Department of
BIOTECHNOLOGY

4 Years B.Tech Degree Programme

REGULATION & SYLLABUS 2017

Choice Based Credit System
Outcome Based Assessment

SEMESTER-III & IV

AUTONOMOUS
Accredited by NBA
Accredited by NAAC with 'A' Grade (3.28 out of 4.00 CGPA)

GANDHI INSTITUTE OF ENGINEERING AND TECHNOLOGY
Affiliated to UGC New Delhi &Biju Patnaik University of Technology, Odisha
GUNUPUR – 765022, Odisha, India

COURSE STRUCTURE

III SEMESTER

Sl. No.	Course Code	Course Title	L	T	P	C	QP
THEORY							
1	**BBTPC3010**	Basics of Biology	3	1	-	4	
2	**BBTPC3020**	Biochemistry	3	-	-	3	
3	**BBTPC3030**	Microbiology	3	-	-	3	
4	**BBSBS3040**	Engineering Mathematics – III	3	1	-	4	
5	**BCSES3050**	OOPS using JAVA	3	-	-	3	
6	**BMGHS3061**	Engineering Economics & Costing	3	-	-	3	
	BMGHS3062	Environmental Engineering & Safety					
PRACTICAL / SESSIONAL							
7	**BBTPC3110**	Basics of Biology Lab	-	-	2	1	
8	**BBTPC3120**	Biochemistry Lab	-	-	2	1	
9	**BBTPC3130**	Micro Biology Lab	-	-	2	1	
10	**BCSES3150**	OOPS using JAVA Lab	-	-	2	1	
Total						**24**	

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPC3010	**Basics of Biology**	**3**	**1**	**-**	**4**	**A**

Course Educational Objective

CEO1: To introduce the basic knowledge of biology and its application

CEO2: To understand the functions of cell , cell division and principle of inheritance in living system

Course Outcome

CO1	Students will obtain knowledge of cell structure, function of cellular organelles, membranes, and biological molecules.
CO2	The undergraduate will understand the inter and intra molecular communication
CO3	Student have an idea about genetic diseases
CO4	Student will know the developmental aspects of plant and animals

UNIT:1 **15 Hours**

Structure & Chemical composition of cells: ultra structure of Cell (Prokaryotic and Eukaryotic), Cell Wall & Cell Membrane, Cell organelles: structure and function, Nucleus, cell inclusions, Molecular organization of chromosome (Nucleosome concept).

UNIT:2 **15 Hours**

Cell Cycle, Cell Divisions- Mitosis and Meiosis, Membrane transport & trafficking, mechanisms of protein sorting and targeting, intercellular communication and associated signaling pathways, cancer cell Biology (Cause, Cell Characteristics).

UNIT:3 **15Hours**

Principles of Inheritance: Chromosome theory of Heredity, Mendelism, Non-Mendelian Gene Interactions (Epistasis, Lethality, Pleiotropy), Polygenes and multiple allele, Allelic Complementation, Cytoplasmic Inheritance, Linkage and Crossing over, Chromosome mapping, Mutation and Chromosomal Aberration, Transposable elements, Genetic diseases in Human(Colour blindness, Haemophillia).

UNIT:4 **15 Hours**

Origin, evolution and diversification of life, natural selection, Types of selection (stabilizing, directional etc), Population Genetics: Hardy-Weinberg's law, Genetic Equilibrium, Changes in gene frequency, gene flow, Genetic Drift, Effect of evolutionary forces on genetic equilibrium of a population. Developmental genetic with reference to Arabidopsis and Drosophila.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books 1. Cell Biology, Genetics, Molecular Biology, Evolution & Ecology by P S Verma and VK Agrawal, S. Chand

2. Cell biology and Genetics by P K Gupta Rastogi Publication

Ref. Books

1. Molecular Biology of the Cell 4th Edition Bruce Alberts

2.The Cell A Molecular Approach Geoffrey M Cooper. Boston University 2nd edition

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPC3020	**Biochemistry**	**3**	**-**	**-**	**3**	

Course Educational Objective
CEO1:To provide the knowledge on microbiologists present in the cell.
CEO2:To have an idea about hormones and their functions.

Course Outcome	
CO1	Students will obtain knowledge about the structure/function of biomolecules such as Carbohydrates, Proteins, Amino acids and Lipids.
CO2	The students will learn the basic structure of nucleic acids and principle of bioenergetics.
CO3	The students will be able to demonstrate the fundamentals of biochemical principles such as cellular metabolism, metabolic pathways and the regulation of biological/biochemical processes.
CO4	Students will understand the different types of enzymes, hormones, vitamins, minerals and their functions.

UNIT:1 11 Hours

Structure and Function of Carbohydrates: Monosaccharide, Oligosaccharides, Polysaccharides (Starch, Glycogen, Cellulose), Optical Isomerism, Structure and Function of Lipids: Saturated and Unsaturated Fatty Acids, Triacylglycerols, Phosphoglycerides, Sphingolipids, Waxes and Sterol. Structure and Function of Proteins: 20 Amino acids, Peptide bond, Hierarchy of protein architecture, Ramachandran Plot.

UNIT:2 11 Hours

Structure and Function of Nucleic Acids: DNA, RNA, Double Helix Model of DNA, Denaturation and Renaturation of DNA; Structure and function of Hormones, Minerals and Vitamins. Principle of Bioenergetics: Bioenergetics and Thermodynamics, Phosphoryl group transfer and energy currency-ATP; Biological Oxidation and reduction reactions.

UNIT:3 12 Hours

Metabolism-I: Introduction to metabolic processes; Metabolism of Carbohydrates: Glycolysis, TCA Cycle, ETS and Oxidative Phosphorylation, Gluconeogenesis,Metabolism of Lipids: Anabolism (Saturated), Catabolism (α- Oxidation, β-Oxidation) and Energetics of lipid metabolism; Metabolism of Nucleic Acids: Catabolism and anabolism of purine and pyrimidine nucleotides. Photosynthesis: Light reaction and dark reaction.

UNIT:4 11 Hours

Metabolism-II: Metabolism of proteins: Biosynthesis of amino acids (role of precursors); Enzymes: Properties of Enzyme, Classification of Enzymes, Mechanism of enzyme action, Kinetics of enzyme action, Activation energy, Enzyme Inhibition, Coenzyme

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books: 1. Principle of Bio-Chemistry – Lehinger, Nelson and Cox 2. Biochemistry of Biochemistry by L. Stryer 3. Fundamentals of Biochemistry by A.C Deb
Ref. Books 1 Fundamentals of Biochemistry – Voet&Voet 2 Biochemistry, Rastogi, Tata McGraw Hill. 3 Fundamental of Biochemistry, Jain and Jain

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPC3030	**Microbiology**	**3**	**-**	**-**	**3**	

Course Educational Objective

CEO1: To make the student learn about origin and evolution of microbes.

