

TYBSC Biotechnology Course Structure

Semester V

| Course code | Title | Theory /Practical | Marks | Credits | No. of Lectures & Practical |
|-------------------|--|-------------------|------------|-----------|-----------------------------|
| SBT501 | Cell biology | Theory | 100 | 2.5 | 60 |
| SBT502 | Medical Microbiology & Instrumentation | Theory | 100 | 2.5 | 60 |
| SBT503 | Genomes and Molecular Biology | Theory | 100 | 2.5 | 60 |
| SBT504 | Marine Biotechnology | Theory | 100 | 2.5 | 60 |
| SBTP501 + SBTP502 | Cell biology+ Medical Microbiology & Instrumentation | Practical | 100 | 3.0 | 72 |
| SBTP503 + SBTP504 | Genomes and Molecular Biology+ Marine Biotechnology | Practical | 100 | 3.0 | 72 |
| Applied Component | Biosafety | Theory | 100 | 2.0 | 48 |
| | Biosafety | Practical | 100 | 2.0 | 48 |
| | TOTAL | | 800 | 20 | 480 |

Semester VI

| Course code | Title | Theory/ Practical | Marks | Credits | No. of Lectures & Practical |
|--------------------|---|--------------------------|--------------|----------------|--|
| SBT 601 | Biochemistry | Theory | 100 | 2.5 | 60 |
| SBT 602 | Industrial Microbiology | Theory | 100 | 2.5 | 60 |
| SBT 603 | Pharmacology and Neurochemisty | Theory | 100 | 2.5 | 60 |
| SBT 604 | Environmental Biotechnology | Theory | 100 | 2.5 | 60 |
| SBT 601 + SBT 602 | Biochemistry + Industrial Microbiology | Practical | 100 | 3 | 72 |
| SBT 603 + SBT 604 | Pharmacology - Neurochemistry + Environmental Biotechnology | Practical | 100 | 3 | 72 |
| Applied component | Agribiotechnology | Theory | 100 | 2.0 | 48 |
| Applied component | Agribiotechnology | Practical | 100 | 2.0 | 48 |
| | TOTAL | | 800 | 20 | 480 |

T.Y.BSc. Biotechnology Sem V

USBT 501

Cell Biology

Course objectives:

The objective of this course is to have a firm foundation in the fundamentals of Cell Biology.

Learning outcomes:

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

- Develop an understanding of the Cytoskeleton and Cell Membrane.
- Discuss the structure of Microtubules, microfilaments.

USBT 502

Medical Microbiology and instrumentation

Course objectives:

The objective of this course is to familiarize students with various infectious agents and the role of chemotherapy and instruments and various Immunotechniques.

Learning outcomes:

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

- Understand the Mechanisms of the actions of different chemotherapeutic drugs for treatment of various infections.
- Understand the principles underlying various Instruments.

USBT 503

Genomics and Molecular biology

Course objectives:

To acquaint students with Genetic Engineering and genetic mapping.

Learning Outcomes :

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

- Understand molecular Biology tools and Techniques
- Develop an understanding of transgenics.

USBT 504

Marine Biotechnology

Course objectives:

The objective of this course is to understand the basics in marine biotechnology and its applications.

Learning outcomes:

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

- Develop an understanding of the various aspects of marine biotechnology.
- Understand principles underlying design of marine drugs, functional foods, nutraceuticals , bioprospecting, and bioresources.

T.Y.BSc Biotechnology Sem VI

USBT 601

Biochemistry

Course objectives:

The objective of this course is to have a firm foundation in applied biochemistry.

Learning outcomes:

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

- Develop an understanding of protein biochemistry and metabolism.
- Get the basic knowledge about endocrinology.
- Gain the knowledge regarding various biochemical aspects of nutrition.

USBT602

Industrial Microbiology

Course objectives:

The objective of this course is to acquaint students with principles underlying various fermentation aspects.

Learning outcomes:

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

- Understand dairy technology.
- Understand the principles underlying downstream processing and fermentation processes.
- Get knowledge about QA-QC.

USBT 603

Basic Toxicology and Neurochemistry

Course objectives:

The objective of this course is learning and understanding basic concepts of pharmacology, basic toxicology and neurochemistry.

Learning outcomes:

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

- Gain an understanding of the basic concepts of pharmacology, basic toxicology and neurochemistry.
- Understand drug absorption, distribution and regulation.

USBT 604

Environmental Biotechnology

Course objectives:

The objective of this course is to understand different aspects of waste treatment and management.

Learning outcomes:

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

- Develop an understanding of the various renewable sources of energy.
- understand the concept of Biosensors.
- Understand principles underlying industrial effluent treatment, waste water treatment, and hazardous waste management.

