps, and tables, Numerical computation and estimation: ratios, percentages, powers, exponents and logarithms, permutations and combinations, and series Mensuration and geometry, Elementary statistics and probability.

Module 2: Analytical Aptitude
Logic: deduction and induction, Analogy, Numerical relations and reasoning.

Module 3: Logical Reasoning
Alphanumeric series, Reasoning Analogies, Blood Relations, Calendars, Cause and Effect, Clocks, Coding-Decoding, Dices, Directions, Seating Arrangements, Data Sufficiency, Decision Making

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text and Reference:

- A Modern Approach to Logical Reasoning by R.S. Aggarwal
- Logical Reasoning and Data Interpretation by Pearson

SKILL, TRAINING & PLACEMENT

Course Code: EBT2613 **Credit: 02**

Course Contents:

Module 1:
Soft Skills, Communication skills, Interview skills, Decision-Making and Problem-Solving Skills, Leadership and Assertiveness Skills.
Presentation Skills: Types, Content, Audience Analysis, Essential Tips – Before, During and After, Overcoming Nervousness.

Module 2:
Positivity and Motivation, Theories of Motivation; Enhancing Motivation Levels.
Public Speaking: Skills, Methods, Strategies and, essential tips for effective public speaking.

Module 3:
Personality Development – Meaning, Nature, Features, Stages, Models; Learning Skills; Adaptability Skills.
Teamwork and Leadership Skills: Concept of Teams, Building effective teams, Concept of Leadership and honing Leadership skills.
Conflict Management: Conflict - Definition, Nature, Types and Causes; Methods of Conflict Resoultion.

Module 4:
Group Discussion: Importance, Planning, Elements, Skills assessed, Effectively disagreeing, Initiating, Summarizing, and Attaining the Objective, Resume writing, Facing the interview board.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text and Reference:

- Managing Soft Skills for Personality Development – edited by B.N.Ghosh, McGraw Hill India, 2012.
- English and Soft Skills – S.P.Dhanavel, Orient Blackswan India, 2010.

Syllabus – Seventh Semester

FOOD BIOTECHNOLOGY

Course Code: EBT2701 **Credit: 03**

Course Objective:
The course is designed for students to understand the process of food preservation and processing .This course mainly help the student to correct the method of food processing to improve the shelf life of the food product.

Module I:
History of Microorganisms in food, Historical Developments. role and significance of microorganisms in foods. Intrinsic and Extrinsic .Parameters of Foods that affect microbial growth. Basic principles, unit operations, and equipment involved in the commercially important food processing methods and unit operations.

Module II:
Microorganisms in fresh meats and poultry, processed meats, dairy products and miscellaneous food products. Starter cultures, cheeses, SCP, medical foods, probiotics and health benefits of fermented milk and foods products.

Module III:
Nutritional boosts and flavor enhancers: Emerging processing and preservation technologies for milk and dairy products. Microbiological Examination of surfaces, Air Sampling, Metabolically Engineered Organisms. Enumeration and Detection of Food-borne Organisms. Bioassay and related Methods .

Module IV:
Food Preservation, Food Preservation methods, Characteristics of Radiations of Interest in Food Preservation. Principles Underlying the Destruction of Microorganisms by Irradiation, Processing of Foods for Irradiation, Application of Radiation, Effect of Irradiation of Food constituents.

Module V:
Storage Stability Food Preservation with Low Temperatures, Food Preservation with High Temperatures, Preservation of Foods by Drying, Indicator and Food-borne Pathogens, Other Proven and Suspected Food-borne Pathogens. Rheology of Food Production

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text / Reference Books:

- Frazier, W.S. and Weshoff, D.C., 1988. Food Microbiology, 4th
- Edn., McGraw Hill Book Co., New York.

- Mann & Trusswell , 2007.
- Essentials of human nutrition. 3rd edition .oxford university press. 3. Jay, J.M., 1987.
- Modern Food Microbiology, CBS Publications, New Delhi.
- Lindsay, 1988. Applied Science Biotechnology. Challenges for the flavour and Food Industry. Willis Elsevier. 5. Roger, A., Gordon, B. and John, T., 1989. Food Biotechnology
- P. Coultate - Food - The Chemistry Of Its Components, 2nd Edition. Royal Society, London, 2002
- B. Sivasanker - Food Processing And Preservation,3rd Edition, Prentice-Hall Of India Pvt. Ltd. New Delhi 2002
- C. Frazier And D.C. Westhoff - Food Microbiology, 4th Ed., McGraw-Hill Book Co., New York
- 2 J.M. Jay - Modern Food Microbiology, 3rd Edition, CBS Pub. New Delhi, 2007

ANIMAL BIOTECHNOLOGY

Course Code: EBT2702 **Credit: 03**

Course Objective:
The application of Animal Biotechnology covers major areas related to commercial applications. Importance will also be given to areas like *in vitro* fertilization, animal cell and tissue culture, hormone vaccine and important enzyme production through animal biotechnology.

