Bachelor of Technology (Biotechnology), UIET, KUK
Credit-Based (2021-22 Onwards)
SCHEME OF STUDIES/EXAMINATIONS (*Semester -III*)

S.No	Course No./ Code	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of exam (Hours)
						Major Test	Minor Test	Practical	Total	
1	BTS-201	Biochemistry	3:0:0	3	3	75	25	0	100	3
2	BTS-203	Microbiology	2:0:0	2	2	75	25	0	100	3
3	BTS-205	Molecular Biology	3:0:0	3	3	75	25	0	100	3
4	BTS-207	Genetics and Cell Biology	3:0:0	3	3	75	25	0	100	3
5	BTS-211	Cell and Molecular Biology Lab	0:0:4	4	2		40	60	100	3
6	BTS-213	Biochemistry Lab	0:0:3	3	1.5	-	40	60	100	3
7	BTS-215	Microbiology Lab	0:0:3	3	1.5		40	60	100	3
8	PTS-201	Technical Seminar	0:0:2	2	1		100	0	100	3
9	HTM-901	Universal Human Values II : Understanding Harmony	3:0:0	3	3	75	25	0	100	3
10	PTS-203	Industrial Training-I	0:0:2	2	1		100	0	100	3
		Total	14:0:14	28	21.0	375	445	180	1000	

HTM-901	Universal Human Values II: Understanding Harmony						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3.0**	**75**	**25**	**100**	**3 Hours**
Purpose	Purpose and motivation for the course, recapitulation from Universal Human Values-I						
Course Outcomes (CO)							
CO 1	Development of a holistic perspective based on self-exploration about themselves (human being),family, society and nature/existence.						
CO 2	Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.						
CO 3	Strengthening of self-reflection.						
CO 4	Development of commitment and courage to act.						

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for ValueEducation

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration–what is it? - Its contentand process; 'Natural Acceptance' and Experiential Validation- as the process for self exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at variouslevels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrarinessin choice based on liking-disliking

Module 2: Understanding Harmony in the Human Being - Harmony in Myself!

7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
8. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
9. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
10. Understanding the characteristics and activities of 'I' and harmony in 'I'
11. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
12. Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available tome. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

Module 3: Understanding Harmony in the Family and Society- Harmony in Human-HumanRelationship

13. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
14. Understanding the meaning of Trust; Difference between intention and competence
15. Understanding the meaning of Respect, Difference between respect and differentiation; the othersalient values in relationship
16. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
17. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- fromfamily to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value inrelationships. Discuss with scenarios. Elicit examples from students' lives

Module 4: Understanding Harmony in the Nature and Existence - Whole existence asCoexistence

18. Understanding the harmony in the Nature
19. Interconnectedness and mutual fulfilment among the four orders of nature-recyclability and self-regulation in nature
20. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space
21. Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" canbe used), pollution, depletion of resources and role of technology etc.

Module 5: Implications of the above Holistic Understanding of Harmony on ProfessionalEthics

22. Natural acceptance of human values
23. Definitiveness of Ethical Human Conduct
24. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
25. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people- friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
26. Case studies of typical holistic technologies, management models and production systems
27. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible

engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations

28. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. todiscuss the conduct as an engineer or scientist etc.

READINGS:

Text Book

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books,New Delhi, 2010

Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J CKumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

MODE OF CONDUCT

Lecture hours are to be used for lecture/practice sessions.

Lectures hours are to be used for interactive discussion, placing the proposals about the topics at handand motivating students to reflect, explore and verify them.

Practice hours are to be used for practice sessions.

While analysing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions, the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration. Scenarios may be used to initiate discussion. The student is encouraged to take up" ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Practice experiments are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based onbasic human values.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses.

This course is to be taught by faculty from every teaching department, including HSS faculty. Teacherpreparation with a minimum exposure to at least one 8-day FDP on Universal Human Values is deemedessential.

ASSESSMENT:

This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. will be used in evaluation.

Example:

Assessment by

faculty mentor: 5 marks

Self-assessment: 5 marks

Assessment by peers: 5 marks

Socially relevant project/Group Activities/Assignments: 10 marks

Semester End Examination: 75 marks

The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

BTE-401	Bioinformatics (B. Tech. Biotechnology Semester VII)						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**1**	**-**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	**To familiarize the students with the basics of Bioinformatics**						
Course Outcomes							
CO1	**Students will learn basic principles of various types of databases**						
CO2	**Students will come to know about various tools related to sequence alignment and statistical significance of alignment**						
CO3	**This unit will enable the students to learn various software tools for sequence analysis and primer designing**						
CO4	**Students will be able to learn predictive methods for nucleotides and protein sequence analysis**						

UNIT I

1. Databases

a. Sequence Databases: introduction of Databases, primary and secondary databases, nucleotide and protein sequence databases: Genbank, EMBL, DDBJ, Swissprot, pfam, Block, PRI

b. Structure Databases: Introduction to structures. PDB (Protein Data bank) Molecular Modeling database at NCBI. , visualizing structural information, database structure viewers.

c. Sequence and Structure File Formats

2. The Entrez system: Integrated information axis, Information retrieval from biological database, sequence database beyond NCBI. Medical databases.

UNIT II

3. Sequence Alignment AND Database Searches

Introduction, the evolutionary basis of sequence alignment, Type of Aligmnents, Pair-wise Alignment, Multiple Alignment, The modular nature of proteins, Optimal alignment methods, substitution scores and gap penalties, statistical significance of alignment. FASTA, BLAST, low-complexity regions, repetitive elements, Tool of multiple sequence alignment: CLUSTAL W/X, progressive alignment method.

4. Phylogenetic Analysis:

Elements of phylogenetic models, phylogenetic data analysis: alignment, substitution model building, tree building and tree evaluation, building the data model (alignment), determining the substitution model, tree- building methods, searching for trees, rooting trees, evaluation trees and data, phylogenic software (PHYLIP). Phylogenetic online

tool.

UNIT III

Sequence Analysis Using Software Resources:

Introduction. The Wisconsin package, the Seq Lab environment, analyzing sequences with operations and Wisconsin package programmes, viewing output, monitoring programme progress and troubleshooting problems, annotating sequences and graphically displaying annotations in the Seqlab Editor, saving sequences in the Seq Lab Editor, Example of analysis that can be undertaken in Seqlab, extending Seqlab by including programmes that are not part of the Wiscosin package.

Plasmid Mapping and Primer Design

Restriction mapping, Mac Vector and OMIGA. Gene construction kit. Vector NTI, primer design for PCR Sequencing, primer design programs and software.

UNIT IV

Predictive Methods using nucleotide sequences: Predictive methods using nucleotide sequences: Introduction, Gene prediction methods, Computational gene prediction in eukaryotes. Gene prediction programs: GRAIL, GeneID, GENSCAN, GENMARK, detecting functional sites in the DNA: Promoters, Intron Splice Sites, and Translation Initition Site.

Predictive methods using protein sequences: protein identity based on composition, physical properties based on sequence, secondary structure and folding classes, specialized structures or features, tertiary structure. Prediction of protein secondary and tertiary structures. Related software.

