HSNC UNIVERSITY, MUMBAI
KISHINCHAND CHELLARAM COLLEGE

FYBSC 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: Preamble

Life Sciences being, the basis of the Biological Sciences

1. Course objective:

The first step to appreciate life forms is to understand the molecular logic of a living cell:

- Paper One develops the concept of biochemical basis of plant and animal life and the underlying uniformity that forms the basis of all organisms at the cellular level.
- Organisms adapt to the environment they live in which is reflected as transitions in body plans and biodiversity in animals and plants. These adaptations are often physiological and have a genetic basis.
- Paper Two is an introduction to the underlying biological mechanisms at the organismic level.
- To encourage problem-based learning (PBL) and correspond with the theory syllabus the Practicals have been introduced either as stand-alone or those that may be converted into short projects which have been highlighted with an asterisk (*).
- These project-based experiments could be recorded in a project format in addition to the journal work.

2. Process adopted for curriculum designing:

- This curriculum for the First 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.
- Using a creative and bloom-based approach, the rote-learning approach has been avoided and the imaginative abilities of the students have been fostered. The curriculum has been designed to be more inclined towards self-discovery of concepts.
- Feedback from the stakeholders, including the students, subject experts, parents, alumni, and industry partners has been referred to in the updation of the syllabus.
- Modifications and changes have been made in the syllabus concerning the current needs and requirements of the industrial professionals' sectors of the subject.

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

Paper I

The topics covered in Paper I, cover the basic concepts of the Origin of Life, the Concept of Cell and Cell Organelles, and Macromolecules, students are expected to understand the underlying principles of Life Sciences so that the difficult topics are then built upon those in the second term.

Paper II

The topics covered in Paper II, cover the basic concepts of Genetics and physiological processes. Students are expected to learn about mutations and Mendelian laws of inheritance. This gives students the advantage of pursuing their interests in these topics at the postgraduate level and PhD level. The interdisciplinary approach to the topics covered helps students to know every concept of Life sciences

and then apply their knowledge in solving bigger issues in the fields of medicine, environment, and agriculture.

4. Learning Outcomes:

- Students' concept of the biochemical basis of plant and animal life and the underlying uniformity that forms the basis of all organisms at the cellular level.
- The study of the life sciences lends important insights into disease processes and allows the development of novel therapeutics and innovative medical devices, thereby directly improving human health.
- The life sciences also enable an understanding of the environment and the other living species with whom we share the earth; this knowledge guides conservation efforts and literally helps us to save our shared planet.
- Life sciences provide the most powerful arguments we have, for the most important issues of our society, issues such as social justice, environmental preservation, animal protection and fundamental human rights.
- Because the life sciences reveal such central principles, the best scientific and engineering minds in history, regardless of discipline, eventually turn their attention to the life sciences.
- Students who study life sciences are well-trained for basic concepts of botany, zoology, genetics, and biostatistics; so, they are prepared for specialization at the post-graduate level and are encouraged to research.

5. Input from stakeholders (Which Sections have been modified) with the relevant introduction:

- The inclusion of relevant topics has been done based on the inputs from the stakeholders of the department.
- In addition to the Biomolecules introduction, it will be taught at the molecular level wherein types of Plasmid DNA, Cosmids etc have been covered.
- More hands-on and skill-based practical sessions have been added in cell biology and microbiological experiments
- Emphasis has been given on use of digital record maintenance and understanding of specimens *in lieu* of ethics.
- Modifying syllabus to make students industry oriented. An attempt to introduce research reading and understanding of *in silico* studies has been done

Part 2: The Scheme of Teaching and Examination

Semester – I

Sr. No.	Choice Based Credit System			Subject Code	Remarks
1	Core Course (Life Sciences)			BLS 101B	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)				
	Skill Enhancement Courses (SEC)			-	

FYBSC Life Sciences Theory and Practical Syllabus under NEP 2020
Credit Framework for F. Y. B. Sc Life Sciences
Detail Scheme Theory
First Year Life Sciences Semester – I
Units – Topics – Teaching Hours
BLS 101B: Evolution and Cytology

Sr.No.	Subject Code	Subject Unit Title		Hours/ Lectures	Total No. of hours/lectures	Credit	Total Marks
1	BLS 101B	I	Origin of Life & Evolution	15	45 L	3	60
		II	Overview of Cell and Cell Organelles I	15			
		III	Biomolecules - I	15			
2	BLS 101D	I	Practical based on Course 1 of theory	30	15x2=30L	1	40
			TOTAL			4	100
Lecture Duration – 60 Minutes One Credit =15 Classroom Teaching Hours							

