Program Handout for

B.Sc. (H) Life sciences

(w.e.f. 2016-17; revised version w.e.f. 2020-2021)

Department of Biosciences
Faculty of Science
Integral University, Lucknow

PROGRAM EDUCATIONAL OBJECTIVES (PEO's)

- Bachelor course in biotechnology offers the synergism of basic concepts of biology, biotechnology, molecular biology, genomics, Recombinant DNA technology, microbiology, biochemistry and bioinformatics with technological applications.
- The main objective of this degree course is to produce graduates with enhanced skills, knowledge and research aptitude to carry out higher studies, entrepreneurship or research and development in the various health, research and industrial areas.
- Develop proficiency in application of current aspects of biotechnology, molecular biology, Recombinant DNA technology, bioinformatics and genomics.
- Students will be able to use state of the art techniques relevant to academia and industry, generic skills and global competencies including knowledge and skills that enable the students to undertake further studies in the field of biotechnology, molecular biology, Recombinant DNA technology, genomics, microbiology, biochemistry or any other related field.
- Imparting an education that includes communication skills, the ability to work in a team with leadership quality, devoted to societal problems with an ethical attitude.

PROGRAM OUTCOMES (PO's)

[PO.1] **Critical Thinking**- Students will demonstrate an understanding of major concepts in all disciplines of biology, biochemistry, biotechnology microbiology and bioinformatics. Understand the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomenaand their relevancies in the day-to-day life.

[PO.2] **Effective Communication**- Development of various communication skills such as reading, listening, speaking, etc., which will help in expressing ideas and views clearly and effectively.

[PO.3] **Social Interaction**- Development of scientific outlook not only with respect to science subjectsbut also in all aspects related to life.

[PO.4] **Effective Citizenship**- Imbibe moral and social values in personal and social life leading tohighly cultured and civilized personality.

[PO.5] **Ethics**- Follow the ethical principles and responsibilities to serve the society.

[PO.6] **Environment and Sustainability**- Understand the issues of environmental contexts andsustainable development.

[PO.7] **Self-directed and Lifelong learning**- Students will be capable of self-paced and self-directedlearning aimed at personal development and for improving knowledge/skill development.

PROGRAM SPECIFIC OUTCOMES (PSO's)

[PSO.1] The course offers basic foundation in core areas of life science including botany, zoology, chemistry and allied subjects.

[PSO.2] Inculcate strong understanding of molecular biology, genetics, microbiology, biochemistry and allied subjects, preparing them for higher education, disciplinary & multi-disciplinary research and to be a life-long learner.

[PSO.3] Prepares the students for immediate entry to the workplace with sound theoretical, experimental, analytical knowledge in the areas of plant and animal diversity, biochemicals, environment and related multidisciplinary fields.

[PSO.4] Become efficient in using standard operating procedures and will be well versed with the regulations for safe handling and use of chemicals, statistical tools, Communication and management skills, written and oral reports, scientific publications.

INTEGRAL UNIVERSITY LUCKNOW
DEPARTMENT OF BIOSCIENCES

EVALUATION SCHEME (CBCS)
B.Sc. (H) Life sciences Semester-I

Course Code	Course Title	Type of Paper	Periods/Week			Evaluation Scheme				Max. Marks	Credits	Total Credit	Attributes						
			L	T	P	UE	TA	Total	ESE				Employability	Entrepreneurship	Skill	Gender	Environment & sustainability	Human values	Professional ethics
LN104	Essential Professional Communication	Foundation	3	1	0	40	20	60	40	100	3:1:0	4	√	√	√			√	√
MT106	Mathematics	Foundation	3	1	0	40	20	60	40	100	3:1:0	4	√		√				
PY103	Introductory Physics	Foundation	3	1	0	40	20	60	40	100	3:1:0	4	√						
CH112	Fundamental of Inorganic Chemistry	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√				
BS121	Introduction to Biology	Core	3	1	0	40	20	60	40	100	3:1:0	4	√				√		
CH113	Chemistry Lab-I	Practical	0	0	6	40	20	60	40	100	0:0:3	3	√	√	√				
PY105	Physics Lab	Practical	0	0	6	40	20	60	40	100	0:0:3	3	√		√				
		Total								700		26							

Revision effective from 2020-21 batch

INTEGRAL UNIVERSITY LUCKNOW
DEPARTMENT OF BIOSCIENCES

EVALUATION SCHEME (CBCS)
B.Sc. (H) Life sciences Semester-II

Course Code	Course Title	Type of Paper	Periods/Week			Evaluation Scheme				Max. Marks	Credits	Total Credit	Attributes						
			L	T	P	UE	TA	Total	ESE				Employability	Entrepreneurship	Skill	Gender	Environment & sustainability	Human values	Professional ethics
ES115	Fundamentals of Environmental Sciences	Foundation	3	1	0	40	20	60	40	100	3:1:0	4					√	√	
CH114	Fundamental of Organic Chemistry	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√				
BS131	Plant Diversity	Core	3	1	0	40	20	60	40	100	3:1:0	4	√				√		
BS132	Animal Diversity-1 “Nonchordates”	Core	3	1	0	40	20	60	40	100	3:1:0	4					√		
BS113	Fundamentals of Microbiology	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√		√		
CH115	Chemistry Lab-II	Practical	0	0	6	40	20	60	40	100	0:0:3	3	√	√	√				
BS134	Biosciences lab.	Practical	0	0	6	40	20	60	40	100	0:0:3	3			√		√		
	Total									700		26							

INTEGRAL UNIVERSITY LUCKNOW
DEPARTMENT OF BIOSCIENCES

EVALUATION SCHEME (CBCS)
B.Sc. (H) Life sciences Semester-III

Course Code	Course Title	Type of Paper	Periods/Week			Evaluation Scheme				Max. Marks	Credits	Total Credit	Attributes						
			L	T	P	UE	TA	Total	ESE				Employability	Entrepreneurship	Skill	Gender	Environment & sustainability	Human values	Professional ethics
CH-215	Fundamentals of Physical Chemistry	Core	3	1	0	25	15	40	60	100	3:1:0	4	√		√				
BS 112	Fundamentals of Biochemistry	Core	3	1	0	25	15	40	60	100	3:1:0	4							
BS 203	Cell Biology & Genetics	Core	3	1	0	25	15	40	60	100	3:1:0	4							
BS 221	Animal Diversity-II “Chordates”	Core	3	1	0	25	15	40	60	100	3:1:0	4					√		
BS 222	Angiosperm Morphology and Taxonomy	Core	3	1	0	25	15	40	60	100	3:1:0	4				√	√		
BS 223	Biochemistry and Animal Diversity Lab	Practical	0	0	6	25	15	40	60	100	0:0:3	3	√		√		√		
BS 224	Elementary biology Lab	Practical	0	0	6	25	15	40	60	100	0:0:3	3	√		√		√		
		Total								700		26							

INTEGRAL UNIVERSITY LUCKNOW
DEPARTMENT OF BIOSCIENCES

EVALUATION SCHEME (CBCS)
B.Sc. (H) Life sciences Semester-IV

Course Code	Course Title	Type of Paper	Periods/Week			Evaluation Scheme				Max. Marks	Credits	Total Credit	Attributes						
			L	T	P	UE	TA	Total	ESE				Employability	Entrepreneurship	Skill	Gender	Environment & sustainability	Human values	Professional ethics
BS 202	Biophysical Chemistry	Core	3	1	0	25	15	40	60	100	3:1:0	4	√	√	√				
BS 212	Molecular Biology	Core	3	1	0	25	15	40	60	100	3:1:0	4	√		√				
BS 231	Ecology & Adaptation	Core	3	1	0	25	15	40	60	100	3:1:0	4					√		
BS 232	Plant Physiology	Core	3	1	0	25	15	40	60	100	3:1:0	4					√		
BS 233	Animal Physiology	Core	3	1	0	25	15	40	60	100	3:1:0	4							
BS 234	Molecular Biology & Microbiology Lab	Practical	0	0	6	25	15	40	60	100	0:0:3	3	√		√		√		
BS235	Physiology & Ecology Lab	Practical	0	0	6	25	15	40	60	100	0:0:3	3			√		√		
		Total								700		26							

INTEGRAL UNIVERSITY LUCKNOW
DEPARTMENT OF BIOSCIENCES

EVALUATION SCHEME (CBCS)
B.Sc. (H) Life sciences Semester-V

Course Code	Course Title	Type of Paper	Periods/Week			Evaluation Scheme				Max. Marks	Credits	Total Credit	Attributes						
			L	T	P	UE	TA	Total	ESE				Employability	Entrepreneurship	Skill	Gender	Environment & sustainability	Human values	Professional ethics
BS211	Immunology	Core	3	1	0	25	15	40	60	100	3:1:0	4	√		√				
BS303	Genetic Engineering	Core	3	1	0	25	15	40	60	100	3:1:0	4	√		√		√		
BS321	Plant Anatomy & Embryology	Core	3	1	0	25	15	40	60	100	3:1:0	4							
BS322	Comparative Anatomy and Developmental Biology	Core	3	1	0	25	15	40	60	100	3:1:0	4	√						
	Electives: (Any one of the following)	Elective																	
BS323	Industrial & Environmental Biotechnology		3	1	0	25	15	40	60	100	3:1:0	4	√	√	√		√		
BS306	Applied Biotechnology												√	√	√		√	√	√
BS216	Immunology Lab	Practical	0	0	6	25	15	40	60	100	0:0:3	3	√	√	√				
BS308	Genetic Engineering Lab	Practical	0	0	6	25	15	40	60	100	0:0:3	3	√	√	√				
	Total									700		26							

INTEGRAL UNIVERSITY LUCKNOW
DEPARTMENT OF BIOSCIENCES

EVALUATION SCHEME (CBCS) B.Sc. (H) Life sciences Semester-VI

Course Code	Course Title	Type of Paper	Periods/Week			Evaluation Scheme				Max. Marks	Credits	Total Credit	Attributes						
			L	T	P	UE	TA	Total	ESE				Employability	Entrepreneurship	Skill development	Gender	Environment & sustainability	Human values	Professional Ethics
BS331	Computational Sciences & Bioinformatics	Core	3	1	0	25	15	40	60	100	3:1:0	4	√		√				
	Elective courses (Any one of the following)										3:1:0	4							
BS332	Plant & Animal Biotech	Elective	3	1	0	25	15	40	60	100			√	√	√				
BM337	Entrepreneurship Development												√	√					
BS314	Bioinformatics Lab	Practical	0	0	4	25	15	40	60	100	0:0:2	2	√		√				
BS315	Project & Training* (3 months)		3 Months							300	0:0:4	4	√		√				√
BS316	Educational Tour (8-10 days)									100	0:0:2	2			√			√	
		Total								700		16							

*** The Evaluation scheme for the Project Work**

	Course Code	Dissertation	Presentation	Viva/Discussion	Total
Project Work	BS315	200	50	50	300

 # Note: The students of B.Sc. (H) Life Sciences have to undergo the educational/Industrial tour in industry/research institution for practical awareness at the end of 6th semester.

Revision effective from 2020-21 batch

B.Sc. Life Science

Syllabi of all courses

withCO, CO-PO and

CO-PSO mapping

B. Sc. LIFE SCIENCE 1st year/ 1st semester						
1. Name of the Department: Physics						
2. Course Name	**INTRODUCTRY PHYSICS**			**L**	**T**	**P**
3. Course Code	**PY103**			3	1	0
4. Type of Course (use tick mark)		**Core (√)**	**Foundation Course ()**		**Departmental Elective ()**	
5. Pre-requisite (if any)	10+2 with Physics	**6. F requency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		
8. COURSE OBJECTIVES: The purpose of this undergraduate course is to impart basic and key knowledge of mechanics, wave motion, relativity, and modern optics. The main goal of the course is to introduce students to introductory physics and its applications and for them to learn the fundamentals of this important topic.						
9. COURSE OUTCOMES (CO): ***After the successful course completion, learners will develop following attributes:***						

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Students will be able to articulate and describe the Inertial and non-inertial reference frames, Newton's laws of motion, conservation principles and motion of a particle in central force field.
CO2	Students will gain an understanding of fundamental ideas of special theory of relativitysuch as length contraction and time dilation and mass –energy invariance.
CO3	Students will gain basic knowledge of physical characteristics of simple harmonic motion (SHM) and obtaining solution of the oscillator using differential equations. Students will understand the basics of physics of hearing, heartbeat.
CO4	Use the principles of wave motion and superposition to explain the physics ofpolarisation, interference, and diffraction.
CO5	Students will gain an understanding of membrane system, membrane physics and thermodynamics of transport process.

10. Unit wise detailed content		
Unit-1	**Number of lectures = 08**	**Title of the unit**: **Mechanics**

Galilean invariance and Newton's Laws of motion. Dynamics of a system of particles, Conservation of momentum and energy, work energy theorem. Conservation of angular momentum, torque, Motion of a particle in central force field. Kepler's Laws, Satellite in circular orbit and applications (Synchronous satellite, GPS, Artificial gravity, apparent weightlessness), Physiological effects of acceleration and angular motion.		
Unit-2	**Number of lectures =08**	**Title of the unit: Theory of Relativity**
Constancy of speed of light, postulate of Special theory of relativity, length contraction, time dilation, relativistic velocity addition, Mass-energy momentum relations Electricity: Simple circuit, Ohm's Law. Semiconductors and amplifiers		

Unit-3	Number of lectures = 08	Title of the unit: Waves and Oscillations
Simple harmonic motion, damped and driven harmonic oscillator, coupled oscillator, energy relation and energy transfer, normal modes, Wave equation, Travelling waves, superposition principle, pulses, Doppler effect, effects of vibrations in humans, physics of hearing,		
Unit-4	**Number of lectures = 08**	**Title of the unit: Modern optics**
Two slit Interference, Diffraction, Resolving power, Resolution of the eye, Laser characteristics, Principle, Population inversion, Application of laser in medical science, Polarization of EM wave, Malus Law, Polarizing materials, Polarizer, Analyzer		
Unit-5	**Number of lectures = 08**	**Title of the unit: Membrane Systems and Membrane Physics**
Micelle and Bilayer formation, structure and function. Physicochemical characterization and analysis of micelles and bilayers. Membrane equlibria and Transport. Thermodynamics of transport process. Ficks', law, Nernst Planck Equations, Diffusion, Osmosis, Donnan effect, permeabilily coefficient Resting potentials, Measurement membrane conductance.		

