SURESH GYAN VIHAR UNIVERSITY

SURESH GYAN VIHAR UNIVERSITY

Accredited by NAAC with 'A' Grade

SCHOOL OF APPLIED SCIENCES

SYLLABUS I, II, III YEAR

B. Sc. BIOTECHNOLOGY

SEMESTER SYSTEM

(Session 2018-19)

Program Aims and Objectives:

The B.Sc. (Biotechnology) program of Suresh Gyan Vihar University, Jaipur designed keeping in view the latest trends in the field of Biotechnology. The students are given an overview of the various subjects of the disciplines during the tenure of their program. The various papers that are put to study during the program include study of Biochemistry, Cell Biology, Microbiology, Molecular Biology, Genetics, Plant and Animal Tissue Culture, Plant and Animal Physiology, Biophysics, etc. in details. Therefore, after completion of the biology program, the students will well versed with the entire area of all the three disciplines and their application in the current scenario.

Undergraduate Programs:

Undergraduates in Biotechnology will develop a broad base of general knowledge, focused primarily in the biotechnological sciences, and capped with in-depth knowledge specific to their particular major program.

Biotechnological Sciences majors will also obtain broad knowledge in Biochemistry, Microbiology, and Cell Biology, etc. coupled with analytical, oral and compositional skills, to promote good citizenship and the capacity for life-long learning.

Our students expected to demonstrate a breadth of knowledge across the sub-disciplines that comprise Biotechnological Sciences. The curriculum meets the needs of students with three post-graduation ambitions: graduate school, professional school, or work in industry or government without further training.

Learning Objectives:

Biotechnology is an integrative discipline, students are required to demonstrate appropriate proficiency in Biochemistry, Cell Biology, Microbiology, Molecular Biology, Genetics, Plant and Animal Tissue Culture, Plant and Animal Physiology, and Biophysics, etc. in order to apply this knowledge to the study of Biotechnology.

Students will acquire a breadth of knowledge in Biotechnology (Biochemistry, Cell Biology, Microbiology, Molecular Biology, Genetics, Plant and Animal Tissue Culture, Plant and Animal Physiology, Biophysics, etc.).

Students will acquire a broad knowledge in biotechnological sciences coupled with analytical, oral and compositional skills, to promote good citizenship and the capacity for life-long learning.

Students will develop and apply oral and written skills, problem-solving skills in developing experimental design and analysis, and participate in individualized hands-on field and laboratory exercises.

Students will be prepared with a sufficient depth of knowledge in their specific major program to assure their admission to graduate or professional school or be prepared for entry-level employment.

The study of biotechnology have a multitude of aims and objectives. Largely, it is studied to allow a

person to enter a specific field of employment. Other aims for studying biology are intellectual, ethical and pragmatic: to increase knowledge about all aspects of organisms, to encourage greater benevolence in the relationship between humans and the natural environment and to implement biological factors into various technologies or management techniques.

Understanding Living Systems and Critical Thinking:

The study of biotechnology, aims to increase understanding of living systems and to allow you to consider the systems in relationship to the self and other organisms in the natural environment. The goal is to be able to test theories developed about living things by utilizing the scientific method and then to apply the new information in a beneficial way.

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Teaching and Examination Scheme

To commence from the Academic year: 2018-19 Program

School of Applied Sciences **Program: B. Sc. Biotechnology: Semester: I**

S. No.	Course Code	Course Name	Type of Course Core/Elective	Credit	Contact Hrs/Wk.			Exam Hours ESE	Weightage (in%)	
					L	T	P		CIE	ESE
1.	EN 103	**English Language 1**	University Core	2	2	0	0	3	40	60
2.	PC 101	**Proficiency in co-curricular activities**	University Core	2	0	0	0	0	100	0
3.	CP 101	**Elementary Computer**	University Core	3	3	0	0	3	40	60
4.	FD102	**Foundation Course-I**	University Core	1	1	0	0	3	25	75
5.	ES 101	**Environmental Studies**	University Core	2	2	0	0	3	40	60
6.	BS101	**Biochemistry & Metabolism**	Program Core	3	3	0	0	3	40	60
7.	BS103	**Cell Biology**	Program Core	3	3	0	0	3	40	60
8.	BS105	**Basics of animal & plant sciences**	Program Core	3	3	0	0	3	40	60
9.	BS151	**Biochemistry & Metabolism Lab**	Program Core	2	0	0	3	3	60	40
10.	BS153	**Cell Biology Lab**	Program Core	2	0	0	3	3	60	40
11.	BS155	**Basics of animal & plant sciences Lab**	Program Core	2	0	0	3	3	60	40
			Total:	25	18	00	09			

L – Lecture

T – Tutorial

P – Practical

CIE – Continuous Internal Evaluation

ESE – End Semester Examination

Signature of Concerned Teacher **Signature of Convener-BOS_____**

Signature of Member Secretary

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Teaching and Examination Scheme

To commence from the Academic year: 2018-19 Program

School of Applied Sciences **Program: B. Sc. Biotechnology: Semester: II**

S. No.	Course Code	Course Name	Type of Course Core/Elective	Credit	Contact Hrs/Wk.			Exam Hours	Weightage (in%)	
					L	T	P	ESE	CIE	ESE
1.	EM 101	**Employability Skills**	University Core	1	0	0	2	3	60	40
2.	PC 102	**Proficiency in co-curricular activities**	University Core	2	0	0	0	0	100	00
3.	HUM102	**Human Values & Ethics**	University Core	1	1	0	0	3	40	60
4.	FD104	**Foundation Course-I**	University Core	1	1	0	0	3	25	75
5.	EN 104	**English language II**	University Core	3	3	0	0	3	40	60
6.	BS202	**General Microbiology**	Program Core	3	3	0	0	3	40	60
7.	BS204	**Animal and Plant Physiology**	Program Core	3	3	0	0	3	40	60
8.	BS206	**Genetics and Molecular Biology**	Program Core	3	3	0	0	3	40	60
9.	BS252	**General Microbiology Lab**	Program Core	2	0	0	3	3	60	40
10.	BS254	**Animal and Plant Physiology Lab**	Program Core	2	0	0	3	3	60	40
11.	BS256	**Genetics and Molecular Biology Lab**	Program Core	2	0	0	3	3	60	40
			Total:	23	18	00	09			

L – Lecture

T – Tutorial

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Teaching and Examination Scheme

