YEAR IV, SEMESTER VII

COURSE CODE	COURSE TITLE	COURSE CATEGORY	HOURS			EVALUATION SCHEME		SUBJECT TOTAL	CREDIT
			L	T	P	CA	EE		
BBT-701	Structural Biology	HSS	3	1	0	30	70	100	4
BBT-702	Bioentrepreneurship	BSC	3	1	0	30	70	100	4
BBT-703	Medical Biotechnology	BSC	3	1	0	30	70	100	4
BBT-704	Biosensors	BSC	3	1	0	30	70	100	4
BBT-705	Vaccine Technology	BSC	3	1	0	30	70	100	4
BBT-706	Biophysics	PCC	3	1	0	30	70	100	4
BBT-751	Structural Biology Lab	BSC	0	0	2	15	35	50	1
BBT-752	Internal Project	PS	0	0	2	50	-	50	1
BBT-753	Seminar	PS	0	0	2	15	35	50	1
GP-701	General Proficiency		-	-	-	50	-	50	1
TOTAL			18	6		310	490	800	28

L - Lecture, T - Tutorial, P - Practical, CA - Continuous Assessment, EE - End Semester Exam; BSC-Basic Science Course; ESC-Engineering Science Course; HSS-Humanities & Social Science Course; PCC-Professional Core Course; AUC-Audit Course; PS-Project work,Seminar,Internship

YEAR IV, SEMESTER VIII

COURSE CODE	COURSE TITLE	COURSE CATEGORY	HOURS			EVALUATION SCHEME		SUBJECT TOTAL	CREDIT
			L	T	P	CA	EE		
BBT 851	Dissertation and Viva	PS	0	0	28	-	300	300	14
TOTAL			0	0	28	-	300	300	14

L - Lecture, T - Tutorial, P - Practical, CA - Continuous Assessment, EE - End Semester Exam; BSC-Basic Science Course; ESC-Engineering Science Course; HSS-Humanities & Social Science Course; PCC-Professional Core Course; AUC-Audit Course;PS-Project work,Seminar,Internship

B.Tech. Biotechnology: Semester-VII BBT 701: STRUCTURAL BIOLOGY	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6 Marks
Credits: 4	Attendance – 12 Marks
	End Semester Exam – 70 marks

Course Objective

The course aims to provide the students with a detailed understanding of the behavior of proteins in solution and how their properties may be altered by changing the physical surroundings. To provide an understanding of the theory and practical techniques involved in developing a purification process.

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Course Learning Outcomes

After completing the course, the student shall be able to:

CO1: At the end of this course, students will be able to understand methods to determine, study protein structures and structural knowledge on proteins.

CO2: Understand energetics and kinetics of proteins.

Unit 1: Chemistry of amino acids and peptides
Side chain structure and function in protein folding and functionality: Secondary structure of proteins -helices, sheets, loops and turns; Structural and functional proteins. Tertiary structure of proteins, homo and hetero-dimers, trimers and tetramers; forces governing protein-protein interactions; open tertiary structure; Classification of proteins; structure of hemoglobin
Unit 2: Protein-ligand interactions:
Lock and key versus handshake mechanism of substrate recognition; structural basis of recognition; reaction mechanisms of enzymes, G-Protein coupled receptors. **Protein solubility, protein stability and stabilization** Salting in and salting out, Parameters affecting; enthalpic and entropic stabilization, mutations increasing stability, helix capping; Native, partially denatured and denatured proteins; Protein denaturation, Physical and chemical denaturants
Unit 3: DNA structure:
Covalent structure of DNA, base pairing, hydrogen bonding, DNA melting and annealing, difference between AT and GC pairing, Watson Crick model; Crystal structure of B-DNA, major and minor groves, dyad symmetry, base pair stacking, propellor twist, A and Z- DNA, triple stranded DNA, telomeric sequences and structure, G-quartcts, palindromic and tandem sequences, Base pair flipping and DNA bulges, DNA methylation; Protein-DNA interactions; drug-DNA interactions; Databases of sequences and structure for protein and DNA, public domain softwares for visualizing and modeling biomolecules -Rasmol, Deepview, Whatif

