KUMARAGURU COLLEGE OF TECHNOLOGY,
An Autonomous Institution affiliated to Anna University, Chennai
COIMBATORE – 641 049.

B.TECH., BIOTECHNOLOGY
REGULATIONS 2018

CURRICULUM AND SYLLABI
I to VIII Semesters

Department of Biotechnology

Signature of BOS chairman, BT
VISION

Strong teaching and research foundation in the area of biotechnology and allied fields through knowledge dissemination to students and the public and to scale new heights in the frontier areas of health and environment and ethics for welfare of humankind globally.

MISSION

- Develop dynamic curriculum and syllabus to promote innovative and creative practices.
- Encourage students for innovation and setting start-ups and equip leadership and entrepreneurial skills.
- Train students on issues related to social welfare.

PEOs:

PEO 1: To become successful professional/entrepreneur by inculcating knowledge in interdisciplinary areas in Science, Technology, Engineering and Management.

PEO 2: To provide strong foundation in core areas of biotechnology to provide biotechnological solutions to real life problems with economic, social and sustainable viability.

PEO 3: Sensitize on environmental, health and bioethical issues, IPR.

POs:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex
6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

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

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1: An ability to apply the knowledge of food/medical/environmental and computational biology to perform image analysis and processing, data mining and Big data analytics.

PSO2: An ability to understand and design solutions using bioprocess principles, bioanalytical instrumentation and techniques and cell culture techniques.
### Semester I

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**Total Contact Hours/ Week:** 26

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**Total Contact Hours/ Week:** 26

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**Total Credits:** 22  
**Total Contact Hours/ Week:** 25

Signature of BOS Chairman
### Semester IV

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**Total Credits:** 23  
**Total Contact Hours/ Week :** 26

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**Total Credits:** 21  
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**Total Credits:** 22  
**Total Contact Hours/ Week :** 26
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Total Credits: 15

Total Contact Hours/Week: 27

### Total Credits - 164

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Signature of BOS Chairman
## List of Professional Electives

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### List of One Credit Courses

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<td>U18BTI0001</td>
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1. Any new course to be included after obtaining approval
SEMESTER I
Course Objectives:
1. To communicate effectively by using appropriate grammar and technical parlance in a range of academic scenarios.
2. To interpret and critically evaluate discourses related to functional English.
3. To disseminate professional information through appropriate means of communication.

Course Outcomes:
After the course the student will be able to:
CO1: Communicate in English with correct grammar
CO2: Communicate effectively (Oral and Written)
CO3: Use communication skills in the real world

CO/PO Mapping:

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Assessment Methods:

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<tr>
<td>2. Assignment</td>
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<td>3. End Semester Examination</td>
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Signature of BOS chairman, BT
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<td>Subject Verb Agreement</td>
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<td>1.3</td>
<td>Speak up (Self Introduction, JAM)</td>
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<tr>
<td>1.4</td>
<td>Writing sentences using ‘Be-forms’</td>
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<td>Articles, Gerunds, Infinitives</td>
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<td>Clauses</td>
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**Reference:**

1. A Modern Approach to Non Verbal Reasoning (English, Paperback, Dr. R S Aggarwal)
2. The Power of Words (Bloomsbury, UK, 2012, Hyacinth Pink)
5. English and Soft skills Orient Black Swan Publishers (S. P. Dhanavel)

Signature of BOS chairman, BT
COURSE OUTCOMES
After successful completion of this course, the students should be able to:

CO1: Identify eigenvalues and eigenvectors and apply Cayley Hamilton theorem.
CO2: Apply orthogonal diagonalisation to convert quadratic form to canonical form.
CO3: Solve first order ordinary differential equations and apply them to certain physical situations.
CO4: Solve higher order ordinary differential equations.
CO5: Evaluate the total derivative of a function, expand the given function as series and locate the maximum and minimum for multivariate function.
CO6: Determine Rank, Inverse, Eigenvalues, Eigenvectors of the given matrix, Maxima-Minima of the function and Solving Differential equations using MATLAB

Pre-requisite: Basics of Matrices, Differentiation and Integration

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Course Assessment methods:

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<tr>
<td>3. End Semester Examination</td>
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THEORY COMPONENT

MATRICES
Rank of a matrix – Consistency of a system of linear equations - Rouche’s theorem - Solution of a system of linear equations - Linearly dependent and independent vectors– Eigenvalues and

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Eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors – Cayley Hamilton theorem (excluding proof)

**DIAGONALISATION OF A REAL SYMMETRIC MATRIX** 6 Hours
Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form –
Reduction of quadratic form to canonical form by orthogonal transformation.

**FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS** 11 Hours
Leibnitz’s equation – Bernoulli’s equation – Equations of first order and higher degree - Clairauls form – Applications: Orthogonal trajectories.

**HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS** 11 Hours
Linear equations of second and higher order with constant coefficients – Euler’s and Legendre’s linear equations – Method of variation of parameters – First order Simultaneous linear equations with constant coefficients – Applications.

**FUNCTIONS OF SEVERAL VARIABLES** 11 Hours

**LAB COMPONENT** 30 Hours

**List of MATLAB Programmes:**
1. Introduction to MATLAB.
2. Matrix Operations - Addition, Multiplication, Transpose, Inverse
3. Rank of a matrix and solution of a system of linear equations
5. Eigenvalues and Eigenvectors of Higher Order Matrices
6. Curve tracing
7. Solving first order ordinary differential equations.
10. Determining Maxima and Minima of a function of two variables.

**Theory:** 45  **Tutorial:** 0  **Practical:** 30  **Project:** 0  **Total:** 75 Hours

**REFERENCES**

Signature of BOS chairman, BT
8. P.Bali., Dr. Manish Goyal., Transforms and partial Differential equations, University Science Press, New Delhi, 2010

U18ME11201 ENGINEERING GRAPHICS

Course outcome

At the end of the course, the student will be able to:

CO1: Construct various plane curves.
CO2: Construct projection of points and projection of lines.
CO3: Develop projection of surfaces and solids.
CO4: Solve problems in sections of solids and development of surfaces.
CO5: Apply free hand sketching and concepts of isometric in engineering practice.
CO6: Draw engineering drawing in AutoCAD with dimensions.

Pre-requisites: Nil
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**Direct**

1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

**PLANE CURVES, PROJECTION OF POINTS, LINES AND PLANES**

10 Hours

Importance of graphics in design process, visualization, communication, documentation and drafting tools, Construction of curves - ellipse, parabola, and hyperbola by eccentricity method only. Orthographic projection of points.

Projections of straight lines located in first quadrant - determination of true length and true inclinations.

Projections of plane surfaces - polygonal lamina and circular lamina, located in first quadrant and inclined to one reference plane.

**PROJECTION AND SECTION OF SOLIDS**

10 Hours

Projection of simple solids - prism, pyramid, cylinder and cone. Drawing views when the axis of the solid is inclined to one reference plane.

Sectioning of simple solids - prisms, pyramids, cylinder and cone. Obtaining sectional views and true shape when the axis of the solid is vertical and cutting plane inclined to one reference plane.

**DEVELOPMENT OF SURFACES, ISOMETRIC PROJECTIONS AND FREE-HAND SKETCHING**

10 Hours

Development of lateral surfaces of truncated prisms, pyramids, cylinders and cones.
Isometric projection, Isometric scale, Isometric views of simple solids, truncated prisms, pyramids, cylinders and cones.

Free hand sketching techniques, sketching of orthographic views from given pictorial views of objects, including free-hand dimensioning.

**INTRODUCTION TO AUTOCAD**  
15 Hours

Introduction to Drafting Software (AutoCAD) & its Basic Commands. Introduction to coordinate systems, object selection methods, selection of units and precession. sketching – line, circle, arc, polygon, rectangle and ellipse. Working with object snaps, layers and object properties. Editing the objects – copy, move, trim, extend, working with arrays, mirror, scale, hatch, fillet and chamfer.

**ISOMETRIC VIEWS WITH AUTOCAD**  
15 Hours

Building drawings – Single and double bed room house (sectional Top view only). Introduction to Motion path animation. Isometric views of simple solid blocks.

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<th>Tutorial: 0</th>
<th>Practical: 30</th>
<th>Project: 0</th>
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**REFERENCES**

Course Outcomes
After successful completion of this course, the students should be able to

**CO1:** Understand the principles of motion and rotation of a rigid body in the plane.

**CO2:** Enhance the fundamental knowledge in properties of matter and its applications relevant to various streams of Engineering and Technology.

**CO3:** Recognise the nature and role of the thermodynamic parameters.

**CO4:** Compute electrostatic field and electric potential due to point and distributed charges.

**CO5:** Use electrostatic & magneto static boundary conditions to relate fields in adjacent media.

**CO6:** Introduce and provide a broad view of the smart materials and Nano science to undergraduates.

**Pre-requisites:** -

**High School Education**

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**CO/PO Mapping**
(S/M/W indicates strength of correlation)
S-Strong, M-Medium, W-Weak
**Course Assessment methods**

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<td>2. Assignment</td>
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<tr>
<td>3. End Semester Examination</td>
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**Theory Component**

**KINEMATICS & RIGID BODY MOTION**

Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion; Euler’s laws of motion, their independence from Newton’s laws, and their necessity in describing rigid body motion; Examples.

**PROPERTIES OF MATTER AND MATERIALS TESTING**

**Properties of matter:** Hooke's Law - Stress - Strain Diagram - Elastic moduli - Relation between elastic constants - Poisson's Ratio - Expression for bending moment and depression - Cantilever - Expression for Young's modulus by Non uniform bending and its experimental determination.

**Materials testing:** Mechanism of plastic deformation, slip and twinning – types of fracture – Vickers Hardness test - fatigue and creep test.

**HEAT**


**ELECTROSTATICS & MAGNETOSTATICS**

**ELECTROSTATICS:** Maxwell’s equation for electrostatics – E due to straight conductors, circular loop, infinite sheet of current - electric field intensity (D) - Electric potential - dielectrics - dielectric polarization - internal field – Clasious - Mosotti equation - dielectric strength - applications.
MAGNETOSTATICS: Maxwell’s equation for magnetostatics - B in straight conductors, circular loop, infinite sheet of current - Lorentz force, magnetic field intensity (H) – Biot–Savart’s Law – Ampere’s Circuit Law – Magnetic flux density (B) – magnetic materials – Magnetization – Applications.

8 Hours

NEW ENGINEERING MATERIALS AND NANO TECHNOLOGY

New Engineering Materials: Metallic glasses – preparation, properties and applications – Shape memory alloys (SMA) – characteristics, properties of NiTi alloy applications - advantages and disadvantages of SMA.

Nano Materials: synthesis - Ball milling - Sol-gel - Electro deposition — properties of nano particles and applications. – Carbon Nano Tubes – fabrication by Chemical Vapour Deposition - structure, properties & applications.

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

REFERENCES

11. Engineering Physics, Rajendran V., Tata McGraw-Hill Education Pvt. Ltd., 2010

Lab component:

LIST OF EXPERIMENTS
1. Determination of thermal conductivity of a bad conductor - Lee’s disc
2. Determination of Acceleration due to Gravity – Compound Pendulum
3. Determination of wavelength of light, Numerical aperture and acceptance of optical fibre
4. Determination of band gap of a semiconductor
5. Determination of compressibility of a given liquid - Ultrasonic Interferometer
6. Determination of thickness of thin sheet – Air wedge
7. Determination of frequency of an electrically maintained turning fork – Melde’s string
8. Determination of wavelength of mercury source using diffraction grating - Spectrometer
9. Determination of solar cell efficiency using Lux Meter
10. Determination of Young’s Modulus – Non-uniform bending

Experiments for Demonstration:
1. Hall effect
2. Hardness Test
3. Four probe experiment
4. Hysteresis curve

Theory: 0  Tutorial: 0  Practical: 30  Project: 0  Total: 30 Hours

REFERENCES

**U18CSI1202** PROBLEM SOLVING AND PROGRAMMING USING C

**Course Outcomes**
After successful completion of this course, the students should be able to

- **CO1:** Acquire knowledge on different problem solving techniques.
- **CO2:** Use appropriate data types and control structures for solving a given problem.
- **CO3:** Execute different array and string operations.
- **CO4:** Experiment with the usage of pointers and functions.
- **CO5:** Organize data using structures and unions.

**Pre-requisites:** Nil

**CO/PO Mapping**
(S/M/W indicates strength of correlation)

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<tr>
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<th>Programme Outcomes(POs)</th>
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**Pre-requisites**
Nil

**Course Assessment methods**

- **Direct**
  1. Continuous Assessment Test
  2. Assignment
  3. End Semester Examination

**THEORY COMPONENT CONTENTS**

**STRUCTURED PROGRAMMING**

6 Hours

ARRAYS AND STRINGS 6 Hours
Defining an array – Processing an array – Multidimensional Arrays Character Arithmetic – Defining a string – Initialization of Strings – Reading and Writing Strings – Processing Strings – Searching and Sorting of Strings

FUNCTIONS, STORAGE CLASSES 6 Hours
Defining a function – Accessing a function – Function prototypes – Passing arguments to a function – Passing arrays to functions – Function with string - Recursion – Storage classes

POINTERS 7 Hours

STRUCTURES AND UNIONS 5 Hours
Structures and Unions: Defining a Structure – Processing a Structure – User defined data types (Typedef) – Unions

<table>
<thead>
<tr>
<th>Theory: 30 Hours</th>
<th>Tutorial: 0</th>
<th>Practical: 0</th>
<th>Project: 0</th>
<th>Total: 30 Hours</th>
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REFERENCES

LAB COMPONENT CONTENTS
LIST OF EXPERIMENTS

1. Writing algorithms, flowcharts and pseudo codes for simple problems.
2. Programs on expressions and conversions
3. Programs using if, if-else, switch and nested if statements
4. Programs using while, do-while, for loops
5. Programs on one dimensional arrays, passing arrays to functions and array operations
6. Programs using two dimensional arrays, passing 2D arrays to functions
7. Programs using String functions
8. Programs using function calls, recursion, call by value
9. Programs on pointer operators, call by reference, pointers with arrays
10. Programs using structures and unions.

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<thead>
<tr>
<th>Theory: 0</th>
<th>Tutorial: 0</th>
<th>Practical: 30 Hours</th>
<th>Project: 0</th>
<th>Total: 30 Hours</th>
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</table>

Signature of BOS chairman, BT
REFERENCES


U18VEP1501 PERSONAL VALUES

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Become an individual in knowing the self
CO 2: Acquire and express Gratitude, Truthfulness, Punctuality, Cleanliness & fitness.
CO 3: Practice simple physical exercise and breathing techniques
CO 4: Practice Yoga asana which will enhance the quality of life.
CO 5: Practice Meditation and get benefited.
CO 6: Procure self healing techniques for propagating healthy society

Pre-requisites : NIL

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<th>CO/PO Mapping</th>
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<td>(S/M/W indicates strength of correlation)</td>
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<td>S-Strong, M-Medium, W-Weak</td>
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Course Assessment methods

Direct

1. Group Activity / Individual performance and assignment
2. Assessment on Value work sheet / Test
Values through Practical activities:

1. **Knowing the self**: Introduction to value education - Need & importance of Value education – Knowing the self – realization of human life – animal instinct vs sixth sense.
4. **Core value**: **Self love& Self care** Gratitude - Happiness - Optimistic –Enthusiasm – Simplicity – Punctual - Self Control - Cleanliness & personal hygiene - Freedom from belief systems.
5. **Fitness**: Simplified physical exercises – Sun salutation - Lung strengthening practices: Naadi saddhi pranayama – Silent sitting and listening to nature – Meditation.

**Workshop mode**

**REFERENCES**


4. **LEARNING TO BE: A HOLISTIC AND INTEGRATED APPROACH TO VALUES** – UNESCO PDF format at www.unesdoc.unesco.org/images/0012/001279/127914e.pdf

5. **PERSONALITY DEVELOPMENT** By SWAMI VIVEKANANDA www.estudantedavedanta.net/Personality-Development.pdf
Course objectives

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

Course Outcomes
After successful completion of this course, the students should be able to:

- **CO1**: Identify a practical problems and find a solution
- **CO2**: Understand the project management techniques
- **CO3**: Demonstrate their technical report writing and presentation skills

Pre-requisite:
NIL

### CO/PO Mapping

(S/M/W indicates strength of correlation)  
S-Strong, M-Medium, W-Weak

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<th>COs</th>
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Course Assessment methods:

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<tr>
<td>1. Project reviews</td>
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<td>2. Workbook report</td>
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<tr>
<td>3. Demonstration &amp; Viva-voce</td>
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Content:
The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the
course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In this semester, students will focus primarily on IOT with C programming using Aurdino

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<thead>
<tr>
<th>Course</th>
<th>Semester</th>
<th>Focus</th>
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<tr>
<td>Engineering Clinic I</td>
<td>1</td>
<td>IOT with C programming using Aurdino</td>
</tr>
<tr>
<td>Engineering Clinic II</td>
<td>2</td>
<td>Raspberry pi based controllers with Python programming</td>
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<td>Engineering Clinic III</td>
<td>3</td>
<td>Design project combining concepts learnt in Engineering clinics I and II</td>
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<td>Engineering Clinic IV</td>
<td>4</td>
<td>Reverse engineering project to improve performance of a product</td>
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<td>Engineering Clinic V</td>
<td>5</td>
<td>Design and developing a prototype</td>
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**GUIDELINES:**

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instruction who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the ‘Engineering Clinics Expo’ at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

**Total Hours: 90**
SEMESTER II

Signature of BOS chairman, BT
U18EN12201 – FUNDAMENTALS OF COMMUNICATION - II
(Common to all branches of II Semester B.E/BTech Programmes)

Course Objectives:
4. To adopt relevant job related oral and written communication skills to competently perform in campus recruitments.
5. To train students in presentation skills, persuasive skills and career skills.
6. To comprehend critical text leading to academic articulation.

Course Outcomes:
After the course the student will be able to:
CO1: Demonstrate comprehension
CO2: Write reports and projects
CO3: Communicate verbally in the business environment

Assessment Methods:

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Signature of BOS chairman, BT
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<td>Listening Skills - IV</td>
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<td>1.3</td>
<td>Speak up (Debate)</td>
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<td>Writing Memos, Circulars, Agenda and Minutes</td>
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<td>3.2</td>
<td>Writing Reviews – Product Review/Article Review</td>
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<td>Book Review – Home Assignment</td>
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<td>4.4</td>
<td>Drafting a project proposal</td>
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<td>Writing a News story / Advertisement</td>
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</table>

Reference:

2. Effective Technical Communication Tata McGraw Hills Publications (Ashraf Rizvi)
3. English and Soft skills Orient Black Swan Publishers (S. P. Dhanavel)
4. Verbal Ability (Bloomsbury, UK, June 2012) Hyacinth Pink

Signature of BOS chairman, BT
U18MAI2101 ADVANCED CALCULUS AND LAPLACE TRANSFORMS
(Common to All branches)

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Evaluate double and triple integrals in Cartesian coordinates and apply them to calculate area and volume.

CO2: Apply various integral theorems for solving engineering problems involving cubes and rectangular parallelepipeds.

CO3: Construct analytic functions of complex variables and transform functions from z-plane to w-plane and vice-versa, using conformal mappings.

CO4: Transform Functions in Time Domain to Frequency Domain using Laplace Transform

CO5: Use Laplace Transforms to Solve Ordinary Differential Equations and Integral Equations

CO6: Determine multiple integrals, vector differentiation, vector integrals and Laplace transforms using MATLAB.

Pre-requisites: U18MAI2201 – Advanced Calculus and Laplace Transform

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CO/PO Mapping
(S/M/W indicates strength of correlation)
S-Strong, M-Medium, W-Weak

COURSE ASSESSMENT METHODS

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

THEORY COMPONENT

Signature of BOS chairman, BT
### MULTIPLE INTEGRALS 10 Hours
Double integration – Cartesian coordinates – Change of order of integration - Application: Area as double integral - Triple integration in Cartesian coordinates — Volume as triple integral.

### VECTOR DIFFERENTIATION 6 Hours
Gradient, divergence and curl – Directional derivative – Irrotational and Solenoidal vector fields.

### VECTOR INTEGRATION 6 Hours
Green’s theorem in a plane, Gauss divergence theorem and Stoke’s theorem (excluding proofs) – Verification of theorem and simple applications

### ANALYTIC FUNCTIONS 8 Hours
Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy- Riemann equations in Cartesian coordinates and sufficient conditions (excluding proofs) – Properties of analytic function – Construction of analytic function by Milne Thomson method – Conformal mapping: \( w = z + c, \frac{cz}{z}, \frac{1}{z} \).