To commence from the Academic year: 2018-19 Program

School of Applied Sciences **Program: B. Sc. Biotechnology: Semester: III**

S. No.	Course Code	Course Name	Type of Course Core/Elective	Credit	Contact Hrs/Wk.			Exam Hours ESE	Weightage (in%)	
					L	T	P		CIE	ESE
1.	EM 203	**Employability Skills**	University Core	1	0	0	2	3	60	40
2.	PCA 103	**Proficiency in co-curricular activities**	University Core	2	0	0	0	0	100	0
3.	BS301	**Biophysics and Bioenergy**	Program Core	4	4	0	0	3	40	60
4.	BS303	**Environmental Biotechnology**	Program Core	4	4	0	0	3	40	60
5.	BS305	**Bioenergetics and Biomembranes**	Program Core	4	4	0	0	3	40	60
6.	BS307	**Enzymology**	Program Core	4	4	0	0	3	40	60
7.	BS351	**Biophysics Lab**	Program Core	2	0	0	3	3	60	40
8.	BS353	**Environmental Biotechnology Lab**	Program Core	2	0	0	3	3	60	60
9.	BS355	**Enzymology Lab**	Program Core	2	0	0	3	3	60	40
			Total:	25	116	00	11			

L – Lecture

T – Tutorial

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Teaching and Examination Scheme

To commence from the Academic year: 2018-19 Program

School of Applied Sciences **Program: B. Sc. Biotechnology: Semester: IV**

S. No.	Course Code	Course Name	Type of Course Core/Elective	Credit	Contact Hrs/Wk.			Exam Hours ESE	Weightage (in%)	
					L	T	P		CIE	ESE
1.	EM 204	**Employability Skills**	University Core	1	0	0	2	3	60	40
2.	PCA 104	**Proficiency in co-curricular activities**	University Core	2	0	0	0	0	100	0
3.	BS402	**Medical Biotechnology**	Program Core	4	4	0	0	3	40	60
4.	BS404	**Plant Tissue Culture & Biotechnology**	Program Core	4	4	0	0	3	40	60
5.	BS406	**Biostatistics**	Program Core	4	4	0	0	3	40	60
6.	BS408	**Mycology & Virology**	Program Core	4	4	0	0	3	40	60
7.	BS452	**Medical Biotechnology Lab**	Program Core	2	0	0	3	3	60	40
8.	BS454	**Plant Tissue Culture & Biotechnology Lab**	Program Core	2	0	0	3	3	60	40
9.	BS456	**Mycology & Virology Lab**	Program Core	2	0	0	3	3	60	40
			Total:	25	16	00	11			

L – Lecture

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Teaching and Examination Scheme

To commence from the Academic year: 2018-19 Program

School of Applied Sciences **Program: B. Sc. Biotechnology: Semester: V**

S. No.	Course Code	Course Name	Type of Course Core/Elective	Credit	Contact Hrs/Wk.			Exam Hours ESE	Weightage (in%)	
					L	T	P		CIE	ESE
1.	EM 204	**Employability Skills**	University Core	1	0	0	2	3	60	40
2.	PCA 104	**Proficiency in co-curricular activities**	University Core	2	0	0	0	0	100	0
3.	BS501	**Immunology and Immunotechnology**	Program Core	4	4	0	0	3	40	60
4.	BS503	**Industrial Biotechnology, IPR, & Biosafety**	Program Core	4	4	0	0	3	40	60
5.	BS505	**Elective-I**	Program Core	4	4	0	0	3	40	60
6.	BS507	**Genetic Engineering**	Program Core	4	4	0	0	3	40	60
7.	BS551	**Immunology and Immunotechnology Lab**	Program Core	2	0	0	3	3	60	40
8.	BS553	**Industrial Biotechnology, IPR, & Biosafety Lab**	Program Core	2	0	0	3	3	60	40
9.	BS555	**Genetic Engineering Lab**	Program Core	2	0	0	3	3	60	40
			Total:	25	16	00	11			

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Signature of Member Secretary

Elective-I

1. **Animal Tissue Culture and Biotechnology**
2. **Bio-fertilisers and hydroponics**
3. **Integrated Pest Management and Biopestiside**

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Teaching and Examination Scheme

To commence from the Academic year: 2018-19 Program

School of Applied Sciences **Program: B. Sc. Biotechnology: Semester: VI**

S. No.	Course Code	Course Name	Type of Course Core/Elective	Credit	Contact Hrs/Wk.			Exam Hours ESE	Weightage (in%)	
					L	T	P		CIE	ESE
1.	BS602	**Bioprocess and Biochemical Engineering**	Program Core	4	4	0	0	3	40	60
2.	BS604	**Bioinformatics and Nanobiotechnology**	Program Core	4	4	0	0	3	40	60
3.	BS606	**Genomics and Proteomics**	Program Core	4	4	0	0	3	40	60
4.	BS608	**Elective - II**	Program Core	4	4	0	0	3	40	60
5.	BS652	**Bioprocess and Biochemical Engineering Lab**	Program Core	2	0	0	3	3	60	40
6.	BS654	**Bioinformatics and Nanobiotechnology Lab**	Program Core	2	0	0	3	3	60	40
7.	BS656	**Genomics and Proteomics Lab**	Program Core	2	0	0	3	3	60	40
			Total:	22	16	00	09			

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Electives-II

1. Basics of Forensic Science (BS610)
2. Molecular Modelling and Drug Designing (BS612)
3. Molecular diagnostics (BS614)
4. Biotechnology and human welfare (BS616)

BS101	**Biochemistry & Metabolism**
Version	1.0
Prerequisite	All students are expected to have a general knowledge of Basic biology.
Learning objective	The learning objective of course are: To create an understanding regarding the Biochemistry & Metabolism. To gain knowledge about Carbohydrates, Lipids, Protein, Nucleic acid.
Salient features	The student will be able to conceptualize basics of biochemistry and metabolism.
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Amino acids, Proteins and Carbohydrates** **8 hours**
	Amino acids & Proteins: Structure and properties of Amino acids, Types of proteins and their classification, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins. Urea cycle, Deamination and transamination. **Carbohydrates**: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Glycoprotein's and their biological functions.
Unit-II	**Lipids and Nucleic acids** **7 hours**
	Lipids: Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol. β-oxidation of fatty acids. **Nucleic acids**: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines, Biologically important nucleotides, Double helical model of DNA.
Unit-III	**Enzymes** **7 hours**
	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,
Unit-IV	**Enzyme specificity and co-enzymes** **7 hours**
	Enzyme specificity: types & theories, Biocatalysts from extreme thermophilic and hyperthermophilic archaea and bacteria. Role of: NAD+, NADP+, FMN/FAD, coenzymes A, Thiamine pyrophosphate, Pyridoxal phosphate,lipoic-acid, Biotin vitamin B12, Tetrahydrofolate and metallic ions
Unit-V	**Carbohydrates Metabolism** **7 hours**
	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.
Reference books	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.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