Suggested Readings

- Biochemistry, R.H. Abeles, P.A. Frey and W.A. Jencks, Jones and Bartlett.
- Essentials of Molecular Biology, D. Freifelder, Jones and Bartlett Publications.
- Genes VII, B. Lewin, Oxford University Press.
- Introduction to Protein Structure, C. Branden and J Tooze, Garland Publishing Company.
- Proteins (Structures and Molecular Properties), T.E. Creighton, W.H. Freeman and Company.
- Database Annotation in Molecular Biology, Arthur M. Lesk.
- Genes & Genomes, M.S. Paul Berg.
- Structure and Machanism in Protein Science, Alan Fersht.

B.Tech. Biotechnology: Semester-VII BBT 702: BIOENTERPRENEURSHIP	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6 Marks
Credits: 4	Attendance – 12 Marks
	End Semester Exam – 70 marks

Course Objective

Understanding basic concepts in the area of entrepreneurship, Understanding the role and importance of entrepreneurship for economic development. Developing personal creativity and entrepreneurial initiative. Adopting of the key steps in the elaboration of business idea, Understanding the stages of the entrepreneurial process.The resources needed for the successful development of entrepreneurial ventures.

Course Learning Outcomes

After completing the course, the student shall be able to:
CO1: Explore entrepreneurial leadership and management style.
CO2: To explore different biotech business models and to acquire the fundamentals of biotech business management..
CO3: To understand the requirements of a biotech business plan in particular from the perspective of prospective funders.
CO4: To be able to manage issues in intellectual property and licensing as they pertain to biotech
CO5: To develop fundamental notions with regard to marketing in the biotech space and to understand the complexity of the interface between stakeholders.

Unit 1: Accounting and Finance
Taking decision on starting a venture; Assessment of feasibility of a given venture/new venture; Approach a bank for a loan; Sources of financial assistance; Making a business proposal/Plan for seeking loans from financial institution and Banks; Funds from bank for capital expenditure and for working; Statutory and legal requirements for starting a company/venture; Budget planning and cash flow management; Basics in accounting practices: concepts of balance sheet, P&L account, and double entry bookkeeping; Estimation of income, expenditure, profit, income tax etc. **Marketing** Assessment of market demand for potential product(s) of interest; Market conditions, segments; Prediction of market changes; Identifying needs of customers including gaps in the market, packaging the product; Market linkages, branding issues; Developing distribution channels; Pricing/Policies/Competition; Promotion/ Advertising; Services Marketing
Unit 2: Negotiations/Strategy
With financiers, bankers etc.; With government/law enforcement authorities; With companies/Institutions for technology transfer; Dispute resolution skills; External environment/changes; Crisis/ Avoiding/Managing; Broader vision–Global thinking. **Information Technology** How to use IT for business administration; Use of IT in improving business performance; Available software for better financial management; E-business setup, management.

Human Resource Development (HRD) Leadership skills; Managerial skills; Organization structure, pros & cons of different structures; Team building, teamwork; Appraisal; Rewards in small scale set up.
Fundamentals of Entrepreneurship Support mechanism for entrepreneurship in India
Role of knowledge centre and R&D Knowledge centres like universities and research institutions; Role of technology and upgradation; Assessment of scale of development of Technology; Managing Technology Transfer; Regulations for transfer of foreign technologies; Technology transfer agencies

Unit 3: Case Study

. Candidates should be made to start a 'mock paper company', systematically following all the procedures.

- The market analysis developed by them will be used to choose the product or services.
- A product or service is created in paper and positioned in the market. As a product or services available only in paper to be sold in the market through the existing links. At this juncture, the pricing of the product or the service needs to be finalized, linking the distribution system until the product or services reaches the end consumer.
- Candidates who have developed such product or service could present the same as a project work to the Panel of Experts, including representatives from industry sector. If the presented product or service is found to have real potential, the candidates would be exposed to the next level of actual implementation of the project.