Examination pattern

Internal Assessment- 40 Marks

| SR. No. | Particulars | Marks |
|---------|--|-----------------|
| 1. | Class test | 15 Marks |
| | Assignments/Presentations | 15 Marks |
| 2. | Department Activities, Attendance etc. | 10 Marks |
| | TOTAL | 40 Marks |

Semester end Exam- 60 marks

| SR. No. | Particulars | Marks |
|---------|---|-----------------|
| | All questions are Compulsory Number Questions : 5 (Five) Each Question carries 12 Marks | |
| 1. | Q 1 – Unit I | 12 Marks |
| 2. | Q 2 – Unit II | 12 Marks |
| 3. | Q 3 – Unit III | 12 Marks |
| 4. | Q 4 – Unit IV | 12 Marks |
| 5. | Q 5 – Short Notes based on Unit I, II, III,IV (Any 3 out of 5) | 12 Marks |
| | TOTAL | 60 Marks |

Practical:

- Would be conducted over a period of 3 days; 50M each paper.
- 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

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
3. Bioinformatics OR
4. Biostatistics

Semester V

| Course code SBT | Title | Unit | Topics | Credit | No of Lectures |
|--------------------|---------------------|----------------------------|--|--------|----------------|
| 501 | Cell Biology | I: Cell cycle | Cell cycle Introduction: Prokaryotic and Eukaryotic- 3 Lectures; The Early Embryonic Cell Cycle and the Role of MPF- 4 Lectures; Yeasts and the Molecular Genetics of Cell-Cycle Control – 4 Lectures; Apoptosis, Cell-Division Controls in Multicellular Animals- 4 Lectures | 2.5 | 15 |
| | | II: Cell Signalling | Cell signalling and signal transduction: Introduction General Principles of Cell Signaling - 3 Lectures; Signaling via G-Protein-linked Cell-Surface Receptors - 3 Lectures; Signaling via Enzyme-linked Cell-Surface Receptors - 3 Lectures; Target-Cell Adaptation, The Logic of Intracellular - 3 Lectures; Signaling: Lessons from Computer-based "Neural Networks"- 3 Lectures | | 15 |
| | | III: Developmental Biology | Overview of how the modern era of developmental biology emerged through multidisciplinary approaches - 5 Lectures; 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 - 6 Lectures; Mechanisms of differentiation- cytoplasmic determinants, embryonic induction, concept of morphogen, mosaic and regulative development Pattern formation-- axis specification, positional identification (regional specification), Morphogenetic movements, Model organisms in Developmental biology - 4 Lectures | | 15 |
| | | IV: Cancer Biology | Cancer: Introduction, Cancer as a Microevolutionary Process - 4 Lectures; The Molecular Genetics of Cancer - 6 Lectures; Cancer and Virus Cancer diagnosis and chemotherapy - 5 Lectures | | 15 |
| | | Total | | | 60 |

References:

1. 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
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. Developmental Biology; Scott Gilbert; 9th Edition

| Course code SBT | Title | Unit | Topics | Credit | No of Lectures |
|--------------------|--|----------------------------|---|--------|----------------|
| 502 | Medical Microbiology and Instrumentation | I: Virology | Introduction to viruses-Position in biological spectrum; Virus properties - 2 Lectures ; General structure of viruses Baltimore Classification and Taxonomy(ICTV) - 2 Lectures ; Cultivation of viruses - 2 Lectures ; Reproduction of ds DNA phages Hepatitis /ss RNA (influenza), animal viruses and plant (TMV)virus - 4 Lectures ; Virus purification and assays - 2 Lectures ; Cytocidal infections and cell damage - 2 Lectures ; Viroids and Prions - 1 Lecture | 2.5 | 15 |
| | | II: Chemotherapeutic drugs | Discovery and Design of antimicrobial agents - 1 Lecture ; Classification of Antibacterial agents, Selective toxicity, MIC, MLC - 2 Lectures Inhibition of cell wall synthesis (Mode of action for): Beta lactam antibiotics: Penicillin, Cephalosporins; Glycopeptides: Vancomycin; Polypeptides: Bacitracin - 2 Lectures Injury to Plasma membrane: Polymyxin – 1 Lecture ; Inhibition of protein synthesis Aminoglycosides, Tetracyclines Chloramphenicol, Macrolides-Erythromycin- 2 Lectures ; Inhibition of Nucleic acid synthesis: Quinolones, Rifampicin, Metronidazole - 2 lectures ; Antimetabolites: Sulphonamides, Trimethoprim - 1 lecture ; Drug Resistance: Mechanism, Origin and transmission of drug resistance - 1 lecture ; Use and misuse of antimicrobial agents - 1 lecture ; Antifungal drugs, Antiviral drugs - 2 lectures | | 15 |
| | | III: Spectroscopy | Principle, instrumentation, working and applications of: Fluorescence Spectroscopy - 3 Lectures Luminometry - 3 Lectures Light scattering spectroscopy - 3 | 15 | |

