Resolution No.:

Bharatiya Vidya Bhavan's

M. M. College of Arts, N.M. Institute of Science, H.R.J. College of Commerce. (Bhavan's College) Autonomous

(Affiliated to University of Mumbai)

Syllabus for: T.Y.B.Sc. Biotechnology

Program: B.Sc.

Program Code: BH.US

Course Code: (BH.USBT)

Choice Based Credit System (CBCS) with effect from academic year 2023-24

PROGRAM OUTCOMES

PO	PO Description **A student completing Bachelor's Degree in Biotechnology program will be able to:**
PO-1	Apply knowledge and experience to foster personal growth and better appreciation of the diverse scientific world.
PO-2	Communicate competently through writing, reading, speaking, and to be able to connect to the scientific community in a meaningful way
PO-3	Acquire knowledge in the field of Chemical, Biological and Allied subjects which make them sensitive and sensible citizen.
PO4	Develop a knowledge base sufficient to appear for various examinations and to choose the post graduate program in the field of biotechnology and related research programs.
PO5	To get trained, skilled human resource to establish the Industry and Research sectors.
PO6	Anticipate the future needs of Biotechnology Sector with more emphasis on imparting *hands-on* skills

	PSO **A student completing Bachelor's Degree in Biotechnology program will be able to:**
PSO 1	Understand the basic principles of Cell, Molecular Biology and Medical Microbiology
PSO 2	Understand the recent advances in biotechnology as well as Marine Biotechnology
PSO 3	Understand the basic concepts of Biochemistry and Human Physiology
PSO 4	Understand and to learn different fields of Industrial Biotechnology
PSO 5	Gain the knowledge of Forensic Science
PSO 6	Understand the fundamentals of Pharmacology and Drug Designing

PROGRAM OUTLINE

YEAR	SEMESTER	COURSE CODE	COURSE TITLE	CREDITS
TYBSc	V	BH. USBT501	Cell & Molecular Biology	2.5
TYBSc	V	BH. USBT502	Medical Microbiology	2.5
TYBSc	V	BH. USBT503	Advances in Biotechnology&Bioanalytical Sciences	2.5
TYBSc	V	BH. USBT504	Marine Biotechnology	2.5
TYBSc	V	BH. USBT505	Biosafety	2.5
TYBSc	V	BH. USBTP 501-502	Practicals of BH. USBT 501& BH. USBT 502	3.0
TYBSc	V	BH. USBTP 503-504	Practicals of BH. USBT 503&BH. USBT504	3.0
TYBSc	V		Practicals of Biosafety	2.0
TYBSc	VI	BH. USBT601	Biochemistry& Physiology	2.5
TYBSc	VI	BH. USBT602	Industrial Biotechnology	2.5
TYBSc	VI	BH. USBT603	Genetic Markers &Forensic Biotechnology	2.5
TYBSc	VI	BH. USBT604	Enviornmental Biotechnology	2.5
TYBSc	VI	BH. USBT605	Pharmacology &Fundamentals of Drug Designing	2.5
TYBSc	VI	BH. USBTP 601-602	Practicals of BH. USBT 601& BH. USBT 602	3.0
TYBSc	VI	BH. USBTP 603-604	Practicals of BH. USBT 603 & BH. USBT 604	3.0
TYBSc	VI		Practicals ofPharmacology &Fundamentals of Drug Designing	2.0
			TOTAL	**20 + 20**

PREAMBLE

Biotechnology is one of the youngest branches of Life Science, which has expanded and established as an advanced interdisciplinary applied science in last few years. Biotechnology at the core envisages the comprehensive study of Life and the Interdisciplinary potential of Biotechnology has led to a unique status for Biotechnology in Research and Industry.

The socio-economic potential of Biotechnology is well established which has almost become synonymous with modern development. Biotechnology has its applications in almost every field touching practically every human activity. The applied aspect of Biotechnology is now getting established with its applications in Industry, Agriculture, Health and Environment, Biotechnology is the lead science expanding exponentially.

Biotechnology demands a trained, skilled human resource to establish the Industry and Research sectors. The field is novel and still expanding which demands inputs in Infrastructure and Technology. The global and local focus is on developing new technological applications are fast growing. Biotechnology sector in Research and Industry is expanding which is set to augur the next major revolution in the world.

The demand for trained workforce in Biotechnology is ever growing in Fundamental Research and Industry Sector. Academic and Research Sectors also require interdisciplinary trained manpower to further the Biotechnology Revolution.

The need of the hour is to design appropriate syllabi which keeps pace with changing times and technology with emphasizes on applications while elucidating technology in depth. The present Syllabi is Restructured anticipating the future needs of Biotechnology Sector with more emphasis on imparting *hands-on* skills. The main thrust is laid on making syllabus compatible with developments in Education, Research and Industrial sectors. The Theory and Practical course in new restructured course will lead to impart *skill-set essentials* to further Biotechnology Sector.

The restructured syllabus combines basic principles of Physical, Chemical and Biological sciences in light of advancements in technology. The curriculum aims to impart basic knowledge with emphasis on its applications to make the students industry ready.

SEMESTER V

Programme: B.Sc. Biotechnology				Semester: V	
Course: T.Y.B.Sc. :Cell Biology& Molecular Biology				Course Code: BH.USBT501	
Teaching Scheme				Evaluation Scheme (Theory)	
Lecture (Periods per week)	Practical (Periods per week per batch)	Tutorial(Periods per week per batch)	Credits (Theory +Practical)	Continuous Internal Assessment (CIA) (CIA-I & II)	End Semester Examination (ESE)
04	04	NIL	2.5+1.5=4	20+20=40	(Marks: 60)

Course Objectives:

The objective of this course is to understand the basic cellular processes with advanced molecular details of cell cycle and cell signaling process and its role in cancer biology.

