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. Sagarika Damle -Chairperson-** Associate Professor, Head, Department of Life Sciences, sagarika.damle@kccollege.edu.in, 9820360383

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. Tejashree Shanbhag** Assistant Professor, Department of Life Science, K. C. College, tejashree.shanbhag@kccollege.edu.in ,9892370263

b. **Dr. Shalini Rai** Assistant Professor, Department of Life Science, K. C. College, shalini.rai@kcollege.edu.in ,9987326613

c. **Dr. (Ms.) Aashu Vajpai** Assistant Professor, Department of Life Science, K. C. College, aashu.vajpai@kccollege.edu.in ,97020 73377

d. **Dr. Suvarna Sharma** Assistant Professor, Department of Life Science, K. C. College, Suvarna.sharma@kccollege.edu.in, 9869525362

3)One Professor / Associate Professor from other Universities or professor / Associate Professor from colleges managed by Parent Body ; nominated by Parent Body;-

e. Dr. Jacinta D'souza Professor, School of Biological Sciences, UM-DAE Center for Excellence In Basic Sciences, University of Mumbai jacintad@gmail.com 9820770314

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, 9987176249

b) Dr. Seema Das - Researcher - Head of the Department Department of Life Science & Biochemistry St. Xavier's College, Autonomous 5, Mahapalika Marg, Mumbai-400 001, seema.das@xaviers.edu, 9820384851

c) Dr. Laxmikant Deshpande - Industry expert Industry Expert Wetland Management System,

Godrej & Boyce Mfg. Co. Ltd, Vikhroli, Mumbai amartd@godrej.com , 9167344890

d) **Dr. Ahmad Ali –** Researcher, Assistant Professor, Department of Life Sciences UDLS, Kalina Campus, Vidyanagari, Santacruz, Mumbai 400098, ahmadali@mu.ac.in , 9870941656

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 , 9819657642

c. **Dr. Hitesh Goswami -** Industry Alumnus, Entrepreneur CEO- 4basecare, Bangalore, hitesh@4basecare.com , 7892138638

Part –I

Outline of Choice Based Credit System as outlined by University Grants Commission:

R. ** : The Definitions Of The Key Terms Used In The Choice Based Credit System And Grading System Introduced From The Academic Year 2020-2021 Are As Under:**

1. **Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

2. **Elective Course:** Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

   2.1 **Discipline Specific Elective (DSE) Course:** Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

   2.2 **Dissertation/Project:** An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper.

   2.3 **Generic Elective (GE) Course:** An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.
   P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

3. **Choice Base Credit System:** CBCS allows students to choose inter-disciplinary, intra-disciplinary courses, skill oriented papers (even from other disciplines according to their learning needs, interests and aptitude) and more flexibility for students.

4. **Honors Program :** To enhance employability and entrepreneurship abilities among the learners, through aligning Inter Disciplinary / Intra Disciplinary courses with Degree Program. Honours Program will have 40 additional credits to be undertaken by the learner across three years essentially in Inter / Intra Disciplinary course.

   A learner who joins Regular Undergraduate Program will have to opt for Honours Program in the first year of the Program. However, the credits for honours, though divided across three years can be completed within three years to become eligible for award of honours Degree.

5. **Program:** A Program is a set of course that are linked together in an academically meaningful way and generally ends with the award of a Degree Certificate depending on the level of knowledge attained and the total duration of study, B.Sc. Programs.

6. **Course:** A 'course' is essentially a constituent of a 'program' and may be conceived of as a composite of several learning topics taken from a certain knowledge domain, at a certain level. All the learning topics included in a course must necessarily have academic coherence, i.e. there must be a common thread linking the various components of a course. A number of linked courses considered together are in practice, a 'program'.

7. **Bridge Course:** Bridge course is visualized as Pre semester preparation by the learner before commencement of regular lectures. For each semester the topics, whose knowledge is considered as essential for effective and seamless learning of topics of the Semester, will be specified. The Bridge Course can be conducted in online mode. The Online content can be created for the Bridge Course Topics.

8. **Module and Unit:** A course which is generally an independent entity having its own separate identity, is also often referred to as a 'Module' in today's parlance, especially when we refer to a 'modular curricular structure'. A module may be studied in conjunction with other learning modules or studied independently. A topic within a course is treated as a Unit. Each course should have exactly 3 Units.

9. **Self-Learning: 20% of the topics will be marked for Self-Learning.** Topics for Self-Learning are to be learned independently by the student, in a time-bound manner, using online and offline resources including online lectures, videos, library, discussion forums, fieldwork, internships etc.

   Evaluative sessions (physical/online), equivalent to the credit allocation of the Self Learning topics, shall be conducted, preferably, every week for each course. Learners are to be evaluated real time during evaluative sessions. The purpose of evaluative sessions is to assess the level of the students' learning achieved

in the topics are marked for Self-Learning.

The teacher's role in these evaluative sessions will be that of a Moderator and Mentor, who will guide and navigate the discussions in the sessions, and offer concluding remarks, with proper reasoning on the aspects which may have been missed by the students, in the course of the Self-Learning process.

The modes to evaluate self-learning can be a combination of the various methods such as written reports, handouts with gaps and MCQs, objective tests, case studies and Peer learning. Groups can be formed to present self-learning topics to peer groups, followed by Question and Answer sessions and open discussion. The marking scheme for Self Learning will be defined under Examination and Teaching.

The topics stipulated for self-learning can be increased or reduced as per the recommendations of the Board of Studies and Academic Council from time to time. All decisions regarding evaluation need to be taken and communicated to the stakeholders preferably before the commencement of a semester. Some exceptions may be made in exigencies, like the current situation arising from the lockdown, but such adhoc decisions are to be kept to the minimum possible.

10. **Credit Point:** Credit Point refers to the 'Workload' of a learner and is an index of the number of learning hours deemed for a certain segment of learning. These learning hours may include a variety of learning activities like reading, reflecting, discussing, attending lectures / counseling sessions, watching especially prepared videos, writing assignments, preparing for examinations, etc. Credits assigned for a single course always pay attention to how many hours it would take for a learner to complete a single course successfully. A single course should have, by and large a course may be assigned anywhere between 2 to 8 credit points wherein 1 credit is construed as corresponding to approximately 30 to 40 learning hours.