| | | | | |
|--|----------------------------------|--|--|----|
| | | | Lectures Infrared Spectroscopy - 3 Lectures Atomic absorption Spectroscopy - 3 Lectures | |
| | IV: Bio-analytical techniques | | Principle, working and applications of: Affinity chromatography - 2 Lectures Ion-exchange chromatography - 2 Lectures Molecular (size) exclusion chromatography - 2 Lectures ; HPLC - Method development and validation- 3 Lectures ; Isotopes in Biology: Nature of radioactivity - 1 Lecture ; Detection Techniques using GM counter, Scintillation counter, autoradiography - 4 Lectures ; Applications of Tracer techniques in Biology - 1 Lecture | 15 |
| | Total | | | 60 |

References:

1. Principles and techniques in biochemistry and molecular biology (2010), Keith Wilson and John Walker, 7th edition, Cambridge University Press
2. Biophysics (2002) Vasantha Pattabhi and N. Gautham, Kluwer Academic Publishers
3. Physical Biochemistry: principles and applications, 2nd edition (2009), David Sheehan , John Wiley & Sons Ltd
4. HPLC method validation for pharmaceuticals: a review (2013), Harshad V. Paithankar, International Journal of Universal Pharmacy and Bio Sciences 2(4): July-August.
5. Mim's Medical Microbiology 5th edition
6. Microbiology by Prescott Harley and Klein 5th edition Mc Graw Hill
7. Medical Microbiology Jawetz,E., Brooks,G.E, Melnick,J.L., Butel,J.S Adelberg E. A 18th edition
8. Medical Microbiology by Patrick Murray 5th edition
9. Foundations In Microbiology by Talaro and Talaro Third edition W.C Brown
10. Understanding Viruses by Teri Shors

PRACTICALS

USBT P 501-502

3 credits

72hrs

1. Separation of components from a mixture using Affinity chromatography
(Kit may be used)
2. Separation of components from a mixture using ion exchange chromatography
(Kit may be used)
3. Separation of components from a mixture using Size exclusion chromatography
(Kit may be used)
4. HPLC method validation.
5. MIC and MLC of any one antibiotic
6. Antibiotic sensitivity test using agar cup method
7. Antibiotic sensitivity test using paper disc method
8. Antibiotic sensitivity test using ditch method.
9. Cancer Biology: (Field visit and 2 page report in the journal)
10. Chick embryo candling and inoculation methods Demonstration experiment
11. Book review (Emperor of all Maladies)

| Course Code SBT | Title | Unit | Topics | Credit | No of Lectures |
|-----------------|--------------------------------|----------------------------------|---|--------|----------------|
| 503 | Genomics and Molecular Biology | I: Genetic engineering of plants | Genetic engineering of plants; Methodology. Plant transformation with the Ti plasmid of <i>A.tumefaciens</i> , Ti plasmid derived vector system - 4 Lectures ; Transgenic plants: Physical methods of transferring genes to plants : electroporation, microprojectile bombardment, liposome mediated, protoplast fusion- 5 Lectures ; Vectors for plant cells - 4 Lectures ; Improvement of seed quality protein - 2 Lectures | 2.5 | 15 |
| | | II: Transgenic Animals | Transgenic mice- methodology-retroviral method, DNA microinjection, ES method - 5 Lectures ; genetic manipulation with cre-loxP - 2 Lectures ; Vectors for animal cells - 2 Lectures ; Transgenic animals recombination system - 2 Lectures ; Cloning live stock by nuclear transfer - 2 Lectures ; Green Fluorescent Protein - 1 Lectures ; Transgenic fish – 1 Lectures | | 15 |
| | | III: Tools in Molecular Biology | Cloning vectors-Plasmids (pUC series), Cosmids, phagemids M13, shuttle vectors, YAC vectors, expression vectors pET - 4 Lectures ; Gene cloning-Isolation and purification of DNA; Isolation of gene of interest: Restriction digestion, electrophoresis, blotting, cutting, and joining DNA, methods of gene transfer in prokaryotes and eukaryotes - 3 Lectures ; Recombinant selection and screening methods: genetic, immunochemical, Southern and Western analysis, nucleic acid hybridization, HART,HRT- 2 Lectures ; Expression of cloned DNA molecules and maximization of expression - 2 Lectures ; Cloning strategies-genomic DNA libraries, cDNA libraries, chromosome walking and jumping - 4 Lectures | | 15 |
| | | IV: Gene sequencing and editing | Maxam Gilbert's method, Sanger's dideoxy method, Automated DNA sequencing, Pyrosequencing - 6 Lectures ; Human genome mapping and it's implications in health and disease - 3 Lectures ; RNAi, ZNF(Zinc finger nucleases), TALENS(Transcription Activator Like Effector Nucleases), CRISPER/Cas system(Clustered Regularly Interspersed Repeats) - 6 Lectures | | 15 |
| | | 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. Genomes 3rd Edition T.A. Brown.
6. Biotechnology B.D. Singh.
7. Gene Cloning and DNA Analysis 6th Edition T.A. Brown.
8. Genomics Cantor C.R., and Smith C.L. John Wiley & Sons. (1999)

