Course Code	HM-BT301					
Category	Humanities and Social Science and Management Course					
Course title	Bioethics and IPR in Biotechnology					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: III
	3	0	0	3	40	
Pre-requisites/Co-requisites (if any)	-					

Course Objective:

1. The course helps to build up knowledge regarding ethical practices appropriate to Biotechnology and to apply the ethical norms relevant to the bio industries & field of research.
2. The course focuses to develop the basic concept of intellectual property rights and make the students aware of the protection of intellectual property and related rights.

Course Content:

Module I: [15 Lectures]
Bioethics: Introduction and need of bioethics, its relation with other branches, types of risk associated with genetically modified microorganisms.
Ethical conflicts in biological sciences: interference with nature, bioethics in health care - patient confidentiality, informed consent, euthanasia; Testing of drugs on human volunteers; Artificial reproductive technologies, prenatal diagnosis, Ethics in transplantation and stem cell research, Human and animal experimentation, animal rights/welfare; organ transplantation and ethical issues; Xenotransplantion and its ethical and social issues; Animal cloning and human cloning and their ethical aspects; Human Genome project.

Module II: [5 Lectures]
Ethical Issues in agricultural science: Ethical issues regarding genetically modified organisms (foods and crops); Agricultural biotechnology; genetically engineered food, environmental risk, labeling and public opinion. Sharing benefits and protecting future generations - Protection of environment and biodiversity – biopiracy.
Regulations on ethical principles in biomedical/ biotechnological practice: The Nuremberg code, declaration of Helsinki; the Belmont report, co-operational guidelines – WHO, guidelines of DBT (India), Guidelines of an informed consent

Module III: [5 Lectures]
Introduction: Basics if Intellectual Property, Introduction to laws, Theories of IP, Different forms of IP and its application.

Trademark: Basic of Trademark, Trademark registration, History and Evolution of Patent Law: Evolution of patent Laws, History of Indian Patent System, International Conventions and Treaties, Patent Laws in other countries.

Module IV: [15 Lectures]
Patent: Basics of patent, patent criteria and filing procedure. Patent Prosecution, Patent infringement and management.
Utility Model protection, Basics of copyright, Copyright registration and infringement
Classification of patents: Classification of patents in India, Classification of patents by WIPO, Budapest Treaty; Patent Cooperation Treaty (PCT) and implications; pest Treaty; Patent Cooperation Treaty (PCT) and implications; Categories of Patent, Special Patents, Patenting Biological products,
Patent owner: Rights and Duties, Ownership of patent, Rights of patent holder and co-owners, Duties of patent holder and co-owners, Transfer of patent Rights, Limitations of patent Rights, Restoration of Patents, Infringement of patent Rights and Offences, Actions against Infringement: Remedies/Relief, Patent Agent

Textbooks:

1. Sateesh M.K, Bioethics & Biosafety, IK Publishers.
2. Traynor PL, Biosafety Management, Virginia Polytechnic Institute Publication.
3. Acharya N K, Text book on Intellectual Property Rights, 4 thEdn, Asia Law house.

Reference books:

1. Sasson A (1993) Biotechnologies in developing countries present and future, UNESCO Publishers.
2. Rao MB (2003) WTO and International Trade, Vikas Publishing House Pvt. Ltd

Web Reference:

1. NPTEL: http://nptel.ac.in/courses/102103016/
2. ePgPathshala: http://epgp.inflibnet.ac.in/ahl.php?csrno=3

Course Outcome (CO):

After successful completion of this course, the student will be able to:

1. **Understand** and **identify** different bioethical issues and risks associated with it.
2. **Analyze** and **design** different genetically modified organisms and **examine** its effect on human health and environment.
3. **Understand and interpret** the Intellectual Property Rights (IPRs), trademark, patent of different forms and its application.
4. **Formulate** and **demonstrate** different business strategies by considering the norms of IPRs.

Course Code	**PC-BT301**					
Category	**Professional Core**					
Course title	**Thermodynamics and Kinetics for Biotechnology**					
Scheme and Credits	**L**	**T**	**P**	**Cr. Points**	**Lec. Hrs.**	**Semester: III**
	2	**0**	**0**	**2**	**30**	
Pre-requisites/Co-requisites (if any)	- **Engineering mathematics** - **Chemistry-I**					

Course Objective:

The objectives of the course are:

1. To make the students aware of basic principles and laws of thermodynamics along with reaction kinetics that can be useful in bioreactor operation.
2. To realize the importance of enzyme technology and analysis of complex metabolic networks inside biological system.

