SOPHIA COLLEGE, (AUTONOMOUS)

Affiliated to

UNIVERSITY OF MUMBAI

Programme: LIFE SCIENCES

Programme Code: SBSLSC

S.Y.B.Sc

(Choice Based Credit System with effect from the year 2021-22)

Programme Outline: SYBSc LSc (SEMESTER III)

Course Code	Unit No	Name of the Unit	Credits
SBSLSC301		**Comparative physiology-I**	6
	1	Physiology and Homeostatic Maintenance	
	2	Control and Coordination in plants and animals	
	3	Sex determination and sexual differentiation	
SBSLSC302		**Life processes at the tissue, organ and organism levels: A Biochemical Approach-I**	6
	1	Enzymes and their environment	
	2	Metabolism - Energy from Carbohydrates	
	3	Metabolism - Energy from Lipids and Proteins	
		Population approach: population and communities as Regulatory unit-I	6
	1	Concepts in Evolution and Population Genetics	
	2	Biostatistics-I	
SBSLSC303	3	Infectious diseases–I and Bioinformatics-I	
SBSLSCP3			2+2+2

Programme Outline: SYBSc LSc (SEMESTER IV)

Course Code	Unit No	Name of the Unit	Credits
SBSLSC401		**Comparative physiology-II**	6
	1	Integration and Coordination	
	2	Adaptations to Physiological stress	
	3	Homeostasis during infections	
SBSLSC402		**Life processes at the tissue, organ and organism levels: A Biochemical Approach-II**	6
	1	Metabolism: Anabolism of biomolecules	
	2	Nucleic acids	
	3	Regulation of gene expression and Integration of metabolism	
		Population approach: population and communities as Regulatory unit-II	6
	1	Evolution and its consequences	
SBSLSC403	2	Biostatistics -II	
	3	Infectious diseases–II and Bioinformatics-II	
SBSLSCP4			2+2+2

Preamble:

The Broad-Based Integrated Biology Undergraduate Program in Life Sciences, which offers the BSc Life Sciences, is a cutting-edge integrated approach to biological sciences. The course is dedicated to the expansion of knowledge, innovation, and ethical practice in the field of life sciences, in recognition of the profound importance of these fields in understanding the complexity of living beings and ecosystems.
Beyond theory, this program provides students with real laboratory activities that will help them hone their skills and obtain invaluable experience in a scientific setting. The student will be prepared to apply state-of-the-art tools and methods, which will reinforce their comprehension of the subjects taught in class. Through encouraging scientific inquiry, interdisciplinary collaboration, and the pursuit of excellence, our program aims to create a community of scholars and researchers who are ready to take on the most important problems facing both humanity and the natural world, regardless of their career goals—research, industry, environmental science, or a combination of these.

PROGRAMME OBJECTIVES

PO 1	**Understand and analyze fundamental biological concepts while merging perspectives from several domains related to modern biology.**
PO 2	**Expand professional studies and research in disciplines such as neurology, genetics, cell biology, physiology, biochemistry, immunology, developmental biology, ecology, and biotechnology.**
PO 3	**Understand and apply information from a variety of scientific resources; assess and interpret graphical data; develop reliable hypotheses, plan experiments, and observational techniques in a laboratory setting; demonstrate problem-solving abilities; and present results from science in verbal and written form.**
PO 4	**Demonstrate expertise in scientific subjects such as biostatistics, bioinformatics, and analytical procedures required for productive biological research; understand biotechnological processes utilized in business; and anticipate need-based entrepreneurial opportunities in all areas of biology.**
PO 5	**Engage as a team, establish interpersonal communication skills, and get the confidence to pursue a career in any field of choice.**

PROGRAMME SPECIFIC OUTCOMES

PSO 1	**The learner will able to understand various fundamental concepts of life science and reflect them in their day to day life.**
PSO 2	**The learner will be proficient with analytical tools and techniques of life sciences.**
PSO 3	**The Learner will be able to draw parallels, and perceive connections developmental biology and organization of nervous system.**
PSO 4	**The Learner will be able to learn skills involved in fermentation technology, recombinant DNA technology.**
PSO 5	**The learner will be able to embrace the importance of sustainability, biodiversity and significance of different environmental agreements.**
PSO 6	**The learner will be able to develop a holistic understanding of the components of our environment and the associated depletion of resources and pollution due to anthropogenic activities.**
PSO 7	**The learner will be able to critical think and analyse any given problem scientifically.**

