

B.Sc BIOTECHNOLOGY

FIRST YEAR - SEMESTER - I

CORE - I: CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY

SEMESTER – I	
Title of The Course: CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY	Category of The Course: CORE COURSE
Course Code: U1R3BTCC1	Nature of The Skill : Skill Development
Marks : CIA : 25 + Ext: 75 = 100	Hrs / Week : 5
Credits : 5	Total Inst. Hrs : 75

Course Objectives:

1	Have an insight of the cell as the fundamental unit of life and to compare the structure of the Eukaryotic cell with the primitive prokaryotic cell	
2	Analyze the structure and obtain a strong foundation about the functional aspects of cell organelles and cell membrane.	
3	Study the structure and functions of Nucleic acid and discuss the molecular mechanism of Replication, Transcription and Translation and post translational modifications of proteins.	
4	Predict the response of cells to the intra and extracellular environment by studying about the intracellular signaling pathways.	
5	Understand the principles and molecular mechanisms involved in cellular differentiation, morphogenesis, growth and Potency of the cell.	
UNIT	Contents	No. of Hours
I	Discovery and diversity of cells - Cell theory - Structure of prokaryotic (bacteria) and eukaryotic cells (plant and animal cells).	10
II	Biomacromolecules and Biomicromolecules (Primary functions in the cell). Structure and Functions of Cell Organelles: Cell wall - Cell membrane - Cytoplasm - Nucleus - chromosomes - Endoplasmic reticulum - Ribosomes - Golgi bodies - Plastids - Vacuoles - Lysosomes - Mitochondria - Microbodies - Flagella - Cilia - Centrosome and Centrioles – Cytoskeleton	20

III	Structure and functions of DNA and RNA -Central Dogma of the cell. DNA - Replication in prokaryotes - Transcription in Prokaryotes and Eukaryotes - RNA Processing - Genetic code- Translation - Similarities and differences in prokaryotic and eukaryotic translation - Post Translational Modifications - Protein Sorting - Protein degradation.	15
IV	Cell cycle - Cell cycle checkpoints - Cell division - Mitosis and Meiosis - Cellular differentiation - Cell junctions - Cell Adhesion - ExtraCellular Matrix - Cell to cell communications - Signal transduction - G - Protein Coupled Receptors Signal transduction pathways.	15
V	Gametogenesis - Spermatogenesis and Oogenesis in mammals. Fertilization- Types of cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals- Organogenesis.	15
Total		75

Text Books :

1	T. Devasena (2012), Cell Biology, Oxford University Press.
2	Gupta, Renu & Makhija, Seema & Toteja, Ravi. (2018). Cell Biology: Practical Manual.
3	Gilbert, S.F. 2016. Developmental Biology, 11 th edition. Sinauer Associates Inc. Publishers, MA. USA.
4	Bruce Alberts, 6 th Edition (2014). Molecular Biology of the cell, W. W. Norton & Company.
5	James D. Watson (2001), The Double Helix: A personal account of the Discovery of the Structure of DNA, Touchstone Publishers.

Reference Books:

1	Karp's Cell and Molecular Biology: Concepts and Experiments. 8 th Edition (2015). Wiley Publications.
2	James D. Watson, 7 th Edition (2014), Molecular Biology of the Gene, Pearson Publications.
3	Geoffrey M. Cooper, 7 th Edition (2015). The Cell: A Molecular Approach, Sinauer Associates, Qxford University Press.
4	Lodish Harwey, 6 th Edition (2016), Molecular Cell Biology, W. H. Freeman Publications.
5	Wolpert L, Tickle C, 2015. Principles of Development, 5 th edition, Oxford University Press.

Web Resources

1	http://www.cellbiol.com/education.php
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2	https://global.oup.com/uk/orc/biosciences/cellbiology/wang/student/weblinks/ch16/
3	https://dnalc.cshl.edu/websites/
4	https://www.cellsignal.com/contents/science/cst-pathways/science-pathways
5	https://nptel.ac.in/courses/102/106/102106025/11.

CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY		Course Code : U1R3BTCC1
S. No.	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO-1	Understand the complete nature of cell and its types	K1
CO-2	Obtain in-depth information about the Cell organelles and functions.	K1
CO-3	Apply his/her knowledge of central dogma for protein synthesis	K2
CO-4	Analyze the cell cycle and checkpoints.	K4
CO-5	Acquire combined knowledge with special emphasis on fertilization	K4

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	1	3	-	3	3	2	3
CO2	3	3	3	3	-	3	3	2	3
CO3	3	3	3	2	-	3	3	2	2
CO4	3	2	3	2	-	3	3	2	3
CO5	3	3	2	2	-	3	3	2	3
TOTAL	15	14	12	12	0	15	15	10	15
AVERAGE	3	2.8	2.4	2.4	0	3	3	2	3

Practical - I - CELL AND MOLECULAR DEVELOPMENTAL BIOLOGY

SEMESTER – I	
Title of The Course: PRACTICAL - I (Covering CC-I)	Category of The Course: Core Course
Course Code: U1R3BTCC2P	Nature of The Skill : Employability Based
Marks : CIA : 40 + Ext: 60 = 100	Hrs / Week : 05
Credits : 5	Total Inst. Hrs : 75

Course Objectives:		
1	Demonstrate the operation of Light Microscope	
2	Identify blood cells and its components	
3	Isolate and identify plant, and animal cells.	
4	Summarizes the concept of gametes	
5	Develop skill to perform cell fractionations.	
UNIT	Contents	No. of Hours
I	Components of a Compound / Light Microscope.	10
II	Blood smear preparation and Identification of Blood cells Buccal smear preparation and Identification of squamous epithelial cells.	15
III	Isolation and Identification of plant cells.	10
IV	Observation of sperm & Egg Mounting of chick Embryo - 24 hrs, 48 hrs, 72 hrs, 96 hrs. Types of placenta in mammals.	25
V	Cell fractionation and Identification of cell organelles (Demo)	15
Total		75
Text Books		
1	K.V. Chaitanya, (2013), <i>Cell and molecular biology: Lab manual</i> , PHI publishers,. ISBN 978-81-203-800-4	

PRACTICAL - I (Covering CC-I)		Course Code : U1R3BTCC2P
S. No.	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO-1	Understand the concept of microscope	K2
CO-2	Know the Importance of Blood smear preparation and Identification of Blood cells	K4
CO-3	isolate and Identify the plant cells	K5
CO-4	Acquire knowledge in sperm & Egg	K2
CO-5	Know about the functions of cell organelles and its importance	K6

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	3	3	2	2
CO2	3	3	3	3	3	3	3	2	2
CO3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	3	3	3
CO5	3	3	2	3	2	2	2	3	3
TOTAL	15	14	14	15	13	14	14	13	13
AVERAGE	3	2.8	2.8	3	2,6	2.8	2.8	2.6	2.6

Discipline Specific Elective - BIOLOGICAL CHEMISTRY

SEMESTER – I	
Title of The Course: BIOLOGICAL CHEMISTRY	Category of The Course: ELECTIVE COURSE
Course Code: U1R3BTDSE1:1	Nature of The Skill : Skill Development
Marks : CIA : 25 + Ext: 75 = 100	Hrs / Week : 4
Credits : 3	Total Inst. Hrs : 60

Course Objectives:	
1	Comprehend the importance of Chemistry and Biochemistry through the concept of acids and bases, and chemical bonding.
2	Demonstrates the formation of different types of solutions, concentrations of solution and preparation of buffer solutions
3	Recall the Structure, Classification, Chemistry and Properties of Carbohydrates and Explain Various Biochemical Cycles involved in Carbohydrate Metabolism.
4	Recall the Structure, Classification, Chemistry and Properties of Lipids, Nucleic acid and Explain Various Biochemical Cycles involved in Fatty acid and Nucleic acid Metabolism.
5	Understand the Structure, Classification, Chemistry and Properties of proteins amino acids and Identify and explain nutrients in foods and the specific functions in maintaining health.

UNIT	Contents	No. of Hours
1	Atomic theory, formation of molecules, electronic configuration of atoms- s & p shapes of atomic orbitals. Periodic table, periodic classification, valency. Types of chemical bonds. Classification of organic compounds -. Hybridization in methane, ethane, acetylene, and benzene. Definition with examples- electrophiles, nucleophiles and free radicals. Types of reactions with an example: addition, substitution, elimination, condensation and polymerization. Electrophilic substitution reaction in benzene, nitration and sulphonation.	12
II	Acids & Bases properties and differences, Concepts of acids and bases- Arrhenius, Lowry-Bronsted and Lewis. Concentration of solution, ways of expressing concentrations of solutions – per cent by weight, normality, molarity, molality, mole fraction. pH of solution, pH scale, measurement of pH. Buffer solutions, properties of	12

