

**PO (Program Outcomes) and CO (Course Outcomes)
for B.Tech (Biotechnology)
Department of Biotechnology,
Haldia Institute of Technology (Autonomous)**

Program Outcomes (PO)

- 1. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- 2. Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- 3. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and the cultural, societal, and environmental considerations.
- 4. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- 5. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- 6. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- 7. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- 8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- 9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- 10. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- 11. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- 12. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Code	HM-BT301					
Category	Humanities and Social Science and Management Course					
Course title	Ethics and Patenting in Biotechnology					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: III
	3	0	0	3	36	
Pre-requisites/Co-requisites (if any)	-					

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** the ethical issues regarding agricultural biotechnology
4. **Understand, remember** the guidelines and regulations of ethical principles in biotechnology
5. **Understand and interpret** the Intellectual Property Rights (IPRs), trademark, patent of different forms and its application.
6. **Formulate** and **demonstrate** different business strategies by considering the norms of IPRs.

Course Code	PC-BT301					
Category	Professional Core					
Course title	Biological Thermodynamics and Kinetics					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: III
	2	0	0	2	24	
Pre-requisites/Co-requisites (if any)	<div>- Engineering mathematics</div> <div>- Chemistry-I</div>					

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.

6. **Develop skills** in data acquisition and **justification** and **discussion** of the results

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	36	
Pre-requisites/Co-requisites (if any)	- Chemistry (10 + 2 level)					

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-BT-303					
Category	Professional Core					
Course title	Biochemistry					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: III
	3	0	0	3	36	
Pre-requisites (if any)	<div>- Biology (10 + 2 level)</div> <div>- Chemistry (10 + 2 level)</div>					

Course Outcome:

After completion of the course, Students can be able to

1. Students will have the requisite background knowledge in the field of Biochemistry to **define, remember, repeat and duplicate the essence of metabolism** so that they have access in higher education/Industry.
2. Students are capable of **conceptualizing metabolic** chemistry of carbohydrates and understanding their roles in the regulation of metabolism.
3. They will have fundamental skills **to understand and interpret** their knowledge on **lipid metabolism**.
4. Students will be able to **understand and define** the metabolism of **amino acids and nucleic acid** in Biochemistry.
5. Students will be able to learn the basics of **signal transduction and apoptosis** in detail and exhibit their creative potential in **investigating and developing** new ideas in Biochemistry based projects.
6. Students will better perform and show competency in **understanding** 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	0	0	3	36	

Pre-requisites/Co-requisites (if any)	- Elementary Physics and Chemistry
--	---

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, the 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	36	
Pre-requisites/Co-requisites (if any)	Chemistry (10 + 2 level) Biology (10+ level)					

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 realizing the role of microorganisms in pathogenicity, body defences, immunology and most importantly in disease transmission and food poisoning.
5. **Cite** the vital role of microorganisms in biotechnology, fermentation, medicine, food production and preservation, and even in maintaining the ecological balance in an environment with examples.
6. Able to **make use of** the 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	Biomolecular Analysis 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 Outcome (CO):

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

1. **Demonstrate, explain** pH, pKa, pK_bpl, 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 qualitative 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	Lab. Hrs.	Semester: III
	0	0	2	1	24	
Pre-requisites/Co-requisites (if any)	Basic knowledge about English grammar, writing and communication					

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 through 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: III
	0	0	3	1.5	36	
Pre-requisites/Co-requisites (if any)	<div>- Chemistry (10 + 2 level)</div> <div>- Biochemistry Theory</div>					

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 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 microbial 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.

Course Code	SI-BT391					
Category	Summer Internship					
Course title	Summer Internship-I Seminar/Training /Workshop (online/offline)					
Scheme and Credits	L	T	P	Cr. Points	Lab. Hrs.	Semester: III
	0	0	4	2	90	
Pre-requisites/ Co-requisites (if any)	-					

Course Outcome (CO):

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

1. **Demonstrate** the knowledge of Applied Sciences substrate with Allied field of engineering/technology.
2. **Understand** the impact of engineering solutions on the society and also will be aware of contemporary issues.
3. **Communicate** effectively in both verbal and written form through critical thinking process which will assist them in the preparation of their proposal and dissertation
4. **Pursue** new and enriched understandings of the texts through sustained inquiry and reevaluate initial hypotheses in light of evidence.
5. **Express, articulate, discuss and defend well** formed arguments within a group or to an audience or to different engineering communities
6. **Understanding** of lifelong learning processes through critical reflection of internship experiences.

Course Code	OE-BT401					
Category	Open Elective Course					
Course title	Numerical Methods and Biostatistics					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: IV
	3	1	0	4	40	
Pre-requisites/Co-requisites (if any)	- -Linear Algebra, Calculus, Two years of high school Mathematics, Statistics and probability in daily life					

Course Outcomes:

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

1. **Calculate** different type of errors & establish the relationship of different operators
2. **Find** interpolation, differentiation, integration and **solve** a differential equation using an appropriate numerical method

3. **Solve** a linear system of equations using an appropriate numerical method
4. **Find** roots of non-linear equations using an appropriate numerical method
5. **Construct** central tendency of science/engineering data & interpret the role of such data and employ appropriate regression models to determine statistical relationships
6. **Apply** basic statistical inference techniques, including confidence intervals, hypothesis testing and analysis of variance, to science/engineering problems.

Course Code	OE-BT402					
Category	Open Elective Course					
Course title	Data Structure and Algorithms					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: IV
	3	0	0	3	36	
Pre- requisites/Co-requisites (if any)	- Numerical Methods					

Course Outcome (CO):

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

1. **Define** and understanding introductory concepts of data structure, abstract data types and array
2. **Illustrate** the concept and implementation of stack, queue, dequeue, circular queue
3. **Understanding** linear data structures with its applications and operations on different Linked lists.
4. **Describe** non-linear data structure such as trees, height-balanced and graph.
5. **Analyze and evaluate** various searching and sorting algorithms, problem analysis and representation of graphs such as BFS and DFS.

6. **Analyze and evaluate** the importance of data structure and be able to correlate future programming structure, and its market issues specific to complex engineering problems.