PSO 8	**The Learner will be able to comprehend with fundamental concepts of genetics and immunology.**

SEMESTER 3

NAME OF THE COURSE	COMPARATIVE PHYSIOLOGY	
CLASS	SYBSC	
COURSE CODE	SBSLSC301	
NUMBER OF CREDITS	6+2	
NUMBER OF LECTURES PER WEEK	3	
TOTAL NUMBER OF LECTURES PER SEMESTER	45	
EVALUATION METHOD	INTERNAL ASSESSMENT	SEMESTER END EXAMINATION
TOTAL MARKS	50	50
PASSING MARKS	20	20

COURSE OBJECTIVES:

CO 1.	Outline physiology and homeostatic maintenance
CO 2.	Compare and contrast the control and coordination in plants and animals
CO 3.	Gain knowledge about sex determination and sexual differentiation

COURSE LEARNING OUTCOMES:

CLO 1.	The Learner will be able to understand the Outline physiology and homeostatic maintenance
CLO 2.	The Learner will be able to Compare and contrast the control and coordination in plants and animals
CLO 3.	The Learner will be able to Gain knowledge about sex determination and sexual differentiation.

UNIT 1	Physiology and Homeostatic Maintenance A. Transport and Circulation (15 LECTURES)
1.1	1. Transport in plants – Transport of water and inorganic solutes – transpiration, stomatal function and regulation, role of proton pumps and factors affecting ascent of xylem sap. Transport of organic solutes – mechanism and its regulation 2. Circulation in animals – (a) Animals without a circulatory system eg. hydra and jellyfish (b) Open and closed circulatory system eg. Insects vs worms 3. Vertebrate circulatory system – heart, single and double circulation.
1.2	Specific adaptations – mammals at high altitudes and diving mammals Cardiovascular system in health and disease – exercise, hypertension and atherosclerosis
1.3	Respiration and Gaseous exchange 1. Aerobic and anaerobic respiration Gas exchange in small animals (across surface) and cutaneous respiration in frogs. Gas exchange in plants – also pneumatophores 2. Gaseous exchange in invertebrates – trachea in insects, book lungs in scorpion 3. Gaseous exchange in vertebrates – gills and lungs Respiratory pigments – O2 and CO2 balance
UNIT 2	Control and Coordination in plants and animals (15 LECTURES)
	1. Phylogenetic development of the Nervous System – nerve net, nerve plexus and ganglionated nervous system in hydra, starfish and earthworm. 2. Human Nervous System – CNS and PNS overview 3. Nature of the Nerve Impulse – Resting potential, Action Potential 4. Transmission of Nerve impulses and synapses 5. a. Behaviour and behavioural adaptations (Neuronal)– Innate and learned behaviour (Habituation) with an example of Aplysia b. Behavioral Strategies in Bird Migration (Physiological aspect-Accumulation of Body fat and thermoregulation)
UNIT 3	Developmental Biology (15 LECTURES)
	Reproduction and Development 1. Basis of Sex Determination (a) Plants: Maize (b) Animals: Role of SRY gene and Aromatase (c) Role of environmental factors – Temperature and Parthenogenesis in insects. Eg. Wasp/Honey bee/Ants (d) Plant-animal interaction for reproduction Fig wasp / Gall wasp (e) Sex reversal 2. Sex differentiation of gonads, internal and external genitalia. 3. Early gametogenic development in plants alternation of generation. e.g: moss/ Ferns. Double fertilization: E.g. angiosperms 4. Ovarian and testicular functions, puberty and regulation of uterine changes in menstrual cycle, menopause, pregnancy, parturition, lactation. 5. Artificial regulation of reproduction: Use of contraceptive methods
SBSLSCP301	Practical (Based on Paper I)
	1. Good Laboratory Practices. 2. Demonstration of reproductive system and location of endocrine glands in Albino Mouse Male and Female (Virtual Lab).

	3. Microtome and preparation of Endocrine gland slides from above dissected specimen or any suitable plant specimen 4. Study of Histological features of Endocrine glands. 5. A complete study of Frog Embryology (Egg to Tadpole to Adult). 6. Study of Floral parts from the given flower (Hibiscus and Pancretium) study of microscopic structure of anthers , ovules. Seed structure (Maize and Okra). 7. Study of pollen germination Using Vinca flower (in vitro) 8. a. Study of pollen germination in Vinca (in Vivo) b. Tracing the path of the pollen tube along the stylar canal using Aniline blue stain 9. Study of effect of temperature and caffeine on heartbeat of Daphnia 10. Demonstration of Liberation of Heat Energy/respirometer During Respiration –plants 11. Principle and working of home pregnancy test slide.