	buffers, Henderson-Hasselbalch equation, mechanism of buffer action of acidic buffer and basic buffer.	
III	Importance to Biochemistry-the chemical foundation of life. Water: its unique properties, ionization of water, buffering action in biological system, properties and characteristics of water. Classification of carbohydrates. Properties of carbohydrates. Ring structure of sugars and conformations of sugars. Metabolism of Carbohydrates – Glycogenesis, Glycogenolysis, Cori's cycle, Glycolysis, TCA cycle, bioenergetics of carbohydrate metabolism.	12
IV	Classification of Lipids. Characteristics, Properties and Biological importance of lipids. Metabolism of Fatty acids, triglycerides, phospholipids, cholesterol. B-oxidation of fatty acids. Classification of nucleic acids. Purine and Pyrimidine bases. Classification of DNA & RNA. Metabolism of Nucleic acids, Salvage pathway.	12
V	Classification and structure of amino acids. Structural conformation of proteins. Classification of proteins. Properties and biological importance of amino acids and proteins. Degradation of Amino acids and Urea Cycle. Vitamins and Hormones. Role of hormones in metabolism. ATP production. Oxidative phosphorylation, Electron transport chain and Photophosphorylation.	12
Total		60
Text Books		
1	P.L. Soni , A Text-book of Inorganic Chemistry, 11 th Edition, S. Chand & Sons publications	
2	Abhilasha Shourie, Shilpa S, Chapadgoankar & Anamika Singh (2020) Textbook of Biochemistry 1 st Edition	
3	J.L. Jain, 2016, Fundamentals of Biochemistry, S. Chand publication, 7th edition.	
4	A.C. Deb, 2016, Fundamentals of Biochemistry, New central book agencies, 7th edition.	
5	Satyanarayana .U, 2016, Biochemistry, MJ publishers 3 rd edition (2006).	
Reference Books		
1	Lehninger (2013) Principles of Biochemistrty 4 th edition WH Freeman and Company NY	
2	Murray <i>et al.</i> , (2003) Harper's biochemistry 26 th edition Appleton and Lange Publishers Florida USA	
3	Geoffrey L. Zubay, William W. Parson, Dennis E. Vance, 1995, Principles of Biochemistry, W.C. Brown Publishers, 1995, 3rd edition.	
4	Lubert Stryer (2007) Biochemistry –Stanford University 5 th Edition-W H Freemann and company San Francisco	
5	Bahl Arun, Bahl B. S. (2016), A Textbook of Organic Chemistry, 22 nd Edition, S. Chand &	

	Sons publications
Web Resources	
1	http://dwb4.unl.edu/chem869p/chem869plinks/s
2	www.longwood.edu/staff/buckalewdw/C3%20Biomolecules.pp
3	https://www.britannica.com › science › biochemistry
4	https://www.sciencedirect.com › topics › agricultural-and-biological-sciences
5	https://biochemistry.org › education › careers › becoming-a-bioscientist › w

BIOLOGICAL CHEMISTRY		Course Code : U1R3BTDSE1:1
S. No.	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO-1	Understand elements which are generally involved in the biochemistry and organic chemistry	K2
CO-2	Finding acids, bases and buffers	K4
CO-3	Understand the properties of carbohydrates and its metabolism	K5
CO-4	Acquire knowledge about the lipids and their classifications	K2
CO-5	Getting wide knowledge in proteins and vitamins	K6

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	1	3	2	2	3	3	3
CO2	3	2	1	3	2	2	3	3	3
CO3	3	1	2	3	2	2	3	3	3
CO4	3	2	3	3	2	1	3	3	3
CO5	3	2	3	2	2	2	3	2	3
TOTAL	15	10	10	14	10	9	15	14	15
AVERAGE	3	2	2	2.8	2	1.8	3	2.8	3

Discipline Specific Elective - ANATOMY & PHYSIOLOGY

SEMESTER – I	
Title of The Course: ANATOMY & PHYSIOLOGY	Category of The Course: ELECTIVE COURSE
Course Code: U1R3BTDSE1:2	Nature of The Skill : Skill Development
Marks : CIA : 25 + Ext: 75 = 100	Hrs / Week : 4
Credits : 3	Total Inst. Hrs : 60

Course Objectives:	
1	To understand the functions of special senses
2	To understand the importance of bones in movements
3	To impart the knowledge of muscles in of our body.
4	To acquire knowledge on Neurons and connections.
5	To gain the knowledge of hormonal impacts in our body

UNIT	Contents	No. of Hours
1	Introduction Type of membrane Skin and its tissue Accessory organs of the skin Regulation of body temperature Skin color Common skin disorder. Somatic sense Special senses: Sense of smell, Sense of taste, Sense of hearing, Sense of equilibrium, Sense of sight.	12
II	Skeletal System: Introduction - Bone structure - Bone development - Function of bones. Organization of the Joints of the Skeletal System: Introduction - Classification of joints - General Structures of a synovial joint - Types of synovial joints -Types of joint movements. Examples of synovial joints	12
III	Muscular Systems: Introduction - Structure of a Skeletal Muscle - Skeletal Muscle contraction - Muscular response: Smooth Muscles, Cardiac Muscle, Skeletal Muscle Actions	12
IV	Central Nervous System: Basic structure and function of the Nervous System. Nervous Tissue - Cell membrane potential - The synapse Processing impulses. Classification of Neurons and Nerve Fibers - Nerve Pathways. Division of the Nervous system. Introduction - Meninges - Spinal cord, Brian, Peripheral Nervous System, Autonomic Nervous System.	12

V	Endocrinology: Structure & Functions of Hormones: Pineal gland, Pituitary, Pancrease, Thyroid, Parathyroid, Thymus, Adrenal glands & Reproductive Hormones.	12
Total		60
Text Books		
1	Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers medical publishers, New Delhi.	
2	Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.	
3	Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A.	
4	Textbook of Human Histology by Inderbir Singh, Jaypee brothers medical publishers, New Delhi.	
5	Textbook of Practical Physiology by C.L. Ghai, Jaypee brothers medical publishers, New Delhi.	
Reference Books		
1	Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI, USA	
2	Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A. 3. Human Physiology (vol 1 and 2) by Dr. C.C. Chatterje ,Academic Publishers Kolkata	
3	Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA 10	
4	Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York	

ANATOMY & PHYSIOLOGY		Course Code : U1R3BTDSE1:2
S.No.	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO-1	Understand the complete nature of our skin and senses in detail.	K2
CO-2	Get an in-depth knowledge about the various joints and movement system of human body	K3
CO-3	apply their Knowledge in muscular contraction & coordination	K3
CO-4	Analyze the various factors which control the movements of our body	K4
CO-5	evaluate their body's growth with the hormones	K6

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	1	3	2	2	3	3	3
CO2	3	2	1	3	2	2	3	3	3
CO3	3	1	2	3	2	2	3	3	3
CO4	3	2	3	3	2	1	3	3	3
CO5	3	2	3	2	2	2	3	2	3
TOTAL	15	10	10	14	10	9	15	14	15
AVERAGE	3	2	2	2.8	2	1.8	3	2.8	3

NON MAJOR ELECTIVE

(Offering to other departments)

Semester -I

FOOD AND NUTRITION

SEMESTER – I	
Title of The Course: FOOD AND NUTRITION	Category of The Course: NON MAJOR ELECTIVE COURSE
Course Code: U1R3BTNME1:1	Nature of The Skill : Skill Development
Marks : CIA : 25 + Ext: 75 = 100	Hrs / Week : 2
Credits : 2	Total Inst. Hrs : 30

Course Objectives:		
1	The student can determine the relationship between food , health and immunity	
2	Able to explain the classification of foods and their deficiency	
3	Can analyse the importance of BMR	
4	Can outline the basic food groups and their adulteration	
5	Apply the concepts of food to prepare different food plans	
UNIT	Contents	No. of Hours
I	Definition of food, Nutrition, Nutrient, Nutritional status, Dietetics, Balance diet, Malnutrition, Energy (Unit of energy-Joule, Kilocalorie). Health, Immunity by food and function of food.	5
II	Carbohydrate, Protein, Fat, Vitamin and Minerals (Calcium, Phosphorous, Sodium, Potassium, Iron, Iodine, Fluorine) -Sources, Classification, Function, Deficiencies of these nutrients. Function of water and dietary fiber.	6
III	BMR: Definition, factors affecting BMR and total energy requirements (Calculation of energy of individuals)	4

IV	Basic five food groups, nutritional significance of cereals, pulses, milk, meat, fish, vegetables, egg, nuts, oils and sugars. Food toxins, Food additives, Food quality, Safe food handling, Food adulteration, Preservatives and Packaging.	6
V	Principles and Objectives of meal planning. Diet for an infant, preschool child, School child, normal male and female of different occupations.	4
Total		30
Text Books		
1	Vidya & D.B. Rao, 2010. A textbook of nutrition by, Discovery Publishing house	
2	Handbook of Nutrition & Food, third edition, CRC Press (Taylor and Francis group) by Carolyn D.Berdanier	
3	Food science and Nutrition, Oxford publication by Sunetra Roday	
4	Janet D Ward & Larry T Ward, Principles of food science by, Good heart-Wilcox publishing.	
5	Dr. M. Swaminathan, 2018. Hand Book of Food & Nutrition, Second edition Bangalore press.	
Reference Books		
1	Joshi, V.K. and Singh, R.S., A. (2013), <i>Food Biotechnology - Principles and practices</i> , I.K.International Publishing House Pvt. Ltd., New Delhi,.	
2	RavishankarRai, V,(2015), <i>Advances in Food Biotechnology</i> , (First edition), John Wiley & Sons, Inc, ISBN 9781118864555	
3	Foster, G.N., (2020), <i>Food Biotechnology</i> , (First edition), CBS Publishers & Distributors Pvt Ltd, ISBN 9789389396348	
4	Anthony Pometto, Kalidas Shetty, Gopinadhan Paliyath, Robert E. Levin (2005), <i>Food Biotechnology</i> , (2 nd edition), <i>CRC Press</i> ,ISBN 9780824753290	
5	Perry Johnson-Green (2018), <i>Introduction to Food Biotechnology</i> , Special Indian Edition, <i>CRC Press</i> , ISBN 9781315275703	

FOOD AND NUTRITION		Course Code : U1R3BTNME1:1
S. No.	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO-1	understand the nutrition and immunity	K2
CO-2	interpret the deficiencies of macromolecules and its effects	K4
CO-3	understand the BMR	K5
CO-4	Acquire knowledge about Food adulteration, Preservatives and Packaging.	K2
CO-5	get wide knowledge in Diet	K6

