आईएफटीएम विश्वविद्यालय, मुरादाबाद, उत्तर प्रदेश
IFTM University, Moradabad, Uttar Pradesh
NAAC ACCREDITED

SCHOOL OF BIOTECHNOLOGY
IFTM UNIVERSITY
www.iftmuniveristy.ac.in

Study & Evaluation Scheme of
Bachelor of Technology (Biotechnology)
Session 2021-2022

Programme:	Bachelor of Technology (Biotechnology)
Course Level:	UG Degree
Duration:	Four Years (Eight semesters) Full Time
Medium of Instruction:	English
Maximum required Attendance:	75%
Maximum Credits:	224

Programme Outcomes (POs)

The student will be able to:

- Apply the knowledge of mathematics, science, engineering fundamentals and engineering concepts like mass transfer heat, transfer and fluid flow to the solution of complex engineering problems.
- Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- Apply their knowledge on Bioprocess engineering techniques like upstream process involving medium optimization and downstream process involving product recovery and purification in fermentation industries.
- Understand professional and ethical responsibility and communicate effectively.
- Recognition of the need for, and an ability to engage in lifelong learning and knowledge of contemporary issues.
- Generate capability for self project management and finance: by using the techniques, skills, and modern engineering tools necessary for engineering practice.
- Develop an ability to carry out research in different areas of Biotechnology resulting in patents, journal publications and product development.
- Entrepreneurship scheme/venture such as consultancy and training centers can be opened.
- Students will be able to understand the potentials, and impact of biotechnological innovations
- Impart their knowledge for finding sustainable solution to issues pertaining to environment, health sector, agriculture, etc

IFTM UNIVERSITY, MORADABAD
B. Tech. Biotechnology Engineering
Course Structure
(Effective from 2021-22)
First Semester

S.N.	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
						Mid Term Exam			External Exam		
			L	T	P	CT	AS +AT	Total			
THEORY											
1.	EMA-102/ EBT-107	Elementary Mathematics-I/ Elementary Biology-I	3	1	0	20	10	30	70	100	4
2.	EPH -101	Engineering Physics-I	3	1	0	20	10	30	70	100	4
3.	ECE-101/ ECH-101	Environmental Science/ Engineering Chemistry	3	1	0	20	10	30	70	100	4
4.	PSD-101/ EME-101	Professional Skill Development-I/ Engineering Mechanics	3	1	0	20	10	30	70	100	4
5.	EEE -101/ EEC-101	Electrical Engineering/ Electronics Engineering	3	1	0	20	10	30	70	100	4
6.	ECS -101/ EBT-102	Computer Fundamentals & Programming/ Introduction to Biotechnology	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT											
7.	EPH -151/ ECH-151	Physics Lab/Chemistry Lab	0	0	2	20	10	30	70	100	1
8.	EEE -151/ EEC-151	Electrical Engg. Lab/ Electronics Engg. Lab	0	0	2	20	10	30	70	100	1
9.	ECS -151/ EBT-152	Computer Lab/ Introduction to Biotechnology Lab	0	0	2	20	10	30	70	100	1
10.	EME -153/ EME-151	Engineering Graphics Lab/ Mechanical Engg. Lab	0	0	2	20	10	30	70	100	1
11.	GP-101	General Proficiency	-	-	-	-	-	100	-	100	1
		Total Credit	18	6	8	-	-	400	700	1100	29

IFTM University, Moradabad
Bachelor of Technology (B. Tech.), Programme
B. Tech. Biotechnology I Year (I Semester)
(Effective from 2021-22)

EMA-102: ELEMENTARY MATHEMATICS – I

Objective(s): The objectives of this course:

- Find the instantaneous rate of change of a function with respect to an independent variable in calculus.
- Integrals are used to evaluate such quantities as area, volume, work and area of a curve.
- Coordinate geometry identify a shape within a shape, discriminate geometric shapes from one another based on the number of sides and corners.

UNIT I: **(8 Sessions)**

Calculus: Limits and Derivatives: Derivative introduced as rate of change both as that of distance function and geometrically intuitive idea of limit, Definition of derivative, relate it to slope of tangent of the curve, Derivative of sum, difference, Product and quotient of functions, Derivatives of polynomial and trigonometric functions.

UNIT II: **(8 Sessions)**

Continuity and Differentiability: Continuity and Differentiability, Derivative of composite functions, Chain rule, Derivatives of inverse trigonometric functions, Derivative of implicit function, Concept of exponential, logarithmic functions and their derivative, Logarithmic differentiation, Derivative of functions expressed in a parametric form, Second order derivatives, Rolle's and Lagrange's Mean Value theorems (without proof) and their geometric interpretations.

Applications of derivatives: Applications of derivatives: Rate of change, Increasing /Decreasing functions, Tangents and normal's, Approximation, Maxima and minima of one variable (first derivative test motivated geometrically and second derivatives test given as a provable tool), Simple problems (that illustrate basic principles and understanding of the subject as well as real –life situations)

UNIT III: **(8 Sessions)**

Integrals: Integration as inverse process of differentiation, Integration of a variety of functions by substitution by partial fraction and by parts, only simple integrals of the type to be evaluated, Definite integrals as a limit of a sum, Fundamental Theorem of calculus (without proof), Basic properties of definite integral and evaluation of definite integrals, Applications of the integrals; Applications in finding the area under simple curves, Lines, Area of Circles/parabola/ellipse (Standard form only), Area between the two curves.

UNIT IV: **(8 Sessions)**

Differential Equations: Definition's order and degree, General and particular solutions of differential equation, Formation of differential equation whose general solution is given, Solution of differential equations by method of separation of variables, Homogeneous differential equation of first order and first degree, Solution of linear differential equation of the type $\frac{dy}{dx} + Py = Q$, where P and Q are the function of *x*.

UNIT V: **(8 Sessions)**

Coordinate Geometry: Straight line: Brief recall of 2D from earlier classes; Slope of a line, angle between two lines and Various forms of equations of a line parallel to axes, Point slope form, Slope intercept form, Two-point form, Intercept form and normal form, General equation of a line, Distance of a point from a line. **Conic Sections:** Circle, Ellipse, Parabola, Hyperbola, a point, a straight line and pair of intersecting lines as a

degenerated case of a conic section, Standard equations and simple properties of parabola, Ellipse and Hyperbola, Standard equation of a circle.

Course Outcomes:

At the end of the course students will able to:

- Remember terminologies and formulae of differential, integral Calculus and Coordinate Geometry.
- Understand and interpret the concepts of differential, integral Calculus and Coordinate Geometry.
- Compare and analyze the methods in differential, integral Calculus and Coordinate Geometry.
- Predict and evaluate the problems in differential, integral Calculus and Coordinate Geometry.

Suggested Readings:

1. R.D. Sharma: Mathematics (I& II-XI), Dhanpat rai publication (Pvt.) Ltd. New Delhi, India.
2. R.D. Sharma: Mathematics (I& II-XII): Mathematics (I& II-XI), Dhanpat rai publication (Pvt.) Ltd. NewDelhi, India.
3. Gorakh Prasad: Differential Calculus, Pothishala Private Limited, Allahabad.
4. Gorakh Prasad: Integral Calculus, Pothishala Private Limited, Allahabad.
5. B.S. Grewal Engg.: Mathematics, Khanna publishers, New Delhi.

Website Sources:

- www.pdfdrive.com
- www.dmi.gov.in
- www.yourarticlelibrary.com
- onlinecourses.nptel.ac.

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B. Tech. Biotechnology I Year (I Semester)
(Effective from 2021-22)

EBT-107: ELEMENTARY BIOLOGY-I

Objective: The main objective of this course:

- Emphasize the basic principles that are common to animals, plants and microorganisms as well as high lighting the relationship of Biology with other areas of knowledge.

UNIT I: **(10 Sessions)**

The Cell: Concept and Cell theory. Structure of prokaryotic cells, eukaryotic cells, plant cells and animal cells. Structure and function cell and cell organelles.

UNIT II: **(10 Sessions)**

Structural Organization: Tissues in animals and plants. 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: **(10 Sessions)**

Classification of living organisms: Five kingdom classification, major groups and principles of classification in each kingdom. Systematic and binomial system of nomenclature. Concept of animal and plant classification.

UNIT IV: **(5 Sessions)**

Concept of alleles and genes: Mendelian Experiments, Cell cycle (Elementary Idea), mitosis and meiosis.

UNIT V: **(5 Sessions)**

Plant Physiology: Concept of diffusion, osmosis, imbibitions. Movement of water, food, nutrients and gases. Plant growth and development.

Course Outcomes:

At the end of the course students will able to:

- Define cell biology and gain some basic concept of functioning of various specific systems of humans, plants and animals.
- Learn the basic concepts of biology and its importance in analyzing the principles of human development
- Develop the knowledge of genes and hereditary.
- Demonstrate medical implications of developmental biology

Suggested Readings:

1. Biology - Textbook for Class XI, NCERT Publication.
2. Biology - Textbook for Class XII, NCERT Publication.
3. Biology by Peter H Raven, George B Johnson, Kenneth A. Mason, Jonathan Losos, Susan Singer (Macgraw Hill).
4. Concepts in Biology by E.D. Enger & F.C. Ross, 9th Ed Tata McGraw Hill.

Website Sources:

- https://www.britannica.com/science/fermentation
- https://nptel.ac.in/courses/102/105/102105064/
- https://www.khanacademy.org

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EPH-101: ENGINEERING PHYSICS-I

Objective(s): The objectives of this course:

- Impart knowledge of statistical mechanics, quantum mechanics, Laser system and their applications.
- The broad education is necessary to understand special theory of relativity.

UNIT I: **(8 Sessions)**

Relativistic Mechanics: Frame of reference, Michelson-Morley Experiment, Lorentz transformation equation, Length contraction & Time dilation, Addition of velocities, Variation of mass with velocity and Mass energy relation.

UNIT II: **(8 Sessions)**

Statistical Mechanics: Concept of phase space, Density of states as a function of energy, Maxwell- Boltzmann statistics, Distribution law and its application in case of ideal gas, Energy and velocity distribution. Bose - Einstein statistics Distribution Law and its application to Black body radiation to obtain Plank's law of radiation. Fermi – Dirac statistics, Distribution law and its application to electrons in metals, Calculation of Fermi energy and average energy of electrons in metals.

UNIT III: **(8 Sessions)**

Quantum Mechanics: De-Broglie Hypothesis, Davisson -Germer Experiment, wave function and its properties, Uncertainty principle. Time Dependent & Time Independent Schrodinger Equation, Particle in one dimensional box, Eigen values and Eigen function

UNIT IV: **(8 Sessions)**

Laser: Principle of Laser, Stimulated and spontaneous emission, Population inversion, Einstein's Coefficients, He-Ne Laser, Ruby Laser, Application of Lasers.

UNIT V: **(8 Sessions)**

Fibre Optics: Fundamental ideas of optical Fiber, Propagation Mechanism, Numerical aperture, Acceptance angle and Acceptance cone, Single and multi-mode fibers, Applications of optical fibres.

Course Outcomes:

At the end of the course students will able to:

- Learn Frame of reference, Lorentz transformation equation
- Understand Statistical Mechanics, Maxwell- Boltzmann statistics and its applications.
- Study Bose -Einstein statistics and Fermi –Dirac statistics
- Understand De-Broglie Hypothesis, Davisson - Germer Experiment
- Study Time Dependent & Time Independent Schrodinger Equation and applications of these equations.
- Attain basic knowledge on different types of LASERs and their applications.
- Gain knowledge of optical fibre.

Suggested Readings:

1. Beiser, “Concepts of Modern Physics
2. Kittel, “Mechanics”, Berkeley Physics Course, Vol.- I.
3. W.T. Silf vast, “Laser Fundamental” Cambridge University Press (1996).
4. G. Keiser “Optical Fiber Communication” New York.
5. K.M. Kanna” Statistical Mechanics”
6. C.Kittel” Elementary Statistical Mechanics”

Website Sources:

- https://web.stanford.edu
- https://sites.google.com
- https://en.wikipedia.org
- https://www.khanacademy.org
- https://www.rp-photonics.com
- https://nptel.ac.in
- https://www.eatm.in

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ECH-101/ ECH-201: ENGINEERING CHEMISTRY

Objective(s): The objectives of this course:

- Emphasize the relevance of fundamentals and applications of chemistry in the field of engineering.
- Take into account appropriate combinations of old and new emerging concepts for the potential uses in engineering.
- Address the principles of general chemistry and specific topics relevant to various engineering disciplines.
- Bring adaptability to new developments in Engineering Chemistry and to acquire the skills required to become a perfect engineer.
- Bring potential applications of chemistry and practical utility in order to become good engineers and entrepreneurs.

UNIT I: **(8 Sessions)**

Matter - Chemical Bonding and its States: Types of bonds (Ionic, covalent and chemical bonds), valence bond theory, molecular orbital theory and its applications to homo and hetero (CO & NO) diatomic molecules. Solid state- Types of unit cells, space lattice (only cubes) calculation of density of the unit cell, two dimensional solids such as graphite and its conduction properties. Fullerenes and their applications.

UNIT II: **(8 Sessions)**

Chemical Kinetics and Electrochemistry: Molecularity and order of reactions, zero, first and second order reactions, theories of reaction rates, electrode potential, electrochemical cells (galvanic and concentration), Nernst equation, electrochemical and galvanic series, definition, significance and classification of corrosion, electrochemical corrosion.

UNIT III: **(8 Sessions)**

Reaction Mechanism and Spectroscopy: Electrophile, Nucleophile (SN^1 and SN^2reactions) Mechanism of the following reactions: (i) Aldol condensation (ii) Beckmann rearrangement (iii) Cannizaro reaction (iv) Hoffmann rearrangement (v) Diels-Alder reaction and (vi) Friedel craft reaction. Basic principle, instrumentation and general application of UV, Visible, IR/ FTIR & ^{1H}NMR spectroscopy (excluding specific applications).

UNIT IV: **(8 Sessions)**

Polymers: Polymers, classification and applications, polymerization (addition and condensation), Thermoplastic and Thermosetting polymers, preparation, properties and uses of PVC, Dacron, nylon66 and Bakelite. Elastomers (Natural rubber, buna-N, buna-S) vulcanization, conducting polymers (Intrinsic & Extrinsic), doping, ion exchange resins, biodegradable polymers.

UNIT V: **8 Sessions)**

Water Treatment and Fuels: Hardness of water, calculation on hardness and its determination by EDTA method, sludge and scale formation, causes and prevention of scale formation (colloidal, phosphate, and calgon conditioning), removal of hardness (Soda lime process, zeolite process & ion-exchange process), calculations based on lime soda process. Definition of fuels, classification of fuels, calorific value, determination by Dulong's formula, analysis of coal (Proximate and ultimate analysis), petroleum, important fractions of petroleum and their uses, gaseous fuels (CNG & LPG)

Course Outcomes:

At the end of the course students will able to:

- Demonstrate knowledge of science behind common impurities in water and methods to treat them and also different methods to remove hardness of water.
- Students will also be able to understand and relate electrochemistry and corrosion.
- Analyze the basic knowledge of various types of Fuels, their properties and Industrial Applications along with the determination of the calorific value of fuels.
- Apply the science for understanding corrosion and its prevention.
- Demonstrate knowledge of superconducting and organic electronic materials.
- Students will be able to understand about different polymers.

Suggested Readings:

1. Text Book of Polymer Science by F.W. Billmeyer, John Wiley & sons, 1994.
2. Liquid Crystals and Plastic Crystals, vol.-I, edited by G.W. Gray and P.A. Winsor, Ellis Harwood Series in Physical Chemistry, New York.
3. Corrosion Engineering by M.G. Fontana McGraw Hill Publications.
4. Engineering Chemistry by J C Kuriacose and J. Rajaram, Tata McGraw-Hill Co, New Delhi (2004).
5. Chemistry of Engineering Materials by C.P. Murthy, C.V. Agarwal and A. Naidu BS Publication Hyd.

Website Sources:

- http://www.commonchemistry.org/
- https://www.engineeringvillage.com/search/quick.url?CID=quickSearch&database=1
- https://www.technicalsymposium.com/

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(Effective from 2021-22)

EME-101/ EME-201: ENGINEERING MECHANICS

Objective(s): The objectives of this course:

- Develop the capacity to predict the effects of force and motion while carrying out the creative design functions of engineering. This capacity requires more than a mere knowledge of the physical and mathematical principles of mechanics.
- Visualize physical configurations in terms of real materials, actual constraints, and the practical limitations which govern the behavior of machines and structures.

UNIT I: **(10 Sessions)**

Two-Dimensional Force Systems: Basic concepts, Laws of motion, Principle of Transmissibility of forces, Transfer of a force to parallel position, Resultant of a force system, Simplest Resultant of Two dimensional concurrent and non-concurrent force systems, free body diagrams, Equilibrium and Equations of Equilibrium, Applications.

UNIT II: **(8 Sessions)**

Trusses: Introduction, Simple Truss and solution of simple truss, Method of Joints and Method of Sections. **Friction**: Introduction, Laws of Coulomb Friction, Equilibrium of Bodies involving Dry-friction, Belt friction, Application.

UNIT III: **(8 Sessions)**

Centroid and Moment of Inertia: Centroid of plane, curve, area, volume and composite bodies, Moment of inertia of plane area, Parallel Axes Theorem, Perpendicular axes theorem, Principal Moment Inertia, Mass Moment of Inertia of Circular Ring, Disc, Cylinder, Sphere and Cone about their Axis of Symmetry.

UNIT IV: **(6 Sessions)**

Beam: Introduction, Shear force and Bending Moment, Differential Equations for Equilibrium, Shear force and Bending Moment Diagrams for Statically Determinate Beams.

UNIT V: **(8 Sessions)**

Kinematics of Rigid Body: Introduction, Plane Motion of Rigid Body, Velocity and Acceleration under Translation and Rotational Motion. Relative Velocity. Kinetics of Rigid Body: Introduction, Force, Mass and Acceleration, Work and Energy, Impulse and Momentum, D'Alembert's Principles and Dynamic Equilibrium.

Course Outcomes:

At the end of the course students will able to:

- Recognize different force systems, moments and couple.
- To draw Free Body Diagram and label the reactions on it.
- Apply equilibrium equations in statics.
- Understand Newton's law in motion, and recognize different kinds of particle motions.

Suggested Readings:

1. Engineering Mechanics by Irving H. Shames, Prentice-Hall

2. Mechanics of Solids by Abdul Mubeen, Pearson Education Asia.
3. Engineering Mechanics by R. K. Bansal, Laxmi Publications, New Delhi.
4. Engineering Mechanics by SS Bhavi Katti, New age International Publisher, New Delhi.

Website Sources:

- https://nptel.ac.in/courses/122/104/122104014/
- https://www.coursera.org/learn/engineering-mechanics-statics
- https://www.edx.org/course/engineering-mechanics-2
- https://www.youtube.com/watch?v=ADR04oYgpAM

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EEC-101/ EEC-201: ELECTRONICS ENGINEERING

Objective: The main objective of this course:

- Familiarize the students with concepts of semiconductor and it's working along with their applications in real life.

UNIT I: **(8 Sessions)**

Theory of Semiconductor material: Energy band Theory of crystals, Insulators, Semiconductors and Metals, classification of semiconductors, Mobility and Conductivity, Donor and Acceptor Impurities, Mass- Action law, Variation in semiconductor parameters with Temperature, Hall – Effect.

UNIT II: **(8 Sessions)**

Semiconductor Diodes and Applications: p-n junction, depletion layer, V-I characteristics, diode resistance, capacitance, p-n junction as rectifiers, filter (Shunt capacitor filter), clipping circuits, clamping circuits, breakdown mechanism, breakdown characteristics, zener resistance, zener diode application as shunt regulator. Introduction of LED, and Photo diode.

UNIT III: **(8 Sessions)**

Bipolar Junction Transistor (BJT): Construction, transistor action, CB, CE and CC configurations, concept of voltage gain, current gain. Field Effect Transistor (FET): JFET: construction, principle of working, concept of pinch-off, drain saturation current, characteristics, characteristic equation, CG, CS and CD configurations, MOSFET: depletion and enhancement type, construction.

UNIT IV: **(8 Sessions)**

Number system: Conversion of bases (decimal, binary, octal and hexadecimal numbers) addition and subtraction, BCD numbers, Boolean algebra, logic gates, concept of universal gates. Canonical forms, minimization using K-map (Upto four variable, don't care conditions also)

UNIT V: **(8 Sessions)**

Operational Amplifier (Op-Amp) : Concept of ideal operational amplifier, parameters. Inverting, non-inverting and unity gain configurations, Op-amp as adder, subtractor, Block diagram of Communication Systems, Introduction to Modulation, Need for modulation, Definition of AM and FM.

Course Outcomes:

At the end of the course students will able to:

- Understand the basic of semiconductor technology
- Define the purpose of different diodes used in several applications
- Develop understanding and impact of resistance regions
- Discuss how basic communication occurs over wireless medium
- Discuss the benefits of transistors over conventional vacuum tubes

Suggested Readings:

1. S. Salivahanan, N Suresh Kumar, “Electronic Devices and circuits” 2nd Edition, TMH.
2. Robert L. Boylestad/ Louis Nashelsky “Electronic Devices and Circuit Theory”, 9th Edition, Pearson Education.
3. Jacob Millman, Christos C. Halkias, “Integrated Electronics”, TMH.
4. Morris Mano “Digital Computer Design”, PHI 2003.
5. Kennedy, Davis, “Electronics Communication System” 4th Edition, TMH.

Website Sources:

- www.sanfoundary.co.in
- Grade up online course on transistors (www.gradeup.org)
- www.nptel.ac.in
- en.wikipedia.org

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B.Tech. Biotechnology I Year (I Semester)
(Effective from 2021-22)

ECS-101/ECS-201: COMPUTER FUNDAMENTALS AND PROGRAMMING

Objective(s): The objectives of this course:

- Introduces the concepts of computer basics & programming with particular attention to Engineering examples.
- The C programming language is used but the course will stress on fundamental parts of programming language, so that the students will have a basic concept for understanding and using other programming language.
- C is the easiest language to understand so basic constructs of C will be cleared.

UNIT I: **(8 Sessions)**

Introduction: Introduction to Computer Systems, Generation of Computers, BIOS, Various types of memories, CPU organization, ALU, registers. Introduction to various operating Systems. Number systems: Binary, hexadecimal, octal and their inter conversions. Computer Languages and Software & hardware: High Level Languages and Low-Level Language, Various types of software. Firmware, Compiler, Interpreter and Assembler. File Allocation Table, Hardware.

UNIT II: **(8 Sessions)**

Input, Output and storage Units: Introduction to various Input and output Devices Printers; Various type of Impact and Non- Impact Printers. Introduction to algorithm and Flow chart: Representation of an algorithm, flowchart symbols and levels of flow chart, advantage and limitations of flowchart and pseudo code. Basics of programming: Introduction to the design and implementation of correct, efficient and maintainable programs. Use of high-level programming languages for the development of programs.

UNIT III: **(8 Sessions)**

Standard I/O in "C", Fundamental Data Types and Storage Classes: Character types, Integer, short, long, unsigned, single and double-precision floating point, storage classes, automatic, register, static and external, Operators and Expressions: Using numeric and relational operators, mixed operands and type conversion, Logical operators, Bit operations, Operator precedence and associatively.

UNIT IV: **(8 Sessions)**

Conditional Program Execution: Applying if and switch statements, nesting if and else, restrictions on switch values, use of break and default with switch, Program Loops and Iteration: Uses of while, do and for loops, multiple loop variables, assignment operators, using break and continue.

UNIT V: **(8 Sessions)**

Modular Programming: Passing arguments by value, scope rules and global variables, separate compilation, and linkage, building your own modules. Arrays: Array notation and representation, manipulating array elements, using multidimensional arrays, arrays of unknown or varying size, Structure, union, enumerated data types, Functions: Introduction, types of functions, functions with array, recursive functions, Introduction to pointers, Introduction to file handling, standard C preprocessors, defining and calling macros, conditional compilation, passing values to the compiler.

Course Outcomes:

At the end of the course students will able to:

- Understanding the concept of input and output devices of Computers and how it works and recognize the basic terminology used in computer programming
- Write, compile and debug programs in C language and use different data types for writing the programs.
- Design programs connecting decision structures, loops and functions.
- Explain the difference between call by value and call by address.
- Understand the dynamic behavior of memory by the use of pointers.
- Use different data structures and create or manipulate basic data files and developing applications for real world problems.