NAME OF THE COURSE	LIFE PROCESSES AT THE TISSUE, ORGAN AND ORGANISM LEVELS A BIOCHEMICAL APPROACH-I	
CLASS	SYBSC	
COURSE CODE	SBSLSC302	
NUMBER OF CREDITS	6+2	
NUMBER OF LECTURES PER WEEK	3	
TOTAL NUMBER OF LECTURES PER SEMESTER	45	
EVALUATION METHOD	INTERNAL ASSESSMENT	SEMESTER END EXAMINATION
TOTAL MARKS	50	50
PASSING MARKS	20	20

COURSE OBJECTIVES:

CO 1.	Familiarize students with the basic biochemical process in the cells and tissues and their regulation .
CO 2.	Acquaint the students to the lipid and protein catabolism by demonstrating its significance in terms of real life examples
CO 3.	Introduce students to different techniques used to extract and purify enzymes and the parameters to study enzyme kinetics and further how enzyme activity is regulated

COURSE LEARNING OUTCOMES:

CLO 1.	The Learner will be able to understand the basic biochemical process in the cells and tissues and their regulation.
CLO 2.	The Learner will be able to familiarize between lipid and protein catabolism by demonstrating its significance in terms of real life examples.
CLO 3.	The Learner will be able to different techniques used to extract and purify enzymes and the parameters to study enzyme kinetics and further how enzyme activity is regulated.

UNIT 1	Enzymes and their environment (15 LECTURES)
1.1	Enzymes 1. Extraction, purification and Specific activity Enzyme example (Plant: RUBISCO, Animal: LDH) (Mention Techniques: Dialysis, Gel-filtration, Ion-exchange, Affinity chromatography and Spectrophotometry) 2. Classification (With an example of each) 3. Effect of pH and Temperature 4. Co-enzymes and co-factors: NAD, FAD, Mn, Mg, Zn and Cu (one reaction each) 5. Kinetics (MM, LB) 6. Enzyme Inhibitors, Activators and feed-back 7. Allosteric enzymes (Kinases in Glycolysis) and their significance in metabolic regulation
UNIT 2	Metabolism – Energy from Carbohydrates (15 LECTURES)
2.1	A. Carbohydrates – Catabolism) Glycolysis – Brief Historical background process and metabolic regulation Citric Acid Cycle – Brief Historical background a) Process and regulation. b) Importance as a central amphibolic pathway unifying all primary biological processes. c) Anaplerosis
2.2	Bioenergetics: 1. Electron Transport System (i) Localisation and (ii) Sequence of electron transporters 2. Oxidative Phosphorylation i. Mitchell's Chemiosmotic Hypothesis ii. ATP synthesis iii. Control of respiration, uncoupling and metabolic poisons
UNIT 3	Metabolism – Energy from Lipids and Proteins (15 LECTURES)
3.1	Lipids –Catabolism: 1. Lipolysis 2. Role of Carnitine in mitochondrial permeability 3. Beta– Oxidation of fatty acids and integration into Kreb's cycle 4. Ketone bodies and their significance
3.2	Amino Acids –Catabolism: 1. Protein Degradation liberating amino-acids' 2. Deamination, Transamination & ammonia disposal by Urea cycle. 3.Decarboxylation & integration into Krebs cycle
SBSLSCP302	Practical (Based on Paper II)
	A. Instrumentation / Technique (I / T) - pH metry - Colorimetry - Titration B- Process / Concept and immediate Relevance (C, R) - Extraction, Purification - Analysis / Estimation - GLP (Good Laboratory practices) incorporated into every practical Acid, bases and buffers