Course Code	MC-BT401					
Category	Mandatory Course (Non Credit)					
Course title	Environmental Science/ Engg.					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: IV
	2	0	0	0	24	
Pre-requisites	Biology, Chemistry					

Course Outcome (CO):

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

1. Understand the concept of environment and elaborate the organization of ecosystem, its components.
2. Identify, understand, and distinguish the different environmental pollution associated with environmental degradation.
3. Describe the principles and techniques supporting the application of Biotechnology to the environment.
4. Design, formulate and develop different control mechanisms, devices to minimize the environmental pollution.
5. Identify, analyze the industrial activities on environmental pollution and its control mechanism.
6. Create and promote various environmental awareness programs in the society.

Course Code	ES-BT401					
Category	Engineering Science					
Course title	Transfer Operation-I					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: IV
	3	0	0	3	36	
Pre-requisites/Co-requisites (if any)	- Engineering Thermodynamics and fluid Mechanics					

Course Outcome (CO):

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

1. **Understand** fundamental of fluid mechanics, heat transfer, mechanical operation and also to gain basic knowledge on working principle of flow measuring devices..
2. **Identify, select** and **apply** the basic principles of transfer operation and solve engineering problems through teamwork.
3. **Learn** and **understand** the skills towards the problems related to transfer operation I and in turn the approach to solve it by applying basic concepts.
4. **Understand, identify** and **illustrate** the different modern tools & techniques based on fundamental of fluid mechanics, heat transfer, and mechanical operation.
5. **understand** the professional ethics and responsibility in aspects of safety and environmental protection
6. **Communicate** effectively through technical writing and viva voce.

Course Code	PC-BT402					
Category	Professional Core					
Course title	Molecular Biology					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: IV
	3	0	0	3	36	
Pre-requisites/Co-requisites (if any)	<div>- Chemistry (10 + 2 level)</div> <div>- Biochemistry</div>					

Course Outcome:

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

1. Helping the students to **remember** DNA structure and replication.
2. Train the students to **understand transcription** in details.
3. Develop students to memorise and describe **translation**.
4. Students can **understand gene regulations**.

5. The students will **evaluate** and **justify** mathematical calculation, and drawing conclusion on the result.

6. Students will **produce** original contribution in work with publication in international peer reviewed journals.

Course Code	PC-BT403					
Category	Professional Core					
Course title	Industrial Biotechnology and Enzyme Technology					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: IV
	3	0	0	3	36	
Pre-requisites/Co-requisites (if any)	<div>- Microbiology</div> <div>- Basic chemistry</div>					

Course Outcome (CO):

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

1. **Understand** and **explain** the basic principles of fermentation technology followed by statistical optimization of media components and its downstream processing for purification of the product.
2. **Be familiar** with different mutation techniques **applied** for enhanced metabolite yield.
3. **Apply** the molecular techniques for manipulation of metabolic pathways to **select** the thermostable enzyme with higher activity.
4. **Compare** between different enzyme immobilization techniques and its application as biosensors in industry.
5. **Analysis** of packed bed and membrane reactor data for enzyme catalyzed reaction and use of different plots to **design** appropriate kinetic model

Course Code	OE-BT491
Category	Open Elective Course
Course title	Numerical Methods and Biostatistics Lab

Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: IV
	0	0	2	1	24	
Co-requisites and Pre requisites (if any)	-Numerical Methods and Biostatistics Theory - Knowledge of any Programming language.					

Course Outcomes:

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

Demonstrate understanding and implementation of numerical solution algorithms applied to the

1. **Code** a numerical method in a modern computer language.
2. **Select** appropriate numerical methods to apply to various types of problems in engineering and science inconsideration of the mathematical operations involved, accuracy requirements and available computational resources.
3. **Demonstrate** understanding and implementation of numerical solution algorithms applied to the course content.
4. **Make** appropriate use of statistical software.
5. **Analyze** quantitative and qualitative data using biostatistical methods and software.
6. **Communicate** the results of statistical analyses accurately and effectively.

Course Code	OE-BT492					
Category	Open Elective Course					
Course title	Data Structure and Algorithms Lab					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: IV
	0	0	2	1	24	
Pre-requisites/Co-requisites (if any)	- Numerical Methods					

Course Outcome (CO):

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

1. **Define** different operations on data structure such as insertion, deletion, merging using arrays.
2. **Demonstrate** implementation of stacks and queues: insertion, deletion of elements, circular queue: insertion, deletion of elements using array.
3. **Construction and implementation** of linked lists: inserting, deleting and traversal
4. **Analyze** implementation of stacks & queues using linked lists.
5. **Implementation** of binary tree traversal.
6. **Design and implement** of different searching and sorting algorithms.

Course Code	ES-BT491					
Category	Engineering Science					
Course title	Transfer Operation I Lab					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: IV
	0	0	2	1	24	
Pre-requisites/Co-requisites (if any)	Transfer Operation I Theory					

Course Outcome (CO):

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

1. **Identify**, name, and characterize different flow patterns and regimes.
2. **Understand** the operations of various types of flowmeters used to measure the internal flow, & their applications.
3. **Understand** the performance and calculation of a packed beds and their application in chemical/biochemical industries.
4. **Explain** the working characteristics of Ball Mill and Hammer Mill, their application and calculation related with their performance.
5. **Estimate** the thermal conductivity of a metal bar and its importance in heat flow.

6. **Understand** the performance difference of a concentric pipe heat exchanger operating under various flow patterns.

Course Code	PC-BT491					
Category	Professional Core					
Course title	Molecular Biology Lab					
Scheme and Credits	L	T	P	Cr. Points	Lab. Hrs.	Semester: IV
	0	0	2	1	24	
Pre-requisites/Co-requisites (if any)	<div><div>-</div>Chemistry (10 + 2 level)</div> <div><div>-</div>Biochemistry</div> <div><div>-</div>Molecular Biology</div>					

Course Outcome (CO):

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

1. Students can define the key principles of Molecular Biology with practical application (during mutagenesis assay, isolation of genetic materials, running gels etc.).
2. Students will be able to understand various practical aspects of Molecular Biology through effective hands-on training. They can describe and explain major experiments of the discipline.
3. They can operate instruments skilfully being familiar with various Molecular Biology techniques, solving and interpreting data.
4. They will be able to collaborate with scientists of diverse backgrounds.
5. Students can appraise and support/argue some experimental results. This will encourage lifelong learning, boosting a feeling of research and ignite an inquisitive mind.
6. Students will develop team spirit, project management, effective utilization of fund, good coordination keeping in mind various environmental facts, molecular biology ethics and monetary issues.