Reference/Text Books-

Bioinformatics by Andreas D.Boxevanis. Wiley Interscience, 4th edition 2020.

Bioinformatics: Sequence and genome analysis by David W.Mount, Cold Spring Harbor, 2004.

Biocomputing Informatics And The Genome Projects by Smith D.W., Academic Press, 2014.

Bioinformatics: A Biologists Guide to Computing and the Internet. by Stuart M. Brown, NKU Medical Center, NY USA, 2000.

Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

BTE-403	Pharmaceutical Biotechnology (B.Tech. Biotechnology Semester VII)						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Major Test**	**Total**	**Time**
3	0	**-**	**3**	**25**	**75**	**100**	**3 Hrs**
Purpose	**To learn various aspects of pharmaceutical biotechnology**						
Course Outcomes							
CO1	**tudents will learn the procedure for discovery and development of drugs**						
CO2	**Students will be able to understand the metabolism of drug in the body and effects of drug on the human body**						
CO3	**Students will learn the basic concepts involved in the preparation of various drugs and their formulations**						
CO4	**Students will understand the management of different Life Style Diseases and know the procedure of Quality control and assurance.**						

UNIT-I

1. Introduction and Different Disciplines of Pharmacy

2. Historical Background and New Drug Discovery and Development – Preclinical and Clinical trials of drugs. Pharmacogenomics, Types of Drug receptors.

UNIT-II

3. Pharmacokinetics and Pharmacodynamics: Drug Bioavailability, Consideration in dosage form design, route of administration (oral, parental, inhalations, topical) Basic Principle of Drug Absorption, Distribution, Metabolism and Excretion.

4. Radiopharmaceuticals and Nanopharmaceuticals- Therapeutic applications of radioisotopes, Applications of Nano technology in Pharmaceuticals.

UNIT-III

5. Basic concepts involved in the preparations of different Drugs and their Dosage forms.Solid Dosage Forms- Tablets , Capsules, Powders , Semisolid Dosage Forms - Creams, Ointments, Pastes, lotions, Liquid Dosage Forms like Mixtures, Solutions, Emulsion, Ophthalmic etc.

6. Additives and Excipients used in drug formulations- Colors , flavours, sweeteners, binders, Disintegrating agents and other additives used in prescriptions.

UNIT- IV

7. **Management of Life style diseases** like obesity, diabetes, B.P., cholesterol heart stroke and cancer, joint problems etc**.** Neutraceuticals: Sources, Types, Potential Benefits, Role in prevention and control.

8. **Pharmaceutical products and their Types**

Laxatives, Analgesics, Antiseptics, Antacids, Antibiotics.

9**. Quality control and assurance**- GMP, GLP, ISO- 9000, validation and Drug Regulatory affairs

Reference/Text Books:

1. Principles of Medicinal Chemistry Vol. 1 Dr. S.S.Kadam, Dr. K.R. Mahadik, Dr. K.G.Bothara
2. Principles of Medicinal Chemistry Vol. 1 Dr. S.S.Kadam, Dr. K.R. Mahadik, Dr. K.G.Bothara
3. Pharmaceutical Dispensing.(2010) Pratibha Anand and Roop K. Khar. CBS Publishers and Distributors Pvt. Ltd.
4. R. M. Mehta, "*Dispensing Pharmacy*", Vallabh Prakashan, New Delhi.
5. Brahmankar, CBS Publishers.
6. Lipin Cott's Illustrated Reviews Pharmacology. Richard Maria, Pamela, Mary, Sheldon .
7. Cooper and Guunn's,*"Dispensing for Pharmaceutical Students",* CBS Publishers, Delhi
8. A Owunwonne, *"Hand Book of Radiopharmaceuticals",* Narosa Publishing House, New Delhi.
9. H C Ansel, *" Introduction to Pharmaceutical Dosage Forms",* K M Varghese& Co., Mumbai.
10. S.N.Pandeya: A Textbook of Inorganic Medicinal Chemistry, S.G.Publishers, Varanasi.
11. Clarke, E. C. G., "*Isolation and Identification of Drugs*", The Pharmaceutical Press, London

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BTE-411	Biosensor and Bioinstrumentation (B.Tech. Biotechnology Semester-VII)						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**1**	**-**	**3**	**75**	**25**	**100**	**3Hrs**
Purpose	**To familiarize the students with basic and applied aspects of Biosensors and Bioinstrumentation**						
Course Outcomes							
CO1	**To familiarize with basic concepts of general properties of transducers and other analytical instruments**						
CO2	**Students will come to know about bioassay design and implementation and basic concepts of automation and robotics**						
CO3	**This unit will enable the students to learn about data retrieval, handling and integration of databases and basics of human cardiac and vascular system**						
CO4	**Students will be able to know the basic concepts and applications of various types of biosensors**						

UNIT – I

1. **Introduction:** Electrical quantities and units, functional elements of an instrumentation system, static and dynamic characteristics, principle of analog and digital meters, CRO, energy meters, time and frequency meters, multimeters.
2. **Transducers**: Classification, resistive strain gauges, RTD, LVDT, Piezoelectric transducers, Electromagnetic transducers, Optical transducers, Transducers for biomedical science and their applications.
3. **Analytical Instruments:** pH meters, radiometric devices, fluorescence spectrophotometers, chromatology (chromatographic techniques- GC and HPLC), electrophoresis, lab on a chip – related instrumentation, Validation, commissioning and maintenance of the above equipments.

UNIT-II

4. **Assay Technologies and Detection methods:** Introduction, bioassay design and implementation, radiometric assay, scintillation proximity assay, fluorescence methodology to cover all types of fluorescence measurements and instrumentation, Reporter gene assay applications. Bio-analytical applications.
5. **Automation and Robotics:** Introduction: management and services issues of a centralized robotics HTS (high throughput screening) core, flexible use of people and machines, Bar-code technology and a centralized database, factors for the successful integration of assays, equipment, robotics and software. Perspectives on scheduling.

UNIT-III

6. **Data retrival, handling and integration:** Database systems, systems integration, data management and tracking
7. **Cardiac and Vascular system:** Overview of cardiovascular system, types of blood pressure sensors, Lumped parameters modeling of a catheter- sensor/system, heart sounds, cardiac catheterization, indirect measurement of blood pressure, measuring blood flow rate, measuring blood volume, pacemakers, defibrillators, cardiac-assist devices and heart valves- related instrumentation of equipments and involved sensors.
8. **Respiratory system**: Modeling the respiratory system, measuring gas flow rate and lung volume, tests of respiratory mechanics, measuring gas concentration, tests of gas transport, ventilators, anesthesia machines- related instrumentation of equipments and involved sensors.

