
**Deccan Education Society's
FERGUSSON COLLEGE (AUTONOMOUS),
PUNE**

**Syllabus
for**

S. Y. B. Sc. (Biotechnology)

[Pattern 2019]

(B.Sc. Semester-III and Semester-IV)

From Academic Year

2020-21

Deccan Education Society's
Fergusson College (Autonomous), Pune
S.Y. B.Sc. Subject (Pattern 2019)
From academic year 2020-21

Particulars		Paper Code	Course Title	No. of Credits
S.Y. B.Sc. Semester III	Theory Paper - 1	BTH2301	Cell Biology -II	02
	Theory Paper - 2	BTH2302	Molecular Biology – I	02
	Theory Paper - 3	BTH2303	Metabolic Pathways	02
	Theory Paper - 4	BTH2304	Medical Microbiology	02
	Theory Paper - 5	BTH2305	Fundamentals of Genetics	02
	Theory Paper - 6	BTH2306	Plant Development	02
	Theory Paper - 7	BTH2307	English\German\French	02
	Practical Paper - 1	BTH2308	Biotechnology Practicals I	02
	Practical Paper - 2	BTH2309	Biotechnology Practicals II	02
	Practical Paper - 3	BTH2310	Biotechnology Practicals III	02
S.Y. B.Sc. Semester IV	Theory Paper - 8	BTH2401	Immunology	02
	Theory Paper - 9	BTH2402	Molecular Biology – II	02
	Theory Paper - 10	BTH2403	Protein Biochemistry and Enzymology	02
	Theory Paper - 11	BTH2404	Food and Dairy Microbiology	02
	Theory Paper -12	BTH2405	Environmental Biotechnology	02
	Theory Paper - 13	BTH2406	Animal Development	02
	Theory Paper - 14	BTH2407	Scientific Writing and Communication\German \French	02
	Practical Paper - 4	BTH2408	Biotechnology Practicals IV	02
	Practical Paper -5	BTH2409	Biotechnology Practicals V	02
	Practical Paper - 6	BTH2410	Biotechnology Practicals VI	02

S.Y. B.Sc. Semester III
Biotechnology Paper -1 (BTH 2301) Cell Biology-II

[Credits-2]

Course Outcomes

At the end of this course, students will be able to

- CO1** • Familiarize themselves with cellular transport and trafficking.
CO2 • Understand cell signaling and its role
CO3 • Have concept of cell death and cancer

Unit	Details	Lectures
I	Types and modes of membrane transport: Passive and active and secondary active transport, membrane potential. Channels and carriers. Exocytosis, endocytosis, pinocytosis and phagocytosis.	6
II	Cell signaling and communication: communication between cells and environment. Signaling at cell surface, signaling molecules, hormones and receptors signaling pathways, signal transduction and second messengers.	10
III	Protein trafficking and targeting- Biogenesis of membrane proteins in organelles, intracellular protein trafficking, vesicle transport. Diseases and disorders related to trafficking and targeting.	10
IV	Cell death: Programmed cell death and necrosis, molecular mechanism and apoptotic pathways. Autophagy. Regulation and control of apoptosis.	7
V	Neoplasia: Oncogenes and tumor suppressors. Types and properties of tumor cells.	3

Books:

1. Molecular Biology of the Cell, Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, 6th Edition (2015), Garland Science, USA
2. Molecular Cell Biology, Harvey Lodish, Arnold Berk, Chris A. Kaiser, Angelika Amon, Hidde Ploegh, Anthony Bretscher, Monty Krieger, Kelsey C. Martin, 8th Edition, (2012) W.H. Freeman and Co., USA
3. The Cell: A Molecular Approach, Geoffrey M. Cooper, Robert E. 6th edition (2013), Hausman, Sinauer Associates, Inc. USA
4. Becker's World of the Cell, Jeff Hardin, Gregory Bertoni, Lewis J. Kleinsmith, 8th Edition (2016), Pearson Education Limited, USA
5. Karp's Cell and Molecular Biology: Concepts and Experiments, Gerald Karp, Janet Iwasa, Wallace Marshall, 6th edition, (2010) John Wiley & Sons., USA

S.Y. B.Sc. Semester III
Biotechnology Paper - 2 (BTH 2302) Molecular Biology-I

[Credits-2]

Course Outcomes

At the end of this course, students will be able to

- CO1** • Know how different genomes are packaged and organized
CO2 • Understand molecular biology processes like replication its regulation
CO3 • Have concept of DNA alterations by mutations and recombination

Unit	Details	Lectures
I	Nucleic acids - structure, properties and function: Structure of DNA - Watson & Crick model, A, B & Z forms Structure of RNA: tRNA, rRNA, mRNA, non-coding RNAs	6
II	Genome Structure and Organization Organization of viral, prokaryotic and eukaryotic genomes Structure of chromatin, nucleosomes, higher order organization- chromosome, centromere, telomere Repetitive DNA elements	6
III	DNA Replication and Regulation DNA polymerases in prokaryotes and eukaryotes Mechanism of DNA replication and regulation in prokaryotes and eukaryotes	12
IV	DNA damage and Repair Types of DNA damage: radiation, chemical, oxidative, intercalating agents DNA repair mechanisms- nucleotide excision repair, base excision repair, mismatch repair	7
V	Recombination Homologous and site-specific recombination, Proteins involved in recombination- RecA, RuvA, B, C	5

Books:

1. Genes XI, 11th edition (2012), Benjamin Lewin, Publisher - Jones and Barlett Inc. USA
2. Molecular Biology of the Gene, 6th Edition (2008), James D. Watson, Tania Baker,
3. Stephen P. Bell, Alexander Gann, Michael Levine, Richard Lodwick. Pearson Education,
4. Inc. and Dorling Kindersley Publishing, Inc. USA
5. Molecular Biology, 5th Edition (2011), Weaver R., McGrew Hill Science. USA
6. Fundamentals of Molecular Biology, (2009), Pal J.K. and Saroj Ghaskadbi, Oxford University Press. India
7. Molecular Biology: genes to proteins, 4th edition (2011), Burton E Tropp, Jones & Bartlett Learning, USA

S.Y. B.Sc. Semester III
Biotechnology Paper - 3 (BTH 2303) Metabolic Pathways

[Credits-2]

Course Outcomes

At the end of this course, students will be able to

- CO1** • Understand basic aspects of metabolism
CO2 • Understand metabolism of carbohydrates, lipids, proteins, regulation of metabolism

Unit	Details	Lectures
I	Introduction to metabolism: <ul style="list-style-type: none"> Metabolic pathways: Metabolites, Catabolism, Anabolism, Principal characteristics of metabolic pathways. 	2
II	Carbohydrate and energy metabolism: <ul style="list-style-type: none"> Intracellular metabolism of glucose - Glycolysis, fates of pyruvate, Gluconeogenesis, TCA cycle, Glycogenesis, Glycogenolysis, Pentose Phosphate Pathway, Regulation of Glycolysis, TCA cycle and Glycogen metabolism. Oxidative phosphorylation and Electron Transport Chain: Sequence of electron carriers, Oxidative Phosphorylation, ATP synthesis 	16
III	Non-carbohydrate metabolism <ul style="list-style-type: none"> Lipid metabolism: Triglycerides, Transport of fatty acid into mitochondria, β-oxidation of fatty acids, reactions and energetic of beta oxidation, Biosynthesis of fatty acid, Overview of biosynthesis of Phospho-lipids and Cholesterol, Metabolism of ketone bodies Protein metabolism: General reactions of amino acid metabolism (Oxidative deamination, Transamination, Decarboxylation), Glucogenic and ketogenic amino acids, Urea cycle 	18

Books:

1. Outlines of Biochemistry, Erice Conn and Paul Stumpf, 5th edi, 2009, Wiley and Sons, USA.
2. Biochemistry, Donald Voet and Judith Voet, 4th edi, 2012, John Wiley and Sons, Inc. USA Biochemistry, Jeremy Berg, LubertStryer, 7th edi. 2006, W.H. Freeman and company, NY
3. Principles of Biochemistry, Albert Lehninger, David Nelson and Michael Cox, 5th edi., 2008, W.H. Freeman and company, NY.
4. Harper's illustrated biochemistry, Victor Rodwell, David Bender, Kathleen Botham, Peter Kennelly, P Weil, 30th edi., 2015, McGraw Hills Publications.

S.Y. B.Sc. Semester III
Biotechnology Paper - 4 (BTH 2304) Medical Microbiology

[Credits-2]

Course Outcomes

At the end of this course, students will be able to

- CO1** • Understand host–parasite interactions by in-depth study of pathogenesis of various microbial parasites
- CO2** • Know about infectious agents colonizing various organs and systems in human body.
- CO3** • Know clinical features and diagnosis of each of the mentioned infections

Unit	Details	Lectures
I	<p>BASICS IN MEDICAL MICROBIOLOGY</p> <p>1. Types of Infectious Diseases -Common Terminologies used in Medical Microbiology -Reservoirs of Infection -Sites of entry, exit and transmission, types of transmission between humans, transmission from animals. -Concepts of normal flora -Concepts of Microbiome -Epidemiology types</p> <p>2. Pathogenesis of Bacterial Diseases -Reservoirs of Bacterial pathogens -Mechanisms of bacterial invasion growth and multiplication of pathogens -Bacterial virulence factors - Bacterial toxins</p> <p>3. Pathogenesis of Viral Diseases -Routes of entry -Viral spread -Significance of Incubation Period -Viriods and Prions – Significance in Medical Microbiology</p> <p>4. Pathogenesis of protozoan diseases</p> <p>5. Pathogenesis of fungal diseases</p>	<p>9</p> <p>9</p> <p>6</p>
II	<p>DETAILED STUDYHOST PARASITE INTERACTIONS Detailed Study of following infections including Etiology, Transmission, Pathogenesis, Laboratory diagnosis.</p> <p>1. Respiratory tract infections: -Diphtheria -Influenza virus infection</p> <p>2. Central nervous system infections: -Tetanus -Polio</p> <p>3. Gastrointestinal tract infections: -Diarrheal diseases caused by bacteria or viral infection</p>	<p>10</p>

	<p>-Entamoeba</p> <p>4. Vector borne infections:</p> <p>-Dengue</p> <p>-Filariasis</p> <p>5. Multi system zoonosis:</p> <p>-Anthrax</p> <p>-Plague</p> <p>6. Infections of skin and soft tissue:</p> <p>-Fungal infections of skin</p> <p>-Bacterial infections of the skin</p> <p>7. Urinary tract infections:</p> <p>-Candida</p>	
III	<p>APPLIED MICROBIOLOGY (Tie up with hospitals and development of Questionnaire)</p> <p>a. Activity (survey / case study etc.) related to the following:</p> <p>b. Noscomial infections</p> <p>c. Pyrexia of unknown origin</p> <p>d. Emerging and reemerging diseases</p>	2