Course Code	SI-BT491					
Category	Summer Internship					
Course title	Assessment by Seminar/Viva Voce (online/offline)					
Scheme and Credits	L	T	P	Cr. Points	Lab. Hrs.	Semester: IV
	0	0	4	2	90	
Pre-requisites/ Co-requisites (if any)	-					

Course Outcome (CO):

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

1. **Demonstrate** the knowledge of Applied Sciences substrate with Allied field of engineering/technology.
2. **Understand** the impact of engineering solutions on the society and also will be aware of contemporary issues.
3. **Communicate** effectively in both verbal and written form through critical thinking process which will assist them in the preparation of their proposal and dissertation
4. **Pursue** new and enriched understandings of the texts through sustained inquiry and reevaluate initial hypotheses in light of evidence.
5. **Express, articulate, discuss and defend well** formed arguments within a group or to an audience or to different engineering communities
6. **Understanding** of lifelong learning processes through critical reflection of internship experiences.

Course Code	HM-BT501					
Category	Humanities and social Science and Management course					
Course title	Fundamentals of Management for Engineers					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: V
	3	0	0	3	36	
Pre-requisites/ Co-requisites (if any)	- Mathematics (10+2)					

Course Outcome (CO):

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

1. **Learn** general principles, practices, and process of management; and fundamentals of organizational behavior in playing an effective managerial role in an organization.
2. **Able to determine** the perfect leadership style to be implemented in various organizational situations and to develop strong group cohesiveness while working in teams.

3. **Demonstrate and analyze** the fundamentals of production management and can make effective and efficient decisions for production planning and control.
4. **Capable to frame** optimum marketing policies to initiate, and maximize sales of the firm.
5. **Obtain an overview** of digital firms through the applications of computers in automating the business processes of a traditional firm.

Course Code	PC-BT501					
Category	Professional Core					
Course title	Genetics					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: V
	3	1	0	4	48	
Pre-requisites (if any)	Biology (10+2 Level) Microbiology (BS-BT301) Molecular Biology (PC-BT402)					

Course Outcome (CO):

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

1. **Describe**, detailed understanding of the principles of Mendelian inheritance and extensions.
2. **List** the structure and function of the DNA molecule to its functional role in encoding genetic material.
3. **Describe** normal chromosome number, structure, and behaviour in organisms, and understand the reason and effect of various aberrations in chromosome.
4. **Understand** bacterial mechanism of horizontal gene transfer methods.
5. **Understand** how to identify and classify mutations in DNA.
6. **Apply** the Hardy-Weinberg Law in analysing population genetics for gene frequency, sex linkage, equilibrium, and heterozygote frequency.

linkage, equilibrium, and heterozygote frequency.							
Course Code	PC-BT502						
Category	Professional Core						
Course title	Bioinformatics						
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: V	
	3	0	0	3	36		
Pre-requisites/co- requisites (if any)	There are no enforced requisite courses for Bioinformatics. However, some knowledge of molecular biology, any computer programming language and database & networking would be advantageous.						

Course Outcomes:

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

1. **Understand** the theoretical basis behind bioinformatics.
2. **Search** databases accessible on the WWW for literature relating to molecular biology and biotechnology
3. **Manipulate** DNA and protein sequences using stand-alone PC programs and programs available on the WWW and understand the programming language PERL.
4. **Find** homologues, analyze sequences, construct and interpret evolutionary trees.
5. **Analyze** protein sequences, identify proteins, and retrieve protein structures from databases. **View and interpret** these structures. **Understand** homology modeling and computational drug design.
6. **Able to query** biological data, **interpret and model** biological information and **apply this** to the solution of biological problems in any arena involving molecular data.

Course Code	ES-BT501					
Category	Engineering Science					
Course title	Transfer Operation II					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: V
	3	0	0	3	36	
Pre-requisites/ Co-requisites (if any)	-Transfer Operation I					

Course Outcome (CO):

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

1. **Understand** the molecular diffusion in fluids along with the mass transfer co-efficient.
2. **Understand** the concept of interphase mass transfer mechanism and fundamentals of absorption tower and packed tower.
3. **Understand** the role of Vapour-liquid equilibrium in different types of distillation and illustrate the McCabe-Thiele Method.
4. **Understand** the liquid-liquid equilibrium in extraction and liquid-solid equilibrium in leaching.
5. **Understand, identify and illustrate** the mechanism of drying and the working principle of different types drier also understand the fundamentals of crystallization.
6. **Understand** the fundamentals of advance separation process.

Course Code	OE-BT501					
Category	Open Elective Course					
Course title	Data Base Management System and Computer Networking					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: V
	3	0	0	3	36	
Pre-requisites/ Co-requisites (if any)	Data Structure and Algorithm					

Course Outcome (CO):

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

1. **Define and understand** the fundamentals of Database management System and traditional file system.
2. **Understand and explain** the concepts of Data Model.
3. **Make use** of the tools to implement Entity Relationship diagrams.
4. **Utilize and take** part in the normalization of the real world database to remove redundancies.
5. **Elaborate** the importance of Locking protocols and Database recovery
6. **Discuss** the importance of Computer Networking, Topologies, OSI 7 layer Model, various layer protocols.

Course Code	PE-BT501					
Category	Professional Core Elective					
Course title	Bioreactor Design And Analysis					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: V
	3	1	0	4	48	
Pre-requisites/ Co-requisites (if any)	<div>- Thermodynamics and Kinetics for Biotechnology</div> <div>- Industrial Microbiology and Enzyme Technology</div>					

Course Outcome (CO):

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

1. **Apply** the knowledge of reaction kinetics to understand the basics of reactor design.
2. Apply the knowledge of reaction kinetics principles to **identify and formulate problems** in chemical and biochemical reaction engineering and find appropriate solutions.
3. **Design/development of solutions** of chemical and biochemical reaction kinetics data
4. Able to analyze and **interpret the data of complex problem** on non-ideal reactor analysis.
5. Ability to use **modern engineering and computational tools**, including prediction and modeling to different engineering activities,
6. Understand the relationship between **biological phenomena and engineering design** for effective bioreactor operations to achieve production goals for **societal issues** and the **ability to learn** in the broad context of technological changes.