2. Go to any venture capital website (like sequoiacap.com) and prepare a proposal for funding from venture capital.

Suggested Readings

- Holger Patzelt and Thomas Brenner, eds., Handbook of Bioentrepreneurship,New York: Springer, 2008, 294pages. $139

B.Tech. Biotechnology: Semester-VII BBT 703: MEDICAL BIOTECHNOLOGY	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6 Marks
Credits: 4	Attendance – 12 Marks
	End Semester Exam – 70 marks

Course Objective

The course aims to build on previous study and, through team-based research, student-led journal clubs and critical evaluation of scientific literature, challenge you to investigate new developments in selected, medical applications of biotechnology

Course Learning Outcomes

After completing the course, the student shall be able to:

CO1: Research, evaluate and critically assess the theoretical basis and practical application of selected medical biotechnologies.
CO2: Demonstrate knowledge and understanding of selected medical biotechnologies.
CO3: Describe in detail essential facts and theory in molecular biology and biotechnology when applied to medicine.
CO4: Describe and critically evaluate aspects of current research in the biosciences with reference to reviews and research articles
CO5: With limited guidance, deploy established techniques of analysis and enquiry within the biosciences.

Unit 1: Classification of genetic diseases
Chromosomal disorders (Numerical disorders like trisomies & monosomies); Structural disorders (deletions, duplications, translocations & inversions); Chromosomal instability syndromes. Gene controlled diseases (Autosomal and Xlinked disorders) Molecular basis of human diseases: Pathogenic mutations. Gain of function mutations: Oncogenes, Huntingtons Disease. Loss of function: Tumour Suppressor. Genomic. Dynamic Mutations: Fragile- X syndrome, Myotonic dystrophy. Mitochondrial diseases
Unit 2: Prenatal diagnosis
Invasive techniques (Amniocentesis, Fetoscopy, Chorionic Villi Sampling (CVS) and Non-invasive techniques (Ultrasonography, X-ray, TIFA, maternal serum and fetal cells in maternal blood). Diagnosis using protein and enzyme markers, monoclonal antibodies. DNA/RNA based diagnosis Hepatitis, CML– bcr/abl, HIV-CD4 receptor. Clinical management and Metabolic manipulation – PKU, Familial Hypercholesterolemia, Rickets. Gene therapy - Ex-vivo, Invivo, Insitu gene therapy.
Unit 3: Vectors used in gene therapy
Biological vectors (retrovirus, adenoviruses); Herpes Synthetic vectors (liposomes, receptor mediated gene transfer).

Gene therapy trials: Familial Hypercholesterolemia, Cystic Fibrosis, Solid tumors. Cell and tissue engineering: Stem cell Potential use of stem cells – Cell based therapies, Nanomedicine.

Suggested Readings

- Diagnostic and Therapeutic Antibodies (Methods in Molecular Medicine by Andrew J.T. George (Editor), Catherine E. Urch (Editor) Publisher: Humana Press; edition (2000)
- Molecular Diagnosis of Infectious Diseases (Methods in Molecular Medicine) by Jochen Decker, U. Reischl Amazon
- Human Molecular Genetics by T. Strachan, Andrew Read Amazon Sales Rank:
- Principles of Biostatistics by Marcello Pagano , Kimberlee Gauvreau
- Essentials of Epidemiology in Public Health, 2nd Edn by Ann Aschengrau , George R., III Seage

B.Tech. Biotechnology: Semester-VII BBT 704: BIOSENSORS	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6 Marks
Credits: 4	Attendance – 12 Marks
	End Semester Exam – 70 marks

Course Objective

The course aims to build on previous study and, through team-based research, students have an idea of biosensors and their principle and working mechanism.

Course Learning Outcomes

After completing the course, the student shall be able to:

CO1: Biosensors and its types and their applications.
CO2: Demonstrate knowledge and understanding of biosensors in medical biotechnology.
CO3: Describe in detail the essential features of biosensors in molecular biology and biotechnology.