11. **Credit Completion and Credit Accumulation:** Credit completion or Credit acquisition shall be considered to take place after the learner has successfully cleared all the evaluation criteria with respect to a single course. Thus, a learner who successfully completes a 4 CP (Credit Point) course may be considered to have collected or acquired 4 credits. learner level of performance above the minimum prescribed level (viz. grades / marks obtained) has no bearing on the number of credits collected or acquired. A learner keeps on adding more and more credits as he completes successfully more and more courses. Thus the learner 'accumulates' course wise credits.

12. **Credit Bank:** A Credit Bank in simple terms refers to stored and dynamically updated information regarding the number of Credits obtained by any given learner along with details regarding the course/s for which Credit has been given, the course-level, nature, etc. In addition, all the information regarding the number of Credits transferred to different programs or credit exemptions given may also be stored with the individual's history.

13. **Credit Transfer:** (performance transfer) When a learner successfully completes a program, he/she is allowed to transfer his/her past performance to another academic program having some common courses and Performance transfer is said to have taken place.

14. **Course Exemption:** Occasionally, when two academic programs offered by a single university or by more than one university, may have some common or equivalent course-content, the learner who has already completed one of these academic programs is allowed to skip these 'equivalent' courses while registering for the new program. The Learner is 'exempted' from 'relearning' the common or equivalent content area and from re-appearing for the concerned examinations. It is thus taken for granted that the learner has already collected in the past the credits corresponding to the exempted courses.

Part-II

O*** The fees for transfer of credits or performance will be based on number of credits that a learner has to complete for award of the degree.**

The Scheme of Teaching and Examination:

The performance of the learners shall be evaluated in two components: Internal Assessment with 40% marks by way of continuous evaluation and by Semester End Examination with 60% marks by conducting the theory examination.

INTERNAL ASSESSMENT:- It is defined as the assessment of the learners on the basis of continuous evaluation as envisaged in the credit based system by way of participation of learners in various academic and correlated activities in the given semester of the programme.

A). Internal Assessment – 40% **40 marks**

Practical's (internal Components of the Practical Course

1. For Theory Courses

Sr. No.	Particulars	Marks
1	**ONE** class test / online examination to be conducted in the given semester	15 Marks
2	One assignment based on curriculum (to be assessed by the teacher Concerned	10 Marks
3	Self-Learning Evaluation	10 Marks
4	Active participation in routine class instructional deliveries	05 Marks

2. For Courses with Practicals

Each practical course can be conducted out of 50 marks with 20 marks for internal and 30 marks for external

Practical's (Internal component of the Practical Course)

Sr. No	Evaluation type	Marks
1	Two Best Practicals /Assignments/Presentation /Preparation of models/ Exhibits **Or** One Assignment/ project with class presentation to be assessed by teacher concerned	10
2	Journal	05
3	Viva	05

The semester end examination (external component) of 60 % for each course will be as follows:

i) **Duration** – **2 Hours** ii) **Theory Question Paper**

Pattern:-

1. There shall be four questions each of 15 marks. On each unit there will be one question and the fourth one will be based on entire syllabus.
2. All questions shall be compulsory with internal choice within the questions. (Each question will be of 20 to 23 marks with options.)
3. Question may be subdivided into sub-questions a, b, c… and the allocation of marks depend on the weightage of the topic.

The marks will be given for all examinations and they will be converted into grade (quality) points. The semester-end, final grade sheets and transcripts will have only credits, grades, grade points, SGPA and CGPA.

3. Project and Assignment:

- Project or Assignment, which can in the following forms
  - Case Studies
  - Videos
  - Blogs
  - Research paper (Presented in Seminar/Conference)
  - Field Visit Report

- Presentations related to the subject (Moot Court, Youth Parliament, etc.)
- Internships (Exposition of theory into practice)
- Open Book Test
- any other innovative methods adopted with the prior approval of Director Board of Examination and Evaluation.

4.Self-Learning Evaluation

- **20% OF THE TOPICS OF CURRICULUM ARE LEARNED BY THE STUDENT THROUGH SELF LEARNING USING ONLINE / OFFLINE ACADEMIC RESOURSE SPECIFIED IN THE CURRICULUM.**

- **HENCE 20% OF THE LECTURES SHALL BE ALLOCATED FOR EVALUATION OF STUDENTS ON SELF LEARNING TOPICS**

- The identified topics in the syllabus shall be learnt independently by the students in a time bound manner preferably from online resources. Evaluative sessions shall be conducted by the teachers and will carry 10 Marks.

  CLUB The self-learning topics into 3-4 GROUPS OF TOPICS ONLY FOR EVALUATION.

- **PRESCRIBE TIME DURATION (IN DAYS) FOR COMPLETION OF EACH GROUP OF TOPIC AND EARMARK SELF LEARNING EVALUATION LECTURES IN THE TIMETABLE. HENCE EACH GROUP OF TOPIC CAN BE ASSIGNED 3 REGULAR LECTURES FOR THIS EVALUATION FOR ENTIRE CLASS**

3 Sub Topics
Each evaluative session shall carry 3 Marks (3 x 3 Units = 9 Marks). Students who participate in all evaluative sessions shall be awarded 1 additional Mark.

4 Sub Topics
Each evaluative session shall carry 2.5 Marks (2.5 x 4 Units = 10 Marks)

- **EVALUATION OF SELF LEARNING TOPICS CAN COMMENCE IN REGULAR LECTURES ASSIGNED FOR SELF LEARNING EVALUATION IN THE TIMETABLE**

3 Evaluative sessions

Each evaluative session shall carry 3 Marks (3 x 3 = 9 Marks). Students who participate in all evaluative sessions shall be awarded 1 additional Mark.

4 Evaluative sessions

Each evaluative session shall carry 2.5 Marks (2.5 x 4 = 10 Marks).