11. CO-PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO 3	PSO4
CO1	3	2	3	1	3	2	1	3	3		
CO2	3	3	3	1	1	1	1	2	3		
CO3	3	2	3	1	1	1	1	3	2		
CO4	3	2	3	1	2	1	1	2	3		
CO5	3	2	3	1	2	2	1	2	3		

3: Strong contribution, 2: Average contribution, 1: Low contribution

12. Brief description of self learning / E-learning component

1. NPTEL :: Physics - NOC:Physics of Biological Systems
2. NPTEL :: Basic courses-Sem 1 and 2 - Engineering Physics I

13. Books recommended:

1. E. M. Purcell, Ed: "Berkeley Physics Course, Vol. 1, Mechanics" (McGraw-Hill).
2. R. P. Feymman, R. B. Lighton and M Sands; The Feymman Lectures in Physics, Vol. 1 (BI Publications, Bombay, Delhi, Calcutta, Madras).
3. J. C. Upadhyay: 'Mechanics (Himalaya Publishing House)
4. D.S. Mathur "Mechanics" (S. Chand).
5. P. K. Srivastava: "Mechanics" (New Age International).
6. Rodney Cotterill; Biophysics: An Introduction, John Wiley & Sons (year)
7. D.S. Mathur, Mechanics, S. Chand & Company Ltd. 2000
8. N. K. Bajaj, The Physics of Waves and Oscillations, Tata McGraw Hill 1988

B. Sc. LIFE SCIENCE 1st year/ 1st semester

1. Name of the Department: Biosciences

2. Course Name	**INTRODUCTION OF BIOLOGY**	**L**	**T**	**P**
3. Course Code	**BS121**	3	1	0

4. Type of Course (use tick mark)		**Core (√)**	**Foundation Course ()**		**Departmental Elective ()**	
5. Pre-requisite (if any)	10+2 with Biology	**6. Frequency (use tick marks)**	Even **()**	Odd (√)	Either Sem ( )	Every Sem ( )

7. Total Number of Lectures, Tutorials, Practicals

Lectures = 30	**Tutorials = 10**	**Practical = 00**

8. COURSE OBJECTIVES: The purpose of this course is to impart an understanding of different theories of origin of life and evolution. cell structure and functions, the economic importance of plants, different employment generating techniques like Sericulture, Apiculture, Lac culture, Poultry culture, Dairy industry and Vermiculture.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:..

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Know theories of origin of life and evolution, Biogenesis and abiogenesis; Evidence of Evolution.
CO2	Know the classification of organisms, systematics and binomial nomenclature.
CO3	Know cell structure and functions of different cell organelles. cell division and cell cycle.
CO4	Sericulture, Apiculture, Lac culture, Poultry culture, Dairy industry and Vermiculture. Methods of vermicomposting.
CO5	Economic importance of plats: timber, food, vegetables. beverages, paper and rubber plants.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: Origin of life and Evolution**

Origin of life: Theories of Origin of life, Biogenesis and abiogenesis. Evidences of Evolution. Theories of Evolution: Darwinism, Lamarckism.

Unit-2	**Number of lectures = 08**	**Title of the unit: Classification of organisms**

Properties of living organisms. Whittaker's five-kingdom concept: Monera, Protista, Fungi, Plantae and Animalia. Systematics and binomial System of nomenclature. Aims and objectives of taxonomy. Outline of classification of plants (Thallophyta and embryophyta); Outline of classification of animals (Chrdates and nonchordates).

Unit-3	**Number of lectures = 08**	**Title of the unit: Cell Structure and Function**

Organization of cell (prokaryotic and eukaryotic); differences between a plant and animal cell; structure and function of cell membrane, nucleus, chloroplast, mitochondria, endoplasmic reticulum, Golgi complex and lysosome, Elementary structure of chromatin and chromosome, Cell cycle, mitosis, meiosis and its significance

Unit-4	**Number of lectures = 08**	**Title of the unit: Economic Zoology**

Overview of Sericulture, Apiculture, Lac culture, Poultry culture and Dairy industry. Vermiculture: Introduction and scope, Species of earthworm, Characteristics features of earthworm. Overview of methods of vermicomposting, Role of earthworm in solid waste management. Vermiwash- its importance, Vermicompost as bio-fertilizer.

Unit-5	**Number of lectures = 08**	**Title of the unit: Economic importance of plants**

Plants used as a source of timber, food: cereals, pulses, oils, fruits and vegetables; spices and condiments; beverages and fibre. Medicinal plants and plants used as raw materials for paper and rubber.

11. CO-PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**2**	**1**	**1**	**1**	**3**	**2**	**3**			
CO2	**3**	**1**	**1**	**1**	**1**	**3**	**2**	**3**			
CO3	**3**	**2**	**1**	**1**	**1**	**1**	**2**	**3**			
CO4	**3**	**2**	**2**	**2**	**1**	**3**	**3**	**3**			
CO5	**3**	**2**	**3**	**2**	**1**	**3**	**3**	**3**			
BS121	**3**	**2**	**2**	**2**	**1**	**3**	**3**	**3**			

3: Strong contribution, 2: Average contribution , 1: Low contribution

12. Books recommended:

1. Biodiversity and Quality of Life. Sengupta. Mc Millan India Pvt. Ltd.
2. Biology: P. H. Raven& G. B. Jhonson
3. Manju Yadav, Economic Zoology- Discovery publishing house, New Delhi Pandey,
4. B.P,1998. Economic Botany, S. Chand& Co.,New Delhi.
5. Environmental studies: D. L. Manjunath, Pearson Education.

1. Name of the Department: Physics						
2. Course Name	**Physics Lab**			**L**	**T**	**P**
3. Course Code	**PY105**			0	0	6
4. Type of Course (use tick mark)		**Core (√)**	**Foundation Course ( )**		**Departmental Elective ( )**	
5. Pre-requisite (if any)	10+2 with Physics	**6. Frequency (use tick marks)**	Even (√)	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 00		**Tutorials = 00**		**Practical = 10**		

8. COURSE OBJECTIVES: The purpose of this undergraduate course is to impart practical knowledge of the concepts through different experiments related to its theoretical course.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	To demonstrate how interference takes place by division of amplitude and by division of wavefront.
CO2	To demonstrate the practical applications of polarization phenomenon in finding the specific rotation and also calculate the cardinal points of a lens system
CO3	To determine the resistance per unit length of a Carey Foster's bridge wire and to calculate g and the variation of T with l for a compound pendulum.
CO4	To get an idea of viscosity of a liquid.and also frequency of AC Mains

10. Syllabus

Exp-01	To determine the wave length of monochromatic light by Newton's ring.
Exp-02	To determine the wave length of monochromatic light with the help of Fresnel's Biprism.
Exp-03	To determine the focal length of two lenses by nodal slide and locate the position of cardinal points.
Exp-04	To determine the specific rotation of cane sugar solution using Half Shade polarimeter.
Exp-05	To determine the resistance per unit length of a Carey Foster's bridge wire and (i) To prepare one ohm coil and (ii) To determine the specific resistance of a given wire.
Exp-06	To study the variation of T with l for a compound pendulum and then to determine the acceleration due to gravity, position of center of gravity of the bar and radius of gyration of the bar.
Exp-07	To determine the coefficient of viscosity of a liquid.
Exp-08	To determine the frequency of an electrically maintained tuning fork by Melde's Method

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	To demonstrate how interference takes place by division of amplitude and by division of wavefront.	3	3	2	1	3	1	3
CO2	To demonstrate the practical applications of polarization phenomenon in finding the specific rotation and also calculate the cardinal points of a lens system	2	2	2	2	2	3	2
CO3	To determine the resistance per unit length of a Carey Foster's bridge wire and to calculate g and the variation of T with l for a compound pendulum.	3	3	1	3	3	1	3
CO4	To get an idea of viscosity of a liquid.and also frequency of AC Mains	2	2	2	3	1	2	2

3: Strong contribution, 2: Average contribution, 1: Low contribution

12. Brief description of self learning / E-learning component

1. https://youtu.be/fWhgguWc8rk
2. https://youtu.be/Bf0Tg-fNWjQ
3. https://youtu.be/dDp_Insp_p0
4. https://youtu.be/N0lxwqANsd4
5. https://youtu.be/G8Rqd2HNhuk
6. https://youtu.be/7Mq4isproEE
7. https://youtu.be/G8Rqd2HNhuk
8. https://youtu.be/NtfbmAw62Hw

13. Books recommended:

1. Practical Physics. by R. K. Shukla, New Age International Private Limited; Third edition.
2. B.Sc. Practical Physics by Harnam Singh and Hemne, S. Chand.
3. B. Sc. Practical Physics by CL Arora, S Chand and Company
4. Practical Physics by Kumar P.R.S., Prentice Hall India Learning Private Limited
5. Engineering Physics Practical by S.K. Gupta, Krishna Prakashan

B. Sc. LIFE SCIENCE 1st year/ 2nd semester

1. Name of the Department: Biosciences

2. Course Name	**PLANT DIVERSITY**	**L**	**T**	**P**
3. Course Code	**BS131**	3	1	0

4. Type of Course (use tick mark)	**Core (✓)**	**Foundation Course ()**		**Departmental Elective ()**	
5. Prerequisite (if any)	10+2 with Biology	**6. Frequency (use tick marks)**	Even **(✓)** Odd ()	Either Sem ( )	Every Sem ( )

7. Total Number of Lectures, Tutorials, Practicals

Lectures = 30	**Tutorials = 10**	**Practical = 00**

8. COURSE OBJECTIVES: The objective of this course is to enable students to identify and classify algae, fungi, lichens, mycorrhiza and bryophytes, Understand their morphology, anatomy and life cycle in general, and know the economic importance of algae, fungi and bryophytes.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:.

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Know the general features, Classification, Reproduction , Reproduction, Economic importance and life Cycle of Algae
CO2	Know the general features, Classification, Reproduction, economic importance, life Cycle of Fungi and Lichens..
CO3	Know the general features, Classification, Reproduction, Economic importance life Cycle of Bryophytes.
CO4	Know the general features, Classification, Stelar organization and Economic importance and life Cycle of Pteridophytes.
CO5	Know the general Characteristics of Gymnosperms, their resemblances and differences with Pteridophytes and Angiosperms.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: Algae**

General features, Classification, Range of thallus organization, Reproduction, Economic importance and life Cycle with special reference to *Spirogyra, Chara* and *Polysiphonia.*

Unit-2	**Number of lectures = 08**	**Title of the unit: Fungi**

General features, Classification, Reproduction, economic importance, life Cycle with special reference to *Pythium, Morchella, Puccinia* and Lichens.

Unit-3	**Number of lectures = 08**	**Title of the unit: Bryophytes**

General features, Classification, Thallus organization, Reproduction, Economic importance life Cycle with special reference to *Marchantia* and *Funaria.*.

Unit-4	**Number of lectures = 08**	**Title of the unit: Pteridophytes**

General features, Classification, Stelar organization. Homospory and Heterospory , Economic importance and life Cycle with special reference to *Pteris.*

Unit-5	**Number of lectures = 08**	**Title of the unit: Gymnosperms**

General Characterstics of Gymnosperms, resemblances and differences of Gymnosperms with Pteridophytes and Angiosperms. Economic importance and life Cycle with special reference to *Cycus*

11. CO-PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**1**				**1**	**1**	**3**			
CO2	**3**	**1**				**1**	**1**	**3**			
CO3	**3**	**1**				**1**	**1**	**3**			
CO4	**3**	**1**				**1**	**1**	**3**			
CO5	**3**	**1**				**1**	**1**	**3**			
BS131	**3**	**1**				**1**	**1**	**3**			

3: Strong contribution, 2: Average contribution , 1: Low contribution
12. B**ooks recommended:**
1. Chapman V.J & Chapman D.J, The Algae, Macmillan India Ltd.
2. Fritsch F. B 1945, Structure and Reproduction of Algae Vol.I & II.Cambridge University Press.
3. Smith G.M 1955, Cryptogamic Botany Vol.I and II, McGraw Hill.
4. Vashishta B.R 1990, Botany for Degree Students, Vol 1,2 and 3. S.Chand & Co.
5. Singh V., Pandey P.C and Jain D.K 1998, A Text book of Botany for Undergraduate Students, Rastogi Publications.
6. Alexopoulos C.J & MIMS C.V 1988. Introductory Mycology, John Wiley & Sons.
7. Webster J 1970, Introduction to Fungi, Cambridge University Press.
8. Parihar N.S 1967, An Introduction to Embryophyta Vol I & II, General Book Depot.
9. Prempuri 1973, Bryophytes - A Broad perspective. Atmaram & Sons.
10. Sporne K.R 1976, Morphology of Pteridophytes, B1 Publications.
11 Sharma O.P: Text book of Pteridophyta II edition:McMillan India Ltd.
12. Bhatnagar, S.P. and Moitra1996. Gymnosperms. New Age International Limited, New Delhi. .

B. Sc. LIFE SCIENCE 1st year/ 2nd semester					
1. Name of the Department: Biosciences					
2. Course Name	**ANIMAL DIVERSITY I "NONCHORDATES"**			**L**	**P**
3. Course Code	**BS132**			3	0
4. Type of Course (use tick mark)		**Core (✓)**	**Foundation Course ()**		**Departmental Elective ()**
5. Pre-requisite (if	10+2 with Biology	**6. Frequency (use tick marks)**	Even **(✓)**	Odd ()	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals					
Lectures = 30		**Tutorials = 10**	**Practical = 00**		

8. COURSE OBJECTIVES: The objective of this course is to enable understanding of general taxonomic rules on animal classification and the complex interactions among animals of different phyla, classification of Protista and Phylum Porifera to Echinodermata with taxanomic keys, distinguishing characters of non chordates, complex evolutionary processes and behaviour of different animals

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:..

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Learn about the diversity of invertebrates, General characters and classification of Protozoa
CO2	Learn general characters and classification of Porifera and Coelenterate, Development of Hydra, Polymorphism in coelenterates.
CO3	Learn general characters and classification of Helminthes and Annelida, Fasciola hepatica, Taenia solium and Ascaris.
CO4	Learn about the General characters and classification of Arthropoda and Mollusca.
CO5	Learn about the General characters and classification of Echinodermata, Morphology and water vascular system of Asterias, General characters and affinities of Protochordata and Hemichordata

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: Protozoa**

General characters and classification; *Plasmodium* species, *Entamoeba histolytica, Euglena* and*Paramicium*- Structure, Life cycle and Control.