Course Contents:

Module I
Historical perspectives, sterilization methods, organ culture techniques, plasma clot, raft methods, agar gel, grid method, organ engineering.

Module II
Cell culture substrates, cultural media, natural and artificial media, initiation and maintenance of cell cultures, cell culture products, cryopreservation techniques, immobilized cultures, 3D cell culture.

Module III
In vitro fertilization and embryo transfer: principle steps and application.

Module IV
Animal genetic engineering- vectors, gene transfer methods - microinjection, virus mediated and other methods of gene transfer

Module V
Transgenic animals with new traits, transgenic animals as bioreactors for producing pharmaceutically important compounds and therapeutic applications, case studies.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text & References

- Cell Culture LabFAx, M. Butler and M. Dawson, Bios scientific Publications Ltd.
- Cell Growth and Division – A Practical approach, R. Basega, IRL Press
- Culture of Animal Cells, R.I Freshney, Wiley-Leiss
- Comprehensive Biotechnology, Moo-Young, Alan T. Bullm Howard Dalton, Panima Publication

GENOMICS AND PROTEOMICS

Subject Code: EBT2703 **Credit: 03**

Course Objective: To provide the students a broader knowledge on the structure and function of genomes, the technologies developed for genomics, functional genomics, and proteomics.

Module-I: Introduction of genome
Origin of genomes, Acquisition of new genes, Noncoding DNA and Genome Evolution, transcriptome, and proteome; Overview of genomes of bacteria, archaea, and eukaryote. Forward genetics and reverse genetics.

Module II: Structural and comparative genomics
Structural Genomics: Protein crystallography, Study of 3D Structure of Protein, Phylogeny, COGS [Cluster of orthologues genes], Introduction to System Biology, Gene Identification Methods. Whole genome sequencing.

Module III: Functional genomics
Genome annotation, ORF and functional prediction, Gene finding, EST, SAGE, TOGA, Microarrays, Oligonucleotide Microarray Chips, Application of Microarrays with examples.

Module IV: Techniques in proteomics
In-vitro and in vivo-labeling of proteins, One and two-dimensional gel electrophoresis, Detection of proteins on SDS gels, Protein cleavage, Edman protein microsequencing, Mass spectrometry principles of MALDI-TOF, Peptide mass fingerprinting.

Module V: Protein profiling
Protein preparation and Separation, Large-scale protein profiling using proteomics, Post-translational modifications, Phosphoprotein, and glycoprotein analyses; Analysis of protein-protein interactions, Protein microarrays and its application.

Examination Scheme:

Components	Class Test	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

TEXTBOOKS:

- Suhai, Sandor "Genomics and Proteomics: Functional and Computational Aspects". Springer, 2000
- Pennington, S.R. and M.J. Dunn "Proteomics: From Protein Sequence to Function". VivaBooks Pvt. Ltd., 2002.
- O'Connor, C.D. and B.D.Hames. "Proteomics". Scion Publishing, 2008.
- Primrose, S.B. and Twyman. "Principles of Genome Analysis and Genomics". 7th Edition, Blackwell Publishing, 2006
- Cantor, Charles R. and Cassandra L. Smith. "Genomics: The Science and Technology Behind the Human Genome Project". John Wiley & Sons, 1999.
- Liebler, R.C. "Introduction to Proteomics". Humana Press, 2002.
- Hunt, Stephen P. and Frederick J. Livesey. "Functional Genomics". Oxford University Press,2000.
- Conard, Edward. "Genomics". Apple Academics, 2010

FOOD BIOTECHNOLOGY LAB

Course Code: EBT2704 **Credit: 02**

Course Contents:

1. Isolation and Characterization of microorganism from contaminated food.
2. Isolation and Characterization of food fermenting organism from idli batter.
3. Estimation of ascorbic acid from given food sample by titrimetric method.
4. Microscopic examination of Food/Milk by breed method.
5. Estimation of lactose from milk.
6. Quality characterization of pasteurized milk by MBRT method.
7. Enzyme assay

Examination Scheme:

IA			EE			
Class Test (Practical Based)	**Mid Term Viva**	**Attendance**	**Major Experiment**	**Minor Experiment/Spotting**	**Practical Record**	**Viva**
15	10	05	35	15	10	10

Reference Books :-

- Gaud R.S. (2000), Practical biotechnology, Nirali Prakashan.
- Sadashivam S. and Manickam A. (1996), Biochemical Methods, 2nd Edi. New age International (P) Ltd., Publications, New Delhi.
- Schmauder Hans Peter (1997), Methods in Biotechnology, Taylor and Francis, London.
- Sharma P.K and Dandiya P.C (2004), Pharmaceutical Biochemistry: Theory and Practicals, Vallabh Prakashan , Delhi.
- Thimmaiah S.K (2006), Standard Methods of Biochemical Analysis, Kalyani Publishers, New Delhi.

SUMMER INTERNSHIP – II

Course Code: EBT2735 **Credit: 02**

GUIDELINES FOR SUMMER INTERNSHIP REPORT FILE

Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation.

Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critiqued by the faculty guide and corrected by the student at each stage.

The File is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation.

Methodology

The students will be sent to various industries and institutes where they will undergo short term training. After the completion of the training the students will be required to submit project report which shall then be evaluated by two internal examiners. The students will then have to appear for a Viva Voce examination to be conducted by an external evaluator at the end of the semester.

In general, the File should be comprehensive and include

- A short account of the activities that were undertaken as part of the project
- A statement about the extent to which the project has achieved its stated goals
- A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project
- Any activities planned but not yet completed as part of the project, or as a future initiative directly resulting from the project
- Any problems that have arisen that may be useful to document for future reference.

Report Layout

The report should contain the following components:

Title or Cover Page

The title page should contain the following information: Project Title; Student‟s Name; Course; Year; Supervisor‟s Name.

Acknowledgements (optional)

Acknowledgment to any advisory or financial assistance received in the course of work may be given.

Abstract

A good "Abstract" should be straight to the point; not too descriptive but fully informative. First paragraph should state what was accomplished with regard to the objectives. The abstract does not have to be an entire summary of the project, but rather a concise summary of the scope and results of the project

Table of Contents

Titles and subtitles are to correspond exactly with those in the text.

Introduction

Here a brief introduction to the problem that is central to the project and an outline of the structure of the rest of the report should be provided. The introduction should aim to catch the imagination of the reader, so excessive details should be avoided.

Materials and Methods
This section should aim at experimental designs, materials used. Methodology should be mentioned in details including modifications if any.

Results and Discussion
Present results, discuss and compare these with those from other workers, etc. In writing these section, emphasis should be given on what has been performed and achieved in the course of the work, rather than discuss in detail what is readily available in text books. Avoid abrupt changes in contents from section to section and maintain a lucid flow throughout the thesis. An opening and closing paragraph in every chapter could be included to aid in smooth flow.
Note that in writing the various secions, all figures and tables should as far as possible be next to the associated text, in the same orientation as the main text, numbered, and given appropriate titles or captions. All major equations should also be numbered and unless it is really necessary never write in "point" form.

Conclusion
A conclusion should be the final section in which the outcome of the work is mentioned briefly.

Future prospects

Appendices
The Appendix contains material which is of interest to the reader but not an integral part of the thesis and any problem that have arisen that may be useful to document for future reference.

References / Bibliography
This should include papers and books referred to in the body of the report. These should be ordered alphabetically on the author's surname. The titles of journals preferably should not be abbreviated; if they are, abbreviations must comply with an internationally recognised system.

Examples
For research article
Voravuthikunchai SP, Lortheeranuwat A, Ninrprom T, Popaya W, Pongpaichit S, Supawita T. (2002) Antibacterial activity of Thai medicinal plants against enterohaemorrhagic *Escherichia coli* O157: H7. *Clin Microbiol Infec*, **8** (suppl 1): 116–117.

