DEPARTMENT OF MOLECULAR BIOLOGY
&
BIOTECHNOLOGY

COURSE STRUCTURES CHOICE BASED CREDIT SYSTEM (CBCS)

B.Sc. (H) IN MOLECULAR BIOLOGY & BIOTECHNOLOGY
AND **B.Sc. PROGRAMME COURSE IN MOLECULAR BIOLOGY**

TABLE OF CONTENTS

LIST OF COURSES IN B.Sc. (H) IN MOL. BIOL. & BIOTECHNOLOGY

CORE COURSES

Code	Course Category	Title of the paper
MBBT 101	**CCR 1**	BIOCHEMISTRY & METABOLISM
MBBT 102	**CCR 2**	CELL BIOLOGY
MBBT 201	**CCR 3**	MAMMALIAN PHYSIOLOGY
MBBT 202	**CCR 4**	DEVELOPMENTAL BIOLOGY
MBBT 301	**CCR 5**	GENETICS
MBBT 302	**CCR 6**	GENERAL MICROBIOLOGY
MBBT 303	**CCR 7**	BIOPHYSICS
MBBT 401	**CCR 8**	MOLECULAR BIOLOGY
MBBT 402	**CCR 9**	IMMUNOLOGY
MBBT 403	**CCR 10**	BIOINFORMATICS
MBBT 501	**CCR 11**	BIOPROCESS TECHNOLOGY
MBBT 502	**CCR 12**	RECOMBINANT DNA TECHNOLOGY
MBBT 601	**CCR 13**	BIO ANALYTICAL TOOLS
MBBT 602	**CCR 14**	GENOMICS AND PROTEOMICS

DISCIPLINE SPECIFIC ELECTIVE (DSE) COURSE B.Sc. (H) IN MOL. BIOL. & BIOTECHNOLOGY

Course category	Code	Title of the paper		Code	Title of the paper
DSE 1	**MBBT 503**	ANIMAL BIOTECHNOLOGY	**OR**	**MBBT 504**	BIOTECHNOLOGY & HUMAN WELFARE
DSE 2	**MBBT 505**	PLANT BIOTECHNOLOGY	**OR**	**MBBT 506**	MICROBIAL PHYSIOLOGY
DSE 3	**MBBT 603**	BIOSAFETY & INTELLECTUAL PROPERTY RIGHTS	**OR**	**MBBT 604**	BIOSTATISTICS
DSE 4	**MBBT 605**	EVOLUTIONARY BIOLOGY	**OR**	**MBBT 606**	ENVIRONMENTAL BIOTECHNOLOGY

COMMON POOL OF SEC COURSES BOTH FOR B.Sc. (H) IN MOL. BIOL. & BIOTECHNOLOGY AND B.Sc. PROGRAMME COURSE IN MOLECULAR BIOLOGY

Code	Title of the paper	Code	Title of the paper
MBSEC 101	BIOFERTILIZERS	**MBSEC 107**	MUSHROOM CULTURE TECHNOLOGY
MBSEC 102	FLORICULTURE	**MBSEC 108**	MICROBIAL DIAGNOSIS IN HEALTH CLINICS
MBSEC 103	APICULTURE	**MBSEC 109**	SERICULTURE
MBSEC 104	ALCOHOL FERMENTATION	**MBSEC 110**	INDUSTRIAL MICROPROPAGATION
MBSEC 105	ENZYMOLOGY	**MBSEC 111**	BASICS OF FORENSIC SCIENCE
MBSEC 106	MOLECULAR DIAGNOSTICS	**MBSEC 112**	INDUSTRIAL FERMENTATIONS

GENERAL ELECTIVE COURSES OFFERED BY THE DEPARTMENT OF MOLECULAR BIOLOGY & BIOTECHNOLOGY FOR THE STUDENTS OF OTHER DEPARTMENTS

Code	Course Category	Title of the paper
MBG 101	**GE 1**	BIOLOGICAL CHEMISTRY
MBG 201	**GE2**	MICROBIOLOGY
MBG 301	**GE3**	MOLECULAR BIOLOGY
MBG 401	**GE 4**	RECOMBINANT DNA TECHNOLOGY

LIST OF COURSES IN B.Sc. PROGRAMME COURSE IN MOLECULAR BIOLOGY

CORE COURSES

Code	Course Category	Title of the paper
MBG 101	**CC 1**	BIOLOGICAL CHEMISTRY
	CC 2	TO BE DETERMINED BY THE STUDENT
	CC 3	TO BE DETERMINED BY THE STUDENT
MBG 201	**CC 4**	MICROBIOLOGY
	CC 5	TO BE DETERMINED BY THE STUDENT
	CC 6	TO BE DETERMINED BY THE STUDENT
MBG 301	**CC 7**	MOLECULAR BIOLOGY
	CC 8	TO BE DETERMINED BY THE STUDENT
	CC 9	TO BE DETERMINED BY THE STUDENT
MBG 401	**CC 10**	RECOMBINANT DNA TECHNOLOGY
	CC 11	TO BE DETERMINED BY THE STUDENT
	CC 12	TO BE DETERMINED BY THE STUDENT

DISCIPLINE SPECIFIC ELECTIVE (DSE) COURSE B.Sc. PROGRAMME COURSE IN MOLECULAR BIOLOGY

Code	Course Category	Title of the paper
MBBT 301	**CCR 5**	GENETICS**
MBBT 303	**CCR 7**	BIOPHYSICS**
MBBT 402	**CCR 9**	IMMUNOLOGY**
MBBT 403	**CCR 10**	CELL BIOLOGY**
MBBT 601	**CCR 13**	BIO ANALYTICAL TOOLS**
MBBT 602	**CCR 14**	GENOMICS AND PROTEOMICS**

THE STUDENTS CAN CHOOSE ANY TWO COURSES FROM THE ABOVE MENTIONED CORE COURSES (** MARKED) OF B.Sc (H) IN MOLECULAR BIOLOGY & BIOTECHNOLOGY IN THEIR RESPECTIVE SEMESTERS AS DISCIPLINE SPECIFIC ELECTIVE (DSE) COURSES

ABILITY ENHANCEMENT COURSES COMMON FOR BOTH B.Sc. PROGRAMME COURSE IN MOLECULAR BIOLOGY & B.Sc. (H) IN MOL. BIOL. & BIOTECHNOLOGY

Course Category	Code	Title of the paper
AECC 1	**MBBT 103**	ENVIRONMENTAL SCIENCE
AECC 2	**MBBT 203**	ENGLISH

STRUCTURE OF B.Sc. (H) IN MOL. BIOL. & BIOTECHNOLOGY
FIRST SEMESTER

Semester	Code	Course Category	Title of the Paper	No. of credits	HPW	Marks			Total Marks
						IA (C1)	IA (C2)	Sem-Endterm (C3)	
FIRST YEAR									
I	MBBT 101 (T)	CCR 1 (Theo)	BIOCHEMISTRY & METABOLISM	4	4	5	5	40	50
	MBBT 101 (p)	CCR 1 (Pract)		2	4		5	20	25
	MBBT 102 (T)	CCR 2 (Theo)	CELL BIOLOGY	4	4	5	5	40	50
	MBBT 102 (P)	CCR 2 (Pract)		2	4		5	20	25
		AECC1 (Theo)	ENVIRONMENTAL SCIENCE (The course content from general pool)	2	2	5	5	40	50
		GE 1 (Theo)	DETERMINED BY THE STUDENTS FROM OTHER DEPARTMENT	4	4	5	5	40	50
		GE1 (Pract)		2	4		5	20	25
I			Total	20	26				275

B.Sc. (H) IN MOL. BIOL. & BIOTECHNOLOGY
SECOND SEMESTER

Semester	Code	Course Category	Title of the Paper	No. of credits	HPW	Marks			Total Marks
						IA (C1)	IA (C2)	Sem-Endterm (C3)	
FIRST YEAR									
II	MBBT 201 (T)	CCR 3 (Theo)	MAMMALIAN PHYSIOLOGY	4	4	5	5	40	50
	MBBT 201 (P)	CCR 3 (Pract)		2	4		5	20	25
	MBBT 202 (T)	CCR 4 (Theo)	DEVELOPMENTAL BIOLOGY	4	4	5	5	40	50
	MBBT 202 (P)	CCR 4 (Pract)		2	4		5	20	25
		AECC2 (Theo)	ENGLISH (The course content from general pool)	2	2	5	5	40	50
		GE 2 (Theo)	DETERMINED BY THE STUDENTS FROM OTHER DEPARTMENT	4	4	5	5	40	50
		GE 2 (Pract)		2	4		5	20	25
II			Total	20	26				275

B.Sc. (H) IN MOL. BIOL. & BIOTECHNOLOGY
THIRD SEMESTER

Semester	Code	Course Category	Title of the Paper	No. of credits	HPW	Marks			Total Marks
						IA (C1)	IA (C2)	Sem-Endterm (C3)	
SECOND YEAR									
III	MBBT 301 (T)	CCR 5 (Theo)	GENETICS	4	4	5	5	40	50
	MBBT 301 (P)	CCR 5 (Pract)		2	4		5	20	25
	MBBT 302 (T)	CCR 6 (Theo)	GENERAL MICROBIOLOGY	4	4	5	5	40	50
	MBBT 302 (P)	CCR 6 (Pract)		2	4		5	20	25
	MBBT 303 (T)	CCR 7 (Theo)	BIOPHYSICS	4	4	5	5	40	50
	MBBT 303 (P)	CCR 7 (Pract)		2	4		5	20	25
		SEC1(Theo)	DETERMINED BY THE STUDENTS FROM COMMON POOL	2	2	5	5	40	50
		GE 3 (Theo)	DETERMINED BY THE STUDENTS FROM OTHER DEPARTMENT	4	4	5	5	40	50
		GE 3 (Pract)		2	4		5	20	25
III			Total	26	32				350

B.Sc. (H) IN MOL. BIOL. & BIOTECHNOLOGY
FOURTH SEMESTER

Semester	Code	Course Category	Title of the Paper	No. of credits	HPW	Marks			Total Marks
						IA (C1)	IA (C2)	Sem-Endterm (C3)	
SECOND YEAR									
IV	MBBT 401 (T)	CCR 8 (Theo)	MOLECULAR BIOLOGY	4	4	5	5	40	50
	MBBT 401 (P)	CCR 8 (Pract)		2	4		5	20	25
	MBBT 402 (T)	CCR 9 (Theo)	IMMUNOLOGY	4	4	5	5	40	50
	MBBT 402 (P)	CCR 9 (Pract)		2	4		5	20	25
	MBBT 403 (T)	CCR 10 (Theo)	BIOINFORMATICS	4	4	5	5	40	50
	MBBT 403 (P)	CCR 10 (Pract)		2	4		5	20	25
		SEC2 (Theo)	DETERMINED BY THE STUDENTS FROM COMMON POOL	2	2	5	5	40	50
		GE 4 (Theo)	DETERMINED BY THE STUDENTS FROM OTHER DEPARTMENT	4	4	5	5	40	50
		GE 4 (Pract)		2	4		5	20	25
IV			Total	26	34				350

B.Sc. (H) IN MOL. BIOL. & BIOTECHNOLOGY
FIFTH SEMESTER

Semester	Code	Course Category	Title of the Paper	No. of credits	HPW	Marks			Total Marks
						IA (C1)	IA (C2)	Sem-Endterm (C3)	
THIRD YEAR									
V	MBBT 501 (T)	CCR 11 (Theo)	BIOPROCESS TECHNOLOGY	4	4	5	5	40	50
	MBBT 501 (P)	CCR 11 (Pract)		2	4		5	20	25
	MBBT 502 (T)	CCR 12 (Theo)	RECOMBINANT DNA TECHNOLOGY	4	4	5	5	40	50
	MBBT 502 (P)	CCR 12 (Pract)		2	4		5	20	25
	MBBT 503 (T)/MBBT 504 (T)	DSE1 (Theo)	ANIMAL BIOTECHNOLOGY/BIOTECHNOLOGY & HUMAN WELFARE	4	4	5	5	40	50
	MBBT 503 (P)/MBBT 504 (P)	DSE1 (Pract)		2	4		5	20	25
	MBBT 505 (T)/MBBT 506 (T)	DSE 2 (Theo)	PLANT BIOTECHNOLOGY/ MICROBIAL PHYSIOLOGY	4	4	5	5	40	50
	MBBT 505 (P)/MBBT 506 (P)	DSE 2 (Pract)		2	4		5	20	25
V			Total	24	32				300

