

HSNC UNIVERSITY, MUMBAI



HSNC UNIVERSITY, MUMBAI
KISHINCHAND CHELLARAM COLLEGE

SECOND YEAR B.Sc. LIFE SCIENCES SYLLABUS

As per NEP 2020
Academic Year 2024-25



HSNC UNIVERSITY, MUMBAI

**Board of Faculty of Science & Technology
Board of Studies in the Subjects of Life Sciences**

- 1) **Name of Chairperson/Co-Chairperson/Coordinator: -**
 - a) Dr. Tejashree Shanbhag –Chairperson– Associate Professor, Head, Department of Life Sciences, tejashree.shanbhag@edu.in, 98203 60383

- 2) **Two to five teachers each having minimum five years teaching experience amongst the full-time teachers of the Departments, in the relevant subject.**
 - a) Dr. Shalini Rai Associate Professor, Department of Life Science, K. C. College, shalini.rai@kcollege.edu.in, 99873 26613
 - b) Dr. (Ms.) Aashu Vajpai Assistant Professor, Department of Life Science, K. C. College, aashu.vajpai@kccollege.edu.in, 97020 73377
 - c) Dr. Suvarna Sharma Assistant Professor, Department of Life Science, K. C. College, suvarna.sharma@kccollege.edu.in, 98695 25362

- 3) **One Professor / Associate Professor from other Universities or professor/ Associate Professor from colleges managed by Parent Body; nominated by Parent Body;**
 - a) Dr. Jacinta D’souza Professor, School of Biological Sciences, UM-DAE Center for Excellence in Basic Sciences, University of Mumbai. jacintad@gmail.com; 98207 70314

- 4) **Four external experts from Industry / Research / eminent scholar in the field relevant to the subject nominated by the Parent Body;**
 - a) Dr. Deepak Modi - Eminent Scholar Research Scholar Scientists- F Molecular and Cellular Biology NIRRH, Parel Mumbai, deepaknmodi@yahoo.com , 99871 76249
 - b) Dr. Nilima Gajbhiye – Head, Department of Life Sciences, Ramnarain Ruia Autonomous College, Matunga, Mumbai– 400 019; nilimalankeshwar@ruiacollege.edu; 88795 18970
 - c) Dr. Ahmad Ali – Researcher, Assistant Professor, Department of Life Sciences UDLS, Kalina Campus, Vidyanagari, Santacruz, Mumbai 400098, ahmadali@mu.ac.in, 98709 41656



5) Top rankers of the Final Year Graduate and Final Year Post Graduate examination of previous year of the concerned subject as invitee members for discussions on framing or revision of syllabus of that subject or group of subjects for one year.

- a) Dr. Anuja Pande - Research scholar – Alumnus, SRI International-Post Doctoral Fellow, Virginia USA, anuja.pande@gmail.com, 001-225-610-8801
- b) Dr. Fatema Bhinderwala- Academician – Alumnus, Coordinator- Certificate course in Bioinformatics, Sophia college, Mumbai, fatema3010@gmail.com, 98196 57642
- c) Dr. Hitesh Goswami - Industry Alumnus, Entrepreneur CEO- 4basecare, Bangalore, hitesh@4basecare.com, 78921 38638



Part 1

A. Program Outcomes

1. **Disciplinary knowledge and skills:** Learner shall be capable of demonstrating comprehensive knowledge and understanding of major concepts, theoretical principles, and experimental findings in Life Sciences, its different subfields, and other related fields of study, including broader interdisciplinary fields such as System Biology, Physiology, Ecosystem studies, etc. along with the ability to use modern instrumentation for understanding the biological phenomenon.
2. **Skilled communicator:** The learner shall be able to transmit complex technical/scientific information in the field of Biological Sciences clearly and concisely in writing and oral skills.
3. **Critical thinker and problem solver:** The learners shall be able to employ critical thinking and efficient problem-solving skills in various areas of Life Sciences.
4. **Ethical awareness and reasoning:** The learner shall learn to avoid unethical behavior such as fabrication, forgery, or misrepresentation of data or committing plagiarism, and appreciate environmental and sustainability issues.
5. **Lifelong learners:** The learner shall be capable of self-paced and self-directed learning aimed at personal development and improving knowledge/skill development and reskilling.

B. Course Learning objective:

1. The course aims to develop an understanding of endocrine and nervous control for the maintenance of homeostasis in plants and animals.
2. The learner will be able to classify and compare the physiological regulation and justify the impairment of immune functions leading to the onset of diseases.
3. The learner will be able to understand and comparatively comment on the basis of Sexual Determination in Plants and Animals observed in nature along with the concepts of sex reversal, alternation of generation, general principles of Gametogenesis in Humans and early developmental stages observed in plant and animals.
4. The learners will also be able to understand and analyse food homeostasis mechanisms in Humans and the response of plants and animals to thermal stress. Further, also assess the stress on Human physiology through eating disorders and lifestyle changes.
5. Learners shall be able to develop skills and acquire knowledge in fundamentals of Biochemical phenomena and will develop disciplinary approaches towards theory and practical in the diversified areas of Biochemistry.
6. To develop in-depth knowledge and understanding of biomolecules, key biochemical concepts, principles and theories and apply them to the related topics under the subject



7. To equip learners with appropriate tools of analysis in different areas of Biochemistry ranging from Metabolism of Biomolecules (Carbohydrate, Lipid, Proteins, and Amino acids, and Nucleic acid), Enzymology, Gene regulation, and Molecular Biology concerning theoretical, practical, and analytical skills to address the queries in the area of study.
8. To provide learners with the knowledge and skill base that would enable them to undertake, design, and provide solutions to research areas in the related multidisciplinary areas.