Books:

1. Emerging Infections, Scheld WM, Armstrong D and Hughes JM, Editors. ASM Press, Washington, DC. 1998. ISBN 1-55581-123-3.
2. Emerging Infections, Scheld WM, Craig WA and Hughes JM, Editors. ASM Press, Washington, DC. 1998. ISBN 1-55581-141-8.
3. Pathology of Emerging Infections. Horsburgh, CR Jr and Nelson AM, Editors. ASM Press, Washington, DC. 1997. ISBN 1-55581-20-5.
4. Pathology of Emerging Infections 2. Nelson AM and Horsburgh, CR Jr, Editors. ASM Press, Washington, DC. 1998. ISBN 1-55581-140-X.
5. Emerging Viruses. Morse SS, Editor. Oxford University Press, New York. 1993. ISBN 0-19-510484-
6. "Microbiology, An Introduction ", Tortora, Funk and Case:"; 6th edn. Benjamin / Cummings Publishing company, California (1998)
7. "Schaechter's Mechanisms of Microbial Disease" by N. Cary Engleberg, Terry Dermody, and Victor DiRita. 4th Edition.
8. Color Atlas and textbook of Diagnostic Microbiology 5th edn Koneman, Elrner W. Allen, Stephen D., Janda, William M. Schreckenberge, Paul C.: Lippincott-Raven Publishers, Philadelphia (1997).
9. Text book of Microbiology, 5th edition, Ananthnarayana, R. and C.E, Jayaram Panikar, 1996, Orient Longman.

S.Y. B.Sc. Semester III**Biotechnology Paper - 5 (BTH 2305) Fundamentals of Genetics****[Credits-2]****Course Outcomes**

At the end of this course, students will be able to

- CO1** • Have concept and importance of genetics
CO2 • Learn various chromosomal aberrations
CO3 • Understand genetic linkage and linkage analysis

Unit	Details	Lectures
I	Genetic basis of Inheritance- Variations, Heredity, Pre - Mendelian concept, Importance of Genetics	2
II	Mendelian Genetics: Laws of Inheritance, Monohybrid and Dihybrid Ratio, Back cross and Test cross.	5
III	Post-Mendelian Discoveries- Incomplete Dominance, Codominance, Dominant and Recessive Epistasis, Complementary genes, Supplementary genes, Pleiotropy, Multiple alleles, Lethal genes.	9
IV	Chromosomal aberrations- Variations in chromosome structure and chromosome number; mechanism and causes of aberrations with examples. X-chromosome inactivation, dosage compensation and Barr bodies	8
V	Linkage and Linkage maps- Concept, Complete and Incomplete linkage, Three point cross, Genetic mapping, Recombination, recombination maps in diploids for 2 point and 3 point test cross, determination of gene order with suitable examples, chromosome interference, Sex linked Inheritance (X linked and Y linked), sex- influenced and Sex-limited genes, Significance of Linkage.	12

Books:

1. Concepts of Genetics (2019) Klug, Cummings, Spencer, Palladino and Killian 12th edition (Pearson Education, UK)
2. Principles of Genetics (2006) Gardner, Simmons, Snustad (Wiley, India) 8th edition
3. Genetics: A Conceptual Approach (2017) Pierce (W H Freeman & Co, New York) sixth edition
4. Genetics (2015) Strickberger 3rd edition (Pearson Education, UK) (Pearson Education, India)
5. Introduction to Genetics: a Molecular approach (2011) Brown 1st edition (Garland Science, New York)
6. Molecular genetics of bacteria (2014) Snyder, Peters, Henkin and Champness 4th edition (ASM Press, USA)
7. Introduction to Genetic Analysis (2015) Griffith, Wessler, Carroll and Doebley 11th edition (W H Freeman & Co, New York)

Biotechnology Paper -5 (BTH 2306) Plant Development

[Credits-2]

Course Outcomes

At the end of this course, students will be able to

- CO1** • Identify and understand different stages of plant growth and development.
- CO2** • Know indepth about development of root, shoot and leaf.
- CO3** • Understand flower patterning, induction of flowering in response to stimulus.
- CO4** • Understand molecular basis of plant development: at genetic, hormonal and signaling mediated level.

Unit	Details	Lectures
I	Plant Development Unique features of plant development	1
II	Concept of competence, determination, commitment, differentiation, de-differentiation and re-differentiation (partial/ terminal) in vivo and in vitro with one example each	2
III	Plant development at: Cellular, organ and whole-plant levels Concept of plant growth regulators Biosynthesis, Bioassay and mode of action of Auxin, Gibberellic acid, Cytokinin, Ethylene and abscisic acid, Hormonal regulation of gene expression- PGRs	6
IV	Major phases of plant development using Arabidopsis as model system Vegetative development: Zygote to seed embryo to seedling till vegetative maturity, Embryogenic mutants Pattern formation in plants- vegetative; axial and radial patterning, Genes in radial, axial development	6
V	Reproductive development: Shift from vegetative to reproductive phase Induction- perception of inductive stimuli and subsequent changes, Pattern formation in plants- flowering; inflorescence meristem, floral whorls specification, whorl boundary specification, ABC model for Flower development	6
VI	Microsporogenesis, development of male gametophyte and male gamete Megasprogenesis, development of female gametophyte and female gamete; Double fertilization and triple fusion . Development of endosperm	5
VII	Fucus as model system to understand plant development	2
VIII	Programmed Cell Death- ageing and senescence	2
IX	Signal transduction in plants governing growth and development	3
X	Light mediated regulation, photoreceptors and circadian rhythm	3

Books:

1. Principles of Development, Wolpert L and Tickle C, 4th edition (2010), Oxford University Press.
2. Embryology of Angiosperms, Bhojwani S.S. and Bhatnagar S.P.(2009) –Vikas Publishing House, New Delhi

3. An Introduction to Plant Cell Development, Burgess J. (1985), Cambridge University Press, UK
4. Plant physiology , Taiz L , and Zeiger E (2010) Sinauer Associates, USA.
5. Plant embryology: Classical and experimental , Sharma HP (2009) (alpha sci)
6. Patterns in plant development. Steeves TA & Sussex IM (2004). Cambridge University Press, Cambridge.