BS103	**Cell Biology**
Version	1.0
Prerequisite	All students are expected to have a general knowledge of Basic biology.
Learning objective	The learning objective of course are: To create an understanding regarding the cells and its organelles. To gain knowledge about cytoplasm and its components.
Salient features	The student will be able to conceptualize basics of cell biology.
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Cell and organelles** **8 hours**
	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	**Cell and organelles** **7 hours**
	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	**organelles** **7 hours**
	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	**Extracellular Matrix and cancer** **7 hours**
	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.
Unit-V	**Interactions between cell & environment** **7 hours**
	Interactions between cell & environment: - cell functions, cells adhesions, cell junction and extracellular matrix, cell signalling through G-protein linked receptors. Cellular regulation. cell cycle and its regulation. Mitosis and Meiosis. cell apoptosis.
Reference books	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.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

BS105	**Basics of animal & plant sciences**
Version	1.0
Prerequisite	All students are expected to have a general knowledge of animal and plant sciences.
Learning objective	The learning objective of course are: To create an understanding regarding the plant and animal sciences.
Salient features	The student will be able to conceptualize basics of animal and plant sciences.
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Plant as a life form** **8 hours**
	Plant as a life form- General & Unique features of plants as a category of living organisms Introduction to plant groups and their characters with respect to increasing complexity in organization of plant body (Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms, Angiosperms with one example each)
Unit-II	**Major aspects of plant sciences I** **7 hours**
	Major aspects of plant sciences: Structural Morphology of vegetative and reproductive plant organs, Plant cell biology – Unique features of a plant cell, Cell wall, Anatomy – Internal organization of vegetative and reproductive plant organs (leaf, shoot, root and flower).
Unit-III	**Major aspects of plant sciences II** **7 hours**
	Meristematic, permanent tissues and Organs, Secondary Growth, Adaptive and protective systems, Structural organization of flower, Embryo and endosperm, Apomixis and polyembryony, Introduction to Bryophyta, Pteridophyta, Lichens, Gymnosperm, Angiosperms
Unit-IV	**Major aspects of animal sciences** **7 hours**
	Criteria for classification of multicellular animals. Taxonomy and classification: General principles of taxonomy - Binomial nomenclature, -Trinomial nomenclature, Rules of nomenclature, Concept of Five kingdom, concept of protozoa, metazoan and levels of organization. Basis of Classification: symmetry, coelom, segmentation and embryology.
Unit-V	**Major aspects of animal sciences** **7 hours**
	Non–Chordates: General characters and Outline Classification upto class, Economic importance. Protozoans, Poriferans, Platyhelminths Aschelminthes, Non–Chordates: General characters and Outline Classification up to class, Economic importance of Annelids, Arthropods, Molluscs, Echinoderms, Hemichordata, Protochordates, Urochordates, Cephalochordates**,** Fishes, Amphibian, Reptiles, Birds and Mammals.
Reference books	1. Jordan, E.L. and Verma P.S. 1978, (i) Chordate Zoology S. Chand & Company Ltd. Ram Nagar. New Delhi. 2. Jordan, E.L. and Verma P.S. 1978 (ii) Invertebrate Zoology. S. Chand & Company Ltd. Ram Nagar. New Delhi. 3. Modern Text Book of Zoology: Invertebrates., R.L.Kotpal. Publisher, Rastogi Publications, 2012. 4. Economic Zoology, Shukla & Upadhyaya, 4th Edition., Rastogi Publications, 2009. 5. Modern Parasitology: A Textbook of Parasitology, 2nd edition, (1993) F. E. G. Cox, Wiley & Sons, USA 7. Devlin R.M. (1983) - Fundamentals of Plant Physiology (Mac. Millan, New York) 8. Dutta A.C. (2000) A Classbook of Botany (Oxford University Press, UK) 9. Kumar H.D. (1999) Biodiversity and sustainable conservation (Oxford & IBH, New Delhi)
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

BS202	**General Microbiology**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of microbiology.
Learning objective	The learning objective of course are: To create an understanding regarding the microbiology.
Salient features	The student will be able to conceptualize basics to advance of microbiology.
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Fundamentals of microbiology** **8 hours**
	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	**Cultivation and Maintenance of microorganisms** **7 hours**
	Cultivation and Maintenance of microorganisms: Nutritional categories of micro-organisms, methods of isolation, Purification and preservation.
Unit-III	**Microbial growth** **7 hours**
	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	**Control of Microorganisms** **7 hours**
	Control of Microorganisms: By physical, chemical and chemotherapeutic Agents Water Microbiology: Bacterial pollutants of water, coliforms and non coliforms. Sewage composition and its disposal.
Unit-V	**Food Microbiology** **7 hours**
	Food Microbiology: Important microorganism in food Microbiology: Moulds, Yeasts, bacteria. Major food born infections and intoxications, Preservation of various types of foods. Fermented Foods.
Reference books	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.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

BS204	**Animal and Plant Physiology**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of physiology.
Learning objective	The learning objective of course are: To create an understanding regarding the animal and plant physiology.
Salient features	The student will be able to conceptualize basics to advance of animal and plant physiology.
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Digestion, Respiration and circulation** **8 hours**
	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 O_2 and CO_2, Oxygen dissociation curve, Chloride shift. Composition of blood, blood cells, Mechanism of coagulation of blood. Mechanism of working of heart.
Unit-II	**Muscle physiology and osmoregulation** **7 hours**
	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-III	**Nervous and endocrine coordination** **7 hours**
	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.
Unit-IV	**Plant water relations and micro & macro nutrients** **7 hours**
	Plant water relations: Importance of water to plant life, diffusion, osmosis, plasmolysis, imbibition, guttation, transpiration, stomata & their mechanism of opening & closing. Micro & macro nutrients: criteria for identification of essentiality of nutrients, roles and deficiency systems of nutrients, mechanism of uptake of nutrients, mechanism of food transport
Unit-V	**Carbon, nitrogen metabolism, and Growth & development** **7 hours**
	Photosynthesis- Photosynthesis pigments, concept of two photo systems, photphosphorylation, calvin cycle, CAM plants, photorespiration, Nitrogen metabolism- inorganic & molecular nitrogen fixation, nitrate reduction and ammonium assimilation in plants. Growth and development: Definitions, phases of growth, growth curve
Reference books	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. 3. Dickinson, W.C. 2000 Integrative Plant Anatomy. Harcourt Academic Press, USA. 4. Esau, K. 1977 Anatomy of Seed Plants. Wiley Publishers. 5. Fahn, A. 1974 Plant Anatomy. Pergmon Press, USA and UK. 6. Hopkins, W.G. and Huner, P.A. 2008 Introduction to Plant Physiology. John Wiley and Sons. 7. Mauseth, J.D. 1988 Plant Anatomy. The Benjammin/Cummings Publisher, USA. 8. Nelson, D.L., Cox, M.M. 2004 Lehninger Principles of Biochemistry, 4th edition, W.H. Freeman and Company, New York, USA. 9. Salisbury, F.B. and Ross, C.W. 1991 Plant Physiology, Wadsworth Publishing Co. Ltd. 10. Taiz, L. and Zeiger, E. 2006 Plant Physiology, 4th edition, Sinauer Associates Inc .MA, USA
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