Course Content:

Module I: [10 lectures]

Basic Concepts of Thermodynamics:

Review offirst and second laws of thermodynamics, The Ideal Gas,PVT behaviour of Pure Substances, Virial Equation of State, Application of Virial Equations,Simple model's for Vapour/Liquid Equilibrium, Roult's Law, Henry's law, Modified Raoult's Law, The Chemical Potential and Phase Equilibria, Fugacity and Fugacity Coefficient

Module II: [14 lectures]

Enzyme and Reaction kinetics:

Rate of chemical reaction; Effect of Temperature on Rate Constant, Arrhenius equation, Collision Theory, Transition State Theory, Order and Molecularity of a Chemical reaction, Elementary Reactions, First, Second and Third order reactions, Pseudo-first order reaction.

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 uncompetitive.Interpretation of batch reactor data for simple and complex reactions.

Module III: [6 lectures]

Biochemical kinetics:

Stoichiometry of cellular reactions, Reaction kinetics – unstructured and structured models.

Textbook:

1. Smith &Vanness, Thermodynamics for Chemical Engineers, MGH
2. Shuler and Kargi, Bioprocess engineering: Basic concepts, 2nd edition, Prentice Hall publisher
3. Levenspiel,O., Chemical Reaction Engineering, Wiley Eastern Ltd.

Reference books:

1. Richardson, J.F., Peacock, D.G.Coulson& Richardson's Chemical Engineering-Volume 3 ed., First Indian ed. Asian Books Pvt. Ltd. 1998
2. Bailey &Olis, Biochemical Engg. Fundamentals, MGH, 1990
3. Physical Chemistry: Castellan, Narosa Publishing.

Web reference:

1. **http://nptel.ac.in/courses/102106026/#**

Course Outcome:

After completion of the course, the student will be able to:

1. **Understand, define** and **recall** the basic laws of thermodynamics and laws regarding energy transfer of the substances hence become familiar with their use and applications in chemical and biological systems.
2. Ability to **explain** thermodynamic properties of substances in gas or liquid state of ideal and real mixture.
3. **Understand** the order and molecularity of a reaction and **distinguish** between various rate constants and reaction order.
4. **Analysis** of batch reactor data for chemical as well as enzyme catalyzed reaction and **use** of different plots to **compare** various kinetic models.
5. **Analyze** complex metabolic flux in biological system.

Course Code	PC-BT302					
Category	Professional Core					
Course title	Structure of Biomolecules					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: III
	3	0	0	3	40	
Pre-requisites/Co-requisites (if any)	- Chemistry (10 + 2 level)					

Course Objective:

The objectives of the course are:

1. After completion of the course, the students should be able to understand the overall structure and functional properties of biological macromolecules in relationship to their biological function.
2. The overall perspective will be the biomolecules and their characteristic properties and organization in carrying out all the living functions which constitute the life.

Course Content:

Module I: [5 Lectures]

Macromolecular Structure and Dynamics
Structure of water molecules, basic concepts of pH, buffer; strong and weak interactions in biomolecules: Configurations and conformations of macromolecules, Factors that stabilize protein and nucleic acid structure - electrostatic interactions, dipole-dipole interactions, VDW interactions, H-bonding, hydrophobic interaction.

Module II: [5 Lectures]

Structural Chemistry of Carbohydrates and Lipids
Chemistry of Carbohydrates: Mono, di and Polysaccharide (glycogen, starch, cellulose), Classification, Structure (based on Fisher, Haworth projection) and Function; Chemistry of Lipids: Classification, Structure and Function (Fatty acids, Fats and oils, phospholipids, sphingolipids, glycolipids and cholesterol).

Module III: [15 Lectures]

Structural Chemistry of Amino Acids, Proteins and Nucleic acids

Chemistry of Proteins: Chemistry of amino acids and peptides, pH titration curve for amino acids, primary, secondary (alpha helix, beta sheet, Ramachandran plot), tertiary (Ribonuclease), quaternary and super secondary structure of protein, Protein denaturation and renaturation; Chemistry of Nucleic Acids: Chemistry of Nucleoside, Nucleotide and nomenclature, Primary, secondary, tertiary and super secondary structure of DNA and RNA, Denaturation and renaturation kinetics of DNA.