Methods for Evaluation of Self-learning topics:

- Seminars/presentation (PPT or poster), followed by Q&A - Objective questions /Quiz / Framing of MCQ questions.
- Debates

- Group discussion
- You-Tube videos (Marks shall be based on the quality and viewership)
- Improvisation of videos
- Role Play followed by question-answers

TEACHERS CAN FRAME OTHER METHODS OF EVALUATION ALSO PROVIDED THAT THE METHOD, DULY APPROVED BY THE COLLEGE EXAMINATION COMMITTEE, IS NOTIFIED TO THE STUDENTS AT LEAST 7 DAYS BEFORE THE COMMENCEMENT OF THE EVALUATION SESSION AND IS FORWARDED FOR INFORMATION AND NECESSARY ACTION AT LEAT 3 DAYS BEFORE THE COMMENCEMENT OF THE EVALUATION SESSION

- Viva Voce
- Any other innovative method

SEMESTER END EXAMINATION: - It is defined as the examination of the learners on the basis of performance in the semester end theory / written examinations.

B. Semester End Examination- 60% ***60 Marks***

1) Duration – These examinations shall be of 2 Hours duration.
2) Question Paper Pattern: -
   i. There shall be four questions each of 15 marks.
   ii. All questions shall be compulsory with internal choice within the questions.
   iii. Question may be sub-divided into sub-questions a, b, c, d & e only and the allocation of marks depends on the weightage of the topic.

THE MARKS OF THE INTERNAL ASSESSMENT SHOULD NOT BE DISCLOSED TO THE STUDENTS TILL THE RESULTS OF THE CORRESPONDING SEMESTER IS DECLARED.

HSNC University Mumbai

(2020-2021)

Ordinances and Regulations

With Respect to

Choice Based Credit System

(CBCS)

For the Programmes Under

The Faculty of Science and Technology

For the Course

Life Sciences

Curriculum – First Year Undergraduate Programmes

Semester-I and Semester -II

2020-2021

Section C

Life Sciences

Part 1:Preamble

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 underling uniformity that forms the basis of all organisms at the cellular level.
- Organisms adapt to environment they live in which reflects 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 underling biological mechanisms at organismic level.
- To encourage problem based learning (PBL) and corresponding with the theory syllabus the practical 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 creative and bloom based approach, rote -learning approach 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.
- Feedback from the stakeholder, 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 done in the syllabus with respect to the current needs and requirements of the industrial professionals sectors of the subject.

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

Paper I

The topics covered in Paper I, cover the basic concepts of 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, Mendelian laws of inheritance. This gives students advantage of perusing their interests in these topics at the post graduate level and at PhD level. The interdisciplinary approach of the topics covered helps students to know every concepts of Life sciences and then apply their knowledge in solving bigger issues in the field of medicine, environment, agriculture.

4. Learning Outcomes:

- Students' concept of 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 that they are prepared for specialization at the post graduate level and they are encouraged for research.

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

- Inclusion of relevant topics has been done based on the inputs from the stakeholders of the department.
- In addition to Biomolecules introduction, it will be taught at 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 don

Part 2: The Scheme of Teaching and Examination

Semester – I

Sr. No.	Choice Based Credit System			Subject Code	Remarks
1	Core Course (Life Sciences)			US-FLS-101 US-FLS-102 US-FLS-1P1 US-FLS-1P2	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)			-	

First Year Semester I Internal and External Assessment Details:

Sr. No.	Subject Code	Subject Title	Periods Per Week						Credit	Seasonal Evaluation Scheme				Total Marks
			Units	S. L.	L	T	P			S. L. E	CT	TA	SEE	
1	US-FLS-101	Life Sciences at the Molecular and Cellular Levels	3	20% *	3	0	0		2	10	20	10	60	100
2	US-FLS-102	Life Sciences as System, Organism at Community Level	3	20% *	3	0	0		2	10	20	10	60	100
3	US-FLS-P1	Practicals based on course 1 of theory Practicals based on course 2 of theory			0	0	6		2				100 (80+ 20)	100
	Total Hours / Credit								06	Total Marks				300

***One to two lectures to be taken for CONTINUOUS self -learning Evaluation.**

Part 3 : Detail Scheme Theory
First Year Semester – I Units – Topics – Teaching Hours

S.N	Subject Code	Subject Unit Title		Hours/ Lectures	Total No. of hours/lectures	Credit	Total Marks
1	USFLS101	I	Features of living cells	15	45 L	2	100 (60+40)
		II	Concept of Prokaryotic and Eukaryotic cells	15			
		III	Cell Organelles I	15			
2	USFLS102	I	Multicellularity and specialized function	15	45L	2	100 (60+40)
		II	Physiological Systems 1	15			
		III	Physiological System 2	15			
3	USFLSP1	I	Practicals based on course 1 of theory	3	45x2= 90L lectures per batch	2	100 (80+10+10)
		II	Practicals based on course 2 of theory	3			
			TOTAL			6	300

- **Lecture Duration – 48 Minutes**
- **One Credit =15 Classroom Teaching Hours**

F.Y.B.Sc. LIFE SCIENCES SYLLABUS (SEMESTER BASED CREDIT AND GRADING SYSTEM)

TO BE IMPLEMENTED FROM THE ACADEMIC YEAR 2020

SEMESTER I

Curriculum Topics along with Self-Learning topics - To be covered, through self-learning mode along with the respective Unit. Evaluation of self-learning topics to be undertaken before the concluding lecture instructions of the respective UNIT