BLS 101B - Semester I Theory

Unit I	**Evolution**	**(15)**
	A. Origin of life a. Theories of origin of life: Overview of Creation myths/ Divine creation; Spontaneous generation; Cosmozoic hypothesis; Steady state; Biochemical origin b. Biochemical theories: Origin of macromolecules; Miller's experiment; RNA world c. Origin of cells: Protocells; Coacervates; Microspheres; Prokaryotes, Eukaryotes **B. Evolution** a. Pre Darwinian ideas, Darwin's theory of natural selection, evidences and objections Evidences for evolution b. Speciation: Concept of species: Physiological species, Biological species Evolutionary species; Significance of speciation c. Speciation and macroevolution: Allopatric, Sympatric, and Parapatric	(07) (08)
Unit II	**Cell and Cell Organelles I**	**(15)**
	A. Cell as a unit of Life **B. Structure of cell wall:** a. Bacterial cell wall: Gram positive and Gram negative. b. Fungal cell wall c. Plant cell wall: Primary and Secondar **C. Cytoskeletal Elements**: a. **Microfilaments:** Structure and function in striated muscle fibers. Role in cytoplasmic streaming in plants. b. **Microtubules:** Structure as in cilia or in flagella, mechanism in movement. Function in mitotic spindle. c. **Intermediate filaments:** Structure and function. **D. Cell Membrane:** a. Membrane models: i. Unit membrane ii. Fluid Mosaic Model b. Membrane lipids and proteins – An overview c. Membrane junctions: i. Tight, ii. Gap, iii. Desmosomes, iv. Septate d. Membrane Transport: i. Diffusion ii. Osmosis iii. Passive and Active Transport e. Endocytosis and Exocytosis **E.** Plastids and Mitochondria **F.** Lysosomes and Endoplasmic Reticulum **G.** Nucleus and Microbodies	(01) (02) (04) (04) . (04)

Unit III	Biomolecules I	(15)
	A. Types of bonds and interactions within molecules	(01)
	B. Physiological Role of Water	(04)
	a. Structure of water	
	b. Dissociation and Ionic Product	
	c. Ionic interactions with water	
	d. Water as a universal solvent in living systems	
	e. Concept of pH and Buffers	
	f. Buffering systems in a living cell	
	C. Carbohydrates	(05)
	a. Classification, structure and functions of carbohydrates	
	b. Monosaccharides:	
	i. Aldoses and Ketoses	
	ii. C3 to C6 sugars (one example each)	
	iii) Glycosidic Bond formation	
	c. Disaccharides: Maltose, Lactose, Sucrose, Cellobiose	
	d. Polysaccharides: Starch, Glycogen & Cellulose	
	e. Biological Significance and Applications of Carbohydrates	
	f. Reactions of Carbohydrates	(02)
	i)Isomerism	
	ii)Oxidation & Reduction	
	iii)Mutarotation	
	D. Lipids	
	a. Bloor's classification of lipids	(03)
	b. Simple lipids	
	c. Complex lipids	
	d. Derived lipids	
	e. Fatty acids: Types, nomenclature, and properties (up to C18)	

Semester – II
First Year Life Sciences
Units – Topics – Teaching Hours
BLS 102B: Cytology and Genetics

Sr.No.	Subject Code	Subject Unit Title		Hours/ Lectures	Total No. of hours/lectures	Credit	Total Marks
1	BLS 102B	I	Cell Division and Cell Cycle	15	45 L	3	60
		II	Biomolecules II	15			
		III	Genetics	15			
2	BLS 102D	I	Practical based on course 2 of theory	30	15x2=30L	1	40(25+15)
			TOTAL			4	100
Lecture Duration – 60 Minutes One Credit =15 Classroom Teaching Hours							

Semester II Theory
BLS 102B

Unit I	**Cell Division and Cell Cycle**	**(15)**
	A. Cell Cycle (G0, G1, S, G2, M phases) **B.** Cell Division - Prokaryotes & Eukaryotes **C.** Factors influencing life cycle and growth curve of Bacterial cell, culture media (enriched and minimal), isolation, preservation. **D.** Factors influencing life cycle and growth curve of Eukaryotic cell, culture media (enriched and minimal), isolation, preservation. **E.** Virion structure, Life cycle of bacteriophage (Lytic and Lysogenic), Plant and animal cell Animal virus (One example each).	**(03)** **(03)** **(02)** **(03)** **(04)**
Unit II	**Biomolecules II**	**(15)**
	A. Amino acids and Proteins a. Classification, structure, and functions of amino acids; Concept of iso-electric pH b. Chemical reactions with acid/alkali, Ninhydrin, Sanger's reaction c. Classification of proteins based on function and shape. **B. Protein Structure:** a. Primary structure and the concept of 'N' and 'C' terminal b. Peptide bond formation; Characteristics of peptide bond c. Secondary structures: α helix, β sheet, random coils d. Tertiary and quaternary structure with a mention of protein 3D structure determination methods. **C. Nucleic Acids:**	**(05)** **(05)**