Suggested Readings:

1. "Let us C", Yashvant Kanitkar.
2. "Programming with C", Byron Gottfried
3. "Computer Fundamentals", Anita Goel, Pearson Education
4. "Computer Concepts and Programming in C", E Balaguruswami, McGraw Hill
5. "C programming", Kernighan and Ritchie, PHI
6. "Computer Fundamentals and Programming in C", Reema Thareja, Oxford Publication

Website Sources:

- www.nptel.ac.in
- www.toptal.com/c/the-ultimate-list-of-resources-to-learn-c-and-c-plus-plus
- www.learn-c.org

IFTM University, Moradabad
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B.Tech. Biotechnology I Year (I Semester)
(Effective from 2021-22)

PSD-101: PROFESSIONAL SKILL DEVELOPMENT-I

Objectives: The objectives of this course:

- To develop knowledge and understanding of grammar.
- To develop abilities to make use of the grammar in own writing English.
- To increase understanding and recall of what is read and listen including facts and main idea.
- To enhance competencies in writing paragraph, gist or abstract/précis of the passage in own words/ language and in writing resume, bio-data, letters and applications of different kinds.
- To develop all the four skills of English language.

UNIT I: **(8 Sessions)**

Basic Applied Grammar and Usage

The Sentences: Parts – Subject and Predicate; Kinds of Sentences and their Transformation. Parts of Speech. **Noun:** Kinds; Gender; Case; Number; Usage**. Pronouns:** Definition; Kinds; Usage. **Adjectives:** Kinds, Degrees of Comparison, Transformation of Degrees. **Determiners:** Kinds: many, many a, a great many; less and fewer; each and every; elder, eldest and older, oldest; much, many; little, a little, the little. **Articles:** Kinds, Articles and Number system, Articles and Gender system, Omission of Articles, Repetition of Articles. **Verbs:** Kinds; Auxiliaries: Principal Auxiliaries; Modal Auxiliaries; Semi-Modals; Usage

UNIT II: **(8 Sessions)**

Basic Applied Grammar Continued

Non-Finite Verbs: Kinds; Infinitives; Gerund; Participle. **Adverbs:** Kinds and Usage. **Prepositions:** Kinds and Usage. **Conjunctions:** Kinds; Usage. **Interjections:** Definition; Usage.

UNIT III: **(8 Sessions)**

Clauses and Phrases, Tenses, Active and Passive Voice, Direct and Indirect Speech

UNIT IV **(8 Sessions)**

Précis Writing: Techniques of Précis Writing; examples**. Paragraph Writing:** Structure of Paragraph, Construction of Paragraphs; Techniques of Paragraph Writing: Unity, Coherence, Emphasis. **Reading Comprehension. Listening Comprehension.**

UNIT V **(8 Sessions)**

Writing of Resume, Bio-Data. **Writing of Letters and Applications:** Formats; Elements; Kinds: Leave Applications, Job Applications, Order Letters, Letters of Claims and Complaints, Letters of Adjustment.

Course Outcomes:

Students completing this course will be able to:

- Write paragraph, gist or abstract/précis of the passage in their own words/language, resume, bio-data, letters and applications of different kinds.
- Use targeted grammatical structures meaningfully and appropriately in oral and written production.
- Enhance competence in the four modes of literacy: writing, speaking, reading & listening.
- Understand and recall facts and main idea.

Suggested Readings:

1. Remedial English Language by Malti Agarwal, Krishna Publications, Meerut.
2. Professional Communication by Malti Agarwal, Krishna Publications, Meerut.
3. High School English Grammar & Composition by Wren & Martin, S. Chand & Company LTD., New Delhi.

Website Sources

- www.wikipedia.com
- www.englishgrammar.org
- www.usingenglish.com
- www.grammarly.com

IFTM UNIVERSITY, MORADABAD
B. Tech. Biotechnology Engineering
Course Structure
(Effective from 2021-22)
Second Semester

S.N.	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
						Mid Term Exam			External Exam		
			L	T	P	CT	AS +AT	Total			
THEORY											
1.	EMA-202/ EBT-209	Elementary Mathematics-II/ Elementary Biology-II	3	1	0	20	10	30	70	100	4
2.	EPH -201	Engineering Physics-II	3	1	0	20	10	30	70	100	4
3.	ECH -201/ ECE-201	Engineering Chemistry/ Environmental Science	3	1	0	20	10	30	70	100	4
4.	EME-201/ PSD -201	Engineering Mechanics/ Professional Skill Development-I	3	1	0	20	10	30	70	100	4
5.	EEC -201/ EEE-201	Electronics Engineering/ Electrical Engineering	3	1	0	20	10	30	70	100	4
6.	EBT-202/ ECS-201	Introduction to Biotechnology/ Computer Fundamentals & Programming	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT											
7.	ECH-251/ EPH -251	Chemistry Lab/ Physics Lab	0	0	2	20	10	30	70	100	1
8.	EEC-251/ EEE -251	Electronics Engg. Lab/ Electrical Engg. Lab	0	0	2	20	10	30	70	100	1
9.	EBT-252/ ECS-251	Introduction to Biotechnology Lab/ Computer Lab	0	0	2	20	10	30	70	100	1
10.	EME-251/ EME-253	Mechanical Engg. Lab/ Engineering Graphics Lab	0	0	2	20	10	30	70	100	1
11.	GP-201	General Proficiency	-	-	-	-	-	100	-	100	1
		Total Credit	18	6	8	-	-	400	700	1100	29

IFTM University, Moradabad
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EMA-202: ELEMENTARY MATHEMATICS-II

Objective(s): The objective of this course:

- Recall and remember basics of algebra, probability theory, vectors and three-dimensional geometry.
- Understand the concepts of basic mathematical methods to solve engineering problems, analyze engineering problems and evaluate the solutions.

UNIT I: **(8 Sessions)**

Algebra: Fundamental theorem of algebra, Solution of quadratic equations in the complex number system, Linear inequalities, Algebraic solutions of linear inequalities in one variable and their representation on the number line, Graphical solution of linear inequalities in two variables, Solution of system of linear inequalities in two variables graphically.

UNIT II: **(8 Sessions)**

Sequences, Series, Permutation & Combination: Sequence and series, Arithmetic progression (A.P.), Arithmetic mean (A.M.), Geometric progression (G.P.), General term of a G.P., Sum of n terms of a G.P., Geometric mean (G.M), Relation between A.M. and G.M., Fundamental principle of counting, Factorial n (n!), Permutation and combinations formulae and their connections, Simple applications, Sum of n terms of the special series n, n^2 and n^3.

UNIT III: **(8 Sessions)**

Probability Theory: Random experiments, Outcomes, Sample spaces (set representation), Events, Occurrence of events, 'and' and 'or' events, Exhaustive events, Mutually exclusive events , Connections with the theories of earlier classes, Probability of an event , Multiplication theorem on probability , Bays theorem , Binomial distribution , Poisson distribution and Normal distribution.

UNIT IV: **(8 Sessions)**

Vector and Scalars: Vectors and Scalars, Magnitude and direction of a vector, Direction cosines / ratios of vectors, Type of vectors (equal , unit, zero, Parallel and collinear vectors), Position vector of a point , Negative of a vector , Components of a vector, Addition of a vectors, Multiplication of a vector by a scalar, Position vector of a point dividing a line segment in a given ratio, Scalar product of vectors, Projection of a vector on a line, Cross product of vectors.

UNIT V: **(8 Sessions)**

Three-Dimensional Geometry: Introduction to three- dimensional geometry coordinate axes and coordinate planes in three dimensions, Coordinates of a point, Distance between two points and section formula, Direction cosines / ratios of a line joining two points, Cartesian and vector equation of a line, Coplanar and skew lines, Shortest distance between two lines, Cartesian and vector equation of a plane, Angle between (i) two lines, (ii) two planes (iii) a line and a plane, Distance of a point from a plane.

Course Outcomes:

At the end of the course students will able to:

- Remember equations, inequalities, and systems of equations to represent situations and find solutions via symbolic, numeric and graphic methods.

- Understand and calculate probabilities by applying probability laws and theoretical results.
- Compare and analyze the methods by using coordinates to represent and work with vectors.
- Understand the concepts & advance topics related to three-dimensional geometry and study the applications of conics.

Suggested Readings:

1. R.D. Sharma: Mathematics (I& II-XI), Dhanpat rai publication (Pvt.) Ltd. New Delhi, India.
2. R.D. Sharma: Mathematics (I& II-XII): Mathematics (I& II-XI), Dhanpat rai publication (Pvt.) Ltd. New Delhi, India.
3. Gorakh Prasad: Differential Calculus, Pothishala Private Limited, Allahabad.
4. Gorakh Prasad: Integral Calculus, Pothishala Private Limited, Allahabad.
5. B.S. Grewal:Engg. Mathematics,khanna publishers, New Delhi.

Website Sources:

- www.pdfdrive.com
- www.dmi.gov.in
- www.yourarticlelibrary.com
- onlinecourses.nptel.ac.in
- en.wikipedia.org

IFTM University, Moradabad
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EBT-209: ELEMENTARY BIOLOGY-II

Objective(s): The objectives of this course:

- Provide necessary knowledge of the microbial world, structure and functions of microbes and their relationship to environment and human health.
- Emphasizes on imparting basic construction of a living organism, its metabolism and relation to diseases.

UNIT I: **(8 Sessions)**

Microbiology: Brief history of microbiology**,** Types of microorganisms, Basic idea of domain bacteria, lichens, algae, protozoa, helminthes and virus, Role of microorganisms in the production of industrial chemicals and pharmaceuticals.

UNIT II: **(8 Sessions)**

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

UNIT III: **(8 Sessions)**

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

UNIT IV: **(8 Sessions)**

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

UNIT V: **(8 Sessions)**

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

Course Outcomes:

At the end of the course students will able to:

- Define the science of microbiology, its development and importance in human welfare.
- Acquire knowledge about the organizational and functional aspects of cell and cell organelles.
- Learn about the interactions of the cells with outside environment.
- Learn about the classical genetics and transmission of characters.

Suggested Readings:

1. Biology-Textbook of Class XI, NCERT Publication
2. Biology-Textbook of Class XII, NCERT Publication
3. Microbiology- Pelzer, Tata Mcgraw- Hill Publishing Com. Ltd., 2002
4. An introduction to immunology by C.V. Rao, Narosa publishing house
5. Biology by Peter H Raven, George b Johnson, Kenneth A., Mason, Jonathan Losos, Susan
6. Singer (MacGraw Hill Publication)

7. General Microbiology: Stainer, Adelberg and Ingraham

Website Sources:

- https://routledgetextbooks.com/textbooks/9780815345138/lecture-notes.php
- https://www.slideshare.net
- https://lecturenotes.in/
- https://www.shomusbiology.com/

IFTM University, Moradabad
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(Effective from 2021-22)

EPH-201: ENGINEERING PHYSICS-II

Objective: The main objective of this course:

- Familiarize students about electromagnetic theory, magnetic materials, solid state Physics, superconductors and their applications.

UNIT I: (10 Sessions)

Electromagnetic Theory: Gauss law, continuity equation, Ampere's Law, Maxwell's equations (differential and integral forms), Pointing vector and Pointing Theorem , propagation of plane electromagnetic waves in free space Non conducting and in conducting media, Skin depth.

UNIT II: (8 sessions)

Dielectric and Magnetic Properties of Materials: Dielectric Properties: Dielectric constants, Polarization of dielectric materials, Polarizability, Claussius- Mossotti Equation, Application of dielectric. Magnetic Properties: Magnetization, Magnetic moment, Dia, Para and Ferro magnetism, Langevin theory for diamagnetic material, Hysteresis Curve.

UNIT III: (8 Sessions)

Solid State Physics: Energy bands in metals, Semiconductors and insulators, Intrinsic and extrinsic semiconductors, Fermi energy levels for doped, undoped semiconductors, P-N junction, Tunnel diode, Zener diode.

UNIT IV: (8 Sessions)

Superconductivity: Meissner Effect, Type I and Type II Superconductors, BCS theory (Qualitative only), London's Equation, Properties of superconductors & applications of superconductors. Nano Materials: Basic principle of nano science and technology, Structure, properties and uses of Fullerene and carbon nano tubes, Application of nano technology.

UNIT V: (8 Sessions)

X-Rays: Diffraction of X-rays, Production and properties, Bragg's Law, Bragg's spectrometer, Applications of X-rays. Ultrasonics: Introduction, Production of Ultrasonics (Magneto striction and piezoelectric methods), properties & applications of Ultrasonic waves.

Course Outcomes:

At the end of the course students will able to:

- Understand Gauss law, Ampere's Law, Maxwell's equations and their applications.
- Study of Propagation of plane electromagnetic waves in free space.
- Understand Dielectric and magnetic properties of the materials.
- Explain Intrinsic and extrinsic semiconductors.
- Construction, Operation and characteristics of diodes.
- Understand concepts of superconductors, Properties of superconductors & applications of superconductors.
- Gain basic knowledge on the properties, production and applications of X-rays.
- Basic principle of nano science and technology and applications of nanotechnology.

Suggested Readings:

1. Concept of Modern Physics: A. BEISER
2. Atomic Physics: Rajam
3. Greiner : Quantum Physics
4. Griffth : Introduction to Electrodynamics
5. S. K. Gupta: Engineering Physics
6. Beiser : Perspective of Modern Physics

Website Sources:

- https://www2.ph.ed.ac.uk
- http://web.mit.edu
- http://pcwww.liv.ac.uk
- http://sites.science.oregonstate.edu
- https://eng.libretexts.org
- https://shodhganga.inflibnet.ac.in
- https://www.electrical4u.com
- https://vardhaman.org

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ECE-101/ECE-201: ENVIRONMENTAL SCIENCE

Objective(s): The objectives of this course:

- Provide every student with opportunities to acquire the knowledge, values, attitudes, commitment, and skills needed to protect and improve the environment.
- Develop and reinforce new patterns of environmentally sensitive behavior among individuals, groups and society as a whole for a sustainable environment.
- Understand the trans-national character of environmental problems such as global warming, climate change, ozone layer depletion etc. and ways of addressing them, including interactions across local to global scales.

UNIT I: **(12 Sessions)**

Environment: Definition of environment. Environmental education. Need for the public awareness. Concept of Ecology: Ecosystem, energy and nutrients flow in ecosystem food chain. Environmental segment: Atmospheric structure. Classification of air pollutants, sources of air pollution and their effect on human health and property.

UNIT II: **(10 Sessions)**

Air quality and standard: Meteorological phenomenon and their influence on air quality, lapse rates, dispersion of pollutants. Air pollution control: Introduction to particulates and gaseous pollutants such as SOx, NOx & CO, and their effects.

UNIT III: **(10 Sessions)**

Water quality: Physical. Chemical & biological parameters. Water quality standard, BOD. COD and BOD COD calculations. Environmental Analysis: pH, alkalinity, conductivity, ammonia, fluoride, sulphate, chloride. Analysis and measurement of gaseous pollutants.

UNIT IV: **(8 Sessions)**

Pollution: Pollution from industry and agriculture. Polymers and plastic, food additives, fertilizers, insecticides, fungicides and herbicides. Heavy metal and energy their environmental implications. Solid waste and its managements. Pollution and public health aspect Environmental Protection- Role of government, initiatives by non-governmental organizations (NGO).

Course Outcomes:

At the end of the course students will able to:

- Understand the issues and challenges related to environmental and ecosystem due to some human activities.
- Understand key concepts from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.
- Appreciate concepts and methods from ecological and physical sciences and their application in environmental problem solving.
- Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
- Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.

Suggested Readings:

1. “Environmental studies” Benny Joseph, Tata McgrawHill-2005.
2. “Environmental studies”-Dr D.L. Manjunath, Pearson Education-2006.
3. “Environmental studies” R. Rajagopalan, Oxford Publication-2005.
4. “Text book of environment science & Technology”, M. Anji Reddy, BS Publication.

Website Sources:

- https://www.india.gov.in/official-website-ministry-environment-and-forests-0
- https://www.earthshare.org/environews/

IFTM University, Moradabad
Bachelor of Technology (B.Tech.), Programme
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(Effective from 2021-22)

PSD-101: PROFESSIONAL SKILL DEVELOPMENT-I

Objectives: The objectives of this course are:

- To develop knowledge and understanding of grammar.
- To develop abilities to make use of the grammar in own writing English.
- To increase understanding and recall of what is read and listen including facts and main idea.
- To enhance competencies in writing paragraph, gist or abstract/précis of the passage in own words/ language and in writing resume, bio-data, letters and applications of different kinds.
- To develop all the four skills of English language.

UNIT I: (8 Sessions)

Basic Applied Grammar and Usage

The Sentences: Parts – Subject and Predicate; Kinds of Sentences and their Transformation. Parts of Speech. **Noun:** Kinds; Gender; Case; Number; Usage**. Pronouns:** Definition; Kinds; Usage. **Adjectives:** Kinds, Degrees of Comparison, Transformation of Degrees. **Determiners:** Kinds: many, many a, a great many; less and fewer; each and every; elder, eldest and older, oldest; much, many; little, a little, the little. **Articles:** Kinds, Articles and Number system, Articles and Gender system, Omission of Articles, Repetition of Articles. **Verbs:** Kinds; Auxiliaries: Principal Auxiliaries; Modal Auxiliaries; Semi-Modals; Usage

UNIT II: (8 Sessions)

Basic Applied Grammar Continued

Non-Finite Verbs: Kinds; Infinitives; Gerund; Participle. **Adverbs:** Kinds and Usage. **Prepositions:** Kinds and Usage. **Conjunctions:** Kinds; Usage. **Interjections:** Definition; Usage.

UNIT III: (8 Sessions)

Clauses and Phrases, Tenses, Active and Passive Voice, Direct and Indirect Speech

UNIT IV (8 Sessions)

Précis Writing: Techniques of Précis Writing; examples**. Paragraph Writing:** Structure of Paragraph, Construction of Paragraphs; Techniques of Paragraph Writing: Unity, Coherence, Emphasis. **Reading Comprehension. Listening Comprehension.**

UNIT V (8 Sessions)

Writing of Resume, Bio-Data. **Writing of Letters and Applications:** Formats; Elements; Kinds: Leave Applications, Job Applications, Order Letters, Letters of Claims and Complaints, Letters of Adjustment.

Course Outcomes:

Students completing this course will be able to:

- Write paragraph, gist or abstract/précis of the passage in their own words/language, resume, bio-data, letters and applications of different kinds.
- Use targeted grammatical structures meaningfully and appropriately in oral and written production.
- Enhance competence in the four modes of literacy: writing, speaking, reading & listening.
- Understand and recall facts and main idea.

Suggested Readings:

1. Remedial English Language by Malti Agarwal, Krishna Publications, Meerut.
2. Professional Communication by Malti Agarwal, Krishna Publications, Meerut.
3. High School English Grammar & Composition by Wren & Martin, S. Chand & Company LTD., New Delhi.

Website Sources:

- www.wikipedia.com
- www.englishgrammar.org
- www.usingenglish.com
- www.grammarly.com

IFTM University, Moradabad
Bachelor of Technology (B. Tech.), Programme
B. Tech. Biotechnology I Year (II Semester)
(Effective from 2021-22)

EEE-101/EEE-201: ELECTRICAL ENGINEERING

Objective(s): The objectives of this course:

- Provide comprehensive idea about AC and DC circuits and its analysis**.**
- Provide the working principles and applications of basic machines in electrical engineering.

UNIT I: (8 Sessions)

D.C. Circuit Analysis: Network, Active And Passive Elements, Concept of Linearity And Linear Network, Unilateral And Bilateral Elements, Sources, Source Transformation, Kirchhoff's Laws, Star-Delta Transformation, Network Theorems: Thevenin's Theorem, Superposition Theorem, Norton's Theorem, Maximum Power Transfer Theorem.

UNIT II: (8 Sessions)

Single Phase AC Circuits: AC Waveforms, Average and Effective Values, Form and Peak Factors, Analysis of Series, Parallel and Series-Parallel RLC Circuits, Active, Reactive and Apparent Powers, Power Factor, Causes of Low Power Factor, Resonance in Series and Parallel Circuits.

UNIT III: (8 Sessions)

Three Phase AC Circuits: Three Phase System, Advantages, Phase Sequence, Star and Delta Connections, Balanced Supply and Balanced Load, Three-phase Power and its Measurement**,** Measuring Instruments: Types of Instruments, PMMC and Moving Iron Instrument, Single-Phase Dynamometer Wattmeter, Induction Type Energy Meter

UNIT IV: (8 Sessions)

Magnetic Circuits: Magnetic Circuit Concepts, Analogy between Electric & Magnetic Circuits, Magnetic Circuits with DC and AC Excitations, B-H Curve, Hysteresis and Eddy Current Losses, Single Phase Transformer: Principle, Working, Construction, E.M.F. Equation, Power Losses, Efficiency, Introduction to Auto-Transformer (Excluding Numericals)

UNIT V: (8 Sessions)

Principles of Electro-Mechanical Energy Conversion, **DC Generator:** Construction & Working, E.M.F. Equation of Generator, Types of D.C. Generator, Applications, D.C. Motor: Principle of operation, Torque Equation of a Motor, Types of D.C. Motor, Applications (Excluding Numericals). Three Phase Induction Motor: Construction-(Squirrel cage and slip-ring motor), Principle of Operation, Applications (Excluding Numericals).

Course Outcomes:

At the end of the course students will able to:

- Predict the behavior of any electrical and magnetic circuits.
- Formulate and solve complex AC, DC circuits.
- Identify the type of electrical machine used for that particular application.
- Realize the requirement of transformers in transmission and distribution of electric power and other applications.
- Function on multi-disciplinary teams.

- Awareness of general structure of power systems.
- Acquire knowledge about the single phase and three base electrical circuits

Suggested Readings:

1. V. Del Toro, “Principles of Electrical Engineering” Prentice Hall International
2. I.J. Nagarath, “Basic Electrical Engineering” Tata McGraw Hill
3. D.E. Fitzgerald & A. Grabel Higginbotham, “Basic Electrical Engineering” Mc- Graw Hill
4. T.K. Nagsarkar & M.S. Sukhija, “Basic Electrical Engineering” Oxford University Press
5. W.H. HaytP, “Engineering Circuit Analysis” Mc Graw Hill

Website Sources:

- www.lecturenotes.in
- www.examupdates.in
- www.iare.ac.in
- www.notes.specworld.in
- www.ocw.mit.edu
- www.nptel.ac.in
- www.vlab.co.in

IFTM University, Moradabad
Bachelor of Technology (B. Tech.), Programme
B. Tech. Biotechnology I Year (II Semester)
(Effective from 2021-22)

EBT-102/ EBT-202: INTRODUCTION TO BIOTECHNOLOGY

Objective(s): The objectives of this course:

- Introduce students to the global significance of biotechnology, the categories of biotechnology processes and products, and in the context of "traditional" Vs "modern" biotechnology processes and its applications.
- Introduce the developments in the field of biotechnology, genomics and proteomics.
- Introduce to the bioinformatics which is one of the emerging fields in biotechnology.

UNIT I: **(8 Sessions)**

Introduction to Biotechnology: Fundamentals of Biochemical Engineering, Biotechnology and Society-Principles and Processes; Application in Health, food, medicine and Agriculture; genetically modified organisms (GMO); biosafety issues.

UNIT II: **(8 Sessions)**

Biomolecules: Building Blocks of Biomolecules-Structure and dynamics. Structure and function of Macromolecules (Carbohydrates, Proteins, Lipids). Classification of Enzymes- Purification and characterization of enzymes from natural sources. Comparison of chemical and enzyme catalysis.

UNIT III: **(8 Sessions)**

Introduction to Cell & Microbiology: Basic concept of Cell and cell theory, Types of Cells, Structure and function of cell organelles, Microbes and their classification. Application of microbes in Biotechnology.

UNIT IV: **(8 Sessions)**

History of Bioinformatics: Introduction and application. Biological databases (nucleotide and protein data bases, Structure databases) Data retrieval system (ENTREZ, SRS and DBGET); Sequence file formats and molecular file formats.

UNIT V: **(8 Sessions)**

Genomics: Genome Sequencing, Gene Prediction and counting, Genome similarity, SNP's and comparative genomics, Human Genome Project.

Course Outcomes:

At the end of the course students will be able to:

- Understand basic concepts in components of cell, structure and biochemical functions.
- Acquire basic concepts of nucleic acids and its structures
- Search and retrieve information from genomic and proteomic databases (e.g. GenBank, Swiss-Prot), and to analyze their search results using software available on the internet (e.g. BLAST, ClustalW).
- Learn the theory of genome sequencing and other predictions.

Suggested Readings:

1. Introduction to Biotechnology by William J. Thieman, Michael A. Palladino, Publisher: Benjamin Cummings.
2. Basic Biotechnology by Colin Ratledge Publisher: Cambridge University Press.

3. Text book of Biotechnology by H.K.Dass (Wiley India publication).
4. Biotechnology by B.D.Singh (Kalyani Publishers).
5. Text book of Biotechnology by R.C.Dubey (S.Chand and company).