Paper-I

Total Credit: 02

Title of Paper: Life Sciences at the Molecular and Cellular Levels

Unit	Content	No. of Lectures
I	**Features of living cells:**	**(15)**
	1.Physiological Role of water: Structure of water molecule, ionic interactions, ionic product of water, concept of pH, buffers.	**04**
	2. Proteins: Amino acids: Classification, Chemical Reactions (Ninhydrin, Edmans, Sangers) of amino acids, peptides. Protein: Structure, Classification globular proteins (Hemoglobin) & Fibrous proteins (keratin), Types of bonds contributing to protein structure.	**06** **05**
	3. Carbohydrates: Carbohydrates: Introduction Structure, physical and chemical properties of Monosaccharides, Disaccharides (maltose, sucrose, lactose), Polysaccharides (starch, glycogen and cellulose)	**(15)**
II	**Concept and Study of Prokaryotic and Eukaryotic cell:**	**04**
	i **1. Microscopy:** Principles of light and electron microscopy	
	2. Prokaryotic cell structure E.g. *E. coli*, Factors influencing life cycle and growth curve of *E. coli*., culture media (enriched and minimal), isolation, preservation.	
	3.Eukaryotic cell structure E.g. Yeast (Unicellular), Plant and Animal cell (Multicellular)	**04**
	4.Evolutionary origin of organelles and Endosymbiont hypothesis	
	5.Virus: Virion structure, Life cycle of bacteriophage (Lytic and Lysogenic),	**05**

III	Plant and Animal virus (One example each). **6.Cell cycle** (G0, G1, S, G2, M phases) **Cell Organelles I** **1.Nucleus:** Structure of an Interphase nucleus: Nuclear membrane, nucleolus, Nucleosome model, Euchromatin and Heterochromatin, Lamp brush and Polytene chromosomes **2.Cytoskeletalelements**: **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. **3.Structure of cell wall:** **a.** Bacterial cell wall: Gram positive and Gram negative. **b**. Fungal cell wall **c.** Plant cell wall: Primary and Secondary	**02** **(15)** **06** **06** **03**

Self Learning Topics to be covered by Learner

Unit	Topics
1	Proteins and Carbohydrates from Plant and Animal Sources
2	Compound Microscope – Structure, working and its maintenance; Microbes involved in food spoilage
3	Types of Chromosomes from plant and animal species

Online Learning topics (Unit wise)

Online Resources		
Life Sciences	**Source of e – learning course**	**Details (Path)**
Semester 1 Course 1Unit 1	Swayam Portal (UG) https://epgp.inflibnet.ac.in ;Swayam Portal (CEC)- Biochemistry and Cell Biology(12); UGC Moocs(UG)- Cell Biology (12) UGC Moocs(UG) Cell Biology (66) http://ndl.iitkgp.ac.in/document/Z2JzN0ZmU2VhdW5kODBJdWRCTmg3SDJ2cU8wMHRhNkVD	Biochemistry and Cell Biology (12)

	QmY5aTdtNklrRkp0bDFGUGZMZE5OOFNWcjRlbTllbXZXVFdnZnVDTjdTMEEvc21XYUd3K2c9PQ	
	Swayam Portal (CEC) https://epgp.inflibnet.ac.in ;Swayam Portal (CEC)- Biochemistry and Cell Biology(12); UGC Moocs(UG)- Cell Biology (12) UGC Moocs(UG) Cell Biology (66)	Cell Biology (12)
	UGC Moocs (UG) https://epgp.inflibnet.ac.in ;Swayam Portal (CEC)- Biochemistry and Cell Biology(12); UGC Moocs(UG)- Cell Biology (12) UGC Moocs(UG) Cell Biology (66)	Cell Biology (66)

References Books: US-FLS-101

Sr.No.	Unit	Reference Books
1	Unit 1	1. Fundamentals of Biochemistry Ed: Voet. And Voet 4th edition, (2010) Pub: John Wiley and Sons. 2. Lehninger Principles of Biochemistry Ed: D. LNelson, 5th edition, (2008) Pub: CBS Publishers and Distributors 3. Principlesof Biochemistry Ed: Zubay G.L, Parson W.W. and Vance D.E. 1st edition (1995) Pub: W. C. Brown. 4. Cell Biology, Genetics, Molecular biology, Evolution and Ecology -P.S. Verma and V.K. Agarwal Publishers: S. Chand and Co. Ltd., (2009).
2	Unit 2	5. Becker's World of the Cell: International Edition – 8th Edition Jeff Hardin Gregory Paul Bertoni, Lewis J. Kleinsmith Publishers: Pearson Dorling Kinderflay India / Pearson India (2011) 6. Molecular Cell Biology – 7th Edition Ed: Harvey Lodish, Arnold Berk, Chris A. Kaiser and 5 more (2012) Pub: Macmillan 7. Essential Cell Biology Ed: Bruce Alberts, Dennis Bray, Karen Hopkin and Alexander Johnson (2009) 3rd Edition Pub: Garland Science. 8. Cell Biology, Genetics, Molecular biology, Evolution and Ecology

		9. Becker's World of the Cell: International Edition – 8thEditionJeff Hardin
3	Unit 3	10. Life: The Science of Biology, William K Purves, D. Sadava, G. H. Orians and H.C. Heller 7th Edn. (2003) Sinauer Associates 11.Molecular Biology of the Cell Ed: Bruce Alberts, Alexander Johnson, Julian Lewis , David Morgan , Martin Raff, Keith Roberts, Peter Walter 5th Edition (2007) 12. Essential Cell Biology Ed: Bruce Alberts, Dennis Bray, Karen Hopkin and Alexander Johnson (2009) 3rd Edition Pub: Garland Science 13. Cell Biology C. B. Powar, 2010. Himalaya Publishing House