Unit-2	**Number of lectures = 08**	**Title of the unit: Porifera and Coelenterata**

Porifera : General characters and classification; Sycon: Morphology, Different types of cells in sycon, canal system in Porifera. **Coelenterata**: General characters and classification; Obelia: - Morphology of Obelia colony, Development of Hydra, Polymorphism in coelenterates.

Unit-3	**Number of lectures = 08**	**Title of the unit: Helminthes and Annelida**

Helminths : General characters and classification; *Fasciola hepatica, Taenia solium* and *Ascaris lubricoides*: - Structure, Life cycle, Pathogenecity & control measures. **Annelida** :General characters and classification with special reference to Earthworm and Leech.

Unit-4	**Number of lectures = 08**	**Title of the unit: Arthropoda and Mollusca**

Arthropoda :General characters and classification with special reference to Prawn and Cockroach.
Mollusca :General characters and classification with special reference to *Unio* and *Pila*.

Unit-5	**Number of lectures = 08**	**Title of the unit: Echinodermata**

Echinodermata : - General characters and classification; *Asterias* (Sea Star): - Morphology and water vascular system. General characters and affinities of Protochordata and Hemichordata.

11. CO-PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**1**				**1**	**1**	**3**			
CO2	**3**	**1**				**1**	**1**	**3**			
CO3	**3**	**1**				**1**	**1**	**3**			
CO4	**3**	**1**				**1**	**1**	**3**			
CO5	**3**	**1**				**1**	**1**	**3**			
BS132	**3**	**1**				**1**	**1**	**1**			

3: Strong contribution, 2: Average contribution , 1: Low contribution

12. Books recommended:

1. Biodiversity and Quality of Life. Sengupta. Mc Millan India Pvt. Ltd.
2. Biology: P. H. Raven& G. B. Jhonson
3. Barnes, B.D. (1987). Invertebrate Zoology. 5th Edition, Saunders College Publishing.
4. Kotpal, R. L. (1988). Protozoa. Rastogi Publications
5. Marshall, A.J. and Williams, W.D. (1979). Text Book of Zoology Vol. I-Invertebrates, Macmillan.
6. Noble, E. R. and Noble, G. A. (1982). Parasitology-The Biology of Animal Parasites, Lea and Febiger, Philadelphia.
7. Ruppert, E.E. and Barnes, R.D. (1994). Invertebrate Zoology. 6th Edition, Saunders College Publishing.
8. Webb, J.E., Wallwork, J.A. and Elgood, J. H. (1981). Guide to Invertebrate Animals, English Language Book Society and Macmillan.

B. Sc. LIFE SCIENCE 1st year/ 2nd semester

1. Name of the Department: Biosciences

2. Course Name	**FUNDAMENTAL OF MICROBIOLOGY**	**L**	**P**
3. Course Code	**BS 113**	3	0

4. Type of Course (use tick mark)		**Core (√)**	**Foundation Course ()**		**Departmental Elective ()**
5. re-requisite (if	10+2 with Biology	**6. Frequency (use tick marks)**	Even **(√)**	Odd ()	Every Sem ( )

7. Total Number of Lectures, Tutorials, Practicals

Lectures = 30	**Tutorials = 10**	**Practical = 00**

8. COURSE OBJECTIVES: The objective of this course is to enable students to understand the basics of microbiology, classification of microbes, control of microorganisms, microbes in extreme environments and microbial interactions and basics of Recombination in Prokaryotes.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:..

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Know the basics of microbiology
CO2	Have knowledge of the general classification of microbes
CO3	understand basics of Control of Microorganisms
CO4	study bacteriophages and microbes in extreme environments and microbial interactions
CO5	know the basics of recombination in Prokaryotes

10. Unit wise detailed content

Unit-1	**Number of lectures**	**Title of the unit: History and classification of microbiology**

Pasteur's experiments, Various forms of microorganisms (bacteria, fungi, viruses, protozoa, PPLOs); Nutritional classification of microorganisms; Nature of the microbial cell surface, gram positive and gram negative bacteria; Growth curve.

Unit-2	**Number of lectures**	**Title of the unit: Control of Microorganisms**

Physical agents (Autoclave, Hot air oven, Laminar airflow and membrane filter.), chemical agents (Alcohol, Halogens and Gaseo us agents, antibiotics), Radiation Methods (UV rays). **Pathogenesis of microorganisms:** Some common pathogenic microorganisms: Bacterial (tuberculosis, gall), viral (SARS, TMV), fungal (red rot of sugar cane, dermatitis) and protozoan

Unit-3	**Number of lectures =**	**Title of the unit: Microbes in extreme environments and microbial interactions**

Thermophiles alkalophiles, acidophiles and symbiosis and antibiosis among microbial population, N2 fixing microbes in agriculture and forestry.

Unit-4	**Number of lectures**	**Title of the unit: Recombination in Prokaryotes**

Transformation, Conjugation and Transduction.

Unit-5	**Number of lectures**	**Title of the unit: Bacteriophage**

Lytic & lysogenic cycle. Stains & staining techniques:Principle of staining, Types of stains – simple stains, structural stains & Differential stains.

11. CO-PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**1**				**1**	**1**	**3**			
CO2	**3**	**1**				**1**	**1**	**3**			
CO3	**3**	**1**				**1**	**1**	**3**			
CO4	**3**	**1**				**2**	**1**	**3**			
CO5	**3**	**1**				**2**	**1**	**3**			
BS113	**3**	**1**				**2**	**1**	**3**			

3: Strong contribution, 2: Average contribution , 1: Low contribution

12. Books recommended:

1. Introduction to Microbiology, Ingraham, 2ed.
2. Brock Biology of Microorganisms, Madigan et al, 9th ed.
3. General Microbiology, R.Y. Stanier, J.L. Ingraham, M.L.Wheelis and P.R. Painter, Macmillian
4. Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill
5. Principles of Microbiology, R.M. Atlas, Wm C. Brown Publisher.
6. The Microbial World, Roger Y. Stanier, Prentice Hall
7. Howe.C. (1995) Gene Cloning and manioulation, Cambridge University Press, USA
8. Lewin, B., Gene VI New York, Oxford University Press.
9. Sambrooket al (2000) Molecular cloning Volumes I, II, & III Cold spring Harbor Laboratory Press, New York, USA
10. Walker J.M. and Gingold, E.B. (1983) Molecular Biology & Biotechnogy (Indian Edition) Royal Society of Cemistry U.K

B. Sc. LIFE SCIENCE 1st year/ 2nd semester					
1.Name of the Department: Biosciences					
2.Course Name	**BIOSCIENCES LAB**	**L**	**T**	**P**	
3.Course Code	**BS134**	0	0	6	
4.Type of Course (use tick mark)	**Core(✓)**	**Departmental Elective( )**			
5.Pre-requisite (if any)	10+2 with Biology	**6.Frequency(use tick marks)**	Even **(✓)**	Odd ()	Either Sem ( )	Every Sem ( )
7.TotalNumberofLectures,Tutorials,Practicals					
Lectures=00	**Tutorials=00**	**Practical=10**			

8. COURSE OBJECTIVES: The objective of this course is to enable students to identify and classify the algae, fungi, lichens, mycorrhiza and bryophytes. The students will also understand the diversity and classification of animals.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	The students will learn the Microscopic Preparation and Study of Algae and Fungi
CO2	The students will learn morphology and reproductive structures of Bryophytes, fern and Gymnosperm
CO3	The students will learn the characteristic features and diversity of Protists
CO4	The students will learn about the structure and life cycle of helminths parasites
CO5	The students will learn the characteristics features and classification of Cockroach, *Asterias, Unio* and *Pila*

10.Syllabus

Exp-01	Microscopic Preparation and Study of Algae
Exp-02	Microscopic Preparation and Study of fungi.
Exp-03	Study of the morphology, reproductive structures and anatomy of Bryophytes.
Exp-04	Study of the morphology and reproductive structures of fern.
Exp-05	Study of the morphology and reproductive structures of Gymnosperm.
Exp-06	Study of whole mount of *Euglena*, *Amoeba* and *Paramecium*
Exp-07	Examination of pond water collected from different places for diversity in protista
Exp-08	Study of adult *Fasciola hepatica*, *Taenia solium* and their life cycles (Slides/microphotographs).
Exp-09	Study of adult *Ascaris lumbricoides* and their life cycles (Slides/microphotographs).
Exp-10	Study of lab specimens of Cockroach, *Asterias, Unio* and *Pila.*

11. CO-PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**3**	**1**			**1**	**3**	**3**			**2**
CO2	**3**	**3**	**1**				**3**	**3**			**2**
CO3	**3**	**3**	**1**				**3**	**3**			**2**
CO4	**3**	**3**	**1**				**3**	**3**			**2**
CO5	**3**	**3**	**1**				**3**	**3**			**2**
BS134	**3**	**3**	**1**			**1**	**3**	**3**			**2**

3: Strong contribution, 2: Average contribution , 1: Low contribution

B. Sc. LIFE SCIENCE 2nd year/ 3rd semester					
1. Name of the Department: Biosciences					
2. Course Name	**FUNDAMENTALS OF BIOCHEMISTRY**		**L**	**T**	**P**
3. Course Code	**BS112**		3	1	0
4. Type of Course (use tick mark)		**Core (✓)**	**Foundation Course ()**	**Departmental Elective ()**	
5. Pre-requisite (if any)	10+2 with Biology	**6. Frequency (use tick marks)**	Even **( )**	Odd (✓)	Either Sem ( ) Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals					
Lectures = 30		**Tutorials = 10**	**Practical = 00**		

8. COURSE OBJECTIVES: The objective of this course is to develop the understanding of basics of biomolecules including carbohydrates, Amino acid & protein, lipids, Nucleic Acid and Vitamins.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Understand the basics of carbohydrate, its classification
CO2	Understand the basics of Amino acids & proteins
CO3	Have knowledge of basics of lipids
CO4	Understand the basics of Nucleic Acids
CO5	Understand the basics of Vitamins

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: - Introduction to Biomolecules**
: Carbohydrates, Proteins, Lipids and Nucleic acids.		
Unit-2	**Number of lectures = 08**	**Title of the unit:** - Carbohydrates
Structure, classification and properties of Monosaccharides, Disaccharides, and Polysaccharides (starch, glycogen, peptidoglycan, cellulose).		
Unit-3	**Number of lectures = 08**	**Title of the unit: Amino acids and Proteins**
Structure, classification and properties of amino acids, Structures and functions of proteins (Hb and Myoglobin).		
Unit-4	**Number of lectures = 08**	**Title of the unit: Lipids**
Structure, classification and properties of Fatty acids, Glycerolipid, Cholesterol, Sphingolipid, phospholipids, lipoproteins, glycoproteins, isoprene		
Unit-5	**Number of lectures = 08**	**Title of the unit: - Nucleic acids**
Purines and pyrimidines, nucleosides, nucleotides, polynucleotides, DNA, types and function, RNA types and functions, Forces stabilizing nucleic acid structure		

11. CO-PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**1**					**1**	**3**			
CO2	**3**	**1**					**1**	**3**			
CO3	**3**	**1**					**1**	**3**			
CO4	**3**	**1**					**1**	**3**			
CO5	**3**	**1**					**1**	**3**			
BS112	**3**	**1**					**1**	**3**			

3: Strong contribution, 2: Average contribution , 1: Low contribution

13. Books recommended:

1. Principles of Biochemistry- AlbertL. Lehninger CBS Publishers & Distributors
2. Biochemistry – Lubert stryer Freeman International Edition.
3. Biochemistry – Keshav Trehan Wiley Eastern Publications
4. Fundamentals of Biochemistry-J.L. Jain, S.Chand and Company

B. Sc. LIFE SCIENCES 2nd year/ 3rd semester						
1. Name of the Department: Biosciences						
2. Course Name	**CELL BIOLOGY AND GENETICS**			**L**	**T**	**P**
3. Course Code	**BS203**			3	1	0
4. Type of Course (use tick mark)		**Core (√)**	**Foundation Course ()**		**Departmental Elective ()**	
5. Pre-requisite (if any)	10+2 with Biology	**6. Frequency (use tick marks)**	Even **( )**	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**	**Practical = 00**			

8. COURSE OBJECTIVES: This course is designed to enable the students to understand the cell structure and its functions, signal transduction and genetics.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Develop an understanding of the cell structure and their functions, cytoskeleton and prokaryotic and eukaryotic cells
CO2	Learn about Cell Division, Membrane transport, transduction, cell senescence and Programmed Cell Death.
CO3	Learn about Chromosomes, Chromosomal Variations, Chromosome mapping, structural and numerical aberrations
CO4	Learn about basic genetics, epistasis, Concepts of allosomes and autosomes, Linkage and Crossing Over.
CO5	Learn about mutations, human Genetics, DNA damage and repair.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: Cell as a Basic unit of Living Systems**

Discovery of cell, The Cell theory Ultrastructure of an eukaryotic cell – (both plant and animal cell). Structure and functions of cell organelles, Cytoskeletal structures (Microtubules, Microfilaments); cell motility.

Unit-2	**Number of lectures = 08**	**Title of the unit: Cell Division**

Cell cycle, mitosis and meiosis, Membrane transport: active and passive transport, introduction to signal transduction and its molecular mechanism, cell senescence, Programmed Cell Death.

Unit-3	**Number of lectures = 08**	**Title of the unit: Chromosomes: Structural Organization**

centromere, telomere, chromonema, euchromatin and heterochromatin, chemical composition and karyotype, nucleosome model, Special types of chromosomes: Salivary gland and Lampbrush chromosomes, Chromosomal Variations, Chromosome mapping, structural and numerical aberrations.

Unit-4	**Number of lectures = 08**	**Title of the unit: Mendelism**

Mendel's laws of heredity, Test cross, Incomplete dominance and simple problems, Interaction of Genes**:** Supplementary factors, Comb pattern in fowls, Complementary genes: Flower color in sweet peas, Multiple factors: Skin color in human beings, Epistasis: Plumage colour in poultry, Multiple allelism: Blood groups in human beings, Concepts of allosomes and autosomes, XX-XY, XX-XO, ZW-ZZ, ZO-ZZ type, Linkage and Crossing Over, Mechanism and importance.

Unit-5	**Number of lectures = 08**	**Title of the unit: Mutations**

Spontaneous and induced mutations, Physical and chemical mutagens, Mutation at the molecular level, Mutations in plants, animals, and microbes for economic benefit of man. Human Genetics: Karyotype in man, inherited disorders: Allosomal (Klinefelter syndrome and Turner's syndrome), Autosomal (Down syndrome and Cri-Du- Chat syndrome). DNA Damage and Repair: Causes and Types of DNA damage, Major mechanisms of DNA repair: photoreactivation, nucleotide and base excision repairs, mismatch repair, SOS repair.