### LAPLACE TRANSFORMS 8 Hours
Definition of the Laplace Transform; Properties of the Laplace Transform – Superposition, Shift in \( t \) or Time Delay, Shift in \( s \), Time Derivatives, Time Integral-Initial Value Theorem - Final Value Theorem; Transform of periodic functions

### INVERSE LAPLACE TRANSFORMS 7 Hours
Inverse transforms - Convolution theorem – Applications to solution of linear ordinary differential equations of second order with constant coefficients - Solution of integral equations.

### REFERENCES
8. N.P.Bali., Dr. Manish Goyal., — Transforms and Partial Differential equations, University science Press, New Delhi, 2010

Signature of BOS chairman, BT
LAB COMPONENT

30 Hours

List of MATLAB Programmes:

1. Evaluating double integral with constant and variable limits.
2. Area as double integral
3. Evaluating triple integral with constant and variable limits
4. Volume as triple integral
5. Evaluating gradient, divergence and curl
6. Evaluating line integrals and work done
7. Verifying Green’s theorem in the plane
8. Evaluating Laplace transforms and inverse Laplace transforms of functions including impulse.
9. Heaviside functions and applying convolution.
10. Applying the technique of Laplace transform to solve differential equations.

Theory: 45     Tutorial: 0     Practical: 30     Project: 0     Total: 75 Hours
U18EE12208 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

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**Course Assessment Method**

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**DC circuits:**

Basic circuit elements and sources, Ohms law, Kirchhoff’s laws, series and parallel connection of circuit elements, Node voltage analysis, Mesh current analysis.

**AC circuits:**


**Electrical Machines:**

Signature of BOS chairman, BT
Construction, Working Principle and applications of DC generators, DC Motors, single phase Transformers, three phase and single phase induction motors.

**Semiconductor devices and Circuits:** 9hrs
PN junction diode – Zener Diode – Half wave and Full wave rectifier-voltage regulators – Bipolar Junction transistors, JFET, MOSFET – characteristics

**Digital Systems:** 9hrs

**Laboratory experiments**

2. Verification of Kirchoff’s Voltage and Current Laws.
3. Verification of Mesh and Nodal analysis.
4. Load test on DC shunt motor.
5. Load test on single phase transformer.
7. Verification of truth tables of OR, AND, NOT, NAND, NOR, EX-OR, EXNOR gates.
8. Full wave rectifier with and without filter.
10. Characteristics of PN junction diode and Zener diode.

**Theory: 45  Tutorial: 0  Practical: 30 H  Project: 0  Total: 75 Hours**

**TEXT BOOKS:**

**REFERENCES**

Signature of BOS chairman, BT
Course Outcomes

After successful completion of this course, the students should be able to
CO1: Apply the basic principles of chemistry at the atomic and molecular level.
CO2: Analyze the impact of engineering solutions from the point of view of chemical principles
CO3: Apply the chemical properties to categorize the engineering materials and their uses
CO4: Integrate the chemical principles in the projects undertaken in field of engineering and technology
CO5: Develop analytical proficiency through lab skill sets to demonstrate in professional practice.

Pre-requisites : Nil

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Course Assessment methods

1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

**Theory Component**

**CHEMICAL BONDING** 7 Hours

Bonding: Introduction – Ionic bonding - Van der Waal’s forces (dipole - dipole, dipole - induced dipole, induced dipole - induced dipole interactions) - hydrophobic interaction.

Bonding in organic molecules: covalent and co-ordinate bonds (overview only) - hybridization (sp, sp2, sp3) - hydrogen bonding and its consequences.

**THERMODYNAMICS** 7 Hours

**ELECTROCHEMISTRY AND CORROSION** 7 Hours
Corrosion: Classification and mechanism of chemical and electrochemical corrosion - Factors influencing corrosion
Corrosion control: Inhibitors – Cathodic protection (Sacrificial anodic protection, Impressed current cathodic protection) – Protective coating: Electroplating (Au) and Electroless plating (Ni).

**WATER TECHNOLOGY** 6 Hours
Treatment of hard water: External treatment (Ion exchange method) - Internal treatment (colloidal, carbonate, phosphate and calgon conditioning) - Desalination (Reverse osmosis, Electrodialysis)

**ENGINEERING MATERIALS** 9 Hours
Polymer: Introduction – Preparation, Properties and Applications of PMMA, PET, PVC.
Composites: Constituents of Composites – Polymer Composites - Metal Matrix Composites - Ceramic Matrix Composites – Applications
Lubricants: Classification - Functions - Properties (viscosity index, flash and fire point, oiliness, carbon residue, aniline point, cloud point and pour point) - Semi solid lubricant (greases with calcium based, sodium based, lithium based) - Solid lubricants (graphite, molybdenum disulphide)

**SURFACE CHEMISTRY AND CATALYSIS** 9 Hours

**Theory: 45  Tutorial: 0  Practical: 0  Project: 0  Total: 45 Hours**

**REFERENCES**

LABORATORY COMPONENT

LIST OF EXPERIMENTS

1. Preparation of Standard solutions
2. Conductometric estimation of mixture of acids vs strong base
3. Estimation of extent of corrosion of Iron pieces by Potentiometry
4. Estimation of the extent of dissolution of Copper / Ferrous ions by spectrophotometry.
5. Estimation of acids by pH metry.
6. Determination of total, temporary and permanent hardness by EDTA method.
7. Estimation of DO by Winkler’s method
9. Estimation of Chloride by Argentometric method
10. Estimation of Sodium and Potassium in water by Flame photometry.
11. Determination of Flash and Fire point of lubricating oil
12. Determination of Cloud and Pour point of lubricating oil
13. Determination of relative and kinematic viscosities of lubricating oil at different temperatures
14. Determination of corrosion rate on mild steel by Weight loss method
15. Morphological studies of corrosion on mild steel by microscopic techniques

Theory: 0  Tutorial: 0  Practical: 30  Project: 0  Total: 30 Hours

REFERENCES

U18CSI2201  PYTHON PROGRAMMING  
(Common to All Branches)

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Classify and make use of python programming elements to solve and debug simple logical problems.

CO2: Experiment with the various control statements in Python.

CO3: Develop Python programs using functions and strings.

CO4: Analyze a problem and use appropriate data structures to solve it.

CO5: Develop python programs to implement various file operations and exception handling.

Pre-requisites: Nil

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CO/PO Mapping
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COURSE ASSESSMENT METHODS

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THEORY COMPONENT CONTENTS

BASICS OF PYTHON PROGRAMMING  
6 Hours
Introduction-Python Interpreter-Interactive and script mode -Values and types, operators, expressions, statements, precedence of operators, Multiple assignments, comments.

CONTROL STATEMENTS AND FUNCTIONS IN PYTHON  
6 Hours
Conditional (if), alternative (if-else), chained conditional (if-elif-else)-Iteration-while, for, break, continue, pass – Functions - Introduction, inbuilt functions, user defined functions, passing parameters, return values, recursion, Lambda functions.

DATA STRUCTURES: STRINGS, LISTS and SETS  
7 Hours
Strings-String slices, immutability, string methods and operations -Lists-creating lists, list operations, list methods, mutability, aliasing, cloning lists, list and strings, list and functions-list processing-list comprehension, searching and sorting, Sets-creating sets, set operations.

DATA STRUCTURES: TUPLES, DICTIONARIES  
5 Hours
Tuples-Tuple assignment, Operations on Tuples, lists and tuples, Tuple as return value-Dictionaries-operations and methods, Nested Dictionaries.

FILES, MODULES, PACKAGES  
6 Hours
Files and Exception-Text files, reading and writing files, format Operator-Modules-Python Modules-Creating own Python Modules-packages, Introduction to exception handling.

| Theory: 30 | Tutorial: 0 | Practical: 0 | Project: 0 | Total: 30 Hours |

REFERENCES

Signature of BOS chairman, BT
**E BOOKS AND ONLINE LEARNING MATERIALS**

1. [www.mhhe.com/kamthane/python](http://www.mhhe.com/kamthane/python)
   (http://greenteapress.com/wp/think-python/)

**LAB COMPONENT CONTENTS**

**LIST OF EXPERIMENTS**

1. Implement simple python programs using interactive and script mode.
2. Develop python programs using id() and type() functions
3. Implement range() function in python
4. Implement various control statements in python.
5. Develop python programs to perform various string operations like concatenation, slicing, Indexing.
6. Demonstrate string functions using python.
7. Implement user defined functions using python.
8. Develop python programs to perform operations on list
9. Implement dictionary and set in python
10. Develop programs to work with Tuples.
11. Create programs to solve problems using various data structures in python.
12. Implement python program to perform file operations.
13. Implement python programs using modules and packages.

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**ONLINE COURSES AND VIDEO LECTURES:**

1. [http://nptel.ac.in](http://nptel.ac.in)
2. [https://www.edx.org/course/introduction-to-python-fundamentals-1](https://www.edx.org/course/introduction-to-python-fundamentals-1)
4. [https://www.edx.org/course?search_query=Computing+in+Python+III%3A+Data+Structures](https://www.edx.org/course?search_query=Computing+in+Python+III%3A+Data+Structures)
INTRODUCTION TO
BIOTECHNOLOGY
L T P J C
2 0 2 0 3

Course Objectives:
- Sensitize students on the safety measures in laboratory, including handling and care of instruments
- To introduce students to biological foundational concepts and their application in the field of biotechnology

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: To comprehend the historical development, current and future trends of the field of biotechnology

CO2: To understand Chemistry, Classification of life forms and Cellular components

CO3: To acquire knowledge in the basic functions of Large Biomolecules

CO4: To understand the fundamental calculations and preparations of solutions

CO5: To acquaint students with applications of General applications and Ethical issues in biotechnology

CO6: To Gain knowledge, scopes in field of process biotechnology such as food, biopharmaceutical industry, agriculture and environment sectors

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Pre-requisite Course: Nil

Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Signature of BOS chairman, BT
Course Content

SCOPE OF BIOTECHNOLOGY 5 hours

Historical Use of microorganisms. Modern Biotechnology and its future, Classification of Biotechnology industries based on products; Skills and manpower requirement for biotechnology sector; Ideas, innovations and entrepreneurship in Biotechnology

ENGINEERED FORMS OF LIFE 5 hours

Chemistry of life; Water and life; Carbon and Molecular diversity; Origin of life on earth; Theory of Evolution (key concepts only); Structure and function of cellular organelles; Cell division - mitosis and meiosis; Synthetic biology and its importance.

FUNCTION OF LARGE BIOMOLECULES AND FUNDAMENTAL CALCULATIONS 9 hours

Carbohydrates, Lipids, Proteins – classification and function (overview only); Central dogma; Concept of genes (DNA and RNA structure in prokaryotes and eukaryotes); Introduction to primary, secondary, tertiary and quaternary protein structure; Role of active site and substrate binding sites in the action of chymotrypsin on proteins.

Concepts of pH, buffers, Henderson–Hasselbalch and Iso-electric point (pI), Titration curves. Calculations involving preparation of buffers, reagents stock solutions and dilutions

APPLICATION OF BIOTECHNOLOGY 6 hours

Genetically engineered products (golden rice, BT cotton, and insulin), role of bacteria and fungi for pollution abatement; Genome sequencing method - Sanger’s method; Medical and forensic applications of DNA fingerprinting, molecular diagnostics and biosensors. Introduction to Transgenic animals and Ethical issues in biotechnology.

PROCESS BIOTECHNOLOGY 5 hours

Upstream and downstream processing steps in the industrial production of vinegar, penicillin, SCP, amino acid (aspartic acid), vaccine and alcohol production by fermentation; Biorefinery –. Concepts. Optional: Vaccine production/papain production/recombinant product production facility (field visit)

List of Experiments 30 Hours

1. Lab safety and GLP concepts (CO1)
2. Calculations in biotechnology lab and solution preparation (CO4)
3. Handling of basic laboratory equipment (CO1)
4. Isolation of cells/disruption from tissue and subcellular fractionation of organelles (CO2)
5. Mitosis – onion root tip (CO2)
6. Estimation of Protein /DNA (C03)
7. Extraction of lycopene from tomato (CO6)
8. Effect of size reduction for polyphenols leaching from natural source (CO6)

Theory: 30 hours  Tutorial: 0 hours  Practical: 30 hours  Project: 0 hours  Total Hours: 60

References:


Signature of BOS chairman, BT

U18INI2600 ENGINEERING CLINIC - II

Course objectives
- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

Course Outcomes
After successful completion of this course, the students should be able to:
CO1: Identify a practical problems and find a solution
CO2: Understand the project management techniques
CO3: Demonstrate their technical report writing and presentation skills

Pre-requisite:
U18INI1600 ENGINEERING CLINICS I

CO/PO Mapping
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Course Assessment methods:

Direct
1. Project reviews
2. Workbook report
3. Demonstration & Viva-voce

Signature of BOS chairman, BT
Content:
The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In this semester, students will focus primarily on Raspberry Pi based controller with python programming

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<tr>
<th>Course</th>
<th>Semester</th>
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<tr>
<td>Engineering Clinic I</td>
<td>1</td>
<td>IOT with C programming using Audino</td>
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<tr>
<td>Engineering Clinic II</td>
<td>2</td>
<td>Raspberry pi based controllers with Python programming</td>
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<td>Engineering Clinic III</td>
<td>3</td>
<td>Design project combining concepts learnt in Engineering clinics I and II</td>
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<td>Engineering Clinic IV</td>
<td>4</td>
<td>Reverse engineering project to improve performance of a product</td>
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<td>Engineering Clinic V</td>
<td>5</td>
<td>Design and developing a prototype</td>
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GUIDELINES:
1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the ‘Engineering Clinics Expo’ at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total Hours: 90
Course Outcomes

After successful completion of this course, the students should be able to

- CO 1: Develop a healthy relationship & harmony with others
- CO 2: Practice respecting every human being
- CO 3: Practice to eradicate negative temperaments
- CO 4: Acquire Respect, Honesty, Empathy, Forgiveness and Equality
- CO 5: Practice Exercises and Meditation to lead a healthy life
- CO 6: Manage the cognitive abilities of an Individual

Pre-requisites:
1. U18VEP1501 / PERSONAL VALUES

CO/PO Mapping
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Course Assessment methods

**Direct**
1. Group Activity / Individual performance and assignment
2. Assessment on Value work sheet / Test

**Indirect**
1. Mini project on values / Goodwill Recognition

Signature of BOS chairman, BT
Values through Practical activities:

1. **Introduction**: Introduction to interpersonal values – Developing harmony with others – Healthy relationship – Need & importance of interpersonal values for dealing with others and team - Effective communication with others.

2. **Maneuvering the temperaments**: From Greed To Contentment - Anger To Tolerance - Miserliness To Charity – Ego To Equality - Vengeance To Forgiveness.


4. **Pathway to Blissful life**:

5. **Therapeutic measures**: Spine strengthening exercises - Nero muscular breathing exercises - Laughing therapy - Mindfulness meditation.

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**Workshop mode**

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**REFERENCES**

1. INTERPERSONAL SKILLS Tutorial (PDF Version) - TutorialsPoint
   www.tutorialspoint.com/interpersonal_skills/interpersonal_skills_tutorial.pdf

2. INTERPERSONAL RELATIONSHIPS AT WORK - KI Open Archive - Karolinska
   www.publications.ki.se/xmlui/bitstream/handle/10616/39545/thesis.pdf?sequence=1

3. VALUES EDUCATION FOR PEACE, HUMAN RIGHTS, DEMOCRACY – UNESCO

4. MANEUVERING OF SIX TEMPERAMENTS - Vethathiri Maharishi
   www.ijhssi.org/papers/v5(5)/F0505034036.pdf

5. THE BLISS OF INNER FIRE: HEART PRACTICE OF THE SIX ... - Wisdom Publications
Course Outcomes
After successful completion of this course, the students should be able to

CO1: Compute measures of central tendencies, dispersions and correlate the variables.

CO2: Understand the concept of probability and its role in engineering.

CO3: Construct probabilistic models for observed phenomena through distributions, which play an important role in many engineering applications.

CO4: Carry out hypothesis testing and interpret the results.

CO5: Understand the principles of design of experiments and perform analysis of variance.

CO6: Sketch control charts and outlines the process control.

Pre-requisites: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation)
S-Strong, M-Medium, W-Weak

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Course Assessment methods

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

STATISTICAL MEASURES
9 +3 Hours
Measures of central tendency: Arithmetic Mean, Median and Mode – Measures of variation: Range, Mean deviation, Standard deviation and Coefficient of variation – Correlation (Discrete Data) – Karl Pearson’s Correlation coefficient – Spearman’s Rank Correlation – Regression lines (Discrete Data).

PROBABILITY AND RANDOM VARIABLES
9+3 Hours
STANDARD DISTRIBUTIONS
Binomial, Poisson and Normal distributions – Moments, Moment Generating functions and properties for the above distributions - Fitting of Binomial and Poisson distributions

9+3 Hours

TESTING OF HYPOTHESIS
Testing of hypothesis for large samples (single mean, difference of means, single proportion, difference of proportions) – Small samples tests based on t and F distributions (single mean, difference of means, paired t- test and variance ratio test) – Chi-square test for independence of attributes and goodness of fit

9+3 Hours

DESIGN OF EXPERIMENTS
Analysis of Variance (ANOVA) – Completely Randomized Design (CRD) – Randomized Block Design (RBD) – Latin Square Design (LSD).

5 +2 Hours

STATISTICAL QUALITY CONTROL
Concept of process control - Control charts for variables – Mean and Range Charts – Control charts for attributes – p, np, c – charts.

4 +1 Hours

Theory: 45   Tutorial: 15   Practical: 0   Project: 0   Total: 60 Hours

REFERENCES
U18BTT3001 BIOORGANIC CHEMISTRY

Course Objectives:
- To gain knowledge on chemical principles governing biochemical reactions
- To learn synthetic strategies and stereochemistry of biomolecules
- To understand the extraction and separation methods for natural products

Course Outcomes (COs):

After successful completion of this course, the students should be able to:

CO1: Recognize role of organic chemistry in biological reactions
CO2: Explain the chemical reactions of coenzymes and metal ions in biocatalysis
CO3: Evaluate the role of metal ions proteins and enzymes
CO4: Describe the chemistry of nucleic acids
CO5: Analyze the synthesis and properties of natural products
CO6: Demonstrate the techniques used to separate natural products

Prerequisites:

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CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

Programme Outcomes (POs)

Signature of BOS chairman, BT
Course Assessment methods:

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<tr>
<td>1. Continuous Assessment Test</td>
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<td>3. End Semester Examination</td>
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Course Content

GENERAL REACTIONS IN BIOORGANIC CHEMISTRY  
9 Hours

Reactions of Fatty acids – Saponification and transesterification, acid number and iodine number of oils; General reactions of amino acid - side chain, carboxyl and amino group, Chemical reactions of amino acids with Ninhydrin, and Sanger’s reagent; Merrifield Peptide Synthesis; Natural β-amino acids and β-peptides; Conformation analysis of ethane, butane and cyclohexane; Fischer and Haworth projections of glucose in hemiacetal formation.

Case study: Chemical modification of cellulose with acyl chlorides

BIOORGANIC CHEMISTRY OF COENZYMES  
9 Hours

Coenzymes in catalysis, Mechanism and role of: pyridoxal phosphate (aminotransferases), NAD/NADP (dehydrogenases); Thiamine pyrophosphate (carboxylases); Enzymes in organic transformations - hydrolysis of amide bond, esters; reduction of aldehydes and ketones using enzymes and whole cells; Cyclodextrins and their applications

Case study: Structure and mechanism of α-chymotrypsin

METAL-LIGAND COMPLEXES IN PROTEINS  
9 Hours

Octet rule; Hund's rule, Aufbau principle, and the Pauli exclusion principle; Transition metal ions and oxidation states; Coordinate bonds in proteins and ligands; Types of ligands; Role of iron in haemoglobin and cytochromes; Copper in hemocyanin; Magnesium in chlorophyll; Cobalt in vitamin B-12 and molybdenum in nitrogenase; Role of important metaloenzymes; Geometrical and optical isomerism in coordination complexes

BIOORGANIC CHEMISTRY OF NUCLEIC ACIDS  
9 Hours

Conformation of sugar-phosphate backbone; Stability of double helix; A, B, and Z double helices; DNA intercalators; Chemical synthesis of DNA and RNA; Catalytic RNA, siRNA; micro RNA; Bioconjugation: Fluorescently-labelled nucleosides and oligonucleotide probes.

