### Scheme of Teaching & Examination

**BE (Biotechnology) IV Semester**

- **L**: Lecture, **T**: Tutorial, **P**: Practical, **ESE**: End Semester Exam, **CT**: Class Test, **TA**: Teachers Assessment

**Note (1):** Duration of all theory papers will be of Three Hours.

**Note (2):** Industrial Training of six weeks is mandatory for B.E. student. It is to be completed in two parts. The first part will be in summer after IV sem. after which students have to submit a training report which will be evaluated by the college teachers during B.E. V SEM.

**Table:**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Board of Study</th>
<th>Subject Code</th>
<th>Subject</th>
<th>Period per week</th>
<th>Scheme of Exam</th>
<th>Total Marks</th>
<th>Credit</th>
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Chhattisgarh Swami Vivekanand Technical University, Bhilai

Name of program: Bachelor of Engineering
Branch: Biotechnology
Subject: Transport Process
Semester: IV
Code: 318451(19)

Total Theory Periods: 40
Total Tutorial Periods: 10
Class Tests: Two (Minimum)
Assignments: Two (Minimum)
ESE Duration: Three Hours
Maximum Marks: 80
Minimum Marks: 28

**Course Objectives:**
To discuss and learn:
1. The fundamental connections between the conservation laws in heat, mass, and momentum in terms of vector and tensor fluxes.
2. How to formulate conservation statements in heat, mass, and momentum at multi scales from microscopic to macroscopic in both steady modes.
3. How to solve analytic linear partial differential equations including separation of variables, similarity solutions.
4. Classic transport solutions including rotating disks flow around spheres and in channels with heat and/or mass transfer occurring.

**UNIT- I**
Introduction of transport processes, classification of transport processes mechanism of momentum transports; Newton’s Law of viscosity, Newtonian fluids, pressure and temperature dependence on viscosity; Equations of continuity in rectangular, cylindrical and spherical coordinate; Equations of motion.

**UNIT- II**
Laminar flow, Shell momentum balance, boundary conditions, flow of falling film, flow through circular tubes and annulus, flow through rectangular duct, adjacent flow of immiscible fluids between two parallel plates.

**UNIT- III**
Introduction to heat transport: Fourier’s Law of heat conduction, temperature and pressure; Dependence of thermal conductivity of gases and liquids, thermal conductivity of Solid, free and forced convection.

**UNIT- IV**
Mechanism of energy transport: Shell energy balances, boundary conditions, heat conduction with an electrical heat source, heat conduction with viscous heat source, heat conduction with nuclear heat source, heat conduction through composite walls, conduction in cooling fins.

**UNIT- V**
Mechanism of mass transport: Fick's Law of diffusion, temperature and pressure dependence of mass diffusivity; Shell mass balance, boundary conditions, diffusion through a stagnant gas film, diffusion into a falling liquid film, diffusion into a Solid Sphere, diffusion from a droplet in a quiescent gas.

**Text Books:**

**Reference Books:**
1. Momentum and mass Transfer, Bennet C.O. and Meyer J.E.,
2. Introduction to Transprot Phenomena, William J.Thomson

**Course Outcomes:**
Students will be able to:
1. Simplify the general equations of change for specific applications.
2. Analyze advanced transport problems in heat, mass, and momentum, both macroscopic and microscopic.
3. Formulate energy and mass balances in chemical processes.
Course Objectives

1. To help the student master several advanced ideas in chemical reaction engineering and thermodynamics notably:
   - Complex chemical reaction mechanisms and kinetics.
   - Transport effects in multiphase reactive systems.
   - Advanced reactor design and stability, including consideration of the energy balance.
2. To enable the students able to design/analyze a variety of complex reacting systems in both traditional and nontraditional areas of chemical engineering and thermodynamics at the end of the course.

UNIT-I
Thermodynamic functions: Laws of thermodynamics, thermodynamic equations, joule, Thompson effects, heat effects-standard heat of reactions, free energy of formation.

UNIT-II
Chemical potential, fugacity, activity, activity coefficient, chemical reaction equilibrium; Standard free energy change, equilibrium conversion, Vant Hoff’s Equation, Clausius Clapeyron Equation, Gibbs Duhem Equation.

UNIT-III
Kinetics of homogenous reaction, Rate constant, Order (0th , 1st, 2nd) and molecularity; Rate equation, Arrhenius equation, Activation energy; Parallel and series reaction; Reaction mechanics.