11. CO-PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**1**					**2**	**3**			
CO2	**3**	**1**					**2**	**3**			
CO3	**3**	**1**					**2**	**3**			
CO4	**3**	**1**					**2**	**3**			
CO5	**3**	**1**					**2**	**3**			
BS203	**3**	**1**					**2**	**3**			

3: Strong contribution, 2: Average contribution , 1: Low contribution

12. Books recommended:

1. Molecular Biology of cell – Bruce Alberts et al, Garland publications
2. Animal Cytology & Evolution – MJD, White Cambridge University Publications
3. Molecular Cell Biology – Daniel , Scientific American Books.
4. Cell Biology – Jack D.Burke, The William Twilkins Company.
5. Principles of Gene Manipulations – Old & Primrose, Black Well Scientific Publications.
6. Cell Biology & Molecular Biology – EDP Roberties & EMF Roberties, Sauder College.
7. Principles of Genetics – E.J.Gardener, M.J.Simmons and D.P.Snustad, John Wiley & Sons Publications

B. Sc. LIFE SCIENCE 2nd year/ 3rd semester

1. Name of the Department: Biosciences

2. Course Name	**ANIMAL DIVERSITY I "CHORDATES"**	**L**	**T**	**P**
3. Course Code	**BS 221**	3	1	0

4. Type of Course (use tick mark)	**Core (√)**	**Foundation Course**		**Departmental Elective ()**	
5. Pre-requisite (if	10+2 with Biology	**6. Frequency (use tick marks)**	Even **( )**	Odd (√)	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practicals

Lectures = 30	**Tutorials = 10**	**Practical = 00**

8. COURSE OBJECTIVES: The objective of this course is to enable students to understand the organization of Protochordata, Urochordata and Cephalochordata, classification of various classes of vertebrates, External morphology and sexual dimorphism in chordates

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	The students will learn about the origin, characteristics and classification of Protochordates and Chordates.
CO2	Learn about the characteristics and classification of Pisces, their adaptations and associations in relation to their environment.
CO3	Learn about the characteristics and classification of Amphibia, Origin of tetrapods, parental care and paedomorphosis.
CO4	Learn about the characteristics and classification of Reptilia and Aves. Origin of reptiles and birds, Poisonous and non- poisonous snakes in India, flight adaptation and migration in birds.
CO5	Learn about the characteristics and classification of Mammals, their adaptation and dentition.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: Chordates**

Introduction and origin. Protochordata: Classification and study of habit and general characters of Balanoglossus, Herdmania and

Unit-2	**Number of lectures = 08**	**Title of the unit: General features of living Agnatha; Pisces**

General characters & classification of different classes of Pisces (up to order) with examples. General account of respiration, locomotion and migration.

Unit-3	**Number of lectures = 08**	**Title of the unit: Amphibia**

. General characters and classification of different classes of Amphibia (up to order) with examples. Origin of tetrapods, parental care, paedomorphosis.

Unit-4	**Number of lectures = 08**	**Title of the unit: Reptilia**

General characters and classification of different classes of Reptilia; (up to order) with examples. Origin of reptiles, Poisonous and non- poisonous snakes in India. Aves: Origin of birds, flight adaptation, migration.

Unit-5	**Number of lectures = 08**	**Title of the unit: Mammalia**

General characters and classification of different classes of mammals, dentition, general features of egg laying mammals, pouched-mammals, aquatic mammals and primates and their interrelationships.

11. CO-PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**1**				**1**	**1**	**3**			
CO2	**3**	**1**				**1**	**1**	**3**			
CO3	**3**	**1**				**1**	**1**	**3**			
CO4	**3**	**1**					**1**	**3**			
CO5	**3**	**1**					**1**	**3**			
BS221	**3**	**1**				**1**	**1**	**3**			

3: Strong contribution, 2: Average contribution , 1:

12. Books recommended:

1. , J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press. Pough H.
2. Vertebrate life, VIII Edition, Pearson International.
3. Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub Co.
4. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.
5. R.L.Kotpal, 2000. Modern textbook of zoology, Vertebrates. (Rastogi Publ., Meerut).
6. E.L. Jordan & P.S. Verma, 1998. Chordate zoology. (S. Chand & Co.).
7. G.S. Sandhu, 2005. Objective Chordate Zoology. Campus Books, vii.

B. Sc. LIFE SCIENCE 2nd year/ 3rd semester

1. Name of the Department: Biosciences

2. Course Name	**ANGIOSPERM MORPHOLOGY AND TAXONOMY**	**L**	**T**	**P**
3. Course Code	**BS 222**	3	1	0

4. Type of Course (use tick mark)	**Core (✓)**	**Foundation Course**	**Departmental Elective ()**

5. Pre-requisite (if	10+2 with Biology	**6. Frequency (use tick marks)**	Even **( )**	Odd (✓)	Either Sem ( )	Every Sem ( )

7. Total Number of Lectures, Tutorials, Practicals

Lectures = 30	**Tutorials = 10**	**Practical = 00**

8. COURSE OBJECTIVES: The objective of this course is to impart an insight into the habit, vegetative characters and diversity, internal structure and reproduction of the most evolved group of plants, the Angiosperm, to understand the distinguishing features of angiosperm families and get an insight into the fruit, seed development and inflorescence.

8. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes

COURSE OUTCOME (CO)	**ATTRIBUTES**
CO1	On completion of this course, students will be able to identify and classify the flowering plants.
CO2	To know the phylogenetic relationship of angiosperms.
CO3	This course helps to learn the taxonomic evidences from numerical and chemical taxonomy.
CO4	Learn about the organization of plant body and important modifications of stems, leaves and roots.
CO5	Detailed description of various dicot and monocot families.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: Plant systematics**

Nomenclature of plants; the international code of botanical nomenclature. Documentation: Herbarium: Functions, preparation and management; important herbaria and botanical gardens of the world and of India; Flora; Keys; Numerical taxonomy and

Unit-2	**Number of lectures = 08**	**Title of the unit: Angiosperm taxonomy**

Unique features of angiosperms and diversity; identification, brief reference of Angiosperm Phylogeny Group (APG) Classification: Bentham and Hooker; Comparative account of outline of various systems of classification of angiosperms (Bentham & Hooker, Engler & Prantl and Hutchinson); Origin and evolution of angiosperms.

Unit-3	**Number of lectures = 08**	**Title of the unit: Organization of plant body**

Important modifications of stems, leaves and roots, Inflorescence: major types, Flower: Floral whorls, Parts, Flower as a modified shoot, Fruits: major types, Seed: Types.

Unit-4	**Number of lectures = 08**	**Title of the unit: Angiospermic Families(A)**

Study of main characters and economic importance of angiospermic families: Brassicaceae, Fabaceae, Euphorbiaceae, Malvaceae,

Unit-5	**Number of lectures = 08**	**Title of the unit: Angiospermic Families(B)**

Study of main characters and economic importance of angiospermic families: Asteraceae, Solanaceae Poaceae, Liliaceae, and

11. CO-PO mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**1**				**1**	**1**	**3**			
CO2	**3**	**1**					**1**	**3**			
CO3	**3**	**1**					**1**	**3**			
CO4	**3**	**1**					**1**	**3**			
CO5	**3**	**1**				**1**	**1**	**3**			
BS222	**3**	**1**				**1**	**1**	**3**			

3: Strong contribution, 2: Average contribution , 1: Low contribution

12. Books recommended:

1. Angiosperm Phylogeny Group An update of the Angiosperm Phylogeny Group classification for the orders and families of the flowering plants: APG II. Botanical Journal of the Linnaean Society 141: 399- 436.
2. Crawford, D.J. Plant Molecular Systematics. Cambridge University Press, Cambridge, UK.
3. Cronquist, A. An Integrated System of Classification of Flowering Plants. Columbia University Press, New York.
4. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. and Donoghue, M.J.
5 Stussy, T.F. 1990. Plant Taxonomy, Columbia University Press, USA
6. Gangulee, H.C., Das, K.S, Dutta, C.D. and Kar, A.K. College Botany Vol. III
7. Daniel M. –Taxonomy – Evolution at work
8. Singh, G. Plant Systematics: Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.

B. Sc. LIFE SCIENCE 2nd year/ 3rd semester

1. Name of the Department: Biosciences

2.Course Name	**BIOCHEMISTRY AND ANIMAL DIVERSITY LAB**	**L**	**T**	**P**
3.Course Code	**BS 223**	0	0	6

4.Type of Course (use tick mark)		**Core(✓)**	**Foundation Course ( )**		**Departmental Elective( )**	
5.Pre-requisite (if any)	10+2 with Biology	**6.Frequency(use tick marks)**	Even **( )**	Odd (✓)	Either Sem ( )	EverySem( )

7.TotalNumberofLectures,Tutorials,Practicals

Lectures=00	**Tutorials=00**	**Practical=10**

8. **COURSE OBJECTIVES:** The objective of this course is to enable students to understand the general test and diversity and classification of animals.

9. COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	**ATTRIBUTES**
CO1	The students will learn about general tests for carbohydrates including Molisch's test & Benedict's test.
CO2	The students will learn spot test for amino-acids including solubility test and ninhydrin test.
CO3	The students will learn protein estimation through Lowry's method.
CO4	The students will learn about the characteristics and classification of Protochordates and Chordates.
CO5	Learn about the diversity among class Aves and difference between poisonous and non-poisonous snakes.

10.Syllabus

Exp-01	Spot test for carbohydrates.
Exp-02	Estimation of reducing sugars by Benedict's Method.
Exp-03	Spot tests for Amino Acids.
Exp-04	Protein estimation.
Exp-05	Salient features and classification up to Orders of following with special emphasis on their adaptive characters: a. Protochordata: Herdmania, b. Pisces: Scoliodon, Labeo, c. Amphibia: Rana, Salamander, Bufo, d. Reptilia; Hemidactytus, Chameoleon , Tortoise e. Mamalia: Mouse, Rabbit, Bat.
Exp-06	Preparation of an album: study of six common birds.
Exp-07	Study of poisonous and nonpoisonous snakes.

11. CO-PO mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**3**	**1**				**3**	**3**			**2**
CO2	**3**	**3**	**1**				**3**	**3**			**2**
CO3	**3**	**3**	**1**				**3**	**3**			**2**
CO4	**3**	**3**	**1**				**3**	**3**			**2**
CO5	**3**	**3**	**1**				**3**	**3**			**2**
BS223	**3**	**3**	**1**					**3**			**2**

3: Strong contribution, 2: Average contribution , 1: Low contribution

12. Books recommended:

1. S.S. LAL PUBLICATIONS: ZOOLOGY INVERTEBRATE

B. Sc. LIFE SCIENCE 2nd year/ 3rd semester							
1. Name of the Department: Biosciences							
2.Course Name	**ELEMENTARY BIOLOGY LAB**			**L**	**T**	**P**	
3.Course Code	**BS 224**			0	0	6	
4.Type of Course (use tick mark)		**Core(✓)**	**Foundation Course ( )**		**Departmental Elective( )**		
5.Pre-requisite (if any)	10+2 with Biology	**6.Frequency(use tick marks)**	Even **( )**	Odd (✓)	Either Sem ( )	EverySem( )	
7.TotalNumberofLectures,Tutorials,Practicals							
Lectures=00		**Tutorials=00**		**Practical=10**			

10.**COURSE OBJECTIVES:** The objective of this course is to enable students to understand the general test and diversity and classification of animals.

11. COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	The students will learn the use of Micrometer and calibration, for measurement of cells.
CO2	The students will learn various phases of cell division.
CO3	The students will know the structure of polytene chromosomes; Barr bodies and learn karyotype analysis
CO4	The students will learn about the vegetative, floral and fruit characters of varied families and in general.
CO5	Learn about the diversity among various plants.

10.Syllabus

Exp-01	Use of Micrometer and calibration, measurement of onion epidermal cells and yeast.
Exp-02	Cell division: Mitotic and meiotic studies onion root tips and flower bud
Exp-03	Chromosomes: Study of polytene chromosomes by slides; Barr bodies
Exp-04	Karyotype analysis – with the help of slides
Exp-05	Study of vegetative and floral characters of any one representative genus of following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e) Brassicaceae, Fabaceae, Euphorbiaceae, Malvaceae, Cucurbitaceae, Asteraceae and Liliaceae.
Exp-06	Morphology study of flower parts, inflorescence, seed, fruit types.
Exp-07	Mounting of a properly dried and pressed specimen of any twelve wild plants with herbarium label (to be submitted in the record book).

11. CO-PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**3**	**1**				**3**	**3**			**2**
CO2	**3**	**3**	**1**				**3**	**3**			**2**
CO3	**3**	**3**	**1**				**3**	**3**			**2**
CO4	**3**	**3**	**1**			**2**	**3**	**3**			**2**
CO5	**3**	**3**	**1**			**2**	**3**	**3**			**2**
BS224	**3**	**3**	**1**			**2**	**3**	**3**			**2**

3: Strong contribution, 2: Average contribution , 1: Low contribution

12. Books recommended:

B. Sc. LIFE SCIENCE 2nd year/ 4th semester

1. Name of the Department: Biosciencess

2. Course Name	**BIOPHYSICAL CHEMISTRY**	**L**	**T**	**P**
3. Course Code	**BS202**	3	1	0

4. Type of Course (use tick mark)	**Core (✓)**	**Foundation Course ()**		**Departmental Elective ()**	
5. Pre-requisite (if any)	10+2 with Biology	**6. Frequency (use tick marks)**	Even **(✓)**	Odd ()	Either Sem ( )	Every Sem ( )

7. Total Number of Lectures, Tutorials, Practicals

Lectures = 30	**Tutorials = 10**	**Practical = 00**

8. COURSE OBJECTIVES: The objective of this course is to develop the understanding of electromagnetic radiation, absorption spectrum, Beer's law and Lambert's law, principle, working and applications of spectrophotometer, concepts of chromatography and concept of partition coefficient and application of various chromatographic techniques, Centrifugation and Electrophoresis-Principles and applications, Importance of radioactivity in biological studies, GM counters and Scintillation counting.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	**ATTRIBUTES**
CO1	Understand the basics of biophysics, chemical bonds and concept of thermodynamics.
CO2	Understand the basics and types of spectroscopy.
CO3	know basic principle, methodology and application of various chromatographic techniques
CO4	study centrifugation and electrophoresis - principles and applications
CO5	Understand the importance of radioactivity in biological studies, GM counters and Scintillation counting.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: Basics of Biophysics**

Chemical bonding – Ionic bond, covalent bond, hydrogen bond and peptide bond, Van Der-Waals forces, Principles of thermodynamics.