Case Study: Aptamers

CHEMISTRY OF NATURAL PRODUCTS  
9 Hours

Extraction of natural products – maceration, reflux extraction, Soxhlet extraction and supercritical fluid extraction; Separation of natural products – silica gel, alumina and molecular imprinted technology; Types, properties and applications of alkaloids - [(drugs - cocaine and quinine) and toxins (nicotine)]; Types, properties and applications of terpenes - volatile oils, and steroids. Isoprene rule; Structure and synthesis of menthol.

Case study: Curcumin – Extraction, structure, properties and applications
REFERENCES


Web references
1  https://nptel.ac.in/downloads/104103018/
2  https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5905184/

U18BTT3102       BIOPROCESS CALCULATIONS       L   T   P   J   C
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Course Objectives:
- To understand and learn about stoichiometry.
- To learn in detail the role of product and yield in bioprocess.
- To recall the thermodynamic preliminaries.

Course Outcomes (COs):
After successful completion of this course, the students should be able to

CO1:    Apply the unit conversion and basic calculations.
CO2:    Solve the material balance without and with involving chemical reactions.
CO3:    Analyze the energy balance involving chemical reactions.
CO4:    Conceptualize energy balance without involving chemical reactions.
CO5:    Elucidate the concept of thermodynamic preliminaries.
CO6:    Elaborate the stoichiometry for growth and product formation

Pre-requisite Course: -

Signature of BOS chairman, BT
CO/PO/PSO Mapping
(S/M/W indicates strength of correlation)  S-Strong, M-Medium, W-Weak

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Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content

CONVERSION AND BASIC CALCULATIONS  9 hours

MATERIAL BALANCE WITHOUT AND WITH INVOLVING CHEMICAL REACTION  9 hours
Material balances without chemical reactions: Material balances involved in distillation, extraction, drying, evaporation, and crystallization - recycle, bypass and purge streams Material balances with chemical reactions: Selectivity, conversion and yield, Limiting and excess reactant.

ENERGY BALANCE WITHOUT AND WITH INVOLVING CHEMICAL REACTION  9 hours

THERMODYNAMIC PRELIMINARIES  9 hours

STOICHIOMETRY OF GROWTH AND PRODUCT FORMATION  9 hours

Signature of BOS chairman, BT
Growth stoichiometry and elemental balances, Respiratory quotient, Degree of reduction, Electron balances, Biomass yield, Product Stoichiometry, Theoretical Oxygen Demand, Unsteady and steady state operation, Material and Energy Balances with Recycle, By-Pass and Purge Streams.

**Theory: 45 hours  Tutorial: 15 hours  Practical: 0 hours  Project: 0 hours  Total Hours: 60**

**References:**


**Web references**

1. https://nptel.ac.in/courses/113104060/4
2. https://nptel.ac.in/courses/103101004/

**Course Objectives:**

• To learn the principles in the metabolism of macromolecules and biological oxidation.

**Course Outcomes (COs):**

After successful completion of this course, the students should be able to

**CO1:** Comprehend and evaluate the nutritional aspects and metabolism of carbohydrates.

**CO2** Analyze and evaluate the dietary importance and metabolism of lipids.

**CO3:** Critically evaluate and analyze the structure and metabolic pathways of amino acids.

**CO4:** Interpret the metabolic disorders of amino acid metabolism and evaluate the functions of proteins

**CO5:** Imbibe the conformation and metabolism of nucleic acids and analyze the metabolic disorders of nucleic acids

**CO6:** Conceptualize the biological oxido-reduction reactions and respiratory chain
Pre-requisite Course: -

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<th>CO/PO Mapping</th>
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**Course Assessment methods:**

- 1. Continuous Assessment Test
- 2. Assignment
- 3. End Semester Examination

**Course Content**

**CARBOHYDRATES**

Nutritional importance and dietary requirements of carbohydrates


**Case Study:** Importance of zinc implementation in diabetes mellitus.

**LIPIDS**

Nutritional importance and dietary requirements of lipids.


**AMINO ACIDS AND PROTEINS**

Nutritional importance and dietary requirements of proteins.


**Case study** – Role of proteins in Alzheimer’s disease

**NUCLEIC ACIDS**

Three dimensional structures of DNA and RNA. Biosynthesis of purines and pyrimidines; Biodegradation of Purines and Pyrimidines. Metabolic disorders of nucleic acid metabolism : Gout

**BIOENERGITICS AND OXIDATIVE PHOSPHORYLATION**

Signature of BOS chairman, BT
Biological oxidation-reduction reactions; redox potentials; High energy phosphate compounds; Mitochondrial respiratory complexes and free radical complex; oxidative phosphorylation.

**List of Experiments:**

1. Estimation of free reducing sugars by 3,5-dinitrosalicylic acid.
2. Estimation of starch by Anthrone method.
4. UV spectrophotometric analysis of proteins.
5. Estimation of glycine by Ninhydrin method.
6. Determination of cholesterol by Zak’s method.
7. Estimation of DNA by diphenylamine method
8. UV spectrophotometry analysis of DNA.
9. Estimation of RNA by orcinol method
10. Antioxidant assay – calculation of ED<sub>50</sub> and LD<sub>50</sub>

**Theory:** 45 hours  **Tutorial:** 0 hours  **Practical:** 30 hours  **Project:** 0 hours  **Total Hours:** 75

**References:**


**Web References:**

1. [http://nptel.ac.in/courses/102105034](http://nptel.ac.in/courses/102105034)
3. [http://nptel.ac.in/courses/122103039/12](http://nptel.ac.in/courses/122103039/12)
Course objectives
- The course helps the student to understand the microbial world and their nutritional requirements for growth and metabolism
- Understand the controlling of microbes using physical and chemical methods
- Understand and evaluate the working principles, procedures of microbiology lab experiments

Course Outcomes (COs)
After successful completion of this course, the students should be able to

CO1: Comprehend knowledge about the taxonomical classifications and fundamentals of Microscopy
CO2: Recognize the fundamental concepts in the structure and functioning of a microbial cell
CO3: Understand concepts of nutritional requirements for microbial growth and pure culture isolation
CO4: Demonstrate the microbial nutritional requirements for growth and metabolism
CO5: Understand the controlling of microbes using physical and chemical methods
CO6: Apply and evaluate the antibiotics and antifungal agents to control the microbial species

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CO/PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

Course Assessment methods

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Signature of BOS chairman, BT
FUNDAMENTALS OF MICROBIOLOGY AND MICROSCOPY 12 Hours
Classification and Nomenclature of microorganisms; Bright field light Microscopy: Compound, Phase Contrast, Fluorescence; Electron microscopy: Transmission and Scanning Electron Microscopy, an outline of specimen preparations for electron microscopy; Microbiological growth media: different types of growth media; Principles of staining methods to differentiate microbes.

MICROBIAL STRUCTURE AND MULTIPLICATION 9 Hours
Microbial morphology: Microbial shapes and Classifications, Structure and Functional anatomy of Prokaryotic and Eukaryotic Cells; Microbial multiplications: Bacteria, viruses and Bacteriophage; algae, protozoa and fungi; Actinomycetes and yeast; Mycoplasma.

MICROBIAL NUTRITION, GROWTH AND METABOLISM 12 Hours
Nutritional requirements; chemical elements as nutrients; different types of microbial medium for culture; Microbial strain improvement and maintenance. Definition of microbial growth; binary fission and cell division; Growth curve in batch culture or closed system; Different methods to quantify microbial growth; Mathematics of microbial growth: Generation time and growth rate constant, factors affecting growth; Microbial metabolism: Entner–Doudoroff pathway, Aerobic and anaerobic respiration.

CONTROL OF MICROORGANISMS AND ANTIMICROBIALS 12 Hours
Physical and chemical control of microorganisms; Sterilization: Heat sterilization (moist heat, autoclave, and dry heat), radiation and filtration; Disinfection: phenol, alcohol, detergents and gases; Antimicrobial Chemotherapy: antibacterial, anti-fungal, anti-viral, Anti parasitic agents; common Mechanism of actions to control microbes; Nosocomial infections, Bacterial resistance to antibiotics.
Case Study- Antibiotic sensitivity assay (Staphylococcus aureus)

LIST OF EXPERIMENTS 30 Hours
1. Handling of Microbiology laboratory equipment (SOP/ Biological Safety/ Microbial Air Monitoring Systems)
2. Preparation of microbial growth media
3. Culture Inoculation: Bacterial & fungal culture
4. Staining methods: Simple, Gram’s, Negative, endospore; Lacto phenol cotton blue staining
5. Pure culture techniques: Serial dilutions, Pour plate, Spread plate and Streak plate.
6. Turbidimetry and Nephelometry (McFarland standards)
7. Enumeration of yeast cells: Direct and Indirect methods (Haemocytometer & Total viable counts).
8. Determination of growth Curve and Kinetics
9. Anaerobic Cultivation: Anaerobic jar methods & fluid thioglycollate medium
10. Antibiotic sensitivity assay : Diffusion assay and (MIC & MBC)

Theory: 45 Tutorial : 0 Practical: 30 Project : 30 Total: 75 Hours

Signature of BOS chairman, BT
REFERENCES


Web References:

U18INI3600 ENGINEERING CLINIC - III

Course objectives
- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

Course Outcomes
After successful completion of this course, the students should be able to:
CO1: Identify a practical problems and find a solution
CO2: Understand the project management techniques
CO3: Demonstrate their technical report writing and presentation skills

Pre-requisite: -

Signature of BOS chairman, BT
CO/PO Mapping
(S/M/W indicates strength of correlation)    S-Strong, M-Medium, W-Weak

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Course Assessment methods:

**Direct**
1. Project reviews
2. Workbook report
3. Demonstration & Viva-voce

Content:
The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In this semester, students will focus primarily on Design project combining concepts learnt in engineering clinics I and II

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<th>Semester</th>
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<td>1</td>
<td>IOT with C programming using Audino</td>
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<td>Engineering Clinic II</td>
<td>2</td>
<td>Raspberry pi based controllers with Python programming</td>
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<td>Engineering Clinic III</td>
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<td>Design project combining concepts learnt in Engineering clinics I and II</td>
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<td>Engineering Clinic IV</td>
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<td>Reverse engineering project to improve performance of a product</td>
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<td>Engineering Clinic V</td>
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<td>Design and developing a prototype</td>
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Signature of BOS chairman, BT
GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the ‘Engineering Clinics Expo’ at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total Hours: 90
Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Develop skills in maintaining the harmony in the family.
CO 2: Create impulsive activities for healthy family
CO 3: Be receptive to troubled individuals
CO 4: Gain healthy life by practicing Kundalini Yoga & Kayakalpa
CO 5: Possess Empathy among family members.
CO 6: Reason the life and its significance

Pre-requisites:
1. U18VEP1501 / PERSONAL VALUES
2. U18VEP2502 / INTERPERSONAL VALUES

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CO/PO Mapping
(S/M/W indicates strength of correlation)
S-Strong, M-Medium, W-Weak

Course Assessment methods

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Signature of BOS chairman, BT
Values through Practical activities:

1. **Family system**: Introduction to Family Values – elements of family values - Adjustment, Tolerance, Sacrifice - Family structure in different society – work life balance.
2. **Peace in Family**: Family members and their responsibility - Roles of parents, children, grand parents -. Respectable women hood
3. **Core value: Empathy**: Unconditional love - Respect - Compassion - sacrifice–Care&share - helping – emotional support- hospitality – cleanliness
5. **Healthy Family**: Good relationship with neighbors - Counseling - Simplified Kundalini Yoga - Kaya Kalpa Yoga

**Workshop mode**

**REFERENCES**

1. FAMILY - [www.download.nos.org/331courseE/L-13%20FAMILY.pdf](http://www.download.nos.org/331courseE/L-13%20FAMILY.pdf)
4. FAMILY VALUES IN A HISTORICAL PERSPECTIVE - The Tanner Lectures on [www.tannerlectures.utah.edu/_documents/a-to-z/s/Stone95.pdf](http://www.tannerlectures.utah.edu/_documents/a-to-z/s/Stone95.pdf)

Signature of BOS chairman, BT
SEMESTER IV
Course outcomes
After successful completion of the course, the student would be able to:

**CO1:** Solve a set of algebraic equations representing steady state models formed in engineering problems

**CO2:** Fit smooth curves for the discrete data connected to each other or to use interpolation methods over these data tables

**CO3:** Find the trend information from discrete data set through numerical differentiation.

**CO4:** Estimate integrals from discrete data through numerical methods.

**CO5:** Predict the system dynamic behaviour through solution of ODEs modeling the system

**CO6:** Solve PDE models representing spatial and temporal variations in physical systems through numerical methods.

Pre-requisite:
Basic knowledge in differentiation, integration and numerical operations.

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**NUMERICAL SOLUTION OF ALGEBRAIC EQUATIONS** 9+3 Hrs

**CURVE FITTING AND INTERPOLATION** 9+3Hrs

Signature of BOS chairman, BT
NUMERICAL DIFFERENTIATION AND INTEGRATION 9+3Hrs
Numerical differentiation by using Newton’s forward, backward and divided differences – Numerical integration by Trapezoidal and Simpson’s 1/3 and 3/8 rules – Numerical double integration.

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9+3Hrs

NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS 9+3Hrs
Finite difference techniques for the solution of two dimensional Laplace’s and Poisson’s equations on rectangular domain – Solution of one dimensional heat equation using Bender Schmidt and Crank Nicholson difference schemes – Solution of one dimensional wave equation by explicit scheme.

Theory: 45 hour  Tutorial: 15 hour  Practical: 0 hour  Project: 0 hour  Total Hour: 60

REFERENCES:
Course Objectives:

- To familiarize the principles and concepts of fluid flow and particle properties for application in bioprocess.

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: Conceptualize fluids properties and its behaviour under static conditions.

CO2: Identify and analyse the significance of pressure drops and boundary layers concepts.

CO3: Elucidate the flow measurements and transportation of fluids.

CO4: Apply the principles of size reduction and equipments.

CO5: Solve importance of mixing and agitation and scale up

CO6: Elaborate the principles of filtration, centrifugal and sedimentation.

Pre-requisite Course:

1. U18BTT3003 Bioprocess Calculations

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Course Assessment methods:

Direct

4. Continuous Assessment Test
5. Assignment
6. End Semester Examination

Course Content

PROPERTIES OF FLUIDS


FLUID DYNAMICS

Flow through pipes: Straight pipe, Annular, Conduits. Pressure drop under laminar and turbulent flow conditions: Continuity equation, Euler’s equation, Bernoulli equation, Hagen-Poiseuille

FLOWMETERY AND TRANSPORTATION

COMMUTATION AND EQUIPMENTS

PARTICLE DYNAMICS
Agitation: Purpose, Flow patterns, Standard design, Dimensional analysis for power correlation, Flow number, Agitator scale-up, Scale up criteria for bioreactors based on oxygen transfer, power consumption and impeller tip speed, Agitation equipments. Filtration: Introduction, Filter media and filter aids, Basic theory of filtration, Filtration equipments. Sedimentation (Thickening and Clarification): Sedimentation test, Sedimentation theory, Thickeners and clarifiers.

Theory: 45 hours  Tutorial: 0 hours  Practical: 0 hours  Project: 0 hours  Total Hours: 45

References:

Web references
1. https://nptel.ac.in/courses/103104043/
2. https://nptel.ac.in/courses/103107127/
Course Objectives:
- To learn the various topologies of protein structures
- To understand the relationship between protein structure and function
- To apply the knowledge on enzymes for their applications

Course Outcomes (COs):
After successful completion of this course, the students should be able to:

CO1: Analyze and demonstrate the secondary, super-secondary, tertiary and quaternary structures of proteins and structure-function relationship

CO2: Apply the knowledge on protein structures in protein engineering and protein prediction

CO3: Compare the enzyme properties and kinetics

CO4: Evaluate the immobilization of enzymes and its effectiveness

CO5: Apply the knowledge on design of enzyme based biosensors and their applications

CO6: Conduct experiments and interpret results on protein structure / enzyme isolation immobilization and their applications

Prerequisites:
U18BTI 3203 Concepts in Biochemistry

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CO/PO/PSO Mapping
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Course Assessment methods:
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content
SUPER SECONDARY, TERTIARY AND QUATERNARY STRUCTURES 9 hours
Primary structure: Insulin; Secondary structures: Alpha (keratin), beta (silk fibroin), loop structures, structure of collagen; Super secondary structures: Helix-turn-helix, hairpin β motif; Ramachandran plot. α-Domain: Four helix bundle; β-domain: Greek key; α / β domains: TIM barrel, Horseshoe fold; Protein folding by chaperones. Quaternary structure: Modular nature, formation of complexes.
PROTEIN STRUCTURE-FUNCTION RELATIONSHIP AND PROTEIN ENGINEERING  9 hours
DNA-binding proteins: helix-turn-helix motif of TRP-repressor & CRO protein in DNA binding; Eukaryotic transcription factors: TATA box-binding proteins, TFIIA and TFIID and Zn-fingers; Membrane Proteins: Photosynthetic reaction center and Bacteriorhodopsin. de novo protein design
Case study: Site directed mutagenesis to increase the thermal stability of T4-lysozyme

ENZYMES AND KINETICS  9 hours
Nomenclature and Classification of enzymes; concept of active site, substrate binding site, allosteric site, and allosteric regulation of enzymes; specificity of enzyme; Kinetics of single substrate reactions: Michaelis & Menten equation, LB Equation; Bisubstrate reactions: single displacement Types of enzyme inhibition – Competitive, non-competitive and un-competitive.

ENZYME PURIFICATION AND IMMobilIZATION  9 hours
Extraction and purification of enzyme from plant, animal and microbial sources; Methods of characterization of enzymes; Development of enzymatic assays; Physical and chemical techniques for enzyme immobilization: adsorption, matrix entrapment, encapsulation, cross-linking and covalent binding. Kinetics of immobilized enzymes.
Case study - Extraction and purification of bromelain enzyme

ENZYME APPLICATIONS  9 hours
Design of enzyme electrodes and their applications as biosensors in industries and health care. Application of enzymes in industries: Food, detergent, leather, wool, brewery, and environment;
Case study - Development of enzyme-based biosensors for environmental applications.

List of Experiments  30 hours
1. Exploring the Protein Data bases for protein structures
2. Conducting DNA mobility shift assay to understand DNA-protein interaction
3. Perform and interpret the results of an enzyme assay: α-Galactosidase / Amylase / Cellulase / laccase
4. Analyzing Enzyme kinetics: Michaelis-Menten parameters
5. Conduct enzyme inhibition studies and interpret the results: Sugars, metal ions and reagents
6. Prepare immobilized enzymes and evaluating their effectiveness: Agar-agar / sodium alginate / chitin
7. Extraction of papain enzyme from papaya leaf and fruit
8. Removal of blood stain from the cloth by papain / removal of starch stain by amylase

Theory: 45 hours  Tutorial: 0 hours  Practical: 30 hours  Project: 0 hours  Total Hours: 75

REFERENCES


Web references
2. https://nptel.ac.in/courses/104105076/7

U18BTI4203 INSTRUMENTAL METHODS OF ANALYSIS

Course Objectives:
- To discuss the basic concepts and applications of fundamental statistical, and extraction methods
- To apply and interpret the data originated from spectroscopy, chromatography and electrophoretic methods
- To know the concept of centrifugal technique, and apply mass spectrometry, x-ray diffraction and NMR techniques

Course Outcomes (COs):
After successful completion of this course, the students should be able to

CO1: Understand and apply the statistical principles to solve biological issues, and apply appropriate extraction methodologies to process biological samples

CO2: Compare, apply and interpret the data of biological solutions acquired from different spectroscopy techniques

CO3: Describe, apply and evaluate the data originated by chromatographic techniques to solve biological problems

CO4: Explain, apply and evaluate the data obtained from different electrophoretic techniques

CO5: Describe and apply mass spectrometry, x-ray diffraction and NMR techniques in the broad field of biotechnology

CO6: Discuss the fundamentals of centrifugation techniques

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Signature of BOS chairman, BT
**Pre-requisite Course:** U18CH2201 Engineering Chemistry

**Course Assessment methods:**

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**Course Content**

**BASICS OF MEASUREMENT AND EXTRACTION METHODS** 9 Hours

Classification of instrumental methods; Fundamentals of accuracy, precision and limits of detection (LOD) and limits of quantification (LOQ); Quality control/ assurance – definition, standard operating procedure, calibration, validation; Introduction and significance of signal to noise ratio (S/N); Solvent extraction – introduction and principle; Factors affecting extraction process; Principle and applications – Temperature assisted and supercritical fluids based extraction.