Course Code	PC-BT-591					
Category	Professional Core					
Course title	Genetics Lab					
Scheme and Credits	L	T	P	Cr. Points	Lab. Hrs.	Semester:
	0	0	3	1.5	36	V
Co-requisites	Genetics Theory					

Course Outcome (CO):

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

1. **Analyze** genetic data using statistical procedures.
2. **Construct** cytological slides for mitotic and meiosis.
3. **Demonstrate** various types of chromosomal aberrations and barr body.
4. **Design** pedigree chart of common human traits.
5. **Calculate** problems based on Hardy-Weinberg equilibrium.

Course Code	PC-BT592					
Category	Professional Core					
Course title	Bioinformatics Lab					
Scheme and Credits	L	T	P	Cr. Points	Lab. Hrs.	Semester: V
	0	0	3	1.5	36	
Pre-requisites/ Co-requisites (if any)	Bioinformatics Theory					

Course Outcome:

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

1. **Describe** the contents and properties of the most important bioinformatics databases.
2. **Searches, and Analyze and Discuss** the results in pairwise sequence alignment by Dot matrix, dynamic programming and word method.
3. **Find homologues, analyze sequences, construct and interpret** evolutionary trees.
4. **Annotate** gene by Computational methods.
5. **Develop** programming skill in PERL.
6. **Predict** the secondary and tertiary structures of protein sequences.

Course Code	ES-BT591					
Category	Engineering Science					
Course title	Transfer Operation II Lab					
Scheme and Credits	L	T	P	Cr. Points	Lab. Hrs.	Semester: V
	0	0	3	1.5	36	
Pre-requisites/ Co-requisites (if any)	Transfer Operation II Theory					

Course Outcome:

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

1. Understand the molecular diffusion in fluids along with the mass transfer coefficient.
2. Understand the role of Vapour-liquid equilibrium in distillation and verify Rayleigh's equation.
3. Understand and determine specific cake resistance and filter medium resistance in plate and frame filtration.
4. Understand, identify and illustrate the mechanism of drying and the working principle of rotary dryer.
5. Understand, identify and illustrate the mechanism of drying and the working principle of tray dryer.
6. Explain the fundamentals of different working principles related to mass transfer operations.

Course Code	OE-BT591					
Category	Open Elective Course					
Course title	Data Base Management System Lab					
Scheme and Credits	L	T	P	Cr. Points	Lab. Hrs.	Semester: V
	0	0	3	1.5	36	
Pre-requisites/ Co-requisites (if any)	DBMS Theory					

Course Outcome (CO):

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

1. **Outline** the underlying concepts of table creation in database technologies.
2. **Define and demonstrate** DDL and DML commands.
3. **Experiment** with SQL to construct and apply to execute database query using SQL clauses.
4. **List and test** the group function on a database using a RDBMS
5. **Explain** Programming in PL/SQL.
6. **Compose** the use of computer networking for modern software development.

Course Code	SI-BT591					
Category	Summer Internship					
Course title	Summer Internship-II Seminar/Training /Workshop (online/offline)					
Scheme and Credits	L	T	P	Cr. Points	Lab. Hrs.	Semester: V
	0	0	3	1.5	68	
Pre-requisites/ Co-requisites (if any)	-					

Course Outcome (CO):

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

1. **Demonstrate** the knowledge of Applied Sciences substrate with Allied field of engineering/technology.
2. **Understand** the impact of engineering solutions on the society and also will be aware of contemporary issues.
3. **Communicate** effectively in both verbal and written form through critical thinking process which will assist them in the preparation of their proposal and dissertation
4. **Pursue** new and enriched understandings of the texts through sustained inquiry and reevaluate initial hypotheses in light of evidence.
5. **Express, articulate, discuss and defend well** formed arguments within a group or to an audience or to different engineering communities
6. **Understanding** of lifelong learning processes through critical reflection of internship experiences.

Course Code	HM-BT601					
Category	Humanities and Social Science and Management Course					
Course title	Project Management and Entrepreneurship					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: VI
	2	0	0	2	24	
Pre-requisites/ Co-requisites (if any)	- Fundamentals of Management, Elementary Mathematics					

Course Outcome (CO):

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

1. **Learn** general concept of a project and project management, the importance of project life cycle and essential elements of project planning.

2. **Analysis** of project evaluation, project scheduling as well as project cost control through application of financial and mathematical tools.
3. **Learn** details of legal and quality aspects of project management to face various issues.
4. **Study and demonstrate** the features of different project management softwares with special emphasis on “MS Project” and can able to select the best PMS subject to desired requirements.
5. **Develop skills** of entrepreneurship both theoretical and practical approach and can take initiative of starting a new business.
6. **Align** the successful approach of entrepreneurship in undertaking large investment projects for the necessity and benefit of the society.

Course Code	PC-BT601					
Category	Professional Core					
Course title	Recombinant DNA Technology					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: VI
	3	0	0	3	36	
Pre-requisites (if any)	<div>- Microbiology (PC-BT402)</div> <div>- Genetics (PC-BT501)</div> <div>- Molecular Biology (PC-BT-402)</div>					

Course outcome:

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

1. **Understand, define** and explain the tools in recombinant DNA technology.
2. **Understand** techniques in recombinant DNA technology.
3. Designing cloning experiments for applications in various genomic and proteomics studies.
4. **Identify, select** and **implement** the PCR and its types in molecular biology and recombinant DNA technology.
5. **Apply** knowledge of genetic engineering in current applications of biotechnology.
6. **Comprehend** and **analyze** the impact of Human Genome Project in genetic engineering programme.