Course Outcomes:

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

- Develop an understanding of the various aspects of cell cycle in unicellular and multi-cellular organism.
- Develop an understanding of Cell signalling and signal transduction pathways.
- Understand cellular processes and causes of cancer.

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Units	Detailed Description	Lecture period /unit
UNIT I **Cell Cycle& Cell Signalling**	Cell cycle Introduction; The Early Embryonic Cell Cycle and the Role of MPF; The Molecular Genetics of Cell-CycleControl; Apoptosis, Cell signalling and signal transduction: Introduction General Principles of Cell Signaling. Signaling via G-Protein-linked Cell-SurfaceReceptors. Signaling via Enzyme-linked Cell-SurfaceReceptors. Target-Cell Adaptation,	15
UNIT II **Cancer Biology**	Cancer: Introduction, Fundamentals of cancer biology, Cancer as a Microevolutionary Process. The Molecular Genetics of Cancer. Cancer and Virus ; Cancer diagnosis and chemotherapy, Radiotherapy, Immunotherapy Molecular approach of the treatment	15
UNIT III **Tools in Molecular Biology**	Cloning vectors-Plasmids (pUC series), Cosmids, phagemids M13, shuttle vectors, YAC vectors; expression vectors pET; Gene cloning-Strategies of isolation of gene of interest& generation of recombinant DNA molecule, Recombinant selection and screening methods: genetic, immunochemical, Southern and Western analysis, nucleic acid hybridization, methods of gene transfer in prokaryotes and eukaryotes;HART, HRT;	15

	Expression of cloned DNA molecules and maximization of expression; Cloning strategies-genomic DNA libraries, cDNA libraries, chromosome walking and jumping.	
UNIT IV **Genetic engineering of plants and animals**	Genetic engineering of plants: Methodology-Planttransformation with the Ti plasmid ofA.tumefaciens, Ti plasmid derived vector system. Physical methods of transferring genes to plants: electroporation, microprojectile bombardment, liposome mediated, protoplast fusion. Transgenic mice:methodology - retroviral method, DNA microinjection, ES method.Transgenic animal recombination system; Cloning live stock by nuclear; Transgenic fish.	15
	TOTAL	**60**

References:

1. Molecular Cell Biology. 7th Edition, (2012) Lodish H., Berk A, Kaiser C., K ReigerM., Bretscher A., Ploegh H., Angelika Amon A., Matthew P. Scott M.P., W.H. Freemanand Co., USA
2. Molecular Biology of the Cell, 5th Edition (2007) Bruce Alberts, Alexander Johnson,Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Garland Science, USA
3. Cell Biology, 6th edition, (2010) Gerald Karp. John Wiley & Sons., USA
4. The Cell: A Molecular Approach, 6th edition (2013), Geoffrey M. Cooper, Robert E.Hausman, Sinauer Associates, Inc. USA
5. iGenetics A Molecular Approach 3rd Edition Peter J. Russell.
6. Molecular Biotechnology-Principles and Applications of Recombinant DNA Technology 3rd Edition Glick B.R., Pasternak J.J., Patten C.L.
7. Principles of Gene Manipulation 7th Edition Primrose S.B., Twyman R.M.
8. Biotechnology 3rd Edition S.S. Purohit.
9. Genomes 3rd Edition T.A. Brown.
10. Biotechnology B.D. Singh.
11. Gene Cloning and DNA Analysis 6th Edition T.A. Brown.

Practicals:

1. Heamolysis of Blood
2. WBC count
3. Differential Count of WBC associated with immunotherapy
4. Demonstration and observation of permanent slides of cancer tissue.
5. Slide preparation using microtomy
6. Cell viability
7. RE digestion & Ligation
8. Transformation & Screening of Recombinants
9. Expression studies using SDS PAGE&Western Blotting

Programme: B.Sc. Biotechnology					**Semester: V**
Course: **T.Y.B.Sc.: Medical Microbiology**					**Course Code: BH.USBT502**
Teaching Scheme				**Evaluation Scheme (Theory)**	
Lecture (Periods per week)	**Practical (Periods per week per batch)**	**Tutorial (Periods per week per batch)**	**Credits (Theory +Practical)**	**Continuous Internal Assessment (CIA) (CIA-I & II)**	**End Semester Examination (ESE)**
04	**04**	**NIL**	**2.5+1.5=4**	**20+20=40**	**(Marks: 60)**

Objective:

1. To gain insight into Disease Factors and Processes and Diseases Caused by Microorganisms
2. To know the different chemical classes of drugs and toxins their mode of action and application
3. To assay the effectiveness of the drugs

Outcomes:

1. Discuss the various aspects of Systemic Infections including Causative Agents, Symptoms and Prophylaxis and treatment.
2. Gain the technical capability of handling, isolating and identifying various different pathogens
3. At the end of course learner learns about the usage of therapeutic application of various drug and testing methods for its evaluation and usage