Unit-2	**Number of lectures = 08**	**Title of the unit: Analytical techniques**

Spectrophotometry and colorimetry, Spectroscopic techniques: UV-visible spectroscopy, NMR, IR, Fluorescence and atomic absorption spectroscopy, X-ray crystallography.

Unit-3	**Number of lectures = 08**	**Title of the unit: Chromatography**

Paper, thin-layer, column, HPLC, GLC and molecular sieving.

Unit-4	**Number of lectures = 08**	**Title of the unit: Centrifugation**

Principles, types, instrumentation and applications. Electrophoresis: Principles and applications (PAGE and Agarose gel electrophoresis).

Unit-5	**Number of lectures = 08**	**Title of the unit: Radioactivity**

Types, their importance in biological studies, measure of radioactivity, GM counters and Scintillation counting.

11. CO-PO mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**1**					**2**	**3**			**1**
CO2	**3**	**1**					**2**	**3**			**1**
CO3	**3**	**1**					**2**	**3**			**1**
CO4	**3**	**1**					**2**	**3**			**1**
CO5	**3**	**1**					**2**	**3**			**1**
BS202	**3**	**1**					**2**	**3**			**1**

3: Strong contribution, 2: Average contribution , 1: Low contribution

13. Books recommended:

1. Narayanan, P (2000) Essentials of Biophysics, New Age Int. Pub. New Delhi.
2. Bliss, C.J.K (1967) Statistics in Biology, Vol. I c Graw Hill, New York.
3. Campbell R.C (1974) Statistics for Biologists, Cambridge Univ. Press, Cambridge.
4. Daniel (1999) Biostatistics (3rd Edition) Panima Publishing Corporation.

5. Swardlaw, A.C (1985) Practical Statistics for Experimental Biologists, John Wiley and Sons, Inc. NY
6. Khan (1999) Fundamentals of Biostatistics Publishing Corporation
7. Roy R.N. (1999) A TextBook of Biophysics New Central Book Agency.

B. Sc. LIFE SCIENCE 2nd year/ 4th semester

1. Name of the Department: Biosciences

2. Course Name	**MOLECULAR BIOLOGY**	**L**	**T**	**P**
3. Course Code	**BS212**	3	1	0

4. Type of Course (use tick mark)		**Core (✓)**	**Foundation Course**		**Departmental Elective ()**	
5. Pre-requisite (if	10+2 with Biology	**6. Frequency (use tick marks)**	Even **(✓)**	Odd ()	Either Sem ( )	Every Sem ( )

7. Total Number of Lectures, Tutorials, Practicals

Lectures = 30	**Tutorials = 10**	**Practical = 00**

8. COURSE OBJECTIVES: The objective of this course is to enable students to understand the gene, pseudogene, cryptic gene and split gene, DNA replication, Transcription Translation, Post translation, transcriptional and Gene expression mechanism in prokaryotes and eukaryotes.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:.

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Concept of gene, pseudogene, cryptic gene, split gene and genetic organization in prokaryotes and eukaryotes.
CO2	DNA replication and regulation in prokaryotes and eukaryotes.
CO3	Transcription in prokaryotes and eukaryotes and post transcriptional modifications.
CO4	post translation and transcriptional mechanism
CO5	Gene expression in prokaryotes using Lap operon and in Eukaryotes by Trp operon.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: Central Dogma of Molecular Biology**

Organization of Genetic Material: split genes, overlapping genes; pseudogenes, cryptic genes, Insertion elements and transposons. Gene organization and expression in Mitochondria and Chloroplasts.

Unit-2	**Number of lectures = 08**	**Title of the unit: DNA Replication**

Prokaryotic and Eukaryotic – Enzymes and proteins involved in replication, Theta model and Rolling circle model.

Unit-3	**Number of lectures = 08**	**Title of the unit: Transcription**

Transcription in prokaryotes and Eukaryotes: Mechanism, Promoters and RNA polymerase, transcription factors, Post-transcriptional modifications of eukaryotic mRNA.

Unit-4	**Number of lectures = 08**	**Title of the unit: Genetic code**

Properties and Wobble hypothesis. Translation: Mechanism of translation in Prokaryotes and Eukaryotes, Post-translational modifications of proteins.

Unit-5	**Number of lectures = 08**	**Title of the unit: - Regulation of Gene expression**

Regulation of Gene expression in Prokaryotes: Operon concept (Lac), Regulation of Gene expression in Eukaryotes: transcriptional activation, galactose metabolism in yeast.

11. CO-PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**1**					**1**	**3**			
CO2	**3**	**1**					**1**	**3**			
CO3	**3**	**1**					**1**	**3**			
CO4	**3**	**1**					**1**	**3**			
CO5	**3**	**1**					**1**	**3**			
BS212	**3**	**1**					**1**	**3**			

3: Strong contribution, 2: Average contribution , 1: Low contribution

12. Books recommended:

1. Howe.C. (1995) Gene Cloning and manioulation, Cambridge University Press, USA
2. Lewin, B., Gene VI New York, Oxford University Press.
3. Sambrooket al (2000) Molecular cloning Volumes I, II, & III Cold spring Harbor Laboratory Press, New York, USA
4. Walker J.M. and Gingold, E.B. (1983) Molecular Biology & Biotechnogy (Indian Edition) Royal Society of Cemistry U.K
5. Karp.G (2002) Cell & Molecular Biology, 3rd Edition, John Wiley & Sons; INC.

B. Sc. LIFE SCIENCE 2nd year/ 4rth semester

1. Name of the Department: Biosciences

2. Course Name	**ECOLOGY AND ADAPTATION**	**L**	**T**	**P**
3. Course Code	**BS 231**	3	1	0

4. Type of Course (use tick mark)		**Core (✓)**	**Foundation Course**		**Departmental Elective ()**	
5. Pre-requisite (if	10+2 with Biology	**6. Frequency (use tick marks)**	Even **(✓)**	Odd ()	Either Sem ( )	Every Sem ( )

7. Total Number of Lectures, Tutorials, Practicals

Lectures = 30	**Tutorials = 10**	**Practical = 00**

8. COURSE OBJECTIVES: The objective of this course is to enable students to understand the plant communities, ecological adaptations along with biotic and abiotic environmental factors, phytogeographic and zoogeographic realms, vegetation types of India, plant types and succession, adaptation in animals along with their behavior..

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:..

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	The students will be able to learn the approaches to the study of ecology.
CO2	Understand the role and importance of biotic & abiotic environment factors in sustenance of plant life.
CO3	The course will impart importance of phytogeography and zoogeography to teach managing regional flora.
CO4	To understand the role and importance of adaptation in the sustenance of animal life.
CO5	Understand importance of phytogeography and zoogeography to teach managing regional flora.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: Introduction to Ecology**

8Inter-relationships between living world and environment, Concept of Biosphere, Biomes, Ecosystem, Food chain, Food web. Introduction to Biogeochemical cycles, Hydrologic cycle. Concept of habitat and niche. Environment related concepts and laws (theory of tolerance, laws of limiting factors).

Unit-2	**Number of lectures = 08**	**Title of the unit: Biogeography**

Phytogeography, Phytogeographic realms, major plant communities of the world, Vegetation of India, Community characteristics-organization and concept of habitats and niche. Zoogeography: Zoogeographic realms, Threatened species of animals

Unit-3	**Number of lectures = 08**	**Title of the unit: Adaptation in plants**

Plant types: Hydrophytes - Hydrilla, Eichhorina, Nymphaea, Typha. Xerophytes – Nerium, Casuarina, Saccharum, Begonia. Ecological succession.: Plant succession – xeroseres, hydroseres.

Unit-4	**Number of lectures = 08**	**Title of the unit: Adaptation in animals**

Aquatic, terrestrial, aerial and arboreal. 8 Animal Behavior: Introduction to Ethology, Patterns of behavior (taxes, reflexes, instinct and motivation); biorhythms; learning and memory, Migration of fishes & birds

Unit-5	**Number of lectures = 08**	**Title of the unit: Population and Community Ecology 8 Population**

Characteristics and regulation, Population attributes, density, natality, mortality, age ratio, sex ratio, dispersal and dispersion of population, exponential and logistic growth, life history strategies, population interactions, predation-types, predator-prey system, functional and numerical response, host-parasite interactions, social parasitism, symbiosis

11. CO-PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1					1	3			
CO2	3	1					1	3			
CO3	3	1					1	3			
CO4	3	1					1	3			
CO5	3	1					1	3			
BS231	3	1					1	3			

3: Strong contribution, 2: Average contribution , 1: Low contribution

12. Books recommended:

1.Mishra, A. Environmental Studies Selective and Scientific Books, New Delhi.
2.Allaby, M. Basics of Environmental Science Routledge .
3.Smith, T.M. and Smith, R.C. Elements of Ecology Ist editon Pearson Publications .
4.Miller, G.T Environmental Science 11th edition Brooks/Cole .
5. Kormondy, E.J. Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
6. Sharma, P.D. Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
7. Simpson, M.G. (Plant Systematics. Elsevier Academic Press, San Diego, CA, U.S.A. 4. Singh, G.

B. Sc. LIFE SCIENCE 2nd year/ 4th semester

1. Name of the Department: Biosciences

2. Course Name	**PLANT PHYSIOLOGY**	**L**	**T**	**P**
3. Course Code	**BS232**	3	1	0

4. Type of Course (use tick mark)	**Core (√)**	**Foundation Course**		**Departmental Elective ()**	
5. Pre-requisite (if	10+2 with Biology	**6. Frequency (use tick marks)**	Even **(√)**	Odd ()	Either Sem ( )	Every Sem ( )

7. Total Number of Lectures, Tutorials, Practicals

Lectures = 30	**Tutorials = 10**	**Practical = 00**

8. COURSE OBJECTIVES: The objective of this course is to enable students to understand the plant water relations, Nutrition in plants, Morphology and physiology of plants and plant growth, plant hormone and its relation with plant growth and development.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:..

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Students will have an understanding of movement of water and solutes in plant, asent of sap and transpiration.
CO2	Have knowledge of Essential elements, their absorption, transport and role in plants and translocation in phloem.
CO3	Know about C assimilation, Photosynthesis, Photorespiration and Nitrogen metabolism specially Biological nitrogen fixation.
CO4	Inculcate basic knowledge on Enzymes and Plant growth regulators, Seed dormancy and germination.
CO5	Comprehend the response of plant to light, temperature and stress, Photomorphogenesis, Photoperiodism and Plant movements.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: Plant-water relations**

Importance of water, Diffusion and water potential, Osmosis, Ascent of sap, Transpiration and its significance; Factors affecting transpiration, guttation.

Unit-2	**Number of lectures = 08**	**Title of the unit: Mineral nutrition and transport**

Essential elements, macro and micronutrients, Role of essential elements; Absorption of mineral salts, Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps. Translocation in phloem, Composition of phloem sap.

Unit-3	**Number of lectures = 08**	**Title of the unit: C and N metabolism**

Photosynthesis Photosynthetic Pigments (Chl a, b); Photosystem I and II, Electron transport and mechanism of ATP synthesis; C3, C4 and CAM pathways of carbon fixation; Photorespiration. Nitrogen metabolism Biological nitrogen fixation; Nitrate and ammonia assimilation.

Unit-4	**Number of lectures = 08**	**Title of the unit: Plant growth regulators: Enzymes**

general structure and properties, Plant growth regulators: Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene. role and applications in agri-horticulture. Seed Physiology: Dormancy, Breaking of dormancy, Germination.

Unit-5	**Number of lectures = 08**	**Title of the unit: Growth and Development**

Plant response to light and temperature: Photomorphogenesis, Plant movements, Photoperiodism, (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Growth response to temperature, Vernalization. Introduction to Stress physiology.

11. CO-PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**1**					**1**	**3**			
CO2	**3**	**1**					**1**	**3**			
CO3	**3**	**1**				**1**	**1**	**3**			
CO4	**3**	**1**					**1**	**3**			
CO5	**3**	**1**					**1**	**3**			
BS232	**3**	**1**				**1**	**1**	**3**			

3: Strong contribution, 2: Average contribution , 1: Low contribution

12. Books recommended:

1. Taiz, L., Zeiger, E.,. Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition.
2. Hopkins, W.G., Huner, N.P.,. Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.
3 Bajracharya, D.,. Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.
4. Frank B. Salisbury, Cleon W. Ross: Plant Physiology. Wadsworth Publishing Company

B. Sc. LIFE SCIENCE 2nd year/ 4th semester

1. Name of the Department: Biosciences

2. Course Name	**ANIMAL PHYSIOLOGY**	**L**	**T**	**P**	
3. Course Code	**BS 233**	3	1	0	
4. Type of Course (use tick mark)	**Core (✓)**	**Foundation Course**		**Departmental Elective ()**	
5. Pre-requisite (if	10+2 with Biology	**6. Frequency (use tick marks)**	Even **(✓)**	Odd ()	Either Sem ( )	Every Sem ( )

7. Total Number of Lectures, Tutorials, Practicals

Lectures = 30	**Tutorials = 10**	**Practical = 00**

8. COURSE OBJECTIVES: The objective of this course is to enable students to gain fundamental knowledge of animal physiology.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:.

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Understand the process of Digestion and absorption.
CO2	Understand blood and cardiovascular system.
CO3	Gain knowledge of muscle system, nervous system.
CO4	Understand the detailed concepts of respiration, excretion and osmoregulation.
CO5	Gain fundamental knowledge of reproductive and endocrine systems.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: Digestion and absorption**

Role of salivary glands, liver, pancreas and intestinal glands. Digestion and absorption of carbohydrates, lipids and proteins.

Unit-2	**Number of lectures = 08**	**Title of the unit: Blood**

Composition of blood, blood cells, plasma proteins and Rh factor; Blood coagulation – mechanism and regulation. Circulatory & Cardiovascular System: Heart and circulation; cardiac cycle.

Unit-3	**Number of lectures = 08**	**Title of the unit: Respiration**

Respiratory volumes, Haemoglobin and oxygen transport, carbon dioxide transport, Bohr's effect and chloride shift. Excretion and osmoregulation: Structure of nephron, urine formation and its regulation ; excretory product.