Website Sources:

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://www.ncbi.nlm.nih.gov/books

IFTM University, Moradabad
Bachelor of Technology (B. Tech.), Programme
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(Effective from 2021-22)

EBT-252: Introduction to Biotechnology Lab

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and Don't	
4.	About Equipments and Accessories: Principle and Working	
5.	Introduction to Laboratory Instruments	Experiment 1
6.	To learn the Preparation of media	Experiment 2
7.	Isolation of microbes from the given sample by spread plate technique	Experiment 3
8.	To characterize bacterial colony using gram staining	Experiment 4
9.	Preparation of buffers and measurement of pH	Experiment 5
10.	Identification of carbohydrates by Molisch's test	Experiment 6
11.	Estimation of reducing sugars by Benedict test	Experiment 7
12.	To distinguish between polysaccharides and other carbohydrates (Iodine test)	Experiment 8

IFTM UNIVERSITY, MORADABAD
B. Tech. Biotechnology Engineering
Course Structure
(Effective from 2021-22)
Third Semester

S.N.	Course Code	Course Name	Periods			Evaluation Scheme				Course Total	Credits
						Mid Term Exam			External Exam		
			L	T	P	CT	AS+AT	Total			
THEORY											
1.	EBT-301	Biochemistry	3	1	0	20	10	30	70	100	4
2.	EBT-302	Microbiology	3	1	0	20	10	30	70	100	4
3.	EBT-303	Cell biology	3	1	0	20	10	30	70	100	4
4.	EBT-304	Bioenergetics	3	1	0	20	10	30	70	100	4
5.	EBT-305	Fluid Flow and Solid Handling	3	1	0	20	10	30	70	100	4
6.	EMA-302	Biostatistics	3	1	0	20	10	30	70	100	4
7.	EHU-301	Disaster Management * (Audit Paper)	3	0	0	20	10	30	70	100	0
PRACTICALS/PROJECT											
8.	EBT-351	Biochemistry	0	0	2	20	10	30	70	100	1
9.	EBT-352	Microbiology & Cell Biology	0	0	2	20	10	30	70	100	1
10.	EBT-353	Fluid Flow and Solid Handling	0	0	2	20	10	30	70	100	1
11.	GP-301	General Proficiency	-	-	-	-	-	100	-	100	1
		Total Credit	21	6	6			400	700	1000	28

***Internal Assessment (Audit Paper not added in total)**

IFTM University, Moradabad
Bachelor of Technology (B. Tech.), Programme
B. Tech. Biotechnology II Year (III Semester)
(Effective from 2021-22)

EBT-301: BIOCHEMISTRY

Objective(s): The objectives of this course:

- Provide basic knowledge and fundamentals of biochemistry.
- Understand the fundamental chemical principles that govern complex biological systems.
- Enable students to acquire a specialized knowledge and understanding for importance and role of biomolecules in life.
- Teach knowledge and understanding of the principles and basic mechanisms of metabolic control and molecular signaling in cells and, to develop basic laboratory skills for biochemical research.

UNIT I: **(8 Sessions)**

Introduction: Background and scope of Biochemistry; properties of water, acids, bases and buffers; Covalent and non-covalent interactions in biological systems; Biomolecules and separating techniques- Centrifugation, Chromatography (Paper and Gel filtration).

UNIT II: **(8 Sessions)**

Carbohydrate: Classification of carbohydrates; Structure and function of carbohydrates; Metabolism- Glycolysis, TCA cycle, Gluconeogenesis, HMP pathway, Glycogenesis, Glycogenolysis.

UNIT III: **(8 Sessions)**

Proteins and Enzymes: Amino acids- Classification, structure and properties of amino acids; Structure of proteins- Primary, secondary, tertiary and quaternary structure; Heme and porphyrin metabolism; Enzymes- Introduction, nomenclature and applications of enzymes.

UNIT IV: **(8 Sessions)**

Fats and lipids: Structure and function; Biosynthesis of fatty acids, Degradation of fatty acids- Fatty acid oxidation (β oxidation of fatty acid); Regulation of fatty acid metabolism; Ketone bodies.

UNIT V: **(8 Sessions)**

Nucleic Acids: Structure and properties of DNA (A-, B- and Z-form) and RNA (mRNA, rRNA and tRNA); metabolism of Purines and Pyrimidines (*De-novo* and Salvage pathway).

Course Outcomes:

At the end of the course students will able to:

- Understand the molecular architecture of eukaryotic cells and organelles; the principles of bioenergetics and enzyme catalysis.
- The chemical nature of biological macromolecules, their three-dimensional construction, and the principles of molecular recognition.
- Understand the metabolic processes by which energy is produced in cells and amino acids, lipids, purines and pyrimidines, and carbohydrates are synthesized.
- Develop analytical and critical-thinking skills that allow independent exploration of biological phenomena through the scientific method
- Use/exploit biochemical methods and techniques for research.

Suggested Readings:

1. David L. Nelson and Michael M. Cox, Lehninger Principles of Biochemistry, 7th Edn, 2017, W. H. Freeman and Co., NY.
2. D. Voet, C. W. Pratt, J.G. Voet, Principles of Biochemistry: International StudentVersion, IV Ed., Wiley, New York.
3. Lupert Styrer, Jeremy M. Berg, John L. Tymaczko, Gatto Jr., Gregory J. Biochemistry. 9th Edn (2019). W.H.Freeman & Co. New York.
4. D. Papachristodoulou, A. Snape, W. H. Elliott, Daphne C. Elliott. Biochemistry and Molecular Biology, V Ed.,Oxford University Press, (2014).
5. Robert K. Murray, Daryl K. Granner, Victor W.Harper's Illustrated Biochemistry, 31th Edn (2018.) Rodwell. McGraw-Hills.USA.

Website Sources:

- https://themedicalbiochemistrypage.org/
- https://www.nature.com/nchembio/
- https://biochemistry.org/
- https://www.ebooks.com/en-ae/2110659/biochemistry-of-lipids-lipoproteins-andmembranes/neale-ridgway-roger-mcleod/

IFTM University, Moradabad
Bachelor of Technology (B. Tech.), Programme
B. Tech. Biotechnology II Year (III Semester)
(Effective from 2021-22)

EBT-302: MICROBIOLOGY

Objective(s): The objectives of this course:

- Provide necessary knowledge of the microbial world.
- Impart knowledge of structure and functions of microbes.
- Study physiology and relationship to the environment and human health.

UNIT I: **(8 Sessions)**

Introduction and History of Microbiology: Broad classification and taxonomy of microorganisms, culture media, isolation and identification of microbes, culture techniques, preservation of cultures. Growth and physiology; Methods of microbial enumeration; Microbial control by physical and chemical techniques, Strain improvement by Mutations and Genetic Engineering.

UNIT II: **(8 Sessions)**

Bacteria: Origin of bacteria, general characteristics, structure and classification. Bacterial photosynthesis- Photosynthetic structures, types of bacterial pigments, photosynthetic electron transport system, Photophosphorylation.

UNIT III: **(8 Sessions)**

Virus: Origin of Virus, Morphology, Shape, Size, Structure, type of envelope and their composition, Classification of viruses, lytic and lysogenic cycles, Viroids and Prions.

UNIT IV: **(8 Sessions)**

Microbial metabolism: Enzymes and their regulation, energy production, respiratory chain, anaerobic respiration, glycolysis, pentose phosphate pathway, Entner-Doudoroff pathway.

UNIT V: **(8 Sessions)**

Applications of microbiology: Microbiology of waste water; bioremediation; Biological nitrogen fixation- Bio fertilizers; Biofuels; Medical Microbiology- tuberculosis, typhoid, diarrhea, amoebiosis, rabies.

Course Outcomes:

At the end of the course students will able to:

- Define microbiology and learn its scope in human welfare.
- Become aware of the historical concept of spontaneous generation and the experiments performed to disprove it.
- Learn the general techniques used in the study of microorganisms.
- Compare and differentiate between the structure and function of microbes.

Suggested Readings:

1. Powar & Dagniwala. Microbiology, Volume 1, Himalaya Publishing House Pvt. Ltd, 2012.
2. M J Pelczar Jr, E C S Chan and N R Krieg. Microbiology, McGraw Hill, Fifth Edition.
3. R Y Stanier, J L Ingraham, M L Wheelis. General Microbiology, MacMillan Fifth Edition, 2007.

4. G J Tortora, B R Funke and C L Case. Microbiology- An Introduction, Pearson Education, Ninth Edition, 2008.

Website Sources:

- https://routledgetextbooks.com/textbooks/9780815345138/lecture-notes.php
- https://www.slideshare.net
- https://lecturenotes.in/
- https://www.shomusbiology.com/

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EBT-303: CELL BIOLOGY

Objective(s): The objectives of this course:

- Familiarize the students with the core principles and concepts of the cellular mechanisms which are significant in the development, growth and survival of the organism.
- Includes the fundamental concepts of cellular biology like cell organelles, various transport mechanisms signal mechanisms.

UNIT I: **(8 Sessions)**

Structure and Function of the Cell: Eukaryotic and prokaryotic cells; Membrane organization - Micelles, membrane proteins, cytoskeleton proteins, contractile proteins (Actin and myosin); Extra cellular matrix; Cell division- Mitosis and meiosis, Cell cycle, Molecules controlling cell cycle.

UNIT II: **(8 Sessions)**

Transport Across Cell Membranes: Passive and active transport; Sodium potassium pump, Ca^{2+} ATPase pump; Lysosomal and vacuolar membrane ATP dependent proton pumps; Co transport; Symport; Antiport; Ion-selective gated channel against neuronal cell membrane; Transport into prokaryotic cells; Endocytosis and exocytosis; Entry of virus and toxins into cells.

UNIT III: **(8 Sessions)**

Receptors and Models of Extra Cellular Signaling: Cytosolic, nuclear and membrane bound receptors; Examples of receptors; Autocrine, paracrine and endocrine modes of action; Quantization and characterization of receptors.

UNIT IV: **(8 Sessions)**

Signal Transduction: Signal amplification; Different models of signal amplifications; Role of cyclic AMP, cyclic GMP and G proteins in signal transduction; Biosynthesis of inositol tri phosphates and their role as messengers; Calcium ion flux and its role in cell signaling, phosphorylation and regulation of protein kinases in signaling, serine – threonine kinases in signaling.

UNIT V: **(8 Sessions)**

Cell Culture: Techniques for the propagation of eukaryotic and prokaryotic cells; Cell lines- Generation of cell lines, maintenance of stock cells, characterization of cells, techniques in cell culture, explants cultures, primary cultures, contamination, three dimensional cultures; Role of matrix in cell growth.

Course Outcomes:

At the end of the course students will able to:

- Understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.
- Understand how these cellular components are used to generate and utilize energy in cells.
- Understand the cellular components underlying mitotic cell division and mechanism underlying the transport across the cell.
- Explain the various models of cell signaling.

- Describe the signal transduction and the techniques for production of animal cell culture and their properties.

Suggested Readings:

1. G.M. Cooper, R. E. Hausman. The Cell: A Molecular Approach, VI Edition, ASM Press and Sinauer Associates, Inc.,USA, 2013.
2. R.I. Freshney. Culture of Animal Cells, VI Ed., Wiley-Blackwell, 2010.
3. De Robertis and De Robertis (2005). (8th edition) (Indian) Cell and Molecular Biology, Lippincott Williams, Philadelphia. [B.I Publications Pvt. Ltd. New Delhi].
4. Watson J.D et al., Molecular Biology of the Gene, VI Ed, Cold Spring harbor laboratory Press, 2008.

Website Sources:

- https://microbenotes.com/category/cell-biology/
- http://www.isca.co.in/BIO_SCI/book/ISBN%20978-93-86675-40-8.pdf
- http://www.biologyjunction.com/cell++notes+bi.htm https://www.biologydiscussion.com/cell/

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EBT-304: BIOENERGETICS

Objective(s): The objectives of this course:

- Study energy flow through living systems and its role in biological processes like growth, development and metabolism.
- Provides deep knowledge about cellular process like cell respiration, metabolic and enzymatic processes.
- Explain thermodynamic principles and concept of free energy.

UNIT I: (8 Sessions)

Introduction to thermodynamics: General idea of system and surrounding; Laws of thermodynamics: Zeroth, First, Second and third laws. Concept of energy, work and heat; Conversion of units; Heat capacity.

UNIT II: (8 Sessions)

Concept of free Energy: Molecular basis of entropy, standard free energy and measurement of free energy, significance in metabolism; Energy rich bonds, ATP and inter conversion of nucleotide phosphates; Phosphorylation potential, redox reaction and reduction potential; ATP generation in bacterial system.

UNIT III: (8 Sessions)

Bioenergetics of animals: Site of Oxidative Phosphorylation; AT synthetase; Electron- Transferring Reactions; Mechanism of Oxidative Phosphorylation; Oxidation of Extra mitochondrial NADH and ATP; Aspartate-malate Shuttle; Glycerol-3-P Shuttle;

UNIT IV: (8 Sessions)

Bioenergetics of plants: Architecture- light harvesting complexes, Hill reaction, photosystem I and II, location and mechanism of energy transfer, photophosphorylation and reduction of carbon dioxide; Calvin cycle, quantitative efficiency, photorespiration, C4 metabolism, Chemiosmotic theory and evidence of its occurrence.

UNIT V: (8 Sessions)

Energetic pathways and their regulation: Glycolytic pathway and its regulation, glycogen breakdown, Citric acid cycle and its cycle, gluconeogenesis, pentose phosphate pathway, glyoxylate pathway.

Course Outcomes:

At the end of the course students will able to:

- Understand that how biological processes in a system works and understanding laws of thermodynamics.
- Understand the role of ATP and reduced cofactors in shuttling energy and electrons around within cells.
- Understand metabolism of ATP and other pathways that synthesize ATP.
- Know how oxidative phosphorylation synthesizes large amount of ATP

Suggested Readings:

1. E.E. Conn, P.K. Stumpf, G. Bruening, R.H. Doi. Outlines of Biochemistry, V Ed.,John Wiley & Sons, (2009).
2. D.L. Nelson, M. M. Cox. Lehninger Principles of Biochemistry, V Ed., CBS Publication (2016).

3. J.M. Berg, J.L., Tymoczko, L. Stryer. Biochemistry: VII Ed., W.H. Freeman Int. Edition (2010).
4. R C Srivastava, S.K. Saha, A.K. Jain. Thermodynamics: A core course, III Ed, PHI Learning Private Limited, New Delhi (2010).

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- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://www.ncbi.nlm.nih.gov/books
- https://www.pnas.org/

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EBT-305: FLUID FLOW AND SOLID HANDLING

Objective(s): The objectives of this course:

- Familiarize the students with the properties of fluids and the applications of fluid mechanics.
- Formulate and analyze the problems related to fluid flow.
- Understand the concept of flow measurement, types of flows and dimensional analysis.

UNIT I: **(8 Sessions)**

Properties of fluids: Types of Fluid, Capillarity, Cavitations, surface tension. Fluid statics: Euler's equation, Hydrostatic Law and Pressure Measurement, Transport of fluids, pipe fittings, minor losses in pipe flow.

UNIT II: **(8 Sessions)**

Flow measurements: Bernoulli's Equation and its application, Orifice meter, venturimeters, rotameter and Pitot tube.

UNIT III: **(8 Sessions)**

Pumps: Reciprocating pumps, rotary pumps, centrifugal Pumps, Characteristic curve, Efficiency, Minimum Operating speed, Net positive suction Head Introduction of fluidization and types of Fluidization.

UNIT IV: **(8 Sessions)**

Properties of solids: Screening, industrial screening equipment, screen analysis, size reduction of solids, stages of reduction. Intermediate and fine size reduction, power requirement and mechanism. Power driven machines: Crushers, grinders and conveyers.

UNIT V: **(8 Sessions)**

Filtration theory: Continuous and branch equipments. Flow of solids through fluids, classification and sedimentation.

Course Outcomes:

At the end of the course students will able to:

- Understand stress-strain relationship in fluids, classify their behavior and also establish force balance in static systems.
- Apply Bernoulli principle and compute pressure drop in flow systems of different configurations.
- Describe function of flow measuring devices and apply Bernoulli equation to determine the performance of these devices.
- Measure the fluid pressure using various types of pressure measuring devices.

Suggested Readings:

1. Fox and McDonald's Introduction to Fluid Mechanics.7 edition. Wiley; (2008) McCabe Smith.
2. Richardson, J.F.; Harker, J.H.; Backhurst, J.R..Coulson and Richardson's Chemical Engineering Volume 2 - Particle Technology and Separation Processes (5th Edition) Elsevier.
3. D.S. Kumar, "Fluid Mechanics and Fluid Power Engineering",2nd Edition, SK. Katania and Sons, 2010.

4. Dr. R.K. Bansal “A Text book of Fluid Mechanics and Hydraulic Machines”, 9th Edition, Laxmi Publications Pvt. Ltd., New Delhi, 2010.
5. A. K. Jain, “Fluid Mechanics Including Hydraulic Machines”, 8th Edition, Khanna Publishers, New Delhi, 2003.

Website Sources:

- nptel.ac.in/course.html
- www.nsf.gov
- en.wikipedia.org
- www.sciencedirect.com
- www.slideshare.net
- www.researchgate.net

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EMA-302: BIOSTATISTICS

Objective: The main objectives of this course:

- Advance statistical science and its application to problems of human health and disease, with the ultimate goal of advancing statistics. The role of biostatisticians is an important one, especially when it comes to designing studies and analyzing data from research problems.

UNIT I: **(8 Sessions)**

Introduction: Frequency Distribution, Types of graphs Histogram, Frequency polygon Frequency Curves, Cumulative frequency curve of ogive, Diagrammatic Representation of date measures of Central Tendency (Mean, Median, Mode). Measures of Dispersion, Range, Quartile, Deviation, Average Deviation or Mean deviation, Standard Deviation, Variance.

UNIT II: **(8 Sessions)**

Moment: Moment generating functions, Skewness, Kurtosis curve fitting, Method of least squares, Fitting of straight lines, Polynomials, Exponential curves ($Y = ab^x$ and $Y = ax^b$ and $Y = ae^{bx}$ etc.).

UNIT III: **(8 Sessions)**

Correlation: Correlation table, Positive and Negative correlation, Karl Pearson's coefficient of correlation; correlation of Rank, Tied Ranks. Linear, Nonlinear and multiple Regression analysis, Line of Regression coefficient, Angle Between two Regression Lines, Binomial, Poisson and normal distribution.

UNIT IV: **(8 Sessions)**

Sampling Theory (small and large): Comparison of Two Large sample, Hypothesis, Null hypothesis & Alternative hypothesis, Test of significance: Chi-square test, t-test, F-test Analysis of variance (One way). Application to Engineering Medicine, agriculture etc.

UNIT V: **(8 Sessions)**

The Design of Experiments: Introduction, Planning of Experiments, Definition of Design of Experiment, and Some Important terms, Field Experiment, Basics principles of Field Experiment, Completely Randomized Design (CRD), Randomized block, Design Latin Square Design.

Course Outcomes:

At the end of the course students will able to:

- Remember restate the principal concepts about biostatistics and collect data relating to variable which will be examined.
- Understand and interpret the concepts of descriptive statistics from these data.
- Understand and be able to address ethical, regulatory and practical aspects of human subjects research including human subjects protections.
- Be capable of self-directed learning of unfamiliar statistical methods and written and oral presentation of results/findings.

Suggested Readings:

1. Georgr W and Willian G., Statistical Methods, IBH Publication.
2. Zar, J, Biostatistics, Prenticw Hall, London.
3. R. Rangaswami, A Text Book of Agricultural Statistics, New Age International Publication.
4. Methods in Biostatistics by B. K. Mahajan: S.Chand& Company (Pvt.) Ltd., New Delhi.
5. Fundamentals of Applied Statistics S.C. GUPTA & V.K. KAPOOR: Sultan Chand & Sons, New Delhi.

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- www.pdfdrive.com
- www.dmi.gov.in
- www.yourarticlelibrary.com
- onlinecourses.nptel.ac.in
- en.wikipedia.org

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EHU-301: DISASTER MANAGEMENT

Objective(s): The objectives of this course:

- Provide students an understanding to the concepts and aspects of disaster and its relationship with development.
- Ensure awareness of Disaster Risk Reduction (DRR) approaches among students.
- Assist students develop ability to respond to their environment with potential response to disaster.

UNIT I: **(8 Sessions)**

Introduction to Disasters: Definition: Disaster, Hazard, Vulnerability, Resilience, Risks; Types of disasters – Earthquake, Landslide, Flood, Drought, Fire, campus shooting, bomb threat, terrorist incidence and financial emergency etc.; Causes and Impacts including social, economic, political, environmental, health, psychosocial, etc.; Differential impacts- in terms of caste, class, gender, age, location, disability; Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II: **(8 Sessions)**

Approaches to Disaster Risk Reduction: Disaster life cycle – its analysis, phases, culture of safety, prevention, mitigation and preparedness; Community based DRR (Disaster Risk Reduction), Structural-nonstructural measures; Roles and responsibilities of community: Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders.

UNIT III: **(8 Sessions)**

Inter-Relationship between Disasters and Development: Factors affecting Vulnerabilities, impact of Development projects such as dams, embankments, changes in Land-use etc.; Climate Change Adaptation-IPCC Scenario and Scenarios in the context of India – Relevance of indigenous knowledge, appropriate technology and local resources; Role of international cooperation's in Disaster Management.

UNIT IV: **(8 Sessions)**

Disaster Risk Management in India: Hazard and Vulnerability profile of India. Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management; Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy – Other related policies, plans, programmes and legislation; Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V: **(8 Sessions)**

Disaster Management: Applications, Case Studies and Field Works: The project /fieldwork are meant for students to understand vulnerabilities and to work on reducing disaster risks and to build a culture of safety. Projects must be conceived creatively based on the geographic location and hazard profile of the region where the college is located. A few ideas or suggestions are discussed below:

Several governmental initiatives require Urban Local Bodies (ULBs) and Panchayati Raj Institutions (PRIs) to be proactive in preparing DM plans and community based disaster preparedness plans. Information on these would be available with the district collector or Municipal corporations. Teachers could ask students to explore and map disaster prone areas, vulnerable sites, vulnerability of people (specific groups) and resources. The

students along with teacher could work on ways of addressing these vulnerabilities, preparing plans and consultation with local administration or NGOs.
Students could conduct mock drills in schools, colleges or hospitals. They could also work on school safety, safety of college buildings, training in first aid. Other examples could be- identifying how a large dam, road/ highway or an embankment or the location of an industry affects local environment and resources or how displacement of large sections of people creates severe vulnerabilities may be mapped by student project work.

The suggested topics for Project work for student could be as follows:

- Monitoring and evaluation plan for disaster response
- Low cost Home based water purification methods
- Planning Nutrition intervention programmes
- Safety tips before during and after earthquake, cyclone, floods and fire accidents.
- Mock Drills
- Major disasters in India
- Disaster Management in India
- Flood affected areas and damages in India
- Heat waves in India
- Earth quakes in India
- Historical Tsunamis in India
- Nuclear emergence
- Traffic accidents in India
- Train Accidents
- Major disease outbreak
- Disaster management structure in India
- Precaution, mitigation of disaster in India
- Warning system in India to prevent disaster
- Bhopal gas tragedy
- Kutch earth quake
- Tsunami (2004)
- Kosi Calamity 2008
- Mayapuri radiation exposure Delhi (2010)
- Mock exercises

Course Outcomes:
At the end of the course students will able to:

- Identify the nature and causes of disaster.
- Apply the disaster risk reduction mechanism.

Suggested Readings:

1. Satish Modh, Introduction to Disaster Management, Macmillan Publisher India Ltd
2. Alexander David, Introduction in 'Confronting Catastrophe', Oxford University Press
3. Blaikie, P, Cannon T, Davis I, Wisner B 1997. At Risk Natural Hazards, Peoples' Vulnerability and Disasters, Routledge.
4. Damon P. Coppola, Introduction to International Disaster Management, Butterworth-Heinemann,
5. Singhal J.P. "Disaster Management", Laxmi Publications. ISBN-10: 9380386427 ISBN-13: 978-9380386423
6. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd, ISBN-10: 1259007367, ISBN-13: 978-1259007361]

7. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi
8. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi.
9. Carter, Nick. Disaster Management: A Disaster Manager's Handbook. Asian Development Bank, Manila Philippines.
10. Cuny, F. Development and Disasters, Oxford University Press. Document on World Summit on Sustainable Development.
11. Govt. of India: Disaster Management Act 2005, Government of India, New Delhi. Government of India, 2009.
12. Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi Indian Journal of Social Work.
13. Special Issue on Psychosocial Aspects of Disasters, Volume 63, Issue 2, April.

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- https://www.physio-pedia.com/Disaster_Management
- http://www.ifrc.org/en/what-we-do/disaster-management
- http://www.wcpt.org/disaster-management/what-is-disaster-management
- en.wikipedia.org.