| Course Code SBT | Title | Unit | Topics | Credit | No. of Lectures |
|-----------------|----------------------|---|--|--------|-----------------|
| 504 | Marine Biotechnology | I: Marine Biotechnology Introduction & Bioprospecting | Introduction to Marine Biotechnology- 1 lecture; The marine ecosystem and its functioning: intertidal, estuarine, salt marsh, mangrove, coral reef, coastal & deep sea ecosystems. Hydrothermal vents- 4 lectures; Bioprospecting, Marine Microbial Habitats and Their Biotechnologically relevant Microorganisms- 2 lectures; Methods for Microbial Bioprospecting in Marine Environments - 2 lectures; Biotechnological Potential of Marine Microbes - 1 lecture; Bioactive compounds from other Marine Organisms: fungi, Microalgae, Seaweeds, Actinomycetes, sponges - 5 lectures | 2.5 | 15 |
| | | II: Marine Drugs and Enzymes | Drugs from Marine organisms: Pharmaceutical compounds from marine flora and fauna - marine toxins, antiviral and antimicrobial agents - 4 lectures; Approved Marine Drugs as Pharmaceuticals - 2 lecture; Marine Natural products and its Challenges - 2 lectures; Marine Microbial Enzymes- Marine Extremozymes and Their Significance, Current Use of Marine Microbial Enzymes - 7 lectures. | | 15 |
| | | III: Marine Functional foods and Nutraceuticals | Marine Functional Foods: Marine Sources as Healthy Foods or Reservoirs of Functional Ingredients - 3 lectures; Marine-Derived Ingredients with Biological Properties- 3 lectures; Functional Foods Incorporating Marine-Derived Ingredients - 2 lectures; Marine Nutraceuticals : Marine Bioactives as Potential Nutraceuticals, Functional Carbohydrates, Polyunsaturated Fatty Acids- 3 lectures; Carotenoids, Soluble Calcium, Fish Collagen and Gelatin, Marine Probiotics - 4 lectures. | | 15 |
| | | IV: Marine Bioresources and | Marine Bioresources, Marine Secondary Metabolites, Marine Proteins, Marine Lipids- 4 lectures; Cosmetics from Marine Sources: Scenario of Marine Sources in the Cosmetic Industry, Cosmetics: Definition and Regulations, | | 15 |

| | | | | | |
|--|--|-----------|--|--|----|
| | | Cosmetics | Cosmeceuticals , Target Organs and Cosmetics Delivery Systems , Components of Cosmetics, Major Functions of Some Marine Components in Cosmetics and Cosmeceuticals , Treatments Based on Marine Resources , Products Based on Marine Resources - 11 lectures. | | |
| | | Total | | | 60 |

References:

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

PRACTICALS

USBT P 503-504

3 credits

72hrs

1. Transformation in *E.coli*.
2. Genomic DNA Extraction: Animal cells.
3. Restriction enzyme digestion and ligation (Kit may be used).
4. Phage titration: *Demonstration*
5. Polymerase chain reaction. *Demonstration*
6. Gradient plate technique
7. Bacterial gene expression (Kit may be used).
8. Study of any 5 marine bacteria and algae (Macro and micro)
9. DPPH assay for antioxidant extracted from marine algae
10. Extraction of carotenoids from marine algae/Bacteria/Fungi
11. Extraction and estimation of Gelatin / Collagen.
12. Extraction of alkaloids from marine organisms and their separation by TLC.