Unit-4	**Number of lectures = 08**	**Title of the unit: Muscle system**

Muscles and Movement, Skeletal, cardiac and smooth muscle. Nervous system: central and peripheral nervous system, nerve impulse – its conduction and synaptic transmission, neurotransmitters.

Unit-5	**Number of lectures = 08**	**Title of the unit: Endocrine system**

Endocrine glands and their functions; Nature of hormones; Regulation of hormone secretion; Mode of action of hormones. Reproductive system: testis, ovary, Spermatogenesis, Oogenesis, Totipotency.

11. CO-PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**1**					**1**	**3**			
CO2	**3**	**1**					**1**	**3**			
CO3	**3**	**1**					**1**	**3**			
CO4	**3**	**1**					**1**	**3**			
CO5	**3**	**1**					**1**	**3**			
BS233	**3**	**1**					**1**	**3**			

3: Strong contribution, 2: Average contribution , 1: Low contribution

12. Books recommended:

1. Textbook of Medical Physiology by Guyton. A.C., H. Sanders Philadelphia. 1988.
2. Physiological basis of Medical practice, West J.B., Best and Taylor.
3. Introduction to Physiology by Davidson H and Segal M.B. Academic Press.
4. Fox S I – Human Physiology, (McGraw Hill, 1998, ISBN: 0071157069)
5. Moffett D and Schauf C L – Human Physiology: Foundations & Frontiers, (Mosby, 1993, ISBN: 801669030)
6. Seeley R, Stephens T and Tate P – Anatomy & Physiology, (McGraw-Hill, 1999, ISBN: 0071169881)
7. Sherwood L – Human Pysiology: From Cells to Systems, (Wadsworth Publishing, 2000,ISBN: 0534568262)
8. Tortora G J Principles of Anatomy & Physiology, (John Wiley & Sons, 1999, ISBN: 0471366927)

B. Sc. LIFE SCIENCE 2nd year/ 4th semester

1. Name of the Department: Biosciences

2.Course Name	**MOLECULAR BIOLOGY & MICROBIOLOGY LAB**	**L**	**T**	**P**
3.Course Code	**BS 234**	0	0	6

4.Type of Course (use tick mark)		**Core (√)**	**Foundation Course ( )**		**Departmental Elective( )**	
5.Pre-requisite (if any)	10+2 with Biology	**6.Frequency(use tick marks)**	Even **(√)**	Odd ()	Either Sem ( )	EverySem( )

7. TotalNumberofLectures,Tutorials,Practicals

Lectures=00	**Tutorials=00**	**Practical=10**

8. COURSE OBJECTIVES: The objective of this course is to enable students to isolate and purify genomic DNA, estimation of DNA and RNA, Biochemical tests, Separation of amino acids by paper chromatography, Study instruments used in lab, know toprepare Media, Staining Techniques, Isolation of bacteria and fungi from soil/ air/water – dilution and pour plate methods and growth pattern of bacteria

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Understand the principle and process of isolation, purification of genomic DNA and Estimation of nucleic acid
CO2	Understand the concept of Biochemical tests like starch hydrolysis, gelatin liquefaction and separation of amino acids by chromatography.
CO3	Knowledge about the Cleaning and sterilization of glass ware and principle and usage of instruments like Compound microscope, Autoclave, etc.
CO4	Knowledge about media preparations and various staining techniques.
CO5	Know about the isolation of bacteria and fungi from soil/ air/water and Growth curve of bacteria

10. Syllabus

Exp-01	Isolation and purification of genomic DNA.
Exp-02	Estimation of DNA and RNA
Exp-03	Biochemical tests–starch hydrolysis, gelatin liquefaction.
Exp-04	Separation of amino acids by paper chromatography.
Exp-05	Cleaning and sterilization of glass ware.
Exp-06	Study instruments: Compound microscope, Autoclave, Hot air oven, pH meter, Laminar airflow and centrifuge
Exp-07	Media preparation: Nutrients agar, Nutrient broth and LB
Exp-08	Staining Techniques: Simple, Negative staining, Gram staining, Endospore staining, fungal staining.
Exp-09	Isolation of bacteria and fungi from soil/ air/water – dilution and pour plate methods.
Exp-10	Study Growth curve of bacteria.

11. CO-PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**3**	**1**				**3**	**3**			**2**
CO2	**33**	**3**	**1**				**3**	**3**			**2**
CO3	**33**	**3**	**1**				**3**	**3**			**2**
CO4	**33**	**3**	**1**				**3**	**3**			**2**

CO5	**33**	**3**	**1**				**3**	**3**			**2**
BS234	**33**	**3**	**1**				**3**	**3**			**2**
3: Strong contribution, 2: Average contribution , 1: Low contribution											

B. Sc. LIFE SCIENCE 2nd year/ 4th semester

1. Name of the Department: Biosciences

2.Course Name	**PHYSIOLOGY & ECOLOGY LAB**	**L**	**T**	**P**
3.Course Code	**BS 235**	0	0	6

4.Type of Course (use tick mark)	**Core (√)**	**Foundation Course ( )**	**Departmental Elective( )**

5.Pre-requisite (if any)	10+2 with Biology	**6. Frequency(use tick marks)**	Even **(√)**	Odd ( )	Either Sem ( )	EverySem( )

7.TotalNumberofLectures,Tutorials,Practicals

Lectures=00	**Tutorials=00**	**Practical=10**

8. COURSE OBJECTIVES: The objective of this course is to enable students to get an in-depth knowledge of basic physiological process and ecological adaptations in plants.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	**ATTRIBUTES**
CO1	The students will understand about the osmotic potential of plant cell.
CO2	Understand transpiration and also learn about the distribution of stomata.
CO3	To have basic knowledge about the different ecological adaptations by plants
CO4	To have basic knowledge about the effect of pH on the activity of enzymes and also learn about the effect of light and other factors on the photosynthetic process.
CO5	To have fundamental knowledge of rate of respiration and R.Q.

10.Syllabus

Exp-01	Determination of osmotic potential of plant cell sap by plasmolytic method.
Exp-02	To study the effect of two environmental factors (light and wind) on transpiration by excised twig.
Exp-03	Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
Exp-04	Study of xerophytic modification in plants: any three specimens as Acacia/ Argemone /Asparagus Opuntia/ Calotropis)
Exp-05	Study of hydrophytic modification in plants (any two specimens as Hydrilla/Echornia/Waterlily).
Exp-06	Demonstrate the activity of any enzyme and study the effect of pH and enzyme concentration.
Exp-07	To study the effect of light intensity and bicarbonate concentration on O2 evolution in photosynthesis.
Exp-08	Comparison of the rate of respiration in any two parts of a plant.
Exp-09	Demonstration of R.Q.

11. CO-PO mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	**3**	**3**	**1**				**3**	**3**			**2**
CO2	**33**	**3**	**1**				**3**	**3**			**2**
CO3	**33**	**3**	**1**				**3**	**3**			**2**
CO4	**33**	**3**	**1**				**3**	**3**			**2**
CO5	**33**	**3**	**1**				**3**	**3**			**2**
BS235	**33**	**3**	**1**				**3**	**3**			**2**

3: Strong contribution, 2: Average contribution , 1: Low contribution

12. Books recommended

BOTANY PRACTICAL VOL.2 ,H.N. SRIVASTAVA PUBLICATION

B. Sc. LIFE SCIENCE 3rd year/ 5th semester

1. Name of the Department: Biosciences					
2. Course Name	**IMMUNOLOGY**		**L**	**T**	**P**
3. Course Code	**BS211**		3	1	0
4. Type of Course (use tick mark)	**Core (√)**	**Foundation Course**		**Departmental Elective ()**	
5. Pre-requisite (if	10+2 with Biology	**6. Frequency (use tick marks)**	Even **( )**	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals					
Lectures = 30	**Tutorials = 10**	**Practical = 00**			

8. COURSE OBJECTIVES: The objective of this course is to enable students to understand the basics of Immunology, types of Immune Responses, antigens and antibodies, histocompatibility, vaccines and Immunization

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:..

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Know the history and scope of Immunology.
CO2	Understand the types of Immunity: Passive, Active, Innate and Acquired immunity, Humoral and Cell Mediated Immunity and the cell and organs of immune responses and their functions, B & T cells.
CO3	Have basic knowledge of Antigens as haptens, epitopes and Factors influencing immunogenicity, and Antibodies structure, types, production and functions of immunoglobulins, Clonal selection theory and Antigen Antibody reactions as Precipitation, Immunoelectrophoresis, Haem-agglutination, RIA and ELISA.
CO4	Comprehend Histocompatibility, structure of MHC class I, II & III antigens and their mode of antigen presentation, MHC restriction Complement system: Components, Classical and alternate pathways of complement activation, Hypersensitivity, Autoimmunity
CO5	Understand Passive and Active immunization, Types of Vaccines: Inactivated, Attenuated, Recombinant and Subunit Vaccines, Peptide and DNA Vaccines.

10. Unit wise detailed content

Unit-1		**Title of the unit: Basics of Immunology**

History and scope of Immunology, Types of Immunity: Passive, Active, Innate and Acquired immunity, Humoral and Cell Mediated Immunity.

Unit-2	**Number of lectures = 08**	**Title of the unit: Immune Responses**

Cell and organs of immune responses and their functions, B & T cells.

Unit-3	**Number of lectures = 08**	**Title of the unit: Antigens and Antibodies. Antigens:**

Antigens: haptens, epitopes and Factors influencing immunogenicity, Antibodies: Structure, types, production and functions of immunoglobulins Clonal selection theory. Antigen Antibody reaction: Precipitation, Immunoelectrophoresis, Haem-agglutination, RIA and ELISA

Unit-4		**Title of the unit: Histocompatibility**

structure of MHC class I, II & III antigens and their mode of antigen presentation, MHC restriction; Complement system: Components, Classical and alternate pathways of complement activation, Hypersensitivity, Autoimmunity.

Unit-5	**Number of lectures = 08**	**Title of the unit: Vaccines and Immunization**

Passive and Active immunization, Types of Vaccines: Inactivated, Attenuated, Recombinant and Sub Unit Vaccines, Peptide and DNA Vaccines.

11. CO-PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**1**					**3**	**3**	**1**		
CO2	**3**	**1**					**3**	**3**	**1**		**2**
CO3	**3**	**1**				**2**	**3**	**3**	**1**		
CO4	**3**	**1**			**2**		**3**	**3**	**1**		

CO5	**3**	**1**		**3**	**2**		**3**	**3**	**1**		
BS211	**3**	**1**		**1**	**1**	**1**	**3**	**3**	**1**		**1**
3: Strong contribution, 2: Average contribution , 1: Low contribution											

12. Books recommended:

1. William, E. Paul (1989) Fundamental Immunology, 2nd Edition Raven Press, New York.
2. William, R. Clark (1991) the Experimental Foundtions of Modern Immunoogy (4th Edition) John Wiley and Sons, New York.
3. Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company
4. Fundamentals of Immunology, W. Paul, Lippincott Williams and Wilkins
5. Immunology, W.L. Anderson, Fence Creek Publishing (Blackwell).
6. Immunology: A Short Course, E. Benjamin, R. Coico and G. Sunshine, WileyLeiss Inc

B. Sc. LIFE SCIENCE 3rd year/ 5th semester

1. Name of the Department: Biosciences

2. Course Name	**GENETIC ENGINEERING**	**L**	**T**	**P**
3. Course Code	**BS303**	3	1	0

4. Type of Course (use tick mark)	**Core (✓)**	**Foundation Course**		**Departmental Elective ()**	
5. Pre-requisite (if	10+2 with Biology	**6. Frequency (use tick marks)**	Even **()**	Odd (✓)	Either Sem (	Every Sem (

7. Total Number of Lectures, Tutorials, Practicals

Lectures = 30	**Tutorials = 10**	**Practical = 00**

8. COURSE OBJECTIVES: The objective of this course is to make students aware of DNA manipulative enzymes and Gene cloning vectors, Screening and selection of recombinants, Techniques and Application of r-DNA techniques.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:..

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Get proper knowledge about the DNA manipulative enzymes: Restriction enzymes and DNA ligases, and Gene cloning vectors.
CO2	Gain knowledge about In vitro construction of recombinant DNA molecules, passenger and vector DNA, and Transformation
CO3	Learn about screening and selection of recombinant host cells, Gene Libraries, cloning techniques, Expression of cloned DNA
CO4	Learn about the basics of Electrophoresis techniques, Polymerase chain reaction (PCR), Site directed mutagenesis (SDM), Nucleic acid sequencing: Blotting techniques.
CO5	have knowledge of Application of r-DNA technique in human health, Production of Insulin, Production of recombinant vaccines: Hepatitis B, Production of human growth hormone.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: DNA manipulative enzymes**

Restriction enzymes and DNA ligases, Gene cloning vectors: Plasmids, Bacteriophage and Chimeric plasmids.

Unit-2	**Number of lectures = 08**	**Title of the unit: DNA molecules**

In vitro construction of recombinant DNA molecules (pBR332, pUC19), Isolation of passenger and vector DNA, creation of r-DNA, Transformation of r-DNA by different methods.

Unit-3	**Number of lectures = 08**	**Title of the unit: Screening and selection of recombinant host cells:**

Immunological screening and colony hybridization, Gene Libraries: Genomic DNA and cDNA cloning techniques, Expression of cloned DNA in E. coli.

Unit-4	**Number of lectures = 08**	**Title of the unit: -Techniques**

Electrophoretic techniques, Polymerase chain reaction (PCR), Site directed mutagenesis (SDM), Nucleic acid sequencing: Sanger's method, Blotting techniques: Southern, Western and Northern blot.

Unit-5	**Number of lectures = 08**	**Title of the unit: Application of r-DNA technique**

Application of r-DNA technique in human health, Production of Insulin, Production of recombinant vaccines: Hepatitis B, Production of human growth hormone.

11. CO-PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1					1	3	3	1	1
CO2	3	1					1	3	1	1	3
CO3	3	1					1	3	1	1	3
CO4	3	1					1	3	1	1	3
CO5	3	1		2	2	1	1	3	1	1	3
BS303	3	1		1	1	1	1	3	2	1	3

3: Strong contribution, 2: Average contribution , 1: Low contribution

12. Books recommended:

1. 1. Glick, B.R & Pasternak J.J (1994) Molecular Biotechnology, Princi[ples and Applications of Recombinant DNA, American Society for Microbiology, Washington D.C
2. Christopler H. (1995) Gene cloning and Manipulating, Cambridge University Press
3. Nicholl, D.S.T (1994) An Introduction of Genetic Engineering, Cambridge University Press.
4. Old. R.W. and Primrose, S.B. (186) Principles of Gene manipulation, An introduction to genetic engineering (3rd Edition) Black well Scientific Publications
5. Watson J.D. Hopkins, N.H Roberts, J.W.Steitz J.A and Weiner A.M(1988). Molecular biology of society for Microbiology
7. Lewin b. (1994) Genes VI, New York, Oxford University Press.