Unit 1: Biosensors
Definition, History, Principle and types of biosensors. Properties of biosensors,Design features of Biosensors, The Biological Component, Signal Transduction: Amperometric Biosensors, Potentiometric Biosensors, Detection of H+ cation, Detections of NH4+ cation, Detection of CN- anion, Calorimetric biosensors, Optical Biosensors, Measuring the change in light reflectance, Measuring luminescence, Pizo-electric biosensors, Immunosensors,
Unit 2: Commercial examples of biosensors.
Biosensors markets- Opportunities and obstacles. Introduction to MEMS (Micro-Electro-Mechanical Systems). Applications of MEMS in Biotechnology and medicine. Fabricating MEMS and Nanotechnology
Unit 3: Biomedical sensors
Sensors and transducers: an overview, measurement systems, Classification of Biomedical sensors and transducers, who do we need Biomedical sensors and Transducers? Important Design considerations and system calibration, the future of Biosensors and Transducers, Sensing Layer: The importance of computers in sensors and Transducer technology. Biosensors and Transducers in modern health care solutions.

Suggested Readings

- Affinity Biosensors: Techniques and Protocols, K.R. Rogers and A. Mulchandani, Humana Press.
- Biosensors and their Applicatrions, V.C. Yang and T.T. Ngo, Plenum Publishing Corporation.
- Chemical Sensors and Biosensors, B.R. Eggins, John Wiley and Sons Inc.
- Sensors and Sensing in Biology and Engineering, F.G. Barth, wt al, Springer Verlag.

B.Tech. Biotechnology: Semester-VII BBT 705: VACCINE TECHNOLOGY	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6 Marks
Credits: 4	Attendance – 12 Marks
	End Semester Exam – 70 marks

Course Objective

The course aims to build on concepts of vaccine, its formulation,storage and administration.Also the different forms of vaccines and their effect.

Course Learning Outcomes

After completing the course, the student shall be able to:

CO1: Medical applications of vaccines
CO2: The immune system of our body.
CO3: Demonstrate knowledge and understanding of antigen-antibody interactions.
CO4: Describe in detail the essential features and formulations of in biotechnology.

Unit 1: Introduction
Introduction to vaccines and immunity .Fundamental concepts in vaccination and traditional methods of vaccine production production of DPT and Rabies vaccine.Production of Modern Vaccines - production of Hepatitis vaccine
Unit 2: Applications
Applications of immunological methods in diagnosis; B-cell epitope prediction methods T-cell epitope prediction methods Resources to study antibodies, antigen-antibody interactions
Unit 3: Immunoinformatics
Reverse vaccinology and immunoinformatics Databases in Immunology Structure Activity Relationship – QSARs and QSPRs, QSAR Methodology Various Descriptors used in QSARs: Electronics; Topology; Quantum Chemical based Descriptors. Neural Networks and Principle Components Analysis in the QSAR equations

Suggested Readings

- Kuby Immunology 4e by Richard A. Goldsby, Thomas J. Kindt and Barbara A. Osborne
- Immunoinformatics: Predicting Immunogenicity in Silico By Darren R Flower Publisher:
- Humana Press
- Immunoinformatics (Immunomics Reviews:) By Shoba Ranganathan ,Vladimir
- Brusic, Christian Schonbach. Publisher: Springer

B.Tech. Biotechnology: Semester-VII BBT 706: BIOPHYSICS	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6 Marks
Credits: 4	Attendance – 12 Marks
	End Semester Exam – 70 marks

Course Objective

The course aims to build on concepts of instrumentation, its working and their applications.

Course Learning Outcomes

After completing the course, the student shall be able to:

CO1: Students will gain knowledge of the instrumentation.
CO2: Fundamentals and the applications of various biomedical techniques.
CO3: Demonstrate knowledge and understanding of Molecular and biochemical engineering.
CO4: Alternatives of sampling techniques and their analysis.