BS206	**Genetics and Molecular Biology**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Genetics
Learning objective	The learning objective of course are: To create an understanding regarding the Genetics and Molecular Biology.
Salient features	The student will be able to conceptualize basics to advance of Genetics and Molecular Biology.
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Introduction and Mendelian genetics** **8 hours**
	Introduction: Historical developments in the field of genetics. Cell Cycle: Mitosis and Meiosis: Control points in cell-cycle progression in yeast. 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	**Non allelic interactions** **7 hours**
	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.
Unit-III	**Genetic organization and mutation** **7 hours**
	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. 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.
Unit-IV	**Replication and DNA damage** **7 hours**
	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. DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair, Homologous recombination.
Unit-V	**Transcription and translation** **7 hours**
	RNA structure and types of RNA, Transcription in prokaryotes, Transcription in eukaryotes, Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics, Prokaryotic and eukaryotic translation, Fidelity of translation, Inhibitors of translation. Posttranslational modifications of proteins.
Reference books	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 Inc. 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. 6. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc. 7. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

BS301	**Biophysics and Bioenergy**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of basic physics and chemistry
Learning objective	The learning objective of course are: To create an understanding regarding the animal and plant physiology.
Salient features	The student will be able to conceptualize basics to advance of animal and plant physiology.
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Spectroscopy** **8 hours**
	Spectroscopy: Definition. Electromagnetic wave. Electromagnetic spectrum. Applications of each region of electromagnetic spectrum for spectroscopy. Introduction to molecular energy levels. Excitation. Absorption. Emission. Rotational spectra. Energy levels of rigid diatomicmolecules. Electron spectroscopy. UV-visible spectroscopy. Principle, construction and working of colorimeter, Spectrophotometer, Flurometer. Application to biomolecules (proteins, DNA, Hb, chlorophyll).
Unit-II	**Radioactivity** **7 hours**
	Radioactivity: Nucleus. Properties. Nuclear forces. Nuclear models (liquid drop and shell model). Radioactive nucleus. Revision of nuclear radiations and their properties - alpha, beta and gamma. Half life, physical and biological handling and standardization of alpha and beta emitting isotopes. Radioimunoassay. Radiopharmaceuticals and their uptake. Production of radionuclides. Measurement of radiation - Dosimetry and detectors. Principle, construction and working of – GM counter. Scintillation Counter (Solid and liquid).
Unit-III	**Thermoregulation and microscopy** **7 hours**
	Thermoregulation: Thermometric properties and types of thermometers (clinical, thermocouple, bimetallic, platinum resistance, thermistor - thermometers). Microscopes: Concepts - Resolving power. Chromatic and achromatic aberrations. Construction and working principles of the following microscopes– Stereozoom (Dissecting), Compound , bright and Dark field, Inverted, Phase contrast, Fluorescence. Electron microscopes: TEM and SEM.
Unit-IV	**Bioinstrumentation** **7 hours**
	Bioinstruments: Concepts- Analytical techniques, analyte, method, procedure and protocol. Principle construction, working and applications for analysis of biomolecules of following instruments. pH meter, weighing balance, ultrasonicator, Centrifuge (RCF, sedimentation concept), different types of centrifuges. Mass spectroscopy (Bainbridge mass spectrometer). Atomic absorption spectrometer (AAS), HPLC, GC-MS
Unit-V	**Bioenergy** **7 hours**
	Forms of renewable bioenergy; Biomass conversion; Biocatalysts; Biochemical engineering; Algal biofuels; Bio-electricity; Microbial fuel cell; Bioenergy system and technology; Bioreactor design and engineering; Consolidated bioprocessing; Organic waste to fuels
Reference books	1. Biophysics, an introduction. 1st edition. (2002) Cotteril R. John Willey and Sons Ltd., USA 2. Biophysics. 1st edition (2002), Pattabhi V and Gautham N. Kluwer Academic Publisher, USA. 3. Textbook of optics and atomic physics, 8th edition (1989) P.P. Khandelwal, Himlaya Publishing House, India. 4. Instrumentation measurements and analysis – 2nd edition (2003). Nakra and Choudhari, Tata Mc Graw Hill, India. 5. Nuclear Physics: An Introduction. 2nd edition (2011). S. B. Patel. Anshan Publication, India
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

BS303	**Environmental Biotechnology**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Environmental Sciences.
Learning objective	The learning objective of course are: To create an understanding regarding the Environmental Biotechnology.
Salient features	The student will be able to conceptualize basics to advance of Environmental Biotechnology.
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Conventional fuels and their environmental impact** **8 hours**
	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	**Bioremediation** **7 hours**
	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	**Waste Treatment** **7 hours**
	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	**Bioleaching** **7 hours**
	Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium). Environmental significance of genetically modified microbes, plants and animals.
Unit-V	**Biodegradation** **7 hours**
	Overview of Biodegradation, Degradation of Basic Structures found in Hydrocarbons & Xenobiotics, Biodegradation of Xenobiotics, PCBs (Poly Chlorinated Biphenyls), DDT, Nitrobenzene, Biomagnifiction, Wastewater, Primary, Secondary, Tertiary treatment processes, Conventional Air Pollutants & Acid rain & Acid mine drainage, An overview of process of Bioremediation
Reference books	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
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