CEO2: To make the student understand structure and functioning of different microbial groups.

Course Outcome

CO1	Students will gain the knowledge about classifications, culture and identification of important microorganisms.
CO2	The undergraduates will understand the microbial growth, reproduction and process of nitrogen fixation.
CO3	Students will obtain the knowledge about food microbiology, human pathogens and their life cycle.
CO4	The undergraduate will learn about the antibiotics and microbiology of different environment.

UNIT:1 11 Hours

Discovery of microorganisms,Theory of spontaneous generation, Identification of Microorganisms - A general account,Introduction to Microbial Kingdom- Bacteria, Viruses, Fungi,Classical and Modern approaches of microbial taxonomy; Classification of bacteria, fungi and Viruses; Methods of Microbiology- Culture media, Sterilization, Establishment of pure culture, Staining of bacteria (Gram's, Acid Fast, Capsule),

UNIT:2 12 Hours

Microbial growth and metabolism: Pattern of bacterial growth, Growth kinetics, Monod's Equation, Synchronous Growth and its Kinetics, Continuous culture and its growth kinetics, Cyanobacteria and nitrogen fixation, Microbial genetics: Organization of bacterial and viral genome, Plasmids ,Genetic recombination in bacteria (Transformation, Conjugation and Transduction), DNA repair mechanisms in bacteria, Transposons, Mutation in Microorganisms, Ames test for Mutagenesis

UNIT:3 12 Hours

Food Microbiology: Microbiology of foods, Types of microbes associated with food spoilage, Food preservation methods, Food poisioning, Microbiology of Milk and dairy products.Medical Microbiology: disease causing bacteria, virus and fungi; Basic concepts, action of pathogens, human pathogenic viruses and bacteria, Gram-positive and Gram-negative Bacilli of medical importance. Miscellaneous bacterial agents of disease; DNA and RNA viruses and their diseases, Fungal diseases. Life cycle of some important pathogens like- Malaria, hepatitis, filaria,

UNIT:4 10 Hours

Antibiotics-classification & mode of action, Therapeutic index. Environmental Microbiology: Microbiology of water, Microbiology of Air, Baceriological analysis of water, Microbiology of extreme environments (Halobacteria, Methanogens, Thermofiles).

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books 1.A text book by Micro biology by R.C.Dubey and D.K. Maheshwari, .S.Chand
2. A text book by Micro biology by Naveen Kango, I.K.International Publishing House

Pvt. ltd.

Ref. Books1. Prescott's Micro biology by Michael J. Pelczar, JR, E.C.S.Chan, Noel R.Krieg. Indian edition

2. Prescott's Micro biology by Joanne M.Willey, Linda M.Sherwood and Christopher J. Woolverton

Title of the subject

Subject Code		L	T	P	C	QP
BCSPC3030	**OOPS Through JAVA**	**3**	**0**	**0**	**3**	**A**

Pre -Requisite:

Course Educational Objective

CEO1: The model of object oriented programming: abstract data types, encapsulation, inheritance and polymorphism

CEO2:Fundamental features of an object oriented language like Java: object classes and interfaces, exceptions and libraries of object collections

CEO3: How to take the statement of a business problem and from this determine suitable logic for solving the problem; then be able to proceed to code that logic as a program written in Java.

CEO4: How to test, document and prepare a professional looking package for each business project using javadoc.

Course Outcome

CO1	Students will be able to map real world problems into the Programming language with oop features and Implement object oriented principles for reusability.
CO2	Students will be able to write programs using basic data types and strings, using loops, Array.
CO3	Student will be able to Assign priorities and resolve run-time errors with Multithreading and Exception Handling techniques
CO4	Students will be able to Interpret Events handling techniques for interaction of the user with GUI and Develop client/server applications using socket programming

UNIT:1 **(12 Hours)**

An introduction Object Oriented Programming, Features of Object Oriented Programming Introduction to Java. Difference between C/C++ and Java, Features of Java, First Java Program, Writing the java program, Compiling the program, JVM and its significance in executing a program?, Architecture of JVM. Understanding, Java Tokens, Datatypes, Operators, Control Structures and Arrays, Conditional Statements, Loops/ Iterators, Jumping Statements, Java Arrays, Multidimensional Arrays, Taking Input from keyboard, Command Line Arguments, Using Scanner Class, Using Buffered Reader class.

UNIT:2 **(14 Hours)**

Introduction to Classes and Objects. Constructors, static Keyword , this Keyword, Array of Objects, Access Modifiers (Public, Private, Protected, Default). Inheritance ,Types of Inheritance and Java supported Inheritance, super, Polymorphism, Method Overloading, Constructor Overloading, Method Overriding, Dynamic Method Dispatching. String Manipulations. Wrapper classes, Auto boxing and unboxing. Abstract classes, Interfaces, Multiple Inheritance Using Interfaces,

Java API Packages, User-Defined Packages, Accessing Packages, Error and Exception Handling, Types of exceptions Hierarchy of Exception classes, try, catch, finally, throw, throws, Commonly used Exceptions and their details ,User defined exception classes.

UNIT:3 (**14 Hours**) Multithreading, Thread in Java, Thread execution prevention methods. (yield(), join(), sleep()), Concept of Synchronization, Inter Thread Communication, Basics of Deadlock, Demon Thread, Improvement in Multithreading, Inner Classes, Introduction, Member inner class, Static inner class, Local inner class, Anonymous inner class. IO Streams (java.io package) ,Byte Stream and Character Stream, Files and Random Access Files, Serialization, Collection Frame Work (java.util), Util Package interfaces, List, Set, Map.
UNIT:4 **(14 Hours)** Applet Introduction, Life Cycle of an Applet, GUI with an Applet, Abstract Window Toolkit (AWT), Introduction to GUI, Description of Components and Containers, Component/Container hierarchy, Understanding different Components/Container classes and their constructors, Event Handling, Different mechanisms of Event Handling, Listener Interfaces, Adapter classes.
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS
Text Books 1 Programming in Java. Second Edition. Oxford Higher Education. (SachinMalhotra/ SauravChoudhary) 2 Core Java For Beginners. (RashmiKanta Das), Vikas Publication
Ref. Books 1.JAVA Complete Reference (9th Edition) HerbaltSchelidt

Title of the subject						
Subject Code		L	T	P	C	QP
BMGHS3061	**Engineering Economics & Costing**	**3**	**0**	**0**	**3**	

Pre -Requisite:

Course Educational Objective

CEO1: to understand the significance of the economic aspects of engineering and to become proficient in the evaluation of engineering proposals in terms of worth and cost

CEO2: to help students to grasp various economics concepts and theories towards making economic decision.