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(Effective from 2021-22)

(EBT-351) Biochemistry

1	Introduction of Laboratory Practices	
2	Safety Measures	
3	Do and don't	
4	About Equipments and Accessories: Principle and Working	
5	Introduction to Laboratory Instruments	Experiment 1
6	Introduction to Biochemistry Lab: Units, Volume / Weight measurements, concentration units	Experiment 2
7	Preparation of Acid and Alkali Solutions	Experiment 3
8	Measurement of pH of any given sample	Experiment 4
9	Identification of carbohydrates by **Molisch's test**	Experiment 5
10	To distinguish between polysaccharides from other carbohydrates **(Iodine test)**	Experiment 6
11	Estimation of reducing sugars by **Benedict test**	Experiment 7
12	Estimation of total carbohydrates by Anthrone's method	Experiment 8
13	Test to distinguish between monosaccharides from disaccharides **(Barfoed's test)**	Experiment 9
14	Test to distinguish ketoses from aldoses sugars **(Seliwanoff's test)**	Experiment 10
15	To detect whether given sample is protein or non-protein	Experiment 11
16	To estimate protein concentration in sample by Biuret assay	Experiment 12
17	Estimation of protein concentration by Lowry method	Experiment 13

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(EBT-352) Microbiology

1	Introduction of Laboratory Practices	
2	Safety Measures	
3	Do and don't	
4	About Equipments and Accessories: Principle and Working	
5	To identify given bacterial culture by Gram's staining method.	Experiment 1
6	To determine the microbial flora in laboratory, tap water and drinking water (Hostel).	Experiment 2
7	To study the Serial dilution technique.	Experiment 3
8	Isolation of soil Microorganisms by spread plate and pours plate methods.	Experiment 4
9	To measure the length and breadth of the given cell sample by using micrometer.	Experiment 5
10	To study the mitosis and meiosis cell cycle in onion root tip.	Experiment 6
11	To identify the blood cell types in human blood smear.	Experiment 7
12	Preparation of microscope slide for Dicot leaf section.	Experiment 8
13	To prepare permanent slides using the given sections like Stem, Root and Leaf.	Experiment 9

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(EBT-353) Fluid Flow and Solid Handling

1	Introduction of Laboratory Practices	
2	Safety Measures	
3	Do and don't	
4	About Equipments and Accessories: Principle and Working	
5	To verify Bernoulli's Theorem.	Experiment 1
6	To measure Surface Tension of a liquid.	Experiment 2
7	To determine the coefficient of discharge, contraction & velocity of an orifice.	Experiment 3
8	To determine the co-efficient of discharge through Orifice meter.	Experiment 4
9	To determine the co-efficient of discharge through Venturimeter.	Experiment 5
10	To verify the momentum equation experimentally by use of Impact of Jet on Vane apparatus. (For flat surface)	Experiment 6
11	To steady the friction factor for turbulent flow in commercial pipes. (Major Losses)	Experiment 7
12	Verification of streamline flow.	Experiment 8
13	To determine the coefficient of discharge of notches & weirs.	Experiment 9
14	To determine the minor losses due to sudden enlargement, sudden contraction and bend.	Experiment 10

IFTM UNIVERSITY, MORADABAD
B. Tech. Biotechnology Engineering
Course Structure
(Effective from 2021-22)
Fourth Semester

S.N.	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
						Mid Term Exam			External Exam		
			L	T	P	CT	AS +AT	Total			
THEORY											
1.	EBT-401	Enzymology	3	1	0	20	10	30	70	100	4
2.	EBT-402	Immunology	3	1	0	20	10	30	70	100	4
3.	EBT-403	Molecular Genetics	3	1	0	20	10	30	70	100	4
4.	EBT-404	Modern Analytical Techniques	3	1	0	20	10	30	70	100	4
5.	ECS-409	Data Structure using C	3	1	0	20	10	30	70	100	4
6.	PSD-401	Professional Skill Development-II	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT											
7.	EBT-451	Immunology	0	0	2	20	10	30	70	100	1
8.	EBT-452	Molecular Genetics	0	0	2	20	10	30	70	100	1
9.	EBT-459	Programming in C	0	0	2	20	10	30	70	100	1
10.	GP-401	General Proficiency	-	-	-	-	-	100	-	100	1
		Total Credit	18	6	6	-	-	370	630	1000	28

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EBT-401: ENZYMOLOGY

Objective(s): The objectives of this course:

- Provide the fundamentals of enzyme structure, functions, and kinetics of enzymes.
- Explain how enzymes are able to increase speed of a biochemical reaction in sense of thermodynamics, kinetics and molecular interactions.
- Current applications and future potential of enzymes.

UNIT I: **(8 Sessions)**

Introduction of Enzyme: Classification, EC-Number, Properties of Enzymes, Factors affecting the Enzyme activity, Isolation and Purification of Enzymes from plant, animal and Microbial Sources

UNIT II: **(8 Sessions)**

Mechanisms of Enzyme Action: Concept of active site and energetic of enzyme substrate complex formation; Kinetics of single substrate reactions; turnover number; estimation of Michaelis-Menton parameters. Importance of K_m, Multi-substrate reaction mechanisms and kinetics.

UNIT III: **(8 Sessions)**

Types of Inhibition: Competitive, un-competitive and non-competitive inhibition; kinetic models; Substrate and Product Inhibition; Allosteric regulation of enzymes; Deactivation kinetics.

UNIT IV: **(8 Sessions)**

Enzyme Immobilization: Physical and Chemical techniques for enzyme Immobilization adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding - examples; Advantages and disadvantages of different Immobilization techniques; Major applications of immobilized enzyme system.

UNIT V: **(8 Sessions)**

Enzyme Reactors- Stirred tank reactor, membrane reactor, continuous flow reactor (CSTR, PBR, FBR), advantages and disadvantages; Application of enzyme reactors in industries (Pharmaceutical, textile and food).

Course Outcomes:

At the end of the course students will able to:

- Understand the enzyme kinetics.
- Use catalytic strategies in interpreting mechanisms of enzymatic action.
- Analyze options for applying enzymes and their inhibitors in medicine and various industries

Suggested Readings:

1. Dixon and Webb. Enzymes: IRL Press.
2. Chaplin and Bucke. Enzyme technology Cambridge University Press.
3. Protein Biotechnology and Biochemistry, 2nd ed.- Walsh, Wiley Publications.
4. Alan Fersht: Structure and Mechanism in Protein Science, 2nd ed. W.H. Freeman & Co.

5. Nicolas Price & Lewis Stevens: Fundamentals of Enymology, 2nd edition, Oxford Univ. Press, New York, NY.
6. Trevor Palmer: Understanding Enzymes, Second Edition, J. Wiley & Sons, New York.

Website Sources:

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://www.ncbi.nlm.nih.gov/books
- https://www.masterclass.com

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EBT-402: IMMUNOLOGY

Objective(s): The objectives of this course:

- Introduce the basic concepts of immunology.
- Describes about immune response, antigen types and blood groups.
- Understand techniques required for diagnosis of diseases like ELISA, RIA and Western blotting are described.
- Provides understanding about development and function of the immune system.

UNIT I: (8 Sessions)

Introduction to immunity: Characteristics of innate and adaptive immunity, Humoral and Cell mediated immune response, Hematopoiesis, Cells and Molecules of the immune system, Primary and Secondary lymphoid organs, T &B cell maturation, activation and differentiation, Inflammation.

UNIT II: (8 Sessions)

Antigens and Antibodies: Factors affecting the immunogenicity, Haptens and adjuvants, ABO blood group Types of antigens, Epitopes, Structure, functions and characteristics of different classes of antibodies, Antigenic Determinants on Immunoglobulins.

UNIT III: (8 Sessions)

Immune interaction: Structure and Function of MHC molecules, Antigen processing and presentation, Complement system, Structure, function and application of cytokines, regulation of immune response, immune tolerance.

UNIT IV: (8 Sessions)

Immunological techniques: Antigen and antibody interactions-Cross reactivity, precipitation reactions, Agglutination reactions; Serological techniques–ELISA, RIA and western blotting; Production and application of monoclonal antibodies, Vaccines.

UNIT V: (8 Sessions)

Immunity against diseases: Immunity against infectious diseases- Influenza, Tuberculosis, Malaria,; Hyper-sensitivity; Autoimmunity; Cancer; AIDS; Transplantation immunology.

Course Outcomes:

At the end of the course students will able to:

- Understand response and will be able to differentiate between innate and adaptive immunity.
- Able to identify different types of blood groups and types of Antigens.
- Understand against the infectious diseases.
- Understand what happens if our immune system overreacts to foreign substances (hypersensitivities and allergies).
- Understand what happens if our body recognize self as non-self (autoimmunity).
- Understand the biology of different vaccines against infectious agents and cancer and solutions to produce better vaccines.

Suggested Readings:

1. Abul K. Abbas, Andrew H. H. Lichtman, Shiv Pillai: Basic Immunology (Function and Disorder of Immune System), 4th Edition; Elsevier Publisher.
2. W.L. Anderson: Immunology, Fence Creek Publishing (Blackwell).
3. Thomas J. Kindt, Barbara A. Osborne, Richard A. Goldsby, Kuby: Immunology, 6th Edition; Publisher: W H Freeman & Co.
4. P.J. Delves, S. J. Martine, D.R. Burton, I.M. Roitt: Immunology, 12th Edition. Wiley-Blackwell.

Website Sources:

- https://www.creative-diagnostics.com/blog/index.php/immunogen-antigen-hapten-epitope-and-adjuvant/
- https://www.redcrossblood.org/donate-blood/blood-types.html
- http://mcb.berkeley.edu/courses/mcb150/lecture5/Lecture5(6).pdf
- https://nptel.ac.in/courses/102/103/102103038/

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EBT-403: MOLECULAR GENETICS

Objective(s): The objectives of this course:

- Understand the fundamental principles of genetics, storage of genetic information and its translation at molecular level in prokaryotic and eukaryotic systems.
- Make students understand intricate molecular mechanisms of carcinogenesis and apoptosis and their applications.

UNIT I: **(8 Sessions)**

Fundamental principles of genetic: Mendelian genetics, Gene interaction, multiple alleles, complementation, linkage, recombination and linkage mapping, extra-chromosomal inheritance, chromosomal basis of heredity; Central Dogma.

UNIT II: **(8 Sessions)**

DNA as the genetic material: Structure and functions of DNA, thermodynamic stability of DNA; supercoiling; linking number; concept of gene, transposable elements.

UNIT III: **(8 Sessions)**

DNA replication: DNA replication in prokaryotes & Eukaryotes; Enzymes involved in DNA replication, DNA proof reading; DNA repair mechanism.

UNIT IV: **(8 Sessions)**

Transcription: Transcription in prokaryotic and eukaryotic; Post transcriptional modification processes (5' capping, poly-A tailing and splicing), open reading frames.

UNIT V: **(8 Sessions)**

Translation: Genetic Code; Wobble hypothesis, Translation in Prokaryotes and Eukaryotes; Regulation of gene expression in prokaryotes and Eukaryotes.

Course Outcomes:

At the end of the course students will able to:

- Explain the properties of genetic materials and storage and processing of genetic information.
- Apply mechanisms of DNA replication, damage and repair in applied molecular genetics.
- Explain mechanisms involved in gene expression.
- Explain molecular basis of complex metabolic diseases.

Suggested Readings:

1. Advance Genetics by G.S. Miglani, Narosa Publishing House.
2. S.B. Primrose, R.Twyman. Principles of Gene Manipulation and Genomics, VII Ed., Wiley-Blackwell, 2006.
3. D.L. Nelson, M.M. Cox. LehningerPrinciples of Biochemistry, V Ed., 2016.
4. M.R. Green, J. Sambrook. Molecular Cloning: A Laboratory Manual (Vol I/II/III), IV Ed., 2014.

5. J.D. Watson. A Passion for DNA: Genes, Genome &Society, Cold Spring Harbor Laboratory Press, 2000.
6. Strickberger M.W., Genetics, Third Edition. Macmillan Publishing, N.Y. London, 1985.
7. Lewin B., Genes VII, 7th edition, Oxford University Press; 2000.

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- https://www.britannica.com/science/fermentation
- https://nptel.ac.in/courses/102/105/102105064/
- https://www.khanacademy.org

IFTM University, Moradabad
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(Effective from 2021-22)

EBT-404: MODERN ANALYTICAL TECHNIQUES

Objective(s): The objectives of this course:

- Acquire basic concepts, principles, and techniques of modern analytical techniques that would empower students with an analytical mind set.
- Solve diverse analytical problems in an efficient and quantitative way that conveys the importance of accuracy and precision of the analytical results.

UNIT I: **(8 Sessions)**

Concept of Good Laboratory Practices: Good Laboratory Practices, Quality assurance and Quality Control, Steps of Analysis, Basic Aspects of Qualitative and quantitative Analysis; Accuracy and precision.

UNIT II: **(8 Sessions)**

Centrifugation: Theory and Principle of centrifugation, Sedimentation, Sedimentation rate, sedimentation coefficient. Use and design of different types of rotors, Types of centrifuges, Preparative and analytical centrifugation: Density gradient centrifugation (zonal and isopycnic), Differential centrifugation.

UNIT III: **(8 Sessions)**

Chromatography: Basic Theory- Plate and Rate Theory, Principle of Chromatography, Chromatographic performance parameters, High performance liquid chromatography, Adsorption chromatography, Partition chromatography, Ion-exchange chromatography, Molecular exclusion chromatography, Affinity chromatography, Reverse phase chromatography.

UNIT IV: **(8 Sessions)**

Electrophoresis: General Principle, SDS PAGE, Agarose electrophoresis of nucleic acid & 2D gel Electrophoresis, Pulsed gel electrophoresis, Capillary Electrophoresis, Microchip Electrophoresis.

UNIT V: **(8 Sessions)**

Microscopy & Spectroscopy: Simple and Compound microscope; Overview of Electromagnetic spectrum; Beer-Lambert's Law; Instrumentation, Principle, Working and application of- UV-Vis spectrophotometer, Colorimeter, IR Spectroscopy; Raman effect.

Course Outcomes:

At the end of the course students will able to:

- Develop an understanding and gain knowledge of analytical methods used in biotechnology and applied sciences.
- Establish an appreciation of the role of scientific tools in quantitative analysis.
- Develop an understanding of the broad role of biochemical techniques in measurement and problem solving for analytical tasks.
- Provide an understanding of techniques employed for elemental and compound analysis.

Suggested Readings:

1. Keith Wilson & John Walker Principles and Techniques of Biochemistry and Molecular Biology, 7th Edition, Cambridge University Press.

2. S. K. Sawhney, Randhir Singh., Introductory Practical Biochemistry, 2nd Edition.
3. Gurdeep R Chatwal Sham K Anand., Instrumental Methods of Chemical Analysis, Oscar publication.

Website Sources:

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://library.nitrkl.ac.in/

IFTM University, Moradabad
Bachelor of Technology (B. Tech.), Programme
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ECS-409: DATA STRUCTURE USING C

Objective(s): The objectives of this course:

- Teach efficient storage mechanisms of data for an easy access.
- Improve the logical ability. To design and implementation of various basic and advanced data structures.
- Introduce various techniques for representation of the data in the real world.
- Develop applications using data structures.
- Teach the concept of protection and management of data.
- Teach various file management techniques.

UNIT I: **(8 Sessions)**

Elementary Data Organization: Algorithm, Asymptotic notations, Space and Time Complexity of an algorithm, Time Space Trade off, Information and its storage representation, Representation and its manipulation of Strings, Pattern Matching. Array: Linear data structures, Arrays, Single and Multidimensional Array, Representation of Array in memory, sparse matrices. Linear search, binary search.

UNIT II: **(8 Sessions)**

Linked List: Single Linked list, Array and Linked representation of Linked List, Two Way List, Operations on linked lists, Polynomial representation and addition using linked list.

UNIT III: **(8 Sessions)**

Queues: Queue operations, Circular queue, Priority queues, Array and linked representation of Queue, Dequeue. Stacks: Stack operations, Array and linked representation of stack, Application of Stack, Prefix and postfix expressions, Recursion, Tower of Hanoi problem.

UNIT IV: **(8 Sessions)**

Non-Linear data structures: Trees, Binary tree, Inorder, Preorder and Post order traversals of a Binary tree, Extended binary tree, complete tree, Huffman Algorithm, Multi linked structure, graphs and their representation, spanning trees, dynamic storage management, Sorting: Selection sort, Bubble sort, Radix sort, Merge Sort, Quick Sort, Insertion Sort, Bucket Sort, Heap Sort, topological sorting, external sorting, internal sorting etc.

UNIT V: **(8 Sessions)**

Search Trees: Binary Search Tree, AVL Tree, B Trees. Hashing: Hashing functions, Collision resolution techniques, Application of Hashing techniques. File structures: external storage devices, sequential files, indexed sequential files, direct files, external searching, linear and virtual hashing.

Course Outcomes:

At the end of the course students will able to:

- Student will be able to choose appropriate data structure as applied to specified problem definition.
- Student will be able to handle operations like searching, insertion, deletion, traversing mechanism etc. on various data structures.

- Students will be able to apply concepts learned in various domains like DBMS, compiler construction etc.
- Students will be able to use linear and non-linear data structures like stacks, queues, linked list, tree etc.

Suggested Readings:

1. Seymour Lipschutz, “Data structures”, McGraw Hill International Edition.
2. Sartaj Sahni, Data structures, Algorithms and Applications in Java, McGraw Hill,
3. J.P.Tremblay and Paul G. Sorenson, “An introduction to data structures with applications”, TMH.
4. Robert Kruse C.L. Tondo and Bruce Leung, “Data Structures and Program Design in C”, Pearson Edu.
5. Tenenbaum A.M and Augenstein M.J, “Data Structures using C ", Prentice Hall.

Websites Sources:

- swayam.gov.in
- onlinecourses.nptel.ac.in
- http://courses.cs.vt.edu/csonline/DataStructures/Lessons/
- https://www.geeksforgeeks.org/

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(Effective from 2021-22)

PSD-401: PROFESSIONAL SKILL DEVELOPMENT-II

Objectives: The objectives of this course are:

- To develop critical thinking and abilities to make correct use of grammar.
- To enhance competencies in written and oral communication.
- To develop mutually beneficial relationships through communication and cooperation with others, collaborate to achieve group goals, practice living and leading with integrity and learn about issues of local and global significance in order to become active members of communities.

UNIT I: Communicative Skills **(8 Sessions)**

Communication: Concept, Classification, Purpose, Process, Importance, Flow & Level of Communication, Barriers & Gateways in Communication, 7 C's of Communication, Types of Communication & communication without words

UNIT II: Intrapersonal Relationship Skills **(7 Sessions)**

Personality: Characteristics of Healthy & Sick Personality
Self Awareness
Self Esteem
Self Confidence
Assertiveness V/S Aggressiveness
Values: Types & Importance

UNIT III: Interpersonal Relationship Skills **(8 Sessions)**

Group: Concepts, Types, Stages
Team: Concepts, Elements, Types, Stages
Presentation Skills& strategies
Interview: Concepts, Types, Process, Interview Preparation Checklist, Interview Handling Skills, Common Interview mistakes

UNIT IV: Argumentative Skills **(10 Sessions)**

Debate
Role Play
Speeches
Elocution
Group Discussion

UNIT V: Campus to Company Skills **(8 Sessions)**

The corporate Fit: Dressing and Grooming
Basic Etiquette: Office (Do's and Don'ts for men and women), Telephone, Email
Dealing with People in Corporate

Course Outcomes:

Students completing this course will be able to:

- Apply the comprehensive set of skills and knowledge for life success.
- Understand the communication process, its benefits and challenges.

- Learn to effectively lead others on a project or in an organization.
- Develop and articulate respect for the diversity of talents, ways of knowing and learning.

Suggested Readings:

1. M.K. Sehgal & V. Khetrapal's Business Communication published by Excel Books.
2. Rajendra Pal's Business Communication published by Sultan Chand & Sons Publication.
3. P. D. Chaturvedi's Busines Communication published by Pearson Education, Delhi.
4. Elizabeth B. Hurlock's Personality Development by Tata McGraw Hills, Delhi.

Website Sources:

- www.wikipedia.com
- www.fluentu.com
- www.mindstool.com
- www.digitalcommons.pace.edu

IFTM University, Moradabad
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(Effective from 2021-22)

(EBT-451) Immunology

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and don't	
4.	About Equipments and Accessories: Principle and Working	
5.	To enumerate total number of RBC in human blood.	Experiment 1
6.	To enumerate total no. of WBC's in Human blood.	Experiment 2
7.	To identify blood group by simple slide agglutination.	Experiment 3
8.	To determine presence of specific antibodies present in serum by rapid slide test (WIDAL test)	Experiment 4
9.	To perform Sandwich ELISA (dot ELISA) for test antigen.	Experiment 5
10.	To perform precipitation reaction - Radial Immunodiffusion	Experiment 6
11.	To Perform precipitation reaction - Ouchterlony double diffusion.	Experiment 7
12.	To perform Counter current Immunoelectrophoresis.	Experiment 8

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(EBT-452) Molecular Genetics

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and don't	
4.	About Equipments and Accessories: Principle and Working	
5.	To study the properties of a buffer solution.	Experiment 1
6.	Isolation and purification of plasmid DNA.	Experiment 2
7.	To perform DNA electrophoresis.	Experiment 3
8.	To estimate the DNA Conc. by the Diphenylamine reaction (DPA)	Experiment 4
9.	To determine the Conc. of RNA from Orcinol method.	Experiment 5
10.	To amplify a specific DNA fragment by Polymerase Chain Reaction using random primers.	Experiment 6
11.	To learn the technique of Northern Blotting for the detection of a specific RNA fragment in a sample.	Experiment 7
12.	To learn the technique of Southern Blotting for the detection of a specific DNA fragment	Experiment 8

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(EBT-459) Programming in C

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and don't	
4.	About Equipments and Accessories: Principle and Working	
5.	To print "I am a student of IFTM University".	Experiment 1
6.	To add, subtract, and find average of two numbers.	Experiment 2
7.	To calculate $E=m*c^2$	Experiment 3
8.	To print the table of N.	Experiment 4
9.	To calculate the Simple Interest.	Experiment 5
10.	To calculate the compound interest.	Experiment 6
11.	Program for addition of two square matrices Algorithm	Experiment 7
12.	To find the roots of a quadratic equation.	Experiment 8
13.	Write a program in C for finding the greatest of 3 numbers	Experiment 9
14.	To print a pattern 1 1 2 1 2 3 1 2 3 4 1 2 3 4 5 ….. N	Experiment 10
15.	Write a program in C to find the factorial of N using function.	Experiment 11

IFTM UNIVERSITY, MORADABAD
B. Tech. Biotechnology Engineering
Course Structure
(Effective from 2021-22)
Fifth Semester

S.N.	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
						Mid Term Exam			External Exam		
			L	T	P	CT	AS +AT	Total			
THEORY											
1.	EBT-501	Bioinformatics	3	1	0	20	10	30	70	100	4
2.	EBT-502	Bioprocess Engineering-I	3	1	0	20	10	30	70	100	4
3.	EBT-503	Engineering Principles and calculations	3	1	0	20	10	30	70	100	4
4.	EBT-504	Genetic Engineering	3	1	0	20	10	30	70	100	4
5.	EBT-505	Heat and Mass transfer	3	1	0	20	10	30	70	100	4
6.	EBT-506	Plant Biotechnology	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT											
7.	EBT-551	Bioinformatics	0	0	2	20	10	30	70	100	1
8.	EBT-552	Bioprocess Engineering	0	0	2	20	10	30	70	100	1
9.	EBT-553	Genetic Engineering	0	0	2	20	10	30	70	100	1
10.	GP-501	General Proficiency	-	-	-	-	-	100	-	100	1
		Total Credit	18	6	6	-	-	370	630	1000	28

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EBT-501: BIOINFORMATICS

Objective(s): The objectives of this course:

- Introduce basic understanding of bioinformatics and its applications.
- Study the tools and databases in homology modeling and sequence alignment.
- Structure visualization and designing new drug molecules.

UNIT I: **(8 Sessions)**

Introduction of bioinformatics: Area, scope and application of Bioinformatics; Type of biological databases- Primary, secondary and composite databases; Database retrieval systems (ENTREZ, SRS, DBGET); Sequence and molecular file formats.

UNIT II: **(8 Sessions)**

Sequencing: Principle of DNA sequencing; RNA sequencing; Protein sequencing (Edman's degradation method).

UNIT III: **(8 Sessions)**

Sequence Alignment: Type of alignment- (Pairwise, global, local and multiple); Dot matrix analysis; Dynamic programming algorithm (Needle-Wunsch algorithm and Smith Waterman algorithm), Heuristic methods (BLAST, FASTA).

UNIT IV: **(8 Sessions)**

Protein structure prediction: Protein characterization, Primary structure analysis and prediction, Secondary structure analysis and prediction (Ramachandran Plot); Protein modeling- methods, Homology modeling, Fold recognition, *Ab-initio* modeling.

