Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Biotechnology

(Applicable from the academic session 2018-2019)

Course Code	PC-BT701					
Category	Professional Core					
Course title	Food Biotechnology					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: VII
	3	0	0	3	40	
Pre-requisites/ Co-requisites (if any)	- Microbiology - Industrial Microbiology and Enzyme Technology					

Course Objective:

The objectives of the course are:

To provide knowledge and understanding on techniques, parameters and issues related to the production, processing and consumption of food related to food microbiology along with an appreciation of their impact on society.

COURSE CONTENT:

Module I: Principle of food processing and preservation: 10L

Scope of Food Processing in India with National and International Perspective, Historical Developments in Food Processing, Food Deterioration and Control, Principles of Food Processing and Preservation, Preservation techniques-High temperature, Low temperature, Irradiation, Dehydration, chemical and natural preservatives, Thermal Death Time Curves, General principles of canning and bottling of foods. Aseptic Processing & Packaging.

Module II: Technology involved in food production: 10L

Status of dairy industry in India and its future scope, Pretreatments to milk for product manufacture, Fermented milk products –Acidophilus milk, Kefir, Koumiss, Yoghurt, cheese, New technologies and product development in dairy industry. Technology involved in bakery industry-Bread, Biscuit, wafer; production of beverages-vinegar, wine, beer, fruit juice, High fructose corn syrup (HFC), Basic preparatory procedures of meat processing, meat tenderization, Application of enzymes in food processing.

Module III: Food additives and food quality assurance: 10L

Introduction to Major Constituents of Food, Functional Classification of Food Additives, Natural additives; Sensory and physical analysis of food, Microbial ecology of food-Intrinsic factors and Extrinsic Factors; Food contaminants and safety measurements; Techniques in food analysis-spectroscopic, polarimetric, chromatographic, electrophoretic etc. Quality control of food; Food spoilage.

Module IV:Advances in food science and technology: 10 L

Development of rapid tests for detection of food borne pathogens and other adulterants, Biosensors: Principles and applications in food analysis; Role of Biotechnology in food processing, Development of Genetically modified food, High fiber food, artificial sweeteners, formulated and fabricated food, nutraceuticals; Application of Nanotechnology in food science.

References:

Textbook:

1. Frazier, Food Microbiology
2. G. Reed, Prescott and Dunn's Microbiology, CBS Publishers, 1987
3. Introduction to Food Biotechnology. Author; Perry Johnson-Green. Publisher; CRC Press. Year; 2002.

References books:

1. Jay, Modern Food Microbiology, CBS Publishers, 1987

2. Desrosier, Technology of food preservation, CBS Publisher

Web Reference:

UGC e pathsala: http://epgp.inflibnet.ac.in/ahl.php?csrno=15

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.

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Syllabus for B. Tech in Biotechnology

(Applicable from the academic session 2018-2019)

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	40	
Pre-requisites/ Co-requisites (if any)	- Microbiology - Molecular Biology - Recombinant DNA Technology					

Course Objective:

The objectives of the course are:

This course provides an introduction to energy systems and renewable energy resources, with a scientific examination of the energy field and an emphasis on alternate energy sources and their technology and application. The class will explore society's present needs and future energy demands, examine conventional energy sources and systems, including fossil fuels and nuclear energy, focusing on alternate, renewable energy sources such as solar, biomass (conversions), wind power, geothermal, and hydro. Energy conservation methods will be emphasized.

COURSE CONTENT:

Module I (10 L):

An Introduction to Energy Sources: Energy sources (conventional & non-conventional), renewable energy resources, primary & secondary energy sources, energy chain, energy demand, national energy strategy & plan, energy management, energy audit & conservation, Energy storage.

Biological fuel generation: Biomass as a renewable energy source; types of biomass – forest, agricultural and animal residues, industrial and domestic organic wastes; conversion of biomass to clean fuels and petrochemical substitutes by physicochemical and/or fermentation processes.

Module II (10 L):

Sources of biomass; biogas from anaerobic digestion; thermal energy from biomass combustion; ethanol from biomass.

Module III (10 L):
Hydrogen production by photosynthetic bacteria, biophotolysis of water and by fermentation. Magneto Hydro-Dynamic (MHD) Power Generation Principle, MHD system, open cycle system, closed cycle system, design problems & developments, advantages, materials for MHD generators, magnetic field & super conductivity. Microbial fuel cell. Microbial recovery of petroleum by biopolymers (Xantham gum), biosurfactants.

Module IV (10 L):
Solar energy: solar collectors, solar pond, photovoltaic cells, chemical storage. Geothermal energy and wind energy: Use of geothermal energy, operating principles of different types of wind energy mills. Tide and Wave energy. Ocean Thermal Energy Conversion (OTEC). Nuclear energy: nuclear reactions and power generating tidal wave energy.