	1. pH meter - (I, C, T) (i) principle & instrumentation and (ii) determination of pH (titration of Acids/Bases/Buffers/ 'chameleon balls'). (in FY the student were introduced to the concept of pH measurement of familiar liquids-here tech & details are given- practically understanding buffering using Glycine / titration curve) 2. Protein precipitation by pH manipulation (Casein from Milk/ Curds) (From previous experiment and pH manipulation, proteins can be precipitated)(C, R) 3. Enzymology & localization: i. Study of Enzyme activity and Kinetics : Determination of KM of an enzyme Urease (from Jack beans)/Lipase/Protease(from detergents) (I,C,T) (Enzyme activity can be detected and estimated - using colorimetry) ii. Histochemical localization of Enzymes (Acid Phosphatase)(C, T) (Enzyme activity can be localized) 4. Estimation / Quantitation: i. Colorimetric Protein Estimation by Biuret Method (Enzyme extract / Casein from previous expts.). I, C, T (Proteins, such as the isolate from experiment 2 can be estimated by colour reaction) C,T,R ii. Colorimetric Cholesterol Estimation / total Lipid Estimation from egg. (lipid metabolism is an important component of our systems, content can be estimated by colour reaction) iii. Colorimetric estimation of Inorganic Phosphates by Stannous chloride method. C, T, R (Estimation of biologically relevant inorganic ions by colorimetric method) iv. Titrimetric estimation of Ascorbic acid (Vit C). C, T, R (Estimation of biological materials by non-colorimetric method)

NAME OF THE COURSE	POPULATION APPROACH: POPULATION AND COMMUNITIES AS REGULATORY UNIT-I	
CLASS	SYBSC	
COURSE CODE	SBSLSC303	
NUMBER OF CREDITS	6+2	
NUMBER OF LECTURES PER WEEK	3	
TOTAL NUMBER OF LECTURES PER SEMESTER	45	
EVALUATION METHOD	INTERNAL ASSESSMENT	SEMESTER END EXAMINATION
TOTAL MARKS	50	50
PASSING MARKS	20	20

COURSE OBJECTIVES:

CO 1.	Familiarize students with the basic bioinformatics tools, database and application
CO 2.	Acquaint the students to statistics and data analysis.
CO 3.	Make the student understand the evolutionary concepts and population studies

COURSE LEARNING OUTCOMES:

CLO 1.	The Learner will gain knowledge about the basic bioinformatics tools, database and application.
CLO 2.	The learner will be able to apprehend to the statistics and data analysis.
CLO 3.	The learner will be to understand the evolutionary concepts and population studies.

UNIT 1	Concepts in Evolution and Population Genetics (15 LECTURES)
1	1. Darwinism: Conceptual arguments for evolution by Natural Selection given by Charles Darwin and Alfred Wallace. 2. Evidences for evolution: Comparative anatomy and embryology, Fossil records and living fossils, Artificial selection. 3. Evolutionary history: The evolutionary time scale; eras, periods and epoch; major events in the evolutionary time scale 4. Populations and allelic frequencies, Hardy Weinberg Equilibrium, change in gene frequencies due to selection, mutation, migration and genetic drift (founders effect) 5. Origin of variability, polymorphism, kinds of selection – directional, stabilizing and

	disruptive, selectionist vs neutralist
UNIT 2	Biostatistics (15 LECTURES)
2	1. Probability definition, addition law, random variable, probability mass function 2. Binomial, Poisson and Normal distribution 3. Bivariate data, scatter diagram and its uses, Karl Pearson's correlation coefficient, Spearman's Rank correlation coefficient 4. Regression equations and their uses
UNIT 3	Infectious Diseases–I and Bioinformatics–I (15 LECTURES)
3.1	Infectious Diseases–I: (to be discussed with respect to epidemiology, aetiology, pathology (of target tissue only), diagnosis, therapy, preventive measures and vaccines) 1. Tobacco mosaic virus, 2. Crown gall bacterial infection 3. Puccinia fungal infection
3.2	Bioinformatics–I: Concept of information network: internet, IP address, TCP/IP, FTP, HTTP, HTML and URLs (A) Introduction to bioinformatics, History, Applications of bioinformatics (B) Biological databases and their types Primary and secondary databases with examples, specialized databases with examplesof species database (Human/Yeast/Dicty) as well as disease database (HIVbase), possible limitations of databases. (C) Important databases: NCBI, EMBL, DDJB, Uniprot/SwissProt, NextProt, PDB (D) Sequence alignments 1. Pairwise versus multiple 2. Local and global 3. BLAST and its variants
SBSLSCP303	Practical (Based on Paper III)
	1. Correlation (Using serial dilution and OD, Data from Paper II and Using MSEXCEL / Population genetics data) 2. Regression Analysis (Using serial dilution and OD, Data from Paper II and Using MS EXCEL / Population genetics data) 3. Probability testing using suitable example 4. Normal Distribution using suitable example 5. NCBI: Searching for protein and nucleotide sequence in FASTA and GenBank formats using NCBI 6. Use of BLAST to search for a single nucleotide or protein sequence 7. Use of BLAST to compare two sequences 8. Staining of capsule and endospore and from the given culture 9. Testing of Hardy-Weinberg law using suitable examples of gene and allelic frequencies -Sex linked (One each) 10. Project proposal based on Bioinformatics/Biostatistics/ Population Genetics /Evolution