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Unit-II Causative Organisms-II	Morphological and cultural characteristics, Pathogenesis, Lab diagnosis, prophylaxis and treatment of diseases caused by pathogen Hepatitis virus Herpes Rabies Influenza virus AIDS virus Corona Virus Plant pathogens Introduction to Bacteria. Fungi, Mycoplasma, Viruses, Viroid as plant pathogens, Tobacco mosaic virus(details with life cycle)	15
UNIT III Anti-microbial agents	1. Antibacterial a. Drugs causes Inhibition of cell wall synthesis: Beta lactam antibiotics; Glycopeptide; Polypeptides b. Injury to Plasma membrane: Polymyxin c. Inhibition of protein synthesis :Aminoglycosides, Tetracyclines Chloramphenicol, Macrolides, Erythromycin; d. Inhibition of Nucleic acid synthesis: Quinolones, Rifampicin, e. Antimetabolites: agents 2. Antifungal drugs, 3. Antiviral drugs 4. Antiprotozoal and Anthelminthic Drugs 5. Drug derived from plants resources 6. An overview of role of Ayurveda in medicinal science	15
UNIT IV Drug resistance and testing the efficacy of anti-microbial	Drug Resistance: Mechanism, Origin and transmission of drug resistance Evaluation of antimicrobial agents Tests for bacteriostatic activity Disc tests, Tests for bactericidal activity, Tests for fungistatic and fungicidal activity, Evaluation of possible synergistic antimicrobial combinations, Tests for biofilm susceptibility, Antibiogram, Use and misuse of antimicrobial (with case studies)	15
	TOTAL	**60**
Practical	1. MIC and MLC of any one antibiotic 2. Antibiotic sensitivity test using agar cup method 3. Antibiotic sensitivity test using paper disc method A. Preparation of Mc-Farlands standards B. Testing AST 4. Antibiotic sensitivity test using ditch method. 5. Synergistic action of drugs 6. E test	

References:

1. Mim's Medical Microbiology 5th edition
2. Prescott Harley and Klein, Microbiology ,5th edition, Mc Graw Hill
3. Jawetz,E., Brooks,G.E, Melnick,J.L., Butel,J.SAdelberg E. A, Medical Microbiology 18th edition
4. Foundations In Microbiology by Talaro and Talaro 3rd edition W.C Brown
5. Ananthanarayan, R. and Paniker, C. Textbook of microbiology. (3rd ed). Orient Longman
6. Cruickshank R., Medical microbiology, (11th ed) , E & S Livingstone Limited
7. Tortora, Gerard J., et al. Microbiology, An Introduction. (8th ed.), Benjamin / Pearson.
8. Hugo, W.B, Russell, A.D, Pharmaceutical Microbiology 6th edition. Oxford Black Scientific Publishers.
9. John A. Lucas, Plant pathology and plant pathogens, 3rd edition, Black Science Limited.
10. https://www.researchgate.net/publication/12255670_Plants_as_source_of_drugs
11. M. Maridass* and A. John De Britto, (*2008*). Origins of Plant Derived Medicines**,** *Ethnobotanical Leaflets 12: 373 387.* https://www.researchgate.net/publication/41115592_Origins_of_Plant_Derived_Medicines
12. Alisha , Singh. N. R. ,Varsakiya Jitendra Role of Ayurveda in Public Health: Compass and Challenges, J. Ayu. Herb. Med. 2019; 5(1): 28-30

Programme: B.Sc. Biotechnology				**Semester: V**	
Course: T.Y.B.Sc.:Advances in Biotechnology & Bioanalytical Sciences				**Course Code: BH.USBT503**	
Teaching Scheme				**Evaluation Scheme (Theory)**	
Lecture (Periods per week)	**Practical (Periods per week per batch)**	**Tutorial(Periods per week per batch)**	**Credits (Theory +Practical)**	**Continuous Internal Assessment (CIA)** (CIA-I & II)	**End Semester Examination (ESE)**
04	**04**	**NIL**	**2.5+1.5=4**	**20+20=40**	**(Marks: 60)**

Course Objectives: The objective of this course is to understand aspects of concept of omics,Molecular markers as well as the molecular approaches of in vitro mutagenesis and gene silencing

- To understand the application of various instruments with their principle.
- To grasp knowledge about working and application of advanced bioanalytical techniques.

Course Outcomes: By the end of the course the student will be able to

- Develop an understanding of the concept of omics, molecular markers as well as the applications of invitro mutagenesis and gene silencing

INDEX		
Units	**Detailed descriptions**	**Lecture period /unit**
UNIT I **The Omics**	Introduction and overview of Genomics: Functional elements of the genome, NGS Transcriptomics: Gene expression measurement and database Microarray design and execution Proteomics: Quantitative proteomics, protein database Metabolomics: Sample analysis and metabolite identification, pathway analysis	15L
UNIT II **Mutagenesis & Gene Silencing**	In vitro mutagenesis Strategies and applications Gene silencing strategies and applications Transcriptional Gene silencing Post transcriptional Gene silencing RNAi,sh RNA Si RNA	15L
UNIT III **Chromato-graphy & Spectro-scopy**	**Chromatography** Principle, instrumentation, working and application of Gas chromatography (GC) High-Performance Liquid Chromatography (HPLC) andvalidation; Ion-exchange chromatography Affinity chromatography Molecular exclusion chromatography **Spectroscopy** Principle, instrumentation, working and applications of UV-Visible spectroscopy, Fluorescence spectroscopy, Atomic absorption spectroscopy and Luminometry	 1L 2L 2L 2L 1L 2L 2L 3L
UNIT IV **Advances in bio-analytical techniques**	**Tracer techniques** Isotopes in Biology, Nature of radioactivity GM Counter Scintillation counter Autoradiography Application of tracer techniques in Biology NMR, MS-Ionization (MALDI, ESI), Analyzer (TOF & Quadrupole), and Detector; PET scan Introduction to Biosensors: Opportunities and Challenges, applications	 1L 1L 2L 2L 3L 4L 2L
	TOTAL	**60**

References:

1. iGenetics A Molecular Approach 3rd Edition Peter J. Russell.
2. Molecular Biotechnology-Principles and Applications of Recombinant DNA Technology 3rd Edition Glick B.R., Pasternak J.J., Patten C.L.
3. Principles of Gene Manipulation 7th Edition Primrose S.B., Twyman R.M.
4. Biotechnology 3rd Edition S.S. Purohit.
5. Biotechnology B.D. Singh.
6. Keith Wilson, John Walker (2010) Principles and Techniques of Biochemistry and Molecular Biology (7th Ed) Cambridge University Press
7. David Sheehan (2009), Physical Biochemistry: Principles and Applications (2nd Ed), Wiley- Blackwell
8. KalochRajan (2011), Analytical techniques in Biochemistry and Molecular Biology, Springer.
9. Upadhyay, A., Upadhyay, K., Nath, N.; Biophysical Chemistry (Principles and Techniques), 4 th ed, Himalaya Publishing House, India, 2016.
10. Skoog D. A., Holler, F. J., and S.R.Crough."Instrumental Analysis, 6th" (2007). Brooks Cole Publishing Company. ISA.
11. Boyer, R..; Modern experimental biochemistry, 3rd ed, Benjamin Cummings, USA, 2000.

Practical :

- Bioinformatic demonstrations of database analysis
- Multiple sequence alignment
- Identification of protein structures CATH/SCOP
- Gene identification
- Separation of components from a mixture using Affinity chromatography (Kit based)
- Separation of components from a mixture using Ion exchange chromatography (Kit based)
- Separation of components from a mixture using Size exclusion chromatography (Kit based)
- HPLC method validation.

Programme: B.Sc. Biotechnology					**Semester:**
Course: T.Y.B.Sc. : Marine Biotechnology					**Course Code:** BH.USBT 504
Teaching Scheme				**Evaluation Scheme (Theory)**	
Lecture (Periods per week)	**Practical (Periods per week per batch)**	**Tutorial (Periods per week per batch)**	**Credits (Theory +Practical)**	**Continuous Internal Assessment (CIA)** (CIA-I & II)	**End Semester Examination (ESE)**
03	**03**	**NIL**	**2+1=03**	**20+20=40**	**(Marks: 60)**

Course Objectives:

To study the different resources that can be obtained from marine organisms to benefit mankind

Course Outcomes:

Learner will learn to explore marine resources such as protein, steroids and sterols, enzymes, lipid phenolic, antioxidants and cosmetics from marine sources

INDEX		
Units	**Detailed descriptions**	**Lecture period /unit**
UNIT I	Marine Biotechnology- Introduction Introduction to Marine Biotechnology; Zones of Marine Environments The marine ecosystem and its functioning: intertidal, estuarine, salt marsh, mangrove, coral reef, coastal & deep sea ecosystems. Hydrothermal vents Marine bioprospecting Marine Microbial Habitats and Their Biotechnologically relevant Microorganisms Methods for Microbial Bioprospecting in Marine Environments Bioprospecting ethics; Threats to marine resources Marine Bioactive Compound from marine organism – Fungi, Microalgae, Seaweeds, Actinomycetes, Sponge	*15L*
UNIT II	**Marine Metabolites and Cosmetics** Marine Secondary metabolites, marine proteins, marine lipids Cosmetics From Marine Sources: Scenario of Marine Sources in the Cosmetic Industry Cosmetics: Definition and Regulation, Cosmeceuticals, Target Organ and Cosmetics Delivery System, Components of Cosmetics Major Functions of Some Marine Components in Cosmetics and Cosmeceuticals, Treatments based on Marine Resources, Products based on Marine Resources	15L
UNIT III	Marine Functional Foods Marine Functional Foods, Marine Sources as Healthy Foods or Reservoirs of Functional Ingredients -3L Functional Foods Incorporating Marine-Derived Ingredients & their Biological Properties- 3L; Functional foods incorporating marine-derived ingredients- 2L Marine Nutraceuticals Marine Nutraceuticals: Marine Bioactive as Potential Nutraceuticals – 3L Carotenoids, Soluble calcium, Fish collagen and gelatin, Marine Probiotics- 4	15L
UNIT IV	**Marine derived drugs** Pharmaceutical compounds from marine flora and fauna – marine toxins, antiviral and antimicrobial agents Approved Marine Drugs as pharmaceuticals Marine Natural Products and its challenges	15L

	Marine Microbial Enzymes – Marine extremozymes and their significance, current use of marine microbial enzymes	
	TOTAL	
practical	1. Study of any 5 marine bacteria and algae (Macro and micro) 2. Extraction and estimation of antioxidant Extraction of antioxidant Estimation of extracted antioxidant by DPPH assay 3. Extraction and estimation of pigments from marine algae 4. Extraction and detection of Collagen from marine crustaceans 5. Extraction and estimation of alkaloids from marine organism A. Extraction of alkaloid B. Estimation of alkaloids using TLC C. Using titrimetric method	

References:

- Kim, S.K. Springer Handbook of Marine Biotechnology; Springer: Berlin, Germany; Heidelberg, Germany, 2015.
- Nollet, Leo M. L- Marine microorganisms- extraction and analysis of bioactive compounds-CRC Press Taylor& Francis (2017)
- R. S. K. Barnes, R. N. Hughes(auth.)-An Introduction to Marine Ecology, Third Edition-Wiley-Blackwell (1999)
- Blanca Hernández-Ledesma, Miguel Herrero-Bioactive Compounds from Marine Foods-Plant and Animal Sources-Wiley-Blackwell (2013)
- Fabio Rindi, Anna Soler-Vila, Michael D. Guiry (auth.), Maria Hayes (eds.)-Marine Bioactive Compounds_ Sources, Characterization and Applications-Springer US (2012)
- W. Evans-Trease and Evans Pharmacognosy 15 th ed.-Saunders (2010)