C. Process adopted for curriculum designing:

1. This curriculum for the Second Year Students of Life Sciences has been developed by maintaining a student-centric learning pedagogical approach, which has been further aimed at being outcome-oriented and curiosity-driven as per the UGC guidelines..
2. Using a creative and Bloom-based approach, rote -learning has been avoided and imaginative abilities of the students have been fostered. The curriculum has been designed to be more inclined towards self-discovery of concepts.
3. Feedback from the stakeholders, including the students, subject experts, alumni and industry partners has been referred to in the up-dation of the syllabus.
4. Modifications and changes have been done in the syllabus with respect to the current needs and requirements of the industrial professionals' sectors of the subject.

D. Salient features, and how it has been made more relevant:

1. The syllabus aims to initiate a dialogue about Life Sciences in various walks of human life rather than just being a didactic monologue on mere theoretical concepts.
2. It aims at a more applicative approach to the subject wherein the classical and theoretically driven topics have been reimagined to make them more relevant to students with examples about real life situations and diseases.
3. The Skill-based Course of the subject aims to strengthen the Biostatistical and Bioinformatics based technical know-how of the students in the field of Life Sciences.
4. Latest topics in both theory and practical components have been added to encourage core competencies and discovery-based learning in students.
5. Syllabus would provide sufficient competency in the field for the students to undertake further discipline-specific studies and target domain-related employment opportunities.

**E. Learning Outcomes:**

1. A Comparative approach to Physiology concerning Control and Coordination in plants and animals would make the learners more interested in Physiological processes. This knowledge can be extrapolated to Model systems for an in-depth study in the subject.
2. Learners will develop an ability to relate various interrelated physiological and metabolic events of any biological system.
3. Learners will be able to critically evaluate a problem and find a solution based on scientific concepts by undertaking projects related to various disciplines under the subject.
4. Learners will be aware of the current developments in different disciplines of Biological Sciences and avenues for research and higher academic achievements in Life Sciences.
5. Learners will be able to develop good experimental and quantitative skills encompassing preparation of laboratory reagents, conducting experiments, analyses of data and interpretation of results. Learners would develop a keen interest and aptitude to work safely and effectively in a laboratory.

F. Input from stakeholders (Which Sections have been modified) with the Relevant Introduction:

1. Based on the inputs from stakeholders, more relevant and trending topics have been included and a more holistic learning approach of theory and practicals is incorporated.
2. More training and application-based approaches need to be introduced which will help learners apply their knowledge in the subject to their Post graduate studies and in research work.
3. The Syllabus prepared under NEP has been made to be more inclined towards the expectations of Industry and Academia.
4. More engaging and explorative Entrepreneurial Avenues have been added to the syllabus which also includes product conceptualization, product design, and product development.
5. Emphasis has been given on the use of digital record maintenance and understanding of specimens in lieu of ethics. Further, the syllabus has been modified to make learners aspire for Higher education, be confident of clearing entrance exams, and be industry-oriented and employable after Graduation.



**Curriculum – Second Year Undergraduate Programmes
Semester - III and Semester – IV - 2024 - 2025**

Part 2: The Scheme of Teaching and Examination

Sr.	Choice Based Credit System		Subject Code	Remarks	
1	Core Course (Life Sciences)			NIL	
2	Elective Course	Discipline Specific Elective (DSE) Course			-
		2.1	Interdisciplinary Specific Elective (IDSE) Course		-
		2.2	Dissertation/Project		-
		2.3	Generic Elective (GE) Course		-
3	Ability Enhancement Courses (AEC)		US-FFC		
	Skill Enhancement Courses (SEC)				

Sr.No	Subject Code	Subject Unit Title		Hours/ Lectures	Total No. of hours/ lectures	Credit	Total Marks
1		Plant and Animal Physiology I		45/L	45 L	3	60
		I	Homeostasis and Endocrine Regulation	15			
		II	Control and Coordination in Plants and Animals	15			
		II I	Developmental Biology	15			
2		Biochemical Dynamics – I					
		I	Enzymes and their Environment	15	45 L	3	60
		II	Metabolism - Energy from Carbohydrates	15			
		II I	Metabolism - Energy from Lipids and Proteins	15			
3		I	Practical based on Course 1 of theory	30	15x2=30L	1	40
4		II	Practical based on Course 2 of theory	30	15x2=30L	1	40
		TOTAL				4	100
<ul style="list-style-type: none"> ● Lecture Duration – 60 Minutes ● One Credit =15 Classroom Teaching Hours 							