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	1	1	3	2	3	3	3
CO2	3	2	1	1	3	3	3	3	3
CO3	3	2	1	1	3	3	3	3	3
CO4	3	2	1	1	3	3	3	3	3
CO5	3	2	1	1	3	3	3	3	3
TOTAL	15	10	5	5	15	14	15	15	15
Average	3	2	1	1	3	2.8	3	3	3

NON MAJOR ELECTIVE**Semester -I****HERBAL MEDICINE**

SEMESTER – I	
Title of The Course: HERBAL MEDICINE	Category of The Course: NON MAJOR ELECTIVE COURSE
Course Code: U1R3BTNME1:2	Nature of The Skill : Employability
Marks : CIA : 25 + Ext: 75 = 100	Hrs / Week : 2
Credits : 2	Total Inst. Hrs : 30

Course Objectives:		
1	To analyses the importance of herbal medicine	
2	The student can learn the role of herbal medicines for health	
3	They can understand about Tribal medicine	
4	The student can analyses the role of traditional medicine for today's health	
5	The student can demonstrate the use of medicinal herbs to health	
UNIT	Contents	No. of Hours
1	Ethnomedicine – definition, history and its scope – Inter disciplinary approaches in ethnobotany – Collection of ethnic information.	5
II	Importance of medicinal plants – role in human health care – health and balanced diet (Role of proteins, carbohydrates, lipids and vitamins).	5
III	Tribal medicine – methods of disease diagnosis and treatment – Plants in folk religion– <i>Aegle marmelos</i> , <i>Ficus benghalensis</i> , <i>Curcuma domestica</i> , <i>Cynodon dactylon</i> and <i>Sesamum indicum</i> .	5

IV	Traditional knowledge and utility of some medicinal plants in Tamil Nadu – <i>Solanum trilobatum</i> , <i>Cardiospermum halicacabum</i> , <i>Vitex negundo</i> , <i>Adathoda vasica</i> , <i>Azadirachta indica</i> , <i>Gloriosa superba</i> , <i>Eclipta alba</i> , <i>Aristolochia indica</i> and <i>Phyllanthus fraternus</i> .	7
V	Plants in day today life – <i>Ocimum sanctum</i> , <i>Centella asiatica</i> , <i>Cassia auriculata</i> , <i>Aloevera</i> . Nutritive and medicinal value of some fruits (Guava, Sapota, Orange, Mango, Banana, Lemon, Pomegranate) and Vegetables - Greens (Moringa, <i>Solanum nigrum</i> Cabbage).	8
Total		30
Text Books		
1	R.K.Sinha & ShwetaSinha (2001), Ethnobiology. Surabhe Publications – Jaipur.	
2	D.C. Pal & S.K. Jain NayaPrakash, (1998), Tribal medicine, BidhanSarani, Calcutta ,	
3	S.K. Jain (2001) Contribution to Indian Ethnobotany – S.K. Jain, 3rd edition, Scientific publishers, B.No.91, Jodhpur, India.	
4	Andrew Chevallie, (2000) Encyclopedia of Herbal Medicine	
5	James Green (2000). The Herbal Medicine-Maker's Handbook: A Home Manual	
Reference Books		
1	Steven Horne and Thomas Easley (2016), Modern Herbal Dispensatory: A MedicineMaking Guide	
2	M.C. Joshi (2007) Handbook of Indian Medicinal Plants Hardcover.	
3	Neelesh Malviya and Sapna Malviya (2019). <i>Herbal Drug Technology</i> , (1st Edition), CBS Publishers and Distributors, ISBN: 9789387964334.	
4	Rageeb Md. Usman, Vaibhav M. Darvhekar, Vijay Kumar D, and Akhila S.A, (2019). <i>Practical Book of Herbal Drug Technology</i> , (1st Edition), Nirali Prakashan Publishers, ISBN: 9789388108002.	
5	Pragi and Varun Arora (2019). <i>Herbal Drug Technology</i> , (1st Edition), S.Vikas and Company Publisher, ISBN: 9781543343687	

HERBAL MEDICINE		Course Code : U1R2BTAC1
S. No.	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO-1	understand the basic concepts of ethnomedicine	K1,K2
CO-2	know the importance of medicinal plants	K3,K4
CO-3	understand the properties of Tribal medicine	K5
CO-4	acquire knowledge in utility of some medicinal plants	K2
CO-5	know the nutritive and medicinal value of fruits	K6

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	-	1	3	3	3	3	3
CO2	3	2	-	1	3	3	3	3	3
CO3	3	2	-	2	3	3	3	3	3
CO4	3	2	2	2	3	3	3	3	3
CO5	3	2	2	2	3	3	3	3	3
TOTAL	15	10	4	8	15	15	15	15	15
Average	3	2	0.8	1.6	3	3	3	3	3

NON MAJOR ELECTIVE

Semester -I

PUBLIC HEALTH AND HYGIENE

SEMESTER – I	
Title of The Course: PUBLIC HEALTH AND HYGIENE	Category of The Course: NON MAJOR ELECTIVE COURSE
Course Code: U1R3BTNME1:3	Nature of The Skill : Employability
Marks : CIA : 25 + Ext: 75 = 100	Hrs / Week : 2
Credits : 2	Total Inst. Hrs : 30

Course Objectives:		
1	understand the importance of health and hygiene	
2	analyze the importance of food and malnutrition	
3	understand the root and cause of diseases	
4	To know about the lifestyle diseases	
5	Will get awareness about various Health Services Organizations	
UNIT	Contents	No. of Hours
1	Scope health and hygiene - Concept of health and disease - Pollution and health hazards; water and airborne diseases. Radiation hazards: Mobile Cell tower and electronic. Role of health education in environment improvement and prevention of diseases. Personal hygiene, oral hygiene and sex hygiene.	5
II	Classification of food into micro and macro nutrients. Balanced diet, Importance of dietary fibres. Significance of breast feeding. Malnutrition anomalies – Anaemia, Kwashiorkar, Marasmus, Rickets, Goiter (cause, symptoms, precaution and cure).	6

III	Communicable viral diseases - measles, chicken pox, poliomyelitis, swine flu, dengue, chickungunya, rabies, leprosy and hepatitis. Communicable bacterial diseases- tuberculosis, typhoid, cholera, tetanus,plague, whooping cough, diphtheria, leprosy. Sexually transmitted diseases - AIDS, syphilis and gonorrhoea. Health education and preventive measures for communicable diseases.	7
IV	Non-communicable diseases such as hypertension, stroke, coronary heart disease, myocardial infarction. Osteoporosis, osteoarthritis and rheumatoid arthritis-cause, symptom, precautions. Diabetes- types and their effect on human health. Gastrointestinal disorders - acidity, peptic ulcer, constipation, piles. (cause, symptoms, precaution and remedy) Obesity (Definition and consequences). Mental illness (depression and anxiety). Oral and lung cancer and their preventive measures.	8
V	Health Services Organizations: World Health Organization (WHO), United Nations International Children’s Emergency Fund (UNICEF) and Indian Red Cross (IRC).	4
Total		30
Text Books		
1	Mary Jane Schneider (2011) Introduction to Public Health.	
2	Muthu, V.K. (2014) A Short Book of Public Health.	
3	Detels, R. (2017) Oxford Textbook of Public Health (6th edition).	
4	Gibney, M.J. (2013) Public Health Nutrition.	
5	Wong, K.V. (2017) Nutrition, Health and Disease.	
Reference Books		
1	S. Lal, (2018), Vikas. <i>Public Health Management Principles And Practice</i> , 2nd Edition, CBS Publishers and Distributors Pvt Ltd, ISBN: 978-93-87742-93-2.	
2	Mary-Jane Schneider (2016), <i>Introduction to Public Health</i> ,(5th Edition), Jones & Bartlett Learning,. ISBN-13: 978-1284197594	

3	Carolyn D. Berdanier, Johanna T. Dwyer, David Heber (2013), <i>Handbook of Nutrition and Food</i> , (3rd Edition), CRC Press,. ISBN 9781466505711
4	Sue Reed, Dino Pisaniello, GezaBenke, Kerrie Burton. (2013), <i>Principles of Occupational Health and Hygiene: An Introduction</i> , (2nd Revised ed. Edition), Allen &Unwin,
5	V. Kumaresan, R. Sorna Raj, (2012) <i>Public Health and Hygiene</i> ,(1st Edition), Saras Publication.

PUBLIC HEALTH AND HYGIENE		Course Code : U1R3BTNME1:3
S. No.	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO-1	understand the role of health education in environment improvement and prevention of diseases.	K2
CO-2	interpret the malnutrition anomalies	K4
CO-3	understand the ccommunicable viral diseases	K5
CO-4	acquire knowledge about Non-communicable diseases	K2
CO-5	get wide knowledge in Health Services Organizations	K6

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	-	2	3	3	3	3	3
CO2	3	3	-	2	3	3	3	3	3
CO3	3	3	1	2	3	3	3	3	3
CO4	3	3	1	2	3	3	3	3	3
CO5	2	3	2	3	3	3	2	2	3
TOTAL	14	15	4	11	15	15	14	14	15
Average	2.8	3	0.8	2.2	3	3	2.8	2.8	3

NON MAJOR ELECTIVE**Semester -I****ENVIRONMENT MANAGEMENT IN INDUSTRIES**

SEMESTER – I	
Title of The Course: ENVIRONMENT MANAGEMENT IN INDUSTRIES	Category of The Course: NON MAJOR ELECTIVE COURSE
Course Code: U1R3BTNME1:4	Nature of The Skill : Employability
Marks : CIA : 25 + Ext: 75 = 100	Hrs / Week : 2
Credits : 2	Total Inst. Hrs : 30