UNIT-IV
Analysis of rate of Reaction; Deferential Method; Integral Method; Half Life Method; Fundamentals of Batch reactor(BFR); Plug Flow Reactor(PFR); Continuous Stirred Tank Reactor (CSTR).

UNIT-V
Michaelis-Menten equation and its various modifications; Kinetics of substrate utilization, product formation and biomass production; Monod growth model and its various modifications, structured and unstructured kinetic rate models, thermal death rate kinetics of cells and spores.

Text Books:

Reference Books:
2. Chemical Engineering Thermodynamics, K.V.Narayanan
3. Theory Thermodynamics, Y.V.C.Rao
4. Engineering Thermodynamics, R.Yadav

Course Outcomes:
1. The introduction of the principles of Chemical Engineering, thermodynamics and illustration of their application to design of chemical process plants will enable the students to implicate the knowledge in making the industrial setup.
2. The content comprising of the fundamental laws of thermodynamics, the estimation of volumetric and key thermodynamic properties of real fluids and mixtures, solution thermodynamics, phase and chemical reaction equilibria will make the students efficient in solving the related problems.
Chhattisgarh Swami Vivekanand Technical University, Bhilai

Name of program: Bachelor of Engineering
Branch: Biotechnology
Subject: Physiology
Semester: IV
Code: 318453(18)

Total Theory Periods: 40
Class Tests: Two (Minimum)
ESE Duration: Three Hours
Total Tutorial Periods: NIL
Assignments: Two (Minimum)

Total Theory Periods: 40
Total Tutorial Periods: NIL
Maximum Marks: 80
Minimum Marks: 28

Course Objectives
1. To make the students understand the functional principles of genetic, cellular and organ level and their use in plant and human physiology.
2. To make the students apply physiological principles for solving environmental health issues.

UNIT-I Introduction to Cell Physiology: Transport of substances through the cell membrane: Osmosis, Diffusion and its types, Active transport (Sodium potassium pump) and Passive transport, Membrane potential, Measuring Membrane Potential, Action Potential, Electrocardiogram (ECG), Electromyography (EMG), Electroencephalography (EEG).

UNIT-II System physiology- Plant (I): Photosynthesis: Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO₂ fixation-C3, C4 and CAM pathways. Respiration and photorespiration: Mitochondrial electron transport in plants, ATP synthesis, alternate oxidase, photorespiratory pathway. Nitrogen metabolism: Amino acid biosynthesis; Nitrate and ammonium assimilation,

UNIT-III System physiology- Plant (II): Plant hormones: Biosynthesis, storage, breakdown and transport, physiological effects and mechanisms of action. Solute transport and photo assimilate translocation: Uptake, transport and translocation of water, ions, solutes and macromolecules from soil: through cells, across membranes and through xylem and phloem; Transpiration; Mechanisms of loading and unloading of plant assimilates. Secondary metabolites: Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles. Stress physiology: Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.


UNIT-V System physiology- Animal (II): Thermoregulation: Comfort zone, body temperature: physical, chemical, neural regulation, acclimatization; Stress and adaptation. Digestive system: Digestion, absorption; Energy balance, BMR. Endocrine system – Endocrine glands, basic mechanism of hormone action, neuroendocrine regulation.

Text Books:

Reference Books:

Course Outcome:
1. At the end of the course, students will have sufficient systematic and comprehensive knowledge about basics of animal and plant physiology which will help them relate to the different physiological processes taking place in the cell and organisms.
Course Objectives:
1. To make the students well acquainted with emerging field of biotechnology i.e. Recombinant DNA Technology as well as create understanding and expertise in wet lab techniques in genetic engineering.
2. To make the students well acquainted with concepts of r-DNA technology and its applications.

UNIT-I Fundamentals of genetics and mutation: Nonsense, misses and point mutations, frame shift mutations, physical, chemical and biological mutagens and transposons; Basic concepts of Genetic Engineering– isolation, identification and characterization of DNA; Plasmids and its uses; Tools of genetic engineering: cloning vectors, restriction enzymes, modifying enzymes- DNA lipase, polymerases, etc.

UNIT-II Vectors: plasmids, phage vector- M13, λ, phagemids, cosmids, artificial chromosomes: BAC, YAC, MAC, Shuttle vector, bacteriophage and other viral vectors.

UNIT-III Gene Cloning: isolation of desired gene, preparation of r-DNA and its integration into host cell, selection and screening of transformants; DNA sequencing; Polymerase chain reactions; DNA fingerprinting; Southern and northern blotting; In-situ hybridization; RAPD; RFLP; Site-directed mutagenesis; Gene transfer technologies, methods of gene transfer- natural and artificial; Gene therapy.