References/Books:

1. J.E. Smith – Biotechnology, 3rd ed. Cambridge Univ Press.
2. S. Sarkar – Fuels and combustion, 2nd ed., University Press.
3. Abbasi, S.A. and Abbasi, N. (2005), Renewable Energy Sources and Environmental Impact, Prentice Hall of India Pvt. Ltd., Pp.134-136.
4. O.P. Gupta, Energy Technology, Khanna Publishing House (Ed. 2018)
5. O.P. Gupta, Elements of Fuels and Combustion, Khanna Book Publishing Co., New Delhi

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	**Bioprocess and process Instrumentation**					
Scheme and Credits	**L**	**T**	**P**	**Cr. Points**	**Lec. Hrs.**	**Semester: VII**
	2	**0**	**0**	**2**	**28**	
Pre-requisites/ Co-requisites (if any)	▪ **Thermodynamics and Kinetics for Biotechnology** ▪ **Industrial Microbiology and Enzyme Technology** ▪ **Biorector Design And Analysis**					

Course Objective:

The objectives of the course are:

1. To make the students aware of the principles, practices and application of the Bioprocess Engineering and Instrumentation control for different bioprocess operation.
2. How to control bioprocess for desired product

Course Content:

Module I 6L

Scale up, scale downand its Difficulties: overview of Reactor Types, Some Considerations on Aeration, Agitation, and HeatTransfer, Scale-up, Scale-down.

Bioreactor Instrumentation and Control: Instrumentation for Measurements of Active Fermentation, Using the Information Obtained,

Sterilization of Process Fluids: Introduction and the Kinetics of Death, Sterilization of Liquids, Sterilization of Gases, Problems

Module II 6L

Traditional Industrial Bioprocess: Anaerobic Bioprocesses: Ethanol Production, Lactic Acid Production, Acetone-Butanol Production, Aerobic Processes: Citric Acid Production, Production of Bakers'Yeast, Production of Penicillins, Production of High-Fructose Corn Syrup (HFCS)

Medical Application of Bioprocess Engineering: Tissue Engineering, Gene Therapy Using Viral Vectors, Stem Cells and Hematopoiesis, Extracorporeal Artificial Liver.

Module III: 11 L

Measurement

Introduction, Principles of measurement, Error Analysis, Static and dynamic characteristics of instruments, Process Instrumentation: Recording, indicating and signaling instruments , Transmission of instrument readings, Instrumentation diagram ,

Industrial instruments for measurement

a. Temperature: Filled system Thermometer, Thermocouples, resistance thermometers, radiation and optical pyrometers

b. Pressure: Manometers, elastic deformation and electrical type gauges. Vacuum gauges – mechanical, electrical and ionization types.

c. Flow: Head flow meters, area flow meters, positive displacement flow meters, mass and magnetic flow meters.

d. Level: Direct and inferential type

Module IV 5L

Measurement of density and specific gravity, humidity, viscosity and composition. Analytical principles involving emission spectrometry, IR, Spectroscopy, Gas chromatography, Polarography, X-ray and pH.

Textbooks:

1. Bioprocess Engineering Basic Concepts, Second Edition Michael L. Shuler and Fikret Kargi, Prentice Hall
2. Coughanowr, D. R., LeBlanc, S. "Process Systems Analysis and Control", 3rd edition, McGraw-Hill

Reference books:

1. Seborg, D.E., Edgar, T.F., Mellichamp, D.A. "Process Dynamics and Control", 2nd edition, John Wiley
2. Stephanopoulos, G. "Chemical Process Control: An Introduction to Theory and Practice",Pearson Education.

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.

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Syllabus for B. Tech in Biotechnology

(Applicable from the academic session 2018-2019)

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	40	
Pre-requisites/ Co-requisites (if any)	- Animal Cell Culture and animal Biotechnology - Biomaterials					

Course Objective:

1. The course focuses on functional biomaterials for manufacturing tissue engineered construct, drug delivery, therapeutics.
2. To make the students learn about how the biomaterials mimic natural cell behavior, showing effective cell growth and repair.

Course Content:

Module I: [12 Lectures]

Introduction (Structural and Organization of tissues): Basic definition, Introduction to tissue engineering, Cells as therapeutic agents with examples. Tissue organization, Tissue Components, Tissue types, Functional subunits. Tissue Dynamics, Homeostasis in highly prolific tissues and Tissue repair. Angiogenesis.

Epithelial, connective; vascularity and angiogenesis, basic wound healing, current scope of development and use in therapeutic and in-vitro testing.

Cellular fate processes, Cell differentiation, Cell migration - underlying biochemical process.

Module II:[12 Lectures]

Molecular & Cellular aspects: Cell-extracellular matrix interactions - Binding to the ECM, Modifying the ECM, Malfunctions in ECM signaling. Cell signaling molecules, growth factors, hormone and growth factor signaling, growth factor delivery in tissue engineering,

Cell attachment: differential cell adhesion, receptor-ligand binding, and Cell surface markers.

Module III[10 Lectures]

Biomaterials: Engineering biomaterials for tissue engineering (collagen, silk and polylactic acid), Characterization techniques (porosity, mechanical strength, 3-D architecture and cell incorporation). Engineered tissues for replacing bone, cartilage, tendons, ligaments, skin and liver. Bioreactors for Tissue Engineering.