UNIT V: **(8 Sessions)**

Protein classification and protein structure visualization: Protein structure database, Protein structure visualization databases (RASMOL, CHIME, Cn-3D) and tools, Protein classification approaches.

Course Outcomes:

At the end of the course students will able to:

- Bioinformatics databases and tools for molecular structure and function prediction.
- Identify the homologous protein and DNA sequences.
- Visualization and characterization of protein structures.

Suggested Readings:

1. Baxevanis, Andreas D., and BF Francis Ouellette. Bioinformatics: a practical guide to the analysis of genes and proteins. Vol. 43. John Wiley & Sons, 2004.
2. Krane, Dan E. Fundamental concepts of bioinformatics. Pearson Education India, 2003.
3. Attwood, Teresa K., and David J. Parry-Smith. Introduction to bioinformatics. Prentice Hall, 2003.
4. Westhead, David R., J. Howard Parish, and Richard M. Twyman. "Instant Notes: Bioinformatics, The INSTANT NOTES Series." (2002).
5. Mallick, Bibekanand. Bioinformatics: principles and applications. Oxford University Press, 2008

Websites Sources:

- http://www.bioinform.com/index
- http://bioinfo.ernet.in/
- www.ncbi.nlm.nih.gov
- http://www.bic.nus.edu.sg/

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EBT-502: BIOPROCESS ENGINEERING-I

Objective(s): The objectives of this course:

- Introduce the fundamental concept of bioprocess engineering.
- Design and optimization method of media preparation.
- Perform material and energy balances for biochemical process.
- Sensors and instruments needed for measurement and control.

UNIT I: (8 Sessions)
Media in fermentation: Chemically defined and complex media; Media formulation – carbon source, nitrogen source, minerals; Media optimization for biomass and product; Inoculum preparation, development of inoculums for bacteria, yeast, mycelia and fungi. Renewable energy sources – industrial and agricultural waste.

UNIT II: (8 Sessions)
Sterilization: Concept & methods. Sterilization of medium. Kinetics of thermal death of microorganism. Batch sterilization, continuous sterilization. Sterilization of fermenter, Filter sterilization of air and fermentation media theory of depth filters.

UNIT III: (8 Sessions)
Microbial growth kinetics: Batch, Fed batch and continuous culture, Kinetics of pellet formation, Effect of Temperature, pH, Aeration & Agitation on growth. Biomass and product yield, Estimation of biomass.

UNIT IV: (8 Sessions)
Material and energy balance: Steady state and equilibrium, Law of conservation of mass, differential and integral balance, steady and unsteady mass balance equation, material balance with recycle, by-pass and purge system, stoichiometry of growth and product formation. Basic concept of internal energy, enthalpy and heat capacity, steady and unsteady state energy balance equation.

UNIT V: (8 Sessions)
Bioreactors: Configuration and construction material, stirred tank, bubble column, Airlift reactor, operating characteristics and application of packed bed, fluidized bed and trickle bed bioreactor, monitoring and control of bioreactor – Feedback control, programmed control.

Course Outcomes:
At the end of the course students will able to:

- Understand design media, sterilization procedure for the growth of micro-organisms for industrial applications
- Apply mass and energy balances to calculate the concentration of different gases in the fermenter off-gas, amount of reactant used, amount of oxygen etc.

Suggested Readings:

1. Michael L. Shuler, FikretKargi, Bioprocess Engineering – Basic Concepts, 2nd Ed.,
2. Pearson Education India, 2015
3. James Bailey, David Ollis, Biochemical Engineering Fundamentals, 2nd Ed., McGraw

4. Hill Education, 2017
5. Roger G. Harrison, Paul W. Todd, Scott R. Rudge, Demetri P. Petrides, Bioseparations
6. Science and Engineering, 2nd Ed., Oxford University Press, 2003.
7. 4.Pauline M. Doran, Bioprocess Engineering Principles, 2nd Ed., Academic Press, 2012
8. 5. Stanbury, Peter F., Allan Whitaker, and Stephen J. Hall. Principles of fermentation technology. Elsevier, 2013.

Website Sources:

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://www.ncbi.nlm.nih.gov/books
- https://www.masterclass.com

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B. Tech. Biotechnology III Year (V Semester)
(Effective from 2021-22)

EBT-503: ENGINEERING PRINCIPLES AND CALCULATIONS

Objective(s): The objectives of this course:

- Introduce the role and application of engineering in biotechnology,
- Study the transport phenomenon in biological system.
- Chemical reaction kinetics, design & analysis of bioreactors.

UNIT I: (8 Sessions)

Applications of engineering principles: Introduction to unit operations and unit processes, concept and application of transport phenomenon (momentum, mass and heat transfer), elementary and non-elementary reactions, reversible and irreversible reactions, Arrhenius law and activation energy, reaction rate.

UNIT II: (8 Sessions)

Interpretation of batch reactor data: Constant volume batch reactor (Differential and integral approach), varying volume batch reactor, temperature and reaction rate, batch mixed and plug flow reactor, Introduction to reactor design, Ideal reactors for single reaction, steady state mixed flow reactor, steady state plug flow reactor.

UNIT III: (8 Sessions)

Design for single reactions: Size comparison of single reactors, multiple- reactor system, equal size mixed flow reactor in series, recycle reactor, Autocatalytic reactions, optimum recycle operations. Temperature and pressure effect for single reaction, heats of reaction and temperature, adiabatic operations and non-adiabatic operations.

UNIT IV: (8 Sessions)

Reactions catalyzed by solids: Introduction to heterogeneous reactions, solid catalyzed reactions: rate equation for surface kinetics, heat effects during reaction, pore diffusion resistance combined with surface kinetics, porous catalyst particles, heat effects during reaction and performance equation for reactors containing porous catalyst particle.

UNIT V: (8 Sessions)

Biochemical reaction system: Enzyme fermentation, Michaelis-Menten kinetics, inhibition by a foreign substance (competitive and non-competitive inhibition), Microbial fermentation, mixed flow fermenter and batch fermenter, product distribution and kinetic expressions.

Course Outcomes:

At the end of the course students will able to:

- Different aspects of reaction rate, kinetics of different modes of reactor operations.
- Designing of single and multiple reactions in reactors.
- Homogeneous and Heterogeneous reaction in biological systems.
- Environmental factors affecting the biological reactions.

Suggested Readings:

1. Levenspiel, Octave: Chemical reaction engineering, John Wiley & Sons, 1999.
2. Fogler, H. Scott: Essentials of chemical reaction engineering, Pearson Education, 2010.

3. Smith, Joseph Mauk: Chemical engineering kinetics, McGraw-hill, book Co., 1981.

Website Sources:

- https://www.britannica.com/science/fermentation
- https://www.youtube.com/watch?v=LXb7zzJRP3Q&feature=emb_logo
- https://www.khanacademy.org

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EBT-504: GENETIC ENGINEERING

Objective(s): The objectives of this course:

- Familiarize the students with the basic concepts in genetic engineering.
- Acquaint the students to versatile tools and techniques employed in genetic engineering and recombinant DNA technology; and to appraise them about applications of genetic engineering**.**

UNIT I: (8 Sessions)

Gene cloning: Concept and basic steps; application of bacteria and viruses in genetic engineering; Cloning vectors: Plasmid based vectors, Bacteriophage vectors and virus vectors. Cosmids, Phagemids; YAC and BAC vectors.

UNIT II: (8 Sessions)

Enzymes used in recombinant DNA technology: Endonucleases, ligases and other enzymes useful in gene cloning, PCR technology and Types of PCR DNA delivery methods -physical methods and biological methods, Genetic transformation of prokaryotes:

UNIT III: (8 Sessions)

Gene library: Construction of cDNA library and genomic library, Screening of gene libraries – screening by DNA hybridization; Marker genes: Selectable markers (antibiotic and non-antibiotic markers); DNA sequencing techniques (Maxam Gilbert's chemical degradation method and Sanger's dideoxy chain termination method), Molecular-Markers-types and Applications.

UNIT IV: (8 Sessions)

Gene expression in prokaryotic and eukaryotic systems: Recombinant protein production in yeast: *Saccharomyces cerevisiae*. Expression systems; Mammalian cell expression vectors: Inducible promoters and regulatable promoters; increasing protein production; Fusion proteins; Translation expression vectors.

UNIT V: (8 Sessions)

Origins of organism cloning in developmental biology: Nuclear transfer procedures and the cloning of sheep (Dolly) & other mammals; therapeutic vs. reproductive cloning; ethical issues and the prospects for human cloning; Two vector expression system; two-gene expression vector, Site-directed mutagenesis; Transposon mutagenesis, Gene targeting, Site specific recombination.

Course Outcomes:

At the end of the course students will able to:

- Understand and explain the concept of genetic engineering including the techniques, applications and limitations.
- Understand the steps involved in recombinant DNA technology.
- Explain the construction of DNA & cDNA library and their applications.
- Demonstrate the ability to design recombinant molecules.
- Understanding of applications of recombinant DNA technology and genetic engineering from academic and industrial perspective.
- Learn principle and operations of Thermal cyclers; Real-time PCR; DNA synthesizer; DNA sequencer.

- Learn methods for selection of recombinants and analysis of cloned genes by sequencing methods. Expression of recombinant protein in E. coli and eukaryotes
- Apply learned knowledge to their future research.

Suggested Readings:

1. Glover, David M., and B. David Hames. DNA cloning 3: a practical approach. IRL Press Ltd, 1995.
2. Maniatis, Tom, Edward F. Fritsch, and Joseph Sambrook. Molecular cloning: a laboratory manual. Vol. 545. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory, 1982.
3. Watson, James D. Recombinant Dna. Macmillan, 1992.
4. Friedberg, Errol C., et al., eds. DNA repair and mutagenesis. American Society for Microbiology Press, 2005.
5. Tamarin, Robert H. Principles of genetics. McGraw-Hill, 2015.

Website Sources:

- https://www.classcentral.com/course/swayam-genetic-engineering-theory-and-application-14090
- https://www.edx.org/learn/genetics
- https://online.stanford.edu/courses/xgen203-genetic-engineering-and-biotechnology
- https://onlinecourses.nptel.ac.in/noc19_bt15/preview
- https://www.shiksha.com/engineering/genetic-engineeri

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EBT-505: HEAT AND MASS TRANSFER

Objective(s): The objectives of this course:

- Introduce a basic study of the phenomena of heat transfer such as conduction convection and radiation.
- Provide useful information concerning the performance and design of particular heat exchanger systems and processes. A knowledge-based design problem requiring the formulations of solid conduction and fluid convection and the technique of numerical computation progressively elucidated in different chapters will be assigned and studied in detail.

UNIT I: **(8 Sessions)**

Conduction & Convection: Basic concepts, Mechanism of heat transfer: Conduction, Convection and Radiation, Fourier law of conduction, General differential equation of heat conduction: Cartesian and Cylindrical Coordinates, one dimensional steady state heat conduction, Critical and Optimum insulation thickness, Basic principles of convection, Empirical correlations for free and forced convection.

UNIT II: **(8 Sessions)**

Radiation: Introduction, Physical mechanism, Features and characteristics of radiation, Laws of Radiation: Stefan Boltzmann Law, Kirchhoff's Law, Radiation shape factors, Gas radiation, Black Body and Grey body concept, solar radiations, combined heat transfer coefficients.

UNIT III: **(8 Sessions)**

Applications of Heat Transfer-heat Exchangers: Heat transfer equipment: Heat exchangers, Condensers, Boilers, Types of heat exchangers, Overall heat transfer coefficient, Fouling factors. Evaporation, Properties of evaporating liquid, Types of evaporators, Performance of evaporators: Capacity and Economy.

UNIT IV: **(8 Sessions)**

Mass Transfer: Molecular diffusion in fluids, Diffusion coefficient, Fick's Law of diffusion, Molecular diffusion in Gases at steady state, Molecular diffusion in Liquids at steady state, Mass Transfer theories, Diffusion in solids: Molecular, Knudsen & surface diffusion, Inter- phase mass transfer: Diffusion between phases, Simultaneous heat and mass transfer.

UNIT V: **(8 Sessions)**

Applications of Mass Transfer- Drying and Absorption: Drying: Solid-gas equilibria, Different modes of drying operation, Types of batch and continuous driers, Definitions of moisture contents, Rate of batch drying, Mechanism of batch drying. Absorption: Gas-Liquid equilibria. Henry's Law, Selection of solvents, Absorption in tray column, Absorption in packed column, HTU, NTU and HTEP concepts.

Course Outcomes:

At the end of the course students will able to:

- Understand the basic laws of heat transfer.
- Analyze problems involving steady state heat conduction in simple geometries.
- Understand the fundamentals of convective heat transfer process.
- Evaluate heat transfer coefficients for natural convection and forced convection inside ducts.

- Calculate radiation heat transfer between black body surfaces & heat exchange between gray body surfaces.

Suggested Readings:

1. Holman, J.P.: "Heat Transfer" 9 th ed. McGraw Hill (1989).
2. Treybal, R "Mass Transfer Operations", 3rd ed. New York: McGraw-Hill, (1980).
3. McCabe Smith: "Unit Operations in Chemical Engineering", McGraw Hill.
4. Ashim K. Datta: "Biological and Bioenvironmental Heat and Mass Transfer", Marcel Dekker, Inc: New York, (2002).

Website Sources:

- https://www.brighthubengineering.com/hvac/5231-what-is-heat-transfer/
- https://www.researchgate.net/profile/Md_Washim_Akram/post/Good_books_on_Fluid_mechanics_and_Heat_Transfer/attachment/5ab22ae44cde266d5892d50a/AS%3A606556357918729%401521625713296/download/heat-transfer-a-practical-approach-by-y-a-cengel.pdf
- https://scholars.unh.edu/day20/33/
- https://nptel.ac.in/courses/112/107/112107211/

IFTM University, Moradabad
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(Effective from 2021-22)

EBT-506: PLANT BIOTECHNOLOGY

Objective(s): The objectives of this course:

- Learn the various plant tissue culture techniques.
- Familiarize the students with the vectors used for cloning vectors.
- Learn the importance and biosafety related to GMOs.
- Impart knowledge of various modern tools and techniques used to adapt plants for specific needs or opportunities.

UNIT I: **(8 Sessions)**

Plant Tissue Culture: Cleaning, sterilization, sterile handling of tissue culture of Plant; Nutritional requirement for in vitro culture; Concept of cellular totipotency, single cell culture, micro propagation, somoclonal variation and its application for plant improvement; Somatic embryogenesis; Anther and ovule culture; Haploid and double-haploid production.

UNIT II: **(8 Sessions)**

Protoplast Culture: Isolation, fusion and culture; Somatic hybridization; Selection system for hybrids; Cybrid production and their application in crop improvement; Gene banks.

UNIT III: **(8 Sessions)**

Plant Cloning Vectors: Ti and Ri plasmid and viral vectors (CaMV based vectors, Gemini virus, TMV based vectors); Mechanism of DNA transfer; particle bombardment, Electroporation, microinjection, transformation of monocots and dicots; Role of virulence Genes; Genetic markers- Use of reporter genes, transgene stability and gene silencing; Herbicide, insect and salt resistance, Plant DNA fingerprinting -Hybridization and PCR based markers (RFLP, RAPD, AFLP etc.).

UNIT IV: **(8 Sessions)**

Ethics in plant biotechnology: Commercial status and public acceptance; Biosafety guidelines for research involving GMO's, benefits and risks; Economic impact and ecological consideration of GMO's.

UNIT V: **(8 Sessions)**

Application of Plant Tissue Culture: Bio pesticides; biological control of pests and disease; Plant cell culture for the production of useful secondary metabolites pigments, perfumes, flavor, pharmacologically significant compounds.

Course Outcomes:

At the end of the course students will able to:

- Understand and explain the concept of genetic Understand basics of plant tissue culture and application of plant tissue culture in crop improvement.
- Understand Basic Knowledge of genetic engineering of plants using several genetic engineering tools.
- Ethics and government regulations that are there for the safe introduction of GMOs.

Suggested Readings:

1. Hammond, John, Peter McGarvey, and Vidadi Yusibov, eds. Plant biotechnology: new products and applications. Vol. 240. Springer Science & Business Media, 2012.
2. Stewart Jr, C. Neal, ed. Plant biotechnology and genetics: principles, techniques and applications. John Wiley & Sons, 2012.
3. Bhojwani, Sant Saran, and Maharaj K. Razdan. Plant tissue culture: theory and practice. Vol. 5. Elsevier, 1986.
4. HS Chawla. Introduction to plant biotechnology. Science Publishers, 2002.

Website Sources:

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://www.ncbi.nlm.nih.gov/books

IFTM University, Moradabad
Bachelor of Technology (B.Tech.), Programme
B.Tech. Biotechnology III Year (V Semester)
(Effective from 2021-22)

EBT-551: Bioinformatics

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and don't	
4.	About Equipments and Accessories: Principle and Working	
5.	Introduction to various biological databases.	Experiment 1
6.	To study the various biological databases with NCBI databases and tools.	Experiment 2
7.	To study various file formats of NCBI.	Experiment 3
8.	To identify all the possible open reading frames in a sequence.	Experiment 4
9.	To obtain the local alignment of the given sequences using the tool BLAST.	Experiment 5
10.	To compute the various physical and chemical parameters of a protein.	Experiment 6
11.	To determine the Secondary structure of P68871 AND P24071	Experiment 7
12.	To learn how to retrieve structural data of a protein using PDB database.	Experiment 8

IFTM University, Moradabad
Bachelor of Technology (B.Tech.), Programme
B.Tech. Biotechnology III Year (V Semester)
(Effective from 2021-22)

EBT-552: Bioprocess

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and don't	
4.	About Equipments and Accessories: Principle and Working	
5.	To plot Microbial growth curve for shake flask culturing using turbidity method.	Experiment 1
6.	Prepare a standard curve of reducing sugar by 3,5-Dinitrosalicylic acid method.	Experiment 2
7.	To Estimate the Monod Parameters for microbial growth kinetics	Experiment 3
8.	To understand the effect of pH on microbial growth	Experiment 4
9.	To understand the effect of temperature on microbial growth.	Experiment 5
10.	To demonstrate the effect of osmotic pressure on microbial growth.	Experiment 6
11.	To understand the effect of agitation on the growth of bacterial cultures.	Experiment 7
12.	To understand yield parameters involved in baker's yeast production.	Experiment 8

IFTM University, Moradabad
Bachelor of Technology (B.Tech.), Programme
B.Tech. Biotechnology III Year (V Semester)
(Effective from 2021-22)

EBT-553: Genetic Engineering

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and don't	
4.	About Equipments and Accessories: Principle and Working	
5.	To maintain and store the bacterial strain for further studies.	Experiment 1
6.	Isolation and purification of plasmid DNA.	Experiment 2
7.	To extract the genomic DNA from Plant Leaves.	Experiment 3
8.	Electrophoresis of extracted DNA.	Experiment 4
9.	To perform restriction digestion of λ- DNA with EcoR1 & HIND-III enzymes and electrophoresis of digested DNA.	Experiment 5
10.	To perform ligation of Lambda (λ) Hind III digest.	Experiment 6
11.	To transform plasmid DNA into bacteria.	Experiment 7
12.	To amplify a specific DNA fragment by Polymerase Chain Reaction using random primers.	Experiment 8

IFTM UNIVERSITY, MORADABAD
B. Tech. Biotechnology Engineering
Course Structure
(Effective from 2021-22)
Sixth Semester

S.N.	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
						Mid Term Exam			External Exam		
			L	T	P	CT	AS +AT	Total			
THEORY											
1.	EBT-601	Advanced Bioinformatics	3	1	0	20	10	30	70	100	4
2.	EBT-602	Animal Biotechnology	3	1	0	20	10	30	70	100	4
3.	EBT-603	Nanobiotechnology	3	1	0	20	10	30	70	100	4
4.	EBT-604	Fermentation Biotechnology	3	1	0	20	10	30	70	100	4
5.	EBT-605	Food Biotechnology	3	1	0	20	10	30	70	100	4
6.	EHU-601	Human Values and Professional Ethics	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT											
7.	EBT-651	Advanced Bioinformatics	0	0	2	20	10	30	70	100	1
8.	EBT-652	Fermentation Biotechnology	0	0	2	20	10	30	70	100	1
9.	EBT-653	Food Biotechnology	0	0	2	20	10	30	70	100	1
10.	GP-601	General Proficiency	-	-	-	-	-	100	-	100	1
		Total Credit	18	6	6	-	-	370	630	1000	28

Note: Industrial Training of 4-6 weeks after VI semester which will be evaluated in the VII semester.

IFTM University, Moradabad
Bachelor of Technology (B.Tech.), Programme
B.Tech. Biotechnology III Year (VI Semester)
(Effective from 2021-22)

EBT-601: ADVANCED BIOINFORMATICS

Objective(s): The objectives of this course:

- Includes descriptions of genetic and biological databases and relevant tools.
- An introduction to Phylogenetic and drug discovery process.
- Evaluate biological data using bioinformatics techniques, and study the machine learning algorithm.

UNIT I: **(8 Sessions)**

Overview of scoring matrices and gap penalties in sequence alignments: Assessing the significance of sequence alignments, sequence alignments and evolutionary distance estimation by Bayesian statistical methods, application of Bayesian statistics to sequence analysis.

UNIT II: **(8 Sessions)**

Machine learning approach: Basic learning model, application of machine learning approach in bioinformatics. Iterative methods of multiple sequence alignment: Genetic algorithm, Hidden Markov Model, Statistical methods for aiding alignment, Position- Specific Scoring Matrices.

UNIT III: **(8 Sessions)**

Phylogenetic Prediction: Relationship of Phylogenetic analysis to sequence alignment. Methods: Maximum parsimony method, Distance methods (Fitch-Margoliash method, Neighbor-joining method, Unweighted pair group method), Maximum likelihood approach, Reliability of Phylogenetic predictions.

UNIT IV: **(8 Sessions)**

DNA versus protein searches, Methods: FASTA, BLAST, psi- BLAST, phi- BLAST. Microarray Data Analysis, Significance Analysis of Microarrays, Self- Organization Maps.

UNIT V: **(8 Sessions)**

Introduction to drug discovery: Technology and Target discovery strategies, Target validation, Computer aided Drug Designing: Introduction, drug-design approaches, ADME- Tox property prediction.

Course Outcomes:

At the end of the course students will able to:

- Understand the computational methods, tools and algorithms employed for Biological Data Interpretation.
- Describe about the various techniques, algorithms and tools used for Phylogenetic Analysis.
- Understand the computational methods, tools used in drug discovery.

Suggested Readings:

1. David W. Mount, Bioinformatics: sequence and genome analysis. Second ed., New York: Cold spring harbor laboratory press, 2004.
2. Jonathan Pevsner, Bioinformatics and Functional Genomics, Wiley Blackwell, 2015.
3. Gibas and Jambeck, Developing Bioinformatics Computer skills, First ed., O'Reilly media, 2001.
4. Zhumur Ghosh and Mallick,Bioinformatics: Principles and Applications, Oxford University press, 2008.

5. S.C. Rastogi, Bioinformatics: Genomics, Proteomics and drug discovery, Fourth ed., PHI publications, 2013.

Website Sources:

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://www.bioinformatics.org/
- https://www.ncbi.nlm.nih.gov/books

IFTM UNIVERSITY, MORADABAD
Bachelor of Technology (B. Tech.), Programme
B. Tech. Biotechnology III Year (VI Semester)
(Effective from 2021-22)

EBT-602: ANIMAL BIOTECHNOLOGY

Objective: The main objective of this course:

- Impart the knowledge and familiarize students with some basic principles of animal cell culture and related techniques like the isolation of animals cells for in vitro studies, maintenance of animal cells in vitro, manipulation of animal cells in vitro, and application of molecular techniques to in vitro situations, different transgenic animal models etc.

UNIT I: **(8 Sessions)**

History and scope of Animal cells and tissue culture: Advantages and limitations of tissue culture, physical requirements for tissue culture, substrates on which cell grow and treatment of substrate surfaces, culture media for animal cell culture, culture procedure-preparation and sterilization of apparatus, media, reagents and animal material.

UNIT II: **(8 Sessions)**

Primary culture: Tissue disaggregation by enzymatic and mechanical methods; Organotypic culture, Histotypic culture, organ culture-Culture of chick embryo, embryonic and adult organ culture of mammalian embryos or ova, whole embryo culture, Culture of Stem cells.

UNIT III: **(8 Sessions)**

Secondary culture: Subculture- Criteria for subculture, subculture of monolayer, subcultures of cells growing in suspension, Evolution of cell-lines, properties of finite and continuous cell-lines; *In vitro* Fertilization and oocyte culture, Tissue engineering and regenerative medicine eg; artificial skin, cartridge embryo transfer methods in Humans.