**SPECTROSCOPY** 9 Hours

Principle, instrumentation and applications - UV-Vis, IR and atomic absorption spectroscopy; Principle, instrumentation and applications - Fluorometry, nephelometry and circular dichroism (CD); Principle and applications of laser light scattering (LLS) technique

**CHROMATOGRAPHY AND ELECTROANALYTICAL METHODS** 9 Hours

Factors affecting the resolution of chromatography; Rate and plate theory; Significance of VanDeemter equation; Principle, technique and applications - Thin layer chromatography, Supercritical fluid chromatography, Gel permeation chromatography, Ion exchange chromatography, High Performance Chromatography (HPLC), High Performance thin layer Chromatography (HPTLC), Ultraperformance liquid chromatography (UPLC) and Gas chromatography (GC); pH electrodes – principle, instrumentation and applications.

**ELECTROPHORESIS** 9 Hours

Electrophoresis – introduction & trouble shooting parameters; Paper, agarose gel, polyacrylamide gel (PAGE), SDS-PAGE, denaturing gradient gel electrophoresis (DGGE) or temperature gradient gel electrophoresis (TGGE), capillary electrophoresis, isoelectric focusing – principle, instrumentation and applications.

**Case study** – PAGE and SDS PAGE

**CENTRIFUGATION AND STRUCTURAL ELUCIDATION METHODS** 9 Hours

Basic principle of sedimentation; Preparative centrifugation – principle and classification; Analytical centrifugation – instrumentation; Mass spectrometry – principle, instrumentation (electron spray ionization [ESI] & chemical ionization [CI]) and applications; x-ray diffraction and nuclear magnetic resonance (NMR) – principle, instrumentation and applications.

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Signature of BOS chairman, BT
LIST OF EXPERIMENTS

1. Temperature assisted extraction of analytes from a sample and estimation of a targeted analyte (spectroscopy method) by construction of calibration curve (standard operating procedure (SOP), simple regression method, Karl Pearson correlation and coefficient of variation (CV))
2. Calculation of ED50 or IC50 of a bioanalyte (Spectroscopy method)
3. Prediction of functional group of a standard bioanalyte using IR spectroscopy and interpretation with unknown sample
4. Analysis of an analyte using fluorimetry method (simple regression method, Karl Pearson correlation and coefficient of variation (CV))
5. Preparation of buffers and determination of pH of an unknown solution
6. Interpretation of Rf value using TLC analysis
7. Interpretation of HPLC and GC peaks (DEMO: model Chromatogram peaks), and structural analysis of bioanalyte fingerprints using MS spectral analysis (DEMO using graphs)

References:


Other references:

1. http://nptel.ac.in/courses.php
2. http://nptel.ac.in/downloads/102103044/
Course Objectives:

To gain conceptual understanding on central dogma of biology.
To acquire in-depth knowledge on prokaryotic and eukaryotic genome organization and evaluate the feasibility of gene expression and molecular biology tools.

Course Outcomes (COs):
After successful completion of this course, the students should be able to

CO1: Critically evaluate and comprehend the fundamental concepts of cell and cell membrane structure and functions.

CO2: Imbibe the concept of membrane transport and signal transduction in cells.

CO3: Critique the concepts of genome organization and replication of prokaryotes and eukaryotes.

CO4: Comprehend the process involved in transcription and translation and interpret the consequences of mutation.

CO5: Apply the concept of gene activity regulation and DNA repair mechanisms in prokaryotes.

CO6: Gain hands-on experience in cell and molecular biology experiments.

Pre-requisite Courses:
1. U18BTI3203 Concepts in Biochemistry

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Course Assessment methods:

Direct

1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content

CELL STRUCTURE AND FUNCTIONS

Introduction to prokaryotic and eukaryotic cells; Intracellular organelles of eukaryotic cells – Structure and functions (Nucleus, Mitochondria and Golgi apparatus); Plasma membrane – structure. Composition of Biomolecules, properties (fluidity and asymmetry) and functions. Cell cycle and Cell Division. Regulation of cell cycle.

Case study - Cancer cell cycle.

MEMBRANE TRANSPORT AND CELL SIGNALING

Membrane transport – passive and active transport, roles of channel proteins, carrier proteins and pumps in membrane transport, bulk transport. Cell signaling - autocrine, endocrine and paracrine models of cell
signaling; signal transduction cascade – role of signaling molecules, receptors, second messengers and protein kinases.

Case study: Quorum sensing and cell-cell communication in bacteria.

NUCLEIC ACIDS AND DNA REPLICAION

Griffith; Hershey and Chase; Avery McLeod & McCarty experiments. ,Cot value; C-value paradox; satellite DNA; Complexity of genes - Pseudogenes, jumping genes, split genes. Prokaryotic replication: Unidirectional and bidirectional replication; Replication in eukaryotic chromosomes; Replication of telomeres in eukaryotes. Inhibitors of replication.

TRANSCRIPTION

Features of promoters and enhancers; Transcription factors; Classes of RNA molecules; Transcription in prokaryotes – initiation, elongation, termination. Transcription in eukaryotes. Post-transcriptional processing – RNA splicing – trans-splicing of mRNA, processing of tRNA and rRNA, capping, polyadenylation. An outline of snRNA

TRANSLATION AND MUTATION

Elucidation of genetic code, Wobble hypothesis, Redundancy, Codon-Anticodon interaction; Polycistronic mRNA. Protein synthesis in prokaryotes and eukaryotes (Initiation, elongation, termination).Inhibitors of translation, Post translational modifications. Introduction to Mutations – Physical, Chemical and Biological mutagens; Reversion.

REGULATION OF GENE ACTIVITY AND REPAIR MECHANISMS

Principles of Regulation. Constitutively expressed genes and Inducible genes. Transcriptional Regulation (Lac Operon, Tryptophan Operon) Attenuation; Autoregulation; Constitutively Expressed Genes.DNA Repair Mechanisms: Photo reactivation; Direct Reversal; Excision Repair; The SOS Response. Case study: DNA integrity scanning proteins in bacteria.

List of Experiments

1. Dose dependant mutation studies using UV irradiation.
2. Chemical carcinogenicity test: Ethidium Bromide intercalation.
3. Analysis of the size of DNA fragments using agarose gel electrophoresis.
4. Isolation of genomic DNA from plant and analyse using agarose gel electrophoresis.
5. Isolation of total RNA from bacteria and analyse of the size of RNA using agarose gel electrophoresis.
7. Analysis of Single and Double stranded DNA using hydroxyapatite column.
8. Visualization of sub-cellular organelles (mitochondria or cell membrane) using fluorescent dyes.

Theory: 45 hours  Tutorial: 0 hours  Practical: 30 hours  Project: 0 hours  Total Hours: 75

References:


Other References:
1. http://leadingstrand.cshl.edu/Course/Keynote/2013/A-MEMBRANE/93
Course objectives

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

Course Outcomes
After successful completion of this course, the students should be able to:

CO1: Identify a practical problems and find a solution
CO2: Understand the project management techniques
CO3: Demonstrate their technical report writing and presentation skills

Pre-requisite:
U18INI3600 ENGINEERING CLINICS III

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Course Assessment methods:

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<td>1. Project reviews</td>
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<td>3. Demonstration &amp; Viva-voce</td>
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Content:
The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the
course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In this semester, students will focus primarily on Design project combining concepts learnt in engineering clinics I and II

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<td>Raspberry pi based controllers with Python programming</td>
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<td>Engineering Clinic III</td>
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<td>Design project combining concepts learnt in Engineering clinics I and II</td>
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<td>Engineering Clinic IV</td>
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<td>Reverse engineering project to improve performance of a product</td>
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<td>Engineering Clinic V</td>
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<td>Design and developing a prototype</td>
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GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the ‘Engineering Clinics Expo’ at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total Hours: 90
Course Outcomes

After successful completion of this course, the students should be able to

Pre-requisites:
1. U18VEP1501 / PERSONAL VALUES
2. U18VEP2502 / INTERPERSONAL VALUES
3. U18VEP3503 / FAMILY VALUES

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CO/PO Mapping
(S/M/W indicates strength of correlation)
S-Strong, M-Medium, W-Weak

Course Assessment methods

Direct
1. Group Activity / Individual performance and assignment
2. Assessment on Value work sheet / Test

Values through Practical activities:

1. Professional skills With Values: Positive Attitude, Adaptability, Responsibility, Honesty and Integrity, Self Esteem, & Self Confidence
2. Building Innovative work cultures: Creative thinking, Critical thinking, Conflict Resolution, Problem Solving, & Decision making

Signature of BOS chairman, BT
3. **Professional Work Ethics:** Types of Ethics, Etiquette, personality Grooming, Emotional quotient, Human Dignity, Safety & Role of Professional in Social Responsibility


5. **Case studies in engineering ethics:** Discussion of case studies relating to Public safety, health, welfare, Quality of product, Improper conduct by management, Product responsibility, Intellectual property

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**Workshop mode**

**REFERENCES**

1. LEARNING TO DO SOURCEBOOK 3 - UNESCO-UNEVOC -PDF
   www.unevoc.unesco.org/fileadmin/user_upload/pubs/LearningToDo.pdf

2. DECLARATION OF PROFESSIONAL VALUES AND ETHICAL STANDARDS

3. KARMA YOGA - SWAMI VIVEKANANDA
   www.vivekananda.net/PDFBooks/KarmaYoga.pdf

4. PROFESSIONAL ETHICS IN ENGINEERING - Sasurie College of Engineering

5. ENGINEERING ETHICS CASE STUDY; Challenger

**U18CHT4000 Environmental Science and Engineering (Common to All branches)**

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**Course Outcomes**

After successful completion of this course, the students would be able to

CO 1: Analyze the impact of engineering solutions in a global and societal context.

CO 2: Discuss contemporary issues that results in environmental degradation and would attempt to provide solutions to overcome those problems.

CO 3: Highlight the importance of ecosystem and biodiversity.

CO 4: Consider issues of environment and sustainable development in his/her personal and professional undertakings.

CO 5: Paraphrase the importance of conservation of resources.

CO 6: Play an important role in transferring a healthy environment for future generations.

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Signature of BOS chairman, BT
CO/PO Mapping  
(S/M/W indicates strength of correlation)  
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**Course Assessment methods**  
**Direct**  
1. Continuous Assessment Test  
2. Assignment  

**INTRODUCTION TO ENVIRONMENTAL STUDIES**  
14 Hours  

**AND NATURAL RESOURCES**  
Definition, scope and importance – Need for public awareness – Forest resources: Use and over-exploitation, deforestation, case studies – Timber extraction, mining, dams and their effects on forests and tribal people.  
Water resources: Use and overutilization of surface and ground water, conflicts over water, dams – benefits and problems – Water conservation, rain water harvesting, watershed management.  
Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.  
Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, case studies.  
Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources, case studies.  
Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification, Wasteland reclamation – Role of an individual in conservation of natural resources.

**ECOSYSTEMS AND BIODIVERSITY**  
9 Hours  

**ECOSYSTEM:** Concept of an ecosystem – Structure and function of an ecosystem: Producers, consumers and decomposers, Food chain, Food web, Energy flow in the ecosystem and Ecological pyramids – Ecological succession – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).  

**BIODIVERSITY:** Introduction to Biodiversity – Definition: genetic, species and ecosystem diversity – Bio geographical classification of India – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic values – India as a mega-diversity nation – Hot-spots of

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ENVIRONMENTAL POLLUTION 8 Hours
Definition – Causes, effects and control measures of: (a) Air pollution – Organic and inorganic pollution – cyclone separator, electrostatic precipitator (b) Water pollution (c) Heavy metal pollution (d) Noise pollution (e) Thermal pollution (f) Nuclear hazards – Role of an individual in prevention of pollution – Pollution case studies – Solid waste and hazardous Management: Causes, effects and control measures from factories, small scale and large scale industries – Waste minimization – Disaster management: floods, earthquake, cyclone and landslides.

SOCIAL ISSUES AND THE ENVIRONMENT 7 Hours

HUMAN POPULATION AND THE ENVIRONMENT 7 Hours

Theory: 45 Hours Total: 45 Hours

REFERENCES
CONSTITUTION OF INDIA
(Mandatory course)

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

CO 1: Gain Knowledge about the Constitutional Law of India
CO 2: Understand the Fundamental Rights and Duties of a citizen
CO 3: Apply the concept of Federal structure of Indian Government
CO 4: Analyze the Amendments and Emergency provisions in the Constitution
CO 5: Develop a holistic approach in their life as a Citizen of India

Pre-requisites: NIL

CO/PO Mapping
(S/M/W indicates strength of correlation)
S-Strong, M-Medium, W-Weak

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Course Assessment methods

Direct
1. Continuous Assessment Test
2. Assignment

THEORY COMPONENT:

Module 1: Introduction to Indian Constitution  4 hours
Meaning of the constitution law and constitutionalism - Historical perspective of the Constitution - Salient features and characteristics of the Constitution of India

Module 2: Fundamental Rights  8 hours

Module 3: Federal Structure  8 hours

Signature of BOS chairman, BT
Federal structure and distribution of legislative and financial powers between the Union and the States - Parliamentary Form of Government in India - The constitutional powers and status of the President of India

**Module.4: Amendment to Constitution** 6 hours
Amendment of the Constitutional Powers and Procedure - The historical perspectives of the constitutional amendments in India

**Module.5: Emergency Provisions** 4 hours
National Emergency, President Rule, Financial Emergency
Local Self Government – Constitutional Scheme in India

**Total** 30 hours

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<th>Theory: 30</th>
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<th>Project: 0</th>
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**REFERENCES**

4. Parliament of India – PDF format
5. The Role of the President of India – By Prof. Balkrishna
SEMESTER V

Signature of BOS chairman, BT
**Course Objectives:**
- To apply types of host-vector systems and steps in creating a recombinant DNA molecule
- To gain knowledge on various recombinant DNA techniques and their applications

**Course Outcomes (COs):**
After successful completion of this course, the students should be able to:

- **CO1:** Comprehend and choose cloning steps for recombinant DNA construction
- **CO2:** Analyse the features of various types of gene cloning vectors and design a suitable vector for recombinant protein expression
- **CO3:** Interpret various types of gene isolation and screening methods
- **CO4:** Apply suitable modern molecular techniques to solve real life problems
- **CO5:** Evaluate regulatory issues of GMOs and their environmental and societal impact
- **CO6:** Analyse and interpret various genome analysis methods

**CO/PO/PSO Mapping**
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**Pre-requisite Course:**
U18BTI4204 Cell and Molecular Biology

**Course Assessment methods:**
- 1. Continuous Assessment Test
- 2. Assignment
- 3. End Semester Examination

**Course Content**

**BASICS OF RECOMBINANT DNA TECHNOLOGY**

DNA manipulating enzymes, construction of recombinant DNA molecules, transformation of r-DNA molecules into target host organisms: Calcium chloride mediated, electroporation, microinjection, gene gun, selection methods for recombinants: antibiotic resistance, reporter assays: blue and white selection, GFP and Luciferase, Cloning vector; properties of a cloning vector: origin of replication, polylinker region, selectable marker genes; Plasmid Vectors: Lambda phage vectors, phagemid, cosmid, yeast vectors, Baculoviral based vector, mammalian expression vectors, plant transformation vector; binary vector,

Case study: TOPO vector- Vector Map

Signature of BOS chairman, BT
GENE CLONING AND APPLICATIONS

Construction and screening of genomic and cDNA libraries, over-expression and purification of recombinant His tag fusion proteins using Ni+ column. Blotting techniques, Polymerase Chain Reaction (PCR); DNA fingerprinting, gene silencing: RNAi and gene knock-out; site directed mutagenesis, genome editing: CRISPR-Cas9 technology, TALEN tool, Modern molecular diagnostic tools; Q –PCR, Spectral karyotype Imaging, MPLA, Application of genetically modified organisms: medicine, agriculture, Biosafety guidelines and release procedure for GMOs in India
Case study: BT cotton -Safety issues

GENOME MAPPING AND SEQUENCING

History and mile stones of human genome project, Genome organization: prokaryote, eukaryote; complexity of genomes; genome mapping: FISH, STS content mapping, Advanced DNA sequencing methods: pyrosequencing, nanopore sequencing, genome sequencing methods: top down approach, bottom- up approach; genome sequence assembly; comparative study on the genome sequencing methods, Differential gene expression analysis; DDRT- PCR, subtractive hybridization, representational display analysis, Serial Analysis of Gene Expression, Microarray: fabrication of cDNA based array, DNA chip; application microarray in gene expression analysis.
Case study: Analysis and interpretation of microarray data

List of Experiments

1. PCR amplification of DNA fragment using gene specific primers
2. Elution of DNA from agarose gel using silica column and calculation of Insert-vector ratio and Ligation of a PCR product in plasmid vector
3. Preparation and Transformation of competent cells (E.coli by heat-Shock/electroporation method)
4. Selection of recombinant clones using blue & white selection.
5. Confirmation of presence of insert in the recombinant clones by colony PCR.
7. Confirmation of recombinant protein using Western blotting.
8. DNA fingerprinting by RAPD analysis.
10. Metagenomic analysis of soil microbes.

Theory:45 Tutorial: 0 hours Practical: 30 Project: 0 hours Total Hours: 75 Hours

References:
5. Sambrook (Joseph) and Russell(David W), (2001), Molecular Cloning :A manual, Cold Spring Harbour Laboratory Press.
Web References
1. http://nptel.ac.in/courses/102103013/

U18BTI5202 BIOPROCESS ENGINEERING  
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Course Objectives: 
- To apply the various chemical engineering principles in production of bioproducts using bioreactor

Course Outcomes (COs):
After successful completion of this course, the students should be able to:

CO1: Apply the knowledge of various optimization methods to design the media for fermentation broth

CO2: Evaluate the sterilization kinetics of media and able to design the holding time for batch sterilization

CO3: Develop a suitable mathematical models for batch, fed-batch and continuous fermentation and able to simulate and evaluate the constants for microbial growth

CO4: Understand and analyse the application of various bioreactors and importance of mass transfer effect in bioprocess engineering

CO5: Apply the various scale-up criteria to design the bioreactors

CO6: Identify and provide the solution for non-ideal performance of bioreactor

Pre-requisite Course:
1. U18BTI3204 Microbiology

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Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content
MEDIA AND ITS OPTIMIZATION METHODS 9 Hours
- Criteria for good medium; Various carbon, nitrogen, minerals, vitamins and other complex nutrients for fermentation industry; Simple and complex media for microbial, plant and animal cells; oxygen requirements;

Signature of BOS chairman, BT

**STERILIZATION KINETICS** 9 Hours
Thermal death kinetics of microorganisms; batch and continuous heat sterilization of liquid media; filter sterilization of liquid media; sterilization of air; design of sterilization equipment for batch and continuous process.

**FERMENTATION KINETICS** 9 Hours
Modes of operation – batch, fed-batch and continuous cultivation, Simple unstructured kinetic models for microbial growth - Monod model; Growth of filamentous organisms and yeast. Product formation kinetics; Leudeking-Piret models, substrate and product inhibition on cell growth and product formation.

**TRANSPORT PHENOMENA IN BIOREACTOR AND TYPES OF BIOREACTOR** 9 Hours
Aeration and agitation in gas-liquid mass transfer, Oxygen transfer rate (OTR), determination of K_a, Factor affecting in OTR in bioreactor, Mass transfer correlation in Oxygen transfer. Types and industrial applications of bioreactors; Stirred-tank reactor and its ancillaries; Bubble-column reactor; Packed-bed reactor; Fluidized-bed; Air-lift reactor; and Photobioreactor.
Case study: algal cultivation

**SCALE-UP OF BIOREACTORS AND NON-IDEAL REACTOR** 9 Hours
Scale-up criteria for bioreactors; Major factors involved in scale-up; Scaling-up of mixing systems: Scale-up of aeration/agitation regimes in stirred tank reactors. Introduction to non-ideal reactors: Residence time distribution (RTD), Reasons for non-ideality in reactors, RTD function and measurement, RTD in plug flow and mixed flow reactor.