UNIT-IV Gene Library- c-DNA preparation, c-DNA library, genomic DNA library, amplification of gene library, difference between c-DNA Library and genomic library; Gene isolation; Gene cloning; Expression of cloned gene; Transposons and gene targeting; DNA labeling Preparation and application of molecular probes, DNA probes, RNA probes, radioactive and non-radioactive labeling of DNA.

UNIT-V Plasmid expression vectors-general features, promoters used in expression vectors: cloning of genes in correct reading frame in expression vector: purification of recombinant protein using Histidine tag, GST tag, chitin binding domain and intein: Codon use in different organisms, codon usage database, codon optimization to increase the expression of recombinant protein.

Text Books:

Reference Books:
4. Genetic engineering, Smita Rastogi, Oxford University Press India.

Course Outcomes:
1. Students will have expertise in the basic molecular techniques with hands-on experience in the techniques.
2. Theoretical as well as experimental knowledge will help in better application of the principles behind the techniques.
UNIT-I  Introduction to Biomolecules and Structures & Properties of carbohydrates and Proteins: Basic principles of organic chemistry; Biomolecules-nature, importance and their conformation; Weak inter-molecular interactions in bio-macromolecules. Biological building block molecules: Carbohydrates: Classification, structure, function and their derivatives, aldoses and ketoses, reducing properties, cyclic structure formation. Proteins & Amino acids: Classification, structure and function of proteins and amino acids, acidic and basic properties, isoelectric points, D and L classification, essential amino acids, test for proteins; Conformation of proteins: Ramachandran plot, structure of proteins, domains, motif and folds.

UNIT-II  Structures & Properties of Lipids and Nucleic Acids: Lipids: Classification, structure and function of lipids and fatty acids, saturated and unsaturated fatty acids, lipoproteins and their functions, significance of cholesterol, Nucleic Acids: Components of nucleic acids, classification and structure of Nucleosides and nucleotides, function of nucleic acids: carrier of chemical energy of cell, nucleic acid analogs; Watson and Crick model of DNA, difference between DNA and RNA. Conformation of nucleic acids (helix (A, B, Z), types of RNA, secondary structure of RNA, enzyme factor, regulatory molecules

UNIT-III  Metabolism of carbohydrates and proteins: Carbohydrate Metabolism: nutrition, digestion and absorption Glycolysis, Krebs cycle and Electron Transport System, Gluconeogenesis, Glycogenesis, HMP shunt; Calculation of ATP production during Glycolysis and TCA cycle. Protein Metabolism: Catabolism of protein, synthesis of amino acids (Leucine and tryptophan), conversion of amino acids to stabilized products, Urea cycle; Regulation of levels of high energy compounds and reducing equivalents in the cell.


UNIT-V  Applied Biochemistry: Plasma proteins and their importance in medical biochemistry, homeostasis and thrombosis, metabolism of xenobiotics, Use of isozymes to diagnose tissue damage, clinical uses of liposomes, anticancer drugs

Text Books:
2. Fundamentals of Biochemistry by Jain and Jain, S. Chand Group.

Reference Books:

Course Outcome:
1. At the end of the course, students will have sufficient systematic and comprehensive knowledge about basics of biomolecules which will help them relate to the different metabolic processes taking place in the cell and how inanimate chemicals cause life.
Name of program: Bachelor of Engineering
Branch: Biotechnology
Subject: Medical Biotechnology
Semester: IV
Code: 318456(18)
Total Theory Periods: 30
Class Tests: Two (Minimum)
ESE Duration: Three Hours
Total Tutorial Periods: 10
Assignments: Two (Minimum)
Maximum Marks: 80
Minimum Marks: 28

Course Objectives:
1. To make the students understand about human genetics, disorders and diseases associated.
2. To familiarize the students with diagnostic techniques used in medicine.
3. To make the students aware with ethical issues associated with techniques in human genetics.

UNIT-I Introduction: Human genetics (types of diseases: Chromosomal disorders, Numerical disorders e.g. trisomies & monosomies, Structural disorders e.g. deletions, duplications, translocations & inversions, chromosomal instability syndromes; Gene controlled diseases: Autosomal and X-linked disorders, mitochondrial disorders), inheritance pattern, general study of causes of genetic disorders.

Cancer and oncogenes: Types of Cancer, properties of cancer, genetic basis of cancer; Oncogenes: Tumor suppressor genes function and mechanism of action of pRB and p53.