For book
Kowalski, M. (1976) Transduction of effectiveness in *Rhizobium meliloti*. SYMBIOTIC NITROGEN FIXATION PLANTS (editor P.S. Nutman IBP), **7**: 63-67

ASSESSMENT OF THE PROJECT FILE
Essentially, marking will be based on the following criteria: the quality of the report, the technical merit of the project and the project execution.
Technical merit attempts to assess the quality and depth of the intellectual efforts put into the project. Project execution is concerned with assessing how much work has been put in. The File should fulfill the following ***assessment objectives:***

Range of Research Methods used to obtain information

Execution of Research

Data Analysis
Analyse Quantitative/ Qualitative information, Control Quality

Draw Conclusions

Examination Scheme:

Internal Assessment	External Assessment
Project Report	Viva Voce
60	40
Total	**100**

MOOCs CERTIFICATION COURSE

Course Code: EBT2736 **Credit: 03**

GUIDELINES FOR MOOCs CERTIFICATION COURSE

Course Objective

A certificate course is a series of educational and practical sessions. In the course, continuous exercise take place related to the topic which is conducted by speaker of NPTEL, which essentially means learning additional knowledge in the field of Biotechnology. This often involves students practicing their new skills during the event under the watchful eye of the instructor. The evaluation will be made by Board of examiners comprising of the faculties.

Three credit will be given to student after successful completion of NPTEL CERTIFICATE COURSE from sources like IITs.

The procedure for earning credits from workshop consists of the following steps:
There will be Three credit per Certification Course attended.
The student has to submit a certificate of participation.
The student has to submit a report of at least 500 words about the learning outcome from the course.

Examination Scheme for MOOCs certification course:

Internal Assessment	External Assessment
Grade received from MOOCs	Viva Voce
80	20
Total	**100**

DRUG DESIGN & DEVELOPMENT

Course Code: EBT2705 **Credit: 03**

Course Objective:
The objective of this course is to make Students understand the basic concepts involved in pharmaceutical industry. The course will give knowledge about new drug development and approval process, ADMET of drugs, about the manufacturing and quality control of conventional, new type of dosage forms and biotechnology derived pharmaceuticals.

Module I: Introduction
Introduction to drugs and pharmacy: An overview and history of pharmaceutical industry. Future of Biopharmaceuticals. Drug regulation and control.

Module II: Drug Discovery
Scope and applications of biotechnology in pharmacy. New drug development and approval process, Strategies for new drug discovery, finding a lead compound, combinatorial approaches to new drug discovery, pre-clinical and clinical trials.

Module III: Drug Administration
Routes of drug administration, membrane transport of drugs, absorption, distribution, metabolism and excretion of drugs. Factors modifying drug action, mechanism of drug action on human beings. Drug Target classification.

Module IV: Drug Doses
Drug dosage forms and their classification. Sterile dosage forms parenteral and biologics, novel dosage forms and targeted drug delivery systems.

Module V: GM protein and regulatory issues
Biotechnology derived pharmaceuticals. Production of pharmaceuticals by genetically modified proteins, Regulatory issues in pharmaceutical products.

Examination Scheme :

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text books

- Allen, L.V., Popovich, N.G. and Ansel, H.C., Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems, Lippincott Williams and Wilkins (2005).
- Walsh, G., Biopharmaceuticals: Biochemistry and Biotechnology, Wiley (1998). Reference Books 1. Gennaro, A.R., Remington: The Science and Practice of Pharmacy. Lippincott Williams and Wilkins (2005).

Reference Book

- Tripathi, K.D., Essentials of Medical Pharmacology, Jaypee Brothers Medical Publishers (2008)

QA & QC IN BIOTECHNOLOGY

Course Code: EBT2706 **Credit: 03**

Course objectives

To introduce basic concepts of quality assurance and control that are essential for various branches of science involving technical procedures for Biotechnological industries. To discuss about various aspects of QA and QC concerns of commercialization of biotech products. To understand the responsibilities of QA & QC departments.

Course Contents:

MODULE-I:

Introduction: Concept and evolution and scopes of quality control and quality assurance, GMP, overview of ICH Guidelines. Good Laboratory Practices: Scope of GLP, definitions, quality assurance unit, protocol for conduct of non-clinical testing, control on animal house, report preparation and documentation. CPCSEA guidelines.

MODULE-II:

cGMP Guidelines according to schedule M, USFDA (inclusive of CDER and CBER), pharmaceutical inspection convention (PIC), control of contamination and Good warehousing practice.