**List of Experiments** 30 Hours
1. Medium optimization by Plackett-Burman design/response surface methodology (RSM) using design expert software
2. Batch sterilization design
3. Determination of specific growth rate for production of bacterial cells
4. Estimation of K_a – power correlation / sulfite oxidation / dynamic gassing method
5. Production of microbial metabolites (enzymes / antibiotics) in bioreactor
6. Production of biofertilizers / biopesticides / mushroom
7. Residence Time Distribution (RTD) studies to find non-ideality of a fermenter
8. Introduction to SuperPro Designer – Material and Energy balance
9. Unit Operations, Component Library and registration, Pure and stock mixtures in Super pro
10. Production of monoclonal antibodies in Super pro

**Theory:** 45 hours  **Tutorial:** 0 hours  **Practical:** 30 hours  **Project:** 0 hours  **Total Hours:** 75

**References:**

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Signature of BOS chairman, BT

Web References:
1. http://www.nptel.ac.in/syllabus/syllabus.php?subjectId=10210702

U1BTI5203
HEAT AND MASS TRANSPORT IN BIOPROCESS
L T P J C
3 0 2 0 4

Course Objectives:
- To comprehend and apply the principles and operations of heat transfer
- To understand the fundamentals and applications of mass transfer in bioprocess engineering.

Course Outcomes (COs):
After successful completion of this course, the students should be able to

CO1: Outline the modes of heat transfer
CO2: Design the heat transfer equipment in bioprocess industries
CO3: Illustrate the principles of diffusion and apply the concepts of interphase mass transfer in bioreactor
CO4: Apply the concept of distillation and drying in bioprocess
CO5: Comprehend the extraction separation in bioprocess
CO6: Interpret the membrane separation in bioprocess

Prerequisite
1. U18BTT3002 Bioprocess Calculations

CO/PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

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Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Signature of BOS chairman, BT
Course Content

FUNDAMENTALS OF HEAT TRANSFER 9 hours
Modes of heat transfer; Conduction: Fourier's law, Thermal conductivity of biological materials, Conduction through plane wall, hollow cylinder and hollow sphere; Convection: Individual and overall heat transfer coefficients, Dimensional analysis for free and forced convection.

HEAT TRANSFER EQUIPMENTS 9 hours
Heat Exchangers: Basic calculations, Heat exchanger types, Design heat exchanger for Food and Bioprocess; LMTD and NTU concepts: Industrial evaporators - types, Methods of operation, Single effect evaporator and its enthalpy calculations.

DIFFUSION AND INTERPHASE MASS TRANSFER 9 hours
Modes of mass transfer; Diffusion: Fick’s first law, Molecular diffusion in gases, liquids and solids; Interphase mass transfer: Individual and overall mass transfer coefficients, Theories of mass transfer; Mass transfer in bioreactors: Factors affecting oxygen transfer rate.

DISTILLATION AND DRYING 9 hours
Distillation: Overview of vapour-liquid equilibria, Flash, differential, continuous, steam, azeotropic and extractive distillation, Determination of number of stages by McCabe-Thiele method; Drying – theory; classification of dryers; batch drying – Mechanism and time of cross through circulation drying.

EXTRACTION AND MEMBRANE SEPARATION 9 hours
Extraction and leaching: Ternary liquid-liquid equilibria, choice of solvents, Single and multistage extraction, Co-current and cross - current extraction. Extraction and leaching equipments, Solid and liquid membranes; concept of osmosis; reverse osmosis; electro dialysis; ultrafiltration.

LIST OF EXPERIMENTS 30 hours
1. Heat transfer calculation in double pipe exchanger
2. Heat transfer calculation in shell and tube heat exchanger
3. Studies on simple distillation
4. Studies on steam distillation
5. Convective drying of food/biological materials
6. Mass transfer studies on rotating disc contactor
7. Liquid membrane separation of bioactive compounds

Theory: 45 hours  Tutorial: 0 hours  Practical: 30 hours  Project: 0 hours  Total Hours: 75 hours

REFERENCES

WEB REFERENCES
1. http://nptel.ac.in/courses/103103032
2. http://nptel.ac.in/courses/103103035

Signature of BOS chairman, BT
Course objectives

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and team work
- To create an engaging and challenging environment in the engineering lab

Course Outcomes

After successful completion of this course, the students should be able to:

**CO1:** Identify a practical problems and find a solution

**CO2:** Understand the project management techniques

**CO3:** Demonstrate their technical report writing and presentation skills

Pre-requisite:

U18INI4600 ENGINEERING CLINICS II

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<td>3. Demonstration &amp; Viva-voce</td>
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Content:

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.
In the semester, students will focus primarily on Design project combining concepts learnt in Engineering clinics I and II

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<th>Course</th>
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<td>IOT with C programming using Audino</td>
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<td>Engineering Clinic II</td>
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<td>Raspberry pi based controllers with Python programming</td>
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<td>Engineering Clinic III</td>
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<td>Design project combining concepts learnt in Engineering clinics I and II</td>
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<td>Engineering Clinic IV</td>
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<td>Reverse engineering project to improve performance of a product</td>
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<td>Engineering Clinic V</td>
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<td>Design and developing a prototype</td>
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GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the ‘Engineering Clinics Expo’ at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total Hours: 90

Signature of BOS chairman, BT
U18VEP5505 SOCIAL VALUES
(Mandatory)

Course Outcomes

After successful completion of this course, the students should be able to

CO 1: Understand the transformation from self to society
CO 2: Acquire knowledge about disparity among Human Beings
CO 3: Realize the new ethics in creating a more sustainable Society
CO 4: Develop skills to manage challenges in social issues
CO 5: Acquire the skills for Management of Social work & Holistic Society
CO 6: Validate the social liabilities at dissimilar situations

Pre-requisites:
1. U18VEP1501 / PERSONAL VALUES
2. U18VEP2502 / INTERPERSONAL VALUES
3. U18VEP3503 / FAMILY VALUES
4. U18VEP4504 / PROFESSIONAL VALUES

CO/PO Mapping
(S/M/W indicates strength of correlation)
S-Strong, M-Medium, W-Weak

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Course Assessment methods

Direct
1. Group Activity / Individual performance and assignment
2. Assessment on Value work sheet / Test

Indirect
1. Mini project on values / Goodwill Recognition

Signature of BOS chairman, BT
Values through Practical activities:

1. **Self and Society**: Relation between self and society – Different forms of society - Elements of Social structures – Realization of Duties and Responsibilities of Individual in the Society


**REFERENCES**

1. SOCIAL PROBLEMS IN INDIA - ForumIAS.com – PDF
discuss.forumias.com/uploads/File upload/.../711b18f321d406be9c79980b179932.pdf...

2. INVESTING IN CULTURAL DIVERSITY AND INTERCULTURAL DIALOGUE: UNESCO ...

3. INDIAN SOCIETY AND SOCIAL CHANGE - University of Calicut
www.universityofcalicut.info/SDE/BA_sociology_indian_society.pdf

4. CULTURE, SOCIETY AND THE MEDIA - E-class
www.eclass.uoa.gr/.../MEDIA164/.../%5BTony_Bennett,_James_Curran,_Michael_G

5. SOCIAL WELFARE ADMINISTRATION - IGNOU
www.ignou.ac.in/upload/Bswe-003%20Block-2-UNIT-6-small%20size.pdf

Signature of BOS chairman, BT
SEMESTER VI
**Course Objective**
- To understand the importance of regulatory affairs in drug control, standards and drug manufacture process.

**Course Outcomes**
After successful completion of this course, the students should be able to

**CO1**: Outline National, International drug Standards, Control and Pharmacopoeia commission

**CO2**: Describe the principles of drug action and mechanism of action

**CO3**: Discuss and obtain knowledge on the drug development, manufacture process and Regulatory practices

**CO4**: Understand the importance of biopharmaceutical final products production using upstream downstream process and ensure the quality of the product analysis

**CO5**: Explain the principles and materials involved during the drug manufacture in pharmaceutical industries

**CO6**: Discuss the clinical uses of biopharmaceutical therapeutics

**Pre-requisites**: Nil

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### CO/PO Mapping

(S/M/W indicates strength of correlation)

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**Course Assessment methods**

**Direct**

1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

**DRUG CONTROL AND STANDARDS**

8 Hours

Drug standards, regulation and control organizations: National agencies (Central Drug Standards and Control Organization (CDSCO); Indian Pharmacopoeia commission (IPC); Drugs Controller General of India (DCGI) and Indian Council for Medical Research (ICMR). International agencies (WHO guidelines on medicines policy; Food and Drug Administration (FDA); New Drug Application (NDA); Medicines and Healthcare products Regulatory Agency (MHRA).
PHARMACOKINETICS AND PRINCIPLES OF DRUG ACTION 7Hours
Route of drug administration: Enteral and parenteral; Pharmacokinetics: Drug Absorption, Distribution, Metabolism and Elimination (ADME); factors influencing ADME process; Pharmacodynamics: basic principles of drug action, Mechanism of drug action through enzymes, drug receptor interactions; radiopharmaceutical

DRUG DEVELOPMENT AND MANUFACTURE PROCESS 7Hours
New Drug development: Drug discovery, patenting, preclinical and clinical trials, and regulatory authorities; Manufacturing process: special manufacturing facilities, sources of biopharmaceuticals, production of final product and analysis of the final products

REGULATORY PRACTICES 7Hours
Good manufacturing practices (GMP); Good clinical practices (GCP); Good laboratory practices (GLP); The Drugs & Cosmetics Act, 1940; Schedule M & Y; Applications monitoring quality control; types of validation

PRINCIPLES OF DRUG MANUFACTURE IN PHARMACEUTICALS 9Hours
Dosage form design: Need for dosage forms, General considerations in Dosage form design; Solid dosage forms: powders, granules, capsules and tablets; Semisolid dosage forms: ointments, creams and gels; transdermal drug delivery system; Pharmaceutical inserts: suppositories and inserts; Liquid dosage forms: solutions; Sterile dosage forms: parenteral (injections), Biologics (vaccine).

BIOPHARMACEUTICAL THERAPEUTICS AND CLINICAL USES 7Hours
Various categories of therapeutics production and uses: Cytokines: interferons, interleukins, tumour necrosis factor. Haemotopoietic growth factors; Colony stimulating factor (granulocyte, macrophage), erythropoietin; Hormones: insulin, glucagons.

REFERENCES

OTHER REFERENCES:
Course Objectives:
- To elucidate the general requirements and fundamentals of plant and mammalian cell culture.
- To understand the different cell culture techniques in both plant and animal cell culture and its applications

Course Outcomes (COs):
After successful completion of this course, the students should be able to

CO1: Outline and design model laboratory layout for setting up a plant tissue culture and animal cell culture lab.

CO2: Compare and illustrate plant and mammalian cell culture techniques and media for culturing of plant and mammalian cells.

CO3: Elaborate and compare various plant tissue culture techniques.

CO4: Significant applications of tissue culture techniques in generating transgenic plants.

CO5: Explain and illustrate techniques for development of primary and established cell culture and measurement of cell viability.

CO6: Illustrate the plant and mammalian cell techniques for economic importance

Prerequisite
U18BTI3204 Microbiology
U18BTI5201 Genetic engineering and genomics

CO/PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

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Course Assessment methods:
- Direct
  1. Continuous Assessment Test
  2. Assignment
  3. End Semester Examination

Course Content
GENERAL REQUIREMENTS FOR CELL CULTURE 9 hours
Basic operations and general equipment’s and facility for mammalian and plant tissue culture lab; Maintenance of Aseptic Laboratory; Precautions to maintain aseptic conditions; Biosafety cabinet, inverted microscope, biosafety level in plant and animal cell culture lab.

Signature of BOS chairman, BT
BASICS OF PLANT AND MAMMALIAN CELL CULTURE 9 hours
Media requirement and stock solution preparation; Callus induction and differentiation; primary and secondary hardening; Importance and progress in animal cell culture; Importance of serum and serum free media; mycoplasma detection and control; Passage procedures; Doubling and generation time; cryopreservation of mammalian cell line and characterization.

PLANT TISSUE CULTURE TECHNIQUES 9 hours
Types of culture techniques: callus, root tip, shoot tip, anther culture, pollen culture; endosperm culture etc., Callus induction and differentiation; primary and secondary hardening; Protoplast culture and protoplast fusion and cell viability test
Case study - Commercialization of banana tissue culture /Micro propagation of tissue culture plants

MAMMALIAN CELL CULTURE TECHNIQUES 9 hours
Primary culture and established cell lines; cell strain, continuous cell line- finite and infinite cell line, commonly used cell lines; Maintenance of cell culture; Measurement of viability and cytotoxicity; Monolayer culture, Anchorage dependent and independent cultures; suspension cell cultures; Cell culture reactors: scaling up
Case study – Development of monoclonal antibodies

APPLICATION OF PLANT AND MAMMALIAN CELL CULTURE 9 hours
Gene transfer methods in plants; Transgenic plants with beneficial traits: herbicide, drought, virus resistance; Transgenic plants as bioreactors- Concept of Molecular farming and pharming.
Gene transfer methods in mammalian cells; Transgenic animal for production of recombinant proteins - vaccines, diagnostic antigens and other pharmaceutical agents (insulin, growth factors); Transfection Technology.

Theory: 45 hours Tutorial: 0 hours Practical:0 hours Project: 0 hours Total Hours: 60 hours

REFERENCES

WEB REFERENCES
1. http://nptel.ac.in/courses/102103012/34
2. http://nptel.ac.in/courses/102103016/4

Signature of BOS chairman, BT
U18BTI6203 IMMUNOLOGY  
L T P J C  
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Course Objectives:
- To gain an in-sight into the cells and effectors of immune system and mechanisms of immunity.
- To learn the concept of antigen-antibody interactions and demonstrate the techniques for their evaluation.

Course Outcomes (COs):
After successful completion of this course, the students should be able to

CO1: Comprehend the general concepts of immune system and elaborate the cells and organs of the immune system.

CO2: Analyze and evaluate the properties of antigens and antibodies with special emphasis on haptens.

CO3: Demonstrate and evaluate various antigen-antibody interactions and techniques.

CO4: Apply the concept of cell mediated immunity and complement system.

CO5: Illustrate the mechanisms behind hypersensitivity and autoimmunity mechanisms.

CO6: Imbibe the concept of transplantation and cancer immunology

Pre-requisite Course:
1. U18BTI3203 Concepts in Biochemistry

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Course Assessment methods:

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1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content

CELLS AND ORGANS OF IMMUNE SYSTEM  
6 hours
General concepts of the immune system. Innate and adaptive immunity. Hematopoeisis. Structure, properties and functions of the immune cells and organs: T and B-lymphocytes, NK cells; Monocytes and macrophages; Neutrophils, eosinophils, and basophils Mast cells and dendritic cells. Thymus and bone marrow; Lymph nodes, spleen, MALT, GALT and CALT.

Signature of BOS chairman, BT
ANTIGENS AND ANTIBODIES 6 hours
Antigens and haptens; Properties; B and T cell epitopes. T-dependent and T-independent antigens. Adjuvants. Antibodies: Classification, Structure, function and properties of the antibodies; Antibody as B cell receptor, antigenic determinants on antibodies (isotype, allotype and idiotype).

TECHNIQUES ON ANTIGEN-ANTIBODY INTERACTIONS 9 hours
Immunological principles of various reactions and techniques: Affinity and avidity, cross reactivity, precipitation, agglutination, immunodiffusion, immunoelectrophoresis, ELISA – types and applications, Western Blotting. Hybridoma technology-Monoclonal antibodies production and applications.
Case study: AIDS diagnosis by monoclonal antibodies.

CELL MEDIATED IMMUNITY & COMPLEMENT 12 hours

HYPERSENSITIVITY, AUTOIMMUNITY & TRANSPLANTATION IMMUNOLOGY 12 hours
Transplantation immunology: Types of grafts, immunologic basis of graft rejection, properties and types of rejection, tissue typing, immunosuppressive therapy. Cancer Immunology: types of tumors, tumor antigens (TSTA and TATA), immune response to tumors.
Case study: Immunotherapy of breast cancer.

LIST OF EXPERIEMENTS 30 hours
1. Blood smear preparation and identification of leucocytes by Giemsa stain
2. Separation of Peripheral Blood Mononuclear cells (PBMC) and analysis of cell viability by Tryphan blue staining
3. Separation of leucocytes by dextran method
4. IgE estimation by myeloperoxidase assay
5. Cytokine assay by ELISA
   Assays for Antigen/antibody interactions
10. Determination of antigen/antibody concentration by ELISA

Theory: 45 hours Tutorial: 0 hours Practical: 30 hours Project: 0 hours Total Hours: 75

References:

Signature of BOS chairman, BT

**Web References:**
1. [http://www.raymondcheong.com/Year1/immuno.html](http://www.raymondcheong.com/Year1/immuno.html)

**U18BTI6204 BIOLOGICAL DATA ANALYSIS**

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**Course Objectives:**
- To introduce the concept of massive data mining from biological experiments.
- To identify basic experimental design principles in solving biological questions.
- To develop and test hypothesis statistically using data using R – programming.

**Course Outcomes (COs):**
After successful completion of this course, the students should be able to

**CO1:** Understand and apply the biological annotation for macromolecules; apply and interpret the structural analysis of macromolecules using high throughput experiment.

**CO2:** Apply and interpret the biological data through fundamental statistical analysis.

**CO3:** Apply and interpret biological data related with hypothesis testing.

**CO4:** Explore and infer biological data using visualization.

**CO5:** Understand and apply R-programming for biological data analysis.

**CO6:** Provide optimal solution and statistics to biological problems

**Pre-requisite**
1. U18BTI3203 Concepts of Biochemistry
2. U18MAT3103 Probability & Biostatistics

**CO/PO Mapping**

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**Course Assessment methods:**

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Signature of BOS chairman, BT
Course Content

**BIOINFORMATICS: MINING THE MASSIVE DATA FROM HIGH THROUGHPUT GENOMICS EXPERIMENTS**  
6 hours

Introduction – Sequence alignment, Genome sequencing - Nanopore and illumina sequencing, gene annotation, RNA folding - RNAhybrid, protein structure prediction - Secondary structure information; Microarray analysis, proteomics, Protein-Protein Interaction

**INTRODUCTION TO BIOSTATISTICAL ANALYSIS**  
6 hours

Statistical methods in the context of biological research – Data exploration and Analysis - Arithmetic mean, standard deviation, coefficient of variation, standard error of mean, correlation analysis; regression analysis [Problems alone should be solved]

**HYPOTHESIS TESTING**  
6 hours

Introduction to general concepts; characteristics - Type I and II error; Student's t-test, chi-square test, One Way ANOVA (Kruskal–Wallis H test), Mann–Whitney U test; Wilcoxon signed-rank test

**DATA EXPLORATION**  
6 hours

Data visualization and summary statistics – variable types, Exploring categorical variable – Relative frequency and percentage, Bar graph, Pie chart; Exploring numerical variables – Histogram, Mean and median, Variance and Standard deviation, quantiles, Box plots; Data Preprocessing – Outliers, data transformation

**BIOLOGICAL DATA ANALYSIS USING R PROGRAMMING**  
6 hours

Overview – Variable, Data types, Operators, Useful Function, Data frames, Working with images and strings, Library functions.

**List of Experiments**  
15 hours

1. Introduction to R installation, package management and basic operators
2. Bioconductor tools – Introduction & usage
3. Biological sequences and sequence analysis
4. Basic plot and customized plot using ggplot2
5. R for large biological datasets
6. Descriptive statistics and One-way ANOVA
7. Image analysis using EBImage
8. Case Study: Microarray data analysis using Bioconductor package [Demo only]

**Theory: 30 hour** **Tutorial: 0 hour** **Practical: 30 hour** **Project: 0 hour** **Total: 60 hours**

**REFERENCES**


**Web References:**

2. [https://onlinecourses.science.psu.edu/statprogram/r](https://onlinecourses.science.psu.edu/statprogram/r)
Course Objectives:
- To gain hands-on training on the methods of sterilization and media preparation for cell culture learn about the techniques in the establishment of primary culture.
- To develop skills in working with cell lines and cell viability and DNA fragmentation assay.

Course Outcomes
After successful completion of this course, the students should be able to:

CO1: Prepare stock solutions and media for plant tissue

CO2: Preparation of explants from the various plant parts

CO3: Induction of callus and regeneration of plants

CO4: Develop skills for sterilization and preparation of culture media for mammalian cell culture

CO5: Perform the establishment of primary culture from chick embryo and demonstrate the cell counting and determine cell viability

CO6: Attain skills in working with cell lines and maintain monolayer cultures and learn to freeze the viable cells by cryopreservation.