UNIT-IV

9. **Biosensors:** Introduction to biosensors: concepts and applications, biosensors for personal diabetes management, micro fabricated sensors and the commercial development of biosensors, electrochemical sensors, chemical fibrosensors, Ion-selective FETs, non-invasive blood-gas monitoring, blood-glucose sensors. Noninvasive biosensors in clinical analysis, Applications of biosensors based instruments to the bioprocess industry. Applications of biosensors to the environmental samples, Introduction to biochips and their application to genomics, BIA core- an optical biosensors

Reference Books

1. M. K.Sezgintürk. Commercial Biosensors and their applications: Clinical, Food and Beyond. Elsevier. 2020.
2. G. Dutta, A. Biswas and A. Chakrabarti. Modern Techniques in Biosensors: Detection Methods and Commercial Aspects. Springer. 2021.
3. Introduction to Bio-analytical Sensors by Alice J Cunningham New York, John Wiley, 1998.
4. Applied Biosensors by DolandL.Wise, 1989
5. Advances in Laboratory Automation – Robotics, Eds. J.R.Strimataitis and J.N. Little, Zymark Corporation, Hopkinton, MA 1991.
6. Instrument methods of analysis by H W Willard, L LMerrit, J A Dean and F ASttle. 6/e, East- West publishers. 1992.
7. Biosensors and their applications by C Yang Victor and TNgo That, Plenum Press NY, 2000

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BTE-413	**DEC-I * Biochips and Microarray Technology (B. Tech. Biotechnology Semester VII)**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**1**	**-**	**3.0**	**75**	**25**	**100**	**3 Hrs.**
Purpose	**The purpose of this course is to familiarize the students with different array techniques**						
Course Outcomes							
CO1	**To familiarize with basic concepts of biochips and microarray technology**						
CO2	**Students will be able to understand about RNA and Protein Chips and electrical detection methods for microarrays**						
CO3	**This unit will enable the students to learn about applications of biochip technology in various fields**						
CO4	**Students will be able to know the commercial aspects of biochip technology and DNA computing**						

UNIT -1

1. **Introduction**: Basics of biochips and microarray technology, historical development of biochip technology .Why are Microarray important.

2. **Biochip and Microarray construction**: DNA microarrays, oligonuleotide, cDNA and genomics microarrays, microchip production technologies, megaclone technology for fluid microarray labels, microarray scanners./headers, microarray robotics. Microfluidics systems, chips and mass spectrometry.

UNIT- II

3. **Biochip and Microarray construction (Continued)**: Biochips, microarrays, Chromosome on a chip, tissue chip, RNA chip, Protein chip technology, glycochips, biochips assays, combination of microarray and biosensor technology, biochip versus gel-based methods, process flow for production and analysis of a chip, standardization of microarray analysis, bioinformatics and microarrays, integrated biochip system, evaluation of conventional microarray technology. Electrical detection methods for microarrays, SERS (Surface-Enhanced Raman spectroscopy)-based microarrays.

UNIT- III

4**. Applications of Biochip Technology:** Molecular diagnostics and pharmacogenomics, Application of microarray technology in drug discovery and development, Gene expression studies, use of DNA chip technology for drug safety, use of microchips for drug delivery, biochips as neural prostheses, use of biochips in health care, use of microarrays in population

genetics and epidemiology, use of microarray in forensics. DNA chip technology for water quality management, Bioagent chip, Application of microarray in the agro-industry, use of microarray in genetic disease monitoring, point of care (POC) applications.

UNIT -IV

5. **Commercial aspects of Biochip technology:**Markets for biochip technologies, commercial support for the development of biochips, government support for biochip development, business strategies and patent issues

6. **DNA Computing:** Introduction, junctions, other shapes, biochips and large-scale structures. Discussion of Robinson and Kallenbach's methods for designing DNA shapes, DNA cube. Computing with DNA, Electrical analogies for biological circuits. Challenges and future trends. Gene ontology and pathway analysis

Reference /Text Books-

1. Arun Jogota, "Microarray Data Analysis and Visualization", The Bay Press, 2001.
2. Ernst Wit and John McClure, "Statistics for Microarrays Design", Analysis and Inference, John Wiley & Sons, 2004.
3. Steen Knudsen, "Guide to analysis of DNA Microarray data", John Wiley & Sons, 2004.
4. Biochips and Microarrays-technology & Commercial Potential, Published by RCK Publishing, 2012.
5 DNA Arrays: Technology and Experimental strategies, Grigorenko (ed), CRC Press, 2002.
6. Microarray Analysis Mark Schena; J. Wiley & Sons (ed., New York), 2002.
7. Microarray Bioinformatics, Dov Stekel, Cambridge University Press, 2003.
8. Microarray Technology and Its Applications, Uwe R. Müller, Dan V. Nicolau, Springer, 2005.
9. DNA Microarrays: Current applications: Emanuele de Rinaldis, Armin Lahm,, Horizon Scientific Press, 2007.

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**** The students should select two Departmental Elective Courses (DEC-I)***

BTE-415	Enzyme Technology (B. Tech Biotechnology semester VII)						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**1**	**-**	**3.0**	**75**	**25**	**100**	**3 Hrs**
Purpose	**To familiarise students about different aspects of enzyme technology**						
Course outcome: After completion of this course the students will be able							
CO1	**To articulate advantages and disadvantages of enzyme based production processes.**						
CO2	**To compare different strategies used for protein engineering**						
CO3	**To explain the principles and parameters used for enzyme immobilization.**						
CO4	**To differentiate between solid state fermentation and submerged fermentation.**						

UNIT I

Introduction to enzyme Technology: What are Biocatalysts? Bio- and Chemo catalysts – Similarities and Differences, Goals and Potential of Biotechnological Production Processes, The Use of Isolated or Intracellular

Enzymes as Biocatalysts, Advantages and Disadvantages of Enzyme-Based Production Processes, Goals and Essential System Properties for New or Improved Enzyme Processes, Essential System Properties for Rational Design of an Enzyme Process , Current Use and Potential of Enzyme Technology

UNIT-II

Enzyme Discovery and Protein Engineering: Enzyme Discovery, Strategies for Protein Engineering, Rational Protein Design, Directed (Molecular) Evolution

Methods to Create Mutant Libraries, Assay Systems, Focused Directed Evolution, Computational Design of Enzymes

UNIT-III

Immobilization of Enzymes: Principles, Parameters of Immobilization, Carriers

Inorganic Carriers, Polysaccharides, Synthetic Polymers, Binding Methods

Adsorption, Covalent Binding, Application of Immobilized Enzymes

Hydrolysis and Biotransformation of Carbohydrates, Amino Acid, Peptide Synthesis, Application of Lipases

UNIT-IV

Enzyme production and Purification: solid state fermentation, submerged fermentation, environmental factors affecting microbial enzyme production in SSF. Strategies to improve production of microbial cellulase.

Reference/Text Books

1. Klaus Buchholz, Volker Kasche, and Uwe T. Bornscheuer "Biocatalysts and Enzyme Technology" 2nd Edition, Wiley-Blackwell, 2012
2. M.Y Khan and Farah Khan " Principles of enzyme technology" PHI, 2015
3. Enzyme Technologies editors: Hsiu-Chiung Yang Wu-Kuang Yeh and James R. McCarthy, Wiley, 2014
4. "Biotechnology of Microbial Enzymes" Editor Goutam Brahmachari, Academic Press, 2017

Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

BTE-417	Advanced Management Information system and Information Technology (B. Tech Biotechnology semester VIII)						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**1**	**0**	**3**	**75**	**25**	**100**	**3 Hour**
Purpose	**To familiarize the students with Management Information System.**						
Course Outcomes After completion of this course the students will be able							
CO1	**To Understand and articulate fundamental concepts of information technology management.**						
CO2	**To Assess and apply IT to solve common business problems.**						
CO3	**To Suggest and defend effective solutions to business problems, and design a database application to solve a business problem.**						
CO4	**To Discuss the ethical aspects of information technology use in the organization and its governance issues.**						

UNIT I

Introduction: Definition information system, role and impact of MIS, The challenges of Information system, Nature of
MIS, Characteristics of MIS, Myths regarding MIS, Requirements of MIS, Problems & Solutions in implementing MIS, Benefits of MIS, Limitations of MIS, Significance of MIS, Components of MIS. Role of MIS, Major Management challenge to building and using information system in Organization, functions of management.