**SYLLABUS OF S. Y. B. SC LIFE SCIENCES
(Semester Based Credit and Grading System)**

Semester III

US-SLS-301 – Paper I – Theory – Plant and Animal Physiology I

PREAMBLE:

Comparative approach to Physiology should indicate and remind students that in isolated, narrow sub-disciplines there is also a wealth of information that can be obtained from unrelated and distant organisms. Thus, comparing and contrasting diverse mechanisms provides a cohesive understanding of physiology. Further understanding of normal physiology also helps treat diseases that lead to its alteration.

Unit I	Homeostasis and Endocrine Regulation	(15L)
	A. Homeostatic mechanisms and Cellular communication	
	a. Control systems in homeostasis and components of homeostatic control	1
	b. An overview of cell signaling and biochemical basis of cell signaling – Release, Transport, and Storage of chemical messengers, communication of signal to target cell	2
	B. Cell signaling in the Nervous system and Endocrine system	3
	a. Receptors and Regulation (up and down regulation)	
	b. Regulation of cell signaling: 1 st , 2 nd and 3 rd order feedback mechanisms.	
	C. An Overview of Endocrine glands and their hormones	1
	a. Classification of hormones based on their nature and mode of action	4
	i. Group I hormones – Steroid and Thyroid hormones	
	ii. Group II hormones – Peptide hormones (Insulin and Glucagon) and amine (Catecholamine)	
	b. Endocrine glands - Hypothalamus, Anterior Pituitary, Pineal, Thyroid, Parathyroid, Pancreas, Adrenal cortex, Testis and Ovary.	
	D. Overview of Ecdysone Steroid hormone	1
	E. Plant hormones and their role in Homeostasis - Ethylene, Cytokinin, Abscisic acid, Gibberellic acid, Auxins (Structure and Functions)	3
Unit II	Control and Coordination in Plants and Animals	(15L)
	A. Animals:	
	a. Phylogenetic development of the Nervous System – Nerve net - Hydra, Nerve plexus - Starfish and Ganglionated nervous system - Earthworm.	1
		3
	b. Human Nervous System – Central, Peripheral, and Autonomic Nervous Systems	1
	c. Nature of the Nerve Impulse – Resting potential, Action Potential	2
	d. Transmission of Nerve impulses	
	i. Synapses - Nervous, Neuromuscular	
	ii. Chemical Messengers - Acetylcholine	
	e. Behavior and behavioral adaptations (Neuronal) – Overview of Innate	3



	and Learned behavior Eg. Behavioral Strategies in Bird Migration (Physiological Aspect-Accumulation of body fat and thermoregulation)	
	B. Plants:	
	a. Plant movements – Cyclosis, Tropisms, Taxes, Nasties, and Kinesis – discuss with suitable examples concerning physiology	2
	b. Study of Phytochrome and its role in plant control and coordination	2
	c. Circadian Rhythm in Plants	1
Unit III	Developmental Biology	(15L)
	A. Reproduction and Development	
	a. Basis of Sex Determination	3
	i. In Plants: Maize	
	ii. In Animals: Role of SRY gene and Aromatase	
	iii. Role of environmental factors in sex determination in plants and animals, E.g., Turtles (Animal), <i>Equisetum</i> (Plant)	
	b. Parthenogenesis E.g., Honey Bees	1
	c. Plant - Animal interaction for reproduction e.g.Fig wasp	1
	d. Sex Reversal	1
	e. Alternation of generations in plants e.g. <i>Adiantum</i> , Fruiting body formation in Slime molds (<i>Dictyostelium discoideum</i>)	1
	f. General Principles of Gametogenesis in Human Reproductive system	4
	i. Sex differentiation of gonads, internal and external genitalia	
	ii. Spermatogenesis and Oogenesis	
	iii. Ovarian and testicular functions, Puberty and regulation of uterine changes in Menstrual cycle	
	iv. Female Reproductive Disorders- PCOS/PCOD, Male Reproductive disorders	
	B. Development in Plants	
	a. Microsporogenesis and Megasporogenesis.	3
	b. Types of ovules and Double fertilization/ Triple fusion.	
	c. Development of embryos in monocot and dicot plants	
	C. Early Development in Animals: Embryo Development- Till Gastrulation in Frog.	1



PRACTICAL BASED ON PAPER I (Based on paper I)