Biotechnology Paper -7 (BTH 2307) English grammar and communication
[Credits-2]

Course Outcomes

At the end of this course, students will be able to

- CO1** • familiarize themselves with various aspects of English language and literature
CO2 • Have correct use of language for effective communication.
CO3 • Develop their English Communication skills- Written and Oral.

Unit	Details	Lectures
I	Comprehension Skill: -The Eyes Have It by Ruskin Bond -The Luncheon by Somerset Maugham	4
II	The Noun: Kinds, Gender, Number, Case The Adjective: Kinds, comparison, adjectives used as nouns, position of the adjectives, correct use of some adjectives Articles and Pronouns : correct use Verb : Transitive and intransitive Adverb: comparison, correct position of adverbs	4
III	Active and passive voice, voice in all tenses Tense: Types and uses	2
IV	Preposition and conjunction: types, use in different sentences Clauses: Adverb, Adjective, Noun	2
V	Sentences: Types, simple, compound, complex Figures of speech: all types, correct use Activity based on using correct language	3
VI	Making oral presentation : Pronunciation, accent, intonation, clarity, speed, fluency, eye contact; Planning and organization	4
VII	Effective written presentation: order of sentences in a paragraph, sentence connection, cohesion and coherence; contradiction, tautology, semantic anomaly, circumlocution	4
VIII	Enrichment of vocabulary: word forms and derivations, prefixes and suffixes, other processes of word formation, scientific and technical vocabulary, spellings, frequently confused words.	3
IX	Difficult words, typical words and sentences, formats used for effective communication	2
X	Using the dictionary and thesaurus The curriculum vitae: its importance, difference between Bio data, résumé and CV	3
XI	Letter writing: formal and informal letters. Report writing ,Essay writing, News writing , Email Writing, Memo and Circular Writing	5

Books:

1. English grammar and composition by Wren and Martin
2. Scientists Must Write. 2nd Edition, (2002), Barrass, R., Routledge, Oxon, UK
3. How to Write and Publish a Scientific Paper. 6th Edition, (2006), Day, R.A. and B. A.
4. Gastgel, Greenwood Press, Westport, CT, USA.
5. Medical Writing: A prescription for clarity. 3rd Edition, (2006), Goodman, N.W. and
6. M.B. Edwards, Cambridge University Press, Cambridge, UK.
7. Planning, Proposing and Presenting Science Effectively, 2nd Edition, (2006), Hailman,
8. J.P. and K. B. Strier, Cambridge University Press, Cambridge, UK.
9. Biomeasurement: Understanding, Analysing and Communicating Data in Biosciences,(2005), Hawkins, D., Oxford University Press, Oxford, UK.
10. The Best of Ruskin Bond, Bond, Ruskin, (2016)
11. Complete Short Stories of W. Somerset Maugham, Maugham, Somerset William, (1954)
12. Basic Communication Skills , Sasikumar, V., P. KiranmalDutt and Geetha Rajeevan (2007),

S.Y. B.Sc. Semester III
Subject Biotechnology Paper -1 (BTH 2308Biotechnology Practical- I

Exercises in Cell Biology II and Medical Microbiology

[Credits-2]

Course Outcomes

At the end of this course, students will be able to

- CO1** • Understand normal flora of humans
CO2 • Understand growth pattern of organisms from samples.
CO3 • Know about different cell cycle phases

Sr. No	List of Practicals	Practical (15Px2H)
1	Study of Normal flora of humans (Skin and oral cavity)	2
2	Enrichment and colony characteristics of samples -pus, urine	3
3	Identification of Candida species using the germ tube test and growth on Crome Candida differential agar	1
4	Electron Micrographs of any 2 pathogenic viruses/ virioids/ prions	1
5.	Isolation and study of types of Plastids (chloroplast /leucoplast/chromoplast)	1
6.	Light microscopy and EM, and their resolution with respect to organelle structure , Study of cell junctions	1
7.	Isolation of nuclei from goat liver by differential centrifugation, staining and counting of nuclei by haemocytometer.	3
8.	Isolation of mitochondria from goat liver by differential Centrifugation and mitochondrial succinate dehydrogenase assay	3

S.Y. B.Sc. Semester III
Subject Biotechnology Paper -2 (BTH 2309) Biotechnology Practical- II

Exercises in Molecular Biology and Metabolic Pathways

[Credits-2]

Course Outcomes

At the end of this course, students will be able to

- CO1** • Understand Basic techniques in isolation and handling of DNA and proteins, their quantification.
- CO2** • Know and apply tests to detect abnormalities in metabolism

Sr. No.	List of Practicals	Practical (15Px2H)
1.	Reagent preparation: Calculation of Molarity, Normality, Ionic	1
2.	Bacterial DNA isolation and Agarose gel electrophoresis	3
3.	Eukaryotic DNA isolation and Agarose gel electrophoresis	3
4.	4a. SDS-PAGE separation of proteins and staining and destaining of protein gels. 4b. Quantification of proteins by UV-Spectroscopy	4
5.	Cholesterol estimation from clinical sample	2
6.	Liver function tests	2