B.Sc. (H) IN MOL. BIOL. & BIOTECHNOLOGY
SIXTH SEMESTER

Semester	Code	Course Category	Title of the Paper	No. of credits	HPW	Marks			Total Marks
						IA (C1)	IA (C2)	Sem-Endterm (C3)	
THIRD YEAR									
VI	MBBT 601 (T)	CCR 13 (Theo)	BIO ANALYTICAL TOOLS	4	4	5	5	40	50
	MBBT 601 (P)	CCR 13 (Pract)		2	4		5	20	25
	MBBT 602 (T)	CCR 14 (Theo)	GENOMICS AND PROTEOMICS	4	4	5	5	40	50
	MBBT 602 (P)	CCR 14 (Pract)		2	4		5	20	25
	MBBT 603 (T)/MBBT 604 (T)	DSE3 (Theo)	BIOSAFETY & INTELLECTUAL PROPERTY RIGHTS/ BIOSTATISTICS	4	4	5	5	40	50
	MBBT 603 (P)/MBBT 604 (P)	DSE3 (Pract)		2	4		5	20	25
	MBBT 605 (T)/MBBT 606 (T)	DSE 4 (Theo)	EVOLUTIONARY BIOLOGY/ ENVIRONMENTAL BIOTECHNOLOGY	4	4	5	5	40	50
	MBBT 605 (T)/MBBT 606 (T)	DSE 4 (Pract)		2	4		5	20	25
VI			Total	24	32				300

STRUCTUREOF B.Sc. PROGRAMME COURSE IN MOLECULAR BIOLOGY

Semester	Code	Course Cate-gory	Title of the Paper	No. of credits	HPW	Marks			Total Marks
						IA (C1)	IA (C2)	Sem-Endterm (C3)	
FIRST YEAR (1ST SEMESTER)									
I	MBG 101(T)	CC 1 (Th)	BIOLOGICAL CHEMISTRY	4	4	5	5	40	50
	MBG 101(P)	CC 1 (Pr)		2	4		5	20	25
		CC 2 (Th)	TO BE DETERMINED BY THE STUDENT	4	4	5	5	40	50
		CC 2 (Pr)		2	4		5	20	25
		CC 3 (Th)	TO BE DETERMINED BY THE STUDENT	4	4	5	5	40	50
		CC 3 (Pr)		2	4		5	20	25
		AECC 1	ENVIRONMENTAL STUDIES	2	4	5	5	40	50
				20	28				275
FIRST YEAR (2ND SEMESTER)									
II	MBG 201(T)	CC4 (Th)	MICROBIOLOGY	4	4	5	5	40	50
	MBG 201(P)	CC4 (Pr)		2	4		5	20	25
		CC 5 (Th)	TO BE DETERMINED BY THE STUDENT	4	4	5	5	40	50
		CC 5 (Pr)		2	4		5	20	25
		CC6 (Th)	TO BE DETERMINED BY THE STUDENT	4	4	5	5	40	50
		CC6 (P)		2	4		5	20	25
		AECC 2	ENGLISH COMMUNICATION	2	4	5	5	40	50
			Total	20	28				275

Semester	Code	Course Cate-gory	Title of the Paper	No. of credits	HPW	Marks			Total Marks
						IA (C1)	IA (C2)	Sem-Endterm (C3)	
SECOND YEAR (3RD SEMESTER)									
III	MBG 301(T)	CC7 (Th)	MOLECULAR BIOLOGY	4	4	5	5	40	50
	MBG 301(P)	CC7 (Pr)		2	4		5	20	25
		CC8 (Th)	TO BE DETERMINED BY THE STUDENT	4	4	5	5	40	50
		CC8 (Pr)		2	4		5	20	25
		CC9 (Th)	TO BE DETERMINED BY THE STUDENT	4	4	5	5	40	50
		CC9 (Pr)		2	4		5	20	25
		SEC 1 (Th)	DETERMINED BY THE STUDENTS FROM COMMON POOL	2	4	5	5	40	50
				20	28				275
SECOND YEAR (4TH SEMESTER)									
IV	MBG 401(T)	CC10 (Th)	RECOMBINANT DNA TECHNOLOGY	4	4	5	5	40	50
	MBG 401(P)	CC10 (Pr)		2	4		5	20	25
		CC11 (Th)	DETERMINED BY THE STUDENT	4	4	5	5	40	50
		CC11 (Pr)		2	4		5	20	25
		CC12 (Th)	DETERMINED BY THE STUDENT	4	4	5	5	40	50
		CC12 (Pr)		2	4		5	20	25
		SEC 2 (Th)	DETERMINED BY THE STUDENTS FROM COMMON POOL	2	4	5	5	40	50
			Total	20	28				275

Semester	Code	Course Cate-gory	Title of the Paper	No. of credits	HPW	Marks			Total Marks
						IA (C1)	IA (C2)	Sem-Endterm (C3)	
THIRD YEAR (5TH SEMESTER)									
V		DSE 1 (Th)	DETERMINED BY THE STUDENTS	4	4	5	5	40	50
		DSE 1 (Pr)		2	4		5	20	25
		DSE 2 (Th)	DETERMINED BY THE STUDENT	4	4	5	5	40	50
		DSE2 (Pr)		2	4		5	20	25
		DSE 3 (Th)	DETERMINED BY THE STUDENT	4	4	5	5	40	50
		DSE3 (Pr)		2	4		5	20	25
		SEC 3 (Th)	DETERMINED BY THE STUDENTS FROM COMMON POOL	2	4	5	5	40	50
				20	28				275
THIRD YEAR (6TH SEMESTER)									
VI		DSE 4 (Th)	DETERMINED BY THE STUDENT	4	4	5	5	40	50
		DSE4 (Pr)		2	4		5	20	25
		DSE 5 (Th)	DETERMINED BY THE STUDENT	4	4	5	5	40	50
		DSE 5(Pr)		2	4		5	20	25
		DSE 6 (Th)	DETERMINED BY THE STUDENT	4	4	5	5	40	50
		DSE 6 (Pr)		2	4		5	20	25
		SEC 4 (Th)	DETERMINED BY THE STUDENTS FROM COMMON POOL	2	4	5	5	40	50
			Total	20	28				275

B.Sc (H) in Molecular Biology & Biotechnology

CORE COURSES

Title of the Paper: BIOCHEMISTRY AND METABOLISM
Code: MBBT 101 (T)
Course Category: CCR 1 (Theo)
Theory 4- Credits

Total: 60 hrs (4hrs/week)
Each Unit: 15hrs (1hr/week)

UNIT I: Introduction to Biochemistry: (10 Periods)

A historical prospective.Amino acids & Proteins: Structure & Function. Structure and properties of Amino acids, Types of proteins and their classification, Forces stabilizing protein structure and shape.Different Level of structural organization of proteins, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins.

Carbohydrates: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoprotein's and their biological functions

UNIT II (10 Periods)

Lipids: Structure and functions –Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol.

Nucleic acids: Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines &pyrimidines,. Biologically important nucleotides, Double helical model of DNA structure and forces responsible for A, B & Z – DNA, denaturation and renaturation of DNA

UNIT III (20 Periods)

Enzymes: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric &oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity, common features of active sites, enzyme specificity: types & theories, Biocatalysts from extreme thermophilic and hyperthermophilicarchaea and bacteria. Role of: NAD^+, $NADP^+$, FMN/FAD, coenzymes A, Thiamine pyrophosphate, Pyridoxalphosphate,lipoic-acid, Biotin vitamin B12, Tetrahydrofolate and metallic ions

UNIT IV (20 Periods)

Carbohydrates Metabolism: Reactions, energetics and regulation. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance,

Gluconeogenesis, Glycogenolysis and glycogen synthesis.TCA cycle, Electron Transport Chain, Oxidative phosphorylation.ß-oxidation of fatty acids.

Title of the Paper: BIOCHEMISTRY AND METABOLISM
Code: MBBT 101 (P)
Course Category: CCR 1 (Pract)
Practical 2- Credits

Total: 60 hrs (4hrs/week)

1. To study activity of any enzyme under optimum conditions.
2. To study the effect of pH, temperature on the activity of salivary amylase enzyme.
3. Determination of - pH optima, temperature optima, Km value, Vmax value, Effect of inhibitor (Inorganic phosphate) on the enzyme activity.
4. Estimation of blood glucose by glucose oxidase method.
5. Principles of Colorimetry: (i) Verification of Beer's law, estimation of protein. (ii) To study relation between absorbance and % transmission.
6. Preparation of buffers.
7. Separation of Amino acids by paper chromatography.
8. Qualitative tests for Carbohydrates, lipids and proteins

SUGGESTED READING

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry.VI Edition. W.H Freeman and Co.
2. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants.American Society of Plant Biologists.
3. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.
4. Hopkins, W.G. and Huner, P.A. (2008) Introduction to Plant Physiology. John Wiley and Sons.
5. Salisbury, F.B. and Ross, C.W. (1991) Plant Physiology, Wadsworth Publishing Co. Ltd.

Title of the Paper: CELL BIOLOGY
Code:MBBT 102(T)
Course Category: CCR2 (Theo)

Theory 4- Credits

Total: 60 hrs (4hrs/week)

UNIT I **(10 Periods)**

Cell: Introduction and classification of organisms by cell structure, cytosol, compartmentalization of eukaryotic cells, cell fractionation.
Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport.

UNIT II **(15 Periods)**

Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments.
Endoplasmic reticulum: Structure, function including role in protein segregation.
Golgi complex: Structure, biogenesis and functions including role in protein secretion.

UNIT III **(20 Periods)**

Lysosomes: Vacuoles and micro bodies: Structure and functions
Ribosomes: Structures and function including role in protein synthesis.
Mitochondria: Structure and function, Genomes, biogenesis.
Chloroplasts: Structure and function, genomes, biogenesis
Nucleus: Structure and function, chromosomes and their structure.

UNIT IV **(15 Periods)**

Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction.
Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics and molecular basis of cancer.

Title of the Paper: CELL BIOLOGY
Code:MBBT 102(P)
Course Category: CCR2 (Pract)

Practical 2- Credits

Total: 60 hrs (4hrs/week)

1. Study the effect of temperature and organic solvents on semi permeable membrane.
2. Demonstration of dialysis.
3. Study of plasmolysis and de-plasmolysis.
4. Cell fractionation and determination of enzyme activity in organelles using sprouted seed or any other suitable source.
5. Study of structure of any Prokaryotic and Eukaryotic cell.
6. Microtomy: Fixation, block making, section cutting, double staining of animal tissues like liver, oesophagus, stomach, pancreas, intestine, kidney, ovary, testes.
7. Cell division in onion root tip/ insect gonads.
8. Preparation of Nuclear, Mitochondrial & cytoplasmic fractions.

SUGGESTED READING

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition.John Wiley & Sons.Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006.Cell and Molecular Biology.8th edition.Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition.ASMPress& Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009.The World of the Cell.7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

Title of the Paper: MAMMALIAN PHYSIOLOGY
Code: MBBT 201 (T)
Course Category: CCR 3 (Theo)
Theory 4- Credits

Total: 60 hrs (4hrs/week)
Each Unit: 15hrs (1hr/week)

UNIT I: Digestion and Respiration	**(15 Periods)**
Digestion: Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids. Composition of bile, Saliva, Pancreatic, gastric and intestinal juice **Respiration: Exchange of gases, Transport of O2 and CO2, Oxygen dissociation curve, Chloride shift.**	
UNIT II: Circulation	**(15 Periods)**
Composition of blood, Plasma proteins & their role, blood cells, Haemopoisis, Mechanism of coagulation of blood. **Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heart beat.**	
UNIT III: Muscle physiology and osmoregulation	**(15 Periods)**
Structure of cardiac, smooth & skeletal muscle, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction. **Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation.**	
UNIT IV: Nervous and endocrine coordination	**(15 Periods)**
Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, saltatory conduction, Neurotransmitters Mechanism of action of hormones (insulin and steroids) Different endocrine glands– Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions.	

Title of the Paper: MAMMALIAN PHYSIOLOGY
Code: MBBT 201 (P)
Course Category: CCR 3 (Pract)
Practical 2- Credits

Total: 60 hrs (4hrs/week)

1. Finding the coagulation time of blood
2. Determination of blood groups
3. Counting of mammalian RBCs
4. Determination of TLC and DLC

5.	Demonstration of action of an enzyme
6.	Determination of Haemoglobin

SUGGESTED READING

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.

2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition. John wiley&sons,Inc

Title of the Paper: DEVELOPMENTAL BIOLOGY/
Code:MBBT 202 (T)
Course Category: CCR4 (Theo)
Theory 4- Credits

Total: 60 hrs (4hrs/week)

DEVELOPMENTAL BIOLOGY

UNIT I: (10 Periods)

Gametogenesis and Fertilization Definition, scope & historical perspective Spermatogenesis, Oogenesis Fertilization - Different types of eggs on the basis of yolk. Gametogenesis – Definition, mechanism, types of fertilization.

UNIT II: Early embryonic development (20 Periods)

Cleavage: Definition, types, patterns & mechanism Blastulation: Process, types & mechanism Gastrulation: Morphogenetic movements– epiboly, emboly, extension, invagination, convergence, de-lamination. Formation & differentiation of primary germ layers, Fate Maps in early embryos.