Note: C, R, T, I Concept, Relevance, Technique, Instrumentation

<p>A. Instrumentation / Technique (I/T)</p> <p>B. Process / Concept and immediate Relevance (C, R)</p> <p>a. Extraction, Purification techniques</p> <p>b. Analysis / Estimation</p> <p>c. GLP (Good Laboratory Practices) incorporated into every practical</p> <p>C. Practical aspects of the paper will also be supported by Research papers to understand the application of the learned techniques and advantages in the field.</p> <p>D. Evaluation and internal assessment can be made by ATP (Alternative to Practical) questions.</p>	
1. Good Laboratory Practices – Role of QA/QC/Material Safety Data Sheet (MSDS) (C, R)	1 1
2. Demonstration of Reproductive system and location of Endocrine glands in Albino Mouse Male and Female (Preserved specimen/ Model/ Virtual dissection). (C, R, T)	
a. Reproductive system	
b. Endocrine Glands	1
3. Study of Histology of Endocrine glands of Mammals from Permanent slides. (C, R, T)	1
4. Demonstration of Microtome technique and preparation of slides from plant/endocrine tissues of animal specimens. (C, R, T, I)	1 1
5. Study of Developmental stages of Frog (Egg to Tadpole to Adult). (C, R)	
6. Study of Floral parts from the given flower (<i>Hibiscus</i> and <i>Pancreatium</i>) Study of the microscopic structure of Anthers, Ovules, Seed structure (Maize/ Okra/ Any other suitable plant seed) (One dicot and one monocot seed). (C, R, T)	1
7. Detection of activity of Gibberellic acid/Auxin/Cytokinin/2,4 D in Seed germination (Dose-dependent response). (C, R, T)	1
8. Study of chemicals on movement/ locomotion in <i>Paramecium</i> .	



USLSC 302 – PAPER II – THEORY

Biochemical Dynamics - I

"Biochemical Insights into Life Processes across Tissue, Organ, and Organism Levels"

Unveiling Biological Dynamics: A Biochemical Examination of Tissue, Organ, and Organismal Life Processes

Unit I	Enzymes and their Environment	(15L)
	1. Classification (With one example of each type) (Inclusive of the 7 th Class of Translocases EC 7)	2
	2. Effect of Environmental Factors on Enzyme Action- Effect of pH, Temperature, Salt and Water, Light	2
	3. Co-enzymes and Cofactors: NAD, FAD, Mn, Mg, Zn, and Cu (One reaction each with significance and application)	2
	4. Kinetics- Concept of Km and Vmax - Michaelis Menten equation and Lineweaver Burk plot	3
	5. Regulation of Enzyme action: Activators, Inhibitors and Feedback Mechanism	3 2
	6. Allosteric enzymes (Kinases in Glycolysis) and their significance in metabolic regulation- E.g., Carboxylase in Animals and Phosphorylation enzymes in plant	1
	7. Overview of Extraction, Purification, and Specific Activity	
Unit II	Metabolism - Energy from Carbohydrates	(15L)
	A. Carbohydrate metabolism:	8
	a. History and elucidation of pathways	
	b. Glycolysis- Process and metabolic regulation	
	c. Citric Acid Cycle – Process and metabolic regulation	
	d. Importance as a central amphibolic pathway unifying all primary biological processes	
	B. Bioenergetics:	3
	a. Basic Thermodynamics: Concept of Free energy	
	b. Electron Transport System:	
	i. Localization	
	ii. Sequence of Electron Transporters	
	iii. ATP as Energy currency - Structure of ATP Synthase Complex	
	C. Oxidative Phosphorylation	4
	a. Mitchell's Chemiosmotic Hypothesis	
	b. ATP synthesis	
	c. Control of respiration, uncoupling, and metabolic poisons	
	d. Oxidative damage to Mitochondria: Huntington's & Parkinson's Disease	
Unit III	Metabolism - Energy from Lipids and Proteins	(15L)
	A. Lipids - Catabolism:	7
	a. Digestion mobilization and transport of Fatty acids	
	b. Lipolysis	



	<ul style="list-style-type: none"> c. Role of Carnitine in Mitochondrial permeability d. Beta– Oxidation of fatty acids and integration into Krebs’s bicycle e. Overview of Ketone bodies and their significance <p>B. Amino Acids - Catabolism:</p> <ul style="list-style-type: none"> a. Protein Degradation liberating amino acids b. Deamination & ammonia disposal by Urea cycle, Genetic defects in Urea cycle- A Biochemical approach. c. Decarboxylation & integration into Krebs’s bicycle 	8
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Practical Based on Paper II