Module IV: [15 Lectures]

Spectroscopic and Microscopic Methods for the Analysis of Macromolecules:
UV-VIS absorption and emission spectroscopy in structure determination: Beer-Lambert's law. Fluorescence Spectroscopy: Microscopy Based on Single Molecule Methods: Introduction, Transmission Electron Microscope (TEM), The Scanning Electron Microscope (SEM).

Text Books:

1. Lehninger's Principles of Biochemistry by David L Nelson; A.L. Lehninger and Michael M. Cox, 5th edition, Worth Publishing.
2. Biochemistry by Lubert Stryer, John L Tymoczko, Jerry M.Berg, 5th edition, W.H. Freeman Company.
3. Biochemistry by Donald Voet and Judith G. Voet, 3rd edition,Wiley John and Sons.
4. Outline of Biochemistry by Eric.E. Conn and P.K. Stumpf, 5th edition, Wiley India.
5. Principles of Fluorescence Spectroscopy, J.R. Lakowicz; (Springer)
6. Fundamentals of Molecular Spectroscopy - C.N. Banwell, (Tata- McGraw-Hill)
7. Biological Spectroscopy-I.D. Cambell & R.A. Durk, (Benjamin Cummings)

Reference Books:

1. Biophysical Chemistry; C.R. Cantor and P.R. Schimmel; (W.H. Freeman &Co.)
2. Principles of Physical Biochemistry, Keith Van Holde, Chien and Ho. Pearson
3. Physical Biochemistry: D.M. Freifelder; Applications to Biochemistry Biology (Freeman)
4. Biophysics-V. Pattabhi & N. Gautham (Narosa, New Delhi).
5. Introduction to Electron Microscopy: S. Wischnitzer.
6. Electron Microscopy in Biology:J.R.Harris (ed.).

Web Reference:

1. NPTEL: http://nptel.ac.in/courses/104103071/
2. NPTEL: http://nptel.ac.in/courses/104105040/
3. NPTEL: http://nptel.ac.in/courses/104102016/
4. NPTEL: http://nptel.ac.in/courses/102105034/
5. NPTEL: http://nptel.ac.in/courses/102105034/
6. NPTEL: http://nptel.ac.in/courses/104105076/

7. NPTEL: http://nptel.ac.in/courses/104106083/36
8. NPTEL: http://nptel.ac.in/courses/104104084/
9. ePgPathshala: http://epgp.inflibnet.ac.in/view_f.php?category=991
10. ePgPathshala: http://epgp.inflibnet.ac.in/view_f.php?category=1354
11. ePgPathshala: http://epgp.inflibnet.ac.in/view_f.php?category=1199
12. ePgPathshala: http://epgp.inflibnet.ac.in/view_f.php?category=991

Course Outcome (CO):

After successful completion of this course, the student will be able to:

1. **Understand the fundamentals** of acid/base equilibrium including pH calculations, buffer behavior, acid/base titrations of some biomolecules and their relationship.
2. **Understand the fundamental** properties and reactivities of biologically important biomolecular interactions with respect to their structural and functional aspects and **to explain** the reaction involved in chemical and biochemical processes**.**
3. **Identify, describe and recognize** the different classes of polymeric biomolecules, monomeric building blocks and the importance of their physical and chemical properties at the atomic level, and **predict** how their behavior change with environmental conditions.
4. **Understand the importance** of biomolecules and their use in the application of biotechnology, food and pharmaceutical products.
5. **Be skilled in problems solving, critical thinking,** and **analytical** reasoning in the aspect of complex structure of biomolecules in different conditions**.**
6. **Know the various qualitative and quantitative** physical methods available for structure determination and **apply** the **analytical skill and design** new experimental techniques to be used in biotechnology.