Course Code	PC-BT602					
Category	Professional Core					
Course title	Immunology					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: VI
	3	0	0	3	36	
Pre-requisites/ Co-requisites (if any)	<div>- Microbiology</div> <div>- Biochemistry</div> <div>- Genetics</div>					

COURSE OUTCOME:

By the end of this course student will be able to:

1. Conceptualize and **infer how** the innate and adaptive immune responses coordinate to fight invading pathogens.
2. Apply the knowledge of basic Immunology to **identify** problems and formulate **solutions** for the protection of human health.
3. **Understand** the theories of different immunological techniques and **apply** them efficiently in **solving** problems related to scientific research, health care, forensic sciences, drug industries for **formulation** of newer medicines etc.
4. **Explore** strategies to **improve** existing vaccines and how to approach these.
5. **Determine** and **design** what immunomodulatory strategies can be used to enhance immune responses or to suppress unwanted immune responses during different immune disorders.
6. **Interpret** and **analyze** results of scientific experiments involving *in vivo* models used in different researches including tumor and cancer biology, autoimmune diseases, immunodeficiency diseases.

Course Code	PC-BT603
Category	Professional Core

Course title	Plant Biotechnology					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: VI
	3	0	0	3	36	
Pre-requisites/ Co-requisites (if any)	<div>- Biochemistry</div> <div>- Microbiology</div> <div>- Genetics</div>					

Course Outcome (CO):

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

1. **Understand** the **use** of different plant tissue culture (PTC) techniques for PTC Industries as well as research.
2. **Identify, select** and **construct** different plant tissue culture media for various PTC techniques.
1. **Understand** the role of PTC in secondary metabolite production and **identify** the appropriate bioreactor for commercial secondary metabolite production.
2. **Understand** the structure and organization of genes & complexity of plant genome and able to **identify** the tools for gene identification.
3. **Understand, identify and illustrate** the different modern tools & techniques of plant genetic manipulation for crop improvement and sustainable agriculture.
4. **Analyze** the impact of plant biotechnology on future crop production and also able to **judge** the intellectual property, environmental, societal issues specific to transgenic crops.

Course Code	PC-BT604					
Category	Professional Core					
Course title	Downstream Processing					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: VI
	3	0	0	3	36	
Pre-requisites/ Co-requisites (if any)	<ul style="list-style-type: none">- Structure of Biomolecules- Biochemistry- Microbiology- Industrial Microbiology and Enzyme Technology					

Course Outcome (CO):

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

1. **Comprehend the necessity** of bioseparation processes in biotechnology.
2. **Accomplish the knowledge** on primary isolation and concentration of desired product.
3. **Acquire the knowledge** to implement suitable techniques for product purification.
4. **Analyze the quality** and characteristics of the purified product.
5. **Ability to formulate** the product to meet marketable standards.
6. **Explain, recommend and demonstrate** the suitable bioseparation approaches comprising of new concepts and emerging technologies that are likely to benefit product recovery for small and large scale in the future.

Course Code	PE-BT602					
Category	Professional Core Elective					
Course title	Animal Cell Culture & Animal Biotechnology					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: VI
	3	0	0	3	36	
Pre-requisites/ Co-requisites (if any)	<div><div>-</div>Microbiology</div> <div><div>-</div>Molecular Biology</div> <div><div>-</div>Recombinant DNA Technology</div>					

COURSE OUTCOMES:

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

1. **Explain** the various components of cell and tissue culture media as well as establishment and optimization of media for particular purposes in different species and cell lines.
2. **Explain, design, analyze** and **perform** the common cell culture techniques, cytotoxicity and viability assays for toxicological and pharmacological studies.
3. **Design** the experiment for development of primary established cell culture and characterize the various cell lines used in mammalian tissue culture in relation to their origins and uses.
4. **Describe, analyze** and **design** the criteria in consideration for scale up of cell culture as well as the appropriate cell model for a large scale process involved in the production of human and animal viral vaccines and pharmaceutical proteins.
5. **Explain, assess** and **design** the strategies involved in embryo transfer & In vitro fertilization, transgenic animal technology, vaccinology, stem cell therapeutics and regenerative medicine as well as analyze important social & environmental problems regarding genetically modified cell and organ models and identify ways to contribute to the solutions, including professional, economic and ethical considerations in social, industrial, medical & agricultural fields.
6. **Explain, assess** and **coalesce** the multidisciplinary need of animal biotechnology with the solution provided by the optimized and modernized animal tissue culture techniques at lab scale, pilot scale and ultimately industrial scale level as well as be able to **communicate** efficiently by preparing proper technical plans through meticulous reports at the end followed by sound oral explanations.

Course Code	PC-BT691					
Category	Professional Core					
Course title	Recombinant DNA Technology Lab					
Scheme and Credits	L	T	P	Cr. Points	Lab. Hrs.	Semester: VI
	0	0	2	1	24	
Pre-requisites/ Co-requisites (if any)	<div>- Microbiology</div> <div>- Genetics</div> <div>- Molecular Biology</div>					

Course Outcome (CO):

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

1. **Demonstrate** and **explain** restriction enzyme digestion of plasmid DNA or lambda DNA.
2. **Understand** the process of gel purification of RE digested DNA fragment.
3. **Understand** the process ligation of DNA fragments with cloning vector pUC18 or pBR322.
4. **Learn, demonstrate** and **explain** the methodology of competent cell preparation and Transformation into *E.coli* with recombinant vector.
5. **Understand** and **explain** primer design for PCR and amplification of DNA by PCR.
6. **Demonstrate** and **explain** the working principle of Southern Hybridization.

Course Code	PC-BT692					
Category	Professional Core					
Course title	Immunology Lab					
Scheme and Credits	L	T	P	Cr. Points	Lab. Hrs.	Semester: VI
	0	0	2	1	24	
Pre-requisites/ Co-requisites (if any)	Microbiology					

COURSE OUTCOMES:

1. **Illustrate** components of the immune system and **explain** their functional interactions and physiology as it relates to immunity, disease states and disorders.
2. **Plan and organize** a variety of serologic assays using basic principles of antigen-antibody reactions.
3. **Apply** major methodology used to diagnose immunological disorders including agglutination, precipitation, electrophoretic techniques, Immunoassays (ELISA, Western blot).
4. **Formulate, compile** and present a well-organized and concise report of the experimental findings, **evaluate** clinical data, **interpret** results, and **compare and correlate** abnormal results with disease states.
5. **Develop** communication skills in the presentation of scientific material and **evaluate, understand and interpret** the methods described in the related scientific journal articles.
6. **Demonstrate** laboratory practice standards in safety, professional behavior and ethical conduct and maintain a safe laboratory environment