S.Y. B.Sc. Semester III
Subject Biotechnology Paper -3 (BTH 2310) Biotechnology Practical- III

Exercises in Plant Development and Genetics

[Credits-2]

Course Outcomes

At the end of this course, students will be able to

- Understand developmental stage of plant embryo.
- Identify meiotic stages during microsporogenesis.
- Do Karyotype Analysis
- Study Barr body

Sr. No.	List of Practicals	Practical (15Px2H)
1	Methods of studying plant development	1
2	Study of apical meristems and florally induced meristems	2
3	Study of microsporogenesis and development of male gametophyte	2
4	Developmental stages during plant embryogenesis.	1
5	Dissection of seeds and excision of young and mature embryo.	2
6	Karyotype Analysis, and genetics problem solving	2
7	Pedigree analysis, study of genetic traits in humans	2
8	Visualization of Barr body	3

S.Y. B.Sc. Semester IV**Biotechnology Paper -8 (BTH 2401) Immunology**

[Credits-2]

Course Outcomes

At the end of this course, students will be able to

- CO1** • Understand cellular and molecular basis of immune responsiveness.
CO2 • Understand antigen antibody reaction
CO3 • Understand the importance of vaccines.

Unit	Details	Lectures
I	Overview of the immune system: <ul style="list-style-type: none"> • Introduction to Immune system. Overview of immune system primary and secondary organs and tissues. 	5
II	Innate immunity: <ul style="list-style-type: none"> • Understanding the physical and chemical barriers, • Cells of the innate immune system. • Process of inflammation. 	5
III	Adaptive immunity: <ul style="list-style-type: none"> • Structure and function of MHC molecules. • Antigen presentation and processing. • Cells of the adaptive immune system. • TCR structure and BCR structure • Functions of immunoglobulins • Humoral and Cellular Immune responses. 	8
IV	Complement system: <ul style="list-style-type: none"> • Three pathways of complement activation. 	4
V	Autoimmunity: <ul style="list-style-type: none"> • Autoimmune diseases • Molecular mimicry • Autoimmune therapy. 	4
VI	Antigen- Antibody Reactions <ul style="list-style-type: none"> • Precipitation reaction (Immunodiffusion/Immuno electrophoresis) • Agglutination reaction (Haemagglutination or Blood typing) • ELISA, Western Blot , Immunofluorescence 	6
VII	Vaccines <ul style="list-style-type: none"> • Active and Passive Immunization • Types of Vaccines 	4
	Seminars/ group discussion/journal club for various current and relevant topics.	

Books:

1. Kuby Immunology, Judy Owen , Jenni Punt , Sharon Stranford., 7th edition 2012, Freeman and Co., NY

2. Cellular and Molecular Immunology, Abul Abbas, Andrew H. Lichtman, Shiv Pillai 9th Edition 2017 Elsevier.
3. Janeway's Immunobiology, Kenneth M. Murphy, Casey Weaver 8th Edition 2011 W. W. Norton & Company
4. Immunology, David Male, Jonathan Brostoff, David Roth Mosby, 7th edition 2006, USA.
5. Roitt and Roitt's Essential Immunology 2011, 12th edition, Wiley and Black Well.
6. The Elements of Immunology, F.H. Khan 2009, Pearson Education.
7. Textbook of Basic and Clinical Immunology, Sudha Gangal and Shubhangi Sontakke, 1st edition 2013, University Press, India.

S.Y. B.Sc. Semester IV**Biotechnology Paper -9 (BTH 2402) Molecular Biology II****[Credits-2]****Course Outcomes**

At the end of this course, students will be able to

- CO1** • Understand structural organization of DNA in prokaryotes and eukaryotes
- CO2** • Understand the concept of operon
- CO3** • Have concept of various molecular biology processes like transcription, translation and its regulation

Unit	Details	Lectures
I	Structural features of coding and non-coding DNA: Definition of gene – introns/exons, Regulatory sequences, promoters, enhancers and silencers, insulators and boundary elements Operons (Lac/Trp/Ara), Gene families, clusters, super-families, Organelle genomes	12
II	Transcription and its Regulation: RNA polymerases Mechanisms of transcription in prokaryotes and eukaryotes and its regulation	12
III	Genetic Code & Translation Mechanism Concept of codon, reading frame, frame shift mutations, degeneracy of codon Translation in Prokaryotes & Eukaryotes Inhibitors of translation	12

Books:

1. Genes XI, 11th edition (2012), Benjamin Lewin, Publisher - Jones and Barlett Inc. USA
2. Molecular Biology of the Gene, 6th Edition (2008), James D. Watson, Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Lodwick. Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. USA
3. Molecular Biology, 5th Edition (2011), Weaver R., McGraw Hill Science. USA
4. Fundamentals of Molecular Biology, (2009), Pal J.K. and Saroj Ghaskadbi, Oxford University Press. India
5. Molecular Biology: genes to proteins, 4th edition (2011), Burton E Tropp, Jones & Bartlett Learning, USA

S.Y. B.Sc. Semester IV

Biotechnology Paper-10 (BTH 2403) Protein Biochemistry and Enzymology

[Credits-2]

Course Outcomes

At the end of this course, students will be able to

- CO1** • Know basic principles of enzymology.
CO2 • Understand how enzymes work in biological systems
CO3 • Understand how enzymes are purified and characterized.