	a. Structure of nucleosides and nucleotides b. Structure of a polynucleotides c. Forms of DNA: 'A', 'B' and 'Z' DNA d. Types of RNA: mRNA, tRNA, rRNA, snRNAs e. Differences between DNA and RNA	**(05)**
Unit III	**Genetics**	**(15)**
	A. Overview of Mendelian Genetics a. Concept of Genes and Alleles- Using sickle cell anemia and SNP as an example b. Mono & Dihybrid ratios with problems, c. Chi square –for 3:1 ratio and 1:1 ratio. **B. Chromosomal inheritance:** a. Sutton's hypothesis b. Sex-linked inheritance c. Study of Human pedigrees: i. Sex linked dominant and recessive ii. Autosomal dominant and recessive C. **Modification of Mendel's laws**: a. Gene interactions: i. Incomplete dominance ii. Co- dominance b. Multiple genes and Multiple alleles c. Epistasis – Dominant and Recessive d. Gene Linkage with one suitable example e. Sex limited and Sex influenced traits **D. Mutations:** a. Point Mutations b. Chromosomal aberrations: i. Structural: deletion, duplication, inversion, translocation. ii. Numerical: euploidy & aneuploidy	**(03)** **(03)** **(05)** **(04)**

List of Recommended Reference Books:

1. Strickberger's Evolution (2008) 4th Edition. Hall, B.K. and Hallgrimsson, B. Jones and Bartlett Publishers.
2. The World of Biology (2008) 8th Edition. Solomon, E.P., Berg, L.R. and Martin D. W. Saunders College Publishing.
3. Essential Biology (2008) 8th Edition. Campbell, N.A., Reece, J.B., Umy, L.A., and Cain, M.A. Pearson Benjamin Cummings.
4. Principles of Microbiology (1997) 2nd Edition. Atlas R.M. William C Brown Publishers.
5. Lehninger Principles of Biochemistry. (2021) International Edition. Nelson, D.L and Cox, M. Springer.
6. Biochemistry. (2019) 9th Edition. Stryer, L., Berg, J.M., Tymoczko, J.I. and Gatto, G.J. Macmillan Learning.
7. Biochemistry (2017) 5th Edition. Satyanarayana, U. and Chakrapani, U. Elsevier. Books and Allied Publishers.
8. Biochemistry. (2010) 4th Edition. Voet, D., and Voet, J.G. Wiley.

9. Molecular Biology of the Cell (2008) 5th Edition, Alberts, B.A., Johnson, A., Lewis, J., Roberts, M.R.K., Walters, P. Garland Science Publication
10. Molecular Cell Biology (2008) 6th Edition, Lodish, H., Berk, A., Kaiser, A.C. Krieger,M., Scott, M.P., Bretscher, A., Ploegh, A., Mortsudira, P. W.H. Freeman and Company, N.Y.
11. Cell and Molecular Biology-concepts and experiments (2005) 4th Edition, Karp, G.John, Wiley and Sons Inc.
12. The World of Cell (2003) 5th Edition, Becker, W.M., Kleinsmith, L.J., Hardin, J. Pearson Education (Singapore)
13. The Cell - A molecular approach (2007) 4th Edition, Cooper, G.M., Hausman, R.E.ASM, Press Washington, D.C.

F.Y.B. Sc Life Sciences
Semester I Practical – BLS 101D
Total Credit: 01 = 15L X 2 = 30P = 15 Practical Sessions

Sr.No.	Content	No. of Practical sessions
1	a. History of Sciences (E Learning: Activity Based) b. An introduction to Laboratory discipline and GLP (Good Laboratory practices) c. Survey of the organization of laboratory instruments, chemicals and glassware d. Lab safety (instruments and chemicals) ***[incorporated into every practical]***	**01**
2	**Introduction to Elementary microbial techniques:** a. Sterilization & Disinfection b. Microbial Staining technique and Microscopy: Comparative study of samples from 5 different sources to check gram positive and gram-negative bacteria - Buttermilk, tap water, sewage water, food item soil, rotten – effect of heat using. i. Monochrome / Gram Staining ii. Cell wall staining	**03**
3	**Molecular biology and Biochemistry:** a. Isolation and Detection of DNA from Onion/ cauliflower/ broccoli/ any other convenient, cost -effective system. b. Detection of Carbohydrates (E.g., wheat/rice atta), c. Detection of Lipids (E.g., Ground nut oil) d. Detection of Proteins (E.g., any edible protein).	**02**
4	**Study of Tissues** a. Plant Tissues: Temporary mounting/ observation of permanent slides: i. T.S. of Sunflower and Maize stem and root ii. Comparison between Dicot stem and Monocot stem iii. Comparison between Dicot root and Monocot root iv. Mounting of Dicot / Monocot Stomata b. Animal Tissues (Permanent slides) i. Epithelial – Squamous, Cuboidal, Epithelial ii. Connective – Areolar, Adipose, Cartilage, Bone iii. Muscular – Striated, Non- Striated, Cardiac iv. Nervous – Medullated, Non-Medullated neurons	**04**
5	**Diversity of Life Part I (present specimens/pictures/models)** a. Five Kingdom Classification –Whittaker Classification i. Classification of Monera, Protista, Fungi ii. Classification of Plants	**02**
6	**Hematology** a. Total RBC count using Hemocytometer. b. Observe different WBCs using Giemsa/ Leishman stain. c. Differential WBC Count	**03**