SEMESTER 4

NAME OF THE COURSE	COMPARATIVE PHYSIOLOGY	
CLASS	SYBSC	
COURSE CODE	SBSLSC401	
NUMBER OF CREDITS	6+2	
NUMBER OF LECTURES PER WEEK	3	
TOTAL NUMBER OF LECTURES PER SEMESTER	45	
EVALUATION METHOD	INTERNAL ASSESSMENT	SEMESTER END EXAMINATION
TOTAL MARKS	50	50
PASSING MARKS	20	20

COURSE OBJECTIVES:

CO 1.	Interpret the Integration and coordination in the living system
CO 2.	Gain knowledge of endocrine glands and hormones
CO 3.	Identify the mechanisms of homeostasis during infections

COURSE LEARNING OUTCOMES:

CLO 1.	The Learner will be able to understand the Outline physiology and homeostatic maintenance
CLO 2.	The Learner will be able to Compare and contrast the control and coordination in plants and animals
CLO 3.	The Learner will be able to Gain knowledge about sex determination and sexual differentiation.

UNIT 1	Integration and Coordination (15 LECTURES)
1.1	A. Homeostatic mechanisms and cellular communication Terminology: Homeostasis and Feedback loop, variables, receptors, integrators, effectors
1.2	B. Biochemical basis of cell signalling Types of hormones: Lipid-derived, amino acid derived and peptide hormone. Mechanism of hormone action: 1. Hormone receptor interactions 2. Receptor specificity 3. Receptor affinity 4. Saturation 5. Agonist and Antagonist Intracellular signalling from receptors: 1. Ion channel receptor

	2. G protein-coupled receptors 3. Enzyme-linked receptors 4. Target cell response.
1.3	C. Endocrine glands and their hormones (An Overview) Pineal Gland and Circadian system, Hypothalamus and Pituitary Thyroid, Parathyroid, Pancreas, Adrenal cortex, Testis and Ovary. Steroid hormone: Ecdysone.
1.4	D. Plant hormone homeostasis: Signalling and functions during development. Auxins, Gibberellic acid, Cytokinin, Abscisic acid, Ethylene
1.5	E. Interdependence of Muscle and support systems: Role of muscle in locomotion Eg Locomotion in earthworm Locomotion in humans – axial and appendicular skeleton and joints. Types of skeletons – hydrostatic (nematodes), exoskeleton (arthropods/molluscs) and endoskeletons (vertebrates) Homeostatic problems with locomotion: Muscular dystrophy/ sprain and strain/Osteoarthritis. Support system in plants – herbaceous and woody plants
UNIT 2	Adaptations to Physiological stress (15 LECTURES)
2.1	A. Ion & Water Homeostasis 1. In plants – water and salt regulation under normal and stressed conditions 2. In animals – Phylogenetic review of organs and processes - contractile vacuole, flame cells, nephridium, Malpighian tubules, kidney and skin in man 3. Concept of osmoregulation and processes associated with osmoregulation (ultrafiltration, selective re-absorption, secretion, acid-base regulation) 4. Nitrogenous excretory products (ammoniotelism, ureotelism and uricotelism) 5. Case studies: mammals in arid regions (camel); salt glands in birds.
2.2	B. Homeostasis to stress: Thermal physiology: 1. Plant adaptation in extreme thermal conditions 2. Thermal strategies in poikilotherms and homeotherms, ecto and endotherms. 3. Temperature regulating reflexes, acclimatization 4. Fever, Hyperthermia, heat exhaustion and heat stroke. 5. Thermogenesis: shivering and non-shivering thermogenesis, Hyperthermia induced by pyrogens 6. Antifreeze proteins.
2.3	C. Fuel Homeostasis during exercise and Stress: 1. Regulation of energy stores: control of food intake 2. Role of Leptin, Ghrelin and Kisspeptin 3. Eating disorders: Anorexia and Bulimia Nervosa 4. Overweight and obesity 5. Type I and Type II Diabetes
UNIT 3	Homeostasis during infections (15 LECTURES)
3.1	A. Host Parasite Relationship 1. Virulence factors and toxins: virulence factors, exotoxins, enterotoxins, Endotoxins 2. Host factors in infection: host risk factors, innate resistance 3. Parasite escape mechanisms - Crown gall bacterial infection- Puccinia fungal infection
3.2	B. Defence mechanisms in plants Biomolecules such as secondary metabolites, surface protectants and enzymes
3.3	C. Defence mechanisms in animals 1. Innate and Adaptive Immunity 2. Introduction to primary and secondary lymphoid organs and Lymphatic Systems