BS305	**Bioenergetics and Biomembranes**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Physics and biology
Learning objective	The learning objective of course are: To create an understanding regarding the Bioenergetics and Biomembranes.
Salient features	The student will be able to conceptualize basics to advance of Bioenergetics and Biomembranes.
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Thermodynamics** **8 hours**
	Fundamentals of thermodynamics - endergonic and exergonic processes, enthalpy, entropy, activation energy, free energy change, phosphoryl transfer reaction, oxidation-reduction reaction, redox potential, equilibrium and non equilibrium thermodynamics, high energy compounds, causes of energy richness in ATP.
Unit-II	**Bioenergetics I** **7 hours**
	Glycolytic pathway and its regulation, homolactic fermentation, alcoholic fermentation, energetics of fermentation, glycogen breakdown, Citric acid cycle and its regulation, gluconeogenesis, Electron transport and oxidative phosphorylation, pentose phosphate pathway, glyoxalate pathway.
Unit-III	**Bioenergetics II** **7 hours**
	Fatty acid oxidation- major and minor pathways of fatty acid oxidation, ketone bodies. Metabolic breakdown of amino acids, transamination, deamination, urea cycle.
Unit-IV	**Biodegradation** **7 hours**
	Thermodynamics of transport, kinetics and mechanism of transport, active and passive transport, ATP-driven active transport, Ion gradient driven active transport.
Unit-V	**Biological membranes** **7 hours**
	Biological membranes: Introduction, Historical, Models, Components *i.e*. Lipids, Proteins, and Carbohydrates, Function. Methods of Study. Biochemical - Solubilization, purification, crystallization, reconstitution, membrane fusion. Artificial Membranes: Vesicles, Black membrane, erythrocyte membrane, Membrane biogenesis.
Reference books	1. Bioenergetics (4th Edition) David G. Nicholls and Stuart Ferguson. Sciencedirect. 2. Bioenergetics. Alexander Lowen. Penguin Books 3. Bioenergetics: Energy Conservation and Conversion. Editors: Schäfer, Günter, Penefsky, Harvey (Eds.), Springer Publications. 4. Bioenergetics: A Practical Approach. Guy C. Brown, Chris E. Cooper. IRL Press. 5. Biomembranes: Molecular Structure and Function. Gennis, Robert B., Gennis, Robert B. (Ed.), Springer Publications 6. Biomembrane Transport, Lon Van Winkle. Academic Press.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

BS307	**Enzymology**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of
Learning objective	The learning objective of course are: To create an understanding regarding the
Salient features	The student will be able to conceptualize basics to advance of
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Enzyme analysis** **8 hours**
	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.
Unit-II	**Enzyme inhibition & Kinetics** **7 hours**
	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-III	**Enzymes: types and inhibition** **7 hours**
	Allosteric enzymes with special reference to aspartate transcarbomylase and phosphofructokinase. Qualitative description of concerted and sequential models. Negative cooperativity 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.
Unit-IV	**Enzyme Technology** **7 hours**
	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.
Unit-V	**Enzymes: Applications** **7 hours**
	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.
Reference books	1. Biochemistry, Lubert Stryer, 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
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

BS402	**Medical Biotechnology**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of basic biology
Learning objective	The learning objective of course are: To create an understanding regarding the medical biotechnology
Salient features	The student will be able to conceptualize basics to advance of medical biotechnology
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Art and Acc** **8 hours**
	Assisted reproductive technology- Pregnancy diagnosis - Animal cell culture-media, maintenance and culture of primary, secondary and continuous cell lines- organ culture- applications- cancer cell lines- apoptosis.
Unit-II	**Diagnostics methods** **7 hours**
	Prenatal diagnosis - Invasive techniques and Non-invasive techniques – Diagnosis of pathogenic microbes: Classical and modern methods- Diagnosis using protein and enzyme markers, DNA/RNA based diagnosis - Molecular markers - Microarray technology - genomic and cDNA arrays.
Unit-III	**Gene therapy Models** **7 hours**
	Gene therapy Models – Liver diseases, Lung diseases, Hematopoietic diseases, Circulated gene products, Cancer & Auto-immune diseases. Vaccines – Vaccine vectors, nucleic acid vaccines, immuno-enhancing technology.
Unit-IV	**Synthetic therapy** **7 hours**
	Synthetic therapy – synthetic DNAs, therapeutic Ribozymes, synthetic drugs. Tissue Engineering – Skin, Liver, Pancreas. Xenotransplantation – terminology, technology behind it, organ donors, social & ethical issues.
Unit-V	**Gene therapy** **7 hours**
	Gene therapy – background, types of gene therapy (ex vivo & in vivo), choosing targets for gene therapy, vectors in gene therapy, retroviruses, adenoviruses, adeno-associated viruses, types of gene delivery, Weismann barrier (soma-to-germ line barrier), epigenetic inheritance, problems & ethics. Gene Delivery methods – Viral delivery (through Retroviral vectors, through Adenoviral vectors), Non-viral delivery, Antibody engineering. Cell Adhesion-based therapy – integrins, inflammation, cancer & metastasis. Drug delivery – conventional & new approaches to drug delivery.
Reference books	1. Jogdand, S. N.. Medical Biotechnology, Himalaya Publishing house, Mumbai, 2005. 2. Click, B. R. and Pasternak.. Molecular Biotechnology: Principle and applications of recombinant DNA. ASM Press, 2010. 3. Ramasamy, P.. “Trends in Biotechnology”, University of Madras, Pearl press, 2002. 4. Trevan.. “Biotechnology”. Tata McGraw-Hill, 2005.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

BS404	**Plant Tissue Culture & Biotechnology**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of plant science
Learning objective	The learning objective of course are: To create an understanding regarding the plant tissue culture & biotechnology
Salient features	The student will be able to conceptualize basics to advance of plant tissue culture & biotechnology
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Plant tissue culture** **8 hours**
	Plant tissue culture – basis, plant hormones in PTC – micropropagation - callus induction, organogenesis, embryogenesis, somatic embryogenesis, somaclonal variation, artificial seeds and embryo rescue, plant cell suspension culture. Protoplast culture.
Unit-II	**Plant tissue culture** **7 hours**
	Introduction, Cryo and organogenic differentiation, 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-III	**Polyploid plant production** **7 hours**
	In vitro haploid production Androgenic methods: Anther culture, Microspore culture andogenesis Significance 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-IV	**Protoplast and somaclonal production** **7 hours**
	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 Nomenclautre, methods, applications basis and disadvantages.
Unit-V	**PGPR** **7 hours**
	Plant Growth Promoting bacteria. Nitrogen fixation, Nitrogenase, Hydrogenase, Nodulation, Biocontrol of pathogens, Growth promotion by free-living bacteria.
Reference books	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. 3rdedition. 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.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