Course Code	PC-BT693					
Category	Professional Core					
Course title	Plant Biotechnology Lab					
Scheme and Credits	L	T	P	Cr. Points	Lab. Hrs.	Semester: VI
	0	0	2	1	24	
Pre-requisites/ Co-requisites (if any)	-					

Course Outcome (CO):

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

1. **Define and recall** the various components of plant tissue culture.
2. **Describe, discuss and explain** various aseptic culture techniques for establishment of plant tissue culture.
3. **Calculate** the composition of various plant tissue culture media and prepare it (e.g. MS, B5, N6, WPM etc.).
4. **Design** the experiments to develop the mass propagation of plants from different explants (e.g. rooting, shooting, callus development etc).
5. **Understand and explain** the various modern tools used in *in vitro* culture techniques for large scale propagation of plants in PTC-Industry.
6. **Establish** a lab for *in vitro* plants tissue culture as well as the lab for mass propagation of plants.

Course Code	PC-BT694					
Category	Professional Core					
Course title	Fermentation Technology and Downstream Processing Lab					
Scheme and Credits	L	T	P	Cr. Points	Lab. Hrs.	Semester: VI
	0	0	2	1	24	
Pre-requisites/ Co-requisites (if any)	<ul style="list-style-type: none">- Basic concepts in Chemistry and Biology- Structure of Biomolecules- Biochemistry- Microbiology- Industrial Microbiology and Enzyme Technology					

Course Outcome (CO):

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

1. **Educate the students** about microorganisms, development of media, and **to impart knowledge** about enzyme kinetics, fermenters, and industrial biotechnology.
2. **Make the students understand** the fermentation process using modern tools and its combination of bioprocess engineering.
3. **Provides an opportunity to experimentally** verify the theoretical concepts already studied.

4. **Understand** the theoretical principles in a more explicit and concentrated manner.
5. **Get exposure** on various Bioseparation process such as Cell disruption techniques, Product enrichment techniques and Product purification methods.
6. **Describe** current knowledge in biological and biochemical technology and to **assess** power requirements in bioreactors; modeling of bioprocesses.

Course Code	HM-BT691					
Category	Humanities and Social Science and Management Course					
Course title	Technical and Popular science article writing and Seminar Presentation (Based on Review article by PPT)					
Scheme and Credits	L	T	P	Cr. Points	Lab. Hrs.	Semester: VI
	0	0	2	1	24	
Pre-requisites/ Co-requisites (if any)	-					

Course Outcomes:

1. Find the best examples of research papers in Biotechnology which have had impact – in whatever terms you think are important.
2. Identify the most promising recent research papers, likely to find application in the future.
3. Choose a thesis topic which will change the world.
4. Become a seasoned, critical, cynical reader of scientific literature.
5. Expand knowledge in preparation of effective PowerPoint presentation.
6. Develop communication skills and personality

Course Code	MC-BT691A					
Category	Mandatory Course (Non Credit)					
Course title	Sports & Yoga					
Scheme and Credits	L	T	P	Cr. Points	Lab. Hrs.	Semester: VI
	0	0	2	0	24	
Pre-requisites/ Co-requisites (if any)						

COURSE OUTCOMES:

Students will be able to

1. Learn techniques for increasing concentration and decreasing anxiety which leads to stronger academic performance.
2. Learn breathing exercises and healthy fitness activities
3. Improve personal fitness through participation in sports and yogic activities
4. Develop healthy mind in a healthy body thus improving social health also
5. Improve efficiency.

Course Code	MC-BT691B					
Category	Mandatory Course (Non Credit)					
Course title	Personality Development Through Life Enlightenment Skills					
Scheme and Credits	L	T	P	Cr. Points	Lab. Hrs.	Semester: VI
	0	0	2	0	24	
Pre-requisites/ Co-requisites (if any)						

COURSE OUTCOMES:

Students will be able to

1. Study of Shrimad-Bhagwad-Gita will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Gita will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

Course Code	PC-BT701A					
Category	Professional Core					
Course title	Food Biotechnology					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: VII
	3	0	0	3	36	
Pre-requisites/ Co-requisites (if any)	<div>- Microbiology</div> <div>- Industrial Microbiology and Enzyme Technology</div>					

Course Outcome:

By the end of this course student will be able to:

1. **Understand and define** various factors affecting life and death of microorganisms in different types of food with special emphasis on spoilage organisms and food borne pathogens.
2. **Identify, select and implement** methods to preserve different types of food and make food consumption safe.
3. **Understand** the principles, practices and recent advancements in food processing techniques.
4. **Understand** different types of biotechnological methods to improve the quality and value of different food and new techniques used in Food Biotechnology.
5. **Critically analyze, assess, control, and communicate** the risks associated with food-borne toxicants along with the development of the strategies used for the evaluation of food safety problems through toxicological criteria.
6. **Explain** the principles, processes and techniques for the assessment and management of food management or food safety hazards and their significances.

Course Code	PC-BT701B					
Category	Professional Core Elective					
Course title	Bioprocess and process Instrumentation					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: VII
	3	0	0	3	36	
Pre-requisites/ Co-requisites (if any)	<ul style="list-style-type: none">▪ Thermodynamics and Kinetics for Biotechnology▪ Industrial Microbiology and Enzyme Technology▪ Bioreactor Design And Analysis					

Course Outcome:

Students will be able to

1. **Understand** the importance of process dynamics (unsteady state operation)
2. **Tune** a controller to reject disturbances or manage operating point transitions
3. **Understand** how to control biological process for effective production.
4. **Ability to use** modern engineering and computational tools for different engineering activities.

Course Code	PE-BT701A					
Category	Professional Core Elective					
Course title	Renewable Energy Technology					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: VII
	3	0	0	3	36	
Pre-requisites/ Co-requisites (if any)	<div>- Microbiology</div> <div>- Molecular Biology</div> <div>- Recombinant DNA Technology</div>					

Course Outcomes:

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

1. **Describe** and **identify** the various renewable energy sources and the possible conversion paths to a useful form of energy and develop their own knowledge and understanding using recently published information.