MODULE-III:

Analysis of raw materials, finished products, packaging materials, in process quality control (IPQC), developing specification (ICHQ6 and Q3). In-process quality control and finished products quality control for dosage in tablets, capsules, ointments, suppositories, creams, parenteral, ophthalmic and surgical products.

MODULE-IV:

Documentation in Pharmaceutical Industry: Three tier documentation, policy, procedures and work instructions, and records (Formats). Standard operating procedures.

MODULE-V:

Manufacturing Operations and Controls: Sanitation of manufacturing premises, mix ups and cross contamination processing of intermediates and bulk products, packaging operations, IPQC, drug product inspection, expiry date calculation, sterile products, aseptic process control, packaging, reprocessing, salvaging, handling of waste and scrap disposal.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

REFERENCES

- Quality Assurance Guide by Organization of Pharmaceutical Procedures of India, 3rd revised edition, Volume I & II, Mumbai, 1996.
- Good Laboratory Practice Regulations, 2nd Edition, Sandy Weinberg Vol. 69, Marcel Dekker Series, 1995.
- Quality Assurance of Pharmaceuticals- A compedium of Guide lines and Related materials Vol I & II, 2nd edition, WHO Publications, 1999.
- How to Practice GMP's – P P Sharma, Vandana Publications, Agra, 1991.

- The International Pharmacopoeia – vol I, II, III, IV & V - General Methods of Analysis And Quality Specification for Pharmaceutical Substances, Excepients and Dosage forms, 3rd edition,WHO, Geneva, 2005.
- Good laboratory Practice Regulations – Allen F. Hirsch, Volume 38, Marcel Dekker Series, 1989.
- ISO 9000 and Total Quality Management
- The drugs and cosmetics act 1940 – Deshpande, Nilesh Gandhi, 4th edition, Susmit Publishers, 2006.
- QA Manual- D.H. Shah, 1st edition, Business Horizons, 2000.
- Sidney H. Willig, Good Manufacturing Practices for Pharmaceuticals a plan for total quality control –, Vol. 52, 3rd edition, Marcel Dekker Series.
- Steinborn L. GMP/ISO Quality Audit Manual for Healthcare Manufacturers and Their Suppliers, Sixth Edition, (Volume 1 - With Checklists and Software Package). Taylor & Francis; 2003.
- Sarker DK. Quality Systems and Controls for Pharmaceuticals. John Wiley & Sons; 2008.

MOLECULAR MARKERS & DIAGNOSTICS

Course Code: EBT2707 **Credit: 03**

Course Contents:

Module 1:
Concept of molecular marker, Hybridization and PCR based molecular marker (minisatallite, microsatellite, RAPD, RFLP, STR, SAMPL, ASAP, AFLP, SNP etc), Advantages and disadvantages of molecular marker, Various Applications of molecular markers, Protein marker and immunogenic marker.

Module 2:
Introduction and history of diagnostics, Diseases- infectious, physiological and metabolic errors, genetic basis of diseases, inherited diseases. Infection – mode of transmission in infections, factors predisposing to microbial pathogenicity, types of infectious diseases- bacterial, viral, fungal, protozoans and other parasites.

Module 3:
Diagnosis of infection caused by Streptococcus, Coliforms, Salmonella, Shigella, Vibrio, and Mycobacterium,
Diagnosis of fungal infections. Major fungal diseases: Dermetophytoses, Candidiosis and Aspergillosis.

Module 4:
Brief introduction to diagnosis of DNA and RNA viruses- Pox viruses, Adenoviruses, Rhabdo Viruses, Hepatitis Viruses and Retroviruses.
Brief introduction to diagnosis of Protozoan diseases: Amoebiosis, Malaria, Trypnosomiosis, Leishmaniasis.

Module 5:
Diagnosis of various disorders like Blood, brief study on: muscle disorders (Duchene muscular dystrophy-DMD, Becker's muscular dystrophy-BMD, spinal muscular atrophy-SMA), bone disorders (Osteogenesis imperfecta, Rheumatoid arthritis), skin disorder (Albinism).