BS406	**Biostatistics**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of mathematics
Learning objective	The learning objective of course are: To create an understanding regarding the Biostatistics To apply statistical methods for analyzing biological data To analyze biological data and to draw inferences
Salient features	The student will be able to conceptualize basics to advance of Biostatistics
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Basics of Statistics** **8 hours**
	Statistics – Definition, functions and its limitations – Collection, Classification, Tabulation of data – Diagrammatic and Graphical representation of data.
Unit-II	**Measures of Central Tendency** **7 hours**
	Measures of Central Tendency – Mean, Median, Mode, Geometric mean, Harmonic mean – Merits and demerits of these measures - Measures of Dispersion – Range, Quartile deviation, Mean deviation, Standard deviation, Variance, Coefficient of Variation, Skewness – Kurtosis.
Unit-III	**Correlation** **7 hours**
	Correlation – Types, scatter diagram – Karl Pearson's coefficient of correlation, Spearman's Rank Correlation – Regression – Formation of Regression lines – Uses of Regression lines.
Unit-IV	**Basics of Probability Theory** **7 hours**
	Basics of Probability Theory – Addition & Multiplication Rule – Binomial, Poisson and Normal Distribution and their uses in biological sciences.
Unit-V	**Test for Mean** **7 hours**
	Test for Mean – Test for the difference between two means – Test for proportion – Test for the difference between two proportions – Small sample Tests: Student's t-test, F-test – Analysis of variance (one-way and two-way – Basic Ideas only).
Reference books	1. Le CT (2003) Introductory biostatistics. 1st edition, John Wiley, USA 2. Glaser AN (2001) High YieldTM 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. 5. S.P.Gupta (2011), Statistical methods, Sultan Chand & Sons,4th Edition. 6. Jerold H.Zar (2009): Bio-statistical Analysis, 4th Edition, Pearson Education Inc., 7. Dorling Kindersley (India) Pvt. Ltd., New Delhi. 8. Antonisamy.B, Solomon Christopher and Prasanna Samuel.P, (2010): 9. Bio-Statistics Principles and Practice, 1st Reprint 2011, Tata McGraw Hill Education Pvt. Ltd., New Delhi.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

BS408	**Mycology & Virology**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of microbiology.
Learning objective	The learning objective of course are: To create an understanding regarding the mycology & virology.
Salient features	The student will be able to conceptualize basics to advance of mycology & virology.
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Classification and application of fungi** **7 hours**
	Classification and application of fungi: General classification and Life cycle, structure and occurrence – (i) Cellular slime molds (ii) True slime mold (iii) Oomycetes (iv) Chytridiomycetes (v) Zygomycetes (vi) Ascomycetes (vii) Basidiomycetes (viii) Deuteromycetes, Bioremediation (of wood, paper, textile, leather), mycotoxins, Economic importance of fungi with examples in agriculture, environment, industry, medicine, food,
Unit-II	**Classification and application of algae** **7 hours**
	Classification and application of algae: General classification Life cycle, thallus organisation and occurrence – (i) Chlorophyceae (ii) Charophyceae (iii) Diatoms (iv) Xanthophyceae (v) Phaeophyceae (vi) Rhodophyceae: (vii) Cyanobacteria. Lichens, Economic importance of algae with examples in agriculture, environment, industry and food.
Unit-III	**Introduction and viral taxonomy** **7 hours**
	Introduction and viral taxonomy: History of viruses, definition of viruses, general properties of viruses, viroids, virusoids, satellite viruses and prions Structure and salient features of viral genomes: Capsid symmetry, enveloped and non-enveloped viruses. TMV, T4 phage, Hepatitis B virus, Picornavirus, Rhabdovirus, Retrovirus, Influenza virus. Classification and nomenclature of viruses. Applications of virology. Isolation, purification, cultivation of viruses,
Unit-IV	**Bacteriophages** **7 hours**
	Bacteriophages: Definition, structure and cycle of T4 and lambda phage, Types of oncogenic DNA and RNA viruses. Concepts of oncogenes, proto-oncogenes, tumor suppressor genes. Transmission, prevention and control of viral diseases: Persistent and non-persistent mode. Antiviral compounds, interferons and viral vaccines. Viral multiplication.
Unit-V	**General methods of Diagnosis** **8 hours**
	General methods of Diagnosis: Cultivation of viruses in embryonated eggs, experimental animals , cell cultures, Primary & secondary cell cultures, suspension cell cultures and monolayer cell cultures, cell strains, cell lines and transgenic systems; assay of viruses physical and chemical methods (Protein, nucleic acid, radioactivity tracers, electron microscopy)-Infectivity assay (plaque method, end point method)- Infectivity of plant viruses.
Reference books	1. Kumar HD. (1990). Introductory Phycology. 2nd edition. Affiliated East Western Press. 2. Kumar HD. (1995). The Text Book on Algae. 4th edition. Affiliated East Western Press 3. Alexopoulos CJ, Mims CW and Blackwell M. (1996). Introductory Mycology. 4th edition. John Wiley and Sons, Inc 4. Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR, Skalka, AM (2004). Principles of Virology, Molecular biology, Pathogenesis and Control. 2nd edition. ASM press 5. Washington DC. 6. Levy JA, Conrat HF, Owens RA. (2000). Virology. 3rd edition. Prentice Hall publication, New Jersey
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

BS501	**Immunology and Immunotechnology**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of circulatory system.
Learning objective	The learning objective of course are: To create an understanding regarding the Immunology and Immunotechnology.
Salient features	The student will be able to conceptualize basics to advance of Immunology and Immunotechnology.
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Immune Response** **7 hours**
	Immune Response - An overview, components of mammalian immune system, molecular structure of Immuno-globulins or Antibodies, Humoral & Cellular immune responses, Tlymphocytes & 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	**Regulation of immunoglobulin gene expression** **7 hours**
	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	**Major Histocompatibility complexes** **7 hours**
	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	**Vaccines & Vaccination** **7 hours**
	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.
Unit-V	**Antibody Related Techniques** **8 hours**
	Immuno-chemistry of Antigens - immunogenecity, Antigenecity, haptens, Toxins-Toxiods, Hapten-carrier system; Genetic bases of immune response – Heterogenecity; Role and properties of adjuvants, Immune modulators; B cell epitopes; Hybridoma Rabbit, human; Antigen – Antibody interaction, affinity, cross reactivity, specificity, epitope mapping; Immuno assays RIA, ELISA, Western blotting, ELISPOT assay, immunofluorescence, Surface plasmon resonance, Biosensor assays for assessing ligand –receptor interaction
Reference books	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's Immunobiology. 7th edition Garland Science Publishers, New York. 5. Peakman M, 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.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