Course Code	**PC-BT303**					
Category	**Professional Core**					
Course title	**Biochemistry**					
Scheme and Credits	**L**	**T**	**P**	**Cr. Points**	**Lec. Hrs.**	**Semester: III**
	3	**0**	**0**	**3**	**40**	
Pre-requisites/Co-requisites (if any)	- **Chemistry (10 + 2 level)**					

Course Objective:

- The Course deals with the journey of the main building block molecules namely Carbohydrates, Proteins and Lipids starting from their synthesis (Anabolism) to their final fate like degradation (Catabolism). The Interplay of various enzymes, regulators, cofactors in mediating the metabolic process would be discussed.
- Apart from that, it sheds light on cellular transport mechanisms along with Signal transduction pathway.
- This course is an overview on entire bimolecular metabolism with its regulation apt for further academic growth and industrial utilization.

Course Content:

Module I: (10L) Introduction to Enzyme & Carbohydrate Metabolism:

Enzymes: Basic concept of enzyme-substrate reaction, short overview on enzyme kinetics, Enzyme inhibition, Regulation of enzyme activity, allosteric regulation. **Metabolic pathways of carbohydrates and their regulation:** glycolysis, TCA cycle, pentose phosphate pathway, Cori cycle, gluconeogenesis, glycogen metabolism, oxidative phosphorylation**,** electron transport chain, Photosynthesis**:** Photophosrylation, Calvin cycle.

Module II: (10L) Metabolism of lipid and nucleic acid:

Oxidation of Fatty acid: Biosynthesis of fatty acids, phospholipids, Beta oxidation and omega oxidation of fatty acids – saturated and unsaturated fatty acids–even and odd numbered, Catabolism of phospholipids, **Nucleic acid metabolism:** nucleotide metabolism, purine and pyrimidine degradation, De Novo and Salvage Pathways.

Module III: (10L) Metabolism of Amino acid and Protein:

Glucogenic amino acids, ketogenic amino acids, Catabolism of amino acids, general metabolism of amino acids (transamination reaction, oxidative deamination), catabolism of Tyrosine, Leucine, Glutamic acid and Arginine, urea cycle and its regulation, Disorder/ diseases of amino acids metabolism.

Module IV: (10L) Cell Signaling and transport:

Cell signaling and signal transduction pathways: Cell surface receptors, signaling through G-protein coupled receptors, Phosphatidyl inositol pathway, second messengers, cellular transport- Na+-K+ ATPase pump.

Textbook:

1. Lubert Stryer, Bio chemistry, Freeman & Co,

Reference books:

1. NY Lehninger's Principles of Biochemistry by Nelson & Cox
2. Voet & Voet, Fundamentals of Biochemistry, John Willey & Sons
3. Harper's Illustrated Biochemistry - R.K.Murray et al. (McGraw Hill)
4. Outline of Biochemistry - Conn & Stump (John Willey & Sons)

Web Reference:

13. NPTEL: http://nptel.ac.in/courses/104105076/
14. ePgPathshala: http://epgp.inflibnet.ac.in/view_f.php?category=982

Course Outcome:

After completion of the course, Students can be able to

1. **remember, define, and repeat** their concept with requisite background knowledge in the field of Enzyme chemistry, their basic mode of action and regulation.
2. **conceptualize metabolic** chemistry of carbohydrates **understanding** their roles in the regulation of metabolism.
3. **understand and interpret** their knowledge on lipid metabolism.
4. **define and illustrate** the metabolism of amino acids and nucleic acid in Biochemistry.
5. **learn** the basics of signal transduction and cellular transport in details and exhibit their creative potential in **investigating and developing** new ideas in Biochemistry based projects.
6. **analyze** the basics of Biochemistry lab coordinating their theoretical knowledge with practical.

Course Code	PE-BT301					
Category	Professional Core Elective					
Course title	Industrial Stoichiometry					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: III
	3	1	0	4	40	
Pre-requisites/Co-requisites (if any)	- Elementary Physics and Chemistry					

Course Objective:

The objectives of the course are:

1. To understand the unit conversions and numerical calculations involving numbers in scientific notation and quantitative expression of the composition in the mixture.
2. To identify and interpret the chemical reactions with the concept of material balance as an application of the law of conservation of mass.

Course Content:

Module I: 10L
Small units and dimensions:
Buckingham Pi-theorem, Dimensionless groups, Conversion of equations, Solution of simultaneous equations, use of loglog and semi-log graph paper, triangular diagram, Graphical differentiation and graphical integration, Treatment and Interpretation of data, Error analysis in connection with computation.