UNIT III: Embryonic Differentiation (20 Periods)

Differentiation: Cell commitment and determination- the epigenetic landscape: a model of determination and differentiation, control of differentiation at the level of genome, transcription and post-translation level Concept of embryonic induction: Primary, secondary & tertiary embryonic induction, Neural induction and induction of vertebrate lens.

UNIT IV: Organogenesis (10 Periods)

Neurulation, notogenesis, development of vertebrate eye. Fate of different primary germlayers Development of behaviour: constancy & plasticity, Extra embryonic membranes, placenta in Mammals.

Title of the Paper: DEVELOPMENTAL BIOLOGY/
Code:MBBT 202 (P)
Course Category: CCR4 (Pract)
Practical 2- Credits

Total: 60 hrs (4hrs/week)

DEVELOPMENTAL BIOLOGY

PRACTICALS

1. Identification of developmental stages of chick and frog embryo using permanent mounts
2. Preparation of a temporary stained mount of chick embryo
3. Study of developmental stages of *Anopheles*.
4. Study of the developmental stages of *Drosophila* from stock culture/ photographs..
5. Study of different types of placenta.

SUGGESTED READING

1. Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
2. Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.
3. Kalthoff, (2000). Analysis of Biological Development, II Edition, McGraw-Hill Professional.

Title of the Paper: GENETICS
Code:MBBT 301 (T)
Course Category: CCR 5 (Theo)
Theory 4- Credits

Total: 60 hrs (4hrs/week)

UNIT I (10 Periods)

Introduction: Historical developments in the field of genetics. Organisms suitable for genetic experimentation and their genetic significance.
Cell Cycle: Mitosis and Meiosis: Control points in cell-cycle progression in yeast. Role of meiosis in life cycles of organisms. Mendelian genetics : Mendel's experimental design, monohybrid, di-hybrid and tri hybrid crosses, Law of segregation & Principle of independent assortment. Verification of segregates by test and back crosses, Chromosomal theory of inheritance, Allelic interactions: Concept of dominance, recessiveness, incomplete dominance, co-dominance, semi-dominance, pleiotropy, multiple allele, pseudo-allele, essential and lethal genes, penetrance and expressivity.

UNIT II (15 Periods)

Non allelic interactions: Interaction producing new phenotype complementary genes, epistasis (dominant & recessive), duplicate genes and inhibitory genes.
Chromosome and genomic organization: Eukaryotic nuclear genome nucleotide sequence composition –unique & repetitive DNA, satellite DNA. Centromere and telomere DNA sequences, middle repetitive sequences- VNTRs & dinucleotide repeats, repetitive transposed sequences- SINEs & LINEs, middle repetitive multiple copy genes, noncoding DNA. Genetic organization of prokaryotic and viral genome.
Structure and characteristics of bacterial and eukaryotic chromosome, chromosome morphology, concept of euchromatin and heterochromatin. Packaging of DNA molecule into chromosomes, chromosome banding pattern, karyotype, giant chromosomes, one gene one polypeptide hypothesis, concept of cistron, exons, introns, genetic code, gene function.

UNIT III (15 Periods)

Chromosome and gene mutations: Definition and types of mutations, causes of mutations, Ames

test for mutagenic agents, screening procedures for isolation of mutants and uses of mutants, variations in chromosomes structure - deletion, duplication, inversion and translocation (reciprocal and Robertsonian), position effects of gene expression, chromosomal aberrations in human beings, abonormalities– Aneuploidy and Euploidy.

Sex determination and sex linkage: Mechanisms of sex determination, Environmental factors and sex determination, Barr bodies, dosage compensation, genic balance theory, Fragile-X- syndrome and chromosome, sex influenced dominance, sex limited gene expression, sex linked inheritance.

UNIT IV **(10 Periods)**

Genetic linkage, crossing over and chromosome mapping: Linkage and Recombination of genes in a chromosome crossing over, Cytological basis of crossing over, Molecular mechanism of crossing over, Crossing over at four strand stage, Multiple crossing overs Genetic mapping.

Extra chromosomal inheritance: Rules of extra nuclear inheritance, maternal effects, maternal inheritance, cytoplasmic inheritance, organelle heredity, genomic imprinting.

UNIT V **(10 Periods)**

Chromosomal aberration- number and structure, deletion, duplication, inversion, transversion, pseudodominnance. Ploidy- euploidy, aneuploidy,nullisomy, monosomy, trisomy, monoploid, diploid, triploid, tetraploid, alloploidy, amphidiploidy. Associated diseases and Evolutionary Significance; Cytogenetics of human disorder, Turner syndrome, Klinefelter syndrome, Down syndrome, copy number variation and human diseases, gene dosage, dosage compensation,

Title of the Paper: GENETICS
Code:MBBT 301 (P)
Course Category: CCR 5 (Pract)
Theory 4- Credits

Total: 60 hrs (4hrs/week)

1. Permanent and temporary mount of mitosis.
2. Permanent and temporary mount of meiosis.
3. Mendelian deviations in dihybrid crosses
4. Demonstration of - Barr Body –
5. Translocationstudy in Rhoeo.
5. Karyotyping with the help of photographs
6. Pedigree charts of some common characters like blood group, color blindness and PTC tasting.
7. Study of polyploidy in onion root tip by colchicine treatment.

SUGGESTED READING

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006). Principles of Genetics.VIII Edition John Wiley & Sons.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics.V Edition. John Wiley and Sons
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics.IX Edition. Benjamin Cummings.
4. Russell, P. J. (2009). Genetics- A Molecular Approach.III Edition. Benjamin Cummings.
5. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis, W. H. Freeman & Co.

Title of the Paper: GENERAL MICROBIOLOGY
Code:MBBT 302 (T)
Course Category: CCR 6 (Theo)
Theory 4- Credits

Total: 60 hrs (4hrs/week)

UNIT I **(10 Periods)**

Fundamentals, History and Evolution of Microbiology. Classification of microorganisms: Microbial taxonomy, criteria used including molecular approaches, Microbial phylogeny and current classification of bacteria.
Microbial Diversity: Distribution and characterization Prokaryotic and Eukaryotic cells, Morphology and cell structure of major groups of microorganisms eg. Bacteria, Algae, Fungi, Protozoa and Unique features of viruses.

UNIT II **(10 Periods)**

Cultivation and Maintenance of microorganisms: Nutritional categories of micro-organisms, methods of isolation, Purification and preservation.

UNIT III **(20 Periods)**

Microbial growth: Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria.
Microbial Metabolism: Metabolic pathways, amphi-catabolic and biosynthetic pathways Bacterial

Reproduction: Transformation, Transduction and Conjugation. Endospores and sporulation in bacteria.

UNIT IV **(20 Periods)**

Control of Microorganisms: By physical, chemical and chemotherapeutic Agents.
Water Microbiology: Bacterial pollutants of water, coliforms and non coliforms.Sewage composition and its disposal.
Food Microbiology: Important microorganism in food Microbiology: Moulds, Yeasts, bacteria. Major food born infections and intoxications, Preservation of various types of foods.Fermented Foods.

Title of the Paper: GENERAL MICROBIOLOGY
Code:MBBT 302 (P)
Course Category: CCR 6 (Pract)
Practical 2- Credits

Total: 60 hrs (4hrs/week)

1. Isolation of bacteria & their biochemical characterization.
2. Staining methods: simple staining, Gram staining, spore staining, negative staining, hanging drop.
3. Preparation of media & sterilization methods, Methods of Isolation of bacteria from different sources.
4. Determination of bacterial cell size by micrometry.
5. Enumeration of microorganism - total & viable count.

SUGGESTED READING

1. Alexopoulos CJ, Mims CW, and Blackwell M. (1996).Introductory Mycology. 4 th edition. John and Sons, Inc.
2. Jay JM, Loessner MJ and Golden DA.(2005). Modern Food Microbiology.7thedition, CBS Publishers and Distributors, Delhi, India.
3. Kumar HD. (1990). Introductory Phycology.2nd edition.Affiliated East Western Press.
4. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms.12th edition.Pearson/Benjamin Cummings.
5. Pelczar MJ, Chan ECS and Krieg NR.(1993). Microbiology.5th edition. McGraw Hill Book Company.
6. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.
7. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9 th edition. Pearson Education.
8. Willey JM, Sherwood LM, and Woolverton CJ.(2008). Prescott, Harley and Klein's Microbiology.7th edition.McGraw Hill Higher Education.

Title of the Paper: BIOPHYSICS
Code:MBBT 303 (T)
Course Category: CCR 7 (Theo)
Theory 4- Credits

Total: 60 hrs (4hrs/week)

Unit-I **(10 periods)**

1. Atomic structure and bonding: Intermolecular attractions, hydrogen bonding, vanderwaals force, hydrophobic and hydrophillic bond, polar bond, properties of water.
2. Thermodynamics, reaction kinetics and energy transduction:Isolated, closed and open systems; First and second laws of thermodynamics and their biological significance; Activation energy and transition-state theory; Different orders of chemical reactions, free energy and chemical reaction. high energy phosphate compounds (ATP, creatine phosphate, thioesters).
3. General Biophysics and biochemistry– Acid, base, salt, buffers, pH, pK, Handerson, Hasbaltch equation, principle of measurement of pH.

Unit II **(20 periods)**

4.Isotopes and radioactivity: Radioactivity, decay law, Radioactive labeling, Detection and measurement of radioactive dose by GM counter, scintillation counter, autoradiography. (4 Periods)
5. Hydrodynamic properties: Surface tension, diffusion, osmosis, sedimentation at molecular level. Factors affecting them.
6. Centrifugation – Basic Principle of Centrifugation, Instrumentation of Ultracentrifuge (Preparative, Analytical), Factors affecting Sedimentation velocity, Standard Sedimentation Coefficient, Centrifugation of associating systems, Rate-Zonal centrifugation, sedimentation equilibrium Centrifugation. (5 Periods)

Unit III **(20 periods)**

7. X-Ray Crystallography – X-ray diffraction, Bragg equation, Reciprocal lattice, Miller indices & Unit cell, Concept of different crystal structure, determination of crystal structure [concept of rotating crystal method, powder method]. (6 Periods)
8. Absorption Spectroscopy – Properties of light, molecular mechanism of the absorption of light by molecules, Beer-Lambert law, Factors affecting the absorption properties of a Chromophore. Infra red spectroscopy, Atomic absorption and emission spectroscopy, dynamic light scattering.(14 Periods)

Unit IV **(10 periods)**

9. Spectroscopy: Raman Spectroscopy – What is Raman Effect, Quantum mechanical reason of Raman effect, NMR Spectroscopy – Basic principle of NMR spectroscopy, Experimental technique & instrumentation, Chemical shift, Hyperfine splitting, Relaxation process.

Title of the Paper: BIOPHYSICS
Code:MBBT 303 (P)
Course Category: CCR 7 (Pract)
Practical 2- Credits

Total: 60 hrs (4hrs/week)

1 .Preparation of buffers: Citrate, Tris-HCl, Phosphate buffer.
2. Use of pH meter
3. Titration of amino acid (Glycine) for determination of pKa
4. ECG pattern study.
5. Column chromatography.
6. Interpretation and measurement of X-ray diffraction pattern.
7. Verify Lambert-Beer's law by Spectrophotometer.
8. Paper chromatographic separation technique: Separation of amino acids and pigments after extraction from plants.
9. Thin layer (TLC) & Column chromatographic technique.

SUGGEST READING:

1. Physical Biochemistry. David Friefelder.2-nd edition, W.H.Freeman and Company.
2. Physical Biochemistry, Upadhaya, Upadhaya, Nath, Himalaya Publishers.
3. Nelson, D.L. Cox M.M. Lehninger Principles of Biochemistry, 6-th edition.

Title of the Paper: MOLECULAR BIOLOGY
Code:MBBT 401(T)
Course Category: CCR8 (Theo)
Theory 4- Credits

Total: 60 hrs (4hrs/week)

UNIT I: DNA structure and replication (10 Periods)

DNA as genetic material, Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, DNA polymerases, The replication complex: Pre-primming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication.

UNIT II: DNA damage, repair and homologous recombination (10 Periods)

DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, translesion synthesis, recombinational repair, nonhomologous end joining. Homologous recombination: models and mechanism.

UNIT III: Transcription and RNA processing (15 Periods)

RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing.

UNIT IV: Regulation of gene expression and translation (18 Periods)

Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics, Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyltRNAsynthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation.,Posttranslational modifications of proteins.

UNIT V: Transposable genetic elements (07 Periods)

Transposons, transposition, types of transposon, mechanism, P elements of Drosophila, Ac/Ds element in maize, hybrid dysgenesis, regulation of kernel colour in maize

Title of the Paper: MOLECULAR BIOLOGY
Code:MBBT 401(P)
Course Category: CCR8 (Pract)
Practical 2- Credits

Total: 60 hrs (4hrs/week)

1. Preparation of solutions for Molecular Biology experiments.
2. Isolation of chromosomal DNA from bacterial cells.
3. Isolation of Plasmid DNA by alkaline lysis method
4. Agarose gel electrophoresis of genomic DNA & plasmid DNA
5. Preparation of restriction enzyme digests of DNA samples
6. Demonstration of AMES test or reverse mutation for carcinogenicity

Title of the Paper: IMMUNOLOGY
Code:MBBT 402(T)
Course Category: CCR9 (Theo)

Theory 4- Credits

Total: 60 hrs (4hrs/week)

UNIT I (20 Periods)

Immune Response - An overview, components of mammalian immune system, molecular structure of Immuno-globulins or Antibodies, Humoral & Cellular immune responses, T-lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells), T-cell receptors, genome rearrangements during B-lymphocyte differentiation, Antibody affinity maturation class switching, assembly of T-cell receptor genes by somatic recombination.