UNIT IV: **(8 Sessions)**

Bioreactors: Types of bioreactors, homogenous bioreactors-stirred tank, Air-lift bioreactors, heterogeneous bioreactors-micro-carriers, hollow fiber bioreactors, membrane bioreactor and perfusion bioreactor

UNIT V: **(8 Sessions)**

Transgenic animals: Gene transfer to animals-chemical and physical transfection techniques, gene transfer using bacteria as vector, gene transfer using viruses as vector; Transgenic mice, cattle and sheep; Applications of transgenic animals.

Course Outcomes:

At the end of the course students will able to:

- Illustrate the methodology to establish animal cell culture and compositions of animal culture media.
- Explain the different methods of producing primary culture, substrates used for growing animal culture.
- Explain the different types of culture like organ culture, whole embryo culture, histotypic culture etc.
- Describe the importance of engineering animal cells for the production of transgenic organisms.
- Describe the different types of bioreactors employed in animal cell culture.
- Equip students with culture techniques and scope of animal biotechnology.
- Provide knowledge on genetic engineering in the improvement of animal for human welfare.

Suggested Readings:

1. R. Ian Whitney, Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, Sixth ed., Wiley Blackwell, 2010.
2. Michael Butler, Animal Cell Culture & Technology, Second ed., Taylor & Francis, 2003.
3. John M. Davis, Animal cell culture: Essential methods, First ed., Wiley publications, 2011.
4. R. Sasidhara, Animal Biotechnology, MJP Publishers, 2009.
5. U. Satyanarayana, Biotechnology, Books and Allied (P) Ltd, 2008

Website Sources:

- https://www.ncbi.nlm.nih.gov/books/NBK207572/
- https://gurukpo.com/Content/Bsc-biotech/Animal%20Biotechnology%28B.pdf
- https://www.cell.com/trends/biotechnology/pdf/S0167-7799(99)01328-1.pdf
- https://www.biologydiscussion.com/biotechnology/animal-biotechnology/recent-trends-in-animal-biotechnology/
- https://www.biotechnologynotes.com/animals/animal-cell-culture-history-types-and-applications/

IFTM University, Moradabad
Bachelor of Technology (B. Tech.), Programme
B. Tech. Biotechnology III Year (VI Semester)
(Effective from 2021-22)

EBT-603: NANOBIOTECHNOLOGY

Objective(s): The objectives of this course:

- Understand the principles of Nanobiotechnology and characterization of nano-structured materials.
- Equipments towards the cutting-edge areas of Nanobiotechnology.
- Encourage innovations and promote translational research to address various theranostics applications.

UNIT I: **(8 Sessions)**

Definitions, History of Nanotechnology, Context of Nanotechnology: Basic biology principles and practice of micro fabrication techniques; Carbon Nanotubes (SWCNTs, MWCNTs, DWCNTs); biological production of metal nanoparticles like silver, gold, copper.

UNIT II: **(8 Sessions)**

Nanomedicine: Nanodrug delivery, developing drug delivery tools through nano biotechnology, nano particle based immobilization assays, quantum dots technology and its application.

UNIT III: **(8 Sessions)**

Application in Biomedical and biological research: Nano particles, viruses as nano-particles, nano chemicals and application, tumor targeting and other diagnostic applications.

UNIT IV: **(8 Sessions)**

Synthesis and characterization of different classes of biomedical polymers: SEM, TEM, AFM, STM, their uses in pharmaceutical, cardiovascular**,** ophthalmic and orthopedic areas.

UNIT V: **(8 Sessions)**

Biosensors and microelectronic devices: Sensors-piezoelectric sensors, optical sensors, ampeomteric sensors and macro mechanical structures and their functioning, immuno-nanotechnology.

Course Outcomes:

At the end of the course students will able to:

- Acquire the knowledge of synthesis and characterization of nonmaterial's for its various applications in the field of biological sciences.
- Develops the understanding of utilizing biomolecules for designing tools and equipment for various applications in food, medicine and health science.

Suggested Readings:

1. Christ of Niemeyer, Chad Mirkin, Nanobiotechnology- concepts, applications and perspectives, First ed., Wiley- VCH publishers, 2004.
2. Donald Martin, Nanobiotechnology of biomimetic membranes, Springer, 2007
3. Physical Chemitry by P. W. Attkins, Oxford Press.
4. Introduction to Modern Colloid Science by Robert J. Hunter, Oxford University Press.
5. Nanoscale Materials in Chemistry by Kenneth J. Khabhunde (ed.) Wiley Interscience.
6. Thermodynamics and Statistical Mechanics by A N Tikhonov, Peter Theodore Landsberg.
7. Thermodynamics and Statistical Mechanics by John M. Seddon, J. D. Gale.

8. Physical Chemistry, 1st Edition by David H. Ball, Brookes Cole.

Website Sources:

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://www.ncbi.nlm.nih.gov/books
- https://www.masterclass.com

IFTM University, Moradabad
Bachelor of Technology (B. Tech.), Programme
B. Tech. Biotechnology III Year (VI Semester)
(Effective from 2021-22)

EBT-604: FERMENTATION BIOTECHNOLOGY

Objective(s): The objectives of this course:

- Introduce the role and application of fermentation technology, different aspects of fermentation like medium components; medium preparation and sterilization are described.
- Isolation and preservation of microbes and their use in value added products like ethanol, citric acid and antibiotics are also explained.

UNIT I: (8 Sessions)

History and development of fermentation industry: Range of fermentation processes component parts of fermentation processes, Introduction to submerged and solid state fermentation, Primary and secondary metabolites.

UNIT II: (8 Sessions)

Raw material availability: Media for microbial fermentation-Carbon sources, Nitrogen sources, Inducers, Minerals, Antifoam; pretreatment of raw materials- agriculture and industrial waste.

UNIT III: (8 Sessions)

Isolation and preservation of microbes: Isolation using selection of desired characteristics and not utilizing selection of desired characteristics, storage of industrially important microbes at reduced temperature and in dehydrates form.

UNIT IV: (8 Sessions)

Regulatory mechanism in microbial metabolite production: Induction, catabolite repression, Crabtree effect, feedback inhibition and feedback repression. Concept for over production of metabolites and Strain improvement: Isolation of different types of mutants for production of primary and secondary metabolites- Auxotrophic mutants, resistant mutants, revertant mutants, recombinant microorganisms.

UNIT V: (8 Sessions)

Large-scale production of industrially important products: Ethanol, Citric acid, Lactic acids, Penicillin, Amino Acids, Biopolymers, Vitamins.

Course Outcomes:

At the end of the course students will able to:

- Different components of fermentation for example medium components and their role in growth of microbes.
- Development of aseptic environment by using different sterilization techniques.
- Different regulatory mechanism for controlling the metabolic process.
- Industrial scale production of ethanol, citric acid, amino acid and antibiotics.

Suggested Readings:

1. Cruger and A Cruger; A textbook of Industrial microbiology, Second ed., Sinaeur Associates, 1990.
2. *Peter F. Stanbury, Allan Whitaker and Stephen J. Hal* ,Principles of Fermentation Technology, Second ed., Pergamon, 1995.

3. Y.H Hui et al., Handbook of Food and Beverages Fermentation Technology, First ed., CRC Press, 2004.
4. A.R. Allman, Mansi El- Mansi, C.F.A. Bryce, Arnold L. Demain, Fermentation Microbiology and Biotechnology, Third ed., CRC press, 2012.
5. Brain McNeil (Editor), Linda Harvey, Practical Fermentation Technology, Wiley-Blackwell, 2008.
6. Greed, Prescott and Dunn's, Industrial Microbiology, Fourth ed., CBS Publishers, 2004.

Website Sources:

- https://www.britannica.com/science/fermentation
- https://nptel.ac.in/courses/102/105/102105058/
- https://www.masterclass.com
- https://www.khanacademy.org

IFTM University, Moradabad
Bachelor of Technology (B.Tech.), Programme
B.Tech. Biotechnology III Year (VI Semester)
(Effective from 2021-22)

EBT-605: FOOD BIOTECHNOLOGY

Objective(s): The objectives of this course:

- Focus on emerging developments and applications of modern genetics, enzymatic, metabolic and systems-based biochemical processes in food and food-related biological systems.
- Produce and improve foods, food ingredients, and functional foods at the processing stage and beyond agricultural production, genetically modified plants are used to enhance taste, shell life, nutrition and quality of food, genetically modified food is synthesized using biotechnological tools.

UNIT I: **(8 Sessions)**

Introduction to food biotechnology: Historical development; food spoilage; intrinsic and extrinsic parameters of food that affect microbial growth; equipments involved in food processing industries; emerging trends-genetically modified foods, biofortification.

UNIT II: **(8 Sessions)**

Microorganisms in food: Role and significance of microorganisms in food-Fresh meat and poultry, processed meat, seafoods, fruits and vegetable products, dairy food products, fermented food products; starter cultures; production process of cheese, beer, wine and distilled spirits.

UNIT III: **(8 Sessions)**

Food preservation: Principles, technological aspects and applications- drying & dehydration, Pasteurization, Sterilization, Irradiation, Refrigeration & freezing, Hurdle technology, Aseptic processing.

UNIT IV: **(8 Sessions)**

Foods in relation to diseases: Classification of food borne diseases- non-bacterial poisoning, infection and intoxication**,** Investigation of food borne diseases outbreak in India; Enumeration and detection of food borne organisms.

UNIT V: **(8 Sessions)**

Nutraceuticals: Classification, Mechanism of action, Phytochemicals as Nutraceuticals-Isoprenoids, polyphenolics, glucosinolates, phytosterols, dietary fiber; Microbes as nutraceuticals- Probiotics and Prebiotics; Animal products as nutraceuticals.

Course Outcomes:

At the end of the course students will able to:

- Describe basic principles of fermentation.
- Describe selected fermentation systems.
- Understand enzyme action and main classes of enzymes.
- Understand factors related to probiotic technology.
- Describe selected industrial food biotechnology process.

Suggested Readings:

1. H. Charley, Food Science, Second ed., John wiley and sons, 1982.
2. Anthony Pometto et al., Food Biotechnology, Second ed., CRC Press, 2005.

3. Sukumar De, Outlines of Dairy Technology, First ed., Oxford University Press, 2007.
4. M. Swaminathan, Food Science, Chemistry and Experimental Foods, Second ed, 1990.
5. Shakuntala Manay, Food Facts and Principles, New Age International, 2009.

Website Sources:

- https://www.sanfoundry.com/
- https://libguides.lib.msu.edu/
- http://ecoursesonline.iasri.res.in/

IFTM University, Moradabad
Bachelor of Technology (B.Tech.), Programme
B.Tech. Biotechnology III Year (VI Semester)
(Effective from 2021-22)

EHU-601: HUMAN VALUES & PROFESSIONAL ETHICS

Objective(s): The objectives of this course:

- Create awareness on Engineering Ethics and Human Values.
- Understand social responsibility of an engineer. To appreciate ethical dilemma while discharging duties in professional life.

UNIT I: **(6 Sessions)**

Human Values: Morals, Values and Ethics – Integrity – Work Ethic – Service – Learning – Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing - Honesty – Courage –Valuing Time – Co-operation – Commitment - Empathy – Self-Confidence – Character - Spirituality.

UNIT II: **(7 Sessions)**

Engineering Ethics: Senses of 'Engineering Ethics' - variety of moral issues - types of inquiry - Moral dilemmas - Moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest - custom and religion - uses of ethical theories. Valuing Time – Co-operation – Commitment.

UNIT III: **(5 Sessions)**

Engineering as Social Experimentation: Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study.

UNIT IV: **(11 Sessions)**

Safety, Responsibilities and Rights: Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three-mile island and chernobyl case studies. Collegiality and loyalty – Respect for authority – Collective bargaining – Confidentiality – Conflicts of interest – Occupational crime – Professional rights – Employee rights – Intellectual Property rights (IPR) – Discrimination.

UNIT V: **(11 Sessions)**

Global Issues: Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers and engineers as expert witness and advisors -moral leadership – Sample code of Ethics like ASME, ASCE, IEEE, IETE etc.

Course Outcomes:

At the end of the course students will able to:

- Ensures students sustained happiness through identifying the essentials of human values and skills.
- Facilitates a correct understanding between profession and happiness
- Understand practically the importance of trust, mutually satisfying human behavior and enriching interaction with nature.
- Develop appropriate technologies and management patterns to create harmony in professional and personal life.

Suggested Readings:

1. Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw-Hill, New York 1996.

2. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.
3. Jayshree Suresh and B.S.Raghavan, “Human values and Professional Ethics”, S.Chand & Company Ltd., New Delhi.

Website Sources:

- https://examupdates.in/professional-ethics-and-human-values
- https://www.uptunotes.com/universal-human-values-and-professional-ethics
- https://lecturenotes.in/

IFTM University, Moradabad
Bachelor of Technology (B.Tech.), Programme
B.Tech. Biotechnology III Year (VI Semester)
(Effective from 2021-22)

EBT-651: Advanced Bioinformatics

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and don't	
4.	About Equipments and Accessories: Principle and Working	
5.	To search different bioinformatics servers and tools for biological data analysis.	Experiment 1
6.	To predict Secondary structure for amino acid sequences of a given protein using homology modeling.	Experiment 2
7.	To predict the secondary structure of a protein using the Chou-Fasman method.	Experiment 3
8.	To determine the conserved domain present in **Q8NFM4**	Experiment 4
9.	To find the gene sequences of Mouse origin similar to U80226.1.	Experiment 5
10.	To identify the 10- homologues sequences of P68871 of various origins. Find the conserved region existing between them comment on the same.	Experiment 6
11.	Multiple sequence alignment of a set of given nucleic acid sequence of 16S rRNA gene/ Amino acid sequence of SOD and their evolutionary relationship.	Experiment 7
12.	To find the approximate region on 2D gel where **Q8N423** is found	Experiment 8

IFTM University, Moradabad
Bachelor of Technology (B.Tech.), Programme
B.Tech. Biotechnology III Year (VI Semester)
(Effective from 2021-22)

EBT-652: Fermentation Biotechnology

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and don't	
4.	About Equipments and Accessories: Principle and Working	
5.	To study different growth phases of bacterial population and plot a bacterial growth curve.	Experiment 1
6.	To isolate amylase producing bacteria from environment.	Experiment 2
7.	To produce ethanol under submerged conditions using *Saccharomyces cerevisiae.*	Experiment 3
8.	To purify ethanol produced under submerged conditions.	Experiment 4
9.	To immobilize microbial cells using sodium- alginate gel entrapment method.	Experiment 5
10.	Isolation of Antibiotic Producing Microbes from Soil.	Experiment 6
11.	To produce amylase enzyme under solid state fermentation and submerged state fermentation.	Experiment 7
12.	To extract the amylase enzyme produced and determination of enzymatic activity.	Experiment 8
13.	To produce biopolymer Dextran from *Leuconostoc mesenteroides.*	Experiment 9
14.	To study the induction and catabolite repression in *E.coli.*	Experiment 10

IFTM University, Moradabad
Bachelor of Technology (B.Tech.), Programme
B.Tech. Biotechnology III Year (VI Semester)
(Effective from 2021-22)

EBT-653: Food Biotechnology

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and don't	
4.	About Equipments and Accessories: Principle and Working	
5.	To find out the moisture content from a given food sample by lab oven method	Experiment 1
6.	To demonstrate the use of rennet in casein coagulation in different pH conditions	Experiment 2
7.	Fermentative production of Citric acid using *Aspergillus niger.* Fermentative production of Citric acid using *Aspergillus niger*	Experiment 3
8.	Fermentative production of Ethanol using *Saccharomyces cerevisiae*	Experiment 4
9.	Fermentative production of Wine using *Saccharomyces cerevisiae*.	Experiment 5
10.	To find out the ash in the given food sample.	Experiment 6
11.	To find out the amount of total carbohydrates in a given food sample.	Experiment 7
12.	To find out the amount of crude fiber in a given food sample.	Experiment 8

IFTM UNIVERSITY, MORADABAD
B. Tech. Biotechnology Engineering
Course Structure
(Effective from 2021-22)
Seventh Semester

S.N.	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
						Mid Term Exam			External Exam		
			L	T	P	CT	AS +AT	Total			
THEORY											
1.	EBT 031-033	Elective-I	3	1	0	20	10	30	70	100	4
2.	EBT 041-043	Elective-II	3	1	0	20	10	30	70	100	4
3.	EHU-701	Industrial Management	3	1	0	20	10	30	70	100	4
4.	EBT-701	Downstream Processing	3	1	0	20	10	30	70	100	4
5.	EBT-702	Bioethics, Biosafety & IPR	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT											
6.	EBT-751	Downstream Processing	0	0	2	20	10	30	70	100	1
7.	EBT-752	Mini-Project	0	0	2	-	-	100	-	100	1
8.	EBT-753	Seminar	0	0	2	-	-	100	-	100	1
9.	EBT-754	Industrial Training (Evaluation & Viva- Voce)	0	0	2	-	-	100	-	100	1
10.	GP-701	General Proficiency	-	-	-	-	-	100	-	100	1
		Total Credit	15	5	8	-	-	580	420	1000	25

LIST OF DEPARTMENT ELECTIVES		
S. No.	**Course Code**	**Course Name**
1	EBT-031/032/ 033	Vaccine Technology & Immunoinformatics/ Biofuels & Alcohol Technology/ Metabolic Engineering
2	EBT-041/042/ 043	Molecular Modeling & Drug Design/ Bioprocess Engineering II/ Bioreactor Engineering

IFTM University, Moradabad
Bachelor of Technology (B. Tech.), Programme
B. Tech. Biotechnology IV Year (VII Semester)
(Effective from 2021-22)

EBT-031: VACCINE TECHNOLOGY & IMMUNOINFORMATICS

Objective(s): The objectives of this course:

- Provide students with detail understanding of vaccination and their application in immunology.
- Provides knowledge about the various databases and resources in immunology that can be used for the prediction of antigen antibody interactions.

UNIT I: **(8 Sessions)**

Vaccines: Introduction to immunity, Fundamental concepts in vaccination and traditional methods of vaccine production (production of DPT and Rabies vaccine), Production of Modern Vaccines (production of Hepatitis vaccine); Reverse vaccinology.

UNIT II: **(8 Sessions)**

Immunological Techniques: Precipitation, Agglutination, Immunoelectrophoresis, RIA, ELISA, Immunofluorescence, Hybridoma technique, Immunoblotting (Western blotting).

UNIT III: **(8 Sessions)**

Immune informatics: Introduction, Databases in Immunology-BIMAS, SVMHC, ProPred, MHCPred, KEGG.

UNIT IV: **(8 Sessions)**

Epitope Prediction methods: B-cell epitope prediction methods, T-cell epitope prediction methods**,** MHC polymorphism, its databases and prediction tools (EpiDOCK, MotifScan, MAPPP, EPISOPT).

UNIT V: **(8 Sessions)**

Structure Activity Relationship: QSARs and QSPRs, QSAR Methodology, Various Descriptors used in QSARs- Electronics, Topological, Quantum Chemical based Descriptors; Pharmacophore modeling; 2D and 3D QSAR approaches like COMFA and COMSIA.

Course Outcomes:

At the end of the course students will able to:

- Explain the importance of vaccines and vaccination in body defense mechanism.
- Apply the knowledge of immune associated mechanisms in medical biotechnology research.
- Demonstrate immunological techniques.
- Generate new vaccine target and develop strategy to design novel vaccine.

Suggested Readings:

1. A K Abbas, A H H Lichtman, Shiv Pillai. Basic Immunology (Function and Disorder of Immune System), Fourth edition; Elsevier Publisher.
2. W L Anderson. Immunology, Fence Creek Publishing (Blackwell).
3. J K Thomas, R A Goldsby, B A Osborne, J Kuby Immunology, W H Freeman & Co. Publisher, Sixth Edition.
4. P J Delves, S J Martin, D R Burton, I M Roitt. Roitt's Immunology, Wiley-Blackwell-Publisher, Twelfth Edition.

5. Darren R Flower Immunoinformatics: Predicting Immunogenicity in Silico Publisher: Humana Press.
6. Shoba Ranganathan, Vladimir Brusic, Christian Schonbach. Immuno informatics (Immunomics Reviews) Publisher: Springer

Website Resources:

- https://routledgetextbooks.com/textbooks/9780815345138/lecture-notes.php
- https://www.slideshare.net
- https://lecturenotes.in/
- https://www.shomusbiology.com/

IFTM University, Moradabad
Bachelor of Technology (B. Tech.), Programme
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(Effective from 2021-22)

EBT-042: BIOPROCESS ENGINEERING-II

Objective(s): The objectives of this course:

- Apply engineering principles to address issues in bioprocesses, analyze and identify limiting factors in a bioprocess scale-up and propose solutions to address biological and engineering problems.
- Enable mass transfer operations like diffusion, solid-liquid, liquid-liquid and gas-liquid mass transfer to improve the design and operations of the bioreactor plant.

UNIT I: **(8 Sessions)**

Introduction to engineering calculations: Unit conversion, measurement conventions, Errors in Data and Calculations, Presentation of Experimental Data, Data Analysis, General Procedures for Plotting Data- Log-log plot, Process Flow Diagrams

UNIT II: **(8 Sessions)**

Mass transfer: Molecular diffusion, convective mass transfer, solid-liquid, liquid-liquid and gas-liquid mass transfer oxygen uptake in cell cultures, factors affecting cellular oxygen demand, oxygen transfer from gas bubble to cell, measurement of k_La-oxygen transfer method, sulphite oxidation and Dynamic method, oxygen transfer in bioreactors.

UNIT III: **(8 Sessions)**

Design and operation of various bioreactors: Mode of operation- Batch, fed batch systems, CSTR; Enzyme-catalysed reactions in CSTRs, CSTR reactors with recycle and wall growth; Criteria for selection of bioreactors; air-lift bioreactors, fluidized bed bioreactors**,** plug-flow tubular reactor.

UNIT IV: **(8 Sessions)**

Scale up of bioprocess: Some consideration in aeration, agitation, mass transfer and heat transfer. Basic principle of scale-up of bioreactor, Practical considerations for bioreactor construction

UNIT V: **(8 Sessions)**

Bioreactor control system: Control of physical, chemical and biological environment of the bioreactor; Advanced control strategies viz. PID controllers, fuzzy logic-based controllers and artificial neural network based controllers. Role of physical, chemical & biological sensors.

Course Outcomes:

At the end of the course students will able to:

- Work on the scale-up process of the bioprocess plant/industry.
- Introduced to different modes of mass transfer operations
- Control of physical, chemical and biological environment of the bioreactor

Suggested Readings:

1. Michael L. Shuler, Fikret Kargi, Bioprocess Engineering – Basic Concepts, 2nd Ed., Pearson Education India, 2015
2. James Bailey, David Ollis, Biochemical Engineering Fundamentals, 2nd Ed., McGraw Hill Education, 2017

3. Roger G. Harrison, Paul W. Todd, Scott R. Rudge, Demetri P. Petrides, Bioseparations Science and Engineering, 2nd Ed., Oxford University Press, 2003.
4. Pauline M. Doran, Bioprocess Engineering Principles, 2nd Ed., Academic Press, 2012
5. Stanbury, Peter F., Allan Whitaker, and Stephen J. Hall. Principles of fermentation technology. Elsevier, 2013.

Website Sources:

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://www.ncbi.nlm.nih.gov/books
- https://www.masterclass.com

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(Effective from 2021-22)

EHU-701: INDUSTRIAL MANAGEMENT

Objective: The main objective of this course:

- Familiarize the students to gain insight about managerial techniques through various assessment tools/models to control and enhance the productivity of the work environment.

UNIT I: **(10 Sessions)**

Introduction: Concept**,** Development, application and scope of Industrial Management. Productivity: Definition, measurement, productivity index, types of production system Industrial Ownership.

UNIT II: **(8 Sessions)**

Management Function: Principle and function of management – Time and motion study, work simplification-process Charts and flow diagrams, production planning.

UNIT III: **(8 Sessions)**

Inventory control: Inventory Cost Deterministic Models, and Introduction to supply chain management. **Quality control:** process control, SQC, Control charts, Double and sequential sampling, introduction to TQM.

UNIT IV: **(7 Sessions)**

Human and Industrial Relations: Importance and necessity of industrial legislation, Types of labour laws and disputes. Brief description of the following Acts: 1948: payments of wages Act 1936: Workmen Compensation Act 1923: Industrial Dispute Act1947, Grievances handling of Grievances, Labour welfare schemes, Accidents & Safety.

UNIT V: **(7 Sessions)**

Environmental Issues: Environmental pollution- various management techniques to control Environmental pollution-Various control acts for Air, Water, Solid waste and Noise pollution.

Course Outcomes:

At the end of the course students will able to:

- Understand the scope of Industrial Management.
- Apply various management tools in systems of different industrial configurations.
- Use various control charts to determine the product acceptability as per designed criteria.
- Control environmental pollution by various management techniques.