Course Outcome

CO1	Understanding the fundamentals of economic theory in general- concept of demand & supply, theories of production-Laws of returns
CO2	Overview of cost and revenue concepts: Understood the nature and behavior of cost, cost sheet, Break-even analysis- linear approach and understanding of depreciation with its measurement.
CO3	Acquainted with evaluation of engineering proposals(Private and public) by learning the concept of Time-value of Money, Determination of economic life of an asset, Replacement of existing asset with a new asset etc.
CO4	Familiar with Indian financial system and banking structure, idea about concept of national income –its measurement and inflation.
CO5	Ultimately learners of the subject get the benefits of understanding the diverse situation happening in the economy and able to make rational decision in the field of engineering.

UNIT:1 (10 Hours)

Engineering Economics –

Meaning,Nature, Scope, Basic problems of an economy, Micro economics and Macro Economics.

Demand and Supply Analysis -Meaning of demand, Demand function, Law of Demand and its exceptions, Determinants of demand, Elasticity of demand &its measurement (Simple numerical problems to be solved) Meaning of supply, Law of supply and its exception, Determinants of supply, Elasticity of supply, Determination of market equilibrium (Simple numerical problems to be solved).

Theory of Production -Production function, Laws of returns: Law of variable proportion, Law of returns to scale

UNIT:2 (10 Hours)

Cost and revenue concepts, Elements of costs, Preparation of cost sheet, Segregation of costs into Fixed and variable costs. Basic understanding of different market structures, Price and output Determination under perfect competition (Simple numerical problems to be solved), Break Even Analysis - Linear approach (Simple numerical problems to be solved). Depreciation- Causes of depreciation, Methods of calculating depreciation (Straight line method, Declining balance method)

UNIT:(12 Hours)

Time value of money -Interest Analysis - Simple and compound, nominal and effective rate of interest, Cash flow diagrams, Principles of economic equivalence.Evaluation of engineering projects- Present worth method, Future worth method, Annual worth method, Internal rate of return method, Cost benefit analysis for public projects. Replacement Analysis- Determination of economic life of an asset, Replacement of existing asset with a new asset.3

UNIT:4 (8 Hours)

Overview of Indian financial system. Commercial bank, Functions of commercial bank, Central bank, Functions of Central Bank. Inflation- Meaning of inflation, types, causes, measures to control inflation. National Income - Definition, Concepts of national income, Method of measuring national

income.
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS
Text Books 1. Riggs, Bedworth and Randhwa, “Engineering Economics”, McGraw Hill Education India Principles of Economics, DevigaVengedasalam; KarunagaranMadhavan , Oxford University Press.
Ref. Books 1. Engineering Economy by William G.Sullivan, ElinM.Wicks, C. PatricKoelling, Pearson R.PaneerSeelvan, “ Engineering Economics”, PHI Ahuja,H.L., “Principles of Micro Economics” , S.Chand& Company Ltd

Title of the subject						
Subject Code		L	T	P	C	QP
BMGHS3062	**ENVIRONMENTAL ENGINEERING & SAFETY**	**3**	**0**	**0**	**3**	

Course Educational Objective

CEO1: Graduates will pursue higher education and work in Research and Development for solving real world problems

CEO2: Graduates will have leadership qualities with social consciousness and ethics.

Course Outcome

CO1	Explain the structure and function of ecosystem and realize its importance for maintaining ecological balance.
CO2	Identify environmental problems arising due to engineering and technological activities and the science behind those problems.
CO3	Describe the major pollutants environmental problems and control devices for environmental management and sustainable development
CO4	Analyze different types of environmental hazards and their management
CO5	Describe the importance of environmental safety.

UNIT:1 (14 Hours)

Ecological Concepts: Biotic components, Ecosystem Process: Energy, Food Chain, Water cycle, Oxygen cycle, Nitrogen cycle etc., Environmental gradients, Tolerance levels of environment factor, Indian Environmental Law. Chemistry in Environmental Engineering: Atmospheric chemistry, Soil chemistry. Noise pollution- Noise standards, measurement and control.

UNIT:2 (14 Hours)

Waste Water Treatment: DO and BOD, Waste water treatment process: pretreatment, primary and secondary treatment of waste water, Activated sludge treatment: Anaerobic digestion, Reactor configurations and methane production.

Air Pollution: Air pollution and pollutants, criteria pollutants, non-criteria pollutants, Acid deposition, Global climate change –greenhouse gases, Air pollution meteorology, Atmospheric dispersion, Industrial Air Emission Control, Flue gas desulphurization, NOx removal, Fugitive emissions.

UNIT:3 (8 Hours) Solid Waste Management, Source, classification and composition of MSW: Separation, storage and transportation, Reuse and recycling, Waste Minimization Techniques. Hazardous Waste Management, Hazardous waste and their generation, transportation and treatment: Incinerators, Inorganic waste treatment. E.I.A., Environmental auditing.
UNIT:4 (8 Hours) Occuptional Safety and Health Acts, Safety procedures, Type of Accidents, Chemical and Heat Burns, Prevention of Accidents involving Hazardous substances, Human error. Hazard Control Measures in steel industry, Petroleum Refinery, Pharmaceutical industry. Fire Prevention -Detection, Extinguishing Fire, Safety Management- Safety Handling and Storage of Hazardous Materials, Corrosive Substances, Hydrocarbons and Wastes. Personal Protective Equipments.
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS
Text Books 1 Environmental Engineering, Irwin/ McGraw Hill International Edition, 1997, G. Kiely 2.Environmental Engineering , Prof. B.K. Mohapatra, Seven Seas Publication, Cuttack 3. Environmental Engineering and Safety , Raut & Sen, Scientific Publishers.
Ref. Books 1. Environmental Engineering, Arcadio P. Sincero & Gergoria A. Sincero PHI Publication 2 Environmental Science, Curringham & Saigo, TMH

Subject Code	**Course Title**	L	T	P	C	QP
BBTPC3110	**Basics of Biology Lab**	**0**	**0**	**2**	**1**	

Pre -Requisite: Mechanics of Solid
Course Educational Objective
In this laboratory, students will have the opportunity to study about microscopy
The microscope used to analyse the different stage of cell division

Course outcomes: At the end of the course, the student will be able to:	
CO1	Students can understand the operation of microscope for the analysis of cells
CO2	Student will understand the cell counting techniques
CO3	Student will gain the knowledge on different types of blood cells.
CO4	The undergraduate can understand the working principle of SEM.