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Reference:

- Medical Microbiology (1997), Edited by Greenwood, D, Slack, R and Peutherer, J, ELST Publishers. 2. Parasitology (1997), Chatterjee K.D, Chatterjee Medical Publishers.
- Bailey & Scott's Diagnostic Microbiology (2002), Betty A. Forbes , Daniel F. Sahm, Alice S. Weissfeld , Ernest A. Trevino, Published by C.V. Mosby
- Jawetz, Melnick, & Adelberg's Medical Microbiology (2004), Geo F. Brooks, Stephen A. Morse, Janet S. Butel.
- Fundamentals of Molecular Diagnostics (2007). David E. Bruns, Edward R. Ashwood, Carl A. Burtis. Saunders Group.
- Henry's Clinical Diagnosis And Management By Laboratory Methods (2007) Mcpherson

- Molecular Diagnostics: Fundamentals, Methods & Clinical applications (2007). Lele Buckingham and Maribeth L. Flaws
- Molecular Diagnostics for the Clinical Laboratorian 2Ed. 2006, W.B. Coleman. Humana Press.
- Molecular Pathology in Clinical Practice (2007). D. G. B. Leonard.
- Microbial Functional Genomics (2004) by J.Zhou, D.K. Thomson. Y.Xu. J.M. Tiedje. J.Wiley & Sons Publishers. 11. Expert Review of Molecular Diagnostics

BIOMATERIALS

Course Code: EBT2708 **Credit: 04**

Objective: The objective of this course is to gain an appreciation for the role of biomaterials in modern medical science. This course deals with materials in hard and soft tissue replacement. Biomaterials covered in the class including metals, ceramics, biological and polymeric materials. The design and application of implants using these materials are discussed in detail. Problems associated with implants are discussed in light of the mechanical, chemical and physiological interactions between body environments.

Course Contents:

Module -1: Introduction to Biomaterials
Introduction and definition of biomaterials, classification of biomaterials, mechanical and physical properties of biomaterials.

Module -2: Metallic and Ceramic Biomaterial
Metallic implant materials: Austenitic stainless steel, Co-based alloys, Titanium-based alloys and Dental alloys, Degradation processes on metallic surfaces, Ceramics implant materials: Glasses and Glass-ceramics, Alumina, Zirconia and Calcium phosphate, Bioresorbable and bioactive ceramics,

Module -3: Polymeric Biomaterial
Synthetic and natural polymer used as biomaterial, advantage and limitation of polymer based biomaterial, Polymeric implant materials, Inert polymers, Natural polymers, Bioactive polymers, Biodegradable polymers.

Module -4: Composite Biomaterial
Different composite biomaterials, Application of composite biomaterials. Structure-property relationships of biological materials, Tissue response to implant surface, Soft tissue replacement: Skin, Sutures, Maxillofacial implants and Blood interfacing implants, Hard tissue replacement: Long bone repair-wires, pins, screws, fractures plates, intramedullary devices, joint replacement-knee and hip joint, dental restorations and spinal implants.

Module -5: Characterization of Biomaterials
Physical and physicochemical surface characterization: Mechanical, Optical and Electrochemical characterization, Definition of biocompatibility, blood compatibility and tissue compatibility and Biological tests.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

TEXT BOOKS :

- J. Park, Biomaterials, An Introduction to Biomaterials, Springer, 2012
- J.B Park, and J.D. Boonzino, Biomaterials: Principles and Application, CRC Press, 2002
- J. B. Park and R. S. Lakes, An Introduction to Biomaterials, Springer, 2007
- B. D. Ratner, F. J. Schoen, A. S. Hoffman, and J. E. Lemons, Biomaterials Science: An introduction to Materials in medicine,, Academic Press, 2012 , 3rd edition
- Sujata V. Bhatt, ―Biomaterials‖, Second Edition, Narosa Publishing House, 2005.
- Sreeram Ramakrishna, MuruganRamalingam, T. S. Sampath Kumar, and Winston O. Soboyejo, ―Biomaterials: A Nano Approach‖, CRC Press, 2010.
- Biomaterials Science: An Introduction to Materials in Medicine, By Buddy D. Ratner, et. al. Academic Press, San Diego, 1996.
- Sujata V. Bhat, Biomaterials, Narosa Publishing House, 2002.
- J B Park, Biomaterials – Science and Engineering, Plenum Press, 1984.
- Biomaterials Science and Biocompatability, Fredrick H. Silver and David L. Christiansen, Piscataway, Springer, New Jersey.
- Biological Performance of Materials: Fundamentals of Biocompatibility, Janathan Black, Marcel Dekker, Inc., New York and Basel, 1981.
- Basic Cell Culture: A Practical Approach, Edited by J.M. Davis, IRL Press, Oxford University

BIOPROCESS PLANT DESIGNING

Course Code: EBT2709 **Credit: 04**

Prerequisite: The student should have basic understanding of Unit Operations of Process Engineering

Course Objective:
Plant design involves modifications and additions to existing plants or creating design layouts of plant / equipments. With rapid rate of increase in the advancement of knowledge, it is important that the students should know the relevant application for equipment design. It has been observed conclusively that practice in using the reference literature and software has helped the students to secure jobs and also to perform better in profession.