UNIT II (15 Periods)

Regulation of immunoglobulin gene expression – clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity, hypotheses (germ line & somatic mutation), antibody diversity.

UNIT III (13 Periods)

Major Histocompatibility complexes – class I & class II MHC antigens, antigen processing. Immunity to infection – immunity to different organisms, pathogen defense strategies, avoidance of

recognition. Autoimmune diseases, Immunodeficiency-AIDS.

UNIT IV **(12 Periods)**

Vaccines & Vaccination – adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, passive & active immunization. Introduction to immunodiagnostics – RIA, ELISA.

Title of the Paper: IMMUNOLOGY
Code:MBBT 402(P)
Course Category: CCR9 (Pract)

Practical 2- Credits

Total: 60 hrs (4hrs/week)

1. Differential leucocytes count
2. Total leucocytes count
3. Total RBC count
4. Haemagglutination assay
5. Haemagglutination inhibition assay
6. Separation of serum from blood
7. Double immunodiffusion test using specific antibody and antigen.
8. ELISA.

SUGGESTED READING

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6 th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
4. Murphy K, Travers P, Walport M. (2008). Janeway'sImmunobiology. 7th edition Garland Science Publishers, New York.
5. PeakmanM, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg.
6. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

Title of the Paper: BIOINFORMATICS/
Code: MBBT 403 (T)
Course Category: CCR10 (Theo)

Theory 4- Credits

Total: 60 hrs (4hrs/week)

BIOINFORMATICS

UNIT I **(10 Periods)**

History of Bioinformatics. The notion of Homology. Sequence Information Sources, EMBL, GENBANK, Entrez, Unigene, Understanding the structure of each source and using it on the web.

UNIT II **(20 Periods)**

Protein Information Sources, PDB, SWISSPROT, TREMBL, Understanding the structure of each source and using it on the web. Introduction of Data Generating Techniques and Bioinformatics problem posed by them- Restriction Digestion, Chromatograms, Blots, PCR, Microarrays, Mass Spectrometry.

UNIT III **(20 Periods)**

Sequence and Phylogeny analysis, Detecting Open Reading Frames, Outline of sequence Assembly, Mutation/Substitution Matrices, Pairwise Alignments, Introduction to BLAST, using it on the web, Interpreting results, Multiple Sequence Alignment, Phylogenetic Analysis.

UNIT IV **(10 Periods)**

Searching Databases: SRS, Entrez, Sequence Similarity Searches-BLAST, FASTA, Data Submission.
Genome Annotation: Pattern and repeat finding, Gene identification tools.

Title of the Paper: BIOINFORMATICS
Code: MBBT 403(P)
Course Category: CCR10 (Pract)

Practicals 2- Credits

Total: 60 hrs (4hrs/week)

BIOINFORMATICS PRACTICALS

1. Sequence information resource
2. Understanding and use of various web resources: EMBL, Genbank, Entrez, Unigene, Protein information resource (PIR)
3. Understanding and using: PDB, Swissprot, TREMBL
4. Using various BLAST and interpretation of results.
5. Retrieval of information from nucleotide databases.
6. Sequence alignment using BLAST.
7. Multiple sequence alignment using Clustal W.

SUGGESTED READING

1. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
2. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell.
3. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.

Title of the Paper: BIOPROCESS TECHNOLOGY
Code: MBBT 501(T)
Course Category: CCR11 (Theo)

Theory 4- Credits

Total: 60 hrs (4hrs/week)

UNIT I	**(10 Periods)**
Introduction to bioprocess technology. Range of bioprocess technology and its chronological development. Basic principle components of fermentation technology. Types of microbial culture and its growth kinetics– Batch, Fedbatch and Continuous culture.	
UNIT II	**(20 Periods)**
Design of bioprocess vessels- Significance of Impeller, Baffles, Sparger; Types of culture/production vessels- Airlift; Cyclone Column; Packed Tower and their application in production processes. Principles of upstream processing – Media preparation, Inocula development and sterilization.	
UNIT III	**(15 Periods)**
Introduction to oxygen requirement in bioprocess; mass transfer coefficient; factors affecting KLa. Bioprocess measurement and control system with special reference to computer aided process control	
UNIT IV	**(15 Periods)**
Introduction to downstream processing, product recovery and purification. Effluent treatment. Microbial production of ethanol, amylase, lactic acid and Single Cell Proteins.	

Title of the Paper: BIOPROCESS TECHNOLOGY
Code: MBBT 501(P)
Course Category: CCR11 (Pract)

Practical 2- Credits

Total: 60 hrs (4hrs/week)

1. Bacterial growth curve.
2. Calculation of thermal death point (TDP) of a microbial sample.
3. Production and analysis of ethanol.
4. Production and analysis of amylase.
5. Production and analysis of lactic acid.
6. Isolation of industrially important microorganism from natural resource.

SUGGESTED READING

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.

Title of the Paper: RECOMBINANT DNA TECHNOLOGY
Code: MBBT 502(T)
Course Category: CCR12 (Theo)

Theory 4- Credits

Total: 60 hrs (4hrs/week)

UNIT I (15 Periods)

Molecular tools and applications- restriction enzymes, ligases, polymerases, alkaline phosphatase. Gene Recombination and Gene transfer: Transformation, Episomes, Plasmids and other cloning vectors (Bacteriophage-derived vectors, artificial chromosomes), Microinjection, Electroporation, Ultrasonication, Principle and applications of Polymerase chain reaction (PCR), primer-design, and RT- (Reverse transcription) PCR.

UNIT II (20 Periods)

Restriction and modification system, restriction mapping. Southern and Northern hybridization. Preparation and comparison of Genomic and cDNA library, screening of recombinants, reverse transcription, Genome mapping, DNA fingerprinting, Applications of Genetic Engineering Genetic engineering in animals: Production and applications of transgenic mice, role of ES cells in gene targeting in mice, Therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines (one example each).

UNIT III (10 Periods)

Random and site-directed mutagenesis: Primer extension and PCR based methods of site directed mutagenesis, Random mutagenesis, Gene shuffling, production of chimeric proteins, Protein engineering concepts and examples (any two).

UNIT IV **(15 Periods)**

Genetic engineering in plants: Use of *Agrobacterium tumefaciens* and A. rhizogenes, Ti plasmids, Strategies for gene transfer to plant cells, Direct DNA transfer to plants, Gene targeting in plants, Use of plant viruses as episomal expression vectors.

Title of the Paper: RECOMBINANT DNA TECHNOLOGY
Code: MBBT 502(P)
Course Category: CCR12 (Pract)

Practical 2- Credits

Total: 60 hrs (4hrs/week)

1. Isolation of chromosomal DNA from plant cells
2. Isolation of chromosomal DNA from *E.coli*
3. Qualitative and quantitative analysis of DNA using spectrophotometer
4. Plasmid DNA isolation
5. Restriction digestion of DNA
6. Making competent cells
7. Transformation of competent cells.
8. Demonstration of PCR

SUGGESTED READING

1. Brown TA. (2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing, Oxford, U.K. Clark DP and Pazdernik NJ. (2009). Biotechnology-Applying the Genetic Revolution. Elsevier Academic Press, USA.
2. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington
3. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
4. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.

Title of the Paper: BIO ANALYTICAL TOOLS
Code: MBBT 601(T)
Course Category: CCR13 (Theo)

Theory 4- Credits

Total: 60 hrs (4hrs/week)

UNIT I	**(10 Periods)**
Simple microscopy, phase contrast microscopy, florescence and electron microscopy (TEM and SEM), pH meter, absorption and emission spectroscopy	
UNIT II	**(15 Periods)**
Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infra-red), centrifugation, cell fractionation techniques, isolation of sub-cellular organelles and particles.	
UNIT III	**(15 Periods)**
Introduction to the principle of chromatography. Paper chromatography, thin layer chromatography, column chromatography: silica and gel filtration, affinity and ion exchange chromatography, gas chromatography, HPLC.	
UNIT IV	**(20 Periods)**
Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse field gel electrophoresis, immuno- electrophoresis, isoelectric focusing, Western blotting. Introduction to Biosensors and Nanotechnology and their applications.	

Title of the Paper: BIO ANALYTICAL TOOLS
Code: MBBT 601(P)
Course Category: CCR13 (Pract)

Practical 2- Credits

Total: 60 hrs (4hrs/week)

1. Native gel electrophoresis of proteins
2. SDS-polyacrylamide slab gel electrophoresis of proteins under reducing conditions.
3. Preparation of the sub-cellular fractions of rat liver cells.
4. Preparation of protoplasts from leaves.
5. Separation of amino acids by paper chromatography.
6. To identify lipids in a given sample by TLC.
7. To verify the validity of Beer's law and determine the molar extinction coefficient of NADH.

SUGGESTED READING

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley& Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 The World of the Cell.7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

Title of the Paper: GENOMICS & PROTEOMICS
Code: MBBT 602(T)
Course Category: CCR14 (Theo)

Theory 4- Credits

Total: 60 hrs (4hrs/week)

UNIT I **(15 Periods)**

Introduction to Genomics, DNA sequencing methods – manual & automated: Maxam & Gilbert and Sangers method. Pyrosequencing, Genome Sequencing: Shotgun & Hierarchical (clone contig) methods, Computer tools for sequencing projects: Genome sequence assembly software.

UNIT II **(10 Periods)**

Managing and Distributing Genome Data: Web based servers and softwares for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. Selected Model Organisms' Genomes and Databases.

UNIT III **(20 Periods)**

Introduction to protein structure, Chemical properties of proteins. Physical interactions that determine the property of proteins. Short-range interactions, electrostatic forces, van der waal interactions, hydrogen bonds, Hydrophobic interactions. Determination of sizes (Sedimentation analysis, gel filteration, SDS-PAGE); Native PAGE, Determination of covalent structures – Edman degradation.

UNIT IV **(15 Periods)**

Introduction to Proteomics, Analysis of proteomes. 2D-PAGE. Sample preparation, solubilization, reduction, resolution. Reproducibility of 2D-PAGE. Mass spectrometry based methods for protein identification. De novo sequencing using mass spectrometric data.

Title of the Paper: GENOMICS & PROTEOMICS
Code: MBBT 602(P)
Course Category: CCR14 (Pract)

Practical 2- Credits

Total: 60 hrs (4hrs/week)

1. Use of SNP databases at NCBI and other sites
2. Use of OMIM database
3. Detection of Open Reading Frames using ORF Finder
4. Proteomics 2D PAGE database
5. Softwares for Protein localization.
6. Hydropathy plots
7. Native PAGE
8. SDS-PAGE

SUGGESTED READING

1. Genes IX by Benjamin Lewin, Johns and Bartlett Publisher, 2006.
2. Modern Biotechnology, 2nd Edition, S.B. Primrose, Blackwell Publishing, 1987.
3. Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition,

5. Molecular Cloning: A Laboratory Manual (3rd Edition) Sambrook and Russell Vol. I to III, 1989.
6. Principles of Gene Manipulation 6th Edition, S.B.Primrose, R.M.Twyman and R.W. Old. Blackwell Science, 2001.
7. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.
4. Russell, P. J. (2009). iGenetics- A Molecular Approach. III Edition. Benjamin Cummings.
5. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
6. Pevsner, J. (2009). Bioinformatics and Functional Genomics. II Edition. John Wiley & Sons.

DISCIPLINE SPECIFIC ELECTIVE (DSE) COURSE

Title of the Paper: ANIMAL BIOTECHNOLOGY
Code:MBBT 503(T)
Course Category: DSE1 (Theo)

Theory 4- Credits

Total: 60 hrs (4hrs/week)

ANIMAL BIOTECHNOLOGY

UNIT I	**(10 Periods)**

Gene transfer methods in Animals – Microinjection, Embryonic Stem cell, gene transfer, Retrovirus & Gene transfer.

UNIT II	**(10 Periods)**

Introduction to transgenesis. Transgenic Animals – Mice, Cow, Pig, Sheep, Goat, Bird, Insect. Animal diseases need help of Biotechnology – Foot-and mouth disease, Coccidiosis, Trypanosomiasis, Theileriosis.

UNIT III	**(20 Periods)**

Animal propagation – Artificial insemination, Animal Clones. Conservation Biology – Embryo transfer techniques. Introduction to Stem Cell Technology and its applications.

UNIT IV	**(20 Periods)**

Genetic modification in Medicine - gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, problems & ethics.