B. Sc. LIFE SCIENCE 3rd year/ 5th semester

1. Name of the Department: Biosciences

2. Course Name	**PLANT ANATOMY AND EMBRYOLOGY**	**L**	**T**	**P**
3. Course Code	**BS321**	3	1	0

4. Type of Course (use tick mark)		**Core (√)**	**Foundation Course ()**		**Departmental Elective ()**	
5. Pre-requisite (if	10+2 with Biology	**6. Frequency (use tick marks)**	Even **( )**	Odd (√)	Either Sem ( )	Every Sem ( )

7. Total Number of Lectures, Tutorials, Practical's

Lectures = 30	**Tutorials = 10**	**Practical = 00**

8. COURSE OBJECTIVES: The objective of this course is to make students aware of the scope and importance of plant anatomy and embryology of angiospermic plant, Importance of studying this paper is highlighted reflecting on the current changing needs of the students by providing latest information of various tissue systems, anomalous secondary growth in plants, know fertilization, endosperm and embryogeny.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:..

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	To evaluate the structural organization of flower and the process of pollination and fertilization, structure and development of dicot and monocot embryos.
CO2	Course component will provide an ample understanding on the evolution of concept of organization of shoot and root apex.
CO3	To understand the basic concepts with ability to identify and distinguish various features related to anatomy and embryology.
CO4	This paper deals to understand the scope and importance of plant anatomy and embryology of angiospermic plant.
CO5	To understand structure and development in microsporangium and megasporangium, process of microsporogenesis and megasporogenesis.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: Plant Anatomy-I**

Root and shoot apical meristems; Simple and complex tissues. Epidermis, cuticle, stomata; Structure of xylem and phloem.

Unit-2	**Number of lectures = 08**	**Title of the unit: Plant Anatomy-II**

Structure of dicot and monocot root stem and leaf. Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood).

Unit-3	**Number of lectures = 08**	**Title of the unit: Plant Embryology-I**

Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature

Unit-4	**Number of lectures = 08**	**Title of the unit: Pollination and seed dispersal**

Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms.

Unit-5	**Number of lectures = 08**	**Title of the unit: Plant Embryology-II**

Endosperm types, structure and functions; Dicot and monocot embryo; Apomixis and polyembryony.

11. CO-PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**1**					**1**	**3**			
CO2	**3**	**1**					**1**	**3**			
CO3	**3**	**1**					**1**	**3**			
CO4	**3**	**1**					**1**	**3**			
CO5	**3**	**1**					**1**	**3**			
BS321	**3**	**1**					**1**	**3**			

3: Strong contribution, 2: Average contribution , 1: Low contribution

12. Books recommended:

1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.
2. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.

B. Sc. LIFE SCIENCE 3rd year/ 5th semester					
1. Name of the Department: Biosciences					
2. Course Name	**COMPARATIVE ANATOMY & DEVELOPMENTAL BIOLOGY**		**L**	**T**	**P**
3. Course Code	**BS322**		3	1	0
4. Type of Course (use tick mark)		**Core (√)**	**Foundation Course ()**	**Departmental Elective ()**	
5. Pre-requisite (if	10+2 with Biology	**6. Frequency (use tick marks)**	Even **( )**	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals					
Lectures = 30		**Tutorials = 10**	**Practical = 00**		

8. COURSE OBJECTIVES: The objective of this course is to make students aware of Ontogenetic and phylogenetic developmental in vertebrates, understand structural comparisons of vertebrate systems in major groups of vertebrates, Gametogenesis, Fertilization and early development, cleavage and its types based upon egg organization, cell types and cell patterns, stem cells, cell potency, cell competence, embryonic induction and cell determination

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:..

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	The students will learn the comparative anatomy of Skeletal System and Digestive System of animal vertebrate types.
CO2	Learn the comparative anatomy of Respiratory System, circulatory and Urinogenital System of animal vertebrate types.
CO3	The students will learn the comparative anatomy of Nervous System and different types of receptors in animal vertebrate types.
CO4	The students will learn about the Gametogenesis, Fertilization, Egg, Cleavage, Stem Cell, Cell lineage, Genomic equivalence.
CO5	Learn Blastulation and Gastrulation, Development of Chick, Extra embryonic membranes of chick and Placentation.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: Integumentary System**

Derivatives of integument w.r.t. glands and digital tips, Skeletal System: Evolution of visceral arches, Digestive System: Brief account of alimentary canal and digestive glands.

Unit-2	**Number of lectures = 08**	**Title of the unit: Respiratory System**

Gills, lungs and air sacs; Circulatory System: Evolution of heart and aortic arches; Urinogenital System: Succession of kidney, Evolution of urinogenital ducts

Unit-3	**Number of lectures = 08**	**Title of the unit: Nervous System**

Comparative account of brain; Sense Organs: Types of receptors

Unit-4	**Number of lectures = 08**	**Title of the unit: Gametogenesis**

Gametogenesis, Fertilization, Egg: structure and types. Types and patterns of cleavage. Stem Cell and Its potency. Cell lineage, Genomic equivalence.

Unit-5	**Number of lectures = 08**	**Title of the unit: Embryonic development**

Process of Blastulation and Gastrulation. Fate Map, Development of Chick up to formation of Primitive streak and mammal (in outline) Extra embryonic membranes of chick. Placentation and types of Placenta.

11. CO-PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**1**					**1**	**3**			
CO2	**3**	**1**					**1**	**3**			
CO3	**3**	**1**					**1**	**3**			
CO4	**3**	**1**					**1**	**3**			
CO5	**3**	**1**					**1**	**3**			
BS322	**3**	**1**					**1**	**3**			

3: Strong contribution, 2: Average contribution , 1: Low contribution

12. Books recommended:

1. Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education.
2. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.
3. Weichert C.K and William Presch (1970). Elements of Chordate Anatomy, Tata Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure,•McGraw Hills John Wiley and Sons.
4. Walter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House. B.
5. Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
6. Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.
7. Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education.
8. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.
9. Walter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House.
10. Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.

B. Sc. LIFE SCIENCE 3rd year/ 5th semester

1. Name of the Department: Biosciences

2. Course Name	**INDUSTRIAL& ENVIRONMENTAL BIOTECHNOLOGY**	**L**	**T**	**P**
3. Course Code	**BS323**	3	1	0

4. Type of Course (use tick mark)		**Core ( )**	**Foundation Course**		**Departmental Elective (√)**	
5. Pre-requisite (if	10+2 with Biology	**6. Frequency (use tick marks)**	Even **( )**	Odd (√)	Either Sem ( )	Every Sem ( )

7. Total Number of Lectures, Tutorials, Practicals

Lectures = 30	**Tutorials = 10**	**Practical = 00**

8. COURSE OBJECTIVES: The objective of this course is to make students aware of principle, methodology and application of Drug and target identification, target validation, Bioprospecting and conservation: importance of biodiversity, free radical and antioxidants, Significance of IPR; Requirement of a patentable novelty and Detailed, information on patenting biological products and biodiversity

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:.

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Get proper knowledge about Structural and Functional dynamics of microbes for fermentation.
CO2	Gain knowledge about Solid waste treatment and management, Effluent Treatment
CO3	Learn about Isolation, screening, maintenance and improvement of industrial strains
CO4	Learn about the basics of general design of fermenter; media and Downstream Processing
CO5	Have knowledge of products obtained by industrial microbiological fermentation.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: Structural and Functional dynamics of microbes**

Structural and Functional dynamics of microbes: diversity, activity and growth, community profiling, biosensors, bioreporters, Microchips. Methanogenesis: methonogenic, acetogenic and fermentive bacteria- technical processes and conditions

Unit-2	**Number of lectures = 08**	**Title of the unit: Solid waste treatment and management, Effluent Treatment**

Solid waste treatment and management, Effluent Treatment: Aerobic and anaerobic water treatment processes: activated sludge, trickling filter, fluidized expanded bed reactor, Upflow anaerobic sludge blanket reactor. Bioleaching, Bioremediation, Biodegradable plastics, Biofuels / Biodiesel, Biopesticides, Biofertilizers and Vermitechnology.

Unit-3	**Number of lectures = 08**	**Title of the unit: General concept and processes in fermentation**

General concept and processes in fermentation, Isolation, screening, maintenance and preservation of industrial strains. Concept of strain improvement. Sterilization

Unit-4	**Number of lectures = 08**	**Title of the unit: Industrial Fermentation**

Media for Industrial Fermentation. General design of fermenter; Scale up concept. Downstream Processing: Filtration, centrifugation, cell disruption, extraction and drying

Unit-5	**Number of lectures = 08**	**Title of the unit: Products obtained by industrial fermentation**

Brief account of the following products obtained by industrial microbiological fermentation: Alcoholic Beverage: Beer, Organic acid: Citric acid, Antibiotic: Penicillin, Amino acids: Glutamic acid, Vitamin: vitamin B12.

11. CO-PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**1**				**2**	**1**	**2**	**2**	**1**	**2**
CO2	**3**	**1**					**1**	**2**	**2**	**1**	**3**
CO3	**3**	**1**			**1**	**3**	**1**	**2**	**2**	**1**	**3**
CO4	**3**	**1**					**1**	**2**	**2**	**1**	**3**
CO5	**3**	**1**				**2**	**1**	**2**	**2**	**1**	**3**
BS323	**3**	**1**			**1**	**2**	**1**	**2**	**2**	**1**	**3**

3: Strong contribution, 2: Average contribution , 1: Low contribution

12. Books recommended:

1. Environmental Studies by Benny Joseph, Tata McGraw Hill, 2005.
2. Environmental Studies by Dr. D.L. Manjunath, Pearson Education, 2006.
3. Principles of Environmental Science and Engineering by P. Venugopal Rao, Prentice Hall of India.
4. Environmental Science and Engineering by Meenakshi, Prentice Hall of India.
5. Microbial Biotechnogy (1995) Alexander n. Glazer Hiroshi Nikaido W.H.Freeman and Company
6. Molecular biotechnogy: Principles a nd Applications of Recombinant DNA –Bernaral R. Glick and Jack J. Pastemak ASM Press. Washington, D.C (1994).
7. Fungal Ecology and Biotechnogy (1993) Rastogi Publicaions, Meerut.
8. Bisen P.S (1994) Frontiers in Microbial Technology, 1st Edition, CBS Publishers. Books (P) Ltd.
9. Crueger W. & Crueger A. (2000) A text of Industrial Microbiology, 2nd Edition, Panima

B. Sc. LIFE SCIENCE 3rd year/ 5th semester

1. Name of the Department: Biosciences

2. Course Name	**APPLIED BIOTECHNOLOGY**	**L**	**T**	**P**
3. Course Code	**BS306**	3	1	0

4. Type of Course (use tick mark)		**Core ( )**	**Foundation Course**		**Departmental Elective (√)**	
5. Pre-requisite (if	10+2 with Biology	**6. Frequency (use tick marks)**	Even **( )**	Odd (√)	Either Sem ( )	Every Sem ( )

7. Total Number of Lectures, Tutorials, Practicals

Lectures = 30	**Tutorials = 10**	**Practical = 00**

8. COURSE OBJECTIVES: The objective of this course is to make students aware of principle, methodology and application of Drug and target identification, target validation, Bioprospecting and conservation: importance of biodiversity, free radical and antioxidants, Significance of IPR; Requirement of a patentable novelty and Detailed, information on patenting biological products and biodiversity

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:.

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Get proper knowledge about Genomics and Proteomics and gene expression.
CO2	Gain knowledge about Drug Discovery and Designing: Drug and target identification, target validation
CO3	Learn about Bioprospecting and conservation: importance of biodiversity
CO4	Learn about the basics of Free Radical Biology: General theory of free radical and antioxidants
CO5	Have knowledge of Significance of IPR; Requirement of a patentable novelty and Detailed, information on patenting biological products and biodiversity.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: Genomics and Proteomics**

Introduction to genomics, Genome annotation, Human genome project and its application, Introduction to Proteomics: Protein expression and its analysis

Unit-2	**Number of lectures = 08**	**Title of the unit: Drug Discovery and Designing**

Drug and target identification, target validation, Molecular docking studies and its Insilco tools e.g. Auto dock, GOLD.

Unit-3	**Number of lectures = 08**	**Title of the unit: Bioprospecting and conservation**

Importance of biodiversity, biodiversity informatics, databases in biological materials. International efforts and issues of sustainability

Unit-4	**Number of lectures = 08**	**Title of the unit: Free Radical Biology**

General theory of free radical and antioxidants. Free radical mediated damage to lipids, proteins and DNA; Natural antioxidants and their applications

Unit-5	**Number of lectures = 08**	**Title of the unit: IPR and Patenting**

Significance of IPR; Requirement of a patentable novelty; Issues related to IPR protection of software and database; IPR protection of life forms; International convention in IPR; Obtaining patent; Invention step and prior art and state of art procedure; Detailed information on patenting biological products and biodiversity.

11. CO-PO

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1					1	3	3		3
CO2	3	1					1	3	3		3
CO3	3	1			1	3	1	3			
CO4	3	1					1	3			
CO5	3	1			3	2	1	3		2	
BS306	3	1			1	1	1	3	2	1	2

3: Strong contribution, 2: Average contribution , 1: Low contribution

12. Books recommended:

1. Environmental Studies by Benny Joseph, Tata McGraw Hill, 2005.
2. Environmental Studies by Dr. D.L. Manjunath, Pearson Education, 2006.
3. Principles of Environmental Science and Engineering by P. Venugopal Rao, Prentice Hall of India.
4. Environmental Science and Engineering by Meenakshi, Prentice Hall of India.
5. O'Reilly, "Developing Bioinformatics Computer Skills".
6. Griffiths JF, "An Introduction to Generic Analysis".
7. Hunter L, "Artificial Intelligence & Molecular Biology".
8. Baxevanis AD,

B. Sc. LIFE SCIENCE 3rd year/ 5th semester

1. Name of the Department: Biosciences

2.Course Name	**IMMUNOLOGY LAB**	**L**	**T**	**P**
3.Course Code	**BS 216**	0	0	6

4.Type of Course (use tick mark)	**Core(✓)**	**Foundation Course ( ) Departmental Elective( )**		
5.Pre-requisite (if any)	10+2 with Biology	**6.Frequency(use tick marks)** Even **( )**	Odd (✓)	Either Sem ( ) Every Sem( )

7.TotalNumberofLectures,Tutorials,Practicals

Lectures=00	**Tutorials=00**	**Practical=10**

8. COURSE OBJECTIVES: The objective of this course is to understand the basics of immunology, Types of Blood grouping, Immuno techniques and Separation of serum from blood & precipitation of Immunoglobulin.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	**ATTRIBUTES**
CO1	Analyze Blood grouping
CO2	Perform and analyze Differential Count of WBC, Detergent lysis of RBC
CO3	Perform and analyze Dot Elisa, ELISA .
CO4	Have knowledge of and can perform Ouchterlouny Double diffusion (ODD) assay.
CO5	Perform and analyze separation of serum from blood & precipitation of Immunoglobulin.