2. **Describe** and **quantify** the major factors affecting the potential contribution to the world's needs of the various sources of energy, such as available resource, status of technical development, and economic aspects.
3. **Describe** and **introspect** the principles behind different non conventional energy sources and finally its future potential both in providing energy and in producing alternative fuels.
4. **Describe, introspect** and **utilize** the renewable energy in problem solving where conventional energy are not fruitful and require replacement.
5. **Explain** and **understand** the design and applications of power generating devices using renewable energy sources as per industrial requirement.
6. **Review** the latest advancement in the materials developments applied to renewable energy and develop a personal well-argued and quantified view of a possible energy future.

Course Code	PE-BT701B					
Category	Professional Core Elective					
Course title	Genomics and Proteomics					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: VII
	3	0	0	3	36	
Pre-requisites/ Co-requisites (if any)	<ul style="list-style-type: none">- Genetics- Recombinant DNA technology- Bioinformatics					

Course Outcome (CO):

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

1. **Identify** and **describe** the structural organization of prokaryotic and eukaryotic genomes.
2. **Explain** the current genomics technologies and demonstrate how these can be used to study gene function.
3. **Perform** various practical techniques including DNA sequencing, PCR and proteomics.
4. **Interpret** data obtained through high throughput expression studies.
5. **Design** a set of experiments to address a particular biological question.

Course Code	PE-BT701C					
Category	Professional Core Elective					
Course title	Tissue Engineering					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: VII
	3	0	0	3	36	
Pre-requisites/ Co-requisites (if any)	<div>- Animal Cell Culture and animal Biotechnology</div> <div>- Biomaterials</div>					

Course Outcome (CO):

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

1. **Understand** and **analyze** the cellular fate to design tissue engineering system.
2. **Design**, fabricate scaffolds and **interpret** cellular interaction for growing biological material.
3. **Construct** multicomponent biomaterials by advanced manufacturing technologies.
4. **Design** a biomaterial system considering the main issues of biocompatibility including toxicity.
5. **Analyze** simple models to quantify aspects of bioreactor design.
6. **Fabricate** biomaterial based tissue engineered construct and **development** of artificial organs.

Course Code	PE-BT701D					
Category	Professional Core Elective					
Course title	Medical Informatics					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: VII
	3	0	0	3	36	
Pre-requisites/ Co-requisites (if any)	-Data Base Management System and Computer Networking -Numerical Methods and Biostatistics					

Course Outcome (CO):

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

1. **To understand and illustrate** the concept of medical informatics in the development of healthcare and clinical research.
2. **Understand** and analyze advanced imaging technology and its enhancement by MI for developing medical diagnostics.
3. **Design** and **develop** clinical software, electronic medical record for healthcare/clinical/laboratory information.
4. **Understand** and **develop** computerized methods to determine health practice problems including ethical, safety and political issues.
5. **Study** and **develop** new and advanced technologies for healthcare development.

Course Code	PE-BT702A					
Category	Professional Core Elective					
Course title	Biomaterials					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: VII
	2	0	0	2	24	
Pre-requisites/ Co-requisites (if any)	<ul style="list-style-type: none">- Structure of Biomolecules- Biochemistry- Microbiology- Immunology- Recombinant DNA Technology					

Course Outcome (CO):

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

1. **Describe and compare** the various classes of mainstream biomaterials on the basis of structure and function currently used for medical applications.
2. **Understand the fundamental principles** of biomaterials and their properties and the working principles and applications of various types of biomedical materials
3. **Apply modern and appropriate** analytical techniques for characterization of biomaterials.
4. **Explain the basic principles** governing biocompatibility and biofunctionality materials, including interactions between materials and living organisms.
5. **Apply the basic concepts** used in designing biomaterials, medical devices and artificial organs with the regulation of ethics.
6. **Analyze biocompatibility** and tissue-material interaction for different kinds of biomaterials.

Course Code	PE-BT702B					
Category	Professional Core Elective					
Course title	Nanobiotechnology					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: VII
	2	0	0	2	24	
Pre-requisites/ Co-requisites (if any)	<div>- Microbiology</div> <div>- Genetics</div>					

Course Outcome (CO):

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

1. **Describe** and **interpret** the basics of synthesis and characterization of nanomaterials.
2. **Learn** and **analyze** the use of engineered nanomaterials in biomedical and environment.
3. **Solve** and **understand** scientific problems related to nanotechnological materials.
4. **Create** awareness on the toxicity of nanomaterials.

Course Code	PE-BT702C					
Category	Professional Core Elective					
Course title	Biosensor and Diagnostics					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: VII
	2	0	0	2	24	
Pre-requisites/ Co-requisites (if any)	-					

Course Outcome (CO):

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

1. **Understand** and **illustrate** the concept of biosensors and transducers specific to diagnostic systems.
2. **Understand** and **design** of biosensors and **evaluate** the physiological signal generation for developing diagnostic tools.
3. **Understand** and **analyze** the role of lab on chip devices to develop new integrated sensors providing practical solution in the field of biomedical engineering.
4. **Design** and **develop** implantable sensors and **evaluate** the challenges based on biocompatibility and other aspects.

5. **Summarize** the advantages, limitations and application of biosensors in the field of diagnostic and therapeutic.

Course Code	PE-BT702E					
Category	Professional Core Elective					
Course title	Medical and Pharmaceutical Biotechnology					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: VII
	2	0	0	2	24	
Pre-requisites/ Co-requisites (if any)	<div>- Microbiology</div> <div>- Genetics</div>					

Course Outcome (CO):

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

1. **Provide** an historical outlook in the field of medical biotechnology and the innovative processes.
2. **Understand, define** and **differentiate** traditional and recombinant therapeutic molecules and their production.
3. Ability to make **understand** disease diagnosis and their therapeutic approach.
4. **Understand** the process and methodology of instruments used for clinical diagnosis.
5. **Applying** interdisciplinary subjects to **analyze** and **evaluate** different therapeutic approaches.
6. **Understanding** the role of Proteomics in **analyzing** diseases progression and development of drug.

Course Code	OE-BT701A					
Category	Open Elective Courses					
Course title	Biosafety					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: VII
	2	0	0	2	24	
Pre-requisites/ Co-requisites (if any)	-					

Course Outcome:

1. **Understanding and identification** of biohazards and functioning of Biosafety committees.
2. **An ability to apply** the GMO regulations and assessment of the personal care products.
3. **An awareness** of the principles of containment for transgenic, infected or exotic animals and plants.