Programme: B.Sc. Biotechnology				**Semester: V**	
Course: T.Y.B.Sc. : Biosafety				**Course Code: BH.USBT505**	
Teaching Scheme				**Evaluation Scheme (Theory)**	
Lecture (Periods per week)	**Practical (Periods per week per batch)**	**Tutorial (Periods per week per batch)**	**Credits (Theory +Practical)**	**Continuous Internal Assessment (CIA) (CIA-I & II)**	**End Semester Examination (ESE)**
04	**04**	**NIL**	**2.5+1.5=4**	**20+20=40**	**(Marks: 60)**

Course Objectives:

- The objective of this course is to have firm foundation of fundamentals of biosafety in microbial and biological laboratories
- To acquaint students with the GLP
- To create awareness about the spoilage of pharmaceutical product caused by microorganisms and its preservation an
- To develop knowledge about quality control of product

Course Outcomes:

- By the end of the course the student will be able to develop an understanding about various laboratory infections caused by microorganisms belonging to various risk group categories and implementation of methods to prevent spread of LAI's from the laboratories.A learner acquire the knowledge of use of GLP and SOP principle in designing various experiment
- A learner acquires the skills of calibration and validation that helps them to get errorless precise data in any scientific research
- The gains the knowledge of safety precaution that are to be taken while handling, using and preserving any pharmaceutical products
- Develops the skills on quality control

INDEX

	Factors determining the outcome of medicament - borne Infection Preservation of medicines using antimicrobial agents: basic principles Quality assurance and the control of microbial risk in medicines Sterilization control and sterility assurance Bioburden determinations Environmental monitoring. Validation and in process monitoring of sterilization procedures Sterility testing and its role	
UNIT IV Biosafety in Biotechnology	Concepts on biosafety in Biotechnology**;** Regulating rDNA technology **;** Regulating food and food ingredients**;** Genetically engineered crops, livestock Bioethics **;** Contemporary issues in Bioethics	15
	TOTAL	**60**

References:

- Pharmaceutical Microbiology - Hugo, W.B, Russell, A.D 6th edition Oxford Black Scientific Publishers.
- Biosafety in Microbiological and Biomedical Laboratories - 5th Edition, L. Casey Chosewood Deborah E. Wilson U.S. Department of Health and Human Services Centers for Disease Control and Prevention National Institutes of Health.
- Molecular Biotechnology –Principles and Applications of Recombinant DNA Glick, B.R, Pasternak, J.J Patten, C.L 3rdedition ASM press

Practicals :

- Validation of micropipette, measuring cylinders, colorimeters
- Calibration of pH meter and weighing balance
- Vitamin B12 bioassay
- Testing for adulterants in food; ex. Starch in milk
- Making SOP for any 2 major laboratory instruments
- Sterility of injectables

SEMESTER VI

Programme: B.Sc. Biotechnology				**Semester: VI**	
Course: T.Y.B.Sc. :Biochemistry& Physiology				**Course Code: BH.USBT 601**	
Teaching Scheme				**Evaluation Scheme (Theory)**	
Lecture (Periods per week)	**Practical (Periods per week per batch)**	**Tutorial(Periods per week per batch)**	**Credits (Theory +Practical)**	**Continuous Internal Assessment (CIA)** (CIA-I & II)	**End Semester Examination (ESE)**
04	**04**	**NIL**	**2.5+1.5=4**	**20+20=40**	**(Marks: 60)**

Course Objectives:

- To understand the importance and significance of various metabolic cycles.
- To gain the knowledge about properties and significance of biomolecules.

- To understand the basic human physiological processes and their role with abnormal dysfunction.

Course Outcomes: On completion of the course, the students will be able to

- To ensure gain of knowledge about protein structure and function
- To understand pathways related to synthesis of important carbohydrates and lipids
- Develop an understanding of the various aspects of Neurochemistry
- Develop an understanding of Endocrinology.
- Understand the cellular and molecular aspects of developmental biology.

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Units	Detailed Description	Lecture period /unit
UNIT I **Protein & Lipid Metabolism**	Complementary interaction between Protein and Ligand Protein interaction modulated by chemical energy: Actin, Myosin and Molecular motors Metabolism of Amino acids (Arginine, Tyrosine, Tryptophan) Transamination decarboxylation & deamination Fatty acid synthesis (saturated and unsaturated) Cholesterol: Biosynthesis and degradation, Atherosclerosis	15
UNIT II **Carbohydrate metabolism**	Carbohydrates: Classification and its properties (Physical and Chemical) Functions of Carbohydrates. Carbohydrate Metabolism: Peptidoglycan in Bacteria Starch and sucrose in Plants Glycogen in Animals HMP pathway	15
UNIT III **Endocrinology**	Mechanism of action of group I and II hormones Structure, storage, release, transport, biochemical functions and disorders associated with hormones secreted by Hypothalamus**;** Anterior Pituitary gland - GH, stimulating hormones) Posterior Pituitary gland – oxcytocin and vasopressin Thyroid gland – Thyroxine, calcitonin Parathyroid gland – PTH; Adrenal medulla – epinephrine and norepinehprine**;** Adrenal cortex – Glucocortocoids**;** Pancreas – insulin and glucagon	15