Note: C, R, T, I Concept, Relevance, Technique, Instrumentation

<p>A. Instrumentation/ Technique (I/T)</p> <ul style="list-style-type: none"> a. pH meter b. Colorimetry - Titration <p>B. Process / Concept and Immediate Relevance (C, R)</p> <ul style="list-style-type: none"> a. Extraction, Purification techniques b. Analysis / Estimation c. GLP (Good Laboratory Practices) incorporated into every practical d. Acid, bases and buffers <p>C. Practical aspects of the paper will also be supported by Research papers to understand the application of the learned techniques and advantages in the field.</p> <p>D. Evaluation and internal assessment can be made by ATP (Alternative to Practical) questions.</p>		
I.	<p>pH meter - (I, C, T)</p> <ul style="list-style-type: none"> 1. Principle & Instrumentation 2. Titration Curve - <i>Glycine titration curve</i> 3. Protein precipitation by pH manipulation (Concept of Isoelectric Point Using Casein from Milk/ Curd as an example) (C, R) 	<p>1</p> <p>1</p> <p>1</p>
II.	<p>Enzymology:</p> <ul style="list-style-type: none"> 4. Extraction of enzyme and study the Effect of Temperature/ pH/ Inhibitors (NaCl, Ethanol, and AgNO₃) on Amylase/ Urease/ Invertase enzyme action. 5. Histochemical localization of Enzymes (Acid Phosphatase) (C, T) <i>(Enzyme activity can be localized)</i> <p>Study of Enzyme Activity and Kinetics:</p> <ul style="list-style-type: none"> 6. Determination of Km of the enzyme (I, C, T) <i>(Detection and estimation of Enzyme activity by Colorimetry)</i> 	<p>1</p> <p>1</p> <p>1</p> <p>1</p>
III.	<p>Estimation / Quantification:</p> <ul style="list-style-type: none"> 7. Colorimetric Protein Estimation by Folin Lowry/Ciocalteu . (I, C, T) (C, T, R) 8. Colorimetric estimation of Inorganic Phosphates by Stannous chloride method. (C, T, R) <i>(Estimation of biologically relevant inorganic ions by colorimetric method)</i> 	<p>1</p> <p>1</p>
IV.	<ul style="list-style-type: none"> 9. Titrimetric estimation of Ascorbic acid (Vit C). (C, T, R) <i>(Estimation of biological materials by non-colorimetric method)</i> 	1



References - SEM III (Theory)

Paper I

1. Plant physiology Taiz and Zeiger (5th edition) (2010) Pub: Sinauer Associates.
2. Fundamentals of Physiology - A Human perspective L Sherwood 5th edition (2006) Pub: Thomson Brooks
3. Principles of Animal Physiology C Moyes and Schulte 2nd edition (2007) Pearson Education
4. Developmental Biology: Scott Gilbert (9th edition) (2010) Sinauer Associates.
5. Textbook of Medical Physiology, International Edition Guyton and Hall, 12th Edition.
6. Inderbir Singh's Textbook Of Human Histology With Colour Atlas And Practical Guide: With color Atlas and Practical Guide, (2016), Jaypee Brothers Medical Publishers.
7. Embryology of Angiosperms, Bhojwani and Bhatnagar 4th ed. (1999) New Delhi Vikas Pub.
8. Vander's Human Physiology, Widmaier, Raff, Strand (10th edition,) (2006) Mc Graw Hill Int. Edition.
9. Richard Jones Kristin H Lopez, Human Reproductive Biology, 4th Edition, eBook ISBN: 9780123821850, Hardcover ISBN: 9780123821843, Imprint: Academic Press. 2013
10. Heide Schatten, Human Reproduction: Updates and New Horizons, Copyright © 2017 by John Wiley & Sons, Inc., Print ISBN: 9781118849583; Online ISBN: 9781118849613; DOI: 10.1002/9781118849613
11. S. K. Verma, and Mohit Verma. A textbook of Plant Physiology, Biochemistry and Biotechnology. S. Chand Publications, New Delhi, 2018
12. Kishan Gopal Ramawat, Jean-Michel Mérillon, K. R. Shivanna, Reproductive Biology of Plants, 1st Edition, CRC Press, 2014 ISBN 9781482201321
13. Tandon, Rajesh, Shivanna, K.R., Koul, Monika (Eds.), Reproductive Ecology of Flowering Plants: Patterns and Processes, 2020, Springer Publications, ISBN 978-981-15-4210-7

Paper II

1. Lehninger's Principles of Biochemistry (2008), 5th Edition, Nelson, D.L., and Cox, M.M., W.H. Freeman and Co.
2. Biochemistry (2006) 6th Edition, Berg, J.M., Tymoczko, J.L. and Stryer, L. W.H. Freeman and Co.
3. Outlines of Biochemistry, 5th Edition by Eric Cohn and Paul Stumpf John Wiley and Sons 2019.
4. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2002). Biochemistry, (5th edition). New York. W.H. Freeman and Co.
5. Zubay G.L, Parson W.W. and Vance D.E. (1993). Principles of Biochemistry, (2nd edition). CBS Publishers and Distributors.
6. Fundamentals of Biochemistry (2001) 9th Revised Edition, DeB, A.C. New Central Book Agency (p) Ltd.
7. Voet's Principles of Biochemistry, 5th Edition, Global Edition Donald Voet, Judith G. Voet, Charlotte W. Pratt Wiley Publication ISBN: 978-1-119-45513-4 August 2018
8. BIOS Instant Notes in Biochemistry Paperback – Illustrated, 31 March 2011 by David Hames and Nigel Hooper (Author) Taylor & Francis Publication ISBN 13-978-0415608459
9. Harper's Illustrated Biochemistry 31/e 31st Edition, (Kindle Edition) by Victor W. Rodwell (Author), David Bender (Author), Kathleen M. Botham (Author), & 2 More