Course Objectives: students will be able to		
1	understands the need of Instruments for Medical field	
2	Can examine the setup of Dairy Industry	
3	Learn the Management skills for Agri Industry	
4	Understanding of hazards in Workplace	
5	Gains knowledge about Industrial hazards and its prevention	
UNIT	Contents	No. of Hours
1	Introduction to life science, computer in life science-Medical imaging, Genomics and phylogenetics, Drug design and discovering, Assistive robotics, Brain-computer interfaces, Simulation of biological systems and Medical treatment optimization.	4
II	Introduction to Dairy industries, The Structure of Dairying in Developing Countries, Application of Computer in Dairy Industry, Milk Procurement & Billing, Plant Automation, Computerized Accounting System, Applications of Management Information System (MIS), Packaging, Supply Chain Integration and Traceability.	6
III	Agribusiness - Application of marketing and decision making in contemporary agribusiness firms. Marketing strategies, marketing research and information, segmentation and targeting, Professional selling skills and knowledge – Rural	6

	Development – NABARD.	
IV	Hazards in the workplace: Pressure, Biological, Chemical, Electricity, Fire, Heat & Cold, Indoor Air Quality, Lighting, Noise, ergonomics, Radiation (ionizing & non ionizing), Vibrations, hours of work, violence in work place, Understanding of Material Safety Data Sheets, Accidents and Safety Management: Accident Prevention methods, Safety Management and audit, Personal Protection Approaches.	8
V	Occupational Health & Industrial Hygiene: Scientific and engineering basis for occupational health, biological monitoring (e.g. BEI), Occupational Hygiene, Concept of First Aid, Preventive Measures, and Occupational Health & Safety Management System: OHSAS – 18000.	6
Total		30
Text Books		
1	Multi-Criteria Decision Analysis for Risk Assessment and Management, Editors Jingzheng Ren, Series Title Industrial Ecology and Environmental Management PublisherSpringer Cham, DOI https://doi.org/10.1007/978-3-030-78152-1	
2	Environmental Management, Butterworth-Heinemann,Editor(s): Iyyanki V.Muralikrishna, Valli Manickam, 2017,Page iv,ISBN 9780128119891, https://doi.org/10.1016/B978-0-12-811989-1.12001-9 . (https://www.sciencedirect.com/science/article/pii/B9780128119891120019)	
3	Life Cycle Sustainability Assessment for Decision-Making Methodologies and Case Studies Book 2020 Editors Jingzheng Ren & Sara Toniolo	
Reference Books		
1	Lalat Chander, 2010. Text book of Dairy Plant Layout and Design, ICAR, New Delhi.	
2	Larry R. Collins, 2001.Physical Hazards of the Workplace, CRC Press, Taylor&Francis group.	
3	Andrew Barkley, 2013, Principles of Agricultural Economics, Taylor&Francis group.	
4	Mishra R.K., 2015. Occupational health management, Aitbs Publishers and Distributors- Delhi.	

ENVIRONMENTAL MANAGEMENT IN INDUSTRIES		Course Code : U1R3BTNME1:4
S. No.	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO-1	Know the uses of computer in life science.	K2
CO-2	Acquire knowledge in dairy industry.	K4
CO-3	Get knowledge on Agribusiness	K5
CO-4	Acquire knowledge about Accidents and Safety Management:	K2
CO-5	Getting wide knowledge in Occupational Health & Industrial Hygiene	K6

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CLO1	3	3	3	3	3	2	3	3	3
CLO2	3	3	3	3	3	2	3	3	3
CLO3	3	3	3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3	3	3	3
CLO5	3	3	3	3	3	3	3	3	3
TOTAL	15	15	15	15	15	13	15	15	15
Average	3	3	3	3	3	2.6	3	3	3

NON MAJOR ELECTIVE

Semester -I

GOOD LABORATORY PRACTICES (GLP)

SEMESTER – I	
Title of The Course: GOOD LABORATORY PRACTICES (GLP)	Category of The Course: NON MAJOR ELECTIVE COURSE
Course Code: U1R3BTNME1:5	Nature of The Skill : Employability
Marks : CIA : 25 + Ext: 75 = 100	Hrs / Week : 2
Credits : 2	Total Inst. Hrs : 30

Course Objectives:		
1	The student obtains adequate information to setup Biotechnology Laboratory	
2	Learn to prepare solutions and maintenance of lab	
3	Can demonstrate the working of lab equipment's	
4	Learns about Biotechnology lab standards	
5	gains knowledge about Safety measures	
UNIT	Contents	No. of Hours
1	Biotechnology lab organization - Types of labs associated with Biotechnology (General lab, microbial culture lab, plant tissue culture lab, Fermentation lab, computational stimulation lab), Types of Chemical (Analytical grade, molecular grade) and its various arrangement (Arrangement of basic chemicals, solvent, acid and base, fine chemicals like dyes, protein and enzyme storage units), Physical chemical characteristics: hygroscopic, corrosive, volatile properties; Fire and explosion hazard data, Health hazards (how to use UV-illuminator), Fumigation technique.	8

II	Lab ethics - Regulatory affairs: Methods and types of documentation (pre-lab writes, result recording and post lab report: interpretation of result), Dilution factor calculation, Molarity, percentage, dilution of concentrated solution, metric units (kg to gms and vice -versa).	5
III	Instrument calibration and importance - Principles, use and maintenance of laboratory instruments like Autoclave, hot air oven, Incubators, Water bath, Refrigerator, Centrifuge, Calorimeter, pH meter, Haemocytometer, Microtome, Electronic balances, Bio safety cabinets. SOP preparation for instrumentation.	6
IV	GLP & Biotechnology Industry standards - Good Laboratory guidelines, Elements of GLP, Standard Operating Procedures and its importance, Quality Assurance & Quality control, Internal audit basics, ISO, BIS and HACCP standards.	5
V	Types of wastes and safe disposal methods - Definition of waste, types of waste: Biological and chemical waste, methods of Safe Disposal of biological and chemical waste: treatment methods of Ethidium Bromide solutions, Electrophoresis Gels, Contaminated Gloves, debris, Wastes containing sodium azide, Silver staining solutions, Perchloric acid, Nanoparticle wastes, Spill management, Awareness and training for personnel.	6
Total		30
Text Books		
1	Milton A. Anderson GLP Essentials: A Concise Guide to Good Laboratory Practice, Second Edition 2nd Edition, Published by CRC press.	
2	GLP Essentials A Concise Guide to Good Laboratory Practice, Second Edition By Milton A. Anderson, Copyright Year 2002	
3	Principles of Good Laboratory Practice Paperback – 1 January 2020 by Pradeep Deshmukh (Author)	
Reference Books		

1	Good Laboratory Practice: Nonclinical Laboratory Studies Concise Reference Paperback – Import, 18 October 2010 by <u>Mindy J Allport-Settle</u> (Author)
2	Good Laboratory Practice Standards: Applications for Field and Laboratory Studies (ACS Professional Reference Book) 1st Edition by <u>Willa Y. Garner</u> (Editor), <u>Maureen S. Barge</u> (Editor), <u>James P. Ussary</u> (Editor)
Web Resources	
1	https://www.oecd.org/chemicalsafety/testing/overview-of-good-laboratory-practice.htm
2	https://www.intechopen.com/chapters/22127

GOOD LABORATORY PRACTICES		Course Code : U1R3BTNME1:5
S.No.	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO - 1	understand the basic calibration and handling of instrumentation in laboratory	K2
CO - 2	maintain laboratory records	K3
CO - 3	answer the complaints with current industry standards	K3
CO - 4	maintain audit records	K4
CO - 5	know the waste disposal methods	K6

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	1	3	2	3	3	3
CO2	3	3	3	2	3	1	3	3	3
CO3	3	3	3	2	3	1	3	3	3
CO4	3	3	2	2	2	3	3	3	3
CO5	3	3	2	2	2	3	3	3	3

TOTAL	15	15	13	9	13	10	15	15	15
Average	3	3	2.6	1.8	2.6	2	3	3	3

NON MAJOR ELECTIVE

Semester -I

ORGANIC FARMING AND HEALTH MANAGEMENT

SEMESTER – I	
Title of The Course: ORGANIC FARMING AND HEALTH MANAGEMENT	Category of The Course: NON MAJOR ELECTIVE COURSE
Course Code: U1R3BTNME1:6	Nature of The Skill : Entrepreneurship
Marks : CIA : 25 + Ext: 75 = 100	Hrs / Week : 2
Credits : 2	Total Inst. Hrs : 30

Course Objectives:		
1	The student will value the concepts of ecology and environment	
2	To know the techniques of Vermicomposting and enjoying the cultivation of common Medicinal Herbs	
3	To gain the knowledge about Principles and Policies in Organic forming and Certification agencies	
4	To realize the Concept of Health and importance of well being	
5	To appreciate the Role of exercise and nutrition in Health related fitness	
UNIT	Contents	No. of Hours
I	Ecology and Environment – Principles of ecology – Ecosystem - Biotic and abiotic components and interaction – Energy flow –Nutrient cycle – Biodiversity – Endemic – Exotic - Interrelationships.	5
II	Composting – Microbial Compost – Vermicompost – Setup for vermicompost unit - Nutrition garden – Ring garden – Double digging – Cultivating vegetables – Common medicinal herbs – Identification and Cultivation.	6