	3. Mechanisms of Innate Immunity – In invertebrates (hemocytes) and in Vertebrates (physical and physiological barriers, phagocytosis and inflammation) 4. Mechanisms of Adaptive Immunity – T and B cells. (Mode of Recognition of Antigen)
SBSLSCP401	Practical (Based on Paper I)
	1. Observation and Study of locally collected Leaf Gall and any other one plant disease. 2. Estimation of chlorophyll stability Index and carotenoid stability index in leaf tissue. 3. Estimation of ABA content in leaf and root. 4. Alkaloid separation by TLC 5. ABO blood typing. 6. Detection of activity of plant hormones (Dose dependent response). 7. Widal Test- Qualitative. 8. Streak plating (T, Pentagon and Quadrant –Any 2) to isolate microorganisms from a mixed culture using differential media. 9. Antibiotic sensitivity of microorganisms (Plant extract, Tetracycline/ Gentamycin

NAME OF THE COURSE	LIFE PROCESSES AT THE TISSUE, ORGAN AND ORGANISM LEVELS A BIOCHEMICAL APPROACH-II	
CLASS	SYBSC	
COURSE CODE	SBSLSC402	
NUMBER OF CREDITS	6+2	
NUMBER OF LECTURES PER WEEK	3	
TOTAL NUMBER OF LECTURES PER SEMESTER	45	
EVALUATION METHOD	INTERNAL ASSESSMENT	SEMESTER END EXAMINATION
TOTAL MARKS	50	50
PASSING MARKS	20	20

COURSE OBJECTIVES:

CO 1.	Familiarize students with the basic biochemical process in the cells and tissues and their regulation .
CO 2.	Understand the molecular process involved in gene expressions.
CO 3.	Introduced to anabolism of biomolecules like carbohydrate, lipids and amino acids, further they will get deeper understanding photorespiration and C3 and C4 cycles in photosynthesis

COURSE LEARNING OUTCOMES:

CLO 1.	The learner will able to Familiarize with the basic biochemical process in the cells and tissues and their regulation.
CLO 2.	The learner will able to Understand the molecular process involved in gene expression.
CLO 3.	The learner will able to understand the anabolism of biomolecules like carbohydrate, lipids and amino acids, further they will get deeper understanding photorespiration and C3 and C4 cycles in photosynthesis.

UNIT 1	Metabolism - Anabolism of biomolecules (15 LECTURES)
1.1	Carbohydrate Anabolism: 1.Gluconeogenesis 2. Pentose phosphate pathway 3. Short account of polysaccharide (Glycogen) synthesis
1.2	Lipids Anabolism: 1. Fatty acid biosynthesis 2. Cholesterol (4 Stages –Condensation, Conversion, Polymerization and Cyclization) and prostaglandin biosynthesis
1.3	Amino-acid Anabolism: 1. Transamination and its significance 2. Glutamine synthesis
1.4	Photosynthesis 1. Photophosphorylation, Hill reaction 2. C3 and C4 cycles 3. Photorespiration
UNIT 2	Nucleic acid (15 LECTURES)
2.1	Existence of two pathways for purine & pyrimidine synthesis and Significance of the 'salvage pathway'.
2.2	DNA replication system in prokaryotes – process and enzymes (with domains of DNA polymerase)
2.3	Transcription (a) Prokaryotes - binding, initiation, elongation & termination (b) Eukaryotes - only in terms of different RNA polymerase along with promoters RNA processing – of rRNA, tRNA and mRNA (5'cap, polyA tail and intron splicing (snRNPs only).
2.4	Concept of Reverse transcription.
UNIT 3	Regulation of gene expression and Integration of metabolism (15 LECTURES)
3.1	Translation: Genetic code; Translation system, post translational Modification (Phosphorylation, methylation and Acetylation)
3.2	Regulation of gene expression and its significance (a) Operon model (Lac, Trp). (b) Alternate splicing (c) Concept of RNAi
SBSLSCP402	Practical (Based on Paper II)
	This practical involves the following points relevant to Biochemistry: A. Instrumentation / Technique (I / T) PAGE (Demonstration) Chromatography – Paper, Thin layer, Column B. Process / Concept and immediate Relevance (C and R) - Extraction, Purification - Analysis / Estimation - GLP (Good Laboratory practices) incorporated into every practical