UNIT II

Information system and Organizations: The relationship between Organization and Information System, Information needs of different organization levels: Information concept as quality product, classification and value of information, methods of data and information collection. Strategic role of information system, Salient features of Organization, Information, management and decision making, How Organization affect Information Systems, How Information system affect Organization, Ethical and Social impact of information system.

UNIT III

Business application of Information System: Foundation Concepts Information systems in Business: Information system and technology, Business Applications, Development and Management. The internetworked E-business Enterprise: Internet, and Extranet in business. Electronic Commerce System: Electronics commerce Fundamentals, Commerce Application and issues. E-business Decision Support: Decision support in E-Business, Artificial Intelligence Technologies in business.

UNIT IV

Strategic and Managerial Implications of Information Systems: Strategic Information System: Introduction, Characteristics of Strategic Information Systems, Strategic Information Systems (SISP), Strategies for developing an SIS, Potential Barriers to developing a Strategic Information System (SIS), Decision Support System (DSS): Decision making concepts, methods, tools and procedures. Managing Information Resources: Introduction, IRM, Principal of Managing Information Resources, IRM functions, Computer Security: Introduction, Computer Security, Types of Computer Security, Disaster Recovery Plan.

Reference/Text Books:

1. W.S . Jawadakar, “Management Information System”, McGraw Hill ,
2. J. O. Brien, “ Management Information System”, TMH, New Delhi
3. Uma G . Gupta, “Management Information System” Fifth Edition TMH.
4. Kenneth C. Laudon, “Management Information System Organisation and Technology” TMH.

Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

BTE-419	Stem Cell Technology (B.Tech. Biotechnology) Semester- VII						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**1**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	**The objective of this course is to enable students to understand the principles of stem cells, their isolation and maintenance and their application in different therapies**						
Course Outcomes							
CO1	**Students will be able to differentiate among the different types of stem cells**						
CO2	**Students will be able to explain the concept of stem cell cloning**						
CO3	**Students will be able to compare the isolation and maintenance methods for different type of stem cells**						
CO4	**Students will be able to recognize the applications of stem cells in different diseases**						

UNIT I

Introduction: Basic concepts and properties of Stem cells, Totipotency and Pluripotency, Types of stem cells: Embryonic stem cells, germinal stem cells, Adult stem cells, Tumor stem cells.

UNIT II

Molecular Cell Biology and Cloning: Molecular mechanisms, Cell cycle regulation in stem cells. Stem cell niches, Stem cell lineage tracing

Therapeutic and reproductive cloning, Nuclear Transfer method, Application of nuclear transfer derived embryonic stem cells.

UNIT III

Stem Cells maintenance and transplant: Sources of stem cells; Cell types for transplantation: Bone marrow, Peripheral stem cells, cord blood stem cells

General methods of Isolation, Identification, Characterization and maintenance of different stem cells: Embryonic stem (ES) cells, Hematopoietic Stem Cells (HSC), Hematopoietic Stem Cells (HSC), Differentiation studies of Mesenchymal stem cells, Neural stem cell and Neural crest stem cell.

UNIT IV

Stem cells and Therapy Cell based therapy, organ factories, drug discovery and development, Medical applications in Leukemia, Immune deficiencies, diabetes, liver diseases, cardiovascular diseases, Neurological disorders

Reference/Text Books

1. Anthony Atala, Robert Lanza. Essentials of Stem Cell Biology. Netherlands: Elsevier/Academic Press, 2014.
2. Atala A & Lanza R, Stem Cells Handbook. Netherlands: Springer New York, 2013.
3. Satish Totey and Kaushik D. Deb. Stem Cell Technologies: Basics and Applications (McGraw-Hill, 2010).
4. Robert A. Meyers Stem Cells: From Biology to Therapy (Current Topics from the Encyclopedia of Molecular Cell Biology and Molecular Medicine), 2013

Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

BTE-421	Herbal Drug Technology (B. Tech. Biotechnology Semester VII)						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**1**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	**To familiarize the students with basic and applied aspects of Herbal Drug Technology**						
Course Outcomes							
CO1	**The contents of first unit will enhance the knowledge of students about traditional herbs and herbal medicine.**						
CO2	**Students will come to know about the basic concepts of various systems of medicine and traditional therapies**						
CO3	**This unit will learn the skills about technology for production of crude drugs.**						
CO4	**To familiarize with basic knowledge of use of herbs in the management of health. Students will learn about the economic aspects of herbs and herbal drugs**						

UNIT I

Herbs as raw materials: Definition of herb, herbal medicine, herbal medicinal product, Common herbals and herbal medicines of India. Sources of Herbs Selection, Identification and authentication of herbal materials. The need for the study of herbs and herbal medicine.

UNIT II

Systems of Medicine : Evolution of systems of medicine, Traditional Therapies and Types of therapies– Ayurveda , Unani, eight chikitsas , eight chakras, Naturopathy, Homeopathy, Aromotherapy, Faith healing, Religious beliefs and Ethnotherapeutics . Concept of Holistic medicine. Ayurvedic Pharmacopoeia of India.

UNIT III

Technology for production of crude drugs: Herbal drug preparation. Processing of herbal raw material, Principles of extraction and different methods of extraction. Formulation and Standardization of herbal extracts. Stabilization and stability of herbal formulations.

UNIT IV

Health Benefits: Evolution of conscious use of plants in the management of health and disease General aspects, scope and types of products available in the market. Health benefits and role of herbs in ailments like Diabetes, CVS diseases, Cancer, and various Gastro intestinal diseases. Role of herbs in cosmetics.

Economic Aspects of Herbal Drugs: Economic value of herbs and herbal drugs, Databases on herbals and herbal drugs. Rescue and Preservation of traditional medicinal knowledge and herbals. Development of herbal medicine industry- Present Scope and future prospects.