BS503	**Industrial Biotechnology, IPR, & Biosafety**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Biology.
Learning objective	The learning objective of course are: To create an understanding regarding the Industrial Biotechnology, IPR, & Biosafety.
Salient features	The student will be able to conceptualize basics to advance of Industrial Biotechnology, IPR, & Biosafety.
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Industrial Production** **7 hours**
	Industrial Production: Alcohol (ethanol) Acids (citric, acetic acid), solvents (glycerol, acetone), antibiotics (Penicillin, streptomycin,), Amino acids (lysine, glutamic acid), Enzymes (amylase, proteases),
Unit-II	**Introduction to Indian Patent Law** **7 hours**
	Introduction to Indian Patent Law. World Trade Organization and its related intellectual property provisions. Intellectual/Industrial property and its legal protection in research, design and development. Patenting in Biotechnology, economic, ethical and depository considerations.
Unit-III	**Entrepreneurship** **7 hours**
	Entrepreneurship: Selection of a product, line, design and development processes, economics on material and energy requirement, stock the product and release the same for making etc. The basic regulations of excise: Demand for a given product, feasibility of its production under given constraints of raw material, energy input, financial situations export potential etc.
Unit-IV	**Bioethics** **7 hours**
	Bioethics – Necessity of Bioethics, different paradigms of Bioethics – National & International. Ethical issues against the molecular technologies.
Unit-V	**Biosafety** **8 hours**
	Biosafety– Introduction to biosafety and health hazards concerning biotechnology. Introduction to the concept of containment level and Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).
Reference books	1. Entrepreneurship: New Venture Creation : David H. Holt 2. Patterns of Entrepreneurship : Jack M. Kaplan 3. Entrepreneurship and Small Business Management: C.B. Gupta, S.S. Khanka, Sultan Chand & Sons. 4. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd. 5. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international Publishers
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

BS505	**Animal Tissue Culture and Biotechnology**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of animal sciences.
Learning objective	The learning objective of course are: To create an understanding regarding the Animal Tissue Culture and Biotechnology.
Salient features	The student will be able to conceptualize basics to advance of Animal Tissue Culture and Biotechnology.
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Gene transfer methods in Animals** **7 hours**
	Gene transfer methods in Animals – Microinjection, Embryonic Stem cell, gene transfer, Retrovirus & Gene transfer.
Unit-II	**Introduction to transgenesis** **7 hours**
	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	**Animal propagation** **7 hours**
	Animal propagation – Artificial insemination, Animal Clones. Conservation Biology – Embryo transfer techniques. Introduction to Stem Cell Technology and its applications.
Unit-IV	**Genetic modification in Medicine** **7 hours**
	Genetic modification in Medicine - gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, problems & ethics.
Unit-V	**Introduction of cloning** **8 hours**
	Cell cloning, micromanipulation and types of cloning. Cell transformation. Application of animal cell culture, limitations of animal cell cultures. Stem cell culture, embryonic stem cells and their applications. Organ and histotypic cultures. Three dimensional culture and tissue engineering
Reference books	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 DNAgenes and genomes- A short course. III Edition. Freeman and Co., N.Y., USA.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

BS507	**Genetic Engineering**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Molecular Biology.
Learning objective	The learning objective of course are: To create an understanding regarding the Genetic Engineering.
Salient features	The student will be able to conceptualize basics to advance of Genetic Engineering.
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and mai ntain the physical health of both animal and plants.
Unit-I	**Molecular tools and applications** **7 hours**
	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	**Restriction and modification system** **7 hours**
	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	**Random and site-directed mutagenesis** **7 hours**
	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	**Genetic engineering in plants** **7 hours**
	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.
Unit-V	**Recombinant protein Technology** **8 hours**
	Recombinant protein Technology: Design and use of expression vectors, selection of suitable promoter sequences, ribosome binding sites, transcription terminator, plasmid copy number. Processing of Recombinant proteins- Stabilization of proteins. Phage Display, Inclusion Bodies, solubilization of insoluble proteins. Codon optimization, Fusion ProteinsGene therapy, Gene silencing.
Reference books	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.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

`BS602	**Bioprocess and Fermentation Technology**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Fermentation Sciences.
Learning objective	The learning objective of course are: To create an understanding regarding the Bioprocess and Fermentation Technology.
Salient features	The student will be able to conceptualize basics to advance of Bioprocess and Fermentation Technology.
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Introduction to bioprocess technology** **7 hours**
	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. 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-II	**Downstream processing** **7 hours**
	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. Introduction to downstream processing, product recovery and purification. Effluent treatment. Microbial production of ethanol, amylase, lactic acid and Single Cell Proteins.
Unit-III	**Production of industrial chemicals** **7 hours**
	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-IV	**Microbial products of pharmacological interest** **7 hours**
	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.
Unit-V	**Purification & characterization** **8 hours**
	Purification & characterization of proteins, Upstream and downstream processing, solids and liquid handling. Distribution of microbial cells, centrifugation, filtration of fermentation broth, ultra centrifugation, liquid extraction, ion-exchange recovery of biological products. Experimental model for design of fermentation systems, Anaerobic fermentations.
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. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited. 4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2ndedition, Elsevier Science Ltd. 5. Salisbury, Whitaker and Hall. Principles of fermentation Technology,
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

BS604	**Bioinformatics and Nanobiotechnology**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Computer Sciences and Biotechnology.
Learning objective	The learning objective of course are: To create an understanding regarding the Bioinformatics and Nanobiotechnology.
Salient features	The student will be able to conceptualize basics to advance of Bioinformatics and Nanobiotechnology.
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**History of Bioinformatics** **7 hours**
	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	**Protein Information Sources** **7 hours**
	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	**Sequence and Phylogeny analysis** **7 hours**
	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. Searching Databases: SRS, Entrez, Sequence Similarity Searches-BLAST, FASTA, Data Submission. Genome Annotation: Pattern and repeat finding, Gene identification tools.
Unit-IV	**Nanomaterial in biotechnology** **7 hours**
	Nanomaterial in biotechnology - nanoparticles, quantum dots, nanotubes and nanowires etc. Development of nanobiotechnology – timelines and progress, overview. Biological nanoparticles production - plants and microbial. Nanobiotechnological applications in health and disease, infectious and chronic.
Unit-V	**Biosensors** **8 hours**
	Biosensors ; different classes, molecular recognition elements, transducing elements. Applications of molecular recognition elements in nanosensing of different analytes, Application of various transducing elements as part of nanobiosensors. Nanobiotechnological applications in Environment and food - detection and mitigation.
Reference books	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.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