SUGGESTED READING

1. Brown, T.A. (1998). Molecular biology Labfax II: Gene analysis. II Edition. Academic Press, California,USA.
2. Butler, M. (2004). Animal cell culture and technology: The basics. II Edition. Bios scientific publishers.
3. Glick, B.R. and Pasternak, J.J. (2009). Molecular biotechnology- Principles and applications of recombinant DNA. IV Edition. ASM press, Washington, USA.
4. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An introduction to genetic analysis. IX Edition. Freeman & Co., N.Y., USA.
5. Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). Recombinant DNA-genes and genomes- A short course. III Edition. Freeman and Co., N.Y., USA.

Title of the Paper: ANIMAL BIOTECHNOLOGY/
Code:MBBT 503 (P)
Course Category: DSE1 (Pract)

Practical 2- Credits

Total: 60 hrs (4hrs/week)

ANIMAL BIOTECHNOLOGY PRACTICALS

1. Sterilization techniques: Theory and Practical: Glass ware sterilization, Media sterilization, Laboratory sterilization
2. Sources of contamination and decontamination measures.
3. Preparation of Hanks Balanced salt solution
4. Preparation of Minimal Essential Growth medium
5. Isolation of lymphocytes for culturing
6. DNA isolation from animal tissue
7. Quantification of isolated DNA.
8. Resolving DNA on Agarose Gel.

Title of the Paper: BIOTECHNOLOGY & HUMAN WELFARE
Code: MBBT 504(T)
Course Category: DSE1 (Theo)

Theory 4- Credits

Total: 60 hrs (4hrs/week)

BIOTECHNOLOGY AND HUMAN WELFARE

UNIT I (10 Periods)

Industry: protein engineering; enzyme and polysaccharide synthesis, activity and secretion, alcohol and antibiotic formation.

UNIT II (10 Periods)

Agriculture: N2 fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; qualitative improvement of livestock.

UNIT III (15 Periods)

Environments: e.g. chlorinated and non-chlorinated organ pollutant degradation; degradation of hydrocarbons and agricultural wastes, stress management, development of biodegradable polymers such as PHB.

UNIT IV (12 Periods)

Forensic science: e.g. solving violent crimes such as murder and rape; solving claims of paternity and theft etc. using various methods of DNA finger printing.

UNIT V (13 Periods)

Health: e.g. development of non- toxic therapeutic agents, recombinant live vaccines, gene therapy,

diagnostics, monoclonal in *E.coli*, human genome project.

Title of the Paper: BIOTECHNOLOGY & HUMAN WELFARE
Code:MBBT 504 (P)
Course Category: DSE1 (Pract)
Practical 2- Credits

Total: 60 hrs (4hrs/week)

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Perform of ethanolic fermentaion using Baker's yeast
2. Study of a plant part infected with a microbe
3. To perform quantitative estimation of residual chlorine in water samples
4. Isolation and analysis of DNA from minimal available biological samples
5. Case studies on Bioethics (any two)

SUGGESTED READING

1. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.
2. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age internationalpublishers

Title of the Paper: PLANT BIOTECHNOLOGY
Code: MBBT 505(T)
Course Category: DSE2 (Theo)

Theory 4- Credits

Total: 60 hrs (4hrs/week)

PLANT BIOTECHNOLOGY

UNIT I **(15 Periods)**

History of plant tissue culture, concept on differentiation, dedifferentiation and redifferentiation. Types of culture: Seed, Embryo, Callus, Organs, Cell and Protoplast culture. Micropopagation Axillary bud proliferation, Meristem and shoot tip culture, cud culture, organogenesis, embryogenesis, advantages and disadvantages of micropropagation.

UNIT- II **(20 Periods)**

In vitro haploid production Androgenic methods: Anther culture, Microspore culture andogenesis Sgnificance and use of haploids, Ploidy level and chromosome doubling, diplodization, Gynogenic haploids, factors effecting gynogenesis, chromosome elimination techniques for production of haploids in cereals.

UNIT – III **(15 Periods)**

Protoplast Isolation and fusion Methods of protoplast isolation, Protoplast development, Somatic hybridization, identifiation and selection of hybrid cells, Cybrids, Potential of somatic hybridization limitations.

Somaclonal variation, methods, applications basis and disadvantages

UNIT – IV **(10 Periods)**

Plant Growth Promoting bacteria.
Nitrogen fixation, Nitrogenase, Hydrogenase, Nodulation,
Biocontrol of pathogens, Growth promotion by free-living bacteria.

Title of the Paper: PLANT BIOTECHNOLOGY
Code: MBBT 505(P)
Course Category: DSE2 (Pract)

Practicals 2- Credits

Total: 60 hrs (4hrs/week)

PLANT BIOTECHNOLOGY

1. Preparation of simple growth nutrient (knop's medium), full strength, half strength, solid and liquid.
2. Preparation of complex nutrient medium (Murashige & Skoog's medium)
3. Selection, Prune, sterilize and prepare an explant for culture.
4. Significance of growth hormones in culture medium.
5. To demonstrate various stages of Micropropagation.

SUGGESTED READING

1. Bhojwani, S.S. and Razdan 2004 Plant Tissue Culture and Practice.
2. Brown, T. A. Gene cloning and DNA analysis: An Introduction. Blackwell Publication.
3. Gardner, E.J. Simmonns, M.J. Snustad, D.P. 2008 8th edition Principles of Genetics. Wiley India.
4. Raven, P.H., Johnson, GB., Losos, J.B. and Singer, S.R. 2005 Biology. Tata MC Graw Hill.
5. Reinert, J. and Bajaj, Y.P.S. 1997 Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture. Narosa Publishing House.
6. Russell, P.J. 2009 Genetics – A Molecular Approach. 3rd edition. Benjamin Co.
7. Sambrook & Russel. Molecular Cloning: A laboratory manual. (3rd edition)
8. Slater, A., Scott, N.W. & Fowler, M.R. 2008 Plant Biotechnology: The Genetic Manipulation of Plants, Oxford University Press.

Title of the Paper: MICROBIAL PHYSIOLOGY
Code: MBBT 506(T)
Course Category: DSE2 (Theo)

Theory 4- Credits

Total: 60 hrs (4hrs/week)

UNIT I (12 Periods)

Nutritional classification of microorganisms based on carbon, energy and electron sources, Metabolite Transport, Diffusion: Passive and facilitated, Primary active and secondary active transport, Group translocation (phosphotransferase system), symport, antiport and uniport, electrogenic and electro neutral transport, transport of Iron.

UNIT II (13 Periods)

Microbial Growth. Definition of growth, balanced and unbalanced growth, growth curve, the mathematics of growth-generation time, specific growth rate, batch and continuous culture, synchronous growth, diauxie growth curve. Measurement of microbial growth. Measurement of cell numbers, cell mass and metabolic activity

UNIT III (15 Periods)

Effect of the environment on microbial growth
Temperature- temperature ranges for microbial growth, classification based on temperature ranges and adaptations, pH-classification based on pH ranges and adaptations, solutes and water activity, oxygen concentration, radiation and pressure. Chemolithotrophic metabolism, Physiological groups of aerobic and anaerobic chemolithotrophs. Hydrogenoxidizing bacteria and methanogens.

UNIT IV (20 Periods)

Phototrophic metabolism. Historical account of photosynthesis, diversity of phototrophic bacteria, anoxygenic and oxygenic photosynthesis, photosynthetic pigments: action and absorption spectrum, type, structure and location, physiology of bacterial photosynthesis: light reactions, cyclic and non-cyclic photophosphorylation. Carbon dioxide fixation, Calvin cycle and reductive TCA cycle.

Title of the Paper: MICROBIAL PHYSIOLOGY
Code: MBBT 506(P)
Course Category: DSE2 (Pract)

Practicals 2- Credits

Total: 60 hrs (4hrs/week)

MICROBIAL PHYSIOLOGY

PRACTICALS

1. To study and plot the growth curve of *E coli* using turbidometric method and to calculate specific growth rate and generation time.
2. To study and plot the growth curve of *Aspergillus niger* by radial growth measurements.
3. To study the effect of pH on the growth of *E. coli*
4. To study the effect of temperature of *Aspergillus niger* by dry weight method.
5. Demonstration of the thermal death time and decimal reduction time of *E. coli.*

SUGGESTED READING

1. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag
2. Madigan MT, Martinko JM and Parker J. (2003). Brock Biology of Microorganisms.10th edition. Pearson/ Benjamin Cummings.
3. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons.
4. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India.
5. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press.

Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education

Title of the Paper: BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS/
Code: MBBT 603(T)
Course Category: DSE3 (Theo)

Theoretical 4- Credits

Total: 60 hrs (4hrs/week)

BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS

Unit 1 **(8 periods)**

Biosafety: Introduction; biosafety issues in biotechnology; Biological Safety Cabinets & their types; Primary Containment for Biohazards; Biosafety Levels of Specific Microorganisms

Unit 2 **(12 periods)**

Biosafety Guidelines: Biosafety guidelines and regulations (National and International); GMOs/LMOs- Concerns and Challenges; Role of Institutional Biosafety Committees (IBSC), RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of International Agreements - Cartagena Protocol.

Unit 3 **(4 periods)**

AERB/RSD/RES guidelines for using radioisotopes in laboratories and precautions.

Unit 4 **(12 periods)**

Introduction to Intellectual Property: Patents, Types, Trademarks, Copyright & Related Rights, Industrial Design and Rights, Traditional Knowledge, Geographical Indications- importance of IPR – patentable and non patentables – patenting life – legal protection of biotechnological inventions – World Intellectual Property Rights Organization (WIPO).

Unit 5 **(12 periods)**

Grant of Patent and Patenting Authorities: Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; An introduction to Patent Filing Procedures; Patent licensing and agreement; Patent infringement- meaning, scope, litigation, case studies, Rights and Duties of patent owner.

Unit 6 **(12 periods)**

Agreements and Treaties: GATT, TRIPS Agreements; Role of Madrid Agreement; Hague Agreement;WIPO Treaties; Budapest Treaty on international recognition of the deposit of microorganisms;UPOV & Brene conventions; Patent Co-operation Treaty (PCT); Indian Patent Act 1970 & recentamendments.

Title of the Paper: BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS/
Code: MBBT 603(P)
Course Category: DSE3 (Pract)

Practical 2- Credits

Total: 60 hrs (4hrs/week)

BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS (PRACTICAL)

1. Study of components and design of a BSL-III laboratory
2. Filing applications for approval from biosafety committee
3. Filing primary applications for patents
4. Study of steps of a patenting process
5. A case study

Suggested Reading

1. Bare Act, 2007.Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., New Delhi.
2. Kankanala C (2007). Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi.
3. Mittal, D.P. (1999). Indian Patents Law, Taxmann, Allied Services (p) Ltd.
4. Singh K K (2015). Biotechnology and Intelectual Property Rights: Legal and Social Impliocations, Springer India.
5. Goel D & Prashar S (2013). IPR, Biosafety and Bioethics. Pearson
6. Senthil Kumar Sadhasivam and Mohammed Jaabir, M. S. 2008. IPR, Biosafety and biotechnology Management. Jasen Publications, Tiruchirappalli, India.

Title of the Paper: BIOSTATISTICS
Code: MBBT 604 (T)
Course Category: DSE3 (Theo)

Theoretical 4- Credits

Total: 60 hrs (4hrs/week)

BIOSTATISTICS

UNIT I	**(12 Periods)**
Types of Data, Collection represntatioon of data; Primary & secondary data, Classification and Graphical data. Statistical skewness and measures of central tendency and Dispersion. Measures of Kurtosis.	
UNIT II	**(18 Periods)**
Probability classical & axiomatic definition of probability, Theorems on total and compound probability), Elementary ideas of Binomial, Poisson and Normal distributions.	
UNIT III	**(18 Periods)**
Methods of sampling, confidence level, critical region, testing of hypothesis and standard error, large sample test and small sample test. Problems on test of significance, t-test, chi-square test for goodness of fit and analysis of variance (ANOVA)	
UNIT IV	**(12 Periods)**
Correlation and Regression. Emphasis on examples from Biological Sciences.	

Title of the Paper: BIOSTATISTICS
Code: MBBT 604(P)
Course Category: DSE3 (Pract)

Practical 2- Credits

Total: 60 hrs (4hrs/week)

BIOSTATISTICSPRACTICALS

1. Practical Based on graphical Representation
2. Practical Based on measures of Central Tendency & Dispersion
3. Practical Based on Distributions Binomial Poisson Normal
4. Practical Based on t, f, z and Chi-square

SUGGESTED READING

1. Le CT (2003) Introductory biostatistics. 1st edition, John Wiley, USA
2. Glaser AN (2001) High Yield™ Biostatistics. Lippincott Williams and Wilkins, USA
3. Edmondson A and Druce D (1996) Advanced Biology Statistics, Oxford University Press.
4. Danial W (2004) Biostatistics : A foundation for Analysis in Health Sciences, John Wiley and Sons Inc.