Reference Books-

1. A lexicon of medicinal plants in India. D.N.Guhabakshi, P.Sensarma and D.C.Pal, 1999.Naya prakash - publications.
2. Glossary of Indian medicinal plants. R.N.Chopra, S.L.Nayar and I.C.Chopra,1956. C.S.I.R, New Delhi.
3. Ethnobotany The Renaissance of Traditional Herbal Medicine. Rajiv K. Sinha, 1996.Ina Shree publishers.
4. The indigenous drugs of India. Kanny, Lall, Dey and Raj Bahadur, 1984. International Book Distributors.
5. Herbal plants and Drugs Agnes Arber, 1999. Mangal Deep Publications.
6. New Natural products and Plant drugs with Pharmacological, Biological (or) Therapeutical activity. H.Wagner and P.Wolff , 1979. Springer, New Delhi.
7. Ayurvedic drugs and their plant source. V.V.Sivarajan and Balachandran Indra, 1994. Oxford IBH publishing Co.
8. Ayurveda and Aromatherapy. Miller, Light and Miller, Bryan, 1988. Banarsidass, Delhi.
9. Principles of Ayurveda. Anne Green, 2000. Thorsons, London.
10. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.
11. Pharmacopoeal standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy)

Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

**** The students should select two Departmental Elective Courses (DEC-I)***

BTE-405	BIOINFORMATICS LAB (B.Tech. Biotechnology Semester VII)						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test (Practical)**	**Minor Test**	**Total**	**Time**
-	**-**	**3**	**1.5**	**60**	**40**	**100**	**3 Hrs.**
Purpose	**To familiarize the students with applied aspects of Bioinformatics**						
Course Outcomes							
CO1	**To familiarize with computer basics and searching of biological databases**						
CO2	**Students will come to know about data mining techniques**						
CO3	**To learn the concepts of phylogenetic analysis using bioinformatics software**						
CO4	**Students will be able to know the basic concepts of protein structure prediction**						

List of Experiments:

1. Computer basics
2. Searching biological database for relevant information
3. Data mining techniques in Bioinformatics.
4. Searching, retrieval and similarity analysis of biological database.
5. Sequence retrieval from nucleic acid and protein database.
6. Restriction mapping
7. Sequence (FASTA & BLAST) searches.
8. Pair wise comparison of sequences.
9. Evolutionary studies/ Phylogenic analysis.
10. Identification of genes in genomes.
11. Protein databank retrieval and visualization.
12. Superposition of structures.
13. Secondary structure prediction of proteins.
14. Pattern searching in nucleic acids.
15. Validation of 3D structures.

Reference/Text Books-

Bioinformatics- A Practical Guide to the Analysis of Genes and Proteins by Andreas D. Baxevanis and B.F.Francis Ouellette, 4th Edition, A John Wiley and Sons, Inc. Publications, 2020.

Bioinformatics: Sequence and Genome Analysis by David W. Mount, Cold Spring Harbor, 2004.

Biocomputing Informatics and the Genome Projects by Smith D.W., Academic Press, 2014.

BTE-402	Biocatalysis & Biotransformation (B.Tech. Biotechnology Semester VIII)						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**-**	**3.0**	**75**	**25**	**100**	**3 Hrs**
Purpose	**To familiarize the students with Concepts of Biocatalysis and Biotransformation**						
Course outcome	**After completion of this course the students will be able**						
CO1	**To articulate the concept of Biocatalysis and Biotransformation.**						
CO2	**To differentiate between different strategies for production of succinic acid.**						
CO3	**To explain the mechanism of pesticide transformation.**						
CO4	**To compare computational tools for enzyme function prediction.**						

UNIT I

1. **Introduction to biocatalysis**, Current market of biocatalysis, fermentation, concept of biotransformation and advantages and limitations of biotransformation.
2. Development of chemo enzymatic processes: synthetic route design and integration of biocatalysis, chemo-enzymatic process development

UNIT II

4. **Production of Dicarboxylic Acid Using Yeasts**: Current Uses and Production of Dicarboxylic Acids, Selection and Improvement of Yeast Strains, Selection and Improvement of Yeast Strains, Metabolic Engineering Strategies for Biotechnological Production of Succinic Acid
5. **Engineering Proteases for Industrial Applications**: Proteases in Industry, Serine Proteases and Subtilisins, Engineering Subtilisin Protease toward Increased Oxidative Resistance, Increasing Protease Tolerance against Chaotropic Agents.

UNIT III

6. **Transformation of pesticides**: Accumulation of pesticide, Mechanism of pesticide transformation, enzymatic reactions in pesticide metabolism
7. Transaminases: Transaminases as a Biosynthetic Route for Chiral Amines, Kinetic Resolution of Amines Employing ATAs, Recent Advances in Industrially Relevant Asymmetric Reductive Amination Reactions, ATA Screening Kit

UNIT IV

8. **Structural Bioinformatics and Biocatalysis Research**: Computational Tools for Function Prediction and Analysis of Enzymes.
9. **Recent development in biotransformation**: current challenges and future scopes of biotransformation process, practical consideration for enhancing efficiency of biotransformation

Reference/text books

1. Green Biocatalysis edited by Ramesh N. Patel, John Wiley and Sons, 2016.
2. Biotransformation of Agricultural Waste and By-Products edited by Palmiro Poltronieri and Oscar Fernando D'Urso, Elsevier Inc, 2016
3. Applied Biocatalysis edited by Lutz Hilterhaus, Andreas Liese, Ulrich Kettling, and Garabed Antranikian, Wiley-VCH, 2016.
4. Journal of Biocatalysis and Biotransformation.

Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

BTE-404	Metagenomics (B.Tech. Biotechnology Semester- VIII)						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**1**	**-**	**3.0**	**75**	**25**	**100**	**3Hr**
Purpose	**The purpose of this course is to provide focus on next generation DNA sequencing technology and p how the metabolic functions, taxonomic distribution, diversity, evenness and species richness of microbial communities varies across environment**						
Course Outcomes							
CO1	**Students will become familiar with Metagenomics**						
CO2	**Students will be able to perform the phylogenetic tree**						
CO3	**Students will develop the knowledge and able to perform Metagenomic analysis of soil microbial communities**						
CO4	**Students will develop focus on the application of metagenomics**						

UNIT -1

What is metagenomics; Types of metagenomes: Amplicon, Shotgun, Functional; Amplicon metagenomics: History, phylogenetic marker, examples; Shotgun metagenomics: History and examples. Techniques subtractive hybridization (SSH); Differential expression analysis (DEA); Microarrays & Metagenome sequencing

UNIT- II

Direct linking of microbial populations to specific biodegradation and biotransformation processes by stable isotope probing of biomarkers- PhyloChip & GeoChip-Detection of xenobiotic-degrading bacteria by using oligonucleotide microarrays

Phylogenetic analysis and Comparative genomics Software's & Tools and Construction of a metagenomic library; Analysis of Metagenomic Libraries; Sequence-based Metagenomics Analysis; Function-based Metagenomics Analysis

UNIT -III

Metagenomic analysis of soil microbial communities; Metagenomic analysis of marine microbial communities; Metagenome of the Microbial Community in Acid Mine Drainage; Metagenomic Analysis of Bacteriophage; Metagenomics and Its Applications to the Study of the Human Microbiome; Archaeal Metagenomics: Bioprospecting Novel Genes and Exploring New Concepts.

UNIT -V

Application of Metagenomics to Bioremediation; Applications of Metagenomics for Industrial Bioproducts; Escherichia coli host engineering for efficient metagenomic enzyme discovery; Next-generation sequencing approaches to metagenomics; Stable isotope probing: uses in metagenomics; DNA sequencing of uncultured microbes from single cells.