	Separation / Extraction techniques 1. Extraction and Detection of RNA/Ribose Sugars. C, T (Extraction of nucleic acid and detection by color reaction) 2. Chromatography of Sugars – Circular Paper C, T (Separation of carbohydrates and detection by color reaction) 3. Thin Layer Chromatography for separation of Plant Pigments (Slide technique) C, T, R (Separation techniques for charged, uncharged materials based on solvent partition) 4. Solvent Extraction of Lipids. C, T, R (Extraction of lipid and proportional estimation by weight) 5. Column Chromatography of Proteins / Pigments. I, C, T (Separation technique for proteins/ other materials based on charge/size) 6. Protein separation by PAGE (Demonstration) I, C (Separation techniques for charged materials based on electrophoretic mobility) 7&8. Plant enzyme (Qualitative / Quantitative) I, C, T 9. Interpretation of pathological reports based on the biochemical analysis.

NAME OF THE COURSE	POPULATION APPROACH: POPULATION AND COMMUNITIES AS REGULATORY UNIT-II	
CLASS	SYBSC	
COURSE CODE	SBSLSC403	
NUMBER OF CREDITS	6+2	
NUMBER OF LECTURES PER WEEK	3	
TOTAL NUMBER OF LECTURES PER SEMESTER	45	
EVALUATION METHOD	INTERNAL ASSESSMENT	SEMESTER END EXAMINATION
TOTAL MARKS	50	50
PASSING MARKS	20	20

COURSE OBJECTIVES:

CO 1.	Make students understand the significance of origin of species, and human evolution .
CO 2.	Familiarize with the biostatistics tests relevant to biological data collection.
CO 3.	Provide an first hand knowledge of the advanced in silico tools

COURSE LEARNING OUTCOMES:

CLO 1.	The learner will able to understand the significance of origin of species, and human evolution.
CLO 2.	The learner will able to Familiarize with the biostatistics tests relevant to biological data collection.
CLO 3.	The learner will able to get a first-hand knowledge of the advanced in silico tools.

UNIT 1	Evolution and its consequences (15 LECTURES)
1.1	Origin of Species: Biological species concept, morphological species, Allopatric and sympatric speciation, isolating mechanism preventing exchange in populations. Rates of speciation- punctuated or gradual. Life history of a species, Mitochondrial DNA and tracing human phylogeny and extinctions
1.2	Human evolution: Factors in Human Origin: Bipedalism, improvement in food acquisition, improved predator avoidance and reproductive success, Hunter gatherer societies and evolution of communication –speech and language. Tool making. Altruism and kin selection.

1.3	Evolution and Society: a) Cultural vs biological evolution b) Social Darwinism and eugenics c) Reproductive technologies and genetic engineering impact on human culture d) Gene machine vs intelligent design arguments.
UNIT 2	Biostatistics-II (15 LECTURES)
	1. Hypothesis and its types, errors in testing and its types, level of significance. 2. Analysis of variance one way classification, F-test. 3. Test for equality of two means, Paired and unpaired t-tests. 4. Comparison between Parametric and Non parametric test. 5. Chi Square test for independence 2x2 table.
UNIT 3	Infectious diseases and Bioinformatics-II (15 LECTURES)
3.1	Infections in Plants 1. Vector borne Diseases – Malaria/ EBOLA/Zika 2. Viral Disease – AIDS/ Herpes 3. Bacterial Diseases – Tuberculosis/ Leprosy/ Typhoid 4. Fungal Diseases – Candidiasis/ Ringworm 5. Helminthic Diseases – Filariasis
3.2	1. Phylogenetic Analysis (a) Concept of homologues - paralogous and orthologous genes, xenologs (b) Rooted versus unrooted trees (c) Cladogram and phylograms (d) Choice of sequence – nucleic acid/protein (e) Maximum parsimony method 2. Gene prediction (a) Concept of six frame translation (b)Annotation of putative genes, ORF finding (c) Gene prediction methods – Homology and Ab initio
SBSLS CP403	Practical (Based on Paper III)
	1. a. Comparative Anatomy of Brain (Invertebrate to vertebrate b. Study of Fossils (Any two) 2. Human Karyotyping- Normal and Abnormal (Numerical and Structural) 3. Chironomous Larva- Study of Giant Chromosome from Salivary Glands 4. BLAST search – to identify the sequence (nucleotide and protein) 5. BLAST for sequence alignment (pairwise) 6. Phylogenetic analysis using Globin gene and Mitochondrial DNA 7. Applications of t distribution 8. Analysis of variance one-way classification 9. Chi square distribution (In all statistical analysis use of Excel should be introduced) 10. Project report based on Bioinformatics/Biostatistics/ Population Genetics / Evolution