LIST OF EXPERIMENT

1. Study of different parts of Microscope and its use.
2. Preparation of Mitosis from Onion Root-tip cells and observation of permanent slides.
3. Preparation of meiotic cell division in grasshopper testis
4. Cell Counting and viability study
5. To isolate the pigments from plant leaf.
6. To identify the blood cell types in human blood smear.
7. To identify the different types cells present in the leaf cross section.
8. To prepare permanent slides using the given sections like Plant and animal samples.
9. Separation of lymphocytes and granulocytes from blood sample
10. To study cellular fractionation of a homogenized rat liver via a technique called differential centrifugation.
11. To study the technical principles underlying Scanning Electron Microscopy (SEM).

Subject Code	**Course Title**	L	T	P	C	QP
BBTPC3120	**Biochemistry Lab**	**0**	**0**	**2**	**1**	

Pre -Requisite: Mechanics of Solid
Course Educational Objective
In this laboratory, students will have the opportunity to do the analysis of different biomolecules through spectophotometry and chromatographic techniques
Analysis of different Enzyme activity and assay are possible by this laboratory

Course outcomes: At the end of the course, the student will be able to:	
CO1	Student can analyze the protein and carbohydrate by spectrophotometry
CO2	Student can be determined the quality and quantity of nucleic acid.
CO3	The undergraduate will separate the biomolecules by chromatography techniques
CO4	Students can extract and study the activity and assay of enzymes

LIST OF EXPERIMENT

1. Estimation of Protein using Lowry's Method
2. Estimation of carbohydrates
3. Estimation of DNA using DPA method
4. Estimation of RNA using Orcinol Method
5. Estimation of iodine Number and Saponification value of fatty acids/Oil
6. Separation of Amino acids by Paper Chromatography
7. Separation of Sugars by Thin Layer Chromatography
8. Separation of Proteins by elctrophoretic method.
9. Extraction of extracellular from bacterial culture.
10. Assay of Enzyme activity: Amylase/Protease

Subject Code	**Course Title**	L	T	P	C	QP
BBTPC3130	**Microbiology Lab**	**0**	**0**	**2**	**1**	

Pre -Requisite: Mechanics of Solid
Course Educational Objective
In this laboratory, students will have the opportunity to learn the sterilization and staining techniques
Here student can know about the preparation of culture media, bacteria culture methods.

Course outcomes: At the end of the course, the student will be able to:	
CO1	Student can understand the micrometry and different staining techniques
CO2	Student will do the preparation of media and its various method of sterilization
CO3	Student can isolate the microbes from natural sources and study the growth and culture technique.
CO4	Student will learn the antibiotic assay of microbes and different kinds of microscopy

LIST OF EXPERIMENT

1. Micrometry: calibration of stage and ocular micrometer and measurement of dimension of microbial cells.
2. Staining of microbial sample (Gram's Staining, Endospore staining, Fungal staining)
3. Media preparation and sterilization (Slant, Stab and Broth culture)
4. Isolation of micro organisms from natural habitats (Air, Water, Soil & Milk)
5. Establishment of pure culture by streak plate and serial dilution method.
6. Study the bacterial growth curve using spectrophotometer and viability assessment.
7. Antibiotic assay and estimation of Zone of inhibition.
8. Chemical assay and MIC determination of antibiotics.
9. Biochemical assay of microorganisms (Starch Hydrolysis, Casein Hydrolysis and IMVIC test).
10. Microscopy: Study of Compound, Phase contrast and Fluorescence Microscopes.

Subject Code	**Course Title**	L	T	P	C	QP
BCSES3150	OOPS using JAVA LAB			**2**	**1**	

Pre -Requisite:	
Course Educational Objective	
CEO1:	CEO1: The model of object oriented programming: abstract data types, encapsulation, inheritance and polymorphism
CEO2:	CEO2: Fundamental features of an object oriented language like Java: object classes and interfaces, exceptions and libraries of object collections
CEO3:	CEO3: How to take the statement of a business problem and from this determine suitable logic for solving the problem; then be able to proceed to code that logic as a program written in Java.
CEO4:	CEO4: How to test, document and prepare a professional looking package for each business project using java doc.
Course Outcome	
CO1	Students will be able to map real world problems into the Programming language with oop features and Implement object oriented principles for reusability.
CO2	Students will be able to write programs using basic data types and strings, using loops, Array.
CO3	Student will be able to Assign priorities and resolve run-time errors with Multithreading and Exception Handling techniques
CO4	Students will be able to Interpret Events handling techniques for interaction of the user with GUI and Develop client/server applications using socket programming

JAVA programs on:

1. Introduction, Compiling & executing a java program.
2. Data types & variables, decision control structures: if, nested if etc.
3. Loop control structures: do, while, for etc.
4. Classes and objects.
5. Data abstraction & data hiding, inheritance, polymorphism.
6. Threads, exception handlings and applet programs
7. Interfaces and inner classes, wrapper classes, generics

COURSE STRUCTURE

IV SEMESTER

Sl. No.	Course Code	Course Title	L	T	P	C	QP
THEORY							
1	**BBTPC4010**	Molecular Biology	3	1	-	4	
2	**BBTPC4020**	Biostatistics	3	1	-	4	
3	**BBTPC4030**	Bio-analytical Techniques	3	-	-	3	
4	**BBTPC4040**	Biochemical Reaction Engineering	3	-	-	3	
5	**BMEES4050**	Fluid Mechanic & Hydraulic Machine	3	-	-	3	
6	**BMGHS3061**	Engineering Economics & Costing	3	-	-	3	
	BMGHS3062	Environmental Engineering & Safety					
PRACTICAL / SESSIONAL							
7	**BBTPC4110**	Molecular Biology Lab	-	-	2	1	
8	**BBTPC4120**	Biostatistics Lab	-	-	2	1	
9	**BBTPC4130**	Bio-analytical Techniques Lab	-	-	2	1	
10	**BMEES4150**	Fluid Mechanic & Hydraulic Machine Lab	-	-	2	1	
Total						**24**	

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPC4010	**Molecular Biology**	**3**	**1**	**-**	**4**	

Pre -Requisite:

Course Educational Objective

CEO1: To provide the general knowledge on cell, cell cellular organs, and their function.