Unit 1: Instrumentation
Instrument Design and applications of UV-Visible Spectra, IR Spectra, Raman Spectra, Fluorescence spectra, NMR and ESR Spectra Instrument Design and applications of all types of Chromatography, Centrifugation & Ultracentrifugation Viscometry, Osmosis, Diffusion and Surface tension.
Unit 2:Design and Applications
Instrument Design and applications of Paper, gel, Pulsed-field, SDS-PAGE, Capillary Electrophoresis, isoelectric focusing; Potentiometry, pH meter, ion selective electrodes, conductometry
Unit 3:Microscopy
Instrument design of Polarimetry, ORD, CD, Light scattering, Refractometry, Flowcytometry, Cytophotometry, Compound, Phase contrast, Interference, Fluorescence, Polarizing, Transmission Electron Microscopy, CCD Camera, Atomic Force Microscopy

Suggested Readings

- *Text Book Of Biophysics Revised Edition (Hardcover) by R. N. Roy. New Central Book Agency (p) Ltd*
- *Biophysics Principles & Techniques By Subramanian Ma. MJP PUBLISHERS*
- *Principles Of Biochemistry And Biophysics by Dr. B. S. Chauhan. Usp*
- *Biophysical Chemistry(Principles and Techniques) By Avinash Upadhyay, Kakoli Upadhyay ,Nirmalendu Nath. Himalaya*

B.Tech. Biotechnology: Semester-VII BBT 751: STRUCTURAL BIOLOGY LAB	
Teaching Scheme	**Examination Scheme**
Practicals: 2 hr/Week	Internal Assessment-15 Marks
Credits: 2	External Assessment– 35 Marks
	End Semester Exams-50 Marks

Course Objective

To analyze and compare structures of proteins and nucleic acids (DNA), and their subunits. To identify and understand similar structural units (folds and domains) in proteins those have different functions.To provide an understanding of the theory and practical techniques involved in developing a purification process.

Course Learning Outcomes

After completing the course, the student shall be able to:
CO1: Understand the relationship between protein structure and its function..
CO2: Introduction to protein engineering.
CO3: Understand methods to determine, study protein structures and structural knowledge on proteins.

Experiment Details

1. Study of physical properties of proteins.
2. Analysis of protein structure.
3. Study of protein finger printing
4. Study of protein fractionation
5. Study of protein folding
6. Study of protein degradation

Suggested Readings

- Hybridoma Techniques: A Lab Course- Muthukkaruppan Vr, Basker S and F. Singilia. Macmillan India
- Wilson Walker-Tools and Techniques
- Molecular Cloning - Sambrook Russel - Vol. 1, 2, 3. 2.
- Fat Detection: Taste, Texture, and Post Ingestive Effects.

- Montmayeur JP, le Coutre J, editors. Boca Raton (FL): CRC Press/Taylor & Francis; 2010.
- Biochemistry. 5th edition. Berg JM, Tymoczko JL, StryerL. New York: W H Freeman; 2002. Course

B.Tech. Biotechnology: Semester-VII BBT 752: INTERNAL PROJECT	
Teaching Scheme	**Examination Scheme**
Practicals: 2 hr/Week	Internal Assessment-15 Marks
Credits: 2	External Assessment– 35 Marks
	End Semester Exams-50 Marks

Course Objective

To learn how to read and select research article from the scientific journals. To understand and learn to derive a scientific hypothesis. To understand what basic experimentation has leads them to conclude their hypothesis which they have presented in there scientific reports. To learn how to cite a references in research hypothesis.To lead students to improve his writing skills.To get expertise in methodology and instrumentation used for drawing the conclusion of the study.

Course Learning Outcomes

After completing the course, the student shall be able to:
CO1: Understand how to write a scientific report.
CO2: Will leads him to think and write his own hypothesis
CO3: Analyze the procedure and instrumentation required for proving his hypothesis.
CO4: Will teach him to cite reference and their importance in field of science
CO5: Will learn how to do results analysis and conclude outcome of the study.
CO6: Will learn to present research data.