Course Assessment methods
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CO/PO MAPPING
(S/M/W indicates strength of correlation)
S-Strong, M-Medium, W-Weak

Course Assessment Method

1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Signature of BOS chairman, BT
LIST OF EXPERIEMENTS
1. Media and Stock solution preparation and sterilization
2. Selection of explants and Induction of callus
3. Suspension culture and production of secondary metabolites
4. Micro propagation of commercial plant for economic importance (Potato / Banana / Bamboo / Jatropha etc.)
5. Establishment of primary culture from leaves and stem explants
6. Establishment of organogenesis from leaves and stem explants
7. Sterilization techniques, media and stock solution and sera preparation
8. Establishment of primary culture using chick embryo
9. Establishment of cell lines by using primary and / or secondary cell culture
10. Staining, Cell counting and viability (Trypfan Blue assay)
11. Preservation of cell line- Cryopreservation
12. DNA fragmentation assay – (Demo only)
13. Field visit : - Animal handling and care

Theory: 0  Tutorial: 0  Practical: 30  Project: 0  Total: 30 Hours

REFERENCES
SEMESTER - VII
Course Outcomes (COs):

After successful completion of the course, the students should be able to

CO1: Evaluate the economic theories, cost concepts and pricing policies
CO2: Analyze the market structures and integration concepts
CO3: Apply the concepts of national income and understand the functions of banks and concepts of globalization
CO4: Apply the concepts of financial management for project appraisal and working capital management
CO5: Understand accounting systems
CO6: Analyze financial statements using ratio analysis

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Course Assessment Methods

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Course Content

1. ECONOMICS, COST & PRICING CONCEPTS 9 hours


2. CONCEPTS ON FIRMS & MANUFACTURING PRACTICES 9 hours


3. NATIONAL INCOME, MONEY & BANKING, ECONOMIC ENVIRONMENT 9 hours


4. CONCEPTS OF FINANCIAL MANAGEMENT 9 hours


Signature of BOS Chairman
5. **ACCOUNTING SYSTEM, STATEMENT & FINANCIAL ANALYSIS**  
9 hours


Theory: 45 hours   Tutorial: 0 hours   Practical: 0 hours   Project: 0 hours   Total hours: 45

**Textbooks:**


**References:**


***
Course Objectives:
- Understand key areas of drug development: preclinical and clinical research regulations
- Understand the basic concepts of trial management, clinical data analysis and reporting

Course Outcomes (COs):

After successful completion of the course, the students should be able to

CO1: Understand the regulatory aspects and ethical considerations involving human subjects.
CO2: Understand the timelines and resources required to discover and develop new drugs in a preclinical setting.
CO3: Demonstrate an understanding of the critical features of each stage of the preclinical drug development process.
CO4: Classify different types of trial designs.
CO5: Apply and demonstrate critical analysis of clinical data using statistical analysis tools.
CO6: Identify quality parameters of clinical research report.

Pre-requisite:
1. U18BTI6204 Biological Data Analysis
2. U18BTT6001 Biopharmaceutical Technology

CO/ PO Mapping

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Course Content

45 hours

1. REGULATORY BODIES AND ETHICAL GUIDELINES

Regulatory bodies: National and International perspective, Drug and in vitro diagnostic device regulatory submissions, approvals and registrations, Ethical guidelines in Clinical Research: Nuremberg code, Declaration of Helsinki, Belmont report; International Conference on Harmonization, Drug and cosmetic act; Schedule Y, ICMR Guidelines: National Ethical Guidelines for Biomedical and Health Research Involving Human Participants

2. DRUG DISCOVERY AND PRECLINICAL RESEARCH

Drug development phases, Preclinical drug development, Types of Pre-clinical trials, safety studies, dose response information to support drug registration, Guidelines for animal studies, carcinogenicity studies, chronic toxicity testing in animals, Importance of CYP Metabolism studies, Pharmacodynamics (PD): Toxicity LD50 and ED50.
3. CLINICAL RESEARCH 9 hours

Scope of Clinical Research, Good Clinical Practices (GCP), History of clinical research, Belmont report, Thalidomide disaster, Types of clinical trials, Special Clinical Trials, Medical Devices Trials, Investigator Brochure, Informed Consent Form, Sponsor Monitor and Investigator responsibility, SOP in Clinical Trials, Clinical Trial Monitoring, Role of CRA, QA and QC in Clinical Trials, CRF Design, Study management: Monitoring process, Coordinating protocol implementation

4. CLINICAL RESEARCH STUDY DESIGNS 9 hours

Overview of study design, Types of studies: Experimental, uncontrolled, RCTs, other designs – equivalence, non-inferiority, observational, retrospective, sample size, bias and confounding, Experimental Design – Randomized Clinical Trials: parallel-group design, stratified parallel group design, parallel group randomized block design, complete cross-over design, simultaneous treatments design, factorial design. Types of randomization: simple, blocked, stratified and Adaptive, Blindness:– unblinded, Single Blind, Double-blind and Triple blind trials. Case Study: Clinical Trial Study Design

5. CLINICAL DATA ANALYSIS AND REPORT 9 hours

Types of data and normal distribution, significance tests and confidence intervals, comparison of means, comparison of proportions, analysis of survival data, subgroup analysis, regression analysis, Good Clinical Data Management Practices, Data Management Plan, CRF designing. Serious adverse event data reconciliation, Database closure, Design and analysis of surveys, CDISC standards, Dataset preparation for analysis, Overview of reporting, Internal and external reporting.

Theory: 45 hours  Tutorial: 0 hours  Practical: 0 hours  Project: 0 hours  Total hours: 45

Textbooks:

Web-References:
3. https://onlinecourses.science.psu.edu/stat509/node/6/
U18BTI7203 BIOINFORMATICS L T P PJ C
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Course Objectives:
- Introduce the student to biological data resources, algorithms and alignment tools
- Apply various algorithms and computational tools for protein structure and stability analysis.

Course Outcomes (COs):

After successful completion of the course, the students should be able to

- **CO1**: To introduce the concept of biological sequence alignment and various genome sequence protocols.
- **CO2**: To familiarize with various biological database searches, parameters and algorithm.
- **CO3**: To apply, interpret and analyze multiple sequence alignments.
- **CO4**: To construct, interpret and access molecular phylogenetic tree prediction.
- **CO5**: To apply, interpret and analyze protein structures prediction algorithms.
- **CO6**: To introduce the concept of computer-aided drug designing (CADD).

Pre-requisite:
1. U18BTI3203 Concepts in Biochemistry
2. U18BTI4202 Protein and Enzyme Technology
3. U18BTI4204 Cell and Molecular Biology

**Course Assessment Methods**

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**Course Content**

**60 hours**

1. **INTRODUCTION TO BIOINFORMATICS**
   - 9 hours
   - Introduction to Bioinformatics; Biological Sequences – Formats; Databases – types, architecture of Biological Databases; Sequence Identify and Similarity, Edit distance – Levenstein and Hamming Distance. Dot plot analysis.

2. **SEQUENCE ALIGNMENT**
   - 12 hours
   - Sequence alignment – Pairwise alignment; Gaps – Constant, Linear, Affine, Convex and Profile-based gaps; Dynamic Programming algorithm – Needleman and Wunch Algorithm, Smith-Waterman Algorithm; Scoring Matrices – PAM and BLOSSUM; BLAST. Limits of detection & significance. Advanced BLAST: PSI-BLAST & PHI-BLAST. Introduction to Next Generation Sequencing techniques and applications.
   - Case Study: NGS-based sequencing for infectious diseases.

**Signature of BOS Chairman**
3. **MULTIPLE SEQUENCE ALIGNMENT** 7 hours

Multiple Alignment Methods – Block-based methods for multiple-sequence alignment, Algorithm of multiple sequence alignments: Sums of pairs method (SP), CLUSTAL W, PILEUP; Overview of iterative MSA methods; Construction of Position-Specific Scoring Matrices (PSSM).

4. **PHYLOGENETICS** 7 hours

Molecular Phylogenetics – Newick Format, Methods for tree construction – Unweighted pair group method of arithmetic mean (UPGMA), Fitch-Margoliash algorithm (FM), Neighbor-Joining method (NJ); Character based methods: Maximum parsimony, maximum likelihood, Tree Reconstruction and evaluation - Bootstrapping technique.

Case Study: Computational exploration of coevolution.

5. **APPLICATIONS IN BIOINFORMATICS** 12 hours


Introduction to Drug Discovery Process, Target Identification and Validation, Virtual Screening of lead compounds, Docking – Principles, Rigid and Flexible docking.

Case study: Drug discovery approaches targeting a metabolic pathway.

**List of Experiments:**

1. Basics of Unix Commands & Scripting
2. Biological Sequence Retrieval
3. Molecular Visualization using Pymol
4. Sequence Homology using BLAST
5. Multiple Sequence Alignment
6. Phylogenetic Analysis
7. NGS Data Analysis of SNP Identification
8. Molecular Modelling of Protein structure and Loop refinement
9. Molecular Docking

**Textbooks:**


**Web-References:**

1. [https://nptel.ac.in/courses/102106065/](https://nptel.ac.in/courses/102106065/)

***
Course Objectives:
- To provide an insight about the chemical engineering concepts for bio-product recovery from biological sources.

Course Outcomes (COs):
After successful completion of the course, the students should be able to

CO1: Apply the various unit operation principles and engineering fundamentals to design the separation processes specific to biologically derived products.

CO2: Analyze and design the various solid-liquid unit operations and different cell-disruption techniques used in downstream processing.

CO3: Apply and analyze the various principles underlying the different unit operations used for the isolation and extraction of bio-products.

CO4: Select and design the various methods of chromatography used in protein purification.

CO5: Apply the different unit operations for polishing and packing the final bioproducts.

CO6: Evaluate the techno-economical analysis for purification of bioproducts.

Pre-requisite:
1. U18BTI5202 Bioprocess Engineering

Course Content 60 hours

1. INTRODUCTION TO DOWNSTREAM PROCESSING AND PRIMARY SEPARATION 9 hours
   Downstream processing principles, classification and characteristics of biomolecules; cell disruption methods for intracellular products release: mechanical methods, chemical, physical and enzymatic methods; unit operations for solid-liquid separation-filtration, types of equipment, batch-continuous, pretreatment methods and centrifugation, scale-up of centrifugation, centrifugal filtration.

2. ISOLATION OF PRODUCTS 9 hours
   Adsorption, Extractive separation: Solvent extraction, Aqueous Two Phase Extractions, Reverse Micelle Extraction, Super Critical Extraction. Precipitation methods: Salts; Organic solvents and Polymers. Membrane Based Separation: Ultrafiltration; Microfiltration; Nanofiltration; Reverse Osmosis; Dialysis and Electrodialysis.

3. PURIFICATION OF PRODUCTS 9 hours
   Size exclusion Chromatography, Ion exchange chromatography, Reverse-phase chromatography, hydrophobic interaction chromatography (HIC), Affinity chromatography, HPLC, FPLC and GC – Operations & application.
4. **POLISHING OF PRODUCTS**  
9 hours

Crystallization: Methods of super saturation, types of nucleation and crystal growth, Material and energy balance, yield of crystal, Types of crystallization and equipment’s. Drying: types of moistures, batch drying process, mechanism of drying, drying time calculation, drying equipment’s; Freeze-drying and Spray drying.

5. **TECHNO-ECONOMICAL ANALYSIS FOR BIOPRODUCT PRODUCTION**  
9 hours

Techno-economical analysis of bioproducts, Illustrative Example of Citric Acid Production, Human Insulin Production. Case studies: Therapeutic Monoclonal Antibody Production.

**List of Experiments:**

1. Disruption of cell walls and estimation of intracellular proteins using cell disruption techniques
2. Concentration of yeast cells using Micro filtration
3. Isolation of proteins using precipitation techniques
4. Recovery of proteins using aqueous two phase extraction
5. Chromatography column packing
6. Purification of enzyme using ion exchange chromatography
7. Purification of enzyme using size exclusion chromatography
8. Purification of enzyme using affinity chromatography
9. Purification of high value product using Fast Protein Liquid Chromatography (FPLC)
10. Freeze-Drying
11. Simulation of production and purification of bioproducts using Superpro software (demo)

Theory: 45 hours  Tutorial: 0 hours  Practical: 30 hours  Project: 0 hours  Total hours: 60

**Textbooks:**

7. BIOTOL series-(1995). Product recovery in Bioprocess Technology VCH publications,

**Web-References:**

1. [http://nptel.ac.in/courses/102106022/](http://nptel.ac.in/courses/102106022/)

***

Signature of BOS Chairman
Course Objectives:

- To develop skills to identify and find solutions to various problems using biotechnology.

Course Outcomes (COs):

After successful completion of the course, the students should be able to

CO1: Ability to survey literature relevant to the topic under consideration.
CO2: Design a research problem using sound scientific principles.
CO3: Conduct experiments with suitable controls and safety considerations.
CO4: Perform statistical operations and analyze results.
CO5: Interpret results and derive new information.
CO6: Present and communicate results to a scientific audience.

Pre-requisite:

1. All core theory and lab courses

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CO/ PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

Course Content

30 hours

Student in discussion with the guide chooses to design and carry out a novel research problem

Theory: 0 hours Tutorial: 0 hours Practical: 0 hours Project: 60 hours Total hours: 30

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Signature of BOS Chairman
Course Outcomes (COs):

After successful completion of the course, the students should be able to

**CO1**: Aware of the concept of Universal Brotherhood and support the organizations which are working for it.

**CO2**: Follow the path of Ahimsa in every aspect of their life.

**CO3**: Uphold the Universal declaration of Human Rights.

**CO4**: Understand the unequal distribution of wealth in the World and bestow their effort towards inclusive growth.

**CO5**: Sensitize the environmental degradation and work for the sustainable development.

**CO6**: Amalgamate harmony through Non-violence and edify the nation headed for upholding development.

Pre-requisite:

1. U18VEP1501 Personal Values
2. U18VEP2502 Interpersonal Values
3. U18VEP3503 Family Values
4. U18VEP4504 Professional Values
5. U18VEP5505 Social Values
6. U18VEP6506 National Values

Course Assessment Methods

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Course Content

1. **Universal Brotherhood**

   Meaning of Universal Brotherhood - Functioning of various organization for Universal human beings - Red Cross, UN Office for Humanitarian Affairs - Case study on humanitarian problems and intervention - Active role of Students/Individual on Universal Brotherhood.

2. **Global Peace, Harmony and Unity**

   Functions of UNO - Principal Organizations - Special organization - Case study relating to disturbance of world peace and role of UNO - Participatory role of Students/Individual in attaining the Global peace and Unity.

Signature of BOS Chairman
3. **Non-Violence**

   Philosophy of nonviolence- Nonviolence practiced by Mahatma Gandhi – Global recognition for nonviolence - Forms of nonviolence - Case study on the success story of nonviolence- Practicing nonviolence in everyday life.

4. **Humanity and Justice**


5. **Inclusive growth and sustainable development**

   Goals to transform our World: No Poverty - Good Health - Education – Equality - Economic Growth - Reduced Inequality –Protection of environment – Case study on inequality and environmental degradation and remedial measures.

**WORKSHOP MODE**

**Web-References:**

1. [Teaching Asia-Pacific Core Values Of Peace And Harmony – Unicef](#)
2. [Three-Dimensional Action For World Prosperity And Peace- Iim Indore -](#)
3. [My Non-Violence - Mahatma Gandhi](#)
4. [Human Rights And The Constitution Of India 8th ... - India Juris](#)
5. [The Ethics Of Sustainability – Research Gate](#)

***
SEMESTER - VIII
Course Objectives:

- To develop skills to identify and find solutions to various problems using biotechnology.

Course Outcomes (COs):

After successful completion of the course, the students should be able to

CO1: Ability to survey literature relevant to the topic under consideration.
CO2: Design a research problem using sound scientific principles.
CO3: Conduct experiments with suitable controls and safety considerations.
CO4: Perform statistical operations and analyze results.
CO5: Interpret results and derive new information.
CO6: Present and communicate results to a scientific audience.

Pre-requisite:

1. All core theory and lab courses

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Programme Outcomes (POs) and Course Objectives (COs) Mapping:

Programme Outcomes (POs)  
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Course Content  

30 hours

Student in discussion with the guide chooses to design and carry out a novel research problem

Theory: 0 hours  Tutorial: 0 hours  Practical: 0 hours  Project: 180 hours  Total hours: 180

***
ELECTIVES
Course Objectives:

- To familiarize the principles and concepts of kinetics and application of reactors.

Course Outcomes (COs):

After successful completion of this course, the students should be able to

- **CO1:** Elucidate the basic laws on chemical kinetics and its application on different types of reactions
- **CO2:** Apply the various ideal reactors and their design equations
- **CO3:** Elaborate the non-ideal behaviour of reactors
- **CO4:** Conceptualize the basic of heterogeneous reacting systems
- **CO5:** Identify and analyse the various multiphase reactors
- **CO6:** Solve the importance of multiphase reactors

Pre-requisite Course:

1. U18BTT4001: Fluid and Particle mechanics in Bioprocess

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Course Assessment methods:

- **Direct**
  1. Continuous Assessment Test
  2. Assignment
  3. End Semester Examination

Course Content

**CHEMICAL REACTION KINETICS**

Classification of chemical reactions, order and molecularity, rate equation, rate constant; Activation energy, Concentration and temperature dependence; Search for reaction mechanism, Methods of analyzing batch reactor data - Integral and differential, Analysis of total pressure data obtained in constant volume system

**IDEAL REACTORS**

Performance equations - batch, plug flow and mixed flow reactors; Space time and Space velocity; Size comparison of single reactors, multiple reactor systems, Recycle reactor and autocatalytic reactions.

**NON-IDEAL REACTORS**

Reasons for non-ideality in reactors; RTD function and measurement; RTD in plug flow and mixed flow reactor; conversion in non ideal flow, relation among E,F and C curve, non - ideal flow models- tank in series and dispersion models.

**HETEROGENEOUS REACTING SYSTEM**

Signature of BOS chairman, BT
Introduction to heterogeneous reacting systems, Ideal contacting patterns, Solid catalysed reactions - Surface kinetics and pore resistance, Kinetics of non catalytic fluid particle systems - Progressive conversion model and shrinking core model, Determination of rate controlling step

INDUSTRIAL REACTORS

Reactors to carry out G/L reactions on solid catalysts - Trickle bed, slurry, three phase fluidized bed, fluid-fluid and fluid-particle reactors.

Theory: 45 hour  Tutorial: 0 hour  Practical: 0 hour  Project: 0 hour  Total Hour: 45

References:

Web reference
1. https://nptel.ac.in/courses/103108097/

U18BTE0002   FOOD PROCESS ENGINEERING

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Course Objectives:
- To illustrate various pre-processing techniques in food processing
- To discuss the methods in processing foods

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: Apply and analyse the pre-cleaning techniques in food processing
CO2: Apply different types of high temperature processing operations
CO3: Illustrate different drying and dehydration techniques
CO4: Categorize several low temperature processing and preservation techniques
CO5: Classify various post-processing operations
CO6: Apply and analyse various packaging operations

CO/PO Mapping

(S/M/W indicates strength of correlation)  S-Strong, M-Medium, W-Weak

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Signature of BOS chairman, BT
Pre-requisite Course:  U18BTI3205 Microbiology

Course Assessment methods:

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Course Content

INTRODUCTION TO PRE-PROCESSING  12 Hour
Raw material preparation: cleaning, air screen cleaners, disk, indent cylinder, spiral, and specific gravity, stone, inclined belt, pneumatic, aspirator; separators: magnetic, cyclone, colour separator, grading; sorting; washing; peeling: flash peeling, steam peeling, knife peeling, abrasion peeling, lye peeling, flame peeling.

HIGH TEMPERATURE PROCESSING  9 Hour
Concepts and equipment used in blanching: Blanching theory, equipment, steam blanchers, hot water blanchers; pasteurization and heat sterilization techniques; extrusion; Case Study: evaporation.