CEO2: To provide detailed knowledge about gene expression.

Course Outcome

CO1	Student will understand the organization and complexity of genome.
CO2	Students will understand the mechanism of DNA replication, DNA repair and DNA recombination.
CO3	Students will emphasize the molecular mechanism of transcription, protein synthesis and gene regulation in various organisms.
CO4	Students will articulate applications of molecular biology in the modern world.

UNIT:1 15 Hours

Genome Organization: Prokaryotes and Eukaryotes, Nuclear genome and Organellar genome, DNA as the genetic material, Central dogma of molecular biology, Genome complexity, C-value Paradox, Cot curve analysis, Repetitive DNA, satellite DNA; Cistron, Recon, Muton; Variants of gene- Split genes, pseudo genes, Overlapping genes and selfish DNA.

UNIT:2 15 Hours

DNA Replication: Models of DNA replication, Enzymology of DNA replication, Process of DNA replication, DNA replication at the telomere, Replication of Mitochondrial and Chloroplast genome, DNA repair, Homologous recombination and Holliday junction.

UNIT:3 15 Hours

Transcription: Transcription machinery (prokaryotes and eukaryotes), Transcription factors, Transcription process, m-RNA processing (Pre and Post transcriptional processing), m-RNA stability and nuclear transport, m-RNA editing.

UNIT:4 15 Hours

Translation: Genetic code, Translation machinery (t-RNA, Aminoacyl t-RNA synthetase, Ribosome), Translation process, Post translational modification of protein. Regulation of Gene expression: Constitutive and Induced gene expression, Operon model (Lac-operon and Trp- operon), Gene silencing, DNA methylation, Introduction to recombinant DNA technology.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books: 1. Molecular Biology of Cell By Lodish and Baltimore

2. Molecular Biology by Frefelder.
3. Gene VII by Benjamin Lewin

Ref. Books 1MolecularBiology. By Turner.
2.Molecular "Biology of Gene" – Watson
3. Genome by T.A Brown

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPC4020	**Biostatistics**	3	1	-	4	

Course Educational Objective
CEO1:To provide the basic knowledge on importance of biostatistics
CEO2:Analyses of biological data with various biostatistical tools to draw conclusion

Course Outcome	
CO1	Student will get the concept on biological variables
CO2	Student will learn the technique of analysis of data
CO3	Students have an idea about the distribution of data in natural condition
CO4	Design of experiment and draw samples without any biasness

UNIT:1 (15 Hours)

Introduction and definition of Biostatistics; Concept of variables in biological systems. Collection, Classification, tabulation graphical and diagrammatic representation of numerical data; Measures of central tendency: Mean, Median and Mode and their relationship; Measures of dispersion: Range, Quartile deviation, Mean deviation, Standard deviation, Concept of standard error, Coefficient of variation, Skewness and Kurtosis.

UNIT:2 (15 Hours)

Probability: Random experiment, events, sample space, mutually exclusive events, independent and dependent events; Various definitions of probability, addition and multiplication theorems of probability, Random variables (discrete and continuous), Probability density functions andits properties; Probability distributions: normal, Binomial, Poisson and their application.

UNIT:3 (15 Hours)

Concept of populations and sample. Simple random sampling without replacement. Definition ofSimple random sample; Designing of Experiments-Random block design and Split plot design;Correlation and Regression, linear regression.

UNIT:4 (15 Hours)

Analysis of variance: One- way and two-way classifications with single observation per cell. Duncan's multiple range test; Tests of significance: Chi-square, student's t, z and f-distributions, their properties and uses.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books 1Biostatistics by P.N.Arora and P.N. Malhan, Himalaya Publishing house
2Introduction to biostatistics by P.K.Banerjee, S.Chand

Ref. Books 1Introduction to Biostatistics and Research methods by P.S.S SundarRao and J. Richard, PHI publication
2 Biostatistics BY MunjuPandey , Euro span Publisher.

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPC4030	**Bio-analytical Techniques**	**3**	**-**	**-**	**3**	

Pre -Requisite:

Course Educational Objective

CEO1: To provide knowledge about bio instruments and their working principle.

CEO2: To learn the use of instruments and their application in research.

Course Outcome

CO1	Student will understand the working principle of spectroscopic and microscopic techniques like Mass s spectroscopy, NMR, IR, ESR and Electron microscopy..
CO2	Student will acquire knowledge on various analytical techniques and instruments used for the separation and analysis of bimolecules.
CO3	Students will learn and design different chromatographic techniques for separation of biological products.
CO4	Students will understand the application of radioactivity in the analysis of biomolecules

UNIT:1 (11 Hours)

Spectroscopic techniques: Spectroscopic methods to study physicochemical properties ofBiomolecules,UV-Vis, IR, FTIR, Fluorescence, Mass Spectroscopy, NMR, ESR and X-ray crystallography. Principles of electron microscopy, preparation of samples, TEM and SEM.

UNIT:2 (12 Hours)

Electrophoresis: General principle of electrophoresis, support media (agarose and polyacrylamide gels), Agarose gel electrophoresis electrophoresis of proteins by SDS-PAGE, native PAGE, gradient gels, isoelectric focusing, two dimensional PAGE, Blotting Techniques: Southern, Northern and Western blot analysis. Polymerase Chain Reaction (PCR).Centrifugation: Basic principles of sedimentation (RCF), Types of centrifuge and centrifugation

UNIT:3 (12 Hours)

Chromatography: Principles of chromatography, distribution coefficient, retention time, Chromatographic methods for macromolecular separation- Paper, TLC and column chromatography, Partition chromatography, ion exchange chromatography, gel exclusion chromatography, affinity chromatography, normal phase and reversed phase chromatography, HPLC, Gas Chromatography

UNIT:4 (10 Hours)

Radioisotope Techniques: Radioactivity activity detection methods based on ionization (Geiger- Muller monitor), excitation (solid and liquid scintillation counting), autoradiography, safety aspects of handling radioactive material.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books 1 Principles and Techniques of Biochemistry and Molecular Biology, Wilson K. and Walker

J., Cambridge University Press (2005) 6th ed.

2. Biochemical Method-A Concise guide for students and researchers, Pingoud A., UrbankeC., Hoggett J. and Jeltsch A. Wiley-VCH Publishers.