F.Y.B. Sc Life Sciences
Semester II Practical - BLS 102D
Total Credit: 01 = 15L X 2 = 30P = 15 Practical Sessions

Sr.No.	Content	No. of Practical sessions
1	**Eukaryotic cells and microscopic measurements:** a. Staining of onion peel / plant cells to reveal structure and organization of cells. b. Micrometry - Using the microscope to measure size of cells/ nucleus/ different pollen grains/onion peel. c. Effect of temp on movements in plants and animals using any system. The following are suggested. i. Cytoplasmic streaming in *Hydrilla* ii. Culturing and observation of feeding in *Paramoecium* from Hay infusion	**03**
2	**Histochemistry** Localization of Carbohydrates, Proteins, Lipids and Nucleic acids from the following or any other convenient A – Starch grains of Potato / of seeds and other tubers B – Proteins – Aleurone layer from Corn C – Fat bodies of Cockroach/Drosophila/lipids of groundnut D – DNA and RNA from onion peel using methyl green pyronin staining	**02**
3	**Study of Electron Micrographs as listed below: Both normal and pathological** a. Mitochondria b. Lysosomes c. Basement membrane/junctions d. Cilia	**01**
4	Determining effect of colchicine / mitotic inhibitor /environmental pollutant / mitotic activator on mitosis in onion root tip by calculating mitotic index.	**02**
5	Meiosis from Tradescantia	**01**
6	Study of Barr Body	**01**
7	**Animal diversity:** Part II: Classification of Animals – Invertebrates Part III: Classification of Animals – Vertebrates	**02**
8	**Soil analysis: Edaphic factors** a. Texture water content	**01**
9	**Biostatistics**	**02**

	a. Purpose of Biostatistics: Data collection, Discrete and continuous variables, qualitative and quantitative Biostatistics. b. Study of Class Intervals and calculation of frequency c. Representation – tabular and graphical – line graph, frequency curve, Ogive curve, histogram and pie diagram. d. Measures of central tendency – mean, median, mode and standard deviation.	

Examination and Evaluation Pattern

A. Theory Component: Semester End Examination for 60 marks – 120 min (2.0 h)
- a. **Component A –** 20 Marks – Open Book Evaluation – 40 min
- b. **Component B –** 40 Marks-Summative/Descriptive Examination – 80 min

B. Practical Component: Semester End Examination for 40 marks
- a. **Self-Learning and Evaluation (SLE) –** 15 Marks
- b. **Practical Examination –** 50 marks reduced to 25 marks
  - i. **Internal Component –** Performing Experiments – 30 marks
  - ii. **External Component –** Field Report (10 marks), Journal Submission (5 marks) and Viva (5 marks) – Total 20 Marks

BLS 103D - VOC – LIFE SCIENCES
(0.66 Credits/ Semester = As 2 Credits shared in Three Subjects)

Total Credit: 0.66 = 5 Practical Sessions

Semester I

Sr. No.	Content	No. of Practical sessions
1	**Colorimetry** a. Preparation of solutions of a given chemical compound b. Molar and percentage solutions - Concept and calculation. c. Preparation of dilutions of required concentration from a stock solution of a colored compound d. Estimation of Lambda max of a colored solution e. Verification of Beer Lambert's law for a colored solution	03
2	**Instrumentation and techniques:** a. Calibration of the pH Meter with standard buffer pH4 and pH9.2 as per GLP b. Checking of pH for common foodstuff e.g., Milk/cola drink/Lime juice or any other relevant sample	02

BLS 104D - Semester II

Sr.No.	Content	No. of Practical sessions
1	**Enzymology:** a. Detection of Dehydrogenase enzyme activity using sprouting grams / beans (as a study of mitochondrial function) b. Estimation of Catalase enzyme activity using paper disc rising-time technique	01
2	**Chromatography** a. Effect of ageing on plant leaf pigments using Paper Chromatography b. Separation of amino acids – using paper chromatography	02
3	**Physiology** a. Effect of anti transpirants on stomatal movements. (1 monocot, 1 dicot) b. Effect of environmental conditions on growth of yeast cells (count using hemocytometer) - effect of temperature and nutrients	02