Module IV [6 Lectures]
Tissue Engineering Case Studies: Artificial skin, Artificial blood vessels, Artificial pancreas, Artificial liver, Regeneration of bone, muscle, nerve.

Textbooks:

1. Principles of tissue engineering, Robert. P.Lanza, Robert Langer & William L. Chick, Academic press.

2. The Biomedical Engineering –Handbook, Joseph D. Bronzino, CRC press.

3. Introduction to Biomedical Engg. , Endarle, Blanchard &Bronzino, Academic press.

Reference books:

1. Tissue Engineering, B. Palsson, J.A. Hubbell, R.Plonsey& J.D. Bronzino, CRC- Taylor & Francis
2. Nanotechnology and Tissue engineering - The Scaffold", Cato T. Laurencin, Lakshmi S. Nair, CRC Press.

Web Reference:

1. NPTEL: http://nptel.ac.in/courses/102103016/

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.

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Syllabus for B. Tech in Biotechnology

(Applicable from the academic session 2018-2019)

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	40	
Pre-requisites/ Co-requisites (if any)	-Data Base Management System and Computer Networking -Numerical Methods and Biostatistics					

Course Objective:

The objectives of the course are:

- The course is designed to develop a better understanding of Medical Informatics, its goals, standards, applications, and uses in healthcare development and clinical research.
- This course will enable the students to identify and analyze problems related to medical informatics and to build up followed by optimization of complex healthcare processes to improve patient outcome and healthcare delivery.

Course Content:

Module I: [15 Lectures]

Introduction: A brief history of Medical Informatics, Taxonomy of Medical Informatics

Systems Design Considerations for the Clinical User, Standards in medical informatics (DICOM and HL7), Basic and advanced medical imaging technology: acquisition, diagnostic display, enhancement and analysis

The Organization of Health Information: The Paper-based Medical Record, The Electronic Medical Record

Module II:[10 Lectures]

Health Information System: Big Data in hospitals, Clinical software development, modeling and performance optimization, Laboratory Information Systems, Radiology Information Systems, Pharmacy Information Systems.

Issues with Electronic Medical Record and Paper-based Medical Record.

Module III[7 Lectures]

e-health: A virtual healthcare delivery system, information provider to the physician and patient, teleradiology, telemedicine, issues in telemedicine.

Module IV [8 Lectures]

Artificial Intelligence in Medicine, Expert Systems in Medicine, Standards and Quality improvement,

Ethical and political issues: Accessibility v. Confidentiality, Equity & Equality, Security and confidentiality in medicine, Health as a Human Right.

Future technologies: The Personal Health Record, Smarte Cards, Wireless, RFID.

Textbooks:

1. Shortliffe et al., BIOMEDICAL INFORMATICS, Computer Applications in Health Care and Biomedicine, (Third Edition), Springer-Verlag, 2006.
2. Oleg S.; Pianykh, "Digital Image Quality in Medicine", Springer(2014).
3. Slack, Cybermedicine: How Computing Empowers Doctors and Patients for Better Health Care, Jossey-Bass.

Reference books:

1. Collen, Morris, A History of Medical Informatics in the United States 1950 to 1990, AMIA (American Medical Informatics Association).
2. Ellis, Technology and the Future of Health Care, Preparing for the Next 30 Years, Jossey-Bass.

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.

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Syllabus for B. Tech in Biotechnology

(Applicable from the academic session 2018-2019)

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	30	
Pre-requisites/ Co-requisites (if any)	- Structure of Biomolecules - Biochemistry - Microbiology - Immunology - Recombinant DNA Technology					

Course Objective:

The objectives of the course are:

1. To understand the principles and biology underlying the design of implants and artificial organs.
2. This course deals with applications resulting from the combination of Biotechnology and Biomedical engineering in the fields of medicine and environment.
3. To focus on principles of biomaterials and its applications.

Course Content:

Module I: [8 Lectures]

Introduction to Biomaterial and Some Common Biopolymers

Introduction to biomaterial, biologically derived materials or materials compatible with biology. Common biomaterials: some proteins, many carbohydrates and some specialized polymers; Collagen (protein in bone and connective tissues): Structure production and its use. Fibroin (protein in silk): Production and its use. Production of these proteins by conventional cloning methods.

Module II [6 Lectures]

Classes of Biomaterials

Major classes of materials used in medicine: Polymers of natural and synthetic origin, Biodegradable Polymers (PHB, PCL, PHV, and PHA, Biopol); Carbohydrates and Modified carbohydrates, polyphenols - Hydrogels – Elastomer – Dendrimers; Ferrous and non-ferrous metals, alloys; Ceramics, Bioceramics, Bioglasses, Composites.

Module III [8 Lectures]

Biomaterial Properties

Polymers: synthesis, polymerization processes, molecular weights determination and distributions (e.g., chain vs. step, thermoplastics vs. thermosets, Elastomer, Dendrimers), Mechanical (Elastic and Viscoelastic) and Thermal properties (glassy and rubbery states), structural features (crystalline vs. noncrystalline materials), general mechanical properties and relationship to processing (stress-strain behavior, moduli, impact energy, hardness, fracture toughness, brittle fracture, fatigue, viscous deformation, viscoelasticity).