Title of the Paper: EVOLUTIONARY BIOLOGY
Code: MBBT 605(T)
Course Category: DSE4 (Theo)

Theoretical 4- Credits

Total: 60 hrs (4hrs/week)

EVOLUTIONARY BIOLOGY

UNIT I **(10 Periods)**

Chemical theory of the origin of life (Oparin-Haldane theory and Miller's experiment), Concepts and theories of organic evolution, The Lamarckian heritage, From Darwin to Modern Synthesis of the theory of evolution, Evidences in favour of Darwinian evolution, Fossil record, types of fossils, transitional forms.

UNIT II **(10 Periods)**

Geological Time Scale, The Cambrian Explosion, Systematics and Classification, Molecular Phylogenies and evolution, Trends in evolution of plants and Animals, Evolution of molecular clock.

UNIT III **(20 Periods)**

Concepts of species and mechanisms of speciation, subspecies and races, Allopatric and Sympatric species, Character displacement, Biological and evolutionary species, "Type" concept of species, Macro and Microevolution, Parallel, convergent and divergent evolution, Anagenesis and Cladogenesis, Extinctions, Back ground and mass extinctions (causes and effects), detailed example of K-T extinction.

UNIT IV **(20 Periods)**

Populations, gene frequencies and equilibrium, Hardy Weinberg Principle, Forces of Evolution: mutation, genetic drift (Founder effect, population bottleneck), gene flow, natural selection, Patterns of natural selection, Polymorphism and selection, Selection in Action: Sickle Cell Anemia vs Malaria, Antibiotic resistance in bacteria, Group selection and Kin selection, r-selection and K-selection, Mimicry and protective colouration, Altruistic behaviour.

Suggested Readings:

1. **Strickberger M. W. (2000). Evolution. III Edition. Jones and Bartlett Publishers,**
2. **Kapoor V.C.Theory and Practice of Animal Taxonomy, IV Edition. Oxford and IBH Publishing Group.**
3. **Rastogi V.B. Organic Evolution. Rastogi Publications.**
4. **Alcock J (2013). Animal Behaviour: An Evolutionary Approach. X Edition. Oxford University Press**
5. **Evolution by Futuyama**

Title of the Paper: EVOLUTIONARY BIOLOGY
Code: MBBT 605 (P)
Course Category: DSE4 (Pract)
Practical 2- Credits

Total: 60 hrs (4hrs/week)

EVOLUTIONARY BIOLOGY

(1) Study of fossils from models/ pictures

(2) Study of homology and analogy from suitable specimens

(3) Demonstration of role of natural selection and genetic drift in changing allele frequencies using simulation studies.
(4) Construction of phylogenetic trees with the help of bioinformatics tools (eg: Clustal W, Phylip, NJ etc) and its interpretation.
(5) Visit to Museum/ excavation sites demarcated by Archaeological Survey of India to get exposed to natural history of plants and animals, techniques of conservation of fossilized specimens and prepare a short report.
(6) Mathematical Problem on Hardy Weinberg Equilibrium and Various factors disrupting it.

Title of the Paper: ENVIRONMENTAL BIOTECHNOLOGY
Code: MBBT 606(T)
Course Category: DSE4 (Theo)

Theoretical 4- Credits

Total: 60 hrs (4hrs/week)

UNIT I **(18 Periods)**

Conventional fuels and their environmental impact – Firewood, Plant, Animal, Water, Coal and Gas. Modern fuels and their environmental impact – Methanogenic bacteria, Biogas, Microbial hydrogen Production, Conversion of sugar to alcohol Gasohol

UNIT II **(20 Periods)**

Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents. Degradation of lignin and cellulose using microbes. Phyto-remediation. Degradation of pesticides and other toxic chemicals by micro-organisms- degradation aromatic and chlorinates hydrocarbons and petroleum products.

UNIT III

Treatment of municipal waste and Industrial effluents. Bio-fertilizers Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil. Algal and fungal biofertilizers (VAM)

UNIT IV **(10 Periods)**

Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium).

Environmental significance of genetically modified microbes, plants and animals.

SUGGESTED READING

1. Environmental Science, S.C. Santra
2. Environmental Biotechnology, Pradipta Kumar Mohapatra
3. Environmental Biotechnology – Concepts and Applications, Hans-Joachim Jordening and Jesef Winter
4. Waste Water Engineering, Metcalf and Eddy, Tata McGraw hill
5. Agricultural Biotechnology, S.S. Purohit
6. Environmental Microbiology : Methods and Protocols, Alicia L. Ragout De Spencer, John F.T. Spencer
7. Introduction to Environmental Biotechnology, Milton Wainwright
8. Principles of Environmental Engineering, Gilbert Masters
9. Wastewater Engineering – Metcalf & Eddy

Title of the Paper: ENVIRONMENTAL BIOTECHNOLOGY
Code: MBBT 606(P)
Course Category: DSE4 (Pract)
Practical 2- Credits

Total: 60 hrs (4hrs/week)

ENVIRONMENTAL BIOTECHNOLOGY

1. Calculation of Total Dissolved Solids (TDS) of water sample.
2. Calculation of BOD of water sample.
3. Calculation of COD of water sample.
4. Bacterial Examination of Water by MPN Method.

COMMON POOL OF SEC COURSES BOTH FOR B.Sc. (H) IN MOL. BIOL. & BIOTECHNOLOGY AND B.Sc. PROGRAMME COURSE IN MOLECULAR BIOLOGY

Title of the Paper: BIOFERTILIZERS
Code: MBSEC 101(T)
Theory-2 credits

Total: 30 hrs (2hrs/week)
Each Unit: 15hrs (1hr/week)

BIOFERTILIZERS

Unit 1:

General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis.*Azospirillum:* isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms.*Azotobacter*: classification, characteristics – crop response to *Azotobacter*inoculum, maintenance and mass multiplication. Cyanobacteria (blue green algae), *Azolla*and *Anabaena azollae*association, nitrogen fixation, factors affecting growth, blue green algae and *Azolla*in rice cultivation.

Unit II:

Mycorrhizal association- types of mycorrhizal association, taxonomy, occurrence anddistribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation andinoculum production of VAM, and its influence on growth and yield of crop plants.Organic farming – Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application.

Suggested Readings

1. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand& Co, New Delhi.
2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
3. John JothiPrakash, E. 2004. Outlines of Plant Biotechnology.Emkay _Publication, New Delhi.
4. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
5. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New _Delhi.
6. Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic _Farming Akta Prakashan, Nadiad

Title of the Paper: FLORICULTURE
Code: MBSEC 102 (T)

Total: 30 hrs (2hrs/week)
Each Unit: 15hrs (1hr/week)

Theory 2- Credits

FLORICULTURE

Unit 1:

Introduction: History of gardening; Importance and scope of floriculture and landscape gardening.

Nursery Management and Routine Garden Operations: Sexual and vegetative methods of propagation; Soil sterilization; Seed sowing; Pricking; Planting and transplanting; Shading; Stopping or pinching; Defoliation; Wintering; Mulching; Topiary; Role of plant growth regulators. Ornamental Plants: Flowering annuals; Herbaceous perennials; Divine vines; Shade and ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents; Palms and Cycads; Ferns and Selaginellas; Cultivation of plants in pots; Indoor gardening; Bonsai.

Unit 2:

Principles of Garden Designs: English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Flower beds, Shrubbery, Borders, Water garden. Some Famous gardens of India. Landscaping Places of Public Importance: Landscaping highways and Educationalinstitutions. Commercial Floriculture: Factors affecting flower production; Production andpackaging of cut flowers; Flower arrangements; Methods to prolong vase life; Cultivation ofImportant cut flowers (Rose, Carnation, Chrysanthemum, Gerbera, Gladiolous,Orchids). Diseases and Pests of Ornamental Plants.

Suggested Readings

1. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

Title of the Paper: APICULTURE
Code: MBSEC 103(T)

Total: 30 hrs (2hrs/week)
Each Unit: 15hrs (1hr/week)

Theory 2- Credits

APICULTURE

Unit 1: Biology of Bees

History, Classification and Biology of Honey Bees, Social Organization of Bee Colony
Rearing of Bees-Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth
Bee Pasturage Selection of Bee Species for Apiculture Bee Keeping Equipment
Methods of Extraction of Honey (Indigenous and Modern)

Unit 2: Industrial production

Bee Diseases and Enemies, Control and Preventive measures; products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis), Pollenetc. Entrepreneurship in Apiculture- Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial, Beehives for cross pollination in horticultural gardens

SUGGESTED READINGS

- Prost, P. J. (1962). *Apiculture*. Oxford and IBH, New Delhi.
- Bisht D.S., *Apiculture*, ICAR Publication.

- Singh S., *Beekeeping in India*, Indian council of Agricultural Research

Title of the Paper: ALCOHOL FERMENTATION
Code: MBSEC 104(T)

Total: 30 hrs (2hrs/week)
Each Unit: 15hrs (1hr/week)

Theory 2- Credits

UNIT I:

History of alcohol production, classical method of ethanol production -Starch Containing Raw Materials (potato, wheat, barley); amylolysis- Enzymatic Starch Liquefaction, enzymatic starch Liquefaction and saccharification (malt), Glucoamylase starch saccharification by using *Aspergillu, Rhizopus;* autoamylolytic enzyme from wheat, Mashing Processes & equipment,washing, grinding, Dispersing, mash tubs (specification), use of heat exchanger, Pressure Boiling Processes, Pressureless Breakdown of Starch (Infusion Processes), Recycling Processes, Fermentation- Batch and continuous Fermentation, Suppression of Contaminants,

UNIT 2:

Distillation- Distillation of Raw Spirit from Mashes, Rectification of Product Spirit from Raw Spirit, combined distillation and rectification, Stillage; Analysis of Raw Materials- Starch Content of Potatoes, grain, Determination of Fermentable Substance in Grain (FS), Autoamylolytical Quotient (AAQ); Analysis of Mashes- Mash Hydrosizing, pH of Mashes, Content of Ethanol in Mashes and Distillates, Microexamination, Analysis of Stillage- Content of Ethanol in Stillage, Energy Consumption and Energy Balance in Classical Processes, Industrial ethanol product by yeast and bacteria, immobilized cell system, substrates for industrial alcohol production.

Suggested Reading

1. The Biotechnology of Ethanol: Classical and Future Applications (2001) Edited by M. Roehr, WILEY Publication
1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
5. Salisbury, Whitaker and Hall. Principles of fermentation Technology

Title of the Paper: ENZYMOLOGY
Code:MBSEC 105 (T)
Theory 2- Credits

Total: 30 hrs (2hrs/week)

ENZYMOLOGY

UNIT – I **(15 Periods)**

Isolation, crystallization and purification of enzymes, test of homogeneity of enzyme preparation, methods of enzyme analysis. Enzyme classification (rationale, overview and specific examples) Zymogens and their activation (Proteases and Prothrombin).
Enzyme substrate complex: concept of E-S complex, binding sites, active site, specificity, Kinetics of enzyme activity, Michaelis-Menten equation and its derivation,
Different plots for the determination of Km and Vmax and their physiological significance, factors affecting initial rate, E, S, temp. &pH. Collision and transition state theories, Significance of activation energy and free energy.
Two substrate reactions (Random, ordered and ping-pong mechanism) Enzyme inhibition types of inhibition, determination of Ki, suicide inhibitor.
Mechanism of enzyme action: General mechanistic principle, factors associated with catalytic efficiency: proximity, orientation, distortion of strain, acid-base, nucleophilic and covalent catalysis. Techniques for studying mechanisms of action, chemical modification of active site groups, specific examples-: chymotrypsin, Iysozyme, GPDH, aldolase, RNase, Carboxypeptidase and alcohol dehydrogenase.
Enzyme regulation: Product inhibition, feed backcontrol, covalent modification.

UNIT – II **(15 Periods)**

Allosteric enzymes with special reference to aspartate transcarbomylase and phosphofructokinase.Qualitative description of concerted and sequential models. Negative co-operativity and half site reactivity. Enzyme - Enzyme interaction, Protein ligand binding, measurements analysis of binding isotherm, cooperativity, Hill and scatchard plots, kinetics of allosteric enzymes. Isoenzymes– multiple forms of enzymes with special reference to lactate dehydrogenase.Multienzyme complexes.Ribozymes.Multifunctional enzyme-eg Fatty Acid synthase.
Enzyme Technology: Methods for large scale production of enzymes.
Immobilized enzyme and their comparison with soluble enzymes, Methods for immobilization of enzymes.Immobilized enzyme reactors.Application of Immobilized and soluble enzyme in health and industry.Application to fundamental studies of biochemistry.Enzyme electrodes.
Thermal stability and catalytic efficiency of enzyme, site directed mutagenesis and enzyme engineering– selected examples, Delivery system for protein pharmaceuticals, structure function relationship in enzymes, structural motifs and enzyme evolution.
Methods for protein sequencing. Methods for analysis of secondary and tertiary structures of enzymes.Protein folding invitro & invivo.