Course Contents:

Module I: Basic Principles of design
Design Factors, Design procedure, Codes and Standards, Optimization, Design Loads, Combined Loading in Equipments, Concept of Stress and Strain, Theories of Failure.

Module II: Pressure Vessels and bioreactors
Design of unfired pressure vessels: Types of pressure vessels, material of construction, selection of corrosion allowance and weld joint efficiency, purging of vessels, Selection and design of various types of heads. Design principles of bioreactors, Geometric configuration, flanges, nozzles, gaskets, supports.

Module III: Bioreactors and Reaction vessels
Accessories for bioreactors, Study of various types of agitators, aerators, air filters, stabilizers, power requirement. Reaction vessels: Introduction, classification, heating systems, various types of jackets like plain, half coil, channel, and limpet oil. Study and design of internal coil of reaction vessels, Heat transfer coefficients in coils, heat exchanger.

Module IV: Design of distillation column
Design variables in distillation, design methods for binary systems, plate efficiency, approximate column sizing, plate contactors and plate hydraulic design - Plate design, weir dimensions, weep point, hole size, and Plate pressure drop.

Module V: Bioreactors
Material for construction of bioreactors and selection criteria Scale up of bioreactors, safety measures in bioreactors. Economic consideration for scale up

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text Books:

- Process Equipment Design. S. D. Dawande, Dennet and Company.
- Process Equipment Design, M. V. Joshi. McMillan India.
- Plant Design and Economics for Chemical Engineers. M. Timmerhouse, McGraw Hill and Co.
- Introduction to Chemical Equipment Design" by B.C. Bhattacharya, C.B.S. Publications.

Reference Books:

- Process equipment design" by L.E. Brownell and E. Young, John Wiley, New York, 1963.
- Mass Transfer Operations" by Treyball R.E., McGraw Hill, New York.
- Chemical Process Equipment-Selection and design" Walas S.M., Butter worth Heinamer, McGraw Hill book company, New York.
- Indian standards Institution" code for shell and tube heat exchangers, IS – 4503
- Applied Process Design for Chemical and Petrochemical Plants" vol 1 and 2, Ludwig E.E., Gulf publishing co. publishing company,

STEM CELL TECHNOLOGY

Course Code: EBT2710 **Credit: 04**

Course Objective:
The course will give an insight about the concept of stem cells, different types of stem cells and describe the concept of stem cell cloning and its applications. The students would be able to recognize treatment of human diseases connected to stem cell therapy.

Course Contents:

Module I:
Stem Cell biology; types; embryonic stem cell, Adult stem cell and potential benefits of stem cell technology, Stem Cells Differentiation. Stem cell self-renewal and pluripotency: molecular mechanisms Cell cycle regulation in stem cells. Stem cell niches, Stem cell lineage tracing

Module II:
Innate and Acquired Immune Response to Stem Cell Therapy,

Module III:
Bone marrow transplants, Immunotherapy, Autoimmune Diseases and Promise of Stem Cell-Based Therapies, Stem Cells and Diabetes, Stem Cells and heart Repair

Module IV:
Use of genetically modified stem cells in experimental gene therapies. Gene delivery methods; viral vectors: adenoviral, adeno-associated virus (AAV), retroviral, lentiviral, herpes virus; non-viral vectors and physical methods & combinatorial methods. Genetic perspectives for gene therapy, gene therapy for cancer and vascular disorders, nervous system.

Module V:
Regulatory and Ethical Considerations of Stem Cell Therapy and FDA requirements for stem cell therapy, Assessing Human Stem Cell Safety.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text and Reference:

- Twyman RM, Developmental Biology Viva Books Pvt. Ltd. (2001)
- Marshak L, Stem Cell Biology, Cold Spring Harbor Publication, (2001).
- Lanza RP, Robert Langer R and Chick WL, Principles of Tissue Engineering,Academic Press (1997).

Reference Books:

- Palsson B and Bhatia S. Tissue Engineering, Pearson-Prentice Hall, (2003).