Suggested Readings:

- Khanna O.P.: Industrial Engineering
- T.R. Banga: Industrial Engineering and Management
- Sharma B.R.: Environmental and Pollution Awareness.
- R.K.Singal: Industrial Management, Vayu Education of India Pub.
- Onkar N. Pandey: Industrial Management, S.K.Kataria& Sons (Katson) Pub.
- Dewan J. M. and Sudarshan K. N.: Industrial Management, Discovery Publishing Pvt. Ltd

Website Sources:

- nptel.ac.in/course.html
- www.nsf.gov
- en.wikipedia.org
- www.sciencedirect.com
- www.slideshare.net
- www.researchgate.net
- www.sanfoundry.com

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EBT-701: DOWN STREAM PROCESSING

Objective(s): The objectives of this course:

- Introduce the student to basic principles of downstream processing.
- Quantitatively and systematically design an integrated downstream process.
- Recovery and purification of biosynthetic products, particularly pharmaceuticals, from natural sources.
- Recycling of salvageable components and the proper treatment and disposal of waste.

UNIT I: **(8 Sessions)**

An overview of Bioseparation: Role of Downstream Processing in Biotechnology; Range and Characteristics of biological products; Problems and requirement for biological product purification; Cost cutting strategies.

UNIT II: **(8 Sessions)**

Primary treatment and solid-liquid separation: Cell Disruption methods (Physical, Mechanical and Chemical used for intracellular products; Removal of insoluble: Sedimentation, Centrifugation- principle, Common types of centrifuges used in bio separation (Tubular bowl, Multi chamber bowl, Disc stack, Decanter or Scroll type centrifuge) and selection of centrifuge types; Filtration- Theory, Batch and Continuous filtration, Flocculation.

UNIT III: **(8 Sessions)**

Concentration and Product Isolation: Extraction- Liquid-liquid Extraction and Aqueous two-phase extraction process; Adsorption and adsorption techniques; Membrane based separation technique Microfiltraion, Ultra filtration, Hyperfiltration Dialysis and Electrodialysis; Precipitation methods using solvent and solute properties modification.

UNIT IV: **(8 Sessions)**

Product Purification: Electrophoresis- principle for product purification, Different Electrophoresis techniques- PAGE, Isoelectric focusing and 2D-PAGE; Chromatography- principles, classification, chromatographic techniques Gel filtration, ion-exchange, affinity and HPLC.

UNIT V: **(8 Sessions)**

Product Polishing: Crystallization- theory and equipment; Drying- principle, theory and formulation; Steps and methods used for recovery of- Extracellular and Intracellular Enzymes, Citric acid, Glutamic acid, Penicillin G, Antibodies.

Course Outcomes:

At the end of the course students will able to:

- Understand that how to isolate and purify biological products.
- Implement the cost cutting strategies in downstream processing industries.
- Work on the scale-up process of bioprocess plant.

Suggested Readings:

1. Comprehensive biotechnology- Murray Moo-Young, Vol., Pergan Publishers, 2011.
2. H. J. Rehm and G. Reed, Biotechnology- Vol. 3, 4, 5, Verlag Publishers

3. Stanbury &Whitteker, Principles of Fermentation Technology, Pergamon Press, 2013.
4. Wilson and Goulding A Biologist's Guide to Principles & Techniques of Practical Biochemistry-Cambridge University Press, 1986.
5. Humphrey, Aiba& Miller, Biochemical Engineering., Academic Press, 1973.
6. Bailly, J.E and Ollis, D. F. Biochemical Engineering Fundamentals, Second Edition, McGraw Hill,1986.
7. B. Sivasnkar, Bioseparations Principles and techniques, 2005.

Website Sources:

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://www.ncbi.nlm.nih.gov/books

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EBT-702: BIOETHICS, BIOSAFETY & IPR

Objective(s): The objectives of this course:

- Concentrates on technology, knowledge and business management aspect of intellectual property, including patenting aspect.
- Provide knowledge on biosafety and risk assessment of products, ethical issues in biological research.

UNIT I: **(9 Sessions)**

Bioethics: Social and ethical implications of biological weapons; patenting of biological material; introduction of NGO for bioethics; Human genome project and ethical issues.

UNIT II: **(9 Sessions)**

Biosafety guidelines: Good laboratory practices (GLP); Biosafety guideline and regulation; Roles of institutional biosafety committee, RCGM, GEAC etc.; Biosafety levels, Cartegena protocol.

UNIT III: **(8 Sessions)**

Intellectual Property Rights (IPR): Definition, purpose and function; Types of IPR- Patent, Copy right, Trade secrets, Trade mark, Industrial Design, Geographical indication and their filing procedures; Plant breeder's rights.

UNIT IV: **(7 Sessions)**

Agreement and Treaties: General agreement on tariffs and trades (GATT), TRIPS, Budapest treaty, Madrid Agreement, WIPO.

UNIT V: **(7 Sessions)**

Rights and Protection: Infringement or violation, remedies against infringement- civil and criminal; Indian Patent Law (1970); Various laws in India- licensing and technology transfer.

Course Outcomes:

At the end of the course students will able to:

- Gain awareness about Intellectual Property Rights (IPRs) to take measure for the protecting their ideas.
- Devise business strategies by taking account of IPRs.
- Assists in technology up gradation and enhancing competitiveness.
- Adequate knowledge in the use of genetically modified organisms and its effect on human health gain more insights into the regulatory affairs.

Suggested Readings:

1. Knight, Patent Strategy for Researches & Research Manegers Wiley Publications.
2. V. Santaniello & R E Evenson, Agriculture & Intellectual & Property Rights, UniversityPress.
3. Thomas, Biotechnology & Safety Assessment, Ane/Rout Publishers.
4. Deepa Goel, IPR, Biosafety and Bioethics, First ed., Pearson, 2013

Website Sources:

- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://library.nitrkl.ac.in/
- https://www.researchgate.net
- https://www.wipo.int/

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(Effective from 2021-22)

EBT-032: BIOFUELS & ALCOHOL TECHNOLOGY

Objective(s): The objectives of this course:

- To teach the concept and application of biofuels and alcohol technology understanding different alcoholic fermentation techniques.
- To provide knowledge about biochemical aspect of alcohol production, recycling and quality control along with concepts of Biomass conversion to heat and power

UNIT I: (8 Sessions)

Introduction to Alcohol Technology: Raw Material of Alcohol Industry, Storage & handling of Raw material in detail, Study of different microbial strains used in alcohol industries.

UNIT II: (8 Sessions)

Alcohol production: Study of different recycling process, Biochemistry of alcohol production. The management of fermentation in the production of alcohol.

UNIT III: (8 Sessions)

Fermentation techniques: Study of different alcoholic fermentation techniques, Batch fermentation, Continuous fermentation, Modem techniques of alcoholic fermentation, Bio still fermentation, Use of cellulosic feed stocks for alcohol production, Scaling in distilleries.

UNIT IV: (8 Sessions)

Alcohol distillation: Fundamental parameters affecting alcoholic fermentations, By products of alcoholic fermentation, Distillery quality control, Alcoholometry.

UNIT V: (8 Sessions)

Description of Biofuels: Biofuel production and uses. Biofuel feed stocks; Biomass conversion to heat and power-thermal\gasification of biomass, anaerobic digestion, Biomass conversion to biofuel-thermochemical conversion, syngas fermentation. Detailed processing for production of bioethanol, biodiesel, biomethane and microbial fuel cell (MFC).

Course Outcomes:

At the end of the course students will able to:

- Explain basic concepts of metabolism and importance of metabolic engineering
- Understand the production of metabolites and its regulatory mechanism
- Explain the applications, specificity and product inhibition of bioconversion.
- Regulation of enzyme production and strain improvement.

Suggested Readings:

1. Olaf Andreas Hougen, Kenneth M. Watson, Roland A. Ragatz.Chemical Process Principles: Material and energy balances
2. Wiley, 1954 KA Jacques, T P Lyons and DR Kelsall.The alcohol textbook, 4th edition, A reference for the beverage, fuel and industrial alcohol industries, Nottingham University Press
3. Product Recovery in Bioprocess Technology ", BIOTOL Series, VCH, 1990

4. Out lines of Chemical Technology by Chmles E.
5. Shieve Chemical Process Industries, 4th Ed., Mc.Graw publication.

Website Sources:

- https://www.energy.gov/eere/bioenergy/biofuels-basics
- https://www.coursera.org/lecture/synbioethics/biofuels-ai9ji
- http://learnbiofuels.org/what-are-biofuels
- https://www.eia.gov/energyexplained/biofuels/

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EBT-033: METABOLIC ENGINEERING

Objective(s): The objectives of this course:

- To understand the overview of cellular metabolism.
- To learn metabolic pathways and metabolic regulation network.
- To understand the metabolic design and control analysis.

UNIT I: **(9 Sessions)**

Basic concepts of Metabolic Engineering: Overview of cellular metabolism, Different models for cellular reactions, Methods for metabolic characterization: genome, transcriptome, proteome, metabolome, fluxome Comprehensive models for cellular reactions.

UNIT II: **(9 Sessions)**

Coordination of metabolic reactions: Feedback inhibition, Energy charge, Multigene networks, Metabolic regulation network at enzyme level and whole cell level, Examples of metabolic pathway manipulations, Metabolic pathway synthesis algorithms.

UNIT III: **(9 Sessions)**

Metabolic flux analysis and its applications: Methods for experimental determination of metabolic fluxes, Metabolite Balancing, Tracer Experiments, MS and NMR in labelling measurement.

UNIT IV: **(9 Sessions)**

Metabolic control analysis (MCA): Analysis of Metabolic control analysis (MCA); Determination of Flux control coefficients, MCA of Linear and Branched pathways, Thermodynamics of cellular processes.

UNIT V: **(9 Sessions)**

Metabolic design: Gene amplification, Gene-disruption, Randomized and targeted strain development, New concepts for quantitative bioprocess research and development.

Course Outcomes:

At the end of the course students will able to:

- Stoichiometry and energetics of metabolism.
- Applications of metabolic engineering in chemical, energy, medical and environmental fields.

Suggested Readings:

1. Stephanopoulas, G, et al, Introduction to Metabolic engineering – Principles and Methodologies, Elsevier Scienc.
2. S. Y. Lee, E.T. Papoutsakis, Metabolic Engineering, Marcel Dekker.
3. F.David, Understanding the Control of Metabolism,, Portland Press
4. R. Heinrich and S., Schuster, The regulation of cellular systems, Springer Science & Business Media

Website Sources:

- https://nptel.ac.in/content/storage2/courses/104108056/module10/PNR%20lecture%2040.pdf
- http://watcut.uwaterloo.ca/webnotes/PDF/MetabolismNotes.pdf
- https://www.saddleback.edu/faculty/jzoval/mypptlectures/ch15_metabolism/lecture_notes_ch15_metabolism_current-v2.0.pdf

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(Effective from 2021-22)

EBT-041: MOLECULAR MODELING AND DRUG DESIGN

Objective(s): The objectives of this course:

- To gain some knowledge on modern approaches used in molecular modeling.
- To identify and design molecules for new medications greatly shortening the discovery phase of drug development by powerful computer-based technology.

UNIT I: **(8 Sessions)**

Introduction to Molecular Modelling. Comparative study of Mechanical and Graphical models. Co-ordinate systems two – matrix, potential energy surface. Postulates of quantum mechanics, electronic structure calculations, ab initio, semi-empirical and density functional.

UNIT II: **(8 Sessions)**

Molecular Mechanisms: energy calculations, Electrostatic interaction- Vander waals interactions. Miscellaneous interaction. Introduction to Molecular Dynamics, Dynamics with continuous potentials and Constant temperature, Conformation searching, Systematic search; Applications to protein folding

UNIT III: **(8 Sessions)**

Protein Modelling: Homology and Threading -the alignment, construction of frame work ,selecting variable regions, side chain placement and refinement, validation of protein models –Ramchandran plot, threading and ab initio modeling.

UNIT IV: **(8 Sessions)**

Introduction to QSAR: lead module, linear and nonlinear modeled equations, biological activities, physicochemical parameter and molecular descriptors, molecular modelling in drug discovery.

UNIT V: **(8 Sessions)**

Drug discovery process: 3D pharmacophores, molecular docking, De novo Ligand design, Free energies and solvation, electrostatic and non-electrostatic contribution to free energies. 3D data base searching and virtual screening, Sources of data, molecular similarity and similarity searching, combinatorial libraries – generation and utility**.**

Course Outcomes:

At the end of the course students will able to:

- Get familiar about the concepts of bioinformatics to be implemented in drug design and development.
- Find new targets to treat disease; mechanism of drug designing
- Understand the concept of molecular modeling, mechanics and interactions
- Develop concepts on bond angle, bond stretching, bond distance and role on different types of bonds in interactions
- Acquire the knowledge about the protein structure prediction and conformational changes throughout the simulation and brief idea of receptor and receptor-ligand complex, inhibition and inactivation of enzyme, receptor theories

Suggested Readings:

1. Andrew R. Leach.Molecular Modelling: Principles and Applications.Prentice Hall, 2001
2. Molecular Modelling by Hans Pieter,Heltje & Gerd Folkens, VCH.
3. Jonathan M. Goodman.Chemical Applications of Molecular Modelling.Royal Society of Chemistry, 1998 Computational Chemistry by Guy H, Grant & W. Graham Richards, Oxford University Press

Website Sources:

- https://www.schrodinger.com/schrodinger-online-learning
- https://www.nyas.org/events/2020/online-course-introduction-to-molecular-modeling-in-drug-discovery/
- https://nptel.ac.in/courses/102/106/102106070/
- https://www.biopharmainstitute.com/course/CADDE

IFTM University, Moradabad
Bachelor of Technology (B. Tech.), Programme
B.Tech. Biotechnology IV Year (VII Semester)
(Effective from 2021-22)

EBT-043: BIOREACTOR ENGINEERING

Objective(s): The objectives of this course:

- To introduce the understanding of bioreactor and its application.
- Designing and operation of bioreactor for microbes, animal and plant cell culture.
- To monitoring and control of bioreactor.

UNIT I: **(8 Sessions)**

Introduction: General design information; Design considerations for maintaining sterility of process streams and process equipments; piping and instrumentation; materials of construction for bioprocess plants. Flow injection analysis for measurement of substrates, product and other metabolites.

UNIT II: **(8 Sessions)**

Bioreactors: Bioreactors for submerged liquid fermentation of microbial cells in: batch reactors - Calculation of batch time, Non-ideality; in semicontinuous reactors; in continuous reactors – PFTR, CSTR; and Combination of reactors.

UNIT III: **(8 Sessions)**

Design and analysis: Packed Bed Bioreactor, Airlift Bioreactor, Hollow Fiber Bioreactor, Plant Cell Bioreactor, Mammalian Cell Bioreactor and bioreactors for solid state fermentation.

UNIT IV: **(8 Sessions)**

Cost Analysis: Residence Time Theory; Residence Time Models: Ideal Reactors and Reactor Combinations, Hydrodynamic Models; Drawbacks of Classical RTD measurements; Transient behavior in bioreactor. Capital Cost Estimating: Components of Capital Cost, Working Capital; Estimating Purchased Equipment Costs; Estimating Installed Costs.

UNIT V: **(8 Sessions)**

Scale-up of Bioreactor & Scale-up of microbial bioreactors: Various approaches to scale-up including regime analysis and scale-down; Scale-up methods by currently used rules-of-thumb viz. constant P/V, KLa etc

Course Outcomes:

At the end of the course students will able to:

- Use of bioreactor in industrially important product formation.
- Use of bioreactor in animal, plant cell culture, enzyme production and waste treatment.
- Designing and configuration of bioreactor for aseptic operation

Suggested Readings:

1. Panda, Tapobrata. Bioreactors: Analysis and Design. Tata McGraw Hill, 2011.
2. Moser, Anton, Bioprocess Technology: Kinetics and Reactors. Springer Verlag, 1988.
3. Bailey J.E. & Ollis, D.F. Biochemical Engineering Fundamentals, 2nd ed., McGraw Hill, 1986
4. Lee, James M. Biochemical Engineering, PHI, USA.
5. Atkinson, Handbook of Bioreactors, Blanch, H.W. Clark, D.S. Biochemical Engineering, Marcel Decker, 1999.

6. Max S. Peters and Klaus, D. Timmerhaus, Plant Design and Economics for Chemical Engineers, 4th Edition, McGraw Hill Book Co., 1991.
7. M. V. Joshi and V.V. Mahajani, Process Equipment Design, 3rd Edition, Macmillan India Ltd., 2000.
8. Michael R. Ladisch, Bioseparations Engineering: Principles, Practice and Economics

Website Sources:

- https://www.schrodinger.com/schrodinger-online-learning
- https://nptel.ac.in/courses/

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EBT-751: Down Stream Processing

1.	Introduction of Laboratory Practices	
2.	Safety Measures	
3.	Do and don't	
4.	About Equipments and Accessories: Principle and Working	
5.	To carry out disruption of yeast cells mechanically and to assay the total protein content.	Experiment 1
6.	To estimate the amount of protein in the given sample by Lowry's method.	Experiment 2
7.	To achieve cell lysis using chemical methods.	Experiment 3
8.	To release periplasmic protein fraction from *E. coli* by cold osmotic shock.	Experiment 4
9.	To filter the given slurry and to determine specific cake resistance α and medium resistance Rm.	Experiment 5
10.	To carry out bulk precipitation of protein from yeast cell suspension using of ammonium sulfate salt.	Experiment 6
11.	To study the effect of increasing rpm and increased time duration on settling of cells during centrifugation.	Experiment 7
12.	To identify the unknown pigments by comparing its R_f value with R_f value of the standards.	Experiment 8

IFTM UNIVERSITY, MORADABAD
B. Tech. Biotechnology Engineering
Course Structure
(Effective from 2021-22)
Eighth Semester

S.N.	Course Code	Course Name	Periods			EVALUATION SCHEME				Course Total	Credits
						Mid Term Exam			External Exam		
			L	T	P	CT	AS +AT	Total			
THEORY											
1.	EBT-801	Environmental Biotechnology	3	1	0	20	10	30	70	100	4
2.	EBT 051-053	Department Elective-IV	3	1	0	20	10	30	70	100	4
3.	EBT 061-063	Department Elective-V	3	1	0	20	10	30	70	100	4
4.	EBT 081-083	Department Elective-VI	3	1	0	20	10	30	70	100	4
PRACTICALS / PROJECT											
5.	EBT-881	Project	0	0	12	-	-	100	200	300	12
6.	GP-801	General Proficiency	0	0	0	0	0	100	-	100	1
		Total Credit	12	5	12	-	-	320	480	800	29

LIST OF DEPARTMENT ELECTIVES

S.No.	Course Code	Course Name
1	EBT-051/052/053	Biotechnology in Health Care/Forensic Science/ Pharmaceutical Biotechnology
2	EBT-061/062/063	Biomedical Instrumentation/ Genomics and Proteomics/ Automation and Robotics
3	EBT-081/082/083	Non-Conventional Energy Resources/ Non Linear Dynamic System/ Product Development

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EBT-801: ENVIRONMENTAL BIOTECHNOLOGY

Objective(s): The objectives of this course:

- Adopt production processes that make optimal use of natural resources, by recycling biomass, recovering energy and minimizing waste generation.
- Promote the use of biotechnological techniques with emphasis on bioremediation of land and water, waste treatment, soil conservation, reforestation, a forestation and land rehabilitation.
- Apply biotechnological processes and their products to protect environmental integrity with a view to long-term ecological security.

UNIT I: **(8 Sessions)**

Environmental Pollution: Environment, Types of Environmental pollution: Air, Water, Land, Radioactive pollution, Measurement of environmental pollution, Microbiology and biochemistry of pollution abatement, Biodegradation methods, Aerobic and anaerobic treatment methods of solid and liquid wastes.

UNIT II: **(8 Sessions)**

Properties of Waste Material: Physico-chemical characteristics of waste material, Availability of waste material, Microbiological and biochemical aspects of anaerobic digestion, Microbial strain improvement for anaerobic processes, Factors influencing anaerobic digestion processes.

UNIT III: **(8 Sessions)**

Analytical techniques for environmental monitoring: Introduction, estimation of total volatile solids, lignin, cellulose, hemicelluloses, Detection of bacteria, Bacteriological examination of water by multiple tube fermentation, Biomarkers.

UNIT IV: **(8 Sessions)**

Bioreactors for liquid waste treatment: Introduction, Physical, Chemical and Biological methods- Activated sludge process, Trickling Filters, Rotating biological contactors, Anaerobic treatment of wastewater; design kinetics for waste treatment processes.

UNIT V: **(8 Sessions)**

Solid waste management: Introduction, Treatment processes for solid wastes, Thermal conversion process, Biological conversion process, landfill bioreactor for solid waste treatment, Biodegradation methods, minimal national standards for waste disposal, Economical and social aspects of waste treatment.

Course Outcomes:

At the end of the course students will able to:

- Classify different kind of Pollutions, natural as well as anthropogenic pollutants, their adverse health and environmental impacts.
- Understand properties of waste and how different microbes (aerobic and anaerobic) metabolize these wastes along with the concept of reuse and recycling of the wastes materials.
- Know how waste could be processed in biofuels which could be used as the source of energy thus serving for biggest challenge in any nation.

- Apply Monod's kinetics and basic chemostat theory to determine microbial growth rates, biomass yield, and substrate concentration and removal rate. Carry out an experiment with nitrification in a continuous lab-scale bioreactor for ammonia removal.
- Describe suitable methods for characterizing the activity, function, diversity, and composition of microbial communities.
- Outline the principles of methods for quantification of organic carbon in wastewater and calculate the theoretical oxygen demand (ThOD) for simple organic compounds.
- Explain the microbial processes and growth requirements underlying the activated sludge process, nitrification, denitrification, enhanced phosphorus removal, and anaerobic digestion.
- Describe the most commonly applied disinfection methods, and the steps typically involved in drinking water treatment process.
- Evaluate the potential for biodegradation through bioremediation of organic pollutants, taking microbial and physical/chemical environments, as well as the chemical structure of the compound itself, into consideration.

Suggested Readings:

1. Metcalf, Eddy. "Wastewater Engineering: Treatment, Disposal, Reuse, Metcalf & Eddy.", Third ed., McGraw-Hill, New York (2003).
2. J. Winter, Environmental Processes I-III, Second ed., Wiley Publications.
3. P. D. Sharma, Ecology & Environment, Twelfth ed., Rastogi Publications, 2015.
4. Ramalho, R. Introduction to wastewater treatment processes. Elsevier, 2012.
5. Pradipta Kumar Mohapatra, Environmental Biotech, I.K. International Pvt. Ltd., 2006.
6. D.P. Singh, S.K. Dwivedi, Environmental Microbiology & Biotechnology, New Age International Publishers, 2004.

Website Sources:

- https://ocw.mit.edu/courses/environment-courses/
- https://www.researchgate.net/publication/282367631_The_Role_of_Bioreactors_in_Industrial_Wastewater_Treatment
- https://ebnet.ac.uk/
- https://onlinecourses.swayam2.ac.in/cec19_bt03/preview
- https://online-learning.tudelft.nl/courses/industrial-biotechnology/

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EBT-051: BIOTECHNOLOGY IN HEALTH CARE

Objective(s): The objectives of this course:

- Realize the growing importance of the biotechnological tools in the field of health care and therapeutics.
- Gain insight into the very important topics of human health like vaccines, cancer and chemotherapeutic agents used therein, various site directed drug delivery systems and more advanced techniques and tools used in the emerging health care system.

UNIT I: **(8 Sessions)**

Therapeutic Aspects of Bio macromolecules: Endogenous peptides and proteins, Modification of endogenous peptides and proteins. Immune System: Overview, Antibody-mediated response, Vaccines, Cell-mediated immune response, Cancer-Immunology.

UNIT II: **(8 Sessions)**

Oligonucleotides: Overview, Gene therapy, Antisense therapy, Ribozymes Oligosaccharides: Overview, Oligosaccharide synthesis, Heparin, Glycoproteins, Polysaccharide bacterial vaccines, Approaches to carbohydrate-based cancer vaccines.

UNIT III: **(8 Sessions)**

Radiological Agents: Radiosensitizers and Radioprotective agents; Cardiovascular Drugs- Myocardial infarction agents, Endogenous vasoactive peptides, Hematopoietic agents, Anticoagulants anthrombotics and hemostatics

UNIT IV: **(8 Sessions)**

Chemotherapeutic Agents: Synthetic antibacterial agents, Lactam antibiotics, Antihelminthic agents, Antiameobic agents, Antiviral agents. Endocrine Drugs: Female sex hormones and analogs, Agents affecting the immune Response

UNIT V: **(8 Sessions)**

Drug Targeting: Basic concepts and novel advances, Brain-specific drug targeting strategies, Pulmonary drug delivery, Cell specific drug delivery.