| Course | Title | Unit | Topics | Credits | Lectures |
|--------------------------|------------------|--|--|---------|-----------|
| Applied component | Biosafety | I: Introduction to biosafety | Introduction - 1 lecture Biological Risk Assessment, Hazardous Characteristics of an Agent- 2 lectures ; Genetically modified agent hazards - 1 lecture ; Cell cultures - 1 lecture ; Hazardous Characteristics of Laboratory Procedures - 1 lecture ; Potential Hazards Associated with Work Practices – 2 lectures ; Safety Equipment and Facility Safeguards - 2 lectures ; Pathogenic risk and management- 2 lectures | 2.0 | 15 |
| | | II: GLP | Concept of GLP- 1 lectures ; Practicing GLP- 1 lecture ; Guidelines to GLP - 2 lectures ; Documentation of Laboratory work - 1 lectures ; Preparation of SOPs - 2 lectures ; Calibration records - 1 lectures ; Validation of methods - 1 lectures ; Documentation of results - 1 lecture ; Audits & Audit reports - 1 lecture. | | 12 |
| | | III: Detection and testing of contaminants | Microbial Contamination in food and pharma product - 3 lectures ; Some common microbial contaminants - 3 lectures ; Microbiological Assays for pharmaceutical products - 4 lectures ; Regulatory Microbiological testing in pharmaceuticals - 3 lectures. | | 12 |
| | | IV: Biosafety in Biotechnology | Concepts on biosafety in Biotechnology - 2 lectures ; Regulating rDNA technology - 2 lectures ; Regulating food and food ingredients - 3 lectures ; Genetically engineered crops, livestock Bioethics - 3 lectures ; Contemporary issues in Bioethics - 2 lectures. | | 12 |
| | | Total | | | 48 |

References:

1. Pharmaceutical Microbiology - Hugo, W.B, Russell, A.D 6th edition Oxford Black Scientific Publishers.
2. 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.
3. Molecular Biotechnology –Principles and Applications of Recombinant DNA Glick, B.R, Pasternak, J.J Patten, C.L 3rd edition ASM press

PRACTICALS**Applied Component- Biosafety****2 Credits****48hours**

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

Semester VI

| Course Code SBT | Title | Unit | Topics | Credits | Lectures |
|-----------------|--------------|----------------------------|--|---------|----------|
| 601 | Biochemistry | I: Protein Biochemistry | Protein structure: Protein Tertiary and Quaternary Structures - 2 Lectures ; Protein Denaturation and Folding – 3 Lectures ; Protein Function: Reversible Binding of a Protein to a Ligand: Oxygen-Binding Proteins – 2 Lectures ; Complementary Interactions between Proteins and Ligands: Immunoglobulins – 1 Lecture ; Protein Interactions Modulated by Chemical Energy: Actin, Myosin, and Molecular Motors - 3 Lectures ; Protein purification – 4 Lectures . | 2.5 | 15 |
| | | II: Metabolism | Carbohydrate biosynthesis and its regulation: Peptidoglycan in Bacteria - 2 Lectures ; Starch and sucrose in Plants - 4 Lectures ; Glycogen in Animals - 4 Lectures ; Biosynthesis and regulation of Cholesterol, Atherosclerosis – 5 Lectures . | | 15 |
| | | III: Endocrinology | Mechanism of action of group I and II hormones- 1 Lecture ; Structure, storage, release, transport, biochemical functions and disorders associated with hormones secreted by Hypothalamus - 1 Lecture ; Anterior Pituitary gland - GH, stimulating hormones) - 1 Lecture ; Posterior Pituitary gland – oxytocin and vasopressin - 1 Lecture ; Thyroid gland – Thyroxine, calcitonin - 2 Lectures ; Parathyroid gland – PTH - 1 Lecture ; Adrenal medulla – epinephrine and norepinephrine - 1 Lecture ; Adrenal cortex – Glucocorticoids - 1 Lecture ; Pancreas – insulin and glucagon - 2 Lectures ; Female Gonads – estrogen and progesterone - 2 Lectures ; Male gonads – testosterone- 1 Lecture ; Placenta – hCG - 1 Lecture . | | 15 |
| | | IV: | Minerals and Vitamins; | | |

| | | | | | |
|--|--|-----------|--|--|----|
| | | Nutrition | Dietary sources, bioactive form, functions and disorders associated with fat soluble (A D E K) and water soluble vitamins- 7 Lectures; Minerals - physiological and biochemical functions of principal and trace elements. - 7 Lectures; Malnutrition – Over nutrition (obesity) and PEM (Kwashiorkor and Marasmus)- 1 Lecture. | | 15 |
| | | Total | | | 60 |

References:

1. Lehninger, principles of biochemistry, 4th edition (2005), David Nelson and Michael Cox *W.H. Freeman* and Company, New York.
2. Biochemistry , 4th edition (2010), Voet and Voet, John Wiley and sons, USA
3. Harper’s Illustrated Biochemistry, 27th edition, RK Murray, DK Granner, PA Mayes and VW Rodwell, McGraw Hills publication.
4. Biochemistry, 4nd edition (2017), Satyanarayana and Chakrapani, Books & Allied (P) Ltd
5. Nutrition Science, 6th edition (2017), Srilakshmi, new age international publishers.

| Course Code SBT | Title | Unit | Topics | Credit | No. of Lectures |
|-----------------|-------------------------|-------------------------------------|---|--------|-----------------|
| 602 | Industrial Microbiology | I: Dairy technology | Milk: Normal flora, changes in raw milk - 2 lectures ; Enumeration - 1 lecture ; Factors affecting bacteriological quality - 1 lecture ; Dairy technology Preservation methods - 2 lectures ; Pasteurization- 1 lecture ; Starter Cultures - 2 lectures ; Fermented products-Production process and spoilage of Cheese: Swiss and Cheddar - 2 lectures ; Butter - 2 lectures ; Yogurt - 1 lectures and Buttermilk - 1 lecture . | 2.5 | 15 |
| | | II: Down-stream Processing (DSP) | Introduction of DSP - 2 lectures ; Foam separation - 1 lecture ; Types of Precipitation - 1 lecture ; Filtration 2 lectures , Centrifugation - 1 lecture ; Chromatography in DSP - 2 lectures ; Cell disruption- physical and chemical methods - 2 lectures ; Solvent recovery, Membrane processes - 1 lecture ; Drying - 1 lecture ; Crystallization and Whole broth processing - 2 lectures . | | 15 |
| | | III: Fermentation process | Introduction to Inoculum development - 2 lectures ; Bacterial and fungal inoculum development with one example each - 3 lectures , scale up, scale down - 2 lectures ; Production of: Streptomycin - 1 lecture ; Protease - 1 lecture ; Mushroom - 1 lecture ; Glutamic acid - 1 lecture ; Lysine - 1 lecture , ethanol production 1 lecture Semi-synthetic Penicillin 1 lecture , Biotransformation - 1 lecture . | | 15 |
| | | IV: QA-QC | Concept of GMP- 1 Lectures ; Requirements of GMP implementation - 2 Lectures ; Documentation of GMP practices - 2 Lectures ; Regulatory certification of GMP - 2 Lectures ; Quality Control (QC): Concept of QC - 2 Lectures ; Requirements for implementing QC - | | 15 |

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|--|--|-------|---|--|----|
| | | | 2 Lectures; QA concepts: Concept of QA - 2 Lectures; Requirements for implementing - 2 Lectures. | | |
| | | Total | | | 60 |

References:

1. Applied Dairy Microbiology Elmer H Marth and James L Steele Mercel Dekker Inc
New York, 2nd edition
2. Microbial Technology Pepler,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 Whittkar
6. Pharmaceutical Microbiology by Russel and Hugo

PRACTICALS

USBT P 601-602

3 credits

72hrs

1. Estimation of Milk protein-Pynes method
2. Microbial analysis of Milk by MBRT and RRT
3. Phosphatase test in Milk
4. DMC of milk sample
5. Isolation of Normal flora from Milk and curd
6. Determination of blood glucose levels for detection of diabetes mellitus.
7. Determination of serum cholesterol (total, HDL and LDL ratio)
8. Estimation vitamin C by DCPIP method from food samples.