	Female Gonads – estrogen and progesterone**;** Male gonads – testosterone**;** Placenta – hCG**.**	
UNIT IV **Neurochemistry & Developmental Biology**	Anatomy and functioning of the brain , Neuronal pathways Propogation of nerve impulses **;** Neuronal excitation and inhibition**;** Synapses and gap junctions**;** Action of Neuro toxins and neurotransmitters Stages of development- zygote, blastula, gastrula, neurula cell fate & commitment – potency- concept of embryonic stem cells, differential gene expression, terminal differentiation ,lineages of three germ layers, fate map**;** Mechanisms of differentiation- cytoplasmic determinants, embryonic induction, concept of morphogen, Morphogenetic movements, Model organisms in Developmental biology	15
	TOTAL	**60**

References:

- Donald Voet, Judith G.Voet, Charlotte W.Pratt, Fundamentals of Biochemistry: Life at the molecular level, Wiley, 5th Ed., 2016. •
- J.L.Jain, Sunjay Jain, Nitin Jain, Fundamentals of Biochemistry, S.Chand Publishers, 7th Ed., 2006.
- Satyanaryana.U, Essentials of Biochemsitry, New India Book Agency, 2nd, 2008.
- T.Devasena, Biomolecules, MJP Publishers, Ist Ed., 2010.
- Donald Voet, Judith G.Voet, Biochemistry, Vol. 1: Biomolecules, Mechanisms of Enzyme Action, and Metabolism, Wiley Publishers, Ist Ed., 2003.
- V.K. Ahluwalia, Biomolecules Chemistry of Living System, Manakin Press, 2015.
- MN Chatterjea, Textbook of Medical Biochemistry, 8th Edition
- Molecular Cell Biology. 7th Edition, (2012) Lodish H., Berk A, Kaiser C., K Reiger M., Bretscher A., Ploegh H., Angelika Amon A., Matthew P. Scott M.P., W.H. Freeman and Co., USA
- Textbook of Medical Physiology Guyton, A.C and Hall 11thedition J.E Saunders
- Developmental Biology; Scott Gilbert; 9thEdition
- Lehninger, principles of biochemistry, 4thedition (2005), David Nelson and Michael Cox *W.H.Freeman*and Company, New York.
- Biochemistry, 4ndedition (2017), Satyanarayana and Chakrapani, Books & Allied (P) Ltd

Practicals:

- Determination of blood glucose levels for detection of diabetes mellitus.
- Determination of serum cholesterol (Total, HDL and LDL)
- Protein estimation by bradford method
- Analysis of a chick embryonic development
- Hormonal assays
- Demonstration of various components of brain

Programme: B.Sc. Biotechnology				**Semester: VI**	
Course: **T.Y.B.Sc. : Industrial Biotechnology**				**Course Code: BH.USBT602**	
Teaching Scheme				**Evaluation Scheme (Theory)**	
Lecture (Periods per week)	**Practical (Periods per week per batch)**	**Tutorial(Periods per week per batch)**	**Credits (Theory +Practical)**	**Continuous Internal Assessment (CIA) (CIA-I & II)**	**End Semester Examination (ESE)**
04	**04**	**NIL**	**2.5+1.5=4**	**20+20=40**	**(Marks: 60)**

Course Objectives:

To explain the different types of fermentation and process with various examples

The objective of this course is to have firm understanding about QA &QC

Course Outcomes:

- Student will learn commercial production of product using different fermentation processes
- The student will be able to develop an understanding about good manufacturing practices followed at industries.

INDEX

Units	Detailed descriptions	Lecture period /unit
UNIT I **Milk**	Milk: Normal flora, changes in raw milk, Enumeration Factors affecting bacteriological quality,Dairy technology Preservation methods,Pasteurization, Starter Cultures,Fermented products-Production process and spoilage of Cheese: Swiss and Cheddar, Butter Yogurt and Buttermilk	*15L*
UNIT IIFermentation processes	Types of fermentation Batch, Continuous, Aerobic, Anaerobic, Surface, Submerged, Solid state, Inoculum development for bacterial, mycelial and yeast processes. Scale up and scale down	15L
UNIT III **Production of Fermentation product**	Production of the products Streptomycin, Amylase, Citric acid, Mushroom, Ethanol, Wine, beer, vinegar	
UNIT III **QA & QC**	Concept of GMP- ,Requirements of GMP implementation - Documentation of GMP practices ,Regulatory certification of GMP Quality Control (QC):Concept of QC , Requirements for implementing QC - QA concepts: Concept of QA - Requirements for implementing	15 L
	TOTAL	**60L**

References:

1. Applied Dairy Microbiology, Elmer H Marth and James L Steele Mercel Dekker Inc New York, 2nd edition
2. Microbial Technology Peppler,H.J and Perlman,D 2nd Academic Press Practicals
3. Industrial Microbiology Prescott and Dunn CBS publishers
4. Dairy technology by Yadav and Grower
5. Fermentation technology by Stanbury and Whittaker 2nd ed
6. Pharmaceutical Microbiology by Russel and Hugo
7. Biotechnology, A text of industrial microbiology, 3rd edition Wulf Crueger, Anneliese Crueger and K.R., Aneja. Scientific international Private Limited

Practicals

1. Estimation of Milk protein-Pynes method
2. DMC of milk sample
3. Isolation of Normal flora from Milk and curd
4. Production of amylase from Aspergillus niger
5. Demonstration of Mushroom cultivation

- Student will be able to develop an understanding about the concept of Quality control and quality assurance in detail.