Unit	Details	Lectures
I	Catalytic strategies: Introduction to protein structure and function. Specificity of enzyme action, hypothesis (lock and key, induced fit), Basic catalytic principles: Covalent catalysis, Acid-base catalysis, Metal ion catalysis, catalysis through Proximity and Orientation effects. Mechanism of action of Lysozyme and Serine protease	15
II	Enzyme kinetics: Enzyme nomenclature, enzyme co-factors, Rapid equilibrium model, Steady state model, Factors affecting enzyme catalyzed reaction: concentration, temperature, pH, time and cofactors, Quantitative assay of enzyme activity: Unit of enzyme activity, specific activity, turnover number, Kinetics of single-substrate enzyme reactions; Significance of K_{cat} and K_m , Other linear transformations of enzyme kinetic data, Inhibition of enzyme catalyzed reaction: reversible and irreversible inhibition, linear-mixed type inhibitions and their kinetics.	7
III	Enzyme regulation: Allosterism, Feedback inhibition and feed forward stimulation. Reversible (phosphorylase) and irreversible (proteases) covalent modifications of enzymes	6
IV	Methods of enzyme purification and characterization : salting in, salting out, dialysis, solvent fractionation, ultrafiltration, ultracentrifugation, ion exchange chromatography, molecular exclusion chromatography, affinity chromatography	8

Books:

- Fundamentals of Enzymology, Nicholas C. Price and Lewis Stevens, 3rd ed., 1999, Oxford University Press.
- Principles of Biochemistry, Albert Lehninger, David Nelson and Michael Cox, 5th ed., 2008 W.H. Freeman and company, NY.
- Biochemistry, Jeremy Berg, Lubert Stryer, 7th ed., 2006, W.H. Freeman and company, NY
- Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, Trevor Palmer, Philip Bonner, 2nd ed., 2014, Woodhead Publishing Ltd.

5. Biochemistry, Donald Voet and Judith Voet, 4thed., 2012, John Wiley and Sons, Inc. USA
6. Biochemical calculations, Irwin Segel, 2nd ed., 2010, Wiley publications, USA
7. An Introduction to practical Biochemistry, David Plummer, 3rd ed., 2004, Tata McGrawHill Publishers Co. Ltd.,New Delhi.

S.Y. B.Sc. Semester IV

Biotechnology Paper -11 (BTH 2404) Food and Dairy Microbiology

[Credits-2]

Course Outcomes

At the end of this course, students will be able to

- CO1** • Know about food Safety & its scope in Quality Control of Foods
CO2 • Know principles & methods involved in food & dairy fermentation
CO3 • Know in depth about preservation as an important field for a microbiologist

Unit	Details	Lectures
FOOD MICROBIOLOGY		
I	Classification of food based on shelf life • Perishable, Semi-perishable & stable	1
II	Factors influencing microbial growth in food • Intrinsic • Extrinsic	2
III	Spoilage of different groups of food: • Meat and poultry • Fruits and Vegetables • Canned /Packed food	2
IV	Food Preservation: • General principles of food preservation • Concepts of TDT, TDP,D , Z & F value & its significance Methods of Food Preservation: • Use of Chemicals & Antibiotics (Added and Developed Preservatives) • Radiations • Low and High Temperature • Canning (Process in detail) • New and Emerging Non Thermal techniques in Food Preservation	5
V	Microbial Foodborne diseases: Food poisoning by: • <i>Clostridium botulinum</i> • <i>Aspergillus flavus</i> Food infection by : • <i>Salmonella typhi</i>	3
VI	Methods for detection of microbes and their products • Conventional Microbiological Methods • Microbial enumeration in food • Qualitative Methods for detection of microbes and their toxins in food • Rapid and new Techniques : PCR , Lux Gene Luminescence etc.	3
VII	Microbiology of fermented foods • Definition and Types and role of starter starter culture and other microorganisms • Oriental and Western fermented food • Examples : Idli , Soy Sauce ,Temphe	2

VIII	Food Regulation: <ul style="list-style-type: none"> • HACCP (Hazard Analysis and Critical Control Points) • Food Regulatory bodies 	1
IX	Activity based on current trends in food industry	1

DAIRY MICROBIOLOGY

X	Dairy Industry in India: Scope and opportunities for dairy Industry, Composition, nutritive value and Physico-Chemical properties of dairy products.	1
XI	Microbiology of milk: <ul style="list-style-type: none"> • Common micro-organisms found in milk • Sources of contamination of milk • Fermentation and spoilage of milk • Flavour and Colour defects, Sweet curdling, and Stormy fermentation, Ropiness • Milk borne diseases 	5
XII	Preservation of Milk by Pasteurization & its storage: <ul style="list-style-type: none"> • Methods of Pasteurization – LTH, HTST, UHT • Storage specifications after pasteurization • Membrane Technology for Milk and Milk Products 	2
XIII	Microbial analysis of milk: <ul style="list-style-type: none"> • Total bacterial count. (direct and indirect methods) • Brucella ring test and tests for mastitis. 	4
XIV	Fermented Dairy Products: <ul style="list-style-type: none"> • Types (Yogurt, Kefir ,different types of Cheeses) • Role Starter cultures and other organisms • Probiotic dairy products and their health benefits • New concepts in Dairy Products. 	3
XV	Milk and Milk Product Standards and Legislations in India.	1

Books:

1. Food Microbiology, Frazier & Westhoff, 4th edition, Tata McGraw Hill Publications
2. Modern Food Microbiology, James Jay, 7th edition, Springer Publications
3. Food Microbiology by Adams & Moss, 3rd edition, The Royal Society of Chemistry
4. Advances in Biotechnology, S. N. Jogdand, Himalaya Publishing House
5. Milk & Milk Products, C. Eckles, 4th edition, Tata McGraw Hill Publications
6. Prescott, S.C. and Dunn, C. G., (1983) Industrial Microbiology, Reed G. AVI tech books.