| Course Code SBT | Title | Unit | Topics | Credits | No of Lectures |
|-----------------|--|---|--|---------|----------------|
| 603 | Basic pharmacology and Neuro-chemistry | I: General principles of Pharmacology | Mechanism of drug action - 2 Lectures ; drug receptors and biological responses - 2 Lectures ; second-messenger systems, the chemistry of drug-receptor binding - 2 Lectures ; dose-response relationship: therapeutic index - 3 Lectures ; ED, LD, - 2 Lectures ; Potency and Intrinsic Activity - 2 Lectures ; Drug antagonism - 2 Lectures . | 2.5 | 15 |
| | | II: Drug Absorption and Distribution | Absorption of drugs from the alimentary tract - 2 Lectures ; factors affecting rate of gastrointestinal absorption - 2 Lectures ; absorption of drugs from lungs - 1 Lecture ; skin - 1 Lecture ; absorption of drugs after parenteral administration factors influencing drug distribution - 2 Lectures ; binding of drugs to plasma proteins - 2 Lectures ; Physiological barriers to drug distribution - 3 Lectures . | | 15 |
| | | III: Basic Toxicology and Regulatory Toxicology | Background Definitions - 1 Lectures ; Causation: degrees of certainty Classification - 1 Lectures ; Causes Allergy in response to drugs Effects of prolonged administration: chronic organ toxicity - 2 Lectures ; Adverse effects on reproduction - 1 Lecture ; <u>Poisons</u> : Deliberate and accidental self-poisoning Principles of treatment Poison-specific measures General measures - 2 Lectures ; Specific poisonings: cyanide, methanol, ethylene glycol, hydrocarbons, volatile solvents, heavy metals, - 3 Lectures ; herbicides and pesticides, - 2 Lectures ; biological substances (overdose of medicinal drugs is dealt with under individual agents) - 1 Lecture ; Incapacitating agents: drugs used for torture - 1 Lecture ; Nonmedical use of drugs - 1 Lecture . | | 15 |
| | | IV: Neuro-chemistry | Anatomy and functioning of the brain - 2 Lectures ; Neuronal pathways - 2 Lectures ; | | 15 |

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|--|--|-------|---|--|----|
| | | | Propogation of nerve impulses - 2 Lectures; Neuronal excitation and inhibition - 3 Lectures; Synapses and gap junctions - 3 Lectures; Action of Neuro toxins and neurotransmitters - 3 Lectures. | | |
| | | Total | | | 60 |

References:

1. Textbook of Medical Physiology Guyton, A.C and Hall 11th edition J.E Saunders
2. Modern Pharmacology with clinical Applications Craig,C.R, Stitzel,R.E 5th edition
3. Clinical Pharmacology Bennet,PN,Brown,M.J, Sharma,P 11th edition Elsevier
4. Biochemistry Metzler, D.E Elsevier

| Course Code SBT | Title | Unit | Topics | Credits | No of Lectures |
|-----------------|-----------------------------|-------------------------------------|---|---------|----------------|
| 604 | Environmental Biotechnology | I: Renewable sources of energy | Energy sources renewable – solar energy, wind power, geothermal energy and hydropower, biomass energy - 5 Lectures ; Biogas technology- biogas plant & types, biodigester. Biogas- composition, production and factors affecting production, uses - 5 Lectures ; Biofuels – ethanol production. Microbial hydrogen production Biodiesel, Petrocrops - 5 Lectures ; | 2.5 | 15 |
| | | II Industrial effluent treatment | Biological processes for industrial effluent treatment, aerobic biological treatment- activated sludge process, CASP, advanced activated sludge processes (any two) Biological filters, RBC, FBR - 5 Lectures ; Anaerobic biological treatment- contact digesters, packed bed reactors, anaerobic baffled digesters, UASB - 3 Lectures ; Solid waste treatment - 2 Lectures ; pollution indicators & biosensors - 2 Lectures ; biodegradation of xenobiotics- persistent compounds, chemical properties influencing biodegradability, microorganisms in biodegradation - 2 Lectures ; Use of immobilized enzymes or microbial cells for treatment - 1 Lecture . | | 15 |
| | | III Waste-water treatment | Wastewater treatment- introduction, biological treatment, impact of pollutants on biotreatment, use of packaged organisms and genetically engineered organisms in waste treatment - 5 Lectures ; Heavy metal pollution – sources, microbial systems for heavy metal accumulation, techniques used for heavy metal removal - 5 Lectures ; biosorption by bacteria, fungi and algae, factors affecting biosorption limitations of biosorption - 5 Lectures . | | 15 |
| | | IV Hazardous waste management | Biodegradation of waste from tanning industry - 2 Lectures ; petroleum industry - 2 Lectures ; paper & pulp industry - 2 Lectures ; Dairy - 2 Lectures ; Distillery - 2 Lectures ; Dye - 1 Lecture ; Antibiotic industry - 2 Lectures ; Removal of oil spillage & grease deposits - 2 Lectures . | | 15 |
| | | Total | | | 60 |

References:

1. Environmental Biotechnology Allan Scragg Oxford University press
2. Environmental Biotechnology (Basic concepts and applications) Indu Shekar Thakur
IK International
3. Environmental Biotechnology (Industrial pollution management) S.D. Jogdand
Himalaya Publishing House