Module IV [8 Lectures]

Biomaterial Applications

Biomaterial requirements for certain medical applications (joint vs. blood vessel, soft and hard tissue replacements, cardiovascular, drug delivery); General overview of components in the human body used to construct implantable materials: temporary or permanent implants, biodegradable and bioactive materials, drug delivery systems; Familiarity with legal and ethical issues related to biomaterials used in medical applications.

Texts Books:

1. Biomaterials Science: An introduction to Materials in Medicine, Edited by Ratner, Hoffman, Schoet and Lemons, Second Edition: Elsevier Academic Press, 2004.
2. Biomaterials: SUJATA V. BHATT, Second Edition, Narosa Publishing House,2005.
3. BIOMATERIALS - Principles and Applications – Joon B.Park Joseph D. Bronzino, CRC Press, 2003
4. Comprehensive structural interity, Vol.9: Bioengineering Editors: Mithe, Ritchie and Karihalo, Elsevier Academic Press, 2003.

Reference Books:

1. Biomaterials Science and Biocompatability, Fredrick H. Silver and David L. Christiansen, Piscataway, Springer, New Jersey.
2. Biological Performance of Materials: Fundamentals of Biocompatibility, Janathan Black, Marcel Dekker, Inc., New York and Basel, 1981.
3. “Biomaterials Science and Engineering”, PARK J.B., Plenum Press, 1984.

4. Standard Handbook of Biomedical Engineering & Design – Myer Kutz, McGraw-Hill, 2003
5. Introduction to Biomedical Engineering – John Enderle, Joseph D. Bronzino, Susan M. Blanchard, Elsevier, 2005.
6. Biomedical Materials, R.Narayan(ed.), Springer Science

1. NPTEL: http://nptel.ac.in/courses/102106057/
2. NPTEL: http://nptel.ac.in/courses/102107058/
3. NPTEL: http://nptel.ac.in/courses/102107058/#
4. NPTEL: http://nptel.ac.in/courses/102106036/

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.

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Syllabus for B. Tech in Biotechnology

(Applicable from the academic session 2018-2019)

Course Code	PE-BT702B					
Category	Professional Core Elective					
Course title	Nanobiotechnology					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester:
	2	0	0	2	30	VII
Pre-requisites/ Co-requisites (if any)	- Microbiology - Genetics					

Course Objective:

The objectives of the course are:

1. Course will deliver a comprehensive knowledge base for evaluation of the potential risks and benefits of nanotechnology to the environment and to human health and safety.
2. Course will cover inter- and multi-disciplinary science and engineering.

Course Content:

Module I: 10 L: Introduction to Nanotechnology

Nanoscale Properties (Electrical, Optical, Chemical); Cellular Nanostructures; Nanopores; Biomolecular motors; Criteria for suitability of nanostructures for biological applications.

Characterization techniques: Electron microscopy; Atomic force microscopy; Photon correlation Spectroscopy; Scanning probe microscopy (AFM, STM), Diffraction techniques (XRD, synchrotron)

Module II: 10 L: Engineered Nanomaterials

Engineered Nanomaterials: Carbon nanomaterials (fullerenes, graphene, nanotubes, nanofibers); Metal nanoparticles (synthesis, properties and applications); Magnetic nanoparticles (synthesis, properties and applications); Quanatum dots, liquid crystals; Nanoporous materials (metalic, zeolite, MOFs)

Module III: 10 L: Health Care Nanotechnology

Nanobiotechnology for Drug Discovery; Cells Targeting by Nanoparticles with conjugated with small Molecules; Devices for Drug Discovery; Nanoscale Delivery of Therapeutics; Nanoparticle-Based Drug Delivery -Trojan Nanoparticles -Self-Assembling Nanoparticles for Intracellular Drug Delivery; Nanoparticle Combinations for Drug Delivery: Liposome–Nanoparticle Hybrids; Valves for Controlled Drug Release -Nanomotors for Drug Delivery.

Module IV: 10 L: Nanotechnology In Foods and Cosmetics

Foods and Cosmetics - Bioavailability and Delivery of Nutraceuticals and Functional Foods Using Nanotechnology - Polymer-Based Nanocomposites for Food Packaging - Nanocomposites for Food Packaging -Toxicity and Environmental Risks of Nanomaterials

Texts:

1. Multilayer Thin Films, Editor(s): Gero Decher, Joseph B. Schlenoff Publisher: Wiley- VCH Verlag GmbH & Co. KGaA.
2. Bionanotechnology: Lessons from Nature Author: David S. Goodsell Publisher: Wiley- Liss.
3. David S Goodsell, "Bionanotechnology", John Wiley & Sons, 2004.
4. Biomedical Nanotechnology Editor: Neelina H. Malsch Publisher: CRC Press

References:

1. Kewal K. Jain, The Handbook of Nanomedicine Humana Press, (2008).
2. Zhang, Nanomedicine: A Systems Engineering Approach" 1st Ed., Pan Stanford Publishing, (2005).
3. Robert A. Freitas Jr., ―Nanomedicine Volume IIA: Biocompatibility, Landes Bioscience Publishers, (2003).