Purpose
Understanding originality and significance during defining of problems, generate questions and hypotheses, review and summarize the literature, apply appropriate methods, collect data properly, analyze and judge evidence, discuss findings, produce publishable results, engage in a sustained piece of research or argument, think and write critically and coherently. Preparation of dissertation report either objective wise or in traditional manner. Preparation of project presentation for assessment and viva.
Writing a Scientific Paper:
Title specification, Abstract, Key words, Introduction, Materials and Methods, Results, Discussion, Tables and Figures, Citations, Reference lists. Format, Flow, Abbreviations in text, etc. *Note: In this student will have to work in lab on the assigned topic and he/she will have to write a scientific paper (review or original article) which will be judged by the examiner.*

B.Tech. Biotechnology: Semester-VII BBT 753: SEMINAR	
Teaching Scheme	**Examination Scheme**
Seminars: 2 hr/Week	Internal Assessment-15 Marks
Credits: 2	External Assessment– 35 Marks
	End Semester Exam – 50 marks

Course Objective

To enhance the computational skills.To get to know the various technical objective and conclusion of his topic. To understand and learn the concepts of any topic that he/she is interested in.To learn and explain the application of the methods.To learn how to present a scientific topic in front of examiner.To understand basic principle of the technique.

Course Learning Outcomes

After completing the course, the student shall be able to:
CO1: Analyze the procedure and instrumentation required for proving his hypothesis.
CO2: Will leads to enhance the confidence and personal aptitude.
CO3: Will enhance student's communication and computational skills.
CO4: Will teach students to boldly accept the outcomes and conclusion of topic.
CO5: Will teach students how to represent a data..
CO6: Will learn to present research data

Seminar
It's compulsory for all the students to give a seminar on the topic assigned by the Department of Biotechnology in the staring of the semester, in the supervision of the assigned supervisor. If the discussion session of seminar / presentation is not found satisfactory then the next date for the said presentation will be given immediately. Presentation Time duration : 30 - 45 minutes Discussion duration : 15 - 20 minutes

B.Tech. Biotechnology: Semester-VIII		
MST 851: Dissertation and Viva		
Teaching Scheme	**Examination Scheme**	
Tenure: 12 to 16 Week	Dissertation	150
	Presentation and Viva Voce	150
Credits: 14	**Maximum Marks**	**300**

Every student will be required to undertake a research project (minimum tenure three months) based on any of the areas of virology, proteomics, genomics, animal, plant, medical microbiology, and bioinformatics or preferably related to major biotechnology/microbiology research. The project report will be submitted in the form of dissertation duly certified by the supervisor of the dissertation by any research organization, industry, national institutes and/or Universities in India, by seeking the placement. The student then shall have to appear for the viva voce examination.

GUIDELINES FOR DISSERTATIONS REPORT LAYOUT:

The report should contain the following components:

Title or Cover Page: The title page should contain the following information: Project Title; Student's Name; Course; Year; Supervisor's Name.

Acknowledgements (optional): Acknowledgment to any advisory or financial assistance receive in the course of work may be given.

Abstract: It should be straight to the point; not too descriptive but fully informative. First paragraph should state what was accomplished with regard to objectives. The abstract have to be concise summary of the scope and results of the project.

Table of Contents: Titles and subtitles are to correspond exactly with those in the text.

Introduction: A brief introduction to the problem that is central to the project and it should aim to catch the imagination of the reader, so excessive details should be avoided.

Materials and Methods: This section should aim at experimental designs, materials used. Methodology should be mentioned in details including modifications if any.

Results and Discussion: Present results, discuss and compare these with those from other workers, etc. In writing these section, emphasis should be given on what has been performed and achieved in the course of the work, rather than discuss in detail what is readily available in text books. Avoid abrupt changes in contents from section to section and maintain a lucid

flow throughout the thesis. An opening and closing paragraph in every chapter could be included to aid in smooth flow.

Note during writing, all figures & tables should as far as possible be next to the associated text, in same orientation as main text, numbered, & given appropriate titles.

Conclusion: This is the final section in which outcome of the work is mentioned briefly.

Future prospects (if applicable)

References / Bibliography: This should include papers and books referred to in the body of the report. These should be ordered alphabetically on the author's surname.

Appendices: This contains material which is of interest to reader but not an integral part of the thesis and may be useful to document for future reference.

Assessment of the Project File:

Essentially, marking will be based on the following criteria: the quality of the report, the technical merit of the project and the project execution. Technical merit attempts to assess the quality and depth of the intellectual efforts put into the project