Course Outcomes:

At the end of the course students will able to:

- Explain the basic concepts related to immunology and biomolecules.
- Describe the use of radiological agents in diagnosis of diseases and various proteins as therapeutics.
- Explain the basic concepts in gene therapy, antisense therapy and synthesis of vaccines.
- Describe the role of different types of chemotherapeutic agents and their properties.
- Describe the basic concepts and advanced research in site specific drug delivery systems

Suggested Readings:

1. Christine Bladon,. Pharmaceutical chemistry: therapeutic aspects of biomacromolecules. John Wiley & Sons, 2002.
2. Donald J Abraham, Burger's medicinal chemistry and drug discovery. Vol. 5. Wiley Interscience, 2003.

3. Grietje Molema, Dirk KF Meijer, Raimund Mannhold, Hugo Kubinyi, and Hendrik Timmerman. "Drug targeting organ-specific strategies."(2001).

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- https://www.healthaffairs.org/doi/full/10.1377/hlthaff.2014.1023
- https://www.biotechnologynotes.com/health-care/use-of-biotechnology-in-health-care/
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3454165/
- https://www.biologydiscussion.com/biotechnology/biotechnology-and-healthcare/
- http://oaji.net/articles/2016/2153-1466509914.pdf

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EBT-052: FORENSIC SCIENCE

Objective: The objectives of this course:

- Is to develop professional, ethical graduates whose competence in problem-solving, legal analysis and application, quantitative reasoning, investigation and scientific laboratory procedures can be applied to immediate employment or advanced study

UNIT I: **(8 Sessions)**

Forensic Science: Definition of Forensic Science, The Role of the Forensic Laboratory, History and Development of Forensic Science in India & Abroad, Pioneers in Forensic Science, Multidisciplinary nature, Forensic Technology solving crimes with advanced technology, Forensic intelligence and Interviews, Narco-Analysis.

UNIT II: **(8 Sessions)**

Forensic Toxicology: Introduction, History and Pioneers (Paracelsus, Mary Blandy James Marsh and M. J. B. Orfila), International organization related to Forensic Toxicology, Different mode of Classification of Poisons, Areas of Forensic Toxicology, Elements of Forensic Toxicology, Applications, Scientific Principles, Instrumentation and equipments, Nature of cases, Role of the Forensic Toxicologist, Laws related to Forensic Toxicology

UNIT III: **(8 Sessions)**

Biological Evidences: Forensic Hair characterization, Forensic Characterization of Blood; Forensic Characterization of Semen; determination of secretor/non-secretor status.

UNIT IV: **(8 Sessions)**

General Forensic Tools and Techniques: Schematic analysis of Chemical, Biological and Physical samples, Colour spot tests in Forensic Biological, Chemical and Physical analysis, microcrystalline test. Blood grouping from stains of body fluids by Absorption-inhibition, Absorption-elution and mixed agglutination techniques; Serological Techniques: ELISA, Methods of Individualization: Blood grouping, enzyme typing and DNA typing.

UNIT V: **(8 Sessions)**

Crime Scenario in India: Concept and Definition of Crime, Introduction to crime, Sociological aspects of crime and criminals in society; Types of crime and its causes: Property crimes, public order crimes, violent crimes, cyber crimes, juvenile delinquency, Society-Criminal interaction and various types of crimes in India. Introduction of Forensic Criminology, Control and Prevention of Crime in context with Organization, Industrialization, Family set up, Psychology

Course Outcomes:

At the end of the course students will able to:

- Describe the basic types of microscopic organic substances that would likely be found useful at a crime scene (e.g. hair, blood, semen, bone, skin)

- Understand, from a legal standpoint, the importance of properly securing a crime scene
- Outline protocols used when a crime scene is being secured and evidence is being procured bylaw enforcement members.
- Classify the various types of evidence that may be obtained at a crime scene
- Identify the importance of taking safety precautions at a crime scene
- Understand sociological aspect of crime and various legal proceeding related to crimes

Suggested Readings:

1. Hand Book of Polygraph Testing by M.Kloinen Academic Press; 1st edition (2001)
2. Detecting Lies and Deceit: Pitfalls and Opportunities (Wiley Series in Psychology of Crime, Policing and Law by A.Vrij (2008)
3. Nanda, B.B. and Tewari, R.K. (2001) Forensic Science in India: A vision for the twenty first century Select Publisher, New Delhi
4. James, S.H and Nordby, J.J. (2003) Forensic Science: An introduction to scientific and investigative techniques CRC Press
5. Indian Evidence Act 3.
6. Criminal Procedure code.
7. Methods of Forensic Science, Volume 2 by Frank Lundquist, Alan S. Curry, Interscience Publishers, 1963.

Website Sources:

- https://www.futurelearn.com/courses/collections/forensics
- https://www.coursera.org/learn/forensic-science
- http://www.forensiceducation.in/
- https://www.sifs.in/
- https://www.forensic.edu.in/
- https://www.educations.com/study-abroad/international-career-institute/forensics-diploma-622288

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EBT-053: PHARMACEUTICAL BIOTECHNOLOGY

Objective(s): The objective of the course is:

- To understand the aspects of biotechnology and its components to develop pharmaceutical manufactures.
- To learn the tools and techniques of animal and plant cell culture to synthesize new drug molecules.
- To study the genomics and proteomics in design of new potent drugs.
- To exercise the fermentation techniques for production of drug and antibiotics.

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UNIT I: (8 Sessions)

Introduction: Biotechnology in the Pharmaceutical Industry- impact of biotechnology in biopharmaceuticals; Genetic manipulation methods; Bacteria, Fungi and Viruses: Structure, Chemistry and Morphology, Cultural, Physiological and Reproductive features, Methods of isolation, Cultivation; Industrially important microorganisms in pharmaceuticals

UNIT II: (8 Sessions)

Animal Cell Culture: Historical Background, Importance of and progress in Animal Cell Culture, Technology, Biology of Animal Cell; Cellular Interactions, Importance of Serum and Serum Free Media, Culturing and Sub-Culturing of Animal Cells, *In Vitro* Transformation of Animal Cells, Cell Differentiation & Cell Movement, Cloning of Animal Cells, Cell Line Preservation, Cell Line Characterization, Chromosome Spreading and Karyotype Analysis.

UNIT III: (8 Sessions)

Plant cell culture: History and evolution, Basics of aseptic culture, *In vitro* propagation, use of plant growth regulators in tissue culture, plant regeneration, organogenesis, somatic embryogenesis, protoplast isolation and culture, somaclonal variation, in vitro mutagenesis, in vitro selection, secondary metabolite production and cell transformation techniques.

UNIT IV: (8 Sessions)

Proteomics, Genomics and Metabolomics: Analyzing gene expression at the mRNA and protein level; Environmental impacts on gene expression; Basic principles of DNA/Protein microarrays and their applications; Construction and study of various types of genome maps and large-scale sequencing; Developing diagnostic tests for plant, animal and human diseases. Identification of biomarkers.

UNIT V: (8 Sessions)

Fermentation technology: Inoculum: preparation and development for industrial fermentation; optimization of the fermentation process (pH, temperature, and oxygen requirements; Fermentation products in Pharmaceutical industry: Antibodies, Therapeutic proteins, Vitamins, Amino acids, Monoclonal Antibodies.

Course Outcomes:

At the end of the course students will able to:

- Impact of Biotechnology on pharmaceutical manufactures.
- Cell culture techniques for production of metabolites-primary and secondary.

- Diagnostic test for animal, plant and human.

Suggested Readings:

1. Alexander N. Glazer, Hiroshi Nikaido MICROBIAL BIOTECHNOLOGY: Fundamentals of Applied Microbiology, Second Edition, 2007 cambridge press.
2. Ronald S. Oosting Ph.D. (auth.) & Daan J. A. Crommelin & Robert D. Sindelar & Bernd Meibohm (eds.): Pharmaceutical Biotechnology: Fundamentals and Applications, Springer 2013.
3. Peter F. Stanbury, Allan Whitaker and Stephen J. Hal: Principles of Fermentation Technology, Pergamon, 1995.

Website Sources:

- https://www.pdfdrive.com/pharmaceutical-biotechnology-fundamentals-and-applications-e164753639.html
- http://www.brainkart.com/subject/Pharmaceutical-Biotechnology--Fundamentals-and-Applications_231/
- https://sites.google.com/site/livescribesmartpennotes/biopharmaceutical-notes

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EBT-061: BIOMEDICAL INSTRUMENTATION

Objective(s): The objectives of this course:

- Introduce student to basic biomedical engineering technology
- Introduce different biological signals, their acquisition, measurements and related constraints.

UNIT I: (8 Sessions)

Overview of Biomedical Instrumentation system – Types of biomedical equipments – Analytical, Diagnostic, Therapeutic and Surgical equipments; Calibration of medical devices and testing of biomedical equipments; Electrical classification of Biomedical Equipments

UNIT II: (8 Sessions)

Analytic Equipments: Flame photometers, Spectro photometers, Beer lambert law, Colorimeters, Blood gas analyzers –Electrodes for pH, pO_2 and pCO_2. Hb meter, Blood cell counters, Auto analyzers.

UNIT III: (8 Sessions)

Diagnostic Equipments: Electrocardiography (ECG) –ECG in diagnosis, Lead systems, Artifacts, ECG Machine. Principles and applications–Vector cardiography (VCG), Magnetocardiography (MCG) – SQUIDS and Phonocardiography (PCG). Electro encephalography (EEG), EEG Machine, Electroretinography (ERG) and Electrooculography (EOG). Principles and applications–Electromyography (EMG); Electroneurography (ENG). Endoscopy, Laparoscopy.

UNIT IV: (8 Sessions)

Patient monitoring system–Bed-side monitors, Central station monitors, Computerized arrhythmia monitors, Cardio scope, Ambulatory monitors, Neonatal monitors, Holter monitoring, Infant Warmer, Neonatal Incubator, Infusion pump, syringe pump, Cardiotocograph – Methods of monitoring fetal heart rate. Biotelemetry – Principles – Types – Single channel and Multichannel – Frequency division and Time division multiplexing, Tele-stimulation, Telemedicine – Principles and applications.

UNIT V: (8 Sessions)

Audiometers –Pure tone, Speech and Mask audiometers, Bekesy audiometers, Tympanometers. Hearing aids, Cochlear implants, Ear moulds. Densitometers – Principle and applications.

Course Outcomes:

At the end of the course students will able to:

- Differentiate and analyze the biomedical signal sources.
- Elucidate cardiovascular system and related measurements.
- Explain the respiratory and nervous systems and related measurements
- Measure non-invasive diagnostic parameters.

Suggested Readings:

1. Leslie Cromwell, Fred J. Weibell, and Erich Pfeiffer. "Biomedical instrumentation and measurement, PHI Pvt." (2006).

2. Cromwell, Leslie. Medical instrumentation for health care. Prentice Hall, 1976.
3. Robert B Northrop, Analysis and application of analog electronic circuits to biomedical instrumentation. CRC press, 2012.
4. Clifford D.Ferris. Introduction to Bioinstrumentation: With Biological, Environmental, and Medical Applications.Humana Press, 1978.
5. Raghbir Singh Khandpur. Handbook of biomedical instrumentation. Tata McGraw-HillEducation,1992.

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- https://onlinecourses.nptel.ac.in/
- https://www.wikipedia.org/
- https://library.nitrkl.ac.in/
- https://study.com/

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EBT-062: GENOMICS AND PROTEOMICS

Objective: The objective of this course:

- To provide introductory knowledge concerning genomics, proteomics and their applications.

UNIT I: **(8 Sessions)**

Introduction to Genomics: Structure and organization of prokaryotic and eukaryotic genomes nuclear, mitochondrial and chloroplast genomes; Phylogenetics; Tools for genome analysis–PCR, RFLP, DNA fingerprinting, RAPD, Automated DNA sequencing; Linkage and pedigree analysis; Construction of genetic maps; Physical maps, FISH to identify chromosome landmarks.

UNIT II: **(8 Sessions)**

Genome sequencing: Human genome project-landmarks on chromosomes generated by various mapping methods; BAC libraries and shotgun libraries preparation; Physical map-cytogenetic map, contig map, restriction map, DNA sequence; DNA sequencing and sequence assembly; Taxonomic classification of organisms using molecular markers- 16S rRNA typing/sequencing.

UNIT III: **(8 Sessions)**

DNA Microarray technology: Basic principles and design: cDNA and oligonucleotide arrays; Applications: Global gene expression analysis, Comparative transcriptomics, Differential gene expression; genotyping/SNP detection; Detection technology; Computational analysis of microarray data.

UNIT IV: **(8 Sessions)**

Proteomics: Overview of protein structure-primary, secondary, tertiary and quarternary structure; Relationship between protein structure and function; Outline of a typical proteomics experiment; Identification and analysis of proteins by 2D analysis; Tryptic digestion of protein and peptide fingerprinting; Mass spectrometry : ion source (MALDI, spray sources); analyzer (ToF, quadrupole, quadrupole ion trap) and detector; clinical proteomics and disease biomarkers; Prions; proteins in disease; Protein-protein interactions: Solid phase ELISA, Yeast two hybrid system, Phage display; Protein interaction maps; Protein arrays-definition, applications- diagnostics, expression profiling.

UNIT V: **(8 Sessions)**

Human disease genes: DNA polymorphism including those involved in disease; Hemoglobin and the anemias; Phenylketonuria (monogenic) and diabetes (multigenic) genetic disorders; SNP detection: hybridization based assays (allele specific probes); Polymerization based assays (allele specific nucleotide incorporation, allele-specific PCR); Ligation based assays (allele specific oligonucleotide ligation); Polymorphism detection without sequence information: SSCP; Proteomics and drug discovery; High throughput screening for drug discovery; Identification of drug targets; drug development.

Course Outcomes:

At the end of the course students will able to:

- Acquire knowledge and understanding of fundamentals of genomics and proteomics
- Understand transcriptomics and metabolomics and their applications in various applied areas of biology.
- Learn about Human Genome and the genetic disorders related to them.

Suggested Readings:

1. Introduction to Genomics . Arthur Lesk. Oxford University Press, 2008
2. Brown TA, Genomes, 3rd Edition, Garland Science, 2006.
3. Bioinformatics, 2nd Edition, Benjamin Cummings, 2007.
4. Primrose S & Twyman R, Principles of Gene Manipulation and Genomics, 7th Edition, Blackwell, 2006.
5. Glick BR & Pasternak JJ, Molecular Biotechnology, 3rd Edition, ASM Press, 1998

Website Sources:

- https://nptel.ac.in/courses/102/103/102103017/
- https://courses.lumenlearning.com/boundless-biology/chapter/genomics-and-proteomics/
- https://academic.oup.com/chromsci/article/55/2/182/2333796
- https://www.classcentral.com/course/swayam-applications-of-interactomics-using-genomics-and-proteomics-technologies-12897

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EBT-063: AUTOMATION & ROBOTICS

Objective: The objective of this course:

- Is to introduce the concepts of Robotic system, its components and instrumentation and control related to robotics.

UNIT I: **(8 Sessions)**
Introduction: Definition, Classification of Robots, geometric classification and control classification.

UNIT II: **(8 Sessions)**
Robot Elements: Drive system, control system, sensors, end effectors, gripper actuators and gripper design.

UNIT III: **(8 Sessions)**
Robot Coordinate Systems and Manipulator Kinematics: Robot co-ordinate system representation, transformation, homogenous transform and its inverse, relating the robot to its world. Manipulators Kinematics, parameters of links and joints, kinematic chains, dynamics of kinematic chains, trajectory planning and control, advanced techniques of kinematics and dynamics of mechanical systems, parallel actuated and closed loop manipulators.4. Robot Control: Fundamental principles, classification, position, path velocity and force control systems, computed torque control, adaptive control, Seroo system for robot control, and introduction to robot vision.

UNIT IV: **(8 Sessions)**
Robot Programming: Level of robot programming, language based programming, task level programming, robot programming synthesis, robot programming for welding, machine tools, material handling, assembly operations, collision free motion planning.

UNIT V: **(8 Sessions)**
Applications: Application of robot in welding, machine tools, material handling, assembly operations parts sorting and parts inspection.

Course Outcomes:
At the end of the course students will able to:

- Explain the fundamentals of robotics and its components
- Illustrate the Kinematics and Dynamics of robotics
- Elucidate the need and implementation of related Instrumentation & control in robotics
- Illustrate the movement of robotic joints with computers/microcontrollers.
- Explain sensors and instrumentation in robotics

Suggested Readings:

1. Coifet Chirroza, “An Introduction to Robot Technology” Kogan Page.
2. Y. Koren “Robotics for Engineers” Mcgraw Hill.
3. K. S. Fu, R.C. Gonzalez Y& CSG Lee, “Robotics” McGraw Hill.
4. J.J. Craig, “Robotics” Addison-Wesley.

5. Grover, Mitchell Weiss, Nagel Octrey, “Industrial Robots” Mcgraw Hill.
6. Asfahl, “Robots & Manufacturing Automation” Wily Eastern.

Website Sources:

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- https://www.wikipedia.org/

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EBT-081: NON–CONVENTIONAL ENERGY RESOURCES

Objective(s): The objectives of this course:

- Understand the various forms of conventional energy resources; also study the present energy scenario and the need for energy conservation. Grab the concept of various forms of renewable energy.
- Learn Outline division aspects and utilization of renewable energy sources for both domestics and industrial application.
- Analyze the environmental aspects of renewable energy resources.

UNIT I: **(8 Sessions)**

Introduction: Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits. Solar Cells: Theory of solar cells. Solar cell materials, solar cell array, solar cell power plant, limitations.

UNIT II: **(8 Sessions)**

Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focusing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

UNIT III: **(8 Sessions)**

Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations. Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations. Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations.

UNIT IV: **(8 Sessions)**

Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations. Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. Performance and limitations of energy conversion systems.

UNIT V: **(8 Sessions)**

Bio-mass: Availability of bio-mass and its conversion theory. Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations. Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants.

Course Outcomes:

At the end of the course students will able to:

- Describe the environmental aspects of non-conventional energy resources. In Comparison with various conventional energy systems, their prospects and limitations.
- Know the need of renewable energy resources, historical and latest developments.
- Describe the use of solar energy and the various components used in the energy production with respect to applications like - heating, cooling, desalination, power generation, drying, cooking etc.
- Appreciate the need of Wind Energy and the various components used in energy generation and know the classifications.

- Understand the concept of Biomass energy resources and their classification, types of biogas Plants-applications
- Compare Solar, Wind and bio energy systems, their prospects, Advantages and limitations.

Suggested Readings:

1. Raja et.al, "Introduction to Non-Conventional Energy Resources" Scitech Publications.
2. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.
3. M.V.R. Koteswara Rao, "Energy Resources: Conventional & Non-Conventional" BSP Publications,2006.
4. D.S. Chauhan, "Non-conventional Energy Resources" New Age International.

Website Sources:

- https://www.toppr.com/guides/physics/sources-of-energy/non-conventional-sources-of-energy/
- https://nptel.ac.in/courses/121/106/121106014/
- https://www.nationalgeographic.com/environment/energy/reference/renewable-energy/
- http://quiznext.in/study-material/learning_material/CBSE-10-Physics/Sources-of-Energy/alternative-or-non-conventional-sources-of-energy/

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EBT-082: NON-LINEAR DYNAMIC SYSTEMS

Objective(s): The objectives of this course:

- To study the successes, limitations, and implications of a modern discovery, that simple deterministic nonlinear evolution equations can generate complex behaviors that quantitatively agree with experimental observations of many physical systems.
- It will take a while to give you the background to appreciate the scope of this discovery and so the course will introduce and discuss concept of Lyapunov stability concepts followed by Lyapunov's theorems.

UNIT I: **(8 Sessions)**

Dynamic systems: Concept of dynamic systems, importance of non-linearity, nonlinear dynamics of flows (in 1, 2, and 3 dimensions) and Maps (1 and 2 dimensions) in phase space, Equilibrium, Periodicity. Picard's theorem, Peano's theorem, boundedness of solutions, omega limit points of bounded trajectories.

UNIT II: **(8 Sessions)**

Stability-I: Stability via Lyapunov's indirect method, converse Lyapunov functions, sublevel sets of Lyapunow functions, Lasalle's invariance principle.

UNIT III: **(8 Sessions)**

Stability-II- Lyapunov's direct method, converse Lyapunov's theorems, Brokett's theorem, applications to control system, stable manifold theorem, centre manifold theorem, normal form theory and applications to nonlinear systems.

UNIT IV: **(8 Sessions)**

Bifurcation: Elementary Bifurcation theory, catastrophe, strange attractor, fractals, fractal geometry and fractal dimension.

UNIT V: **(8 Sessions)**

Chaos: Deterministic Chaos, routes to chaos (period doubling, quasiperiodicity, intermittency, universality, renormalization); Measurement of Chaos (Poincare section, Lyapunov index, entropy); control of chaos.

Course Outcomes:

At the end of the course students will able to:

- Analyze the behavior of dynamical systems (e.g. find periodic orbits and assess their stability, draw phase portraits, etc.) expressed as either a discrete-time mapping or a continuous-time flow.
- Apply the techniques of nonlinear dynamics to physical processes drawn from a variety of scientific and engineering disciplines.
- Analyze changes (i.e. bifurcations) to dynamical systems as system parameters are varied.

Suggested Readings:

1. D.K. Arrowsmith and C.M. Place, "An Introduction to Dynamical Systems" Cambridge
2. University press, London, 1990.

3. K.T. Alligood, T.D. Sauer, and J.A Yorke, “CHAOS: An Introduction to Dynamical System” Springer Verlag, 1997.
4. H.K. Khalis, “Nonlinear Systems” Prentice Hall, 1996.
5. R. R. Mohler, “Non linear systems, Vol-I: Dynamics and Control” Prentice Hall, 1991.
6. J.M. T. Thomson and H.B. Stewart, “Nonlinear Dynamics and Chaos” John Wiley &
7. Sons, 1986.
8. Stanislaw H. Zak, “Systems and control” Oxford University Press, 2003. (15)

Website Sources:

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- https://www.classcentral.com/course/complexity-explorer-nonlinear-dynamics-mathematical-and-computational-approaches-1195
- https://engineering.purdue.edu/online/courses/nonlinear-dynamics-systems-control
- https://www.coursera.org/lecture/robotics-mobility/1-2-2-introduce-nonlinear-mechanical-dynamical-systems-the-dissipative-pendulum-6tDSi

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EBT-083: PRODUCT DEVELOPMENT

Objective(s): The objectives of this course:

- Competence with a set of tools and methods for product design and development.
- Confidence in your own abilities to create a new product.
- Awareness of the role of multiple functions in creating a new product (e.g. marketing, finance, industrial design, engineering, production).
- Ability to coordinate multiple, interdisciplinary tasks in order to achieve a common goal.
- Reinforcement of specific knowledge from other courses through practice and reflection in an action-oriented setting.

UNIT I: **(8 Sessions)**

Concept of Product, definition and scope. Design definitions, old and new design methods, design by evolution, examples such as evolution of sewing M/C, bicycle, safety razor etc., need based developments, technology based developments physical relaibility & economic feasibility of design concepts.

UNIT II: **(8 Sessions)**

Morphology of design, divergent, transformation and convergent phases of product design, identification of need, Analysis of need. Design criteria; functional, aesthetics, ergonomics, form, shape, size, colour. Mental blocks, Removal blocs, Ideation techniques, Creativity, Check list.

UNIT III: **(8 Sessions)**

Transformations, Brainstorming & Synetics, Morphological techniques. Utility Concept, Utility Value, Utility Index, Decision making under Multiple Criteria. Economic aspects, Fixed and variable costs, Break-even analysis.

UNIT IV: **(8 Sessions)**

Reliability considerations, Bath tub curve, Reliability of systems in series and parallel, Failure rate, MTTF and MTBF, Optimum spares from Reliability considerations. Design of display and controls, Man-machine interface, Compatibility of displays and controls. Ergonomic aspects, Anthroprometric data and its importance in design. Application of Computers in Product development & design.

UNIT V: **(8 Sessions)**

Existing techniques, such as work-study, SQC etc. for improving method & quality of product. Innovation versus Invention. Technological Forecasting. Use of Standards for Design.

Course Outcomes:

At the end of the course students will able to:

- Evaluating methods for identifying market needs and assessing demand
- Examine the process associated with new product development by
- Learn how to introduce a product to a market by: a. Researching how to develop a new product from concept to reality and evaluating the process associated with test-marketing, market introduction, commercialization and branding.

- Understand how to test the success of a new product by developing a testing methodology for a given market, product or consumer.

Suggested Readings:

1. A.K. Chitab & R.C. Gupta "Product design & Manufacturing" – Prentice Hall (EE)
2. R.P. Crewford, "The Technology of creation Thinking" Prentice Hall.
3. C.D. Cain, "Product Design & Decision" Bussiness Books.
4. C.D. Cain, "Engg. Product Design" Bussiness Books.

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- https://www.elearninglearning.com/product/
- https://www.coursera.org/courses?query=product%20development
- https://www.coursera.org/courses?query=product%20development
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