Course Outcome (CO):

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

1. **Describe** and **interpret** the basic 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.

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Syllabus for B. Tech in Biotechnology

(Applicable from the academic session 2018-2019)

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	30	
Pre-requisites/ Co-requisites (if any)	-					

Course Objective:

The objectives of the course are:

- The module gives an introduction and elementary idea about biosensors, transducers and also imparts knowledge of electrical or optical signal that can be quantified and recorded.
- The course also illustrates the development of lab on chip technology based diagnostic tools in the field of medical science.

Course Content:

Module I: [8 Lectures]

Fundamentals of Biosensors: Principles; Characteristics of Ideal Biosensors; Basic measuring procedure; Medically significant measurands, functional specifications of medical sensors; Sensor characteristics: linearity, repeatability, hysteresis, Components of biosensor; Advantages & Limitations.

Types of biosensors, bio-chemical sensors, chemical potential and equilibrium;electrochemical cell at equilibrium; Nernst equation; pH electrode; Ion-sensitive electrodes.

Module II:[6 Lectures]

Bioelectric potentials/Physiological signals: Action potentials and impulse propagation, origin of bioelectric signals, electrode theory, types of electrodes, selection criteria for electrodes recording electrodes and skin-contact imped.

Lab on chip: Microfluidic interfaces for biosensors, DNA and protein microarrays, Microfabricated PCR technology,Nanobiosensor.

Module III[10 Lectures]

Basics of Transducers: Transducers in general, active and passive transducers, Principles and applications –Potentiometric, Amperometric, Conductrometric, resistormetric, Piezoelectric, Semiconductor, Impedimetric, Chemiluminiscene based biosensors.

Physiological Transducers: Calorimetric, Optical, Pressure transducers, catheter tip pressure transducers, temperature transducers, pulse sensors, respiration sensors, digital transducers, selection criteria for transducers.

Module IV [6 Lectures]
Diagnostic uses: Ultrasonic, Optical & Laser biosensors: Basics of ultrasound, theory, characteristics, design, applications in medical science for diagnostic and therapeutic, Optical fiber sensor, Polarization, Refractive index, Light scattering, micro-opto- electromechanical system [MOEMS], Laser in industry.

Textbooks:

1. Biosensors : Tran Minh Canh, Chapman & Hall

2. Biosensors: Oxford University Press, USA;

Reference books:

1. Turner, A.P.F, Karube. I.,and Wilson, G.S, Biosensors Fundamentals and applications, Oxford Univ. Press.

2. Handbook of Biosensors and Electronic Noses: Medicine, Food and the Environment: CRC-Press; 1 edition;1996

Web Reference:

NPTEL: http://nptel.ac.in/courses/102103016/

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 devises 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.

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Syllabus for B. Tech in Biotechnology

(Applicable from the academic session 2018-2019)

Course Code	PE-BT702D					
Category	Professional Core Elective					
Course title	Genomics and Proteomics					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: VI
	3	0	0	3	40	
Pre-requisites/ Co-requisites (if any)	- Genetics - Recombinant DNA technology - Bioinformatics					

Course Objective:

The objectives of the course are:

1. The course will expose students to the understanding of the principles of genomic analysis of prokaryotes and eukaryotes and application of bioinformatics methods used in this analysis.
2. The aim of this course is to teach students techniques in genomics and proteomics using model organisms representing plants and animals.

Course Content:

Unit I (10L):

Structure and organization of prokaryotic and eukaryotic genomes - nuclear, mitochondrial and chloroplast genomes; C Value Paradox. Computational analysis of sequences- finding genes and regulatory regions, gene annotation; Genetic variation-polymorphism; Phylogenetics: ribo-typing; Cancer Genetics & Proteomics;

Unit II (10 L):

Comparative genomics of relevant organisms such as pathogens and non-pathogens; DNA Microarray technology: Basic principles and design; cDNA and oligonucleotide arrays; Applications: Global gene expression analysis comparative transcriptomics; Differential gene expression; Genotyping/SNP detection; Detection technology; Computational analysis of microarray data.

Unit III (10 L):

Relationship between protein structure and function; Outline of a typical proteomics experiment (Identification, Isolation, Purification of protein; Identification and analysis of proteins by 2DGE; Spot visualization and picking; Tryptic digestion of protein and peptide fingerprinting; Mass spectrometry (ESI/MALDI/TOF/PMF). Protein Folding (Levinthal paradox, Anfinsen's dogma), Chaperone, Co-Chaperone, Chaperonin. Protein folding Diseases(CJD, BSE, CF & cancer), Prions Clinical proteomics and disease biomarkers; Protein-protein interactions: Yeast

two hybrid system and Phage display; Pull-down assays (using GST-tagged protein); Protein arrays-definition; Applications- diagnostics, expression profiling.

Unit IV (10 L):
Human disease genes; DNA polymorphism including those involved in diseases; 'disease' gene vs. 'susceptibility' gene; SNP detection: hybridization based assays (allele specific probes); Polymerization based assays (allele specific nucleotide incorporation, allele-specific PCR); Ligation based assays (allele specific oligonucleotide ligation); Polymorphism detection without sequence information: SSCP; High throughput screening for drug discovery; Identification of drug targets; Pharmacogenomics and pharamacogenetics and drug development; Toxicogenomics.