Programme: B.Sc. Biotechnology				**Semester: VI**	
Course: T.Y.B.Sc.: Genetic Markers &Forensic Biotechnology				**Course Code: BH.USBT603**	
Teaching Scheme				**Evaluation Scheme (Theory)**	
Lecture (Periods per week)	**Practical (Periods per week per batch)**	**Tutorial(Periods per week per batch)**	**Credits (Theory +Practical)**	**Continuous Internal Assessment (CIA) (CIA-I & II)**	**End Semester Examination (ESE)**
04	**04**	**NIL**	**2.5+1.5=4**	**20+20=40**	**(Marks: 60)**

Course Objectives: The objective of this course is to understand the role of human blood group system and DNA based authentication in Forensic Biotechnology

Course Outcomes: By the end of the course the student will be able to

- Develop an understanding of the various aspects of forensically significant blood group systems and its inheritance pattern
- Develop an understanding of DNA Sample collection, processing and preservation
- Understand significance of Forensic DNA typing system.

Units	**Detailed descriptions**	**Lecture period /unit**
UNIT I **Genetic markers**	Genetic markers - Classical markers with examples DNA markers RFLP, RAPD, AFLP, SSR, SNP DNA Barcoding- Barcoding Markers, steps, Recent advances, Benefits, Limitations Application of Molecular Markers	15
UNIT II **Sequencing**	Maxam Gilbert's method, Sanger's dideoxy method, Automated DNA sequencing, Pyrosequencing Single cell sequencing Mi RNA sequencing RNAi, ZNF (Zinc finger nucleases), TALENS (Transcription Activator Like Effector Nucleases), CRISPR-Cas system (Clustered Regularly Interspersed Repeats	15
UNIT III **Forensic Genetics**	Sample collection and preservation Human blood group systems. History, biochemistry and genetics of ABO, Rh, Mn and other forensically significant blood group systems. Methods of ABO blood grouping (absorption inhibition, mixed agglutination and absorption elution) from blood stains and other body fluids/stains. New approaches in bloodstain grouping. Blood group specific ABH substances. Secretors and non- secretors. Blood groups that make racial distinctions. Lewis antigen. Bombay Blood groups. HLA antigens and HLA typing. Role of sero-genetic markers in individualization and paternity disputes.	15
Forensic DNA typing	Forensic DNA typing system – RFLP, Amp-RFLP. STR. Mini STR. Y-STR. XSTR. Single Nucleotide Polymorphism. STR allele nomenclature. STR loci of Forensic significance. STR kits. STR typing: Manual and Capillary Electrophoresis. Gender identification. Interpretation of the DNA typing results. CODIS, Statistical evaluation of DNA typing results and preparation of reports. RNA and its application in Forensics, Emerging molecular techniques in Forensics.	15

	TOTAL	60

References:

1. Goodwin, William; "An Introduction to Forensic Genetics", John Wiley & Sons Ltd., 2007.
2. Kothari, Manu L; "Essentials of Human Genetics", University Press (India) Pvt. Ltd., 2009.
3. Rudin, Norah; "An Introduction to Forensic DNA Analysis", CRC Leviw Publishers, 2002.
4. Vij, Krishan; "Basics of DNA and Evidentiary Issues", Jaypee Brothers, 2004.
5. Mark A. Farley & James J. Harrington; "Forensic DNA Technology", CRC Press, 1991

Practicals:

1. ABO grouping from hair root.
2. Rh grouping of bloodstains.
3. MN grouping of blood stains
4. Quantitative Analysis of DNA
5. DNA Extraction from biological samples (Blood and other body fluids and tissues) using Organic (Phenol-Chloroform) Method.
6. DNA Extraction from biological samples using Chelax Method.

Course:	**T.Y.B.Sc. : Environmental Biotechnology**			**Course Code: BH.USBT604**	
Teaching Scheme				**Evaluation Scheme (Theory)**	
Lecture (Periods per week)	**Practical (Periods per week per batch)**	**Tutorial (Periods per week per batch)**	**Credits (Theory +Practical)**	**Continuous Internal Assessment (CIA) (CIA-I & II)**	**End Semester Examination (ESE)**
04	**04**	**NIL**	**2.5+1.5=4**	**20+20=40**	**(Marks: 60)**

Course Objectives:

- To develop an understanding about different types of waste and different methods and strategies to treat the industrial effluent
- To give knowledge of bioremediation, a sustainable method to safeguard environment from environmental pollution
- To have firm foundation of fundamentals of biogas technology , biofuels and renewable sources of energy

Course Outcomes:

- Student would be learning characteristics of the waste, different bioreactors used for waste treatment and scheme of waste treatment at the industrial level with representative examples.
- Student will be able to develop an understanding about various biofuels and its production. They will be able to develop an understanding about biogas and its manufacturing process.
- Students learns the various strategy to safeguard environment in an ecofriendly way

INDEX

Units	**Detailed descriptions**	**Lecture period /unit**
UNIT I Processes and Bioreactors for waste treatment	Types of waste, Wastewater treatment- introduction, Biological processes for industrial effluent treatment, chemical properties influencing biodegradability, microorganisms in biodegradation, aerobic biological treatment- activated sludge process, CASP, advanced activated sludge processes, Biological filters, RBC, FBR**,** Anaerobic biological treatment- contact digesters, packed bed reactors, anaerobic baffled digesters, UASB, Solid waste management.	15
UNIT II Strategies of waste treatment	Use of immobilized enzymes or microbial cells for treatment Use of packaged organisms and genetically engineered organisms in waste treatment Microbial systems for heavy metal accumulation, Techniques used for heavy metal removal biosorption by bacteria, fungi algae Bioremediation: Microbial and phytoremediation	15