Module II: 16L
Material balance:
Introductory Concepts, Simplification of the general mass balance equation for steady and unsteady state processes, Procedure for material balance calculations, Material balance without chemical reactions, humidification such as continuous filtration, batch mixing, crystallizer, distillation column, Material balance with chemical reaction: Stoichiometry of growth and product formation, growth stoichiometry and elemental balances, Material Balance with recycle, bypass and purge streams.

Module III: 7L
Energy Balance:
General energy balance equation for steady and unsteady state processes, Without Chemical Reaction, With Chemical Reaction, Enthalpy calculation procedures, Special cases e.g., spray dryer, Distillation Column, Enthalpy change due to reaction: Heat of combustion, Heat of reaction for processes with biomass production, Energy-balance equation for cell culture, for fermentation processes.

Module IV: 7L
Combined Material and Energy Balances
Simultaneous material and energy balances, selected industrial process calculations for chemical and bioprocesses.

BEYOND SYLLABI COVERAGE
Details of graphical methods that would be linked with Bioreactor Design and Analysis

Textbook:

1. Stoichiometry and process calculations,K.V. Narayanan B. Lakshmikutty

Reference books:

1. Bhatt &Vora, Stoichiometry , 4th Ed., TM
2. Hougen and Watson, Chemical Process Principles (Part one): 2nd ed, John Wiley

Course Outcome (CO):

After successful completion of this course, the student will be able to:

1. **Apply** the basic knowledge of science and technology to understand the unit conversions and numerical calculations involving numbers in scientific notation and quantitative expression of the composition in the mixture.
2. **Apply** the knowledge of energy, work, heat relationships, concept of chemical equilibrium and basic chemical reactions to **identify, formulate** the solution of simultaneous equations using graphical method, Treatment and Interpretation of data, Error analysis in connection with computation.
3. **Identify** practical Bioengineering problems and **design and develop solutions** using the concept of material balance.
4. **Identify and interpret the chemical reactions** with the concept of material balance as an application of the law of conservation of mass.
5. **Design and conduct the experiment** by using the concept of energy balance equation for steady and unsteady state processes
6. **Get** the opportunity to apply the knowledge of simultaneous material and energy balances to **investigate the complex industrial problems** process calculations and have the preparation and ability to engage in independent and **life-long learning** in the broad context of technological changes.

Course Code	BS-BT301					
Category	Basic Science Course					
Course title	Microbiology					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: III
	3	0	0	3	40	
Pre-requisites/Co-requisites (if any)	Knowledge of Biology					

Course Objective:

The objectives of the course are:

1. To make the students aware of the structures, nutritional patterns, growth parameters, mode of reproduction, cultivation techniques from different samples, pathogenesis and classification of different types of microbes including bacteria, virus, fungi, algae.
2. Also they can understand the role of micro-organisms in environment, in food industry, in medical fields and also in maintaining the balance in eco system in agricultural field etc.

Course Content:

Module I : **10L :Introduction to Microbiology**

History and development of microbiology, contributions of Leeuwenhoek, Koch, Pasteur, Jenner, Fleming and other scientists of 20^{th} century, scope of Microbiology, Principles and modern approaches of bacterial taxonomy: Basic idea about Hackel and Whittaker's kingdom concept and domain concept of Carl Woose, Bergey's manual, numerical classification, new approaches, GC:AT Ratio, DNA Hybridization, 16SrRNA classification and phylogeny, Cell structure and sub cellular organelles of bacteria–Slime layer, capsule, cell wall, flagella, pili, fimbriae, nucleoid, plasmid and episome (F, R, Ti as example) ribosome, cytoplasmic inclusions (inorganic and organic), endospores, Archaebacteria (importance-structure-reproduction), Moulds (importance- structure- reproduction), yeast (structure reproduction), algae (importance- structure-reproduction). Virology- General classification of virus, animal viruses, plant viruses, Importance of viruses, life cycle of viruses, lytic cycle (T4) and lysogenic (lambda).

Module II: 10L: Basic principles of Microbiology

Principles and applications of Microscopy- dark field, bright field, resolving power, numerical aperture, chromatic aberration, phase contrast microscopy, fluorescent microscopy, inverted microscopy, stereo microscopy, electron microscopy, TEM and SEM. Cultivation of bacteria– Types of growth media (natural, synthetic, complex, enriched, selective- definition

with example), pure culture methods (streak plate, spread plate, pour plate, stab culture, slant culture). Anaerobic (thioglycolate, anaerobic chamber, Robertson's media, microaerophilic), liquid shake culture of aerobic bacteria, Control of microbes- Sterilisation, disinfection, antiseptic, tyndallisation, pasteurization; Antibiotics and chemotherapeutic agents.