SUGGESTED READING

1. Biochemistry, LubertStryer, 6th Edition, WH Freeman, 2006.
2. Harper's illustrated Biochemistry by Robert K. Murray, David A Bender, Kathleen M.Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil. 28th Edition, McGrawHill, 2009.
3. Biochemistry, Donald Voet and Judith Voet, 2nd Edition, Publisher: John Wiley andSons, 1995.
4. Biochemistry by Mary K.Campbell& Shawn O.Farrell, 5th Edition, Cenage Learning,2005.
5. Fundamentals of Enzymology Nicholas Price and Lewis Stevens Oxford University Press 1999
6. Fundamentals of Enzyme Kinetics Athel Cornish-Bowden Portland Press 2004
7. Practical Enzymology Hans Bisswanger Wiley–VCH 2004
8. The Organic Chemistry of Enzyme-catalyzed Reactions Richard B. Silverman Academic Press 2002

Title of the Paper: MOLECULAR DIAGNOSTICS
Code:MBSEC 106 (T)

Theory 2- Credits

Total: 30 hrs (2hrs/week)

MOLECULAR DIAGNOSTICS

UNIT I **(15 Periods)**

Enzyme Immunoassays:
Comparison of enzymes available for enzyme immunoassays, conjugation of enzymes. Solid phases used in enzyme immunoassays. Homogeneous and heterogeneous enzyme immunoassays. Enzyme immunoassays after immuno blotting. Enzyme immune-histochemical techniques. Use of polyclonal or monoclonal antibodies in enzymes immuno assays. Applications of enzyme immunoassays in diagnostic microbiology

Molecular methods in clinical microbiology:
Applications of PCR, RFLP, Nuclear hybridization methods, Single nucleotide polymorphism and plasmid finger printing in clinical microbiology

UNIT II **(15 Periods)**

Laboratory tests in chemotherapy:
Susceptibility tests: Micro-dilution and macro-dilution broth procedures. Susceptibility tests: Diffusion test procedures. Susceptibility tests: Tests for bactericidal activity. Automated procedures for antimicrobial susceptibility tests. Automation in microbial diagnosis, rapid diagnostic approach including technical purification and standardization of antigen and specific antibodies.Concepts and methods in idiotypes. Anti-idiotypes and molecular mimicry and receptors.Epitope design and applications.Immunodiagnostic tests.Immuno florescence.Radioimmunoassay.

SUGGESTED READING

1. Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker
2.Bioinstrumentation, Webster
3.Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe,Kluwer Academic
4.Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology.7th edition (edited by Paniker CKJ).University Press Publication.
5.Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology.24th edition.McGraw Hill Publication.
6.Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology.4th edition.Elsevier.
7.Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology.19th edition.Appleton-Centuary-Crofts publication.
8.Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology.7th edition.McGraw Hill Higher Education.
9.Microscopic Techniques in Biotechnology, Michael Hoppert

Title of the Paper: Mushroom Culture Technology
Code: MBSEC 107(T)
Theory-2 credits

Total: 30 hrs (2hrs/week)
Each Unit: 15hrs (1hr/week)

Unit 1:

Introduction, history. Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms.Types of edible mushrooms available in India - *Volvariella volvacea, Pleurotuscitrinopileatus, Agaricus bisporus*. Cultivation Technology : Infrastructure: substrates (locally available) Polythene bag,vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroomunit (Thatched house) water sprayer, tray, small polythene bag. Pure culture: Medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation Low cost technology, Composting technology in mushroom production.

UNIT 2

Storage and nutrition : Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickels, papads), drying, storage in saltsolutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content – Vitamins, Food Preparation:Types of foods prepared from mushroom.Research Centres - National level and Regional level. Cost benefit ratio - Marketing in India and abroad, Export Value.

Suggested Readings

1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
2. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
3. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications,

Delhi.
4. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II

Title of the Paper: MICROBIAL DIAGNOSIS IN HEALTH CLINICS
Code: MBSEC 108(T)
2-credits

Total: 30 hrs (2hrs/week)
Each Unit: 15hrs (1hr/week)

Unit 1 Importance of Diagnosis of Diseases

Bacterial, Viral, Fungal and Protozoan Diseases of various human body systems, Disease associated clinical samples for diagnosis.How to collect clinical samples (oral cavity, throat, skin, Blood, CSF, urine and faeces) and precautions required. Method of transport of clinical samples to laboratory and storage. Examination of sample by staining - Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa stained thin blood film for malaria; Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkey agar, Distinct colony properties of various bacterial pathogens.

Unit 2: Methods of Diseases Diagnosis

Serological Methods - Agglutination, ELISA, immunofluorescence, Nucleic acid based methods - PCR, Nucleic acid probes; Kits for Rapid Detection of Pathogens- typhoid, Dengue and HIV, Swine flu.Testing for Antibiotic Sensitivity in Bacteria- Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method,Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial double dilutionmethod

SUGGESTED READING

1. Ananthanarayan R and Paniker CKJ (2009) Textbook of Microbiology, 8th edition, Universities Press Private Ltd.
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Randhawa, VS, Mehta G and Sharma KB (2009) Practicals and Viva in Medical Microbiology 2nd edition, Elsevier India Pvt Ltd
4. Tille P (2013) Bailey's and Scott's Diagnostic Microbiology, 13th edition, Mosby
5. Collee JG, Fraser, AG, Marmion, BP, Simmons A (2007) Mackie and Mccartney Practical Medical Microbiology, 14th edition, Elsevier.

Title of the Paper: SERICULTURE
Code: MBSEC 109 (T)

Total: 30 hrs (2hrs/week)
Each Unit: 15hrs (1hr/week)

Theory 2- Credits

Unit 1:

Sericulture: Definition, history and present status; Silk route,Types of silkworms, Distribution and Races
Exotic and indigenous races, Mulberry and non-mulberry Sericulture; Life cycle of *Bombyx mori*
Structure of silk gland and secretion of silk; Rearing of Silkworms-Selection of mulberry variety and establishment of mulberry garden. Rearing house and rearing appliances; Disinfectants: Formalin, bleaching powder, RKO Silkworm rearing technology: Early age and Late age rearing,Types of mountages, Spinning, harvesting and storage of cocoons

Unit 2:

Pests and Diseases- Pests of silkworm: Uzi fly, dermestid beetles and vertebrates, Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial Control and prevention of pests and diseases; Entrepreneurship in Sericulture- Prospectus of Sericulture in India: Sericulture industry in different states, employment, potential in mulberry and non-mulberry sericulture. Visit to various sericulture centres.

SUGGESTED READINGS

- Handbook of Practical Sericulture: S.R. Ullal and M.N. Narasimhanna CSB, Bangalore
- Appropriate Sericultural Techniques; Ed. M. S. Jolly, Director, CSR & TI, Mysore.
- Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, Fuzi Pub. Co. Ltd., Tokyo, Japan1972.
- Manual of Silkworm Egg Production; M. N. Narasimhanna, CSB, Bangalore 1988.
- Silkworm Rearing; Wupang—Chun and Chen Da-Chung, Pub. By FAO, Rome 1988.
- A Guide for Bivoltine Sericulture; K. Sengupta, Director, CSR & TI, Mysore 1989.
- Improved Method of Rearing Young age silkworm; S. Krishnaswamy, reprinted CSB, Bangalore, 1986

Title of the Paper: INDUSTRIAL MICROPROPAGATION
Code: MBSEC 110 (T)

Total: 30 hrs (2hrs/week)
Each Unit: 15hrs (1hr/week)

Theory 2- Credits

Industrial Micropropagation

UNIT I:

Propagation of plants- seed propagation, vegetative propagation, micropropagation, History of

micropropagation industry, demand and need of micropropagation industries in India, minimum infrastructure needed to develop a micropropagation industry; Laboratory design, equipment, glassware and chemicals, designing a green-house for micropropagation; culture media preparation- composition of basal medium, media preparation from stock solution preparation to sterilization, use of different plan growth regulators in different stages of propagation, filter sterilization process of heat labile chemical solution, storage; explant preparation surface sterilization process of suitable explant, cleaning and sterilization of laminar hood, inoculation,

UNIT II

Different stages of micropropagation, the principal methods of micropropagation, effect of physical environment, Problems Inherent with Micropropagation contamination during culture inoculation, incubation and hardening, Hyperhydration, Oxidative Browning cleaning of plantlets, cleaning and sterilization of glass wares; Hardening of plantlets- primary and secondary hardening, controlling of light, temperature, humidity in hardening chamber, soil media preparation and sterilization before primary and secondary hardening, watering, fertigation, pest and disease control;
Micropropagation protocol for Musa accuminata; Protocol for micropropagation of the orchid—Phalaenopsis, Micropropagation protocol for Gladiolus; Techniques for detection of off types or somaclonal variants by molecular marker, virus free plant detection, packaging and transportation; advantages and disadvantages micropropagation, market demand and marketing strategies of micropropagated plants.

Suggested reading:

1. Bhojwani, S.S. and Razdan 2004 Plant Tissue Culture and Practice.
2. Raven, P.H., Johnson, GB., Losos, J.B. and Singer, S.R. 2005 Biology. Tata MC Graw Hill.
3. Reinert, J. and Bajaj, Y.P.S. 1997 Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture. Narosa Publishing House.
4. Sambrook & Russel. Molecular Cloning: A laboratory manual. (3rd edition)
5. Slater, A., Scott, N.W. & Fowler, M.R. 2008 Plant Biotechnology: The Genetic Manipulation of Plants, Oxford University Press.
6. Edwin F. George, Michael A. Hall, Geert-Jan De Klerk 2008, Plant Propagation by Tissue Culture
7. Sant Saran Bhojwani Prem Kumar Dantu 2012. Plant Tissue Culture: An Introductory Text

Title of the Paper: BASICS OF FORENSIC SCIENCE
Code: MBSEC 111 (T)
Theory 2- Credits

Total: 30 hrs (2hrs/week)

Unit I	**(10Periods)**

Introduction and principles of forensic science, forensic science laboratory and its organization and service, tools and techniques in forensic science, branches of forensic science, causes of crime, role of modus operandi in criminal investigation. Classification of injuries and their medico-legal aspects, method of assessing various types of deaths.

Unit II	**(10 Periods)**

Classification of fire arms and explosives, introduction to internal, external and terminal ballistics.Chemical evidence for explosives. General and individual characteristics of handwriting, examination and comparison of handwritings and analysis of ink various samples.

Unit III	**(10 Periods)**

Role of the toxicologist, significance of toxicological findings, Fundamental principles of fingerprinting, classification of fingerprints, development of finger print as science for personal identification,
Principle of DNA fingerprinting, application of DNA profiling in forensic medicine, Investigation Tools, eDiscovery, Evidence Preservation, Search and Seizure of Computers, Introduction to Cyber security.

SUGGESTED READING

1. Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
2. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi (2001).
3. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi (2002).
4. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).
5. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (ED.), CRC Press, Boca Raton (1997).
6. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).
7. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).

Title of the Paper: INDUSTRIAL FERMENTATIONS
Code: MBSEC 112 (T)

Theory 2- Credits

UNIT I	**(15 Periods)**

Production of industrial chemicals, biochemicals and chemotherapeutic products. Propionic acid, butyric acid, 2-3 butanediol, gluconic acid, itaconic acid, Biofuels: Biogas, Ethanol, butanol, hydrogen, biodiesel, microbial electricity, starch conversion processes; Microbial polysaccharides; Microbial insecticides; microbial flavours and fragrances, newer antibiotics, anti-cancer agents, amino acids.

UNIT II	**(15 Periods)**

Microbial products of pharmacological interest, steriod fermentations and transformations.Over production of microbial metabolite, Secondary metabolism – its significance and products.Metabolic engineering of secondary metabolism for highest productivity.
Enzyme and cell immobilization techniques in industrial processing, enzymes in organic synthesis, proteolytic enzymes, hydrolytic enzymes, glucose isomerase, enzymes in food technology/organic synthesis.