	Development/ Establishment of Biodegradation Pits, Phytoremediation Plots,	
III	International Environmental Laws, Environmental laws and Movements in India, National policy on EIA(Environment Impact Assessment)	5

Reference Books:

1. Ecology and environmental biology (2011) Saha T K Books & Allied (p) Ltd, Kolkata
2. An Introduction to Geographic Information Technology (2009) Suchandra Choudhury I K International Pvt. Ltd., New Delhi.
3. Ecology and environment (2005) Sharma PD Rastogi Publication, New Delhi
4. Ecology science and practice (2001) Faurieet al Oxford & IBH Publ. Co. Pvt. Ltd, New Delhi
5. Ecology: Principles and Applications (1998) J. L. Chapman, M. J. Reiss Cambridge
6. Environment Problems & Solutions (2001) Asthana&Asthana S. Chand Limited, New Delhi
7. Environmental Biology (2000) Varma & Agarwal S. Chand Limited, New Delhi
8. Environmental biology and toxicology (2011) Sharma PD Rajpaland Sons Publishing, Delhi
9. Environmental biotechnology (2010) RanaRastogi Publications, New Delhi
pollution and health hazard in India (1987) Ram Kumar Ashish Pub. House, New Delhi
10. Environmental risks and hazards (1994) Susan Cutter Prentice Hall, Inc., New Jersey
11. Environmental Science (2010) G. TyMiller, Jr., Scott Spoolman Brooks and Coel, Cengage Brain learning, USA
12. Environmental Science (2011) Santra S.C. New Central Book Agency, Kolkata
13. Fundamentals of Ecology (2005) Eugene Pleasants Odum, Gary W. Barrett Brooks and Coel, USA
14. Fundamentals of Ecology (2009) Dash 3 edition, Tata McGraw-Hill Education, NewDelhi
15. Introduction to Environmental Biotechnology (2007) Chattergy PHI Learning Pvt. Ltd, Delhi
16. Textbook of environmental studies for undergraduate courses (2005) Erach Bahrucha Universities Press, Hyderabad
17. The Microbiology of Activated Sludge (2010) R. J. Seviour IWA publication, UK
18. Principles of microbiology (1997) Ronald M. AtlasWm. C. Brown Publishers, Science

S.Y. B.Sc. Semester IV**Biotechnology Paper -13 (BTH 2406) Animal Development****[Credits-2]****Course Outcomes**

At the end of this course, students will be able to

- CO1**
- Have a concept of early development, preprogrammed events and various molecular and cellular events responsible for success in animal development.

Unit	Details	Lectures
I	Gametogenesis: Oogenesis; Continuous and Discontinuous with examples Spermatogenesis: Meiosis and Spermiogenesis Structure of mature gametes	4
II	Fertilization: Sperm Hyperactivation, Egg Metabolic Activation, Early and Late Responses, Cytoplasmic Rearrangement	5
III	Cleavage patterns and importance: Correlation with amount of yolk	3
IV	Blastula and fate maps; Morphogenetic Movements, Comparative account of Gastrulation in Amphioxus, Frog and Chick	6
V	Formation of body plan using Drosophila as a model system	5
VI	Concept of Cell Lineage, Cell potency, determination commitment and differentiation	4
VII	Induction; Different experiments to prove inductive interactions, Neurulation, Optic Induction and overview of Organogenesis	4
VIII	Post embryonic Development: Metamorphosis (Frog and Drosophila), Regeneration (Hydra and Salamander model systems), Aging and Death	5

Books:

1. Developmental Biology (VIII edition) S. F. Gilbert.
2. Principles of Development (III edition) Lewis Wolpert
3. An Introduction to Embryology (V edition). B. I. Balinsky.
4. Developmental Biology: R. M. Twyman. Bios Scientific Publishers LTD. New Delhi (2001)

S.Y. B.Sc. Semester IV**Biotechnology Paper -14 (BTH 2407) Scientific Writing and Communication****[Credits-2]****Course Outcomes**

At the end of this course, students will be able to

- CO1** • Use correct way of scientific communication.
- CO2** • Know and understand errors in scientific writing and communication.
- CO3** • Will be acquainted with research methodologies, research paper reading and presentation.

Unit	Details	Lectures
I	Scientific method: Concept, hypothesis, theory, law; Design of experiment; Inductive and deductive reasoning	3
II	Types of presentation: Oral, poster, written, audio-visual. Aids for presentation	3
III	Preparing the manuscript. Guidelines for authors. The IMRAD format.	2
IV	Title, byline; Abstract and Summary; Keywords.	2
V	Introduction: Defining the problem; Literature survey; Justification of study.	2
VI	Materials and Methods: Contents, sources, procedures, techniques, reproducibility, Units of measurements, metric system and SI units. Basic statistical techniques, confidence limits, tests, probability, significance.	3
VII	Results: Text; How to present data; Tables and illustrations. Writing captions, labels and legends.	3
VIII	Discussion: Components and sequence. Analysis, comparison and integration of data. Likely sources of errors in Results; Conclusions and significance. Implications for further study.	3
IX	Acknowledgements. Literature citation systems. Sources of references: Journals, books, bibliographies, abstracting journals; Databases.	3
X	Preparing and submitting the manuscript. Revising, editing, proofreading.	3
XI	Different modes of scientific communication Details of – Proposal writing, Research paper writing, Thesis writing	3