UNIT-IV Therapy: Gene Knockouts /silencing, gene disruption-p53, immunological (MAb, vaccines); Gene therapy for non-inheritable diseases: somatic cell gene therapy and germ line gene therapy; Stem cell therapy; Radiotherapy; Chemotherapy; Enzyme therapy.

UNIT-V Ethical issues in medicine: In vitro fertilization, surrogate therapy; Prenatal sex determination; Genetic counseling; Germline gene therapy; IPR, patenting; Human transgene.

Text Books:
2. Medical Biotechnology, S. N. Jognand (2000), Himalaya Publication

Reference Books:

Course Outcome:
1. The students will gain knowledge of human genetics and molecular mechanisms of the diseases using which they can apply the concepts in research related works.
Chhattisgarh Swami Vivekanand Technical University, Bhilai

Name of program: Bachelor of Engineering
Branch: Biotechnology
Subject: Transport Process Laboratory
Semester: IV
Code: 318461(19)
Total Lab Periods: 36
Maximum Marks: 40
Batch Size: 15
Minimum Marks: 20

List of Experiments: (At least Ten experiments are to be performed by each student)

1. To determine heat transfer coefficient of pin fin extended surfaces heat transport
2. To determine all heat transfer forces convection apparatus.
3. To determine over all heat transfer coefficient of double pipe heat exchanges.
4. To determine over all heat transfer coefficient of shell and tube heat excluder.
5. To determine coefficient of discharge of venturi and orifice.
6. To calibrate given rotameter.
7. Study of sudden expansion and sudden contraction and determine expansion and contraction losses.
8. To determine Reynolds number of flowing fluid and draw fiction factor curve.
9. To determine discharge coefficient of weir notch.
10. To determine pressure drop in packed bed apparatus.
11. To determine fluidiction coefficient of fluidized bed.
12. To determine diffusivity in forced diffusion system.
14. Study of spray dryer
15. Determine the heat transfer coefficient for heat flow through composite wall.

Equipments/Machines/Instruments/Tools/Software Required:

- Pin fin Apparatus
- Shell and tube heat exchanger
- Sudden expansion and sudden contraction arrangement
- Fluidized bed.
- Spray dryer.
- Humidifier

Recommended Books:
Name of program: Bachelor of Engineering  
Branch: Biotechnology  
Subject: Thermodynamics & Biochemical Reaction Engineering Laboratory  
Semester: IV  
Code: 318462(19)  
Total Lab Periods: 36  
Maximum Marks: 40  
Batch Size: 15  
Minimum Marks: 20

**List of Experiments:** *(At least Ten experiments are to be performed by each student)*

1. Study of kinetics of Irreversible reaction in Batch Reactor  
2. Study of kinetics of irreversible reaction in isothermal PFR.  
4. Study of kinetics of irreversible reaction in CSTR.  
5. Estimation of Carbohydrate  
6. Estimation of Protein  
7. Determination of Iodine value of fat  
8. Determination of Saponification value of fat  
9. Identification of given sample (Carbohydrate, Protein, Fat)  
10. Separation of amino acid by paper chromatography.  
11. Isolation of amylase producing organism  
12. To determine heat of reaction for given reaction system.

**Equipments/Machines/Instruments/Tools/Software Required:**
- Batch Reactor  
- Plug Flow Reactor (PFR)  
- Adiabatic Reactor  
- Mixed Flow Reactor (MFR)  
- Heterogeneous Catalytic Reactor  
- Biochemical Reactor

**Recommended Books:**

2. Chemical Engineering Thermodynamics, K.V.Narayanan  
Chhattisgarh Swami Vivekanand Technical University, Bhilai

Name of program: **Bachelor of Engineering**
Branch: **Biotechnology**
Subject: **Recombinant DNA Technology Laboratory**

Semester: IV  
Batch Size: 15

Code: 318463(18)  
Minimum Marks: 20

**Total Lab Periods:** 36  
**Maximum Marks:** 40

**List of Experiments:** *(At least Ten experiments are to be performed by each student)*

1. Isolation of DNA from plant cell by CTAB method.
2. Isolation of DNA from onion cell.
3. Electrophoresis of DNA from plant/onion cell.
4. Isolation of RNA from yeast cell.
5. Estimation of DNA by Diphenyl method.
7. Total Genomic DNA extraction (Kit).
8. Plasmid Conjugation (Kit).
9. Isolation of DNA from Blood (Kit).
10. Silver Staining of DNA isolated from plant/Animal (Kit).
11. DNA Ligation (Kit).
12. Restriction Digestion (Kit).
13. Experiments to perform amplification of DNA
14. Transfer of DNA/Protein from Gel to nitrocellulose membrane by western blotting.