III	Organic farming – Principles and Policies – Certification agencies – AGMARK, fssai, Halal certification – Participatory grading system (PGS) – Storage – Packing – Transportation – Marketing. Micro-enterprises – Self Help Groups – Economics of cultivations – Sustainability.	7
IV	Health: Concept of Health, changing concepts definitions of health, dimensions of health, concept of well being, spectrum of health, determinants of health, ecology of health, right to health, responsibility for health, indicators of health.	6
V	Exercise and Health related fitness: Health related fitness, health promotion, physical activity for health benefits. Sports related fitness: Role of nutrition in sports, nutrition to athletic performance.	6
Total		30
Text Books		
1	G.K. Veeresh, 2006. Organic farming , First edition, New Delhi, India Foundation Books in association with Centre for Environment Education.	
2	Mangala rai, 2012.Hand Book of Agriculture, Sixth Edition, ICAR New Delhi.	
3	B.B. Sharma , 2007. A Guide to Home Gardening, Second Edition, MIB India, New Delhi.	
4	Adrienne E. Hardman, 2009. Physical Activity and Health – The evidence explained, Second edition, Taylor and Francis Group.	
Reference Books		
1	Farmers of Forty Centuries: Permanent Organic Farming in China, Korea, and Japan Hardcover – 10 June 2011, by F. H. King (Author)	
2	Organic Farming: Components And Management Edition: 1 Author/s:Gehlot D , Publisher: M/s AGROBIOS (INDIA) ISBN: 9788177544008	

NON MAJOR ELECTIVE

Semester -I

BIOTECHNOLOGY FOR SOCIETY

SEMESTER – I	
Title of The Course: BIOTECHNOLOGY FOR SOCIETY	Category of The Course: NON MAJOR ELECTIVE COURSE
Course Code: U1R3BTNME1:7	Nature of The Skill : Employability
Marks : CIA : 25 + Ext: 75 = 100	Hrs / Week : 2
Credits : 2	Total Inst. Hrs : 30

Course Objectives:		
1	understand the role of Biotechnology in Sericulture, Apiculture and Mushroom Cultivation	
2	gain knowledge about the production of Bio fertilizer and advantages of Biopesticides	
3	understand the significance of microorganisms in Biodegradation	
4	get know about History of Antibiotics	
5	able to comprehend about Transgenic Plants	
UNIT	Contents	No. of Hours
1	Introduction to Biotechnology- Role of Biotechnology in sericulture- Rearing of silkworms- Importance and applications- Role of Biotechnology in apiculture- Bee hive hierarchy- Bee keeping process- Products obtained- Mushroom farming stages- Cultivation of paddy straw mushroom- Importance of mushroom cultivation.	8
II	Biofertilizer- Definition- Mass production of <i>Rhizobium</i> -Advantages and disadvantages- Biopesticides- Definition- Microbial biopesticides- <i>Bacillus thuringiensis</i> - Single cell protein- Introduction- history- production of <i>Spirulina</i> SCP- Applications- Advantages & disadvantages.	7

III	Biodegradation- Definition- Process-role of microorganisms in biodegradation - biodegradable plastics-advantages- Bio weapons- introduction- history- potential agents- delivery methods- harmful effects.	6
IV	Antibiotics- Definition- Introduction and history of antibiotics- sources- classification- spectrum- production of penicillin- definition of antibiotic resistance.	4
V	Transgenic plants – Definition of transgene and transgenesis - BT Cotton, Flavr-Savr tomato and Golden rice- history – importance, applications, advantages and disadvantages.	5
Total		30
Text Books		
1	Sathyanarayana, U., Chakrapani, U., (2008). <i>Biotechnology</i> , First edition, Books and allied (P) Ltd, Kolkata.	
2	A.K. Chatterji, (2011). <i>Introduction to Environmental Biotechnology</i> , Third edition, PHI Learning Pvt Ltd. New Delhi. ISBN-978-81-203-4298-9	
3	R.C. Dubey, (2014). <i>A text book of Biotechnology</i> , S.Chand& Company, New Delhi. ISBN 9788121926089	
4	H. Patel, (2011). <i>Industrial Microbiology</i> ,(2 nd edition), MacMillan Publishers	
5	Thakur, I.S., (2019). <i>Environmental Biotechnology- Basic principles and applications-</i> (2 nd edition)- Dreamtech Press, ISBN 978-93-89307-55-9	
Reference Books:		
1	Basics of Biotechnology Paperback – 1 January 2004, by A.J. Nair (Author) Publisher Laxmi Publications	
2	Basic Biotechnology Paperback – 2 February 2008, by Ratledge Colin (Author) Publisher Cambridge University Press	

BIOTECHNOLOGY FOR SOCIETY		Course Code: U1R3BTNME1:7
S.No	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO - 1	obtain knowledge on industrial production of enzymes etc	K1
CO - 2	understand the transgenic plants and their techniques	K2
CO - 3	realize the waste management and sewage treatment systems	K3
CO - 4	acquire knowledge on forensic science	K3
CO - 5	know vaccine production	K4

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	2	3	3
CO3	3	2	3	3	3	3	3	2	3
CO4	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	2	3	2	3	3
TOTAL	15	14	15	15	14	15	13	14	15
Average	3	2.8	3	3	2.8	3	2.6	2.8	5

NON MAJOR ELECTIVE

Semester -I

COMPUTATIONAL BIOLOGY

SEMESTER – I	
Title of The Course: COMPUTATIONAL BIOLOGY	Category of The Course: NON MAJOR ELECTIVE COURSE
Course Code: U1R3BTNME1:8	Nature of The Skill : Skill Development
Marks : CIA : 25 + Ext: 75 = 100	Hrs / Week : 2
Credits : 2	Total Inst. Hrs : 30

Course Objectives:		
1	understand Primary and Secondary Biological Databases which are currently used in Bioinformatics	
2	identify the similarity between the Sequences by using different software's	
3	Develop skills to generate Phylogenetic trees for the analysis of multiple sequences alignment and phylogenetic analysis (PHYLIP)	
4	gain knowledge of Drug Discovery and Drug designing	
5	expertise in Structure prediction of proteins and homology modeling of proteins by learning different types of Visualization tools and Gene prediction tools.	
UNIT	Contents	No. of Hours
I	Overview and Definition, Application of Bioinformatics, Sequences format used in Bioinformatics- Biological Database: Introduction, Classification of biological databases, Primary database- Nucleic acids- NCBI-DDBJ-EMBL. Protein- PDB-SWISSPORT. Secondary database- PROSITE, PFAM. Structure and classification- SCOP-CATH, Metabolic pathway database.	8
II	Sequences similarity, Identify & homology- Definition of homologues, Orthologues, Paralogues. Scoring matrices, Pairwise Sequences alignment. Dot Matrix, BLAST,	5

	FASTA- Needleman Wunsch – Smith and waterman Algorithm.	
III	Multiple Sequences alignment – Different method of multiple sequences alignment- Evolutionary analysis, clustering methods Phylogenic trees- rooted and unrooted tree- Methods to generate phylogenetic tree- Tools for multiple sequences alignment and phylogenetic analysis (PHYLIP).	5
IV	History of Drug Discovery, Steps in Drug design - Chemical libraries – Role of molecular docking in drug design.	4
V	Protein prediction - Study of internet resources in Bioinformatics -Tools for primary (Compute PT/Mw, Protparam), secondary (PROSITE), Tertiary (Swiss Model), Structure prediction of proteins, Homology modeling of proteins. Visualization tools (RASMOL), Gene prediction tools (Genscan, Grail).	8
Total		30

Text Books

1	Rastogi, S.C, Mendiratta, N,Rastogi, P., 2004. Bioinformatics methods and application. Prentice-Hall of India private limited, New Delhi.
2	David Mount., Bioinformatics: sequence and genome analysis, second edition., Taylor & Francis, UK; 2009.
3	D.R.Westhead. Instant Notes in Bioinformatics., second edition., Taylor & Francis, UK; 2009.
4	Gautam B. Singh., Fundamentals of Bioinformatics and Computational Biology, Oakland University Rochester, Michigan USA.
5	Arthur M.Lesk., Introduction to bioinformatics., Oxford University Press.

Reference Books

1	Mohammad AmjadManaullahAbid. (2019). <i>Fundamentals of Computers</i> . (1 st Ed.)DreamtechPress, ISBN-978-93-89520-39-2
2	S.P. Gupta (2019), <i>Biostatistical methods</i> (1 st Ed.)Sultan Chand and Sons, ISBN 93-5161-112-7
3	Veer Bala Rastogi (2018). <i>Biostatistics</i> . Medtech Publisher, ISBN: 9789384007591, 9384007595
4	Jerrold H. Zar (2014), <i>Biostatistical Analysis</i> (5 th Ed), New Delhi: Pearson Education

5	Priti Sinha Pradeep K. Sinha (2018). <i>Computer Fundamentals</i> (6 th Ed.) BPB Publications; Reprint Edition, ISBN: 9788176567527
Web Resources	
1	www.expasy.org

COMPUTATIONAL BIOLOGY		Course Code : U1R2BTNME1:8
S. No.	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO-1	Understand the concept of Application of Bioinformatics	K2
CO-2	Know the Importance of Sequences similarity	K4
CO-3	Understand the Multiple Sequences alignment	K5
CO-4	Acquire knowledge molecular docking	K2
CO-5	Know the Protein prediction	K6

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	3	3	3	3
CO2	3	3	3	2	2	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3
TOTAL	15	15	15	13	13	15	15	15	15
Average	3	3	3	2.6	2.6	3	3	3	3

Foundation Course - GOOD LABORATORY PRACTICES (GLP)

SEMESTER – I	
Title of The Course: GOOD LABORATORY PRACTICES (GLP)	Category of The Course: FOUNDATION COURSE
Course Code: U1R3BTFC	Nature of The Skill : Employability
Marks : CIA : 25 + Ext: 75 = 100	Hrs / Week : 2
Credits : 2	Total Inst. Hrs : 30

Course Objectives:	
1	The student obtains adequate information to setup Biotechnology Laboratory
2	Learn to prepare solutions and maintenance of lab
3	Can demonstrate the working of lab equipment's
4	Learn about Biotechnology lab standards
5	Gains knowledge about Safety measures and waste disposal