Reference/Text Books

8. Diana Marco Universidad Nacional de Cordoba, Argentina, "*Metagenomics: Theory, Methods and Applications"*, Caister Academic Press,2010.
9. Diana Marco Universidad Nacional de Cordoba, Argentina "*Metagenomics: Current Innovations and Future Trends"*,Caister Academic Press,2011.
10. Joanna R. Freeland, Heather Kirk, Stephen Petersen, "*Molecular Ecology*", Mc Graw Hill, 2nd Edition "2012.
11. Beebee T.J.C., D G. Rowe," *An Introduction to Molecular Ecology*", Mc Graw Hill, 2004.

Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

BTE-406	Molecular Modelling and Drug Design (B.Tech. Biotechnology Semester VIII)						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**1**	**-**	**3**	**75**	**25**	**100**	**3Hrs**
Purpose	**The course will focus on the Molecular Modelling in context of drug designing**						
Course Outcomes							
CO1	**To understand the critical relationship among biomolecular structure, function and force field models.**						
CO2	**To be able to utilize basic modelling techniques to explore biological phenomena at the molecular level.**						
CO3	**To emphasize Modelling drug/receptor interactions in detail by molecular mechanics, molecular dynamics simulations and homology modelling.**						
CO4	**An awareness of rational drug design, based on understanding the three-dimensional structures and physicochemical properties of drugs and receptors will be created.**						

UNIT I

1. **Introduction to Molecular Modelling**: Introduction - Useful Concepts in Molecular Modelling: Coordinate Systems. Potential Energy Surfaces. Molecular Graphics. Surfaces. Computer Hardware and Software. The Molecular Modelling Literature.

UNIT II

2. **Force Fields: Fields. Bond Stretching**. Angle Bending. Introduction to Non-bonded Interactions. Electrostatic Interactions. Van der Waals Interactions. Hydrogen Bonding in Molecular Mechanics. Force Field Models for the Simulation of Liquid Water.

UNIT III

3. **Energy Minimisation and Computer Simulation**: Minimisation and Related Methods for Exploring the Energy Surface. Non-Derivative method, 1st and 2nd order minimisation methods. Computer Simulation Methods. Simple Thermodynamic Properties and Phase Space. Boundaries. Analyzing the Results of a Simulation and Estimating Errors. GROMACS and CNS.

UNIT IV

4. **Molecular Dynamics & Monte Carlo Simulation**: Molecular Dynamics Simulation Methods. Molecular Dynamics Using Simple Models. Molecular Dynamics with Continuous Potentials. Molecular Dynamics at Constant Temperature and Pressure. Metropolis Method. Monte Carlo Simulation of Molecules. Models Used in Monte Carlo Simulations of Polymers. Molecular Modeling software: BIOSUITE
5. **Structure Prediction and Drug Design**: Structure Prediction - Introduction to Comparative Modeling. Sequence Alignment. Constructing and Evaluating a Comparative Model. Predicting Protein Structures by 'Threading', Molecular Docking, AUTODOCK and HEX. Structure based De Novo Ligand design, Drug Discovery – Chemoinformatics – QSAR.

Reference/Text Books

1. S. Ramasamy. Molecular Modeling. Lambert Academic Publishing, USA. 2015
2. V. Magnasco. Methods of Molecular Quantum Mechanics- An Introduction to Electronic Molecular Structure. Wiley. 2009
3. A.R.Leach, Molecular Modelling Principles and Application, Longman, 2001.
4. J.M.Haile, Molecular Dynamics Simulation Elementary Methods, John Wiley and Sons, 1997.
5. S. P. Gupta. QSAR and Molecular Modeling, Springer - Anamaya Publishers, 2008.

Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

BTE-408	Cancer Biology (B.Tech. Biotechnology) Semester- VIII						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**1**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	**To give complete overview of cancer as a disease detailed analysis of biological changes of the tumor cells. Analyze the impact of the cell cycle (proliferation), gene mutations and apoptosis in cancer. Discuss the impact of applied/translational research in cancer diagnosis as well as the design of novel targeted therapeutic agents in the treatment of cancer.**						
Course Outcomes							
CO1	**Students will be able to categorize the different forms of cancer**						
CO2	**Students will be able to explain the genetic basis of cancer**						
CO3	**Students will be able to recognize the role of different proteins in cancer and their clinical significance**						
CO4	**Students will be able to assess/compare different diagnostic and therapy methods**						

UNIT I

Fundamentals of Cancer Biology and Principles of Carcinogenesis

Overview of the hallmarks of cancer, Different forms of cancers, Diet and cancer, Natural history of Carcinogenesis, Chemical Carcinogenesis, Metabolism of Carcinogenesis, Principles of Physical Carcinogenesis, X - Ray radiation - mechanism of radiation Carcinogenesis.

UNIT II

Molecular Cell Biology of Cancer: Tumor viruses and Oncogenes, Identification of Oncogenes, Mechanism of oncogene activation, Role of growth factors and receptors in carcinogenesis, RAS signaling in cancer

Regulation of Cell cycle, modulation of cell cycle in cancer, Tumor suppressor genes, pRb tumor suppressor, Apoptosis and p53 tumor suppressor

UNIT III

Principles of Cancer Metastasis: Three-step theory of Invasion, Proteinases and tumour cell, Basement Membrane disruption, The biology of angiogenesis, Metastatic cascade

UNIT IV

Detection of Cancer and Cancer Therapy: Fundamental principles behind cancer diagnosis, Advances in Cancer detection, Different forms of therapy: Chemotherapy, radiation Therapy, and Immuno therapy, Applications of omics technologies in diagnostics and treatment.

Reference/Text Books

5. Pecorino, Lauren. Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics. United Kingdom: Oxford University Press, 2016.

6. Weinberg, Robert Allan. The Biology of Cancer. United Kingdom: Garland Science, 2014.

7. Vincent T. DeVita Jr. MD, Theodore S. Lawrence, Steven A. Rosenberg Cancer: Principles and Practice of Oncology Primer of Molecular Biology in Cancer(3rd edition)

4 Oxford Textbook of Cancer Biology, edited by Pezzella, Francesco, Mahvash Tavassoli, and David J. Kerr. Oxford, UK: Oxford University Press, 2019-05. https://oxfordmedicine.com/view/10.1093/med/9780198779452.001.0001/med-9780198779452.

Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

BTE-410	Developmental Biology (B. Tech. Biotechnology) Semester- VIII						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**1**	**-**	**3.0**	**75**	**25**	**100**	**3h**
Purpose	**This course will help the students to understand the basic knowledge of morphogenesis and organogenesis in plants and animals.**						
Course Outcomes							
CO1	**Students will be able to illustrate the basic concept of development.**						
CO2	**Students will be able to classify Gametogenesis between plant and animal.**						
CO3	**Students will be able to develop the knowledge of morphogenesis in animals.**						
CO4	**Students will be able to develop the knowledge of morphogenesis in plants.**						

UNIT -1

Basic concepts of development : Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.

UNIT- II

Gametogenesis, fertilization and early development: Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination.