Paper-II **Total Credit:02**

Title of Paper: Life Sciences as System, Organism at Community Level

Unit	Content	No. of Lectures
I	**Multicellularity and Specialized Function**	**(15)**
	1.Classification –Whittaker's 5 kingdom classification Concept of Multicellularity and division of labor (Volvox and Sponges as examples)	**02**
	2.Organization into Tissues Introduction to Plant and Animal tissues	**04**
	3. Organization from Tissues to Organs and Systems	
	a. For maintenance of organism – An overview of following Life Processes Nutrition/Digestion, Transport and Circulation, Support and Locomotion Respiration, Osmoregulation and Excretion.	**02**
	b. Control and Coordination – An overview of the following systems Endocrine, Nervous, Immune, Reproductive	**02**
	4. Nutrition – Autotrophic and Heterotrophic	**05**
	a. Autotrophic nutrition – Importance of photosynthesis in plants and in autotrophic prokaryotes eg. Nitrifying bacteria, Cyanobacteria. Nutritional adaptations – eg. Symbiotic Nitrogen fixation, Insectivorous plants.	
	b. Heterotrophic nutrition i) Holozoic nutrition- eg. Fluid feeders (mosquito or housefly) ii) Microphagous (amoeba or paramecium) iii) Macrophagous (mammals) iv) Saprophytic (fungi) v) Parasitic(tapeworm)	
	c. Evolutionary adaptation associated with diet eg. dental, stomach and intestine (ruminant)	
II	**Physiological Systems** **1.Transport and Circulation**	**(15)**
	a. Transport in plants –	**05**

	i) Transport of Water and Inorganic Solutes – Transpiration pull, Stomatal function and regulation, role of Proton Pumps and factors affecting Ascent of Xylem Sap. ii) Transport of organic solutes – Phloem Transport- Mechanism and its Regulation **b.** Circulation in animals i) Animals without a circulatory system eg.Hydra and Jellyfish ii) Open and closed circulatory system eg. Insects vs Worms iii) Comparative Overview of Vertebrate circulatory system iv)Specific adaptations – Mammals at high altitudes and Diving mammals. **2. Support and Locomotion** **a.** Support in plants – Herbaceous and Woody plants **b.** Types of skeletons i) Hydrostatic (Nematodes) ii) Exoskeleton (Arthropods/Molluscs) iii) Endoskeletons (Vertebrates) **c.** Role of muscle in locomotion (Activity Based Learning) i) Locomotion in Earthworm ii) Locomotion in humans – Axial and Appendicular skeleton and joints	**05** **05**
III	**Physiological systems 2** **1.Respiration and Gaseous Exchange** **a.** Aerobic and Anaerobic Respiration Gas exchange in i) Invertebrates – Trachea in insects; Book Lungs in Scorpion ; Across the surface in Earthworm and Cutaneous in Frogs. ii)Vertebrates – Gills in Fish and Lungs in Mammals iii) Respiratory pigments – Hb, Haemocyanin O_2 and CO_2 balance iv)Plants – Stomata and Pneumatophores **2.Excretion and Osmoregulation** **a.** Plants – Water and Salt Regulation under normal and stressed conditions **b.** Animals – Phylogenetic overview of organs and processes i) Contractile Vacuole ii) Flame cells iii) Nephridium iv) Malpighian Tubules v) Kidney and Skin in Man **c.** Concept of osmoregulation and processes associated with	**(15)** **07** **08**

	i) Osmoregulation - Ultrafiltration, Selective re-absorption, Secretion, Acid-Base Regulation. ii)Nitrogenous Excretory Products - Ammonotelism, Ureotelism and Uricotelism. **d.** Case studies: (Activity Based Learning) i) Mammals in Arid Regions (camel); ii)Salt glands in Birds	

Self-Learning topics (Unit wise)

Unit	Topics
1	Specialization of animal cells and plant cells with respect to function; Macro and micro nutrients for plants;
2	Cardiovascular system in health and disease – exercise, hypertension and atherosclerosis
3	Osmoregulation of plants and animals inhabiting different ecosystems

Online Resources		
Life Sciences	**Source of e – learning course**	**Details (Path)**
Semester 1 Course 2	Swayam (NPTEL) https://epgp.inflibnet.ac.in Swayam (NPTEL) Animal Physiology (12) http://ndl.iitkgp.ac.in/document/Qkh4R2FGUkRNZjFicFUvWmpzQ2loVUhyU29EcE5jWWVNMUh1Wm13WXp6MWw0YXlEWXJDSVBrRHNuSWxTNU9xcA	Animal Physiology (12)

References Books: US-FLS-102

Sr.No.	Unit	Reference Books
1	Unit 1	1. Biological Science, Taylor, Green and Stout., 3rd edn. Ed. R. Soper. (2005) Cambridge Univ. press 2. Biology A Modern Introduction, B.S. Beckett (1994), GCSE Edn. Oxford Univ. Press. 3. Biological Science: - Scott Freeman (2004) Pub: Benjamin Cummings Publishing Company

2	Unit 2	4. Principles of Anatomy and Physiology 10th edition (2003) Gerard J. Tortora and Sandra R. Grabowski John Wiley & Sons, Inc. 5. Biological Science, Taylor, Green and Stout., 3rd edn. Ed. R. Soper. (2005) Cambridge Univ. press
3	Unit 3	6.Comparative Animal Physiology, Philip C. Withers, (1992), Saunders College Publishing House. 7. Biology A Modern Introduction, B.S. Beckett (1994), GCSE Edn. Oxford Univ. Press. 8. Biological Science: - Scott Freeman (2004) Pub: Benjamin Cummings Publishing Company 9.Principles of Anatomy and Physiology 10th edition (2003) Gerard J. Tortora and Sandra R.Grabowski John Wiley & Sons, Inc.

Part 4: Practicals

Paper-I-Practical **Total Credit: 01**

Course Code:			
Unit	**Content**	**No. of Lectures**	**Reference Books**
I	**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]*** **2.** Introduction to Elementary microbial techniques : a. ***** Sterilization & Disinfection b. Microbial Staining technique and Microscopy: c. Comparative study of samples from 5 different sources to check gram positive and gram negative bacteria - Butter milk, tap water, sewage water, food item soil, rotten – effect of heat using i. Monochrome / ***** Gram Staining ii. Cell wall staining **3.** Colorimetry a. Preparation of solutions of a given chemical compound- b. Molar and percentage solutions - Concept and calculation only. c. Preparation of dilutions of required concentration from a stock solution of a colored compound d. Estimation of Lambda max of a coloured solution e. Verification of Beer Lambert's law for a coloured solution **4.** Molecular biology and Biochemistry: a. * Isolation and Detection of DNA (by observing spools) from Onion/ cauliflower/ broccoli/ any other convenient, cost -effective system. DPA detection optional / demonstration. b. ***** Detection of Carbohydrates (eg. wheat/rice atta), Lipids (eg. Ground nut oil) and proteins (eg. any edible protein). **5.** Instrumentation and techniques: a. Calibration of the pH Meter with standard buffer pH4 and pH9.2 as per GLP ***** Checking of pH for common foodstuff e.g. Milk/cola drink/Lime juice or any other relevant sample	**03** **03** **03** **03** **03** **03**	1