**SEM III
(Practical)**

Practical I
1. Developmental Biology by Wolpert 2. College Botany by G Gangulee
Practical II
1. Practical Plant Biochemistry (2014) by Muriel Wheldale Onslow Publisher : Cambridge University Press; Reissue edition (3 April 2014) ISBN-13 : 978-1107634312 https://www.researchgate.net/publication/301647645_PRACTICAL_BIOCHEMISTRY/link/571f81ea08aed056fa234bac/download
2. An Introduction to Practical Biochemistry 3rd Edition July 2017 by David Plummer McGraw Hill Education; 3rd edition (1 July 2017) ISBN-10 : 9780070994874, ISBN-13 : 978-0070994874
3. · Practical Textbook of Biochemistry for Medical Students (English, Paperback, Vasudevan DM) Publisher: Jaypee Brothers Medical Publishers, ISBN: 9789352705146, 9789352705146



Semester – IV - 2024 - 2025

Part 2: The Scheme of Teaching and Examination

Semester – IV

Sr.	Choice Based Credit System		Subject Code	Remarks	
1	Core Course (Life Sciences)		US-SLS-203 US-SLS-204 US-SLS-2P3 US-SLS-2P4	NIL	
2	Elective Course	Discipline Specific Elective (DSE) Course			-
		2.1	Interdisciplinary Specific Elective (IDSE) Course		-
		2.2	Dissertation/Project		-
		2.3	Generic Elective (GE) Course		-
3	Ability Enhancement Courses (AEC)		US-FFC		
	Skill Enhancement Courses (SEC)		-		

Sr. No.	Subject Code	Subject Unit Title		Hours/ Lectures	Total No. of hours/ lectures	Credit	Total Marks
Plant and Animal Physiology II							
1		I	Stress Biology	15	45 L	3	60
		II	Defense Mechanism in Plants and Animals	15			
		II I	Disease Biology	15			
Biochemical Dynamics -II							
2		I	Enzymes and their Environment	15	45 L	3	60
		II	Metabolism - Energy from Carbohydrates	15			
		II I	Metabolism - Energy from Lipids and Proteins	15			
3		I	Practical based on Course 3 of theory	30	15x2=30 L	1	40
4		II	Practical based on Course 4 of theory	30	15x2=30 L	1	40
			TOTAL			4	100
<ul style="list-style-type: none"> ● Lecture Duration – 60 Minutes ● One Credit =15 Classroom Teaching Hours 							



USLSC 401 – PAPER I – THEORY
Plant and Animal Physiology II

Unit I	Homeostasis and Stress	(15L)
	A. Homeostasis: a. Regulation of energy stores: Control of Food Intake: Role of the Central Nervous System b. Role of Leptin, Ghrelin, Kisspeptin and Anandamide c. Eating disorders: Anorexia and Bulimia Nervosa d. Hypoglycemia, Increased Plasma Cholesterol B. Thermal Physiology: a. Plant adaptation in extreme hot and cold conditions b. Thermal strategies in Poikilotherms and Homeotherms, Ectotherms and Endotherms c. Temperature regulating Reflexes, Acclimatization d. Thermogenesis: Shivering and Non – shivering thermogenesis, Hyperthermia induced by Pyrogens e. Hypothermia, Frostbite, Hyperthermia and Fever f. Antifreeze proteins	2 3 2 1 2 1 1 1 1 1
Unit II	Defense Mechanism in Plants and Animals	(15L)
	A. Defense mechanisms in Plants a. Physical defense mechanism in plants - thorns, prickles, trichomes, spines b. Overview of Shikimic acid pathway, Role of Secondary metabolites (Alkaloids, Nitrogen and Sulphur containing compounds, Phenolics, Terpenoids) and enzymes (Chitinase, Phenylalanine Ammonia Lyase) in defense mechanisms of plants B. Defense mechanisms in Animals a. Innate and Adaptive Immunity b. Mechanisms of Innate Immunity – In Invertebrates (hemocytes) and in Vertebrates (physical and physiological barriers, phagocytosis, and inflammation) c. Overview of Hematopoiesis – Development of T and B cells C. Host-Parasite Relationship a. Virulence factors and Toxins: virulence factors, exotoxins, enterotoxins, endotoxins b. Host factors in infection: host risk factors, innate resistance e.g. <i>Agrobacterium tumefaciens</i> c. Parasite escape mechanisms	4 1 3 3 4
Unit III	Disease Biology	(15L)
	A. Introduction to Disease Biology with respect to terminologies, epidemiology, aetiology, pathology (of target tissue only), diagnosis, therapy, preventive measures and vaccines)	2



a. Vector borne Diseases: Malaria, Kala-azar	1
b. Viral Diseases: Covid 19, Herpes	3
c. Bacterial Diseases: Tuberculosis, Leptospirosis	3
d. Fungal Diseases: Ringworm, Candidiasis	2
e. Helminthic Diseases: Filariasis	1
B. Infections in Plants	
a. Viral: Tobacco Mosaic Virus	1
b. Bacterial: Crown Gall bacterial infection	1
c. Fungal: Puccinia Infection	1