XII	Ethics in scientific communication Concept of IPR, patent submissions	3
XIII	Research paper reading	3

Books:

1. Medical Writing: A prescription for clarity. 3rd Edition, (2006), Goodman, N.W. and M.B. Edwards, Cambridge University Press, Cambridge, UK.
2. Scientists Must Write. 2nd Edition, (2002), Barrass, R., Routledge, Oxon, UK
3. How to Write and Publish a Scientific Paper. 6th Edition, (2006), Day, R.A. and B. A. Gastgel, Greenwood Press, Westport, CT, USA.
4. Planning, Proposing and Presenting Science Effectively, 2nd Edition, (2006), Hailman, J.P. and K. B. Strier, Cambridge University Press, Cambridge, UK.
5. Biomeasurement: Understanding, Analysing and Communicating Data in Biosciences, (2005), Hawkins, D., Oxford University Press, Oxford, UK.
6. AMA Manual of Styles. A Guide for Authors and Editors, 10th Edition, (2007), JAMA and Archives Journals, Oxford University Press, New York.
7. Successful Scientific Writing: A step-by- step guide for the biological and medical sciences, 3rd Edition, (2008), Mathews, J.R. and R.W. Mathews, Cambridge University Press, Cambridge, UK
8. Writing Papers in the Biological Sciences. 4th Edition, (2004),McMillan, V.E., Bedford Books/St Martins.
9. A Short Guide to Writing About Biology. 6th Edition, (2006), Pechenik, J.A., Longman, New York.
10. A Manual for Writers of Research Papers, Theses and Dissertations. 7th Edition , (2007), Turabian K.L., W.C. Booth, G.G. Colomb, J.M. Williams and University of Chicago Press Staff, University of Chicago Press, Chicago, IL, USA.

S.Y. B.Sc. Semester IV**Biotechnology Paper -4 (BTH 2408) Biotechnology Practicals IV
Exercises in Immunology and Food & Dairy Microbiology****[Credits-2]****Course Outcomes**

At the end of this course, students will be able to

- CO1** • Isolate and identify organism from spoiled food and starter organism.
- CO2** • Obtain knowledge on different methods by which one can grade the quality of milk and also comment on its efficiency.
- CO3** Practically apply antigen antibody reactions
- CO4** • Observe and understand cells of the immune system

Sr. No.	List of Practicals	Practical (15Px2H)
1.	Isolation and identification (Genus level) of spoilage causing microorganisms from spoiled foods	1
2.	To determine TDT, TDP and D values	3
3.	Determination of efficiency of Pasteurization by quantitative phosphatase test. Grading of raw milk (Dye reduction test)	1.5
4.	Isolation and identification of starter organisms from Idli batter/ Dahi	2
5.	Ouchterlony Double Diffusion/Dot ELISA	1.5
6.	Radial Immunodiffusion	2
7.	Study of immune cells from blood smear	2
8.	Blood agglutination.	2

S.Y. B.Sc. Semester IV**Biotechnology Paper -5 (BTH 2409) Biotechnology Practicals V
Exercises in Molecular Biology, Protein Biochemistry and Enzymology [Credits-2]****Course Outcomes**

At the end of this course, students will be able to

- CO1** • Obtain knowledge on various methods of protein extraction, separation and estimation.
- CO2** • Understand efficiency of various cell lysis methods.
- CO3** • Understand and perform enzyme assays

Sr. No.	List of Practicals	Practical (15Px2H)
1	UV-Visible Absorption spectra and quantification of DNA, RNA and proteins. Choosing the correct wavelength for a molecule; structural basis for obtaining emission.	3
2	Effect of mutations on DNA: growth of auxotrophs on minimal medium/Effect of UV/EtBr on growth	3
3	Native-PAGE separation of proteins and activity staining of protein gels.	4
4	Effect of various cell lysis methods on protein extraction efficiency a. Sonication b. Homogenisation c. SDS lysis buffer Protein quantification by Biuret/Lowry/Bradford reagents.	3
5	Enzyme assay: Acid phosphatase/ β -galactosidase/amylase	2

S.Y. B.Sc. Semester IV**Biotechnology Paper -6 (BTH 2410) Biotechnology Practicals VI
Exercises in Environmental Biotechnology and Animal Development
[Credits-2]****Course Outcomes**

At the end of this course, students will be able to

- CO1** • Assess portability of water
CO2 • Estimate BOD and COD
CO3 • Prepare Biofertilizers
CO4 • Understand various developmental stages of chick embryo
CO5 • Obtain practical knowledge on hydra

Sr. No.	List of Practicals	Practical (15Px2H)
1.	Assessment of potability of water a. Presumptive b. Confirmed c. Completed test d. Eijkman's test e. IMViC tests	3
2.	BOD and COD estimation of polluted water	2
3.	Preparation and Efficiency testing of Biofertilizer / Biopesticide.	1
4.	Visit to an Effluent treatment or Waste water treatment Plant	1
5.	Study of different types of egg types	1
6.	Study of frog developmental stages	1
7.	Chick embryo culture by filter paper ring technique/ shell less culture	2
8.	Chick embryo mounting, staging and staining (24h, 48h, 72h, 96)	2
9.	Demonstration of regeneration in hydra	2