**Equipments/Machines/Instruments/Tools/Software Required:**

- Refrigerated Micro-Ultracentrifuge
- Gel Electrophoresis Apparatus
- Oven
- Incubator
- UV Transilluminator
- Micropipette
- PCR Machine
- Western Blotting Apparatus
- Gel Rocker
- –20 Refrigerator

**Recommended Books:**

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Name of program: Bachelor of Engineering
Branch: Biotechnology
Subject: Biochemistry Laboratory
Total Lab Periods: 36
Maximum Marks: 40

Semester: IV
Code: 318464(18)
Batch Size: 15
Minimum Marks: 20

List of Experiments: (At least Ten experiments are to be performed by each student)

1. Lab equipment orientation.
2. Qualitative tests for carbohydrates – distinguishing reducing from non-reducing sugars and keto from aldo sugars.
4. Protein estimation by Biuret method.
5. Protein estimation by Bradford method.
6. Total Carbohydrate estimation by Anthrone method.
7. Extraction of lipids and analysis by TLC.
10. Enzymatic assay of amylase from *Aspergillus niger* extract

Equipments/Machines/Instruments/Tools/Software Required:

- pH meter
- Colorimeter
- Water bath
- Balance (500 g – 0.1 g)
- Balance (200g - 0.1 mg)
- Table top Centrifuge
- Microfuge
- Micropipettes (200 μl – 1000 μl), (20 μl - 200 μl), (1 μl – 20 μl).
- Hot air Oven
- UV – Vis spectrometer
- Vortex shaker
- Magnetic Stirrer
- Fume hood
- Bunsen Burner

Recommended Books:
1. Experiments in Microbiology, Plant Pathology and Biotechnology, K. R. Aneja, New Age International
UNIT- I HEALTH & HYGIENE: Concept of health, Physical health and mental health and wellbeing and how to achieve these, longevity and how to achieve it, concept and common rules of hygiene, cleanliness and its relation with hygiene; Overeating and undereating, amount of food intake required, intermittent fasting; adequate physical labour, sleep; consumption of junk fast food vs nutritious food; fruits, vegetables cereals and qualities of each of these.

UNIT-II INTRODUCTORY KNOWLEDGE OF COMMON STREAMS OF MEDICINAL CURE: History, development, basic concepts, modes of operation of Alopasthy, Ayurved, Homoeopathy, Biochemic, Unani, Siddha, Accupressure, Acupuncture, Naturopathy, Yogic and Herbal system of medicines, Introduction of Anatomy and Physiology concerned.

UNIT- III YOGASANS: Meaning and concept of Yoga, Yogasans and its mode of operation, How to perform Yogasans, Common Yogasans with their benefits, such as, Padahastasan, Sarvangasan, Dhanurasan, Chakrasan, Bhujangasan, Paschimottasan, Gomukhasan, Mayurasan, Matsyasana, Matsyendrasan, Pawanmuktasan, Vajrasan, Shalabhasan, Sinhasan, Shashankasan, Surya Namaskar, Halasan, Janushiras, Utshep Mudra.

UNIT-IV YOGASANS FOR COMMON DISEASES: From Yogic Materia Medica with symptoms, causes, asans and herbal treatment.

- Modern silent killers: High blood pressure, diabetes and cancer, causes and cure; Common health problems due to stomach disorders, such as, indigestion, acidity, dysentry, piles and fissures, arthritis, its causes, prevention and cure.
- Asans for relaxation: Shavasan, Makarasan, Matsyakridasan, Shashankasan.
- Asans to increase memory and blood supply to brain: Shirsh padasan, Shashankasan.
- Asans for eye sight: Tratak, Neti Kriya .
- Pranayam: Definition and types: Nadi Shodhan, Bhastrik, Shitakari, Bhramari useful for students.

UNIT-V CONCENTRATION: Concentration of mind and how to achieve it. Tratak (त्रटक), Concentration on breath, Japa (जप), Asan, (आसन), internal silence (सिद्धान्त आसन), visualization in mental sky (सिद्धान्त आसन), Concentration on point of light (तृणातीति आश्रय आसन), Concentration on feeling (स्वप्न आश्रय आसन), Concentration on figure (सूत आश्रय आसन).

Text Books:
Health, Hygiene & Yoga, Dr P B Deshmukh, Gyan Book Pvt Ltd. New Delhi.

Reference Books:
(1) Yogic Materia Medica
(2) Asan, Pranayam and Bandh.