Unit –III

Morphogenesis and organogenesis in animals : Cell aggregation and differentiation in *Dictyostelium*; axes and pattern formation in Drosophila, amphibia and chick, organogenesis – vulva formation in *Caenorhabditis elegans*, eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development- larval formation, metamorphosis; environmental regulation of normal development; sex determination.

UNIT –IV

Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in Arabidopsis and Antirrhinum. Programmed cell death, aging and senescence.

Reference/Text Books

1. Developmental Biology by Gilbert SF and Sunderland MA. 6th Edition, 2000.
2. Abu-Shaar M, Mann R S. Generation of multiple antagonistic domains along the proximodistal axis during *Drosophila* leg development. Development. 1998.
3. The Biology of Aging by Sinauer Associates, Sunderland, MA *2nd Ed 1998.*

Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

BTE-412	Protein Engineering* (B.Tech. Biotechnology Semester VIII)						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**1**	**-**	**3.0**	**75**	**25**	**100**	**3 Hrs.**
Purpose	**To create awareness with concepts of protein engineering**						
Course Outcomes: After completion of this course the students will be able							
CO1	**To differentiate between secondary and tertiary structures of protein**						
CO2	**To demonstrate structure function relationship of membrane proteins**						
CO3	**To explain the concept of designed protein**						
CO4	**To identify protein- protein interactions.**						

UNIT I

1. **Structure Function Dynamics Correlation**. Basic structural concepts – Primary, secondary, tertiary and quaternary structures. Ramachandran plot, super secondary structures – motif and domain. Protein folding and mechanisms.

UNIT II

2. **Structure Function Engineering**. The correlation of structure and function in – transcription factors, serine proteinases, membrane proteins, signal transduction proteins and recognition in immune system.

UNIT III

3. **Library Construction for Protein Engineering**: Established methods for library construction, critical methods in evaluation of library construction methods. Designed proteins, examples of designed proteins (enzymes) with enhanced stability and efficiency, playing a significant role in industries.

UNIT IV

4. **Engineering of Therapeutic Proteins**: Sources of Protein Therapeutics, Strategies for Designing Effective Protein Therapeutics, Examples of Protein Therapeutics
5. **Proteomics Application**. Mining proteomes, protein expression profiling, identifying protein – protein Interactions and protein complexes, mapping- protein identification, new directions in proteomics.

References/Text Books

1. Amit Kessel and Nir Ben-Tal, "Introduction to Protein" 2nd Edition, Chapman and Hall, 2018
2. Anton Torres Editor "Protein Engineering and Design," Syrawood Publishing House, 2017
3. Daniel C. Liebler, "Introduction to Proteomics – Tools for the New Biology," Humana Press, 2001
4. Protein Engineering and Design edited by Sheldon J. Park Jennifer R. Cochran, CRC Press, 2010

5 M.Romya and P. Ponmurugan, Protein Engineering, Narosa Publications, New Delhi, 2015

Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

BTE-414	Bioethics, IPR and Biosafety (B. Tech. Biotechnology) Semester- VIII						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**1**	**0**	**3**	**75**	**25**	**100**	**3hrs**
Program Objective (PO)	Students will able to acquire knowledge of regulatory bodies ,acts and organization indulge in creating a balancing force between advent in technology with monitoring their impacts on human and ecology alongwith biosafety measures with ethical conduct to society.						
Course Outcomes							
CO1	Students will be able to describe the basic terms and procedure for IPR, patent filing and implications on society of commercialized products.						
CO2	Students will be able to learn and describe various act, policies, different organizations and guidelines for biosafety.						
CO3	Students will develop knowledge of outbreak and risk assessment and management at laboratory level along with health impacts.						
CO4	Students will develop awareness of ecological impact of release of genetically modified organisms and monitoring methods.						

UNIT -1

Introduction- Intellectual Property Rights, Copyrights, Trademarks, Trade secrets, Geographical indications, Patents, Patent Filing, Indian Patent act and amendments, Implications of intellectual property rights on the commercialization of Biotechnology products, Patented products in Market and Success story.

UNIT- II

Policies, Agreements and Organization -National biosafety policies and law, The Cartagena protocol on biosafety, Convention on biological diversity, Cross border movement of germplasm and agreements, World Trade Organization and agreements, Updated Regulatory frameworks.

UNIT-III

Biological Containment- Risk assessment, Risk management, General principal for biological containment at laboratory level, Health impact of containment issues- Allergenicity, Antibiotic resistance and Toxicology. Case studies.

UNIT –IV

Ecological Impacts-Genetically Modified organism and impact on biodiversity, gene flow, gene escape and creation of superweeds/ superviruses, Monitoring strategies and method of detecting transgenics(Radioactive /Non radioactive methods).Case studies.

Reference/Text Books

1. Padma Nambisan, An introduction to ethical safety and intellectual property rights issues in biotechnology, Academic Press,ISBN-978-0-12-809231-6, 2017.
2. Deepa Goel and Shomini Parashar, IPR, Biosafety and Bioethics, Pearson Education,India,ISBN-978933251429,2013.
3. V. Sree Krishna, Bioethics and Biosafety in Biotechnology, New age international private ltd., 2007.
4. Gerald A. Urban, BioMEMS, Springer, 2010.

Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

OEC-BT-418	Biomedical Electronics (B. Tech Biotechnology semester VIII)							
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**-**	**100**	**3**
Course Outcomes **At the end of this course students will demonstrate the ability to**								
CO1	**Understand and explain the concept of biomedical signals, electrodes and instrumentation**							
CO2	**Understand and explain the physiological transducers and recording systems**							
CO3	**Understand and explain biomedical recorders and patient monitoring systems**							
CO4	**Understand and explain cardiac pacemakers, defibrillator and patient safety**							

UNIT-I

Introduction: Role of technology in medicine, physiological systems of the body, sources of biomedical signals, basic medical instrumentation and their performance requirements, intelligent medical instrumentation systems, consumer and portable medical equipment, implantable medical devices, role of engineers in healthcare facilities.

Bioelectric Signals and Electrodes: Origin of bioelectric signals, recording electrodes, silver- silver chloride electrodes, electrodes for ECG, electrodes for EMG, electrical conductivity of electrode jellies and creams, microelectrodes.

UNIT-II

Physiological Transducers: Definition, classification and performance characteristics of transducers, displacement, position and motion transducers, pressure transducers, transducers for body temperature measurement, photoelectric transducers, optical fiber sensors, biosensors, smart sensors.

Recording System: Basic recording system, general considerations for signal conditioners, preamplifiers, sources of noise in low level measurements, biomedical signal analysis and processing techniques, the main amplifier and driver stage, writing systems.

UNIT-III

Biomedical Recorders: Electrocardiograph, vectorcardiograph (Vcg), phonocardiograph (Pcg), digital stethoscope, electroencephalograph (Eeg), electromyograph.

Patient Monitoring Systems: System concepts, cardiac monitor, bedside patient monitoring systems, central monitors, measurement of heart rate, measurement of temperature, measurement of respiration rate, catheterization laboratory instrumentation, ambulatory monitoring instruments.

UNIT-IV

Cardiac Pacemakers and Defibrillators: Need for cardiac pacemaker and defibrillator, external pacemakers, implantable pacemakers, pacing system analyzer, DC defibrillator, implantable defibrillators, types of defibrillators, defibrillator analyzer.