Module III: 10L: Microbial Growth and Metabolism

Growth of bacteria- Definition, growth phases, kinetics of growth, direct and indirect measurement of growth, The mathematical nature and expression of growth. Bacterial nutrition, influence of environmental factors-pH, temperature, oxygen. Bacterial metabolism- Aerobic and anaerobic respiration (definition, examples), fermentation (alcoholic, mixed acid, acetic acid, lactic acid), Entner Duodruffs pathway, bacterial photosynthesis (green and purple bacteria), biochemical nitrogen fixation– non-symbiotic, symbiotic (definition and examples), basic concept of nif –genes. Nod genes, nitrogenase complex, leghaemoglobin.

Module IV: 10L: Microbiology of Air, Water and Soil

Air microbiology- Microorganisms in the air, sampling techniques, air borne pathogens. Microbiology of water-Microbiology of fresh water and wastewater (sewage), Important water borne diseases– cholera, typhoid, (name of pathogen, preventive measures), Outlines of method for detection of microorganisms in drinking water (presumptive, confirmatory and completed tests), Distinction between fecal and non-fecal coliforms, Soil microbiology- Soil microorganisms, different kinds of association between soil microflora, between micro and macro organisms.

Textbook:

1. M. Pelczar, E.Chan, N.Kreig, Microbiology, 5th ed, MGH
2. Prescott, Harley, and Klein's microbiology, 8th ed, Joanne M Willey; Linda Sherwood; Christopher J Woolverton; Lansing M Prescott; New York : McGraw-Hill.
3. Brock Biology of Microorganisms Paperback –14th ed, Madigan Michael T. , Martinko John M. , Bender Kelly S. , Pearson.
4. Stanier R. –General Microbiology, 5th ed, Macmilan Press ltd.
5. R.C Dubey and D. K Maheshwari -A Text Book of Microbiology, 3rd ed, S. Chand and Company.
6. C.B Powar and H.F Daginawala- General Microbiology (Vol I & II) 3rd ed, Himalaya Publishing House.

Reference books:

1. Salle.A.J- Fundamental Principles of Bacteriology, Tata Mcgraw Hill

2. Hans G. Schlegel, General Microbiology, 7th ed, Cambridge Low Price Edns

Web Reference:

1. NPTEL: http://nptel.ac.in/courses/102103016/
2. ePgPathshala: http://epgp.inflibnet.ac.in/ahl.php?csrno=3

Course Outcome (CO):

After successful completion of this course, the student will be able to:

1. **Understand, identify** and **analyze** the structures, characteristics of different micro-organisms.

2. **Demonstrate, explain** and **apply** the techniques, tools and methodologies utilized in fundamental microbiological experiments.

3. **Analyze** and **compare** microbial growth patterns, metabolism and basic genetics with higher organisms and infer how microorganisms are used as model systems to study basic biology, genetics, metabolism and ecology.

4. **Extend** their knowledge in **understanding** the ways to control microbial growth by physical and chemical means after realizing the role of microorganisms in pathogenicity, virulence, epidemiology, body defenses, immunology, and hypersensitivity and most importantly in disease transmission, food poisoning.

5. **Cite** the vital role of microorganisms in biotechnology, fermentation, medicine, food production and preservation, and even in maintaining ecological balance in environment with examples.

6. Able to **make use of** ethical code of conduct prescribed by national and international organizations and address the emerging ethical, legal, and social concerns in the field of biological and biomedical sciences.

Course Code	PC-BT391					
Category	Professional Core					
Course title	Structure of Biomolecules Lab					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: III
	0	0	3	1.5	36	
Pre-requisites/Co-requisites (if any)	Chemistry (10 + 2 level)					

Course Objective:

The objectives of the course are:

1. To enable the students to acquire knowledge on different techniques for the study of physical and chemical structure of biomolecules.
2. To enable the students to know the methods and apply those in research and development in the area of biomedical analysis as well as biomedical methods and technology.