4. **Ability to evaluate** risk assessments for work involving biological agents including with radioactive materials.
5. **Analyze** the appropriate measure to study cause of health problems in society.

Course Code	OE-BT701B					
Category	Open Elective Courses					
Course title	Soft Skill					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: VII
	2	0	0	2	24	
Pre-requisites/ Co-requisites (if any)	-					

Course Outcome (CO):

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

1. **Understand** the **use** and the **significance** of soft skills in the working environment.
2. **Apply** conflict resolution skills to **solve** their problems and able to **minimize** their stress.
3. **Identify** their good and bad habits which help them to **forming** habits of success
4. **Understand** the significance of listening to **influence** the people.
5. **Interpret** non-verbal cues as well as body language.
6. **Developed** trust and integrity in their professional as well as personal life.

Course Code	OE-BT701C					
Category	Open Elective Courses					
Course title	Research Methodology					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: VII
	2	0	0	2	24	
Pre-requisites	- Computer Basic, Microsoft-Office (MS Word, MS Power Point, MS Excel), Networking					

Course Outcome (CO):

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

1. Understand the basic concepts of research and its methodologies.
2. Select and define appropriate research problem and parameters.
3. Understand, Identify and develop various research designs and techniques.

4. Examine and Analyze quantitative, qualitative methods for data collection, observation and result.
5. Understand and implement the presentation tools and its features.
6. Formulate a research report and thesis.

Course Code	HM-BT791					
Category	Humanities and Social Science and Management Course					
Course title	GROUP DISCUSSION					
Scheme and Credits	L	T	P	Cr. Points	Lab. Hrs.	Semester: VII
	0	0	1	0.5	12	
Pre-requisites/ Co-requisites (if any)	-					

Course Outcome (CO):

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

1. **Understanding** the mechanism of interpretation through language learning by practising reading, writing and comprehension skills.
2. **Understanding** complex engineering problems by a sound grammatically correct knowledge base of English & honing LSRW skills for software research, solutions, marketing etc.
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. **Equipping** learners to solve various problems related to aptitude tests and interviews through the practice of various Verbal reasoning, analytical essays & business correspondence.
5. **Learning** field survey along with leadership qualities and statistical analysis through Technical Report Writing & learning team-work through language activities.
6. **Awareness** about the society, public health and safety, growth and changes in society, culture and environment through comprehension, technical report writing practice, group discussions & presentations.

Course Code	PC-BT791A					
Category	Professional Core Elective					
Course title	Food Biotechnology Lab					
Scheme and Credits	L	T	P	Cr. Points	Lab. Hrs.	Semester: VII
	0	0	2	1	24	
Pre-requisites/ Co-requisites (if any)	- Chemistry - Microbiology					

Course Outcome (CO):

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

1. **Understand and analyze** the various properties of water.
2. **Construct** a comprehensive understanding of the nutritional properties of food constituents.
3. **Estimate** qualitatively and quantitatively proteins, lipids, carbohydrates and metabolites of foods.
4. **Understand and apply** the microbiological techniques for the study of foods.
5. **Examine, Analyze** foods and food products for detection of chemical components and adulterants.

Course Code	PC-BT791B					
Category	Professional Core Elective					
Course title	Bioprocess and Instrumentation Control Lab					
Scheme and Credits	L	T	P	Cr. Points	Lab. Hrs.	Semester: VII
	0	0	2	1	24	
Pre-requisites/ Co-requisites (if any)	- Chemistry - Microbiology					

Course Outcome (CO):

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

1. Measure different parameters in bioprocess system
2. Analyze and formulate mechanisms for bioprocess.
3. Optimize different parameters.
4. Perform a bioprocess in a controlled manner

Course Code	PW-BT791
Category	Project
Course title	Project Work-I (In-house/Industry/Research Institute) (Online/Offline) & Presentation

Scheme and Credits	L	T	P	Cr. Points	Lab. Hrs.	Semester: VII
	0	0	4	2	90	
Pre-requisites/ Co-requisites (if any)	-					

Course Outcome (CO):

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

1. **Demonstrate** a sound technical knowledge of their selected project topic.
2. **Undertake** problem identification, formulation and solution.
3. **Design** engineering solutions to complex problems utilizing a systems approach.
4. **Conduct** an engineering project
5. **Communicate** with engineers and the community at large in written and oral forms.
6. **Demonstrate** the knowledge, skills and attitudes of a professional engineer.

Course Code	SI-BT791					
Category	Summer Internship					
Course title	Summer Internship-III (Seminar/Training /Workshop) (Online/Offline)					
Scheme and Credits	L	T	P	Cr. Points	Lab. Hrs.	Semester: VII
	0	0	6	3	135	
Pre-requisites/ Co-requisites (if any)	-					

Course Outcome (CO):

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

1. **Demonstrate** the knowledge of Applied Sciences substrate with Allied field of engineering/technology.
2. **Understand** the impact of engineering solutions on the society and also will be aware of contemporary issues.
3. **Communicate** effectively in both verbal and written form through critical thinking process which will assist them in the preparation of their proposal and dissertation
4. **Pursue** new and enriched understandings of the texts through sustained inquiry and reevaluate initial hypotheses in light of evidence.

5. **Express, articulate, discuss and defend well** formed arguments within a group or to an audience or to different engineering communities
6. **Understanding** of lifelong learning processes through critical reflection of internship experiences.

Course Code	PW-BT891					
Category	Project					
Course title	Project Work-II (In-house/Industry/Research Institute) & Presentation					
Scheme and Credits	L	T	P	Cr. Points	Lab. Hrs.	Semester: VIII
	0	0	18	9	405	
Pre-requisites/ Co-requisites (if any)	-					

Course Outcome (CO):

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

1. **Demonstrate** a sound technical knowledge of their selected project topic.
2. **Undertake** problem identification, formulation and solution.
3. **Design** engineering solutions to complex problems utilizing a systems approach.
4. **Conduct** an engineering project
5. **Communicate** with engineers and the community at large in written and oral forms.
6. **Demonstrate** the knowledge, skills and attitudes of a professional engineer.