Texts

1. Voet D, Voet JG & Pratt CW, Fundamentals of Biochemistry, 2nd Edition. Wiley 2006
2. Brown TA, Genomes, 3rd Edition. Garland Science 2006
3. Campbell AM & Heyer LJ, Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Benjamin Cummings 2007

References

1. Primrose S & Twyman R, Principles of Gene Manipulation and Genomics, 7th Edition, Blackwell, 2006.
2. Glick BR & Pasternak JJ, Molecular Biotechnology, 3rd Edition, ASM Press, 1998.
3. Strachan T & Read A, Human Molecular Genetics, 3rd Edition, Garland Science, 1999.

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.

Maulana Abul Kalam Azad University of Technology, West Bengal

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Syllabus for B. Tech in Biotechnology

(Applicable from the academic session 2018-2019)

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	28	
Pre-requisites/ Co-requisites (if any)	- Microbiology - Genetics					

Course Objective:

The objectives of the course are:

1. The course aims exposing students to various topics in Biotechnology, including the pharmacist's role in Biotechnology, genetic engineering and its application to pharmacy.
2. The course will also cover methods in producing commercial products and modern diagnostic system.

Course Content:

Module 1: 7L: Drug Development in Pharmaceutical Process:

Introduction to production, formulation and packaging of large and small molecule pharmaceuticals; Generation of large molecule pharmaceuticals by natural extraction (Blood products, Haemophilia A and B, Anticoagulants, Thrombolytic agents) and recombinant methods (hormones, interferon's and Erythropoietin as biopharmaceutical); New techniques for production of the above large molecule pharmaceuticals and their advantages/ therapeutic applications; Techniques for development of new generation antibiotics.

Module II: 7L: Disease Diagnosis Techniques:

Antibody Related Techniques: Hybridoma Rabbit, human; Antigen–Antibody interaction, affinity, cross reactivity, specificity, epitope mapping; ELISA, Western blotting, ELISPOT assay, Biosensor assays for assessing ligand –receptor interaction; Antibody engineering; Antibodies as in vitro and in vivo probes; DNA and RNA based diagnostics and therapy: PCR, PCR/OLA procedures, RFLP, SSCP, Microarrays, In-situ hybridization

Module III: 7L: Disease Therapy

Vaccine technology: Rationale vaccine design based on clinical requirements: Convectional vaccines; Sub unit vaccines; Recombinant DNA and protein based vaccines, plant-based vaccines and reverse vaccinology; conjugate vaccines;

Gene Therapy, Antisense RNA therapy Ribozyme therapy, status, problems and prospects of further development. Toxicogenomics: Use of toxicological profiles and information in genomics; need and development

Module Iv: 7L: Proteomics in Drug Development:
Development and applications of proteomics in drug development process; Use of proteomics in protein based biomarkers in disease diagnosis (e.g. cancer); development and future prospects; drug development pipeline; applications of enzyme immunoassays for diagnosis

Textbooks

1. Biopharmaceuticals- Biochemistry and Biotechnology : Gary Walsh; John Wiley & Sons
2. S. P. Vyas, V. Dixit, Pharmaceutical Biotechnology, CBS Publishers
3. Pharmaceutical Biotechnology ; Sambhamurthy & Kar , NewAge Publishers

Reference Books

1. Epenetos A.A.(ed), Monoclonal antibodies: applications in clinical oncology, Chapman and Hall Medical, London
2. V.Venkatesharalu -Biopharmaceutics and Pharmacokinetics-Pharma Books Syndicate
3. F.C. Hay, O.M.R. Westwood, Practical Immunology, 4th Edition-, Blackwell Publishing, 2002
4. S. Hockfield, S. Carlson, C. Evans, P. Levitt, J. Pintar, L. Silberstein, Selected Methods for Antibody and Nucleic Acid probes, Volume1, Cold Spring Harbor Laboratory Press,1993.

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.

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Syllabus for B. Tech in Biotechnology

(Applicable from the academic session 2018-2019)

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	28	
Pre-requisites/ Co-requisites (if any)	-					

Course Objective:

The objectives of the course are:

The recent advances in the field of Biotechnology have brought into focus several safety issues. The inventions in the field of genetic engineering and related fields of molecular biology not only affect us but also the plants, microflora, animals and the entire environment and the way we practice agriculture, medicine and food processing. The present course focuses on the biosafety the modern society confronts.

Topics such as biosafety levels, GM food debate, and impact of biotechnology on biosafety, governance of biosafety, environmentally responsible use of biotechnology, will be discussed in the course.

Course Content:

Module I: Introduction (04 Lectures)

Historical background, introduction to biological safety cabinets, primary containment for biohazards, biosafety levels of specific microorganisms, recommended biosafety levels for infectious agents and infected animals.