Course Content:

1. To prepare an Acetic - Na Acetate Buffer system and validate the Henderson-Hasselbach equation.
2. Amino Acid Analysis: pH measurements and Buffer Preparation
3. Amino Acid Analysis: Isoelectric Point Determination
4. To determine an unknown protein concentration by plotting a standard graph of BSA using UV-Vis Spectrophotometer and validating the Beer- Lambert's Law.
5. Determination of N, P, K, organic C from soil smaples
6. Separation of Lipid/sugar: TLC/Paper Chromatography
7. Estimation of cholesterol by Zak's method
8. Estimation of DNA /RNA by chemical method (DNA estimation by diphenyl amine and RNA by orcinol method)
9. Estimation of Saponification Value of Fats/Oils.
10. Estimation of Iodine Value of Fats and Oils

Course Outcome (CO):

After successful completion of this course, the student will be able to:

1. **Demonstrate, explain** pH, pKa, pKb pI, and buffers preparation in different condition.

2. **Understand and determine** the process of determination of protein/lipid/nucleic acid/sugars etc from unknown solution quantitatively.
3. **Deal** with the study of structural and functional aspects of biomolecules.
4. **Understand and explain** the separation of different biomolecules and their partial characterization.
5. **Demonstrate** and **explain** the working principle of different qualititative testing for fats/oils and soil samples.
6. **Understand and develop** their skills in accuracy and precession during the analysis of different biomolecules.

Course Code	HM-BT391					
Category	Humanities and Social Science and Management Course					
Course title	Technical Report Writing and Language Lab Practices					
Scheme and Credits	L	T	P	Cr. Points	P. Hrs.	Semester: III
	0	0	3	1.5	36	
Pre-requisites/Co-requisites (if any)	Basic knowledge about English grammar, writing and communication					

Course Objective:

Objectives of this Course:

1. To inculcate a sense of confidence in the students.

2. To help them become good communicators both socially and professionally.

3. To assist them to enhance their power of Technical Communication.

Course Content:

Module I: Technical Communication (2P)
The Theory of Communication – Definition and Scope
Barriers of Communication
Current models of Communication (viz. Transectional Model)
Verbal and Non-verbal communication- Definition and Types

Module II: Technical Communication (4P)
Editorial Letter, Business letter
Job related Communication (Job Application-solicited and unsolicited, Writing CV, Drafting Job Acceptance letter and Resignation letter)
Organizational Communication

Module III [2P]

Enhancing Listening Skills through Language Lab Audio device

Module IV [4P]

Developing Speaking and Presentation Skills through Conversation Practice with the aid of Language Lab Audio-Visual Input, through Extempore, Role Play, Poster Presentation, Act Impromptu, Power point presentation etc. (5 L)

Recommended books:

1. Ashraf Rizvi (2005): *Effective Tech Communication*. Tata Mc Graw-Hill Education

2. Meenakshi Raman & Sangeeta Sharma (2015): Technical Communication Principles and Practice (3rd edition). Oxford university Press.

3. Kulbhushan Kumar, Effective Business Communications, Khanna Publishing House (2019)

4. Dr. Nira Konar (2011): *English Language Laboratories: A Comprehensive Manual*. Prentice Hall India Learning Private Limited.

Course Outcome (CO):

After successful completion of this course, the student will be able to:

1. **Improving** comprehension ability in English & understanding the mechanism of interpretation through language learning.
2. **Honing** conversation skills by learning to substantiate conclusions in grammatically correct English
3. **Honing** 'Reading Skills' and its sub skills using Visual / Graphics/Diagrams /Chart Display/Technical/Non Technical Passages; Learning Global / Contextual / Inferential Comprehension for technical competence.
4. **Learning** effective, real life communication skills in English though several language lab activities pertaining to the four basic skills of LSRW
5. **Learning** basic soft skills and leadership qualities
6. **Engaging** the learner in a positive and imaginative environment to hone socio-cultural, ethical and moral skills.

Course Code	PC-BT392					
Category	Professional Core					
Course title	Biochemistry Lab					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: IV
	0	0	3	1.5	36	
Pre-requisites/Co-requisites (if any)	- Chemistry (10 + 2 level) - Biochemistry Theory					

Course Objective:

- The Course boosts students with practical hands on training for several fundamental concepts like spectroscopy, its application. Based on it, the course teaches them estimation of protein, enzyme activity, kinetics and inhibition.
- Apart from that, it trains the students with basic partition procedures like thin layer chromatography and paper chromatography to separate amino acids/sugars.
- This course gives an overview on basic techniques like buffer preparation, pH estimation, weighing reagents/chemicals, instrument maintenance that is fundamental and applicable for subsequent all laboratory classes of various courses.