UNIT	Contents	No. of Hours
I	Biotechnology lab organization - Types of labs associated with Biotechnology (General lab, microbial culture lab, plant tissue culture lab, Fermentation lab, computational stimulation lab), Types of Chemical (Analytical grade, molecular grade) and its various arrangement (Arrangement of basic chemicals, solvent, acid and base, fine chemicals like dyes, protein and enzyme storage units), Physical chemical characteristics: hygroscopic, corrosive, volatile properties; Fire and explosion hazard data, Health hazards (how to use UV-illuminator), Fumigation technique.	8
II	Lab ethics - Regulatory affairs: Methods and types of documentation (pre-lab writes, result recording and post lab report: interpretation of result), Dilution factor calculation, Molarity, percentage, dilution of concentrated	5

	solution, metric units (kg to gms and vice -versa).	
III	Instrument calibration and importance - Principles, use and maintenance of laboratory instruments like Autoclave, hot air oven, Incubators, Water bath, Refrigerator, Centrifuge, Calorimeter, pH meter, Haemocytometer, Microtome, Electronic balances, Bio safety cabinets. SOP preparation for instrumentation.	5
IV	GLP & Biotechnology Industry standards - Good Laboratory guidelines, Elements of GLP, Standard Operating Procedures and its importance, Quality Assurance & Quality control, Internal audit basics, ISO, BIS and HACCP standards.	5
V	Types of wastes and safe disposal methods - Definition of waste, types of waste: Biological and chemical waste, methods of Safe Disposal of biological and chemical waste: treatment methods of Ethidium Bromide solutions, Electrophoresis Gels, Contaminated Gloves, debris, Wastes containing sodium azide, Silver staining solutions, Perchloric acid, Nanoparticle wastes, Spill management, Awareness and training for personnel.	7
Total		30
Text Books		
1	Milton A. Anderson GLP Essentials: A Concise Guide to Good Laboratory Practice, Second Edition 2nd Edition, Published by CRC press.	
2	2nd Edition, GLP Essentials, A Concise Guide to Good Laboratory Practice, Second Edition, By Milton A. Anderson, Copyright Year 2002	
3	Principles of Good Laboratory Practice Paperback – 1 January 2020 by Pradeep Deshmukh (Author)	
Reference Books		
1	Good Laboratory Practice: Nonclinical Laboratory Studies Concise Reference Paperback – Import, 18 October 2010 by Mindy J Allport-Settle (Author)	
2	Good Laboratory Practice Standards: Applications for Field and Laboratory Studies	

(ACS Professional Reference Book) 1st Edition by Willa Y. Garner (Editor), Maureen S. Barge (Editor), James P. Ussary (Editor)

Web Resources

1	https://www.oecd.org/chemicalsafety/testing/overview-of-good-laboratory-practice.htm
2	https://www.intechopen.com/chapters/22127

GOOD LABORATORY PRACTICES		Course Code : U1R3BTFC
S.No.	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO-1	Understand the basic calibration and handling of instrumentation in laboratory	K2
CO-2	Maintain laboratory records	K3
CO-3	Complaints with current industry standards	K3
CO-4	Maintain audit record	K4
CO-5	know the waste disposal methods	K6

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	1	3	2	3	3	3
CO2	3	3	3	2	3	1	3	3	3
CO3	3	3	3	2	3	1	3	3	3
CO4	3	3	2	2	2	3	3	3	3
CO5	3	3	2	2	2	3	3	3	3
TOTAL	15	15	13	9	13	10	15	15	15
AVERAGE	3	3	2.6	1.8	2.6	2	3	3	3

B. Sc BIOTECHNOLOGY

FIRST YEAR - SEMESTER - II

CORE - III: GENETICS

SEMESTER – II	
Title of The Course: GENETICS	Category of The Course: CORE COURSE
Course Code: U2R3BTCC3	Nature of The Skill : Skill Development
Marks : CIA : 25 + Ext: 75 = 100	Hrs / Week : 5
Credits : 5	Total Inst. Hrs : 75

Course Objectives:		
1	Learn about the classical genetics and transmission of characters from one generation to the next.	
2	Obtain a strong foundation for the advanced genetics.	
3	Explain the properties of genetic materials and storage and processing of genetic information.	
4	Acquire knowledge about the Mutagens, Mutations, DNA Repairs and Genetic disorders in human.	
5	Categories Eugenics, Euphenics and Euthenics and in depth Knowledge on population Genetics.	
UNIT	Contents	No. of Hours
I	Mendel's experiments , Monohybrid cross, Dihybrid cross, Backcross or Testcross, Mendel's laws. Incomplete dominance. Interaction of Genes - Epistasis lethal genes. Multiple alleles – In Drosophila, Rabbit and Blood group inheritance in man.	10
II	Linkage - linkage in Drosophila- Morgan's experiments, factors affecting linkage. Crossing over- types, mechanism, significance of crossing over. Mapping of Chromosomes, interference and coincidence. Cytoplasmic inheritance - Carbon dioxide sensitivity in Drosophila and milk factor in mice. Sex Linked Inheritance and Sex- Determination in Man.	20

III	Fine structure of the gene and gene concept, Operon Concept. Identification of the DNA as the genetic material- Griffith experiments, Avery, McLeod, McCarty and Hershey Chase experiment. Microbial Genetics- bacterial recombination, Conjugation, Transformation, Transduction and sex duction	20
IV	Mutation - types of mutation, mutagens, DNA damage and Repair Mechanism. Chromosomal aberrations- Numerical and Structural, Pedigree Analysis-Mendelian inheritance in human. (Cystic Fibrosis, Muscular Dystrophy)	15
V	Population Genetics – Hardy Weinberg principle, gene frequency, genotype frequency and factors affecting gene frequency. Eugenics, Euphenics and Euthenics.	10
Total		75

Text Books :

1	Dr. Veer Bala Rastogi, 2020, Elements of Genetics, 11 th Revised & Enlarged Edition, Kedar Nath Ram
2	Nath Publications, Meerut, 250001. www.knrnpublications.com, ISBN-978-81-907011-2-9
3	Verma, P.S. and Agarwal, V.K., 1995. Genetics, 8 th edition, S.Chand & Co., New Delhi – 10055.
4	Verma, P.S., and Agarwal, V.K., 1995. Cell and Molecular Biology, 8 th edition, S.Chand and Co., New Delhi, 110055.

Reference Books:

1	Gardener E.J. Simmons M.J. Slustad D. P. 2006. Principles of Genetics
2	Lewis, R.2001. Human Genetics- Concepts and application. 4 th edition. McGraw Hill.
3	Griffiths, Miller, J.H., An Introduction to Genetic Analysis W.H.Freeman. New York.
4	Winter, P.C., Hickey, G.J. and Fletcher, H.L.2000. Instant notes in Genetics. Viva books, Ltd
5	Good enough U. 1985. Genetics. Hold Saunders international.

Web Resources

1	https://nptel.ac.in/courses/102/106/102106025/
2	http://www.ocw.mit.edu
3	http://enjoy.m.wikipedia.org
4	https://www.acpsd.net
5	https://nptel.ac.in/courses/102/106/102106025/

S. No.	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO - 1	obtain acquaintance on historical overview of microbial genetics and genetic materials	K3
CO - 2	comprehend the concept of replication of genetic materials	K2
CO - 3	understand about regulation of gene expression and mutation	K1
CO - 4	demonstrate the genetic exchange mechanism in microorganisms	K6
CO - 5	grasp the basics of genetics and their role	K5

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO -1	3	3	3	3	2	3	3	2	2
CO -2	3	3	3	3	3	3	3	2	2
CO -3	3	3	3	3	3	3	3	3	3
CO -4	3	2	3	3	3	3	3	3	3
CO -5	3	3	2	3	2	2	2	3	3
TOTAL	15	14	14	15	13	14	14	13	13

Practical - II - GENETICS

SEMESTER - II	
Title of The Course: PRACTICAL - II (Covering CC3)	Category of The Course: Core Course
Course Code: U2R3BTCC4P	Nature of The Skill : Employability Based
Marks : CIA : 40 + Ext: 60 = 100	Hrs / Week : 05
Credits : 5	Total Inst. Hrs : 75

Course Objectives:		
1	Demonstrate the basic principles of important techniques in Molecular biology and Genetics.	
2	Analyze the Polytene chromosome of the organisms	
3	Identify Barr bodies from Buccal smear	
4	Demonstrate the Preparations and maintenance of culture medium	
5	Demonstrate Human karyotyping	
UNIT	Contents	No. of Hours
I	Mitotic stages of onion (<i>Allium cepa</i>) root tip Meiotic stages of cockroach testes/ Flower bud	10
II	Giant chromosomes from Chironomus larvae/ Drosophila salivary glands	15
III	Identification of Barr bodies from Buccal smear	10
IV	Preparations of culture medium and culture of Drosophila – methods of maintenance Identifications of mutants of Drosophila	25
V	Human karyotyping (Demo)	15
Total		75
Text Books		
1	Practical Manual on "Fundamentals of Genetics" (PBG-121). 2019, Edition: First Publisher: Odisha University of Agriculture & Technology. Editor: Kaushik Kumar Panigrahi	

S. No.	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO -1	Be impressed on the milestones of Genetics and present status	K1
CO -2	Identify key components and their functions in both prokaryotes and eukaryotes.	K5
CO -3	Know various stages in mitosis and meiosis and their applications	K3
CO -4	Understand the culture methods of Drosophila.	K5
CO -5	Know the various Physical and Chemical mutagens.	K2

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO -1	3	3	3	3	3	3	3	3	3
CO -2	3	3	3	3	3	3	3	3	3
CO -3	3	3	3	3	2	3	3	3	3
CO -4	3	3	3	2	3	2	3	3	2
CO -5	3	3	2	3	3	3	3	2	3
TOTAL	15	15	14	14	14	14	15	14	14
AVERAGE	3	3	2.8	2.8	2.8	2.8	3	2.8	2.8