Module II: Biosafety guidelines (10 Lectures)

Government of India definition of genetic modified organism (GMOs) and living modified organisms (LMOs), roles of institutional biosafety committee, review committee on genetic manipulation (RCGM), genetic engineering approval committee (GEAC) for GMO applications in food and agriculture, environmental release of GMOs. The GM-food debate and biosafety assessment procedures for biotech foods and related products, including transgenic food crops,

case studies of relevance. Biosafety assessment of pharmaceutical products such as drugs/vaccines etc.

Module III: Handling and transportation of GM, infectious and radioactive materials (06 Lectures)

Risk analysis, risk assessment, risk management and communication, overview of national regulations and relevant international agreements including Cartagena Protocol.

Module IV: Biosafety management & Concept of social science (08 Lectures)

Key to the environmentally responsible use of biotechnology, ethical implications of biotechnological products and techniques, social and ethical implications of biological weapons.

Reason to apply its principles to study cause of health problems and suggest appropriate intervention/ solution to problem.

Text Books/ Reference Books:

1. Regulatory Framework for GMOs in India (2006) Ministry of Environment and Forest, Government of India, ND.
2. Cartagena Protocol on Biosafety (2006) Ministry of Environment and Forest, Government of India, New Delhi.
3. P.K. Gupta, Biotechnology and Genomics, Rastogi Publications
4. Biotechnology & Safety Assessment, Thomas, Ane/Rout Publishers.

Web References:

1. http://www.cbd.int/biosafety/background.shtml

2. http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section 3.html MAJOR

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:
	2	0	0	2	30	VII
Pre-requisites/ Co-requisites (if any)	-					

Course Objective:

The objectives of the course are:

1. To cause a basic awareness about the significance of soft skills in professional and inter-personal communications and facilitate an all-round development of personality.
2. To comprise pleasant and appealing personality traits as self-confidence, positive attitude, emotional intelligence, social grace, flexibility and friendliness.

Course Content:

Module I: [5 Lectures]

Introduction:
A new approach to learning, planning and goal-setting, human perceptions: understanding people, types of soft skills: self-management skills, aiming for excellence: developing potential and self-actualisation, need achievement and spiritual intelligence

Module II:[5 Lectures]

Conflict and Stress:
Conflict resolution skills: seeking win-win solution; types of conflicts: becoming a conflict resolution expert; types of stress: self-awareness about stress; regulating stress: making the best out of stress

Module III[5 Lectures]

Habits:
habits: guiding principles; habits: identifying good and bad habits; habits: habit cycle; breaking bad habits; using the zeigarnik effect for productivity and personal growth; forming habits of success

Module IV [15 Lectures]

Communication, Communication barrier and body language:
communication: significance of listening; active listening; ; barriers to active listening; telephone communication; technology and communication: technological personality?; mobile personality?; e-mail principles; netiquette; e-mail etiquette; communication skills: effective communication; barriers to communication; interpersonal transactions; miscommunication; non-verbal communication: pre-thinking ; pre-thinking ; interpreting non-verbal cues; body language: for interviews; body language: for group discussions; human relations: developing trust and integrity

Textbooks:

1. Dorch, Patricia. What Are Soft Skills? New York: Execu Dress Publisher, 2013.
2. Petes S. J., Francis. Soft Skills and Professional Communication. New Delhi: Tata McGraw-Hill Education, 2011.

Web Reference:

NPTEL: http://nptel.ac.in/syllabus/109104107/

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	30	
Pre-requisites/ Co-requisites (if any)	-					

Course Objective:

The objectives of the course are:

1. To learn the basic research terminology.
2. To study the various research designs and techniques.
3. To identify various sources of information for literature review and data analysis.
4. To study the content of research report and thesis.

Course Content:

Module I: [6 Lectures]

Introduction to Research Methodology: Meaning of Research, Objectives of Research, Purpose of Research, Types of Research, Research Approaches, Significance of Research, Criteria of Good Research.
Selection and formulation of a Research Problem: Meaning of research problem, Choosing the problem, Review of Literature, Formulating the problem, Objective of formulating the problem, Techniques involved in formulating problem.

Module II: [7 Lectures]

Hypothesis: Meaning of Hypothesis, Types of Hypothesis, Concept of Hypothesis Testing, Procedure for Testing Hypothesis, Statistical Testing of Hypothesis.
Research Design: Meaning and Objectives, Need for Research Design, Components of Research Design, Classifications of Research Design, Principles of experimental design.

Module III: [10 Lectures]

Methods of Data Collection: Meaning and importance of Data, Primary sources of Data, Secondary sources of Data, Methods of collecting Data.

Processing and Analysis of Data: Recapitulation (Measures of Central Tendency, Dispersion, correlation and Regression, Chi- square test: Applications, Steps, characteristics, limitations, Analysis of Variance and Co-variance.)
Observation: Meaning of Observation, Process of Observations, Types of Observation.

Module IV: [7 Lectures]

Presentation tool: Introduction to Presentation Tool, Features & Functions, Creating Presentations, Customizing Presentation. [Tools used: Microsoft PowerPoint, Open Office or any other tool].
Research Report Writing: Meaning of Research Report, Types of Research Report, and Contents of the Research Report.