Ref. Books 1Bioseparations: Science and Engineering, Harrison, R.G., Todd, P., Rudge, S.R. andPetrides, B.B. Oxford University Press (2006).

2. Molecular Spectroscopy, McHale, J.L., Prentice Hall (1998).

3. Microscopy and Microtechniques. Marimuthu, R., MJP Publishers (2008).

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPC4040	**Biochemical Reaction Engineering**	**3**	**-**	**-**	**3**	

Pre -Requisite:

Course Educational Objective

CEO1:To imbibe the knowledge on different reaction and their theory

CEO2: To have an idea about different reactor and their application in production

Course Outcome

CO1	Develop rate laws for homogeneous reactions
CO2	Design of ideal reactors for single and complex reactions
CO3	Explain non-isothermal reactors and the heat exchange.
CO4	Distinguish between various RTD curves and predict the conversion from a Non-ideal reactor using tracer information.

UNIT:1 (10 Hours)

Material Balance & Energy Balances: Mathematical requisites – use of log-log and semi-log graph paper, triangular diagram, graphical differentiation and graphical integration, material balance without chemical reaction, material balance with chemical reaction, energy balance; enthalpy changes, heat of reaction and its temperature dependence, heats of solution and mixing, adiabatic flame temperature, use of psychometric charts.

UNIT:2 (12 Hours)

Kinetics of homogeneous reactions: classification of reactions, reaction rate, speed of reaction, rate equation, concentration-dependent term of rate equation, rate constant, order and molecularity, representation of elementary and nonelementary reactions, kinetic models for nonelementary reactions, temperature-dependent term of a rate equation, activation energy and temperature dependency.

UNIT:3 (10 Hours)

Kinetic analysis of batch reactor data: Integral and differential methods for analyzing kinetic data, interpretation of constant volume batch reactor, data for zero, first, second and third order reactions, half life period, irreversible reaction in parallel and series, auto catalytic reaction. Kinetic interpretation of batch reactor data for single reactions: interpretation of variable volume batch reaction data for zero, first and second order reactions, Ideal batch reactor, steady state CSTR and plug flow reactors and their use for kinetic interpretation. Design for single reaction: size comparison of single reactors, plug flow reaction in series and/or parallel, equal and different size of mixed reactor in series, finding the best system for given conversion, recycle reactor, Design of multiple reactions in batch, CSTR and PFR.

UNIT:4 (10 Hours)

Biochemical reaction systems: Cell and enzyme fermentation, Monod's model of growth kinetics. Kinetics of Enzyme catalyzed reactions for free and immobilized enzymes. – derivation of Michaelis-Menten equation, Briggs-haldane relationship, the determination and significance of kinetic constants, Lineweaver-burk and Eadie-Hofstee plot, principles of enzyme inhibition – Competitive, noncompetitive and uncompetitiveMichaelish-Menten kinetics, inhibition by foreign substances, kinetics of competitive and noncompetitive inhibitions, microbial fermentation, batch fermentor and mixed flow fermentor, kinetic expressions of fermentation.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS
Text Books 1: Ievenspiel O. Chemical Reaction Engineering, Wiley International 2:Fogler H. S., Chemical Kinetics and Reactor Calculation.
Ref. Books 1: Smith J. M., Chemical Engineering Kinetics, McGraw Hill. 2: Wales J. M., Kinetics for Chemical Engineering, McGraw Hill.

Title of the subject						
Subject Code		L	T	P	C	QP
BMEES4050	**Fluid Mechanic & Hydraulic Machine**	**3**	**-**	**-**	**3**	

Pre -Requisite:

Course Educational Objective

CEO1: To know the concept of fluid and its properties, manometer, hydrostatic forces acting on different surfaces and also problem solving techniques.

CEO2: To relate the basic laws of fluids, flow patterns, viscous flow through ducts and their corresponding problems.

CEO3: To analyze the hydrodynamic forces acting on vanes and their performance evaluation

CEO4: To evaluate of the importance, function and performance characteristics of hydro machinery

Course Outcome

CO1	Explain the basic of fluidisation.
CO2	Describe the various industrial application of fluidisation.
CO3	Explain the various fluidisationregime,Classification of particles.
CO4	Describe the staging of fluidised bed reactor.

Unit:1 (10 hours)

The Phenomenon of Fluidization, Liquidlike Behavior of a Fludized Bed, Advantages and Disadvatages of Fluidized Beds for Industrial Operations, Fluidization Quality, Industrial Applications of Fluidized Beds**:** Coal Gasification, Gasoline from Other Petroleum Fractions, Gasoline from Natural and Synthesis Gases, Synthesis Reactions, Metallurgical and Other Processes Physical Operations: Heat Exchange, Solidification of a Melt to Make Granules, Coating Metal Objects with Plastic, drying of Solids, Cracking of Hydrocarbons: (FCC), Fluid Coking and Flexi-Coking, Thermal Cracking Combustion and Incineration: Fluidized Combustion of Coal, Incineration of solid Waste ,Carbonization and Gasification: Gasification of Coal and Coke, Activation of Carbon, Gasification of Solid Waste, ,Reactions Involving Solids: Roasting Sulfide Ores, Silicon for the Semiconductor and Solar Cell Industries, Chlorination and Fluorination of Metal Oxides, Reduction of Iron Oxide, Bio fluidization

Unit:2(10 hours)

Fluidization and Mapping of Regimes

Fixed Beds of Particles: Characterization of Particles, Fixed Beds-One Size of Particles, Fixed Beds-Solids with a Distribution of sizes, Fluidization without Carryover of Particles: Minimum Fluidizing Velocity, umf, pressure Drop-versus-Velocity Diagram, Effect of Pressure and Temperature on Fluidized Behaviour, Sintering and Agglomeration of Particles at High Temperature.