Paper-II-Practicals **Total Credit:01**

Course Code:			
Unit	**Content**	**No. of Lectures**	**Reference Books**
I	**1.**a. History of Science (E Learning- Activity Based) b. GLP: Handling of biological materials / chemicals /other safety issues **2.**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 (structure and function) 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 **3.Hematology** a. Total RBC count using Hemocytometer b. Observe different WBCs using Giemsa/ Leishman stain c. Differential WBC Count **4. Diversity of Life Part I (present specimens/pictures/models)** Five Kingdom Classification –Whittaker Classification *Classification of Monera, Protista, Fungi * Classification of Plants **Digital recording and detailed classification of one plant and (one animal in 2nd semester) from campus/ local environment** **5.Study of Mouth parts in Insect** Comparative identification of different mosquito genera and sexual dimorphism using head morphology from permanent slides/ field samples. **6.Comparative assessment of mouth parts according to function as given below** **i)**Types of Mouth Parts a. Biting and Chewing Type-E.g. Cockroach (E Resource/Demonstration) b. Piercing and sucking Type- E.g. Mosquito c. Sponging Type- E.g. Housefly	**03** **03** **03** **03** **03** **03**	2,3,4

	ii) Mounting of Nephridium of Earthworm and permanent slide of kidney		

Online Resources		
Life Sciences	**Source of e – learning course**	**Details (Path)**
Semester 1 Practical Course 1 and 2	Swayam (CEC) https://epgp.inflibnet.ac.in ;Swayam Portal (CEC)- Biochemistry and Cell Biology(12); UGC Moocs(UG)- Cell Biology (12) UGC Moocs(UG) Cell Biology (66) https://ndl.iitkgp.ac.in/homestudy/science	Experimental Biochemistry (12)

Reference Books : USFLS1P1&1P2

1	1P1	1. Essential Cell Biology Ed: Bruce Alberts, Dennis Bray, Karen Hopkin and Alexander Johnson (2009) 3rd Edition Pub: Garland Science. 2. Comparative Animal Physiology, Philip C. Withers, (1992), Saunders College Publishing House.
2	1P2	3. An Introduction to Practical *Biochemistry* 3rd Edition by *David Plummer*. 4. Life: The Science of Biology, William K Purves, D. Sadava, G. H. Orians and H.C. Heller 7th Edn. (2003)Sinauer Associates.

Part 5
First Year Semester – II
Summary

Sr. No.	Choice Based Credit System			Subject Code	Remarks
1	Core Course (**Life Sciences**)			US-FLS-201 US-FLS-202 US-FLS-2P1 US-FLS-2P2	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)			-	

First Year Semester-II Internal and External Assessment
Detail Scheme

Sr. No.	Subject Code	Subject Title	Periods Per Week						Seasonal Evaluation Scheme				Total Marks
			Units	S. L.	L	T	P	Credit	S. L. E	CT	TA	SEE	
1	USFLS201	Life Sciences at The Molecular and Cellular Levels	3	20% *	3	0	0	2	10	20	10	60	100
2	USFLS202	Life Sciences as System, Organism at Community Level	3	20% *	3	0	0	2	10	20	10	60	100
3	USFLSP2	Practicals based on course 3and course 4 of theory			0	0	6	2				100 (80+ 20)	100
	Total Hours / Credit							06	Total Marks				300

***One to two lectures to be taken for CONTINUOUS self -learning Evaluation.**

First Year Semester – II Units – Topics – Teaching Hours

Sr. No.	Subject Code	Subject Unit Title		Hours /Lectures	Total No. of hours/ lectures	Credit	Total Marks
1	USFLS201	I	Macromolecules	15	45 L	2	100 (60+40)
		II	Cell Organelles II	15			
		III	Energy Metabolism and Cell Division	15			
2	USFLS202	I	Classical Genetics	15	45L	2	100 (60+40)
		II	Post Mendelian Genetics	15			
		III	Ecology and Behaviour	15			
3	USFLSP2	I	Practicals based on course 3 of theory	3	45x2= 90L lectures per batch	2	100 (80+10+10)
		II	Practicals based on course 4 of theory	3			
			TOTAL			6	300

- **Lecture Duration – 48 Minutes = 0 .78 Hours**
- **One Credit =15 Classroom Teaching Hours**

Part 6: Detail Scheme Theory

SEMESTER-II

Curriculum Topics along with Self-Learning topics - to be covered, through self-learning mode along with the respective Unit. Evaluation of self-learning topics to be undertaken before the concluding lecture instructions of the respective UNIT

Paper-I **Total Credit: 02**

Title of Paper: Life Sciences at the Molecular and Cellular Levels

Unit	Content	No. of Lectures
I	**Macromolecules**	**(15)**
	1. Lipids: Classification of lipids- Simple, Derived and Complex with one example each.	**04**
	2. Nucleic acids: a. Structure and Forms of Eukaryotic DNA-A, B, Z b. Structure of RNA - m RNA, t RNA, r RNA c. Comparison between bacterial DNA and eukaryotic DNA d. Extra chromosomal DNA- Mitochondrial, Chloroplast and Plasmid	**05** **06**
	3. Separation techniques: a. Chromatography - Paper and thin layer b. Agarose Gel Electrophoresis c. Centrifugation d. Precipitation Technique -Salting in and salting out	**(15)**
II	**Cell Organelles II**	**07**
	1. 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 iv) Endocytosis and Exocytosis	**03**
	2. Endoplasmic Reticulum: **a.** Structure including Sarcoplasmic Reticulum **b**. Role in: i) Protein synthesis (ER- Ribosome) ii)Transport (Signal Hypothesis)	**02**