Discipline Specific Elective - MICROBIOLOGY

SEMESTER - II	
Title of The Course: MICROBIOLOGY	Category of The Course: ELECTIVE COURSE
Course Code: U2R3BTDSE2	Nature of The Skill : Skill Development
Marks : CIA : 25 + Ext: 75 = 100	Hrs / Week : 4
Credits : 3	Total Inst. Hrs : 60

Course Objectives:	
1	Understand the classification of Microorganisms and structure of bacteria
2	Understand the various microbiological techniques, different types of media and techniques involved in culturing microorganisms.
3	Categorize the methods of sterilization and identify the significance of culture media in the growth of different microbes.
4	Exhibit knowledge in analyzing the importance of Bio insecticides, Bio fertilizers, prebiotics and probiotics.
5	Describe the role of microbes in food intoxications and distinguish the normal flora and pathogens,

UNIT	Contents	No. of Hours
1	History of Microbiology, Classification of bacteria, fungi, virus, protozoa and algae -classical and molecular approaches. Scope of microbiology – Role of microbes in biotechnology.	12
II	Structure of bacteria - Bacterial growth and measurement of growth, Media - types and preparation- plating methods - staining methods (Gram's, capsule, spore, LCB mount) - methods of preservation and storage of microbes. Culture of fungi, virus and algae.	12
III	Sterilization methods - physical and chemical methods- Mode of action - Antibiotic in clinical use - Resistance to antibacterial agents - MRSA, ESBL.	12
IV	Bioinsecticides - <i>Bacillus thuringiensis</i> , Baculoviruses - Biofertilizers – <i>Azospirillum</i> and Blue green algae - single cell protein - prebiotics and probiotics - Dairy products (Cheese and Yoghurt).	12
V	Microbial Disease - host -pathogen interaction, clinical features, lab diagnosis and treatment of Airborne disease (Pneumonia, Chicken pox), food borne	12

	disease (Typhoid, Aspergillosis), Water borne disease (Cholera, Amoebiasis), Sexually transmitted disease (AIDS, Trichomoniasis), Vector borne disease (Dengue, Malaria).	
Total		60
Text Books		
1	Pelczar.M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7th Edition.,McGraw – Hill, New York.	
2	Dubey R.C. and Maheswari, S. (2003). A textbook of Microbiology, New Delhi: S. Chand & Co.	
3	Ananthanarayanan, Paniker, Kapil, Textbook book of Microbiology, 9th edition, Orient BlackSwan, 2013.	
4	Prescott, Harley, Klein, Microbiology, 10 th Edition, McGraw – Hill, 2016.	
5	Gerhardt, P., Murray, R.G., Wood, W.A. and Kreig, N.R. (Editions) (1994) Methods for General and Molecular Bacteriology. ASM Press, Washington, DC	
Reference Books		
1	Madigan, Martinko, Bender, Buckley, Stahl, Brock Biology of Microorganisms, 14 th edition, 2017.	
2	Gillespie, Bamford, Medical Microbiology and Infection at a Glance, 4 th edition, 2012.	
3	Boyd, R.F. (1998). General Microbiology, 2 nd Edition., Times Mirror, Mosby CollegePublishing, St Louis.	
4	Tortora, G.J., Funke, B.R., Case, C.L. (2013). Microbiology. An Introduction 11 th Edition., A La Carte Pearson.	
5	Salle. A.J (1992). Fundamental Principles of Bacteriology. 7 th Edition., McGraw Hill Inc. New York.	
Web Resources		
1	<u>Horst W. Doelle (2004). Microbial Metabolism and Biotechnology. Proceedings of an E-seminar organized by the International organization for Biotechnology and Bioengineering (IOBB)</u>	
2	<u>http://www.ejb.org/content</u> .	
3	<u>www. Biotech.kth.se Electronic Journal of biotechnology</u>	
4	<u>https://www.cliffsnotes.com/study_guides/biology/microbiology/introduction-to-microbiology/a-</u>	

	brief-history-of-microbiology
5	https://bio.libretexts.org/@go/page/9188

MICROBIOLOGY		Course Code : U2R3BDSE2
S. No.	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO - 1	get an idea on the milestones of Microbiology and present status	K1
CO - 2	identify key components and their functions in both prokaryotes and eukaryotes.	K5
CO - 3	know various culture media and their applications and also understand various physical and chemical means of sterilization.	K3
CO - 4	understand the microbial transport systems and the modes and mechanisms of energy conservation in microbial metabolism.	K5
CO - 5	know the physical and chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement.	K2

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO -1	3	3	3	3	3	3	3	3	3
CO -2	3	3	3	3	3	3	3	3	3
CO -3	3	3	3	3	2	3	3	3	3
CO -4	3	3	3	2	3	2	3	3	2
CO -5	3	3	2	3	3	3	3	2	3
TOTAL	15	15	14	14	14	14	15	14	14
AVERAGE	3	3	2.8	2.8	2.8	2.8	3	2.8	2.8

NON MAJOR ELECTIVE

(Offering to other departments)

SEMESTER -II

SEMESTER-II	
Title of The Course : APPLICATIONS OF BIOTECHNOLOGY IN SOCIETY	Category of The Course : NON MAJOR ELECTIVE
Course Code : U2R3BTSEC2:1	Nature of The Skill : Employability Based
Marks : CIA : 25 + Ext: 75 = 100	Hrs / Week :2
Credits : 2	Total Inst. Hrs : 30

Course Objectives:	
1	The course explains the applications of industrial products
2	To understand the technology for the production of transgenic plants.
3	Students will get an idea about the hazards to our environment, solutions to protect and for sustainable development.
4	To know the importance of forensic DNA fingerprinting.
5	To get knowledge about vaccine production

UNIT	Contents	No. of Hours
I	Protein engineering; enzyme and polysaccharide synthesis, activity and secretion, alcohol and antibiotic formation	8
II	N ₂ fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; Transgenic plants and their applications - BT Cotton, Flavr- Savr tomato and Golden rice.	5
III	Chlorinated and non-chlorinated organ pollutant degradation; degradation of hydrocarbons and agricultural wastes, stress management, development	5

	of biodegradable polymers such as PHB.	
IV	Solving violent crimes such as murder and rape; solving claims of paternity and theft etc. using various methods of DNA finger printing.	5
V	Development of non-toxic therapeutic agents, recombinant live vaccines, gene therapy, diagnostics, monoclonal in <i>E.coli</i> , human genome project. Transgenic animals and their applications- Mice, Sheep and Fish.	7
Total		30

Text Books

1	Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
2	Environmental Biotechnology- Dilip Kumar MarKandey and Neelima Rajvaidya (APH publishing corporation, New Delhi) Chawla, H.S. Biotechnology in crop improvement. International Book distributing Company (1998).
3	Guptha, P.K. Elements of Biotechnology. Rastogi and Co. Meerut, (1996)
4	Animal biotechnology, R. Sasidhara, 2006, MJP Publishers.
5.	Text book of Animal Biotechnology, Dr. P. Ramadass, Dr. S. Meera rani, 2 nd Edition 2002, MJP publishers.

Reference Books

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	Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
4	Henry, R.J. 1997. Practical Application of plant Molecular biology. Chapman and hall.
5	Paul Christou and Harry Klee. 2004. Hand Book of Plant Biotechnology. Vol I & II. John Wiley & Sons. Ltd

COURSE OUTCOMES

APPLICATIONS OF BIOTECHNOLOGY IN SOCIETY Course Code : U2R3BTNME1:1		
S.No	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO - 1	obtain knowledge on industrial production of enzymes etc	K1
CO - 2	understand the transgenic plants and their techniques	K2
CO - 3	Realize the waste management and sewage treatment systems.	K3
CO - 4	acquire knowledge on forensic science	K3
CO - 5	know the vaccine production	K4

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	1	3	2	3	3	3
CO2	3	3	3	2	3	1	3	3	3
CO3	3	3	3	2	3	1	3	3	3
CO4	2	3	2	2	2	3	3	3	3
CO5	3	3	2	2	2	3	3	3	2
TOTAL	14	15	13	9	13	10	15	15	14
AVERAGE	2.8	3	2.6	1.8	2.6	2	3	3	2.8

NON MAJOR ELECTIVE

(Offering to other departments)

SEMESTER -II

SEMESTER-II	
Title of The Course : Basic Concepts of Biotechnology	Category of The Course : NON MAJOR ELECTIVE
Course Code : U2R3BTSEC2:2	Nature of The Skill : Skill Development
Marks : CIA : 25 + Ext: 75 = 100	Hrs / Week : 2
Credits : 2	Total Inst. Hrs : 30

Course Objectives:	
1	To know the basic concepts of biotechnology
2	To understand the technology of gene cloning
3	To be able to use and apply modern tools, techniques and skills in genetic engineering.
4	To be able to understand the basic concepts, application and methodology of PCR
5	To get the knowledge of Genetics

UNIT	Contents	No. of Hours
I	Scope of Biotechnology, History of Biotechnology: Conventional and Modern Biotechnology- Biotechnology Industries, Biotechnology tree.	8
II	Introduction to gene cloning, Tools used in gene cloning- Restriction endonucleases- Types- Feature. Ligases – Linkers, Adaptors and homopolymer tails. Modifying enzymes.	5
III	Vectors-Properties of good Vector. Constructed plasmid- pBR322. Cosmid Vectors –SV40. Plant vectors.	5

IV	Introduction of gene – Vector Mode- Transformation and Transfection. Vector less mode- Biolistics, Electroporation, and Microinjection.	5
V	Selection of recombinants. Marker techniques- PCR, RFLP, RAPD and Blotting Techniques.	7
Total		30
Text Books		
1	Principles of gene manipulation. Old & Primrose, (1989), 3 rd edition.	
2	Biotechnology, Satyanarayana.U, (2008). Books and Allied(P) Ltd.	
3	Biotechnology and Genomics, Gupta .P.K. (2004) Rastogi Publication.	
Reference Books		
1	Gene Cloning and DNA analysis Brown, T.A (1996). Blackewll Science, Osney mead, Oxford	
2	A text Book of biotechnology, Dubey. R.C. (2007) S. Chand & Company Ltd. New Delhi.	
3	Biotechnology, Singh, B.D (2004), Kalyani publishers, New Delhi.	