The Geldart Classification of Particles Fluidization with Carryover of Particles: Terminal Velocity of Particles, utFast Fluidization, Mapping of Fluidization Regimes

Unit:3(10 hours)

The Dense Bed: Distributors, Gas Jets, and Pumping Power

Distributor Types: Ideal Distributors, Perforated or Multiorifice Plates, Tuyeres and Caps, Pipe Grids and Spargers ,Pressure Drop Requirements across Distributors

Bubbling Fluidized Beds Estimation of Bed Properties: Gas Flow in the Emulsion phase, Bubble Gas flow, Bubble Size and Bubbles Growth, Bubble Rise Velocity, Beds with Internals

Unit4:(10 hours) **Solid Movement: Mixing, Segregation and Staging** Vertical Movement of Solids:, Dispersion Model, Counterflow Solid Circulation Models, Relating the Counterflow to the Dispersion Model, coarse Particle Beds. Horizontal Movement of Solids: Mechanistic Model Based on the Davidson Bubble, Mixing index. Segregation of Particles: Mixing-Segregation Equilibrium, Steady State Separation of Particles. Large Solid in Beds of Smaller Particles: Large Solids Resting on Distributors.
Teaching Mentod (s):Chalk& Board/PPT/Video Lectures /MOOC/ Internship/Industry Guest Lecture/Invited Guest Lecture Demonstration. (can be chosen one or many)
Text Books 1.Fluidization Engineering: Daizo Kunii and Octave Levenspiel
Ref. Books 1

Title of the subject						
Subject Code		L	T	P	C	QP
BMGHS3061	**Engineering Economics & Costing**	**3**	**0**	**0**	**3**	

Pre -Requisite:

Course Educational Objective

CEO1: to understand the significance of the economic aspects of engineering and to become proficient in the evaluation of engineering proposals in terms of worth and cost

CEO2: to help students to grasp various economics concepts and theories towards making economic decision.

Course Outcome

CO1	Understanding the fundamentals of economic theory in general- concept of demand & supply, theories of production-Laws of returns
CO2	Overview of cost and revenue concepts: Understood the nature and behavior of cost, cost sheet, Break-even analysis- linear approach and understanding of depreciation with its measurement.
CO3	Acquainted with evaluation of engineering proposals(Private and public) by learning the concept of Time-value of Money, Determination of economic life of an asset, Replacement of existing asset with a new asset etc.
CO4	Familiar with Indian financial system and banking structure, idea about concept of national income –its measurement and inflation.
CO5	Ultimately learners of the subject get the benefits of understanding the diverse situation happening in the economy and able to make rational decision in the field of engineering.

UNIT:1 (10 Hours)

Engineering Economics –

Meaning,Nature, Scope, Basic problems of an economy, Micro economics and Macro Economics.

Demand and Supply Analysis -Meaning of demand, Demand function, Law of Demand and its exceptions, Determinants of demand, Elasticity of demand &its measurement (Simple numerical problems to be solved) Meaning of supply, Law of supply and its exception, Determinants of supply, Elasticity of supply, Determination of market equilibrium (Simple numerical problems to be solved).

Theory of Production -Production function, Laws of returns: Law of variable proportion, Law of returns to scale

UNIT:2 (10 Hours)

Cost and revenue concepts, Elements of costs, Preparation of cost sheet, Segregation of costs into Fixed and variable costs. Basic understanding of different market structures, Price and output Determination under perfect competition (Simple numerical problems to be solved), Break Even Analysis - Linear approach (Simple numerical problems to be solved). Depreciation- Causes of depreciation, Methods of calculating depreciation (Straight line method, Declining balance method)

UNIT:(12 Hours)

Time value of money -Interest Analysis - Simple and compound, nominal and effective rate of interest, Cash flow diagrams, Principles of economic equivalence.Evaluation of engineering projects- Present worth method, Future worth method, Annual worth method, Internal rate of return method, Cost benefit analysis for public projects. Replacement Analysis- Determination of economic life of an asset, Replacement of existing asset with a new asset.3

UNIT:4 (8 Hours)

Overview of Indian financial system. Commercial bank, Functions of commercial bank, Central bank, Functions of Central Bank. Inflation- Meaning of inflation, types, causes, measures to control inflation. National Income - Definition, Concepts of national income, Method of measuring national

income.
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS
Text Books 1. Riggs, Bedworth and Randhwa, “Engineering Economics”, McGraw Hill Education India Principles of Economics, DevigaVengedasalam; KarunagaranMadhavan , Oxford University Press.
Ref. Books 1. Engineering Economy by William G.Sullivan, ElinM.Wicks, C. PatricKoelling, Pearson R.PaneerSeelvan, “ Engineering Economics”, PHI Ahuja,H.L., “Principles of Micro Economics” , S.Chand& Company Ltd

Title of the subject						
Subject Code		L	T	P	C	QP
BMGHS3062	**ENVIRONMENTAL ENGINEERING & SAFETY**	**3**	**0**	**0**	**3**	

Course Educational Objective

CEO1: Graduates will pursue higher education and work in Research and Development for solving real world problems

CEO2: Graduates will have leadership qualities with social consciousness and ethics.

Course Outcome

CO1	Explain the structure and function of ecosystem and realize its importance for maintaining ecological balance.
CO2	Identify environmental problems arising due to engineering and technological activities and the science behind those problems.
CO3	Describe the major pollutants environmental problems and control devices for environmental management and sustainable development
CO4	Analyze different types of environmental hazards and their management
CO5	Describe the importance of environmental safety.

UNIT:1 (14 Hours)

Ecological Concepts: Biotic components, Ecosystem Process: Energy, Food Chain, Water cycle, Oxygen cycle, Nitrogen cycle etc., Environmental gradients, Tolerance levels of environment factor, Indian Environmental Law. Chemistry in Environmental Engineering: Atmospheric chemistry, Soil chemistry. Noise pollution- Noise standards, measurement and control.

UNIT:2 (14 Hours)

Waste Water Treatment: DO and BOD, Waste water treatment process: pretreatment, primary and secondary treatment of waste water, Activated sludge treatment: Anaerobic digestion, Reactor configurations and methane production.

Air Pollution: Air pollution and pollutants, criteria pollutants, non-criteria pollutants, Acid deposition, Global climate change –greenhouse gases, Air pollution meteorology, Atmospheric dispersion, Industrial Air Emission Control, Flue gas desulphurization, NOx removal, Fugitive emissions.

UNIT:3 (8 Hours)

Solid Waste Management, Source, classification and composition of MSW: Separation, storage and transportation, Reuse and recycling, Waste Minimization Techniques. Hazardous Waste Management, Hazardous waste and their generation, transportation and treatment: Incinerators, Inorganic waste treatment.

E.I.A., Environmental auditing.