Patient Safety: Electric shock hazards, leakage currents, safety codes for electromedical equipment, electrical safety analyzer.

Text/Reference Books:

1. R S Khandpur: Handbook of biomedical instrumentation, 3rd ed., McGraw Hill Education.
2. Joseph D. Bronzino: The biomedical engineering handbook, 2nd ed., CRC Press.

Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

OEC-BT-420	Matlab&Simulation (B.Tech Biotechnology Semester VIII)						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**-**	**3**	**75**	**25**	**100**	**3 Hrs.**
Course Outcomes (CO) At the end of the course students will be able to							
CO1	**Write basic commands and script files in MATLAB**						
CO2	**Solve mathematical equations**						
CO3	**Create 2D and 3D analysis plots**						
CO4	**Design Simulink models**						

UNIT I

Introduction to MATLAB: Introduction to MATLAB software, Key features, MATLAB window, Command window, Workspace, Command history, Setting directory, Working with the MATLAB user interface, Basic commands, Assigning variables, Operations with variables. Working with script tools, Writing Script file, Executing script files, The MATLAB Editor, Saving m files. Introduction to Graphical User Interface (GUI).

UNIT II

Matrix and Data files: Character and string, Arrays and vectors, Column vectors, Row vectors, Basic Mathematics, BODMAS Rules, Arithmetic operations, Operators and special characters, Mathematical and logical operators, Solving arithmetic equations, Operations on matrix, Crating rows and columns Matrix, Matrix operations, Finding transpose, determinant and inverse, Solving matrix, Trigonometric functions, Complex functions. Writing user defined functions.

UNIT III

2D and 3D Plots: Plots: Plotting vector and matrix data, Plot labelling, curve labelling and editing, 2D Plots: Basic Plotting Functions, Creating a Plot, Plotting Multiple Data Sets in One Graph, Specifying Line Styles and Colors, Graphing Imaginary and Complex Data, Figure Windows, Displaying Multiple Plots in One Figure, Controlling the Axes, 3D Plots: Creating Mesh and Surface, About Mesh and Surface Visualizing, Subplots.

UNIT IV

MATLAB Programming and Simulink: Automating commands with scripts, Writing programs with logic and flow control, Writing functions, Control statement Programming, Conditional Statement Programming, Control Flow Conditional Control — if, else, switch, Loop Control — for, while, continue, break, Program Termination — return. Introduction to Simulink, Simulink Environment & Interface, Study of Library, Circuit Oriented Design, Equation Oriented Design, Model, Subsystem Design, Connect Call back to subsystem, Application.

Text and Reference Books/Material:

1. Marvin Marcus, Matrices and MATLAB: A Tutorial, Prentice Hall , 2010
2. MATLAB Primer by MATHWORKS: http://www.mathworks.com/help/releases/R2014b/pdf_doc/matlab/getstart.pdf

Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

OEC-BT-422	History of Science (B.Tech Biotechnology semester VIII)						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**-**	**3.0**	**75**	**25**	**100**	**3 Hr**
Purpose	**The purpose of this course is to aware the students about development of science in India**						
Course outcome : After completion of this course the students will be able							
CO 1	**To articulate the scope and importance of science and technology in development of society.**						
CO2	**To appreciate the development of science and technology in Ancient India.**						
CO3	**To explain the development of science and technology in Medieval India.**						
CO4	**To appreciate the Policy development in the field of science and Technology.**						

UNIT-I

Concepts and Perspectives: Meaning of History Objectivity, Determinism, Relativism, Causation, Generalization in History; Extent of subjectivity, contrast with physical sciences, interpretation and speculation, concept of historical inevitability, Historical Positivism.

Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.

UNIT-II

Science and Technology in Ancient India: Technology in pre-historic period, beginning of agriculture and its impact on technology, Science and Technology during Vedic and Later Vedic times.

UNIT-III

Science and Technology in medieval India: Legacy of technology in Medieval India, Interactions with Arabs, Astronomy and Mathematics: interaction with Arabic Sciences, Science and Technology on the eve of British conquest

UNIT-IV

Science and Technology in a post-independent India: Science, Technology and Development discourse Shaping of the Science and Technology, Policy Developments in the field of Science and Technology, Social implications of new technologies like the Information Technology and Biotechnology

Reference/Text Books

1. M. Bhardwaj “History of science and Technology in Ancient India” Publisher Bookwin, 2010
2. Bal Ram Singh, Nath Girish and Umesh Kumar Singh “ Science and Technology in ancient Indian Text, D.K.Print world, 2012
3. Kamlesh Mohan “Science and Technology in Colonial India, Aakar Publisher, 2014

Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

OEC-BT-424	Internet of Things (B.Tech. Biotechnology Semester VIII)						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**-**	**3.0**	**75**	**25**	**100**	**3 Hrs**
Purpose	**To familiarize students about basics of Internet of Things**						
Course Outcomes							
CO 1	**Understand what IoT technologies are used for today, and what is required in certain scenarios.**						
CO2	**Understand the types of technologies that are available and in use today and can be utilized to implement IoT solutions.**						
CO3	**Understand the type of protocols and challenges for designing IoT systems.**						
CO4	**Apply these technologies to tackle scenarios in teams of using an experimental platform for implementing prototypes and testing them as running applications. Understand operating system requirements of IOT.**						

UNIT 1

Introduction to IoT: Defining IoT, Characteristics of IoT, Functional blocks of IoT, Physical and logical design of IoT, Smart cities and IoT revolution, ,Difference between IoT and M2M, M2M and peer networking concepts Ipv4 and IPV6, Software Defined Networks SDN,

UNIT 2

Developing IoTs: IoT design methodology, case study on IoT system for weather monitoring. IoT system Management,

Developing IoT applications through embedded system platform: Introduction to sensors, IoT physical devices and endpoints, Raspberry pi, Raspberry pi interfaces, Arduino, arduino interfaces.

UNIT 3

Protocols for IoT- messaging protocols, transport protocols, Ipv4, Ipv6, URI, Cloud for IoT: IoT with cloud, challenges, introduction to fog computing, cloud computing,

Challenges in IoT: Design challenges, development challenges, security and legal considerations.

UNIT 4

Logic design using Python: Introduction to python, data types, data structures, control flow, functions, modules, file handling and classes., implementing IotT concepts with python, Applications of IoT, Connected cars IoT Transportation, Smart Grid and Healthcare sectors using IoT,

References/Text Books:

1) A Bahaga, V. Madisetti, “Internet of Things- Hands on approach”, University press, 2014.
2) S.K.Vasudevan, A.S.Nagarajan, “Internet of Things”, Wiley, 2019.
3) CunoPfister, “Getting started with Internet of Things”, Maker Media, 1st edition, 2011. Samuel Greenguard, “Internet of things”, MIT Press, 2015.

Web resources:

1) http://www.datamation.com/open-source/35-open-source-tools-for-the-internet-of-things-1.html
2) https://developer.mbed.org/handbook/AnalogIn
3) http://www.libelium.com/50_sensor_applications
4) M2MLabs Mainspring http://www.m2mlabs.com/framework Node-RED http://nodered.org/