10.Syllabus

Exp-01	Blood grouping
Exp-02	Differential Count of WBC
Exp-03	Detergent lysis of RBC
Exp-04	Dot Elisa
Exp-05	ELISA – Demonstration
Exp-06	Ouchterlouny Double diffusion (ODD)
Exp-07	Separation of serum from blood & precipitation of Immunoglobulins

11. CO-PO mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**3**	**1**				**3**	**3**	**1**		**3**
CO2	**33**	**3**	**1**				**3**	**3**	**1**		**3**
CO3	**33**	**3**	**1**				**3**	**3**	**1**		**3**
CO4	**33**	**3**	**1**				**3**	**3**	**1**		**3**
CO5	**33**	**3**	**1**				**3**	**3**	**1**		**3**
BS216	**33**	**3**	**1**				**3**	**3**	**1**		**3**

3: Strong contribution, 2: Average contribution , 1: Low contribution

B. Sc. LIFE SCIENCE 3rd year/ 5th semester

1. Name of the Department: Biosciences

2.Course Name	**GENETIC ENGINEERING LAB**	**L**	**T**	**P**
3.Course Code	**BS 308**	0	0	6

4.Type of Course (use tick mark)	**Core(✓)**	**Foundation Course ( )**	**Departmental Elective( )**

5.Pre-requisite (if any)	10+2 with Biology	**6.Frequency(use tick marks)**	Even **( )**	Odd (✓)	Either Sem ( )	Every Sem( )

7.TotalNumberofLectures,Tutorials,Practicals

Lectures=00	**Tutorials=00**	**Practical=10**

8.COURSE OBJECTIVES: The objective of this course is to develop an understanding of the basics of RDT and PCR

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	**ATTRIBUTES**
CO1	Be able to isolate genomic DNA from bacteria, plant and animal tissue
CO2	Be able to isolate plasmid DNA (E. coli)
CO3	Be able to perform Restriction digestion of DNA
CO4	Be able to perform Agarose Gel Electrophoresis
CO5	Understand basics of PCR

10.Syllabus

Exp-01	olation of genomic DNA from bacteria, plant and animal tissue
Exp-02	olation of plasmid DNA (E. coli)
Exp-03	striction digestion of DNA
Exp-04	Agarose Gel Electrophoresis
Exp-05	monstration of PCR

11. CO-PO mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	**3**	**3**	**1**				**3**	**3**	**2**	**1**	**3**
CO2	**3**	**3**	**1**				**3**	**3**	**2**	**1**	**3**
CO3	**3**	**3**	**1**				**3**	**3**	**2**	**1**	**3**
CO4	**3**	**3**	**1**				**3**	**3**	**2**	**1**	**3**
CO5	**3**	**3**	**1**				**3**	**3**	**2**	**1**	**3**
BS308	**3**	**3**	**1**				**3**	**3**	**2**	**1**	**3**

3: Strong contribution, 2: Average contribution , 1: Low contribution

B. Sc. LIFE SCIENCE 3rd year/ 6th semester

1. Name of the Department: Biosciences

2. Course Name	**COMPUTATIONAL SCIENCE AND BIOINFORMATICS**	**L**	**T**	**P**
3. Course Code	**BS331**	3	1	0

4. Type of Course (use tick mark)		**Core (✓)**	**Foundation Course**		**Departmental Elective ()**	
5. Pre-requisite (if	10+2 with Biology	**6. Frequency (use tick marks)**	Even **(✓)**	Odd ()	Either Sem (	Every Sem (

7. Total Number of Lectures, Tutorials, Practicals

Lectures = 30	**Tutorials = 10**	**Practical = 00**

8. COURSE OBJECTIVES: The objective of this course is to develop basic knowledge of computer networking and internet devices, Fundamental concepts of Internet and web technologies, Study biological databases, algorithms and flowchart design, Sequence Alignment, Data mining and understand applications of Bioinformatics

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:..

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Know basics of Bioinformatics
CO2	Have knowledge of GenBank's, EMBL, DDBJ, Swissprot, PIR/NBRF, IG, GCG, FAST
CO3	Know about basics of Sequence Alignment
CO4	Utilize and configure computer peripheral devices, install and operate system and application software. Establish a small computer network and utilize resource sharing.
CO5	Design flowcharts, apply algorithms to solve problems and use biological databases. Design and develop website

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: Computers**

Computers: Input and Output Devices; Internet- Web Browsers, URL; Types of network - LAN and WAN. Need of Computers in Biological Sciences, Benefits of computational sciences.

Unit-2	**Number of lectures = 08**	**Title of the unit: Bioinformatics**

Introduction to Bioinformatics, Application of Bioinformatics in life sciences. Biological databases: primary and secondary databases; various types and categories of Biological databases.

Unit-3	**Number of lectures = 08**	**Title of the unit: Sequence databases**

Nucleotide sequence databases: Genbank, EMBL, DDBJ; Protein sequence databases: SWISS PROT, TrEMBL; Structural databases: PDB and MMDB and its applications.

Unit-4	**Number of lectures = 08**	**Title of the unit: Molecular Visualization & Database similarity search**

Molecular Visualization tools: PyMOL, Rasmol. Introduction to NCBI and its various components; Database similarity search tools: BLAST – algorithm and its versions. FASTA – algorithm and its version.

Unit-5	**Number of lectures = 08**	**Title of the unit: Advanced Bioinformatics**

Advanced Bioinformatics: Protein Structure prediction studies – Homology Modeling, method and tools; Multiple sequence alignment – concept and implications – MSA in phylogenetics; Application of bioinformatics in Computer Aided drug Design .

11. CO-PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**1**					**1**	**3**	**2**	**1**	
CO2	**3**	**1**					**1**	**3**	**2**	**1**	
CO3	**3**	**1**					**1**	**3**	**2**	**1**	
CO4	**3**	**1**					**1**	**3**	**2**	**1**	
CO5	**3**	**1**					**1**	**3**	**2**	**1**	**3**
BS331	**3**	**1**					**1**	**3**	**2**	**1**	**1**

3: Strong contribution, 2: Average contribution , 1: Low contribution

12. Books recommended:

1.“Reilly “Developing Bioinformatics computer skills”.
2..F. Griffiths “An intro to generic Analysis”
3. Andreas D. Baxevanis “Bioinformatics: A practical Guide to the analysis of genes and• proteins”

B. Sc. LIFE SCIENCE 3rd year/ 6th semester					
1. Name of the Department: Biosciences					
2. Course Name	**PLANT AND ANIMAL BIOTECHNOLOGY**	**L**	**T**	**P**	
3. Course Code	**BS332**	3	1	0	
4. Type of Course (use tick mark)	**Core ()**	**Foundation Course**	**Departmental Elective (√)**		
5. Pre-requisite (if	10+2 with Biology	**6. Frequency (use tick marks)**	Even **(√)**	Odd ()	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals					
Lectures = 30	**Tutorials = 10**	**Practical = 00**			

8. COURSE OBJECTIVES: The objective of this course is to make students aware of basic plant and animal biotechnology techniques and their applications in plant growth and development and cell culture, and large scale production of natural products from plant source, Production of transgenics and expression of Cloned proteins and vaccines

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:..

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Get proper knowledge about the history and Scope of Animal Tissue Culture, Culture Media, Simulating natural conditions for growth of animal cells.
CO2	Gain knowledge about Primary Culture, cell lines and Secondary Culture, transformed animal cells and continuous cell lines. Monolayer formation, Synchronization.
CO3	Learn about transfection of animal cell lines, Selectable makers and Transplantation of Cultural Cells. Microinjection, In vitro fertilization and Stem cell technology.
CO4	The students will get proper knowledge about the media preparation for In-vitro propagation of plants and different aseptic techniques used during preparation.
CO5	The students learn the role of techniques haploid plant production and its significance.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: Aseptic Techniques for Callus and suspension culture**

Aseptic Techniques, Nutrient media, and use of growth regulators (Auxins, Cytokininis and Gibberellins). Callus and suspension

Unit-2	**Number of lectures = 08**	**Title of the unit: Haploid plant production**

Haploid plant production: microspore and ovule culture, Organ Culture and their applications, Somatic Embryogenesis: Techniques and applications. Protoplast Culture, somatic hybridization, methods of protoplast fusion: chemical and electro fusion, practical application of somatic hybridization.

Unit-3	**Number of lectures = 08**	**Title of the unit: Role of tissue culture & Techniques of transformation**

Role of tissue culture in agriculture, horticulture and forestry, Transgenic plants, Technique of transformation: Agrobacterium-mediated and physical methods (Microprojectile bombardment and electroporation).

Unit-4	**Number of lectures = 08**	**Title of the unit: Primary Culture**

Primary Culture: Cell lines, and cloning, isolation and mechanical disaggregation of tissue, enzyme. Secondary Culture: transformed animal cells and continuous cell lines. Monolayer formation, Synchronization.

Unit-5	**Number of lectures = 08**	**Title of the unit: Expression of Cloned proteins in animal cell**

Expression of Cloned proteins in animal cell: Expression vector, over production and downstream processing of the expressed proteins, Production of Vaccines in animal Cells. Production and Applications of monoclonal antibodies, HAT selection

11. CO-PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**1**					**1**	**2**	**2**	**1**	**3**
CO2	**3**	**1**					**1**	**2**	**2**	**1**	
CO3	**3**	**1**					**1**	**2**	**2**	**1**	**3**
CO4	**3**	**1**					**1**	**2**	**2**	**1**	**3**
CO5	**3**	**1**				**1**	**1**	**2**	**2**	**1**	**3**
BS332	**3**	**1**				**1**	**1**	**2**	**2**	**1**	**3**

3: Strong contribution, 2: Average contribution , 1: Low contribution
12. Books recommended:
1. Ravishankar G.A and Venkataraman L.V(1997) Biotechnology applications of Plant Tissue & cell culture. Oxford & IBH Publishing co., Pvt Ltd. 2. Bhan (1998) tissue Culture, Mittal Publications, New Delhi. 3. H. S. Chawla “Plant Biotechnology: A Practical Approach” 4. Lydiane Kyte & John Kleyn (1996) Plants from test tubes. An introduction to Micropropogation (3rd Edition) timber Press, Partland. 5. Chrispeel M.J. and Sdava D.E. (1994 Plants, Genes and agriculture, Jones and Barlett Publishers, Boston. 6. Ian Freshney Animal cell culture.(4th Edition) 7. Davis, Cell culture techniques. 8. Brown TA “Gene cloning: An introduction”

B. Sc. LIFE SCIENCE 3rd year/ 6th semester

1. Name of the Department: Biosciences

2.Course Name	**BIOINFORMATICS LAB**	**L**	**T**	**P**
3.Course Code	**BS 314**	0	0	6

4.Type of Course (use tick mark)	**Core(✓)**	**Foundation Course ( )**	**Departmental Elective( )**	
5.Pre-requisite (if any)	10+2 with Biology	**6.Frequency(use tick marks)**	Even **(✓)**	Odd ()	Either Sem ( )	Every Sem( )

7. TotalNumberofLectures,Tutorials, Practicals

Lectures=00	**Tutorials=00**	**Practical=10**

8. COURSE OBJECTIVES: The objective of this course is to make students aware of sequence databases, Retrieving sequences, Simple sequence comparison using DOTPLOT, Pair wise Sequence Alignment, FASTA & BLAST search, Multiple Sequence Alignment (ClustalX & Treeview), Protein Structure Visualization (RASMOL, Swiss-PDB Viewer), Gene Finding tools (Grail or Genscan)

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	**ATTRIBUTES**
CO1	Learn about types of sequence databases (Nucleotide & Protein)
CO2	Know about Retrieving sequences from the databases and simple sequence comparison using DOTPLOT
CO3	Have knowledge of Pair wise Sequence Alignment (NW and SW approach), FASTA & BLAST search and Multiple Sequence Alignment (ClustalX & Treeview)
CO4	Have basic knowledge of Protein Structure Visualization (RASMOL, Swiss-PDB Viewer)
CO5	Have basic knowledge about Gene Finding tools (Grail or Genscan)

10. Syllabus

Exp-01	Introduction to types of sequence databases (Nucleotide & Protein)
Exp-02	Retrieving sequences from the databases
Exp-03	Simple sequence comparison using DOTPLOT
Exp-04	Pair wise Sequence Alignment (NW and SW approach)
Exp-05	FASTA & BLAST search
Exp-06	Multiple Sequence Alignment (ClustalX & Treeview)
Exp-07	Protein Structure Visualization (RASMOL, Swiss-PDB Viewer).
Exp-08	Gene Finding tools (Grail or Genscan)

11. CO-PO mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**3**	**1**				**3**	**3**	**1**	**1**	**1**
CO2	**3**	**3**	**1**			**1**	**3**	**3**	**2**	**1**	**3**
CO3	**3**	**3**	**1**				**3**	**3**	**2**	**1**	**3**
CO4	**3**	**3**	**1**			**1**	**3**	**3**	**2**	**1**	**3**
CO5	**3**	**3**	**1**			**1**	**3**	**3**	**2**	**1**	**3**
BS314	**3**	**3**	**1**			**1**	**3**	**3**	**2**	**1**	**3**

3: Strong contribution, 2: Average contribution , 1: Low contribution

B. Sc. LIFE SCIENCE 3rd year/ 6th semester						
1.Name of the Department: Biosciences						
2.Course Name	**PROJECT & TRAINING**					
3.Course Code	**BS315**					
4.Type of Course (use tick mark)		**Core(√)**	**Foundation Course ( )**		**Departmental Elective( )**	
5.Pre-requisite (