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SBSLSC 302 and 402

1. Lehninger's Principles of Biochemistry, Eds: D.L Nelson and M.M. Cox, Pub: W. H Freeman Publishers, New York. 4th edition (2005)

2. Biochemistry, Eds: J.M. Berg, J L Tymencko and L. Stryer, Pub: W H Freeman and co., New York. 5th edition (2002)

3. Fundamentals of Biochemistry by, Eds: D.Voet, J. G. Voet, Pub: John Wiley &Co., New York Pratt 1st Ed (2004)

4. Principles of Biochemistry, Ed: Lehninger.A, Pub: CBS Publishers and Distributors, 2nd Edition (1993)

5. Principles of Biochemistry, Eds: Zubay G.L, Parson W.W. and Vance D.E., Pub: W. C. Brown, First Edition (1995)

6. An Introduction to Genetic Analysis, Ed: Griffiths A.J. et al., Pub: W. H. Freeman (London)

Seventh Edition (2000)

SBSLSC 303 and 403

1. Strickberger's Evolution – B. Hall and B. Hallgrimsson 4th Edition (2008) Jones and Bartlett Publishers

2. Remarkable Creatures: Epic Adventures in Search of the Origin of Species. Sean B. Carrol, (2009). Mariner Books,

3. Population Genetics, M.B.Hamilton, (2009). Wiely-Blackwell,

4. Population Genetics: A Concise Guide, J.H.Gillespie, (2004), Johns Hopkins University Press.

5. Methods in Biostatistics of Medical students and Research Workers, B.K.Mahajan, 8th Edition, (2010), Jaypee.

6. Fundamental concepts of Bioinformatics. Krane and Raymer (2003). Benjamin Cummings Publication.

7. Exploring Bioinformatics – A Project-based Approach, St. Clair and Visick (2010), Jones and Bartlett Publishers

8. Bioinformatics for Dummies, Jean-Michel Claverie, Cedric Notredame, 2003, John Wiley & Sons

ASSESSMENT DETAILS:(this will be same for all the theory papers)

Internal assessment (50 marks)

Three or four activities having two tests and one activity OR two tests and two activities. The best two marks will be considered for the Internal assessment total out of 50

- Test (25 marks)-Students will be given a test from any of the units for 25 marks. The duration of the test will be 50 minutes. (Multiple choice questions- 10 marks, Answer in one word/sentence - 05 marks, Subjective questions - HWY, Justify, Differentiate between, Diagrammatically etc. - 10 marks.)
- An activity for 25 marks would be given in the form of a creative learning process. (Powerpointpresentation, Report and Viva, Model making and presentation, poster presentation, Analytical problems on higher order thinking, any other activity)

Semester end examination (50 marks)

If Online

- The question paper shall consist of two parts - Part A and B. Part A will consist of 30 marks MCQs (including both 1 and 2 mark MCQs) whereas Part B will consist of 20 marks subjective having 5 mark questions **OR** The question paper will be a 50 mark paper having MCQs of 1 and 2 marks.

If Offline

- The duration of the paper will be two hours.
- There shall be five compulsory questions.
- Q1-4 shall correspond to the four units. Q1-4 shall contain an internal choice (any two out of four). Q1-4 shall carry a maximum of 10 marks.
- Q5 shall be from Units 1 to 4. Q5 shall carry a maximum of 10 marks (attempt any 5 out of 10)

Practical Assessment

- The duration of the practical exam will be three days.
- There will be 50 marks practical per paper.
- The students are allowed to write the paper if the attendance for practicals is more than 75%.
- To appear in the practical exam, students must bring a properly certified journal.