	3. Ribosomes: **a.** Subunits in Prokaryotes and Eukaryotes (including those within chloroplast and mitochondria); **b.**ER-Ribosome complex	**02**
	4. Golgi Apparatus: **a.** Origin and relationship to Endoplasmic reticulum. **b.** Role in synthesis, storage and secretion of zymogen and glycoproteins	
	5. Lysosomes: Types and Role of Lysosomes.	**01**
III	**Energy Metabolism and Cell Division**	**(15)**
	1. Mitochondria: Structure of inner, outer membranes & the matrix with brief mention of Oxidative Phosphorylation.	**05**
	2. Plastids: **a.** Types of Plastids **b.** Structure of Chloroplast **c.** Photosynthetic pigments & a brief mention of photo-phosphorylation	**05**
	3. Peroxisomes and Glyoxisomes: Structure and function in plant and animal cells.	**02**
	4. Mitosis and Meiosis & their significance	**03**

Reference Books: US-FLS-201

Sr.No.	Unit	Reference Books
1	Unit 1	1. Fundamentals of Biochemistry Ed: Voet. and Voet4th edition, (2010) Pub: John Wiley andSons 2. Lehninger Principles of Biochemistry Ed: D.L. Nelson, 5th edition, (2008) Pub: CBS Publishers and Distributors
2	Unit 2	3. Principles of Biochemistry Ed: Zubay G. L, Parson W.W. and Vance D.E. 1st edition (1995) Pub: W. C.Brown.
3	Unit 3	4.Life: The Science of Biology, William K Purves, D. Sadava, G.H. Orians and H.C. Heller 7th Edn. (2003)Sinauer Associates.

Paper-II

Total Credit: 02

Title of Paper: Life Sciences as System, Organism at Community Level

Unit	Content	No. of Lectures
I	**Classical Genetics** **1.**Mendelian Inheritance: **a.** Concept of Genes and Alleles- Using sickle cell anemia and SNP as an example **b.** Mendel's Laws **c.** Mono &Dihybrid ratios with problems, **d**. Chi square –for 3:1ratio and 1:1 ratio. 2 **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	**(15)** **09** **06** **(15)**
II	**Post Mendelian Genetics** **1. 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 **2. Mutations:** **a.** Point Mutations **b.** Chromosomal aberrations: i)Structural: deletion, duplication, inversion, translocation. ii)Numerical: euploidy& aneuploidy **3.Principles of Genetic Engineering and its applications** **a.** In Medicine -e.g.; Insulin /any other suitable example **b.** In Agriculture - e.g.; Bt Cotton /any other suitable example	**07** **05** **03** **(15)**

III	**Ecology and Behavior:** **a. Principles of Ecology** Food chains, flow of energy, food webs, trophic levels, ecological pyramids & their efficiencies **b. Intraspecific Interactions** i) Commensalism ii) Mutualism iii) Parasitism iv) Ammensalism v) Symbiosis **c. An overview of Ecological succession** –Primary and Secondary **d. Types of Ecosystems:** i)Terrestrial ii)Aquatic iii)Thermal vents as an ecosystem iv)Effect of Environmental change on different ecosystems **e. Behavioral Ecology:** i)Basic behavioral patterns – taxis, tropism, reflex, instinct & conditioned behaviour ii) Ecological adaptations – camouflage & mimicry iii) Biological clocks and rhythms **f. Biostatistics:** i) Graphical representations, ii) Central tendencies- mean, median, mode, iii) Measures of Variation - range, variance and standard deviation	**03** **02** **01** **05** **04** **03**

Self-Learning topics (Unit wise)

Unit	Topics
1	Basic Terminologies in Mendelian Genetics ; Ethical issues with r DNA Technology
2	Genetic Diseases and Gene Therapy
3	Study of components of any one Ecosystem and their interrelationship

Online Resource		
Life Sciences	**Source of e – learning course**	**Details (Path)**
Semester 2 Course 2	Swayam (NPTEL) https://epgp.inflibnet.ac.in ;Swayam (NPTEL) Genetics (12) http://ndl.iitkgp.ac.in/document/Qkh4R2FGUkRNZjFicFUvWmpzQ2loWFRBd1N6M1U3OGgwMkxsUHlrc2FvV2ZHaGZpZDg0O	Genetics (12)

	Gl1bEdyUzRrdnlkRQ	
	Moocs online Course (UG) Moocs online Course (UG) Principles of Genetics (16) http://ndl.iitkgp.ac.in/document/Qkh4R2FGUkRNZjFicFUvWmpzQ2loU1NPaEl6eWpVaXpnNGUwc21iQzZKbFF3eE9YZGtiUUJZaTVMUkV1K2crdTlzVXU1TTdKSC9HVDQyaWltVDl6RVE9PQ	Principles of Genetics (16)
	Swayam (NPTEL) Swayam (NPTEL) Ecology and Environment (0 http://ndl.iitkgp.ac.in/document/Qkh4R2FGUkRNZjFicFUvWmpzQ2loY2I1c2hBY3M5ZWxYUFpramFobnNvSU9RTGIzeTRtMHlKTWhnTE1yYjZ3eg	Ecology and Environment (0)
	Moocs online Course (UG) Moocs online Course (UG) Environment and elements of ecology (21)	Environment and elements of ecology (21)

Reference Books: US-FLS-202

Sr.No.	Unit	Reference Books
1	Unit 1	1. Cell Biology, Genetics, Molecular biology, Evolution and Ecology P.S. Verma and V.K. Agarwal Publishers: S. Chand and Co.Ltd., (2009) 2. An Introduction to Genetic Analysis Ed: Griffiths A.J. et al (2000) Pub: W. H. Freeman (London) Seventh Edition
2	Unit 2	3.Essentialsof Human Genet ics, S.M. Bhatnagar, M.L. Kothari & L.A. Mehta, (1994), Orient Longman's Publication. 4. Biological Science, Taylor, Green and Stout., 3rd edn. Ed. R. Soper. (2005) Cambridge Univ. press 5. Biological Science: - Scott Freeman (2004) Pub: Benjamin Cummings Publishing Company
3	Unit 3	6. Biostatistics -P. Ramakrishnan, Saras Publication, 2015 Edition 7. Ecology E. P. Odum, 198. Saunders Philadelphia 8. Techniques in Research C. R. Kothari, 4thedition,