PRACTICALS

USBT P 603-604

3 credits

72hrs

1. LD 50, ED 50 evaluation using suitable models e.x daphnia
2. Study the effect of heavy metals on the growth of bacteria.
3. Determination of Total Solids from an effluent sample.
4. Study of physico-chemical (pH, color, turbidity, BOD, COD) parameters of any one industrial effluent sample
5. Estimation of chromium from Effluents (Demonstration)
6. Visit to ETP/ CETP

| Course | Title | Unit | Topics | Credit | No. of Lectures |
|-------------------|--------------------|---|--|--------|-----------------|
| Applied component | Agri-Biotechnology | I: Precision Agriculture and Agriculture systems | Introduction to Agriculture and Agriculture systems- 1 Lecture ; Green house Technology-- Types of green house, importance, functions and features of green house, Design criteria and calculation - 2 Lectures ; Construction material, covering material and its characteristics, growing media, green house irrigation system. nutrient management - 3 Lectures ; Greenhouse heating, cooling and shedding and ventilation system, Computer controlled environment - 3 Lectures ;; Phytotrons, fertigation and roof system - 1 Lecture ; Precision Cultivation- tools, sensors for information acquisition - 2 Lectures . | 2 | 12 |
| | | II: Plant stress biology | Abiotic stress –Physiological and molecular responses of plants to water stress, salinity stress, temperature stress – heat and cold, Photooxidative stress, stress perception and stress signaling pathways, Ionic and osmotic homeostasis, reactive oxygen species scavenging- 4 Lectures ; Biotic stress - plant interaction with bacterial, viral and fungal pathogens, plant responses to pathogen–biochemical and molecular basis of host-plant resistance , toxins of fungi and bacteria , systemic and induced resistance –pathogen derived resistance, signalling - 8 Lectures . | | 12 |
| | | III: Molecular Markers in Plant Breeding | Genetic markers in plant breeding-- Classical markers, DNA markers (RFLP, RAPD, AFLP, SSR, SNP)- 4 Lectures ; Application of Molecular Markers to Plant Breeding [quantitative trait locus (QTL) mapping] - 4 Lectures ; Plant DNA Barcoding- Barcoding Markers (matK, rbcL, ITS, tmH-psbA), steps, recent advances, Benefits, Limitations - 4 Lectures . | 12 | |

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|--|--|---|--|--|----|
| | | IV: Biofertilizers and Biopesticides | <p>Biofertilizer: Nitrogen-fixing Rhizobacteria - Symbiotic Nitrogen Fixers -2 Lectures; Nonsymbiotic Nitrogen Fixers Plant Growth Promoting Microorganisms-Phosphate-Solubilizing Microbes (PSM), Phytohormones and Cytokinins, Induced Systemic Resistance- 2 Lectures; Plant Growth Promotion by Fungi-- Mycorrhizae Arbuscular Mycorrhizae Ectomycorrhizae -2 Lectures; Microbial Inoculants -- Inocula, Carriers, and Applications, Monoculture and Co-culture Inoculant Formulations Biocontrol, Polymicrobial Inoculant Formulations-3 Lectures; Biopesticides – types, Bacillus thuringiensis, insect viruses and entomopathogenic fungi (characteristics, physiology, mechanism of action and application) -3 Lectures.</p> | | 12 |
|--|--|---|--|--|----|

References:

1. M. Ajmal Ali, G. Gyulai, F. Al-Hemaid -Plant DNA Barcoding and Phylogenetics, LAP Lambert Academic Publishing (2015)
2. P. Parvatha Reddy (auth.)-Sustainable Crop Protection under Protected Cultivation- Springer Singapore (2016)
3. S.B. Anderson (ed.), Plant Breeding from Laboratories to Fields, InTech,2013
4. Henry Leung, Subhas Chandra Mukhopadhyay (eds.) - Intelligent Environmental Sensing (2015, Springer International Publishing)
5. Travis R. Glare, Maria E. Moran-Diez - Microbial-Based Biopesticides_ Methods and Protocols (2016, Humana Press)
6. Altieri, Miguel A.Farrell, John G-Agroecology- The Science Of Sustainable Agriculture, Second Edition-CRC Press (2018)
7. Arie Altman, Paul Michael Hasegawa-Plant Biotechnology and Agriculture_ Prospects for the 21st Century-Academic Press (2011)

PRACTICALS

Applied component Agri-Biotechnology

USBT P 603-604

2 credits

48 hrs

1. RAPD analysis demonstration experiment.
2. Isolation of *Rhizobium*.
3. Isolation of *Azotobacter*.
4. Isolation of Phosphate solubilising bacteria.
5. Study of effect of abiotic stress on plants.
6. Rapid screening tests for abiotic stress tolerance (drought, - PEG, Mannitol & salinity NaCl).
7. Estimation of antioxidants and antioxidant enzymes – Ascorbic acid, Catalase, and Peroxidase.
8. Visit to green house facility and submission of field visit report.