PROCESSING USING HOT AIR AND OIL  9 Hour
Drying: advantages of drying, moisture content, definition, direct and indirect methods of determination; drying methods: heated air and heated surface drying: hot air dryer, contact dryer, rehydration; drying methods and equipment; osmotic dehydration; baking and roasting: theory and equipment; frying: theory and equipment, Osmotic dehydration

PRESERVATION BY LOW TEMPERATURE  9 Hour
Chilling: theory and equipment, freezing equipment, freeze drying equipment, freeze drying, freeze concentration, thawing, Modified atmospheric storage(MAS), controlled atmospheric storage (CAS).

POST PROCESSING OPERATIONS  6 Hour
Coating, enrobing, packaging-, Modified atmospheric packaging(MAP), controlled atmospheric packaging(CAP), filling, sealing.

Theory: 45 hour  Tutorial: 0 hour  Practical: 0 hour  Project: 0 hour  Total Hour: 45

REFERENCES:
1  Barbosa-Canovas, G. V., & Ibarz, A. (2014). Introduction to food process engineering. CRC Press.
WEB REFERENCES
1. www.fao.org/wairdocs/x5434e/x5434e00.htm

U18BTE0003

FOOD PRESERVATION TECHNOLOGY

L T P J C
3 0 0 0 3

Course Objectives:
 To explain the principles of food preservation and their impact on the shelf life, quality, and other physical and sensory characteristics of foods.
 To describe with the recent methods of minimal processing of foods
 To discuss the materials and types of packaging for foods

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: Identify the causes of spoilage
CO2: Categorize high temperature processing techniques
CO3: Apply drying techniques for different foods
CO4: Compare various low temperature processing techniques
CO5: Examine various non-thermal methods of preservation
CO6: Analyze various packaging techniques

CO/PO/PSO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

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Pre-requisite Course:
1. U18BTE002 Food Process Engineering

Course Assessment methods:

Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content

FOOD AND ITS PRESERVATION
General principles of preservation, classification of methods used for preservation, need and importance of preservation at domestic and large scale, Causes of food spoilage; Nature of harvested crop, plant and animal – moisture, pH and water activity of foods.

CANNING, RETORT PROCESSING, CONCENTRATION AND DRYING

6 Hour

12 Hour
Types and classification of foods used for canning; spoilage of canned and bottled foods, storage of canned foods; Influence of canning on the quality of food; retort pouch processing. Drying –influence of drying on pigments and enzymes; Dehydration of fruits, vegetables, milk, animal products; Case Study: Osmotic methods. Principles of preservation by use of acid, sugar and salt; High solid - high acid foods; jelly making, food concentrates. Pickling and curing and microbial fermentation.

**PRESERVATION BY LOW TEMPERATURE**  
9 Hour

Principles of storage using low temperature; Product storage; Effect of cold storage on quality, storage of grains; Principles of refrigerated gas storage of foods, Gas packed refrigerated dough, Sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers. Principles of food freezing: Freezing of raw and processed foods, freeze concentration, freeze drying, IQF.

**NON-THERMAL METHODS**  
9 Hour

Chemical preservatives, preservation by ionizing radiations, ultrasonication, high pressure, fermentation, curing, pickling, smoking, membrane technology; Hurdle technology, application of infra-red microwaves; Ohmic heating; control of water activity.

**FOOD PACKAGING**  
9 Hour

Basic packaging materials, types of packaging materials used for different kinds of foods, HACCP Introduction and Principles, Introduction to Food Labelling.

| Theory: 45 hour | Tutorial: 0 hour | Practical: 0 hour | Project: 0 hour | Total Hour: 45 |

References:

**U18BTE0004** CANCER BIOLOGY

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Course Objectives:
- To learn about the fundamentals of carcinogenesis and role of oncogenes
- To understand the regulation of cell cycle in cancer and mechanism of cancer metastasis
- To know about the strategies for cancer diagnosis and therapy

Course Outcomes (COs):

After successful completion of this course, the students should be able to

**CO1:** Comprehend role and function of genes in cell cycle regulation

**CO2:** Apply and evaluate mechanism of oncogenes and proto-oncogenes in cell cycle regulation in cancer

**CO3:** Attain the knowledge in the fundamentals of carcinogenesis and its role in cancer

Signature of BOS chairman, BT
CO4: Illustrate the mechanism of cancer metastasis and progression of cancer stage

CO5: Comprehend the basis of molecular diagnosis of cancer and cancer therapy

CO6: Apply techniques in the field of cancer diagnosis and forms of therapy

Prerequisite
U18BTI4203 Cell & Molecular Biology
U18BTI5201 Genetic engineering and genomics

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Course Assessment methods:
Direct
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content
CELL CYCLE REGULATION 9 hour
Regulation of cell cycle - S. pombe, S. cerevesiae and mammalian system; Types of mutations that cause changes in signal molecules; Effects on receptor; Tumor suppressor genes -p53 and Rb proteins; Modulation of cell cycle in cancer; Mechanism of action of telomerase. Interaction of cancer cells with normal cells. Role of antioxidants in preventing cancer

ONCOGENES AND PROTO ONCOGENES 9 hour
Mechanism of oncogene and proto oncogene – epidermal growth factor (EGF), platelet derived growth factor (PDGF), transforming growth factor (TGF), src and myc; RAS cycle; Oncogenes – Identification and detection; Apoptosis – intrinsic and extrinsic pathways. Genetic rearrangements in progenitor cells

MECHANISM OF CARCINOGENESIS 9 hour
Carcinogenesis – introduction and types; Chemical carcinogenesis – Direct acting and indirect acting carcinogens; Metabolism of carcinogens - CYP450 reductase mechanism; Mechanism of radiation carcinogenesis – ionizing and non-ionizing radiation; Retroviruses - RSV life cycle and its role in cancer; Identification of carcinogens- Long (rat or mice model) and short term bioassays (Bacteria and yeast culture).

CANCER METASTASIS 9 hour
Metastasis – Introduction and cascade; Clinical significances and three step theory of invasion; Significance of proteases in basement membrane disruption; Properties of cancer cell; brain, oral, lung, uterus, breast & blood – etiology, diagnosis and treatment.

Case study – oral, breast and blood cancers

MOLECULAR DIAGNOSIS AND THERAPY 9 hour

Signature of BOS chairman, BT
Cancer diagnosis– biochemical assays; Tumor markers; Molecular tools for early diagnosis of cancer; Prediction of aggressiveness of cancer; Different forms of therapy – stem cell therapy, Chemotherapy, Radiation therapy and Immunotherapy.

Theory: 45 hour   Tutorial: 0 hour   Practical: 0 hour   Project: 0 hour   Total Hour: 45

REFERENCES

Web References:

U18BTE0005    VACCINE TECHNOLOGY

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Course Objectives:

- To describe the differences between conventional vaccines and purified antigen vaccines.
- To understand advancement of therapeutic vaccines preparation methods and technological applications.
- To acquire fundamental knowledge related to regulatory issues, guidelines and environmental concerns with the use of recombinant vaccines.

Course Outcomes (COs):

After successful completion of this course, the students should be able to:

CO1: Comprehend knowledge about the historical vaccine development and conventional vaccines in disease prevention.

CO2: Classify and understand about different bacterial vaccine preparation methods.

CO3: Acquire fundamental research knowledge to implement the production viral vaccines.

CO4: Understand advancement of therapeutic vaccines and technological applications.

CO5: Recognize the fundamental knowledge vaccine production through modern recombinant DNA and vaccine delivery methods.

CO6: Understand the regulatory issues, guidelines and environmental concerns with the use of recombinant vaccines.

Prerequisite
U18BTT6001 Biopharmaceutical Technology; U18BTT6204 Immunology

Signature of BOS chairman, BT
CO/PO/PSO Mapping
(S/M/W indicates strength of correlation)  S-Strong, M-Medium, W-Weak

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Course Assessment methods:
1. Continuous Assessment Test
2. Assignment
3. End Semester Examination

Course Content
INTRODUCTION TO VACCINATION  9 hour
History of vaccine development, Conventional Vaccines, Purified antigen Vaccines. Role of WHO and UIP in disease prevention, Conventional strategies for vaccine development. Live, attenuated, subunit and killed vaccines

BACTERIAL VACCINES  9 hour
Brief history of Fermentation culture; Technology related to monitoring, temperature, sterilization, environment, quality assurance and related areas. Production techniques - growing the microorganisms in maximum toxicity level, preservation techniques, production and testing of BCG, DPT, TT, Case Study : A cellular pertussis vaccine and Meningococcal vaccine

VIRAL VACCINES  9 hour
Primary culture, secondary culture, continuous cell lines, suspension cultures; application of animal cell culture for virus isolation, application of cell culture technology in production of human and animal viral vaccines, Bioreactor technology, freeze drying.
Case study

VACCINE BIOTECHNOLOGY AND DELIVERY METHODS  9 hour
Vaccine production through recombinant DNA - Various approaches for Novel Vaccine production. Recombinant polypeptide Vaccines, DNA vaccines, Edible Vaccines, reverse vaccinology; peptide vaccines, conjugate vaccines, plant-based vaccines, Strategies and Development (Vaccinia virus recombinants), Role and properties of adjuvants, types of adjuvant, Immunomodulators Innovative methods of delivery of immunogen through liposome’s, microspheres, ISCOMS, Nasal immunization.
Case study: Nanoemulsion

GUIDELINES FOR THE MANAGEMENT  9 hour
Regulatory issues Environmental concerns with the use of recombinant vaccines - Disease security and biosecurity principles and OIE guidelines such as seed management Method of manufacture – in-process control, batch control, test on final products.
Theory: 45 hour  Tutorial: 0 hour  Practical: 0 hour  Project: 0 hour  Total Hour: 45

REFERENCES

U18BTE0006

MOLECULAR DIAGNOSTICS

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Course Objectives:
- To learn about the diagnostic techniques related to pathogenic diseases and pre-natal testing.
- To understand the biomarkers for disease diagnosis and biochemical diagnostics.
- To explore the diagnostics tools available for cancer and genetic disorders.

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: Define the significance of molecular diagnostics and enlist the type of diseases and infections.
CO2: Evaluate the diagnostic tools available for identifying the infections caused by micro-organisms.
CO3: Relate the biomarkers as diagnostic tools and infer the biochemical diagnostics for metabolic disorders.
CO4: Comprehend the techniques for the pre-natal testing of inherited genetic disorders.
CO5: Apply the methods available for the diagnosis of cancer.
CO6: Outline the genetic disorders and the tools employed for the detection of neo-natal diseases.

Pre-requisite Courses:

1. U18BTI5201 – Genetic Engineering and Genomics

Signature of BOS chairman, BT
CO/PO/PSO Mapping
(S/M/W indicates strength of correlation)  S-Strong, M-Medium, W-Weak

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Course Assessment methods:

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Course Content

**INTRODUCTION TO MOLECULAR DIAGNOSTICS**  9 hour
History of diagnostics, Age of molecular diagnostics, Significance, Scope, Rise of diagnostic industry in Indian and global scenario.

**PATHOGEN DIAGNOSTIC TECHNIQUES**  6 hour
Diagnosis of DNA and RNA viruses. Pox viruses, Adenoviruses, Rhabdo Viruses, Hepatitis Viruses and Retroviruses. Diagnosis of Protozoan diseases: Amoebiosis, Malaria, Trynosomiasis, Leishmaniasis. Study of helminthic diseases: *Fasciola hepatica* and *Ascaris lumbricoides*. Filariasis and Schistosomiasis

**CASE STUDY**: Diagnosis of Dengue virus

**BIOMARKERS IN DISEASE DIAGNOSTICS AND BIOCHEMICAL DIAGNOSTICS**  9 hour
FDA definition of disease markers, Role of markers in Disease diagnosis. Approaches and methods in the identification of disease markers, predictive value, diagnostic value, emerging blood markers for sepsis, tumour & cancer markers, markers in inflammation and diagnosis of cytoskeletal disorders.
Biochemical diagnostics: inborn errors of metabolism, haemoglobinopathies, mucopolysaccharidoses, lipidoses, and glycogen storage disorders

**PRENATAL DIAGNOSIS**  9 hour
Invasive techniques - Amniocentesis, Fetoscopy, Chorionic Villi Sampling (CVS), Non-invasive techniques -Ultrasoundography, X-ray, TIFA, maternal serum and fetal cells in maternal blood. Diagnosis using protein and enzyme markers, monoclonal antibodies. DNA/RNA based diagnosis Hepatitis, CML-bcr/abl, HIV - CD 4 receptor. Microarray technology- genomic and cDNA arrays, application to diseases.

Signature of BOS chairman, BT
After successful completion of this course, the students should be able to

- Understand the synthesis processing of various nanomaterials
- Apply and interpret the various characterization techniques for nanomaterials
- Apply and evaluate the various nanomaterials applications in different fields
- Understand and apply the natural bionanomolecules for various biological applications
- Understand and apply the nanobiochips, nanobiosensor and microarray for biological applications
- Evaluate the nanomaterials in cancer diagnosis and treatment

Web References:
7. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1214554/
8. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4375750/
Prerequisite: U18BBT3002 – Biomolecules and Genetics

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Course Content

INTRODUCTION TO NANOBIOTECHNOLOGY 9 hour
Introduction to Nanotechnology and nanobiotechnology: Properties at nanoscale; overview of nanodevices and techniques; General synthesis methods of nanoscale materials; top down and bottom up approaches; Biological approach to self assembly.

CHARACTERIZATION TECHNIQUES 9 hour
X-ray diffraction technique; Scanning Electron Microscopy with EDX; Transmission Electron Microscopy, Zeta Potential, Particle size analyzer; Surface Analysis techniques; AFM, SPM, STM, SNOM, ESCA, SIMS; Nanoindentation.

NANOMATERIALS AND APPLICATIONS 9 hour
Inorganic nanoscale systems for biosystems: nanostructure materials of fullerenes, carbon nanotubes, quantum dots and wires, preparation, properties and applications; Nanopores: applications.

NANOMOLECULES IN BIOSYSTEMS 9 hour
Nanomolecules in biosystems: Proteins, RNA and DNA nanoscale elements for delivery of materials into cells; DNA based artificial nanostructures; proteins as components in nanodevices; Tissue regeneration using anti-inflammatory nanofibres; Polymer nanofibers and applications; polymer nanocontainer; magnetosomes; bacteriorhodopsin: applications; S-layer proteins.

APPLICATION OF NANOBIOTECHNOLOGY 9 hour
Nanoscale devices for drug delivery: micelles for drug delivery; targeting; bioimaging; microarray and genome chips; nanobiosensors and nanobiochips; Nanotechnology for cancer diagnosis and treatment; Case study: Nanomaterials on drug delivery.

Theory: 45 hour Tutorial: 0 hour Practical: 0 hour Project: 0 hour Total Hour: 45

REFERENCES
1. Niemeyer, C. M., and CA Mirkin, C. A., (2010); NanoBiotechnology II – More concepts,

Signature of BOS chairman, BT

Web References

Course Objectives:
- To learn about the neuroanatomy and neurophysiology
- To understand the concept of synaptic transmission and mechanism of action of neurotransmitters
- To gain insight into the mechanism of sensations and disorders related to nervous system.

Course Outcomes (COs):

After successful completion of this course, the students should be able to

CO1: Comprehend the central and peripheral nervous system, and describe the structure and functions of neurons and supporting cells

CO2: Analyze the mechanism of action potential conduction and working of voltage dependent channels.

CO3: Illustrate the concept of synaptic transmission and mechanism of action of neurotransmitters.

CO4: Evaluate mechanism of sensations and skeletal muscle contraction.

CO5: Enumerate the mechanisms associated with motivation behaviors.

CO6: Summarize the various disorders of nervous system.

Pre-requisite Course:
1. U18BTI3204 Concepts in Biochemistry
CO/PO/PSO Mapping
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Course Content

**NEUROANATOMY**
Classification of central and peripheral nervous system, Neurons: structure, types and functions – Neuronal membrane, cytoskeleton, axon, dendrites; Glial cells: types; Synapses: types and functions; Myelination; Blood Brain barrier; Neural Development; Cerebrospinal fluid: origin and composition; Spinal cord functions.

**NEUROPHYSIOLOGY**
Resting and action potential: introduction; Properties and mechanism of action potential conduction; Voltage dependent channels: sodium and potassium channels; Principle of metabotropic receptors; Electrical transmission

**NEUROPHARMACOLOGY**
Synapse formation; Synaptic transmission: Principles of Chemical synaptic transmission. Principles of synaptic integration; neurotransmitters and their mechanism of action: acetyl choline, serotonin, dopamine and γaminobutyric acid (GABA); Peptide transmitters: mechanism of action; Nicotinic and muscarinic acetyl choline receptors; hypothalamic control of neuronal function

**APPLIED NEUROBIOLOGY & MODERN DIAGNOSTIC TOOLS**
Basic mechanisms of sensations: touch, pain, smell, taste; neurological mechanisms of vision and audition; skeletal muscle contraction (neuromuscular junction). Imaging techniques to study Brain functions – EEG, MRI

**Case study** – Brain-Machine Interface
**BEHAVIOURAL SCIENCE**

Basic mechanisms associated with motivation; Hypothalmus, homeostasis and motivated behavior; regulation of feeding, sleep, emotions. Molecular mechanisms of memory and leaning; Disorders associated with nervous system: Parkinson’s disease, Alzheimer’s disease, Schizophrenia, Epilepsy; Anxiety and mood disorders - Depression, Agrophobia.

**Case study** – Degenerative diseases of the nervous system

**Theory:** 45 hour  **Tutorial:** 0 hour  **Practical:** 0 hour  **Project:** 0 hour  **Total Hour:** 45

**References:**

**Web References:**

**U18BTE0009**  **MEMBRANE TECHNOLOGY**  

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**Course Objectives:**
- To learn and apply the principles of membranes in the water treatment, bioprocess and food process industries

**Course Outcomes (COs):**

After successful completion of this course, the students should be able to

**CO1:** Learn various transport models for the calculation of membrane fluxes and the extent of separation for various membrane systems

**CO2:** Identify the types of experimental data needed for the calculation of membrane parameters

**CO3:** Understand the pretreatment techniques for the membranes

**CO4:** Select a membrane process and design components to carry out a specific separation

**CO5:** Comprehend advancements in membrane techniques to solve environmental problems

**CO6:** Design the membrane separation for bio and food processes

**Prerequisite**
1. U18BTT3003 Bio-process Calculations

![Signature of BOS chairman, BT](image)
2. U18BTI5205 Heat and mass transport in Bioprocess

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**Course Content**

**INTRODUCTION**

**THEORY AND PRINCIPLE**
Microfiltration-Ultrafiltration-Nano Filtration -Reverse Osmosis -Electro dialysis-Pervaporation - Membrane Module/Element designs-Membrane System components-Design of Membrane systems

**PRETREATMENT**
Membrane Fouling -Pretreatment methods and strategies -monitoring of Pretreatment-Langlier Index, Silt Density Index, Chemical cleaning, Biofoulant control

**HETEROGENEOUS REACTING SYSTEM MEMBRANES IN WATER TREATMENT**
Introduction and Historical Perspective of Membrane Bioreactors (MBR), Biotreatment Fundamentals, Biomass Separation MBR Principles, Fouling and Fouling Control, MBR Design Principles, Design Assignment, Alternative MBR Configurations

**MEMBRANE IN BIO AND FOOD PROCESSES**
Bioprocess: Hemodialysis-electrodialysis-Virus removal by ultrafiltration. Food process: membrane distillation, Pervaporation, membranes in dairy industry

**Theory:** 45 hour  **Tutorial:** 0 hour  **Practical:** 0 hour  **Project:** 0 hour  **Total Hour:** 45

**References:**

Signature of BOS chairman, BT


**Web References**
1. http://nptel.ac.in/courses/103103032
2. http://nptel.ac.in/courses/103103035

**Course Objectives:**
- To learn about the factors, attributes and indicators of bio-entrepreneurship.
- To learn the business strategies and technology transfer in biotech companies.
- To study the various concepts on creativity, innovation, product development and technology transfer

**Course Outcomes (COs):**
After successful completion of this course, the students should be able to

**CO1:** Learn about the factors, attributes and indicators of bio-entrepreneurship.
**CO2:** Learn business strategies and technology transfer in biotech companies.
**CO3:** Illustrate the components of biotechnology companies.
**CO4:** Impart the knowledge on Creativity, Innovation and New product development.
**CO5:** Inculcate novel strategies on identifying market demands, establishing market niche.
**CO6:** Understand the market and product development strategies

**Pre-requisite Course:**

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**Course Assessment methods:**

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**Course Content**

**FUNDAMENTALS OF ENTREPRENEURSHIP**

9 hour

Signature of BOS chairman, BT
Entrepreneurship, Definition; Factors necessary for Entrepreneurship, Attributes in an Entrepreneur, Bio-entrepreneurship, Indicators of Bio-entrepreneurship Case study: Building of a Bio-entrepreneur.