PRACTICAL USLSCP1 - Based on paper I

Note: C, R, T, I Concept, Relevance, Technique, Instrumentation

<p>A. Instrumentation / Technique (I/T)</p> <p>B. Process / Concept and immediate Relevance (C, R)</p> <p>a. Extraction, Purification techniques</p> <p>b. Analysis / Estimation</p> <p>c. GLP (Good Laboratory practices) incorporated into every practical</p> <p>C. Practical aspect of the paper will also be supported by Research papers to understand the application of the learned techniques and advantages in the field.</p> <p>D. Evaluation and internal assessment can be made by ATP (Alternative to Practical) questions.</p>	
<p>To identify novel plant compounds for anti-microbial activity and determining their toxicity:</p> <p>1. Demonstration of extraction of Secondary Metabolites using Soxhlet and reflux apparatus (C, R, T, I)</p> <p>2. Detection of Plant alkaloids, saponins, tannins and volatile oils from suitable plant source using Qualitative tests. (C, R, T)</p> <p>3. Alkaloid separation by TLC (C, R, T, I)</p> <p>4. Streak plating (T, Pentagon and Quadrant) to isolate microorganisms from a mixed culture using 2 different media (C, R, T, I)</p> <p>5. Antibiotic sensitivity of microorganisms (Plant extract, Tetracycline/ Gentamycin) using Disc Diffusion Method. (C, R, T)</p> <p>6. Study of the effect of Temperature and Chemicals (Control and Test) on heart-beat of Daphnia. (C, R, T, I)</p> <p>7. Observation and Study of locally collected Leaf Gall and any other one plant disease. (C, R, T)</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>
<p>Diagnostic Techniques:</p> <p>8. ABO blood typing (C, R, T, I)</p> <p>9. Widal Qualitative Test for Typhoid (C, R, T, I)</p> <p>10. Immuno Lateral Flow Chromatographic Test for the Detection of Infection from given sample (C, R, T, I)</p>	<p>1</p> <p>1</p> <p>1</p>



**USLSC402 - PAPER II - THEORY
BIOCHEMICAL DYNAMICS - II**

Unit I	Metabolism - Anabolism of biomolecules	(15L)
	A. Carbohydrate Anabolism a. Gluconeogenesis b. Pentose Phosphate Pathway c. A short account of polysaccharide synthesis - Glycogen	4
	B. Lipids Anabolism a. Fatty acid biosynthesis b. Cholesterol (4 Stages – Condensation, Conversion, Polymerization and Cyclization) – Biosynthesis and Regulation c. Prostaglandins biosynthesis and regulation	3
	C. Overview of Amino acid Anabolism	2
	D. Photosynthesis a. General idea of Pigment Molecule and Light Harvesting Complex b. Photophosphorylation: i. Electron Transport in Photosynthetic bacteria ii. One and Two centers reaction scheme for NADPH and ATP formation via electron transport c. Role of ATP and NADPH in CO ₂ fixation d. Path of Carbon fixation in Photosynthesis: C ₃ and C ₄ e. Photorespiration	6
Unit II	Nucleic Acids	(15L)
	A. Chemistry of Nucleic Acids Pathways of Purine and Pyrimidine Biosynthesis a. <i>de novo</i> pathways for Purine & Pyrimidine synthesis b. Regulation of Purine and Pyrimidine <i>de novo</i> synthesis c. Salvage pathway – Purine and Pyrimidine d. Significance of Salvage pathway with an example of Lesch Nyhan syndrome and Toxoplasmosis	5
	B. DNA replication in Eukaryotes Process and enzymes- with domains of DNA polymerase	3
	C. Transcription a. Prokaryotes – Processes - Binding, Initiation, Elongation & Termination b. Eukaryotes - RNA polymerases along with promoters, RNA processing of rRNA, tRNA, and mRNA (5'cap, poly A tail)	5
	D. Overview of Reverse transcription and cDNA	2
Unit III	Regulation of Gene expression	(15L)
III	A. Regulation of Gene Expression and it's significance: a. Overview of Gene Regulation b. Operon Model - <i>C. elegance</i> c. Intron splicing with Calcitonin gene/ Sex determination in	10



	<p>Drosophila)</p> <p>d. Hormonal Control:</p> <p style="padding-left: 20px;">i. In Plants: e.g. Gibberellic Acid in Seed Germination</p> <p style="padding-left: 20px;">ii. In Animals: Steroid hormone- Glucocorticoid</p> <p>e. Gene Silencing by Protein Degradation – Knock in and Knockouts, RNAi with Application</p> <p>B. Translation: Comparative Account of the Translation Process in Prokaryotes and Eukaryotes</p> <p>C. Post Translational Modification – Glycosylation, Phosphorylation, Methylation and Acetylation</p>	<p>3</p> <p>2</p>
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PRACTICAL USLSCP2