UNIT III Industrial effluent management	Characteristics and degradation of waste generated from tanning industry, petroleum industry, paper & pulp industry, Dairy , Distillery , Antibiotic industry, Food processing industry degradation of xenobiotic compounds	15
UNIT IV **Renewable sources of energy**	Energy sources renewable – solar energy, wind power, geothermal energy and hydropower, biomass energy, Biogas technology- biogas plant & types, biodigester. Biogas- composition, production and factors affecting production, uses; Biofuels – ethanol production. Microbial hydrogen production Biodiesel, Petrocrops	15
	TOTAL	**60**
	References: • Environmental Biotechnology Allan Scragg Oxford University press • Environmental Biotechnology (Basic concepts and applications) Indu Shekar Thakur IK International • Environmental Biotechnology (Industrial pollution management) S.D. Jogdand Himalaya Publishing House Environmental Biotechnology, M.H. Fulekar 1st ed, CRC press	
	Practical: • Isolation of heavy metal (Cd) tolerating Study the effect of heavy metals on the growth of bacteria. • Estimation of chromium from Effluents (Demonstration) • Assessment of total standard plate count in wastewater (any industry) • Assessment of total coliform count in wastewater (any industry) • Role of fungal system in decolorisation of effluent • Visit to ETP/ CETP • Visit to biogas plant	

Programme: B.Sc. Biotechnology				**Semester: VI**	
Course: T.Y.B.Sc.:Fundamentals of Drug Designing				**Course Code: BH.USBT605**	
Teaching Scheme				**Evaluation Scheme (Theory)**	
Lecture (Periods per week)	**Practical (Periods per week per batch)**	**Tutorial(Periods per week per batch)**	**Credits (Theory +Practical)**	**Continuous Internal Assessment (CIA)** (CIA-I & II)	**End Semester Examination (ESE)**
04	**04**	**NIL**	**2.5+1.5=4**	**20+20=40**	**(Marks: 60)**
Course Objectives:					
Course Outcomes: By the end of the course the student will be able to • understand the concept of pharmacology Drug designing and its fate once delieverd .					

INDEX		
Units	**Detailed descriptions**	**Lecture period /unit**
UNIT I **General Principles of Pharmacology**	Mechanism of drug action**;** drug receptors and biological responses**;** second-messenger systems, the chemistry of drug–receptor binding**;** dose–response relationship: therapeutic index**;** ED, LD,**;** Potency and Intrinsic Activity**;** Drug antagonism	15
UNIT II **Drug designing**	**.** Drug Molecule designing and development Drug discovery Computer aided drug designing Molecular modelling In silico drug drsigning	15
UNIT III **Drug Absorption and Distribution**	Absorption of drugs from the alimentary tract factors affecting rate of gastrointestinal absorption -absorption of drugs from lungs **;** skin **-;** absorption of drugs after parenteral administration factors influencing drug distribution binding of drugs to plasma proteins Physiological barriers to drug distribution -	15
UNIT IV **Toxicology**	Background Definitions**;** Causation: degrees of certainty Classification**;** Causes Allergy in response to drugs Effects of prolonged administration: chronic organ toxicity**;** Adverse effects on reproduction**;** Poisons: Deliberate and accidental self-poisoning Principles of treatment Poison-specific measures General measures**;** Specific poisonings: cyanide, methanol, ethylene glycol, hydrocarbons, volatile solvents,	15

	heavy metals,**;** herbicides and pesticides,**;** biological substances (overdose of medicinal drugs is dealt with under individual agents**) -;** Incapacitating agents: drugs used for torture**;** Nonmedical use of drugs **-.**	
	TOTAL	**60**

References:

- Modern Pharmacology with clinical Applications Craig,C.R, Stitzel,R.E 5th edition
- Clinical Pharmacology Bennet,PN,Brown,M.J, Sharma,P 11th edition Elsevier
- Biochemistry Metzler, D.E Elsevier

Practicals :

- Estimation of LD50 using model organisms
- Drug molecule designing using bioinformatics tools
- Drug targetting using bioinformatics tools

Examination pattern for:
Theory:
• The question paper for the Term End Exam would be of 60 marks consisting of 4 Questions (15M each), of which one question would be common for all units in the syllabus.

• There shall continuous internal assessment of 40 marks for each paper.
Practical:
• Each student to perform 2 major and 2 minor practical for Sem V and 2 major and project presentation for Sem VI ,
• Viva would be conducted during the practical during Sem V; Sem VI would have ONLY project presentation
• Journals would be uniform throughout all the centres; matter would be communicated to all the centres by the syllabus committee.
• Distribution of marks for the experiments carried out during the examination:
Sem V (50M/ paper): Major: 20M; Minor: 10M; Viva: 10M; Journal 10M.
Sem VI (50M/paper): Major (x2): 40M; Journal: 10M; Project 50M
The report could be around 25-30 pages with appropriate referencing and formatting.
Marks distribution for the project would be as follows:
25M documentation, 15M presentation, 10 M viva and interactions;
• Students would undertake a project for 1-2 months during the last semester for 50 M.
The project should include either of the following:
1. One/ more major instrumentation OR
2. One / more major technique/s required in the field of interest OR

Rubrics of evaluation for ESE

UNIT	Knowledge	Understanding	Analysis & critical thinking	Total marks / Unit
1	03	06	06	15
2	03	06	06	15
3	03	06	06	15
4 (from all)	03	06	06	15
Total per objective	12	24	24	60
% weightage	20	40	40	100

Rubrics of evalution for CIA-2 assignment

Parameters	Max marks	80-100% Excellent	60-80% Good	40-60% Satisfactory	20-40% Poor	0-20% very poor
Content	10					
Content : Introduction	02					
Content : Development	03					
Content : Conclusion	03					
Content : Bibilography & Acknowledgement	02					
Effective presentation / Research skills	10					
Language, Style and structure	05					
Aids	05					
Total	20					