Syllabus – Eighth Semester

DISSERTATION (INDUSTRIES/ACADEMICS/R&D ORGANIZATIONS)

Course Code: EBT2801 **Credit: 16**

Course Objective:
The students are expected to utilize their scheduled periods by undertaking the project that would be completed during the semester

Every student shall undertake a major Project. The major Project shall be undertaken in some biotechnology industry or laboratory of repute. Each student shall be assigned to a faculty who shall continuously monitor the progress of the Project in the concerned laboratory or industry. The faculty, in consultation with the concerned scientist of the industry/laboratory, shall decide the topic of the project. At the conclusion of the project the student shall submit a seminar and a dissertation. The dissertation shall be evaluated by the internal faculty/examiner. The student then shall have to appear for the viva voce examination.

GUIDELINES FOR MAJOR PROJECT FILE
Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation.

Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critiqued by the faculty guide and corrected by the student at each stage.

The File is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation.

In general, the File should be comprehensive and include

- A short account of the activities that were undertaken as part of the project;
- A statement about the extent to which the project has achieved its stated goals.
- A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project;
- Any activities planned but not yet completed as part of the project, or as a future initiative directly resulting from the project;
- Any problems that have arisen that may be useful to document for future reference.

Report Layout
The report should contain the following components:

Title or Cover Page
The title page should contain the following information: Project Title; Student's Name; Course; Year; Supervisor's Name.

Acknowledgements (optional)
Acknowledgment to any advisory or financial assistance received in the course of work may be given.

Abstract
A good "Abstract" should be straight to the point; not too descriptive but fully informative. First paragraph should state what was accomplished with regard to the objectives. The abstract does not have to be an entire summary of the project, but rather a concise summary of the scope and results of the project

Table of Contents
Titles and subtitles are to correspond exactly with those in the text.

Introduction
Here a brief introduction to the problem that is central to the project and an outline of the structure of the rest of the report should be provided. The introduction should aim to catch the imagination of the reader, so excessive details should be avoided.

Materials and Methods
This section should aim at experimental designs, materials used. Methodology should be mentioned in details including modifications if any.

Results and Discussion
Present results, discuss and compare these with those from other workers, etc. In writing these section, emphasis should be given on what has been performed and achieved in the course of the work, rather than discuss in detail what is readily available in text books. Avoid abrupt changes in contents from section to section and maintain a lucid flow throughout the thesis. An opening and closing paragraph in every chapter could be included to aid in smooth flow.

- Note that in writing the various secions, all figures and tables should as far as possible be next to the associated text, in the same orientation as the main text, numbered, and given appropriate titles or captions. All major equations should also be numbered and unless it is really necessary never write in "point form"

Conclusion

A conclusion should be the final section in which the outcome of the work is mentioned briefly.

Future prospects

Appendices
The Appendix contains material which is of interest to the reader but not an integral part of the thesis and any problem that have arisen that may be useful to document for future reference.

References / Bibliography
This should include papers and books referred to in the body of the report. These should be ordered alphabetically on the author's surname. The titles of journals preferably should not be abbreviated; if they are, abbreviations must comply with an internationally recognised system.

Examples

For research article

Voravuthikunchai SP, Lortheeranuwat A, Ninrprom T, Popaya W, Pongpaichit S, Supawita T. (2002) Antibacterial activity of Thai medicinal plants against enterohaemorrhagic *Escherichia coli* O157: H7. *Clin Microbiol Infect*, 8 (suppl 1): 116–117.

For book

Kowalski, M.(1976) Transduction of effectiveness in *Rhizobium meliloti*. SYMBIOTIC NITROGEN FIXATION PLANTS (editor P.S. Nutman IBP), **7**: 63-67

ASSESSMENT OF THE PROJECT FILE

Essentially, marking will be based on the following criteria: the quality of the report, the technical merit of the project and the project execution.

Technical merit attempts to assess the quality and depth of the intellectual efforts put into the project. Project execution is concerned with assessing how much work has been put in. The File should fulfill the following ***assessment objectives:***

Range of Research Methods used to obtain information

Execution of Research

Data Analysis

Analyse Quantitative/ Qualitative information, Control Quality

Draw Conclusions

Examination Scheme:

Internal Assessment	**External Assessment**	
Dissertation Report	Viva Voce	Presentation
350	100	50
Total	**500**	