**FUNDING OPTIONS, FINANCIAL PLANNING AND INVESTMENT STRATEGIES 9 hour**
Writing a business proposal, funding and establishing a biotech start-up, basics of trading, stocks and shares, risk management and diversification of risks.

**COMPONENTS OF BIOTECH COMPANY AND BUSSINESS MODELS 9 hour**
Paths for starting new biotech ventures, history of pioneering biotech companies, Key for success, Mission and Strategy, product selection for new biotech venture, evaluation of company’s annual report (a case study).

**INNOVATION AND TECHNOLOGY TRANSFER 9 hour**
Intellectual property in biotech - Licensing, Accessing University technology, Licensing of Biotechnological invention, Funding agencies in India.

**MARKET RESEARCH AND PRODUCT DEVELOPMENT 9 hour**
Strategies to identify market demands, establishing market niche, competing in a crowded market place, adaptation to market needs and case study on Indian and global entrepreneurs.

**Theory: 45 hour Tutorial: 0 hour Practical: 0 hour Project: 0 hour Total Hour: 45**

**REFERENCES:**

**U18BTE0011 INDUSTRIAL BIOSAFETY AND BIOETHICS**

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**Course Objectives:**
- To create awareness, practice of Industrial biosafety regulation and bioethics

**Course Outcomes (COs):**
After successful completion of this course, the students should be able to

- CO1: Describe various risk assessments and associated biosafety practices at industrial level.
- CO2: Demonstrate and Classify Biosafety levels
- CO3: Elucidate various biosafety guidelines, norms and regulations.
- CO4: Assess GMO’s and its regulation in terms of environmental release
- CO5: Acquire knowledge on ethical issues, guideline and regulations.
- CO6: Discuss environmental release of GMOs and their impact

Signature of BOS chairman, BT
Pre-requisite Course: -

Course Assessment methods:

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Course Content

**INDUSTRIAL BIOSAFETY**

Introduction to Biosafety; Causes- classification, identification of hazards; issues handling; awareness of accidents at industrial level; types of accidents; first aid, precautionary measure; Clean room procedures- Classification specification; Personal protective equipment working with biohazards; Proper gowning and hygiene for clean room work; Behavioral requirements in a controlled environment; Basic methods for safe handling, transport, and storage of biological and chemical materials; Equipment related laboratory techniques; Contingency plan and emergency procedures.

**LEVELS OF BIOSAFETY**

Introduction to Biological safety cabinets; Horizontal & Vertical Laminar Air Flow Cabin; Fume hood; Primary and secondary containments; Biosafety levels of specific Microorganisms (food and water borne pathogens), Infectious Agents (Chemicals and carcinogens); MSDS- Material Safety Data Sheet- Understanding, and infected animals (test animals).

**FDA AND FPO BIOSAFETY GUIDELINES**

FDA guideline and approval; FPO specification and guidelines for food products; GOI - Biosafety procedure, time frames and specification for Production and manufacturing industries- Case study

**INTRODUCTION TO BIOETHICS**

Definition of bioethics; Environmental release of GMOs- Risk analysis, Risk assessment, Risk management and Communication; Precaution before and after environmental release of GMO’s – case study

**REGULATORY AFFAIRS**

Overview of national regulation and international agreement on GMO; Cartagena protocol- articles; Ethical committee- administration channel; Role of NIH, IACUC, IBSC

**Theory: 45 hour  Tutorial: 0 hour  Practical: 0 hour  Project: 0 hour  Total Hour: 45**

References:

1. Deepa Goel and Ms.Shomini Parashar , (2013) IPR, Biosafety and Bioethics, Pearson Education publisher

Signature of BOS chairman, BT

**Web References**
1. http://blink.ucsd.edu/safety/research-lab/biosafety/

**U18BTE0012 BIOPROCESS DESIGN AND ECONOMICS**

**Course Objectives:**
To introduce about the various application of chemical engineering principles for development of new processes to produce these new chemicals, and development of marketable technology

**Course Outcomes (COs):**
After successful completion of this course, the students should be able to

**CO1:** Able to apply and develop the flow sheets used in bioprocess industry

**CO2:** Apply and evaluate the capital cost for construction of a new plant or modifications to an existing chemical manufacturing plant

**CO3:** Apply and evaluate the manufacturing cost (operating cost) for production of bioproducts

**CO4:** Apply and evaluate the economic evaluation of the bioproducts

**CO5:** Understand the basics of techno-economical assessments for bioenergy systems

**CO6:** Understand the basics of life cycle assessments for the analysis of bioenergy systems

**Prerequisite:** U18BTI5203 Heat and Mass Transport in Bioprocess

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**DIAGRAMS FOR UNDERSTANDING CHEMICAL PROCESSES** 9 hours


**ESTIMATION OF CAPITAL COSTS** 9 hours


**ESTIMATION OF MANUFACTURING COSTS** 9 hours


**ENGINEERING ECONOMIC ANALYSIS** 9 hours


**TECHNO-ECONOMIC ASSESSMENT** 5 hours

Introduction to Techno-Economic analysis (TEA). Basic steps in TEA; Tools, Software & Data source for performing TEA – Tools available for performing TEA, Procedure for TEA using commercial software, Data source for performing TEA, Process optimization using TEA.

**LIFE CYCLE ANALYSIS** 4 hours


**Theory**: 45 hours  **Tutorial**: 0 hours  **Practical**: 0 hours  **Total**: 45 Hours

**References**


Web References

1. https://nptel.ac.in/syllabus/103103039/
Course Objectives:

- To learn the fundamental concepts of different physiological processes of human beings
- To understand and describe the pathophysiology of selected diseases contracted by mankind
- To analyze and interpret the clinical results of few selected diseases

Course Outcomes (COs):

After successful completion of the course, the students should be able to

CO1: Describe the digestion and absorption physiology, and to evaluate the pathophysiological conditions
CO2: Understand, elaborate and interpret the functioning of cardiac cycle, mechanism of regulation of blood pressure, and allied pathophysiology
CO3: Demonstrate the physiological and pathophysiological processes of renal and respiratory systems
CO4: Discuss the phenomenon of conduction of nerve impulses and interpret the mechanism of Parkinson’s disease
CO5: Understand and illustrate the physiological phases of spermatogenesis and menstrual cycle, and explain the etiology of menopause
CO6: Analyze and interpret the clinical oriented diagnostic results of selected diseases

Pre-requisite:

1. Nil

CO/ PO Mapping

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Course Content

45 hours

1. GASTROINTESTINAL PHYSIOLOGY AND PATHOPHYSIOLOGY  9 hours

   Introduction to digestive system; Overview of GI tract layers; Overview of digestion and absorption processes; Composition and functions – salivary, gastric, pancreatic and bile juices; Functions of small and large intestines. Functions of liver; Pathophysiology – peptic ulcer and diabetes mellitus

2. CARDIOVASCULAR PHYSIOLOGY AND PATHOPHYSIOLOGY  9 hours

   Blood – composition, properties and functions; Overview of layers of heart wall and heart valves; Physiology of blood circulation process; Overview of cardiac cycle (briefing the stages is sufficient); Overview of blood pressure and mechanism of renin-angiotensin and baroreceptor system to control blood pressure; Pathophysiology – Myocardial infarction & valvular diseases.
3. **RENAAL AND RESPIRATORY PHYSIOLOGY, AND PATHOPHYSIOLOGY**  
**9 hours**
- Functions of renal system (kidney); Overview of structure of nephron; Mechanism of urine formation; Overview of structure of respiratory tract; Mechanism of gaseous exchange in lungs; Bohr’s effect and chloride shift
- Etiology of acute and chronic failures; Pathophysiology of pulmonary tuberculosis & SARS CoV infection

4. **NEURO AND REPRODUCTIVE PHYSIOLOGY AND PATHOPHYSIOLOGY**  
**9 hours**
- Introduction and classification of nervous system, Structure and functions of neuron, Conduction of nerve impulse – resting and action potentials; Physiological phases of spermatogenesis & menstrual cycle; Functions of sex hormones. Etiology, symptoms and therapy of menopause; Pathophysiology of Parkinson’s disease.

5. **CLINICAL DIAGNOSIS**  
**9 hours**
- Diabetes type I & II – Plasma glucose levels (fasting & postprandial), oral glucose tolerance test (OGTT), immunoassay predictions & serum glycated hemoglobin (HbA1c) levels; Impact of cholesterol levels in several diseases (hypo- & hypercholesterolemia); Impact of International Normalized Ratio (INR) in critical cardiac diseases; Liver function tests (LFTs) – serum aminotransferases, bilirubin, prothrombin time (PT) & albumin; Renal function tests (RFTs) – physical, microscopic & biochemical analysis of urine, and serum biochemical analysis.

  *(Protocols NOT needed; Interpretation of diseases based upon normal values is sufficient)*

**Theory:** 45 hours  **Tutorial:** 0 hours  **Practical:** 0 hours  **Project:** 0 hours  **Total hours:** 45

**Textbooks:**

**Web-References:**
1. [SARS-CoV](#)
2. [SARS-CoV Mechanism](#)

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Signature of BOS Chairman
Course Objectives:

- To understand the impact of various traditional medicinal systems against ailments
- To learn the occurrence, extraction methods and biological applications of different phytochemicals or natural products from plant sources
- To comprehend the significance of herbal medicine and nutraceuticals

Course Outcomes (COs):

After successful completion of the course, the students should be able to

CO1: Compare and contrast the significance of different types of traditional medicine
CO2: Understand and explain the classification and biological applications of alkaloids
CO3: Learn and demonstrate the types and functional benefits of flavonoids
CO4: Describe the classification and health benefits of essential oils
CO5: Illustrate the classification and biological applications of phytosterols
CO6: Explain the overview of biological impact of herbal medicines and nutraceuticals

Pre-requisite:

1. Nil

Programme Outcomes (POs) to Course Outcomes (COs)

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CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

Course Assessment Methods

Direct | Indirect
---|---
1 Internal Tests | 1 Course end survey
2 Assignments | 
3 End semester examination | 

Course Content

1. INTRODUCTION TO TRADITIONAL MEDICINE

Traditional medicine – Introduction, types and history; Ayurveda, siddha and traditional Chinese medicine (TCM) - basic principles, diagnosis and therapy; Overview of African, Middle East, Australian and European traditional medicine; Natural products – definition, historical background and classification.

2. ALKALOIDS

Alkaloids – definition, occurrence, classification, biosynthesis (Structures NOT needed, any one type of alkaloid is sufficient), physical properties, extraction and purification methods, and biological applications.

Case Study: Piperdine, pyridine and opium alkaloids – occurrence, isolation, characteristic features and biological applications.
3. **FLAVONOIDS**
   Polyphenols – Introduction and classification; Flavonoid – Classification, biosynthesis (Structures NOT needed, any one type of flavonoid is sufficient), physical properties, extraction and purification methods, and biological applications.

   **Case Study:** Occurrence and biological applications (any ONE flavonoid with mechanism)

4. **ESSENTIAL OILS AND PHYTOSTEROLS**
   Essential oils - definition, classification, occurrence, physical properties, extraction methods, and biological applications; Phytosterols - definition, classification, occurrence, and biological applications.

5. **HERBAL INDUSTRY AND NUTRACEUTICALS**
   Herbal industry – overview of standardization of plant materials, regulatory requirements for herbal medicines; WHO guidelines on traditional / herbal medicine; Nutraceuticals – definition, classification, and biological applications.

Theory: 45 hours   Tutorial: 0 hours   Practical: 0 hours   Project: 0 hours   Total hours: 45

**Textbooks:**

**Web-References:**
1. Flavonoid
2. Quercetin Review
3. Phytosterol
4. Nutraceuticals

***
Course Objectives:

- The purpose of this course is to explain the various recent techniques of food packaging, applications, principles and requirements of these techniques.
- Identify the purpose, principle and advance knowledge related to the various packaging technology systems.
- Awareness of students about the recycling of packaging materials, biodegradable packaging materials and safety and legislative aspects.

Course Outcomes (COs):

After successful completion of the course, the students should be able to

CO1: Comprehend advance knowledge on the properties of various packaging materials and effect of various indicators used in supply chain management to indicate the food quality

CO2: Learn about different types of packaging machineries.

CO3: Understand about active packaging systems requirements

CO4: Learn about consumer response about new packaging systems and safety and legislative requirements

CO5: Acquaint about food-package interaction between package-flavour, gas storage systems for food storage

CO6: Recycling and use of green plastics for reducing the pollution and their effect on food quality

Pre-requisite:

1. Nil

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CO/ PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

PROGRAMME OUTCOMES (POs)

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Course Assessment Methods

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Course Content

1. TYPES OF PACKAGING

Important functions of package, packaging materials and various package forms, pouches, Properties, advantages and limitations of the following packaging materials: Glass, aluminum, its foil, metal tin containers; Paper and paperboards, laminates and multilayer composition, retortable pouches plastic films: LDPE, and LLDPE, HDPE, PVC, PS, PP, BOPP, PVD, EVA Polyester, cellulose acetate, PET, blister packaging; packaging regulations of FSSAI.
2. PACKAGING MACHINERY, LABEL AND PACK DESIGN, TESTING AND IDENTIFICATION

Form fill and Seal machine, gravitational and volumetric filling, filler for pasty products, filler for dry products, piston type filling machine Label, types of label, importance of Nutritional Labeling Package design consideration, cushioning materials and their properties Testing and Identification of packaging materials.

3. ACTIVE PACKAGING TECHNIQUES

Active and intelligent packaging techniques, oxygen, ethylene and other scavengers: Oxygen scavenging technology, selection of right type of oxygen scavengers, ethylene scavenging technology, carbon dioxide and other scavengers, antimicrobial food packaging, antimicrobial packaging system, effectiveness of antimicrobial packaging.

Case Study: Perspectives of Human Wisdom on Eco-Friendly Food.

4. MODIFIED AND CONTROLLED ATMOSPHERIC PACKAGING

Modified atmosphere packaging (MAP): Novel MAP applications for fresh-prepared produce, novel MAP gases, testing novel MAP applications, Applying high O2 MAP. Combining MAP with other preservation techniques, role of differing packaging materials. Controlled atmospheric packaging: CAP gases, methods.

5. MODERN PACKAGING SYSTEMS

Green plastics for food packaging, problem of plastic packaging waste, range of biopolymers, developing novel biodegradable materials, storage and distribution: alarm systems and time temperature indicators, traceability: radio frequency identification, outline on recycling packaging materials, aseptic packaging, biodegradeable polymers.

Theory: 45 hours  Tutorial: 0 hours  Practical: 0 hours  Project: 0 hours  Total hours: 45

Textbooks:


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Signature of BOS Chairman
U18BTE0016 MICROBIAL PATHOGENESIS  L  T  P  PJ  C  
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Course Objectives:

• To gain knowledge about host-pathogen interaction and defense mechanisms
• To understand the microbial pathogenesis of specific pathogens
• To explore the experimental and diagnostics tools available to control pathogens

Course Outcomes (COs):

After successful completion of the course, the students should be able to

CO1: Outline the principles of microbial pathogenesis, clinical importance of specific pathogens.
CO2: Acquire importance of Host defense mechanisms and pathogen adaptation against host defense.
CO3: Compare the molecular mechanisms involved in pathogenesis of diseases caused by E.coli, Vibrio, Shigella, Salmonella, malarial parasite and Influenza virus.
CO4: Evaluate the different host-pathogen interaction with respect to the pathological damage of pathogens
CO5: Acquire knowledge about virulence and virulence factors in genomic approach
CO6: Recognize the different diagnostic techniques like ELISA, RIA etc.,

Pre-requisite:

1. U18BTI3204 Microbiology

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Course Assessment Methods

Direct | Indirect
1 Internal Tests | 1 Course end survey
2 Assignments |
3 End semester examination

Course Content 45 hours

1. MICROBIAL PATHOGENESIS  9 hours

Introduction to the infectious diseases: Molecular Koch postulates; Clinical importance of pathogenic bacteria, fungi, virus and parasite with Examples; Principles of microbial pathogenesis: Microbial modes of entry mechanism and colonization; Components of microbial pathogenesis; Inflammation process.

2. HOST-DEFENSE AGAINST PATHOGENS AND PATHOGENIC STRATEGIES  9 hours

Virulence, virulence factors, virulence-associated factors and virulence lifestyle factors; Introduction to host defense: First line and second line defense mechanisms; Antimicrobial compounds; Mechanism of killing by humoral and cellular defense mechanisms; Pathogenic adaptations to overcome the above defenses; Complement system: types of complement system.
3. MOLECULAR MICROBIAL PATHOGENESIS

Clinical features and molecular mechanism of pathogenesis: Enteric pathogens- E.coli pathogens (Enteropathogenic (EPEC), Enterotoxigenic (ETEC), Enteroinvasive E.coli (EIEC)); Shigella; Salmonella; Vibrio - PAI; Superficial mycoses: Dermatophytes, Candidiasis; Malaria: Plasmodium life cycle; Influenza virus: Intracellular stage, H1N1; HIV.

4. EXPERIMENTAL STUDIES ON HOST-PATHOGEN INTERACTIONS

Virulence assay: Adherence, cytopathic, cytotoxic; Criteria and tests in identifying virulence factors- Classical, biochemical, genetic and genome approaches; Molecular characterization of virulence factors.

5. MODERN DIAGNOSIS TO CONTROL PATHOGENS

Modern diagnosis based on highly conserved virulence factors: Immuno and DNA-based techniques (Precipitation, agglutination, ELISA, RIA, PCR, Blotting techniques- Southern and Western blotting); Vaccines: types, applications and their advantages and disadvantages.

Theory: 45 hours Tutorial: 0 hours Practical: 0 hours Project: 0 hours Total hours: 45

Textbooks:

Web-References:

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Signature of BOS Chairman
Course Objectives:

At the end of the course the students would be able to

- Provide the current market-scenario of medical textile industries
- Learn various types of Biopolymer, Principles of Tissue Engineering and wound-dressing.
- Understand Smart textiles and standard use of medical textile products testing.

Course Outcomes (COs):

After successful completion of the course, the students should be able to

CO1: Comprehend various aspects related to the emerging field of medical textiles
CO2: Classify biopolymers and their role in wound healing and drug-release kinetics.
CO3: Demonstrate the various stages in wound healing, its mechanism
CO4: Understand tissue engineering with various scaffolds
CO5: Understand various standards used for testing medical textile products
CO6: Identify bio-based products for smart textile development.

Pre-requisite:

1. Nil

CO/ PO Mapping

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Course Assessment Methods

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Course Content

45 hours

1. INTRODUCTION

Medical textiles – classification, current market scenario in India and world, government initiatives on functional clothing; antimicrobial fibres and finishes; nano-fibrous materials and films; super absorbent polymers; operating room garments; personal health care and hygiene products applications of non-wovens in medicine; textiles in infection prevention control.

2. BIOPOLYMERS, TESTING AND TISSUE ENGINEERING


Signature of BOS Chairman
3. IMPLANTABLES, NON-IMPLANTABLES AND DRUG DELIVERY

Bandages-types, properties and applications; sutures: types and properties; implantable textiles – hernia mesh, vascular prostheses, stents; Extra corporeal materials: Cartilage nerves – liver ligaments, kidney, tendons, cornea; Drug delivery textiles: classification, mechanism various fabrication methods, characterization & applications. Hydrogels – types, biopolymers used for hydrogel preparation, properties and drug release kinetics from hydrogels.

4. WOUND CARE AND REUSABLE MEDICAL TEXTILES

Wound: types and stages in wound healing and mechanism, various types of wound dressings: bio-active dressing, anti microbial textiles dressing, composite dressing, testing of wound care materials; Wound compression textiles; Reusable medical textiles: types, advantages, physical properties and performance – reusable processing methods.

5. SMART MEDICAL TEXTILES AND LEGAL ISSUES

Smart textiles – types and characteristics – smart textiles in wound care; applications of phase change and shape memory materials – mobile health monitoring; electronics in medical textiles; textile sensors for healthcare; legal and ethical values involved in the medical textile materials.

Theory: 45 hours   Tutorial: 0 hours   Practical: 0 hours   Project: 0 hours   Total hours: 45

Textbooks:


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Signature of BOS Chairman