Part 7: Practicals

Paper-I-Practical **Total Credit:01**

Course Code:			
Unit	**Content**	**No. of Lectures**	**Reference Books**
I	1.A. History of Science 1B. 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 1. Effect of temp on movements in plants and animals using any system. The following are suggested. a. Cytoplasmic streaming in Vallisneria b. *Culturing and observation of feeding in Paramoecium from Hay infusion (students must be demonstrated how to develop a culture) Source- vermicompost / cow dung) 3. Histochemistry and enzymology: (a) *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 of peas / cockroach muscles C- Fat bodies of Cockroach/Drosophila/lipids of groundnut D - DNA and RNA from onion peel using methyl green pyronin staining (b) Enzymology: i. Detection of Dehydrogenase enzyme activity using sprouting grams / beans or muscle (as a study of mitochondrial function) ii *Estimation of Catalase enzyme activity using paper disc rising-time technique (use different seeds as source) 4. Effect of ageing on plant leaf pigments / separation of amino acids – using paper chromatography 5. Effect of anti transpirants on stomatal movements. (1 monocot, 1 dicot) 6. Study of Electron Micrographs as listed below: Both normal and pathological a. Mitochondria b. Lysosomes c. Basement membrane/junctions d. Cilia 7. Field work and report writing	**03** **03** **03** **03** **03** **03**	1 to 8

Paper-II-Practical **Total Credit:01**

Course Code:			
Unit	**Content**	**No. of Lectures**	**Reference Books**
I	1. A. History of Science	**03**	9 to 17
	1.B. Determining effect of colchicine / mitotic inhibitor /environmental pollutant / mitotic activator on mitosis in onion root tip by calculating mitotic index. (Statistical analysis of the data to be done)	**03**	
	1. Meiosis from Tradescantia (demonstration/Photograph)	**03**	
	2. Study of Barr Body	**03**	
	3. * Animal diversity: Part II: Classification of Animals – Invertebrates (as in the chart, provided) Part III: Classification of Animals – Vertebrates (as in the chart, provided)		
	Digital recording and detailed classification of one animal from campus/		
	Local environment	**03**	
	4. ***Biostatistics**		
	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. (Also represented using computers – Excel)		
	(d) Measures of central tendency – mean, median, mode and standard deviation. (data from experiments done in class can be used for biostatistics)		
	6. Soil analysis: Edaphic factors Texture, water content, soil organisms (fungi using slide culture method)	**03**	
	7. Field study / Microhabitat of aquarium or pond. Data logging in ecology – temperature, light, pH (in a pond or aquarium)	**03**	
	OR		
	7. Effect of environmental conditions on growth of yeast cells (count using hemocytometer) - effect of temperature and nutrients (food source – 2%sucrose)	**03**	
	8. Collection of blood group information from family and construction of pedigree charts	**03**	
	Assignment: Perform a search on any one topic using pubmed , download about ten abstracts and prepare a summary of the literature	**03**	

Online Resource		
Life Sciences	**Source of e – learning course**	**Details (Path)**
Semester 2 Practical Course 1 and 2	Swayam (CEC) https://epgp.inflibnet.ac.in ;Swayam Portal (CEC)- Biochemistry and Cell Biology(12)	Experimental Biochemistry (12)
	Swayam (CEC) https://epgp.inflibnet.ac.in ;Swayam Portal (CEC)- Biochemistry and Cell Biology(12)	Animal Diversity (12)
	Swayam (NPTEL) Swayam (NPTEL)	Biostatistics and Design of Experiments (12)

Reference Books: US-FLS 2P1& 2P2

Sr.No.	Course	Reference Books
1	2P1	1.Fundamentals of Biochemistry Ed: Voet. and Voet4th edition, (2010) Pub:John Wiley and Sons 2. Principles of Biochemistry Ed: Lehninger D.L. Nelson, 5th edition, (2008) Pub: CBS Publishers and Distributors 3. Becker's World of the Cell: International Edition – 8th Edition Jeff Hardin 4. Biology A Modern Introduction, B.S. Beckett (1994), GCSE Edn. Oxford Univ.Press. 5. Principles and Techniques Of. Biochemistry And. Molecular Biology. Seventh Edition. Edited By Keith *Wilson* And John *Walker* 6. An Introduction to Practical *Biochemistry* 3rd Edition by *David Plummer* 7. The Cell: International Edition – 8th Edition JeffHardin Biology A Modern Introduction, B.S. Beckett (1994), GCSE Edn. Oxford Univ.Press. 8. Principles and Techniques Of. Biochemistry And Molecular Biology. Seventh Edition. Edited By Keith *Wilson* And John*Walker* 9. An Introduction to Practical *Biochemistry* 3rd Edition by *David Plummer* 10. Biological Science, Taylor, Green and Stout., 3rd edn. Ed. R. Soper (2005) Cambridge Univ.press

2	2P2	11. Comparative Animal Physiology, Philip C. Withers, (1992), Saunders College Publishing House. 12.Cell Biology, Genetics, Molecular biology, Evolution and Ecology 13.Becker's World of the Cell: International Edition – 8th Edition Jeff Hardin 14.Life: The Science of Biology, William K Purves, D. Sadava, G.H. Orians and H.C. Heller 7th Edn. (2003) Sinauer Associates 15. Invertebrate Zoology.*E. L. Jordan*. &P.S. Verma S. Chand & Company 16.Biostatistics: P. Ramakrishnan, Saras Publication,2015Edition 17. *Chordate Zoology* and Elements of Animal Physiology. Authors, E.L. *Jordan*, P. S. *Verma*. Edition, Publisher,S Chand and Company, 1993.

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