BS606	**Genomics and Proteomics**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Molecular Biology.
Learning objective	The learning objective of course are: To create an understanding regarding the Genomics and Proteomics.
Salient features	The student will be able to conceptualize basics to advance of Genomics and Proteomics.
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Introduction to Genomics**
	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	**Genome Data**
	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	**Introduction to protein structure**
	Introduction to protein structure, Chemical properties of proteins. Physical interactions that determine the property of proteins. Short-range interactions, electrostatic forces, Vander Waal interactions, hydrogen bonds, Hydrophobic interactions.
Unit-IV	**Determination of sizes**
	Determination of sizes (Sedimentation analysis, gel filtration, SDS-PAGE); Native PAGE, Determination of covalent structures – Edman degradation.
Unit-V	**Introduction to Proteomics**
	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.
Reference books	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, B.R. Glick, J.J. Pasternak and C.L. Patten, 2010. 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.
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

Electives Courses

BS610	**Basics of Forensic Science**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Biology
Learning objective	The learning objective of course are: To create an understanding regarding the Basics of Forensic Science
Salient features	The student will be able to conceptualize basics to advance of Basics of Forensic Science
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Basics of Forensic Science** **8 hours**
	Introduction and principles of forensic science, forensic science laboratory and its organization and service, tools and techniques in forensic science, branches of forensic science
Unit-II	**Crime Forensic** **7 hours**
	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-III	**Fire Arm Forensic** **7 hours**
	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-IV	**Toxicology Forensic** **7 hours**
	Role of the toxicologist, significance of toxicological findings, Fundamental principles of fingerprinting, classification of fingerprints, development of finger print as science for personal identification.
Unit-V	**Genetic Engineering Forensic** **7 hours**
	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.
Reference books	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).
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

BS612	**Molecular Modelling and Drug Designing**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Bioinformatics and drugs
Learning objective	The learning objective of course are: To create an understanding regarding the Basics of Molecular Modelling and Drug Designing
Salient features	The student will be able to conceptualize basics to advance of Basics of Molecular Modelling and Drug Designing.
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Basic concepts of molecular structure** **8 hours**
	Basic concepts of molecular structure (bond length, bond angle, torsion angle and non-covalent interactions – Molecular structure and internal energy – Energy minimization of small molecules – Empirical representation of molecular energies – Use of force fields and the molecular mechanics method –Discussion of global energy minimum – Molecular representation in graphics.
Unit-II	**Basic principles of molecular dynamics** **7 hours**
	Basic principles of molecular dynamics and Monte Carlo Simulation for conformational analysis - ab initio – Density-Functional Theory and semiemperical methods.
Unit-III	**Macromolecular modeling** **7 hours**
	Macromolecular modeling – Identification and mapping of active sites - Design of ligands for known macromolocular target sites. Drug-receptor interactions. Classical SAR/QSAR studies and their Implications to the 3-D modeler. 2-D and 3-D database searching –pharmocophore identification and novel drug design.
Unit-IV	**Cancer and related diseases** **7 hours**
	Cancer and related diseases – mechanism and action of available anti-cancer drugs - New targets for anti-cancer drugs - Drugs that rescue mutant p53's and tubulin.
Unit-V	**Enzyme background** **7 hours**
	Enzyme background – Theories of enzyme inhibition - Enzyme inhibition as a tool for drug development – Structured-based drug design – structural bioinformatics in drug discovery - Examples.
Reference books	1. Andrew Leach, Molecular Modelling: Principles and Applications (2nd Edition), Addison Wesley Longman, Essex, England, 1996. 2. Alan Hinchliffe, Modelling Molecular Structures, 2nd Edition, John-Wiley, 2000. 3. Alan Hinchliffe, Molecular Modelling for Beginners, John-Wiley, 2003. 4. N. Cohen (Ed.), Guide Book on Molecular Modeling in Drug Design, Academic Press, San Diego, 1996. 5. D. Frenkel and B. Smith, Understanding Molecular Simulations. From Algorithms to Applications, Academic Press, San Diego, California, 1996. 6. C. Rauter and K. Horn, X-ray crystallography and drug design, Elsevier, 1984. 7. M. Kalos and P. A. Whitlock, Monte Carlo Methods. John Wiley & Sons, New York, 1986. 8. J.A. McCammon and S.C. Harvey. Dynamics of Proteins and Nucleic Acids. Cambridge University Press, Cambridge, 1987. 9. D.C. Rapaport. The Art of Molecular Dynamics Simulation.Cambridge University Press, Cambridge, England., 1995
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

BS614	**Molecular Diagnostics**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of Microbiology and Immunology
Learning objective	The learning objective of course are: To create an understanding regarding the Basics of Molecular Diagnostics
Salient features	The student will be able to conceptualize basics to advance of Basics of Molecular Diagnostics
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Enzyme Immunoassays** **8 hours**
	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 immuno histochemical techniques. Use of polyclonal or monoclonal antibodies in enzymes immuno assays. Applications of enzyme immunoassays in diagnostic microbiology
Unit-II	**Molecular methods in clinical microbiology** **7 hours**
	Applications of PCR, RFLP, Nuclear hybridization methods, Single nucleotide polymorphism and plasmid finger printing in clinical microbiology
Unit-III	**Laboratory tests in chemotherapy** **7 hours**
	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.
Unit-IV	**Automation in diagnostics** **7 hours**
	Automation in microbial diagnosis, rapid diagnostic approach including technical purification and standardization of antigen and specific antibodies.
Unit-V	**Idiotyping** **7 hours**
	Concepts and methods in idiotypes. Antiidiotypes and molecular mimicry and receptors. Epitope design and applications. Immunodiagnostic tests. Immuno florescence. Radioimmunoassay.
Reference books	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
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	

BS616	**Biotechnology and human welfare**
Version	1.0
Prerequisite	All students are expected to have a basic knowledge of biotechnology
Learning objective	The learning objective of course are: To create an understanding regarding the Basics of Biotechnology and human welfare
Salient features	The student will be able to conceptualize basics to advance of Basics of Biotechnology and human welfare.
Utility	A degree in Biotechnology allows students to understand the living systems of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and plants.
Unit-I	**Industry** **8 hours**
	Industry: protein engineering; enzyme and polysaccharide synthesis, activity and secretion, alcohol and antibiotic formation.
Unit-II	**Agriculture** **7 hours**
	Agriculture: N2 fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; qualitative improvement of livestock.
Unit-III	**Environment** **7 hours**
	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	**Forensic science** **7 hours**
	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	**Health** **7 hours**
	Health: e.g. development of non-toxic therapeutic agents, recombinant live vaccines, gene therapy, diagnostics, monoclonal in E.coli, human genome project.
Reference books	1. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd. 2. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international publishers
Mode of Examination	Assignment/Quiz/Viva-Voce/student seminar/written examination/PPT
Recommended By BOS on:	
Approved by academic council on:	