Course Content:

1. Spectrophotometry: Verification of Lambert-Beer's law
2. Estimation of protein by Lowry method
3. Estimation of specific activity of an enzyme (α and β amylase)
4. Determination of pH optima of amylase
5. Estimation of temperature optima of amylase
6. Enzyme Kinetics - (Determination of Km and Vmax) of amylase
7. Enzyme Inhibition – determining the nature of inhibition
8. Separation of amino acids - Thin layer chromatography.
9. Separation of amino acids - Paper chromatography.
10. Separation of proteins by Polyacrylamide Gel Electrophoresis (PAGE)
11. Mini Project: Relevant to the techniques known earlier (Done beyond the syllabus)

Textbooks:

1. Lehninger Principles of Biochemistry by Nelson and Cox, McMillan publishers
2. Biochemistry by Lubert Stryer. W. H. Freeman & Company, NY
3. Principles and techniques of Practical Biochemistry: K. Wilson and J. Walker (1994), CUP, Cambridge University Press.
4. An introduction to Practical Biochemistry by David T. Plummer (1988), McGraw-Hill Book Company.

Course Outcomes:

After completion of the course, Students can be able to

1. **Remember** and **define** the fundamental concepts of spectroscopy with practical application (during enzyme assay, chemical estimation of biomolecules).

2. **Understand** and **explain** the calculation, data analysis and graph preparation during enzyme assays.

3. **Apply** various techniques, and **implement** theoretical knowledge to separate amino acids, using various techniques like paper and thin layer chromatography.

4. **Compare** theoretical knowledge with lab practicals testing enzyme kinetics, inhibition with effective hands on training.
5. **Develop** decision making potential, team spirit, project management, effective utilization of fund, good coordination keeping in mind various environmental facts, ethics and monetary issues.
6. **Create** lifelong learning practice boosting **new and original work** and develop an inquisitive mind.

Course Code	BS-BT391					
Category	Basic Science Course					
Course title	Microbiology Lab					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: III
	0	0	3	1.5	36	
Pre-requisites/Co-requisites (if any)	Knowledge of Biology					

Course Objective:

The objectives of the course are:

1. To teach the students microbiological techniques and to show them the impact of microbes on our daily lives and their central roles in nature.
2. To make them proficient at laboratory skills and safety procedures along with collection and analysis of data, making careful observations and drawing appropriate conclusions.

COURSE CONTENT:

1. Sterilization techniques
2. Media preparation
3. Microscopy
4. Isolation, enumeration and purification of microbes from a given sample
5. Staining Techniques (Simple, Gram staining, spore staining)
6. Biochemical Characterization of Bacteria Oxidation/Fermentation Test Catalase, Oxidase and Urease Tests IMViC test Hydrogen Sulfide Test and Nitrate Reduction Test. Casein and Starch Hydrolysis
7. Antibiotic Assay - Antimicrobial Sensitivity Test (Disc Diffusion Method)
8. Growth Kinetics (Bacterial Growth Curve)

Reference :

1. Laboratory Manual
2. Microbiology: A Laboratory Manual, Cappuccino, Sherman, Low Price Edition.

COURSE OUTCOMES:

After successful completion of this course, the student will be able to:

1. **Demonstrate and make use of** aseptic techniques including laboratory safety rules and procedures and can properly handle microorganisms and other biohazards.

2. **Analyze and experiment** with different samples (water, soil, blood, milk, any food or others) to know their microbial load and also can predict the identity of the microbes present.
3. **Make use of** microscopic techniques along with some biochemical assays to **illustrate, identify, compare** and even **categorize** different bacterial samples.
4. Formulate cultural media for cultivation of different bacteria, test their growth patterns and show the effects of the environment (Temperature, pH, salinity etc) on growth.
5. **Formulate, compile** and present a well-organized and concise report of the experimental findings, **evaluate** clinical data and **interpret** results.
6. **Develop** communication skills in the presentation of scientific material and **evaluate, understand and interpret** the methods described in the related scientific journal articles.