Practical Based on Paper II

Note: C, R, T, I Concept, Relevance, Technique, Instrumentation

<p>A. Instrumentation / Technique (I / T)</p> <p style="padding-left: 20px;">i. Polyacrylamide Gel Electrophoresis (PAGE)- (Demonstration)</p> <p style="padding-left: 20px;">ii. Chromatography – Paper, Thin layer, Column</p> <p>B. Process / Concept and immediate Relevance (C and R)</p> <p style="padding-left: 20px;">i. Extraction, Purification</p> <p style="padding-left: 20px;">ii. Analysis / Estimation</p> <p style="padding-left: 20px;">iii. GLP (Good Laboratory Practices) incorporated into every practical Separation /Extraction technique</p> <p>C. Research papers will also support the practical aspect of the paper to understand the application of the learned techniques and advantages in the field.</p> <p>D. Evaluation and internal assessment can be made by ATP (Alternative to Practical) questions.</p>		
1	Study of Absorption spectra of Nucleic Acids (C, R, T, I)	1
2	Protein separation by PAGE (Comparison between Coomassie Blue and Silver Nitrate Staining Methods) (C, R, T, I)	1
3	Extraction, Detection and Quantification RNA by Orcinol method (C, T) <i>(Extraction of nucleic acid and detection by color reaction and quantification by colorimetry)</i>	2
4	Chromatography of Food dyes/ Plant metabolites/Amino acid – Circular Paper (C, T) <i>(Separation and detection by colour reaction)</i>	1
5	Thin Layer Chromatography for separation of Plant pigments (Slide technique) (C, T, R) <i>(Separation techniques for charged, uncharged materials based on solvent partition)</i>	1
6	Estimation of Total Chlorophyll Content (C, R, T, I) <i>(Estimation by using calculations after colorimetric analysis)</i>	1
7	Solvent Extraction of Lipids (C, R, T, I) <i>(Extraction of lipid and proportional estimation by weight)</i>	1



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SEM-IV (Theory)

Paper I
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Paper II
<ol style="list-style-type: none"> 1. Principles of Biochemistry, Lehninger 7th edition, David L. Nelson, Michael M. Cox 2. Harper's Illustrated Biochemistry, Robert Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell 3. Biochemistry (2006) 6th Edition, Berg, J.M., Tymoczko, J.L. and Stryer, L. W.H. Freeman and Co. 4. Fundamentals of Biochemistry (2001) 9th Revised Edition, Deb, A.C. New Central Book Agency (p) Ltd. 5. Voet's Principles of Biochemistry, 5th Edition, Global Edition Donald Voet, Judith G. Voet, Charlotte W. Pratt Wiley Publication ISBN: 978-1-119-45513-4 August 2018 6. BIOS Instant Notes in Biochemistry Paperback – Illustrated, 31 March 2011 by David Hames and Nigel Hooper (Author) Taylor & Francis Publication ISBN 13-978-0415608459 7. Harper's Illustrated Biochemistry 31/e 31st Edition, (Kindle Edition) by Victor W. Rodwell (Author), David Bender (Author), Kathleen M. Botham (Author), & 2 More 8. Biochemistry by Satyanarayana and Chakrapani 9. Biotechnology by Satyanarayana and Chakrapani 10. An Introduction to Genetic Analysis, Ed: Griffiths A.J. et al, Pub: W. H. Freeman (London) Seventh Edition (2000) 11. iGenetics- A Molecular Approach 3rd Edition by Peter J. Russel, Pearson 2002 12. I Genetics; A Mendelian approach by Peter Russel 2nd edn. Pearson 2006.



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14. Principles of Genetics by R. Tamarin 7th edn 2002
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16. Molecular Techniques in Biochemistry and Biotechnology by S Shrivastava (2010) Pub. New central book Agency (P) Ltd
17. Molecular Biology by Robert Weaver, second edition Pub McGraw Hill (2003)
18. Text book of cell and Molecular Biology by Ajoy Paul Pub Books and Allied (P) Ltd. Second edition (2009)

SEM IV (Practical)

Practical I

1. Textbook of Basic and Clinical Immunology by Sudha Gangal and Shubhangi Sontakke
2. Microbiology by Prescott

Practical II

1. Practical Plant Biochemistry (2014) by Muriel Wheldale Onslow Publisher : Cambridge University Press; Reissue edition (3 April 2014), ISBN-13 : 978-1107634312
2. An Introduction to Practical Biochemistry | 3rd Edition July 2017 by David Plummer McGraw Hill Education; 3rd edition (1 July 2017) ISBN-10 : 9780070994874, ISBN-13 : 978-0070994874
3. Practical Textbook of Biochemistry for Medical Students (English, Paperback, Vasudevan DM) Publisher: Jaypee Brothers Medical Publishers, ISBN: 9789352705146, 9789352705146
4. Biochemistry and Clinical Pathology by Pillai K.K. Publisher: CBS Publishers & Distributors, ISBN: 9788123902890, 9788123902890 Pages: 172
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