SUGGESTED READING

1. Casida LE. (1991). Industrial Microbiology.1st edition.Wiley Eastern Limited.
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition.Panima Publishing Co. New Delhi.
3. Patel AH. (1996). Industrial Microbiology.1st edition, Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ.(2006). Principles of Fermentation Technology.2nd edition, Elsevier Science Ltd.
5. Salisbury, Whitaker and Hall. Principles of fermentation Technology

CORE COURSES OF B.Sc PROGRAMME IN MOLECULAR BIOLOGY AS WELL AS GENERAL ELECTIVE COURSES OFFERED BY THE DEPARTMENT OF MOLECULAR BIOLOGY & BIOTECHNOLOGY FOR THE STUDENTS OF OTHER DEPARTMENTS

Title of the Paper: BIOLOGICAL CHEMISTRY

Code: MBG 101(T)

Course Category: CC1/GE 1 (Th)

Theory 4- Credits

Total: 60 hrs (4hrs/week)

Each Unit: 15hrs (1hr/week)

UNIT – I: Carbohydrates

1.1. **Carbohydrates**-Importance, classification and physical and chemical properties of carbohydrates

1.2. Structure, configuration and biochemical importance of Monosaccharides (Glucose and Fructose) Oxidation, Reduction, Osazone formation, Aldose &Ketose, Glycosides (Streptomycin, Cardiac glycosides and Ouabain)

1.3. Structure, configuration and biochemical importance of Disachharides and glycosidicbond ,Mutarotation, Haworth projection (Sucrose, Trehalose, Lactose, Maltose, Isomaltose, Cellobiose)

1.4. Homopolysaccharides (Starch, Glycogen, Inulin, Cellulose and Chitin)

1.5. Hetero polysachharides (Hyaluroic acid, Chondroitin sulfate, Heparin, Peptidoglycan)

UNIT – II: Proteins and Enzymes

2.1 Classification, structure and physical and chemical properties of aminoacids&protiens

2.2 Lipids, Fattyacids-importance, properties and classification, Simple lipids-TAG, Complex lipids, Derived lipids, sterols, Fatty acids: Saturated and Unsaturated fatty acids with examples. Biosynthesis of Fatty acids -palmitoyl-CoA, Cholesterol

2.3 Enzymes-classification and nomenclature. MichaelisMenton Equation-Factors influencing the enzyme reactions and Enzyme inhibition (Competitive and Non-competitive), role of co-enzymes and Enzyme Techonology.

2.4 Hormones, mode of action (Thyroid gland)

2.5 Vitamins- classification, sources, functions and applications

UNIT – III: Bioenergistics of biomolecules

3.1 Glycolysis

3.2 Gluconeogenesis and its significance

3.3 TCA Cycle, electron transport, Oxidative phosphorylation

3.4 β-oxidation of fatty acid

3.5 Transamination and Oxidative deamination reactions of amino acids. Amino acid catabolism (Phenyl ketonuria, albinism)

UNIT – 1V: Intermediary Metabolism

4.1 Urea cyle and regulation

4.2 Biosynthesis and regulation of purine and pyrimidine nucleotides, de novo and salvage pathways
4.3 Photosynthesis – Light reaction and photophosphorylation,
4.4 Photosynthesis – Carbon Assimilation

Title of the Paper: BIOLOGICAL CHEMISTRY
Code: MBG 101(P)
Course Category: CC1/GE 1 (Pr)

PRACTICAL- 2 Credits

Total: 60 hrs (4hrs/week)

1. Preparation of normal, molar and molal solutions
2. Preparation of buffers (acids, basic and neutral)
3. Qualitative tests of Sugars, amino acids and lipids
4. Estimation of proteins by Biurate method
5. Estimation of total sugars by Anthron method
6. Reducing sugars DNS method
7. Separation of protein by SDS – PAGE.
8. Separation of amino acids by paper chromatography, TLC

SUGGESTED READING

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley& Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 The World of the Cell.7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

Title of the Paper: MICROBIOLOGY
Code: MBG 201(T)
Course Category: CC4/GE 2 (Th)

Theory 4- Credits

Total: 60 hrs (4hrs/week)
Each Unit: 15hrs (1hr/week)

UNIT I :History of microbiology and an overview of bacterial structure

1.1 The Discovery of Microorganisms and contributions of Louis Pasteur, and Edward Jenner, Leeuwenhoek,the Conflict over spontaneous generation, Koch's postulates, the Scope and relevance of Microbiology

1.2 An overview of procaryotic cell structure; procaryotic cell membranes; the cytoplasmic matrix (inclusion bodies), ribosomes, the nucleoid, the procaryotic cell wall (gram positive & gram negative), the mechanism of gram staining; Components external to the cell wall (capsules, slime layers, and s-layers; pili and fimbriae), flagella and motility (flagellar ultrastructure, mechanism of flagellar movement, chemotaxis); the bacterial endospore

UNIT II: Microbial nutrition, growth and control

2.1 Nutrient req.
uirement for bacterial growth (macro- and micronutrients, purines, pyrimidines, amino acids, vitamins), iron Uptake and SiderophoresNutritional Types of Microorganisms; types of media (synthetic, complex, differential media)

2.2 Isolation of Pure Cultures (The Spread Plate and Streak Plate, The Pour Plate); the Growth Curve, the mathematics of growth Measurement of Microbial Growth (Cell Numbers, Cell Mass), The Continuous Culture of Microorganisms (Chemostat, Turbidostat

2.3 The Influence of Environmental Factors on Growth (extremophiles, Halophiles), effect of pH, Temperature (Psychrophiles, Mesophiles, thermophiles, hyperthermophiles) Pressure; Quorum Sensing and Microbial Populations

2.4 The physical Methods used to control bacteria (Heat, Low Temperatures, Filtration, Radiation), The chemical Methods used to control bacteria (Phenolics, Alcohols, Halogens

UNIT III: The Virology

3.1 General Properties of Viruses, cultivation of Viruses, Viral multiplication, Attachment, entry, un-coating, replication, assembly, release, Cell transformations, Cultivation of viruses-Assay techniques
3.2 The Structure of Viruses (Virion Size, General Structural Properties, Helical Capsids) types of viral nucleic Acids, Viral Envelopes and Enzymes

3.3. Animal viruses-Virus-Host interactions-Viral infections, plant viruses, bacteriophages,
3.4 host response and antiviral agentsimmune responses to viruses, interferon and other cytokines, antiviral therapy.

UNIT IV: Food and Industrial Microbiology

4.1 Microbial Growth and Food Spoilage, Controlling Food Spoilage, Removal of Microorganisms (Low Temperature, High Temperature, Pasteurization) Chemical-Based Preservation, Radiation, bacteriocins

4.2 Food-Borne Diseases, Food-Borne Infection, Food-Borne Intoxications, Detection of Food-Borne Pathogens

4.3 Production of Fermented Milks (buttermilk, sour cream, and yogurt); Cheese Production; Production of Alcoholic Beverages (Wines and Champagnes, Beers and Ales, Distilled Spirits), Production of Breads, a brief concept on probiotics.

Title of the Paper: MICROBIOLOGY
Code: MBG 201(P)
Course Category: CC4/GE 2 (Pr)
Practical 2- Credits

Total: 60 hrs (4hrs/week)

1. Demonstration, use and care of microbiological equipments.
2. Preparation of media, sterilization and isolation of bacteria.
3. Simple staining of bacteria
4. Gram staining of Bacteria
5. Endospore staining.
6. Demonstration of starch hydrolysis by bacterial cultures.
7. Growth of fecal coliforms on selective media.
8. Isolation of pure culture by streak plate method.
9. Antibiotic sensitivity assay.

SUGGESTED READING

1. Alexopoulos CJ, Mims CW, and Blackwell M. (1996). Introductory Mycology. 4 th edition. John and Sons, Inc.
2. Jay JM, Loessner MJ and Golden DA. (2005). *Modern Food Microbiology*. 7thedition, CBS Publishers and Distributors, Delhi, India.
3. Kumar HD. (1990). Introductory Phycology. 2nd edition. Affiliated East Western Press.
4. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/Benjamin Cummings.
5. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
6. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.
7. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9 th edition. Pearson Education.

8. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

Title of the Paper: MOLECULAR BIOLOGY

Code: MBG 301(T)

Course Category: CC7/GE 3 (Th)

Total: 60 hrs (4hrs/week)

Each Unit: 15hrs (1hr/week)

Theory 4- Credits

UNIT I : Structure of Nucleic Acids

1.1 DNA as the genetic material – Griffiths experiments, Avery, McLeod and Mc Carty's experiments. Hershey – Chase experiments.

1.2 RNA as genetic material – Tobacco Mosaic Virus

1.3 Structure and chemistry of DNA – Watson and Crick Model

1.4 Forms of DNA – A, B and Z forms of DNA, Super coiled and relaxed DNA – Role of DNA topoisomerases.

1.5 Structure of Cytoplasmic DNA – chloroplast DNA and Mitochondrial DNA.

UNIT II: Functions & Mechanisms of Nucleic Acids

2.1 DNA Replication – Models of DNA replication (Semi-conservative, non-conservative models)
2.2 Mechanisms of DNA replication – Linear and circular – Rolling circle and theta mechanism of replication. Enzymes involved in DNA replication.
2.5 DNA Recombination

UNIT III: Gene expression

3.1 Transcription in prokaryotes: Enzymatic Synthesis of RNA, Basic features of RNA synthesis, E.coli RNA polymerase, Classes of RNA molecules, Transcription mechanism in prokaryotes- Promoter, initiation, elongation, proof reading and Rho dependent and Rho independent termination.
3.2 Transcription in Eukaryotes: Polymerases of eukaryotes, Promoters of eukaryotes,
3.3 Synthesis of hn RNA, Splicing mechanisms-Self splicing, protein mediated splicing, alternative splicing, Capping and polyadenylation.
3.4 The Genetic Code, properties of genetic code, Wobble hypothesis.
3.5 Translation mechanism in prokaryotes and eukaryotes

UNIT IV: Regulation of Gene expression

4.1. Regulation in Prokaryotes: General aspects of Regulation
4.2. Transcription level regulation-positive, negative, auto and coordinated regulation
4.3. Operon concept – lac, trp operons.
4.4. Transcriptional Control through Transcription factors.
4.5 Translation regulation in Eukaryotic and prokaryotic organism

Title of the Paper: MOLECULAR BIOLOGY
Code: MBG 301(P)
Course Category: CC7/GE 3 (Pr)

Total: 60 hrs (4hrs/week)

Practical 2- Credits

1. Isolation of DNA from plant, animal/bacterial cells
2. Isolation of plasmid DNA
3. Identification of different topological forms of plasmid DNA
4. Analysis of DNA by agarose gel electrophoresis
5. Demonstration of PCR
6. Competent cell preparation, transformation and selection.
7. Study of induction β-Galactosidase Activity in *E.coli*

SUGGESTED READING

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
4. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.

Title of the Paper: RECOMBINANT DNA TECHNOLOGY
Code: MBG 401(T)
Course Cate-gory: CC10/GE 4 (Th)

Total: 60 hrs (4hrs/week)
Each Unit: 15hrs (1hr/week)

Theory 4- Credits

UNIT I:

Cutting and Joining DNA Fragments:
1.1 Host-controlled restriction and modification, Different types of restriction enzymes and their characteristic features
1.2 Viewing DNA Fragments, principle of gel electrophoresis, Southern, Northern and Western Blotting
1.3 Transformation of *E. coli,* Joining DNA molecules

UNIT II:

Cloning of genes:
2.1 Different types ofPlasmid vectors and their characteristic features, Concept and the use of selective markers

2.2 Bacteriophage vectors, Cosmid vectors
2.3 Expression vectors
2.4 Cloning vectors for eukaryotes, Yeast artificial chromosomes (YACs), Bacterial artificial chromosomes (BACs), Ti plasmid

UNIT III:

Finding Genes
3.1 Creating a genomic and cDNA library, Screening DNA libraries
3.2 Chromosome walking, Cloning Strategies
3.3 Polymerase Chain Reaction to Amplify DNA, DNA Foot printing, site-directed mutagenesis, Knockout mice

UNIT IV:

Applications of Recombinant DNA Technology
4.1 Pharmaceuticals
4.2 Specialized Bacteria
4.3 Agricultural Products
4.4 Oligonucleotide Drugs
4.5 Genetic Testing; Gene Therapy, Gene Mapping, DNA Fingerprinting

Title of the Paper: RECOMBINANT DNA TECHNOLOGY
Code: MBG 401(P)
Course Category: CC10/GE 4 (Pr)

Total: 60 hrs (4hrs/week)

Practical- 2Credits

1. Artificial transformation of *E.coli* with plasmid.
2. Primer design for PCR amplification
3. Agarose gel electrophoresis of DNA
4. SDS – PAGE electrophoresis.
5. Restriction digestion of DNA and Restriction mapping.
7. Isolation of RNA

SUGGESTED READING

1. Brown TA. (2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing, Oxford, U.K.
2. Clark DP and Pazdernik NJ. (2009). Biotechnology-Applying the Genetic Revolution. Elsevier Academic Press, USA.
3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington
4. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.

5. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.

DISCIPLINE SPECIFIC ELECTIVE (DSE) COURSE B.Sc. PROGRAMME COURSE IN MOLECULAR BIOLOGY

FOR DETAILED CONTENT OF THE SYLLABUS OF DSE COURSES THE STUDENTS HAVE TO CONSULT THE CORE COURSES OF B.Sc (H) IN MOLECULAR BIOLOGY & BIOTECHNOLOGY.

ABILITY ENHANCEMENT COURSES COMMON FOR BOTH B.Sc. PROGRAMME COURSE IN MOLECULAR BIOLOGY & B.Sc. (H) IN MOL. BIOL. & BIOTECHNOLOGY

FOR DETAILED CONTENT OF THE SYLLABUS OF AECC COURSES THE STUDENTS HAVE TO CONSULT UNIVERSITY WEBSITE