Textbooks:

1. Kothari, C.R. (2004). Research methodology: Methods and techniques. New Age International (P) Ltd., New Delhi.
2. Kumar, R. (2011). Research methodology: A step-by-step guide for beginners. Los Angeles: SAGE.

Reference books:

1. Blessing, L.T.M. and Chakrabarti, A. (2009). DRM: a Design Research Methodology. Springer.
2. Blessing, L.T.M. and Chakrabarti, A. (2002). DRM: A Design Research Methodology, in International Conference on The Science of Design - The Scientific Challenge for the 21st Century, INSA, Lyon, France.
3. Blessing, L.T.M., Chakrabarti A. and Wallace, K.M. (1998). An Overview of Design Studies in Relation to a Design Research Methodology, Designers: the Key to Successful Product Development, Frankenberger & Badke-Schaub (Eds.), Springer-Verlag.

Web Reference:

1. http://nptel.ac.in/courses/121106007/
2. http://nptel.ac.in/courses/107108011/

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	1	30	
Pre-requisites/ Co-requisites (if any)	-					

Course Objective:

The objectives of the course are:

A **group discussion** among students is being organized to see and evaluate their thinking skills, listening abilities and how they are communicating their thoughts. One should learn to control the conversation through listening attentively and then having the perseverance to mould it towards his/her own direction.

Course Content:

Module I:

Practice GD-sessions and help them learn the application of various soft skills related to it. (2P)

Module II:

Enhancing Reading Comprehension ability through practicing various types of passages on Subjective (/non-technical), Objective (/scientific) writing, though Case Studies etc. (2P)

Module III

Developing good writing style through assignments on various Creative writing topics, writing reviews, proposals, analytical essays etc. (2P)

Module IV

Developing Interview Skills through Lessons on different types of interviews, how to strategically handle various unexpected situations in an interview board, Conducting Mock Interview Sessions, Solving Questions on Verbal Reasoning to crack the Aptitude test etc. (4P)

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. Dr. Kulbhushan Kumar, Effective Communication Skills, Khanna Publishing House, Delhi

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. **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	PE-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	30	
Pre-requisites/ Co-requisites (if any)	- Chemistry - Microbiology					

Course Objective:

The objectives of the course are:

1. To study the properties of water and testing of various parameters.
2. To learn and understand the principles behind the qualitative and quantitative estimation of biomolecules.
3. To understand the methods of isolating and characterizing various microbes associated with food.
4. Analysis of foods and food products for chemical components, detection of adulterants.

Course Content:

1. Quality of water (pH, TDS, TSS, Hardness etc.)
2. Estimation of Calcium, Sodium and Potassium present in water using flame photometer
3. Determination of Moisture, Acidity and pH in food sample/beverages
4. Determination of Protein in food sample
5. Determination of total Fat of a food sample
6. Determination of total Carbohydrate of a food sample
7. Quantification of Microbes: Sampling and Serial Dilution; Bacterial count in food Products (TVC)
8. Chromatographic separation of Food colors and estimation by spectrophotometer
9. Detection of Adulterants in spices and spices powder
10. Determination of adulterants in milk and milk products
11. Estimation of (a) Iodine value, (b) Saponification value (c) acid value (d) peroxide value, (e) RM value (f) P value, (g) K value of fats and oils

Reference books:

1. S. Sadasivam, A. Manickam (2007) Biochemical Methods. New Age International (P) Limited.

2. W.F. Harrigan (2011) Laboratory Methods in Food Microbiology. Academic Press.
3. D.T. Plummer (1987) Introduction of Practical Biochemistry. Tata McGraw-Hill.

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	**PE-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**	**30**	
Pre-requisites/ Co-requisites (if any)	- **Chemistry** - **Microbiology**					

Course Objective:

The objectives of the course are:

1. To develop and control bioprocess system.

2. To describe and formulate optimization problems arising in process systems engineering.

Course Content:

1. Design of experiment for parameters optimization, Data analysis, Validation of experiment

2. Temperature Measurement using Resistance Temperature Detector (RTD), Thermistor and Thermocouple.
3. Pressure gauge calibration using Dead Weight Tester
4. Measurement using Load Cell

5. Demonstration of Bourdon tube, diaphragm gauge, etc.

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	**SI-BT791**					
Category	**Summer Internship**					
Course title	**Industrial project/training (Report, Power Point Presentation & viva voce)**					
Scheme and Credits	**L**	**T**	**P**	**Cr. Points**	**Lab. Hrs.**	**Semester: VII**
	0	**0**	**0**	**1.5**	**6 to 8 weeks (summer vacation in between 6th and 7th sem)**	
Pre-requisites/ Co-requisites (if any)	**-**					

Course Objective:

The objectives of the course are:

1. The aim of this course is to use the internship experience to enable students to develop their engineering skills and practice.

2. The internships will be aligned with the aims of the engineering program and its areas of specialization. Students will experience a real-life engineering workplace and understand how their engineering and professional skills and knowledge can be utilized in industry and research.
3. They will also be able to demonstrate functioning engineering knowledge, both new and existing, and identify areas of further development for their future careers.

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 evidences.
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.