UNIT:4 (8 Hours)

Occuptional Safety and Health Acts, Safety procedures, Type of Accidents, Chemical and Heat Burns, Prevention of Accidents involving Hazardous substances, Human error. Hazard Control Measures in steel industry, Petroleum Refinery, Pharmaceutical industry. Fire Prevention -Detection, Extinguishing Fire, Safety Management- Safety Handling and Storage of Hazardous Materials, Corrosive Substances, Hydrocarbons and Wastes. Personal Protective Equipments.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books 1 Environmental Engineering, Irwin/ McGraw Hill International Edition, 1997, G. Kiely

2.Environmental Engineering , Prof. B.K. Mohapatra, Seven Seas Publication, Cuttack 3. Environmental Engineering and Safety , Raut & Sen, Scientific Publishers.
Ref. Books 1. Environmental Engineering, Arcadio P. Sincero & Gergoria A. Sincero PHI Publication 2 Environmental Science, Curringham & Saigo, TMH

Subject Code	**Course Title**	L	T	P	C	QP
BBTPC4110	**Molecular Biology Lab**	**0**	**0**	**2**	**1**	

Pre -Requisite: Mechanics of Solid
Course Educational Objective
In this laboratory, students will have the opportunity to isolate the nucleic acids from various organisms.
Students can estimate the amount of DNA and RNA isolated by spectrophotometry

Course outcomes: At the end of the course, the student will be able to:	
CO1	Students will study the isolation of nucleic acid from different organisms.
CO2	The undergraduate will learn the separation of macromolecule using electrophoresis.
CO3	They will know the quantification of biomolecules.
CO4	Students can understand the restriction digestion and molecular mapping.

LIST OF EXPERIMENT

1. Isolation, purification of DNA from plant sample and its yield estimation.
2. Isolation, purification of DNA from blood sample and its quantification using UV spectrophotometer.
3. Isolation, purification of DNA from bacterial sample and its quality assessment.
4. Isolation of plasmid DNA from bacteria and estimation its size using agarose gel electrophoresis.
5. Effect of gel concentration on solidification and migration of DNA sample
6. Restriction digestion of supplied DNA sample and estimate the molecular weight of the fragments resulted.
7. Elution of the DNA from the supplied gel and assess the integrity of the fragments.
8. Isolation and purification of RNA from plant/yeast sample and its quantification using UV spectrophotometer..
9. Isolation and purification of protein from the supplied sample and its quantification using UV spectrophotometer.

Subject Code	**Course Title**	L	T	P	C	QP
BBTPC4120	**Biostatistics Lab**	**0**	**0**	**2**	**1**	

Pre -Requisite: Mechanics of Solid
Course Educational Objective
In this laboratory, students will have the opportunity to study the important application of Biostatistics in various biotechnological experiments
The analysis and decision making techniques will be learned by the students.

Course outcomes: At the end of the course, the student will be able to:	
CO1	Students will understand the importance and application of biostatistics.
CO2	The undergraduates will learn how to represent the biological data for analysis
CO3	Student will know the comparison of data and application of null hypothesis.
CO4	Students will gain the practical knowledge on ANOVA and correlation of coefficient.

LIST OF EXPERIMENT

1. Introduction to biostatistics and measurement.
2. Construct and interpret graphical displays such as histograms, bar charts, ogive etc.
3. Collection of sample data and opening sample datasets.
4. Measures of central tendency
5. Measures of dispersion.
6. Hypothesis testing; Students t-test and interpreting confidence level.
7. Hypothesis testing; Chi-square test and interpreting confidence level.
8. Analysis of variance (ANOVA)
9. Conduct and interpret correlation

Subject Code	Course Title	L	T	P	C	QP
BBTPC4130	**Bio-analytical Techniques Lab**	**0**	**0**	**2**	**1**	

Pre -Requisite: Mechanics of Solid
Course Educational Objective
In this laboratory, students will have the opportunity to study the various bioinstruments.
Separation and quantification of biomolecules using various biophysical methods.

Course outcomes: At the end of the course, the student will be able to:	
CO1	Students can study the spectrophotometric analysis of DNA and protein
CO2	The undergraduate will learn the denaturation of protein and nucleic acid and their estimation.
CO3	The student will understand the techniques of electrophoresis.
CO4	The student will have basic idea on operation of HPLC, GC, DSC, FTIR and Electron microscopy (SEM/TEM).

LIST OF EXPERIMENT

1. UV-Visible spectroscopy: UV – spectrophotometric analysis of DNA and protein samples/
2. Determine λmax of DNA, protein, bromophenol blue solutions by wavelengthscan
3. Denaturation of proteins and nucleic acids.
4. Determination of Protein- ligand interaction.
5. Column chromatographic analysis of chlorophyll
6. 2D-TLC analysis of amino acids
7. Use of viscometer in protein analysis
8. Comparison of Coomassie brilliant blue and silver staining methods for visualizing protein bands in SDS-PAGE
9. Comparison of ethidium bromide and silver staining methods for visualisation of small DNA fragments analyzed by native PAGE
10. Fluorescence spectroscopy (demonstration)
11. GC & HPLC (demonstration)
12. Differential scanning calorimetry (demonstration)
13. FTIR (demonstration)
14. Electron microscopy (SEM/TEM) (demonstration)

Subject Code	Course Title	L	T	P	C	QP
BMEES4150	**FLUID MECHANICS AND HYDRAULIC MACHINES LAB**			**2**	**1**	

Pre -Requisite: Mathematics, Fluid Mechanics and Hydraulic Machines
Course Educational Objective
CEO 1: To know the concept of fluid and its properties, manometer, hydrostatic forces acting on

different surfaces and also problem solving techniques.	
CEO 2: To relate the basic laws of fluids, flow patterns, viscous flow through ducts and their corresponding problems.	
CEO 3: To analyze the hydrodynamic forces acting on vanes and their performance evaluation	
CEO 4: To evaluate of the importance, function and performance characteristics of hydro machinery	
Course outcomes: At the end of the course, the student will be able to:	
CO1	**Understand** the basic units of measurement, convert units and determine the magnitude.
CO2	**Discuss** the differences among measurement techniques, their relevance and applications.
CO3	**Explain** the condition of floating and submerging of any object in water.
CO4	**Calculate** the performance analysis of turbines and pumps that can be used in power plants.

List of experiments (Any Eight experiments to be done)

1. Determination of Metacentric Height and application to stability of floating bodies.
2. Determination of C_v and C_d of Orifices.
3. Experiments on impact of Jets
4. Experiments on performance of Pelton Turbine
5. Experiments on performance of Francis Turbine
6. Experiments on performance of Kaplan Turbine
7. Experiments on performance of centrifugal pump
8. Experiments on performance of reciprocating pump
9. Experiments on Reynold's Apparatus
10. Experiments on Flow through pipes
11. Experiments on performance of Gear pump
12. Verifications of momentum equation