COURSE OUTCOMES

Basic Concepts of Biotechnology		Course Code : U2R3BTNME1:2
S.No	Course Outcome	Knowledge Level
Upon completion of the course, the students will be able to		
CO - 1	obtain knowledge on basic concepts of biotechnology	K1
CO - 2	understand the gene cloning and their techniques	K2
CO - 3	understand about regulation of gene expression	K3
CO - 4	Know various stages in PCR and their applications	K3
CO - 5	obtain knowledge of Genetics	K4

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	1	3	2	3	3	3
CO2	3	3	3	2	3	1	3	3	3
CO3	3	3	3	2	3	1	3	3	3
CO4	2	3	2	2	2	3	3	3	3
CO5	3	3	3	2	2	3	3	3	2
TOTAL	14	15	13	9	13	10	15	15	14
AVERAGE	2.8	3	2.6	1.8	2.6	2	3	3	2.8

Skill Enhancement Course - 3:1 MARINE BIOTECHNOLOGY

SEMESTER - II	
Title of The Course: MARINE BIOTECHNOLOGY	Category of The Course: SKILL ENHANCEMENT COURSE
Course Code: U2R3BTSEC3:1	Nature of The Skill : Skill Development
Marks : CIA : 25 + Ext: 75 = 100	Hrs / Week : 2
Credits : 2	Total Inst. Hrs : 30

Course Objectives:	
1	Students will gain knowledge about Marine Ecosystem and Resources.
2	Will learn about bioactive compounds from Marine sources
3	Can understand about the importance of medicinal seaweeds
4	Will know about culture of seaweeds and Aquaculture
5	Can understand the applications of Marine biotech products

UNIT	Contents	No. of Hours
I	Marine Ecosystems & Its functioning, Ocean currents, Physical & chemical properties of seawater, Ecological divisions of the Sea - Euphotic -Mesopelagic – Bathopelagic - Benthos - Intertidal, Estuarine - Salt Marsh – Mangrove - Coral Reef.	8
II	Marine microbial habitats - Screening for Secondary metabolites from marine microbes (Bacteria, Fungi, Actinomycetes and marine microalgae). Biofouling, Biofilm, Antifouling, Anticorrosion. Probiotic bacteria and their importance in aquaculture.	5
III	Definitions - Medicinal compounds from flora (Seaweeds, Seagrass and Mangrove) and fauna (Sponges, Sea anemone and Corals) - marine toxins-antiviral and antimicrobial agents.	5

IV	Culture aspect - Seaweed (<i>Kappaphycus alvarezii</i>), Fish chromosome manipulation in aquaculture - Hybridization- Gynogenesis- Androgenesis- Polyploidy, Artificial Insemination, Eyestalk ablation- Transgenesis and Cryopreservation.	5
V	Agar - Agarose – Alginate – Carrageenan – Chitin – Chitosan - Heparin.	7
Total		30

Text Books

1	Italy, E (Eds). 1998, New Developments in Marine Biotechnology, Plenum Pub. Corp.
2	Milton Fingerman and Rachakonda Nagabhushanam, 1996, Molecular Genetics of Marine Organisms, Science Pub Inc.
3	Y. Le Gal and H.O.Halvorson 1998, New Developments in Marine Biotechnology. Springer.
4	David H. Attaway, 2001. Marine Biotechnology, Volume 1, Pharmaceutical and Bioactive Natural Products.
5	Rita R. Colwell 1984. Biotechnology in the Marine Sciences (Advances in Marine Science & Biotechnology) Wiley Interscience

Reference Books

1	Scheupr, P.J. (Ed.), 1984. Chemistry of Marine Natural Products, ,Chemical and Biological Perspectives. Vol. I III, Academic Press, New York
2	Marine Biology- Lalli C.M. and T.R. Parsons., 1997. Biological Oceanography - An Introduction, Elsevier, 314 pp
3	Marine Pollution- Clark, R. B. 2001. Marine pollution, Fifth edition. Oxford University press, New York Inc., 231pp
4	Gloria Sanchez, Elizabeth Hernandez,(2019), <i>Environmental Biotechnology and cleaner Bioprocess</i> , (1 st edition), CRC Press, ISBN 9780367455552
5	Kirchman, D.L.Gasol, J.M. (2018), Microbial ecology of the oceans, (3 rd edition), Wiley – Blackwell.

Web Resources	
1	http://coe.genomics.org.cn/
2	http://www.bcb.iastate.edu/
3	http://www.nwfsc.noaa.gov/protocols/bioinformatics.html
4	http://www.ebi.ac.uk/ ExPASy.org/
5	http://www.expasy.org/

MARINE BIOTECHNOLOGY		Course Code : U2R3BTSEC3:1
S. No.	Course Outcome	Knowledge Level
Upon completion of course, the students will be able to		
CO- 1	elucidate the commercially important Marine Products	K1
CO - 2	be aware of Toxin Degradation	K4
CO - 3	know about marine bioactive compounds	K3
CO - 4	develop knowledge on waste disposal management in marine environment	K5
CO - 5	gain knowledge about water quality management	K2

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO -1	3	3	3	1	2	3	3	3	3
CO -2	3	3	3	1	2	3	3	3	3
CO -3	3	3	2	1	2	3	3	3	3
CO -4	3	3	2	1	2	3	3	3	3
CO -5	3	3	3	1	2	3	3	3	3

TOTAL	15	15	13	5	10	15	15	15	15
Average	3	3	2.6	1	2	3	3	3	3

Skill Enhancement Course - 3:2 STEM CELL TECHNOLOGY

SEMESTER – II	
Title of The Course: STEM CELL TECHNOLOGY	Category of The Course: SKILL ENHANCEMENT COURSE
Course Code: U2R3BTSEC3:2	Nature of The Skill : Skill Development
Marks : CIA : 25 + Ext: 75 = 100	Hrs / Week : 2
Credits : 2	Total Inst. Hrs : 30

Course Objectives:	
1	To learn the unique properties of all stem cells.
2	To understand the embryonic and adult stem cells.
3	To know the potential uses of human stem cells.
4	To learn the principle of surface antigen markers
5	To understand the principles of stem cell therapy

UNIT	Contents	No. of Hours
I	Definition, Classification and sources, primary embryonic stem cells, Umbilical cord stem cells, human embryonic stem cells. Properties of Stem cells -Pluripotent - Totipotent.	8
II	Blastocyst and inner cell mass cells, organogenesis, stem cell differentiation, trophoblastic stem cells, identification and lineage specificity, isolation and maintenance of neural precursors. Laboratory test to identify ES cells	5
III	Somatic stem cells, Different type of adult stem cells, Test for identification of adult stem cells, Adult stem cell differentiation, Skin, mammary gland, dental and neural stem cells. Endodermal stem cells-Liver stem cells – GI tract and liver, pancreatic stem cells.	5

IV	Surface antigen markers and its identification, microarray.	5
V	Stem cell therapy for Neuro degeneration disease, Parkinson's, Alzheimer, spinal cord injury and other brain syndrome, tissue system failures, diabetes, cardio myopathy, kidney failure, liver failure.	7
Total		30
Text Books		
1	Stem cell technologies, basics and applications, Kaushik D.Deb, 2010 1 st edition, Mc Graw Hill education.	
2	Stem cells, Eapen cherian, 2011, 1 st edition, Jay Pee brothers medical publishers.	
3	Essentials of Stem cell Biology, Lanza .R, 2005, Academic Press.	
4	Human Embryonic stem cells, Kiessling AA, 2nd Edition, 2006, Jones and Barlett Publishers.	
Reference Books		
1	Fisher. Mikos Bronzino. 2007. Tissue Engineering. C.R.S Press.	
2	Stem cell and Tissue Engineering, Editors Li, L Heureux and Elisseeff, World Scientific (2011), ISBN: 9789814317054	
3	Stem Cell Engineering : Principles and Application Editors Artmann, Minger and Hescheler , Springer (2011), ISBN 978-3-642-11865-4	
4	Tissue Engineering, Senior Editor Ulrich Martin , Springer (2009), ISBN: 978-3-642-32618-9	
5	Strachen and Read.2011. Human Molecular Genetics. 4th Edition. Garland Science Publications.	
Web Resources		
1	Stem cells.nih.gov/info/basics.	
2	www.medicalnewstoday.com/info/stem-cell/	

S.No	Course Outcome	Knowledge Level
Upon completion of course, the students will be able to		
CO -1	Understand the basic concept of statistics, and also apply statistical measures which are used to analyze the data.	K1
CO -2	Acquire knowledge on measures of central tendency and Measures of dispersion.	K2
CO -3	Prepare reports to conclude the findings in data analysis.	K5
CO -4	Review and Extend knowledge of Measures of dispersion.	K3
CO -5	Understand the concept of Skewness & kurtosis.	K4

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	1	3	2	3	3	3
CO2	3	3	3	2	3	1	3	3	3
CO3	3	3	3	2	3	1	3	3	3
CO4	3	3	2	2	2	3	3	3	3
CO5	3	3	2	2	2	3	3	3	3
TOTAL	15	15	13	9	13	10	15	15	15
AVERAGE	3	3	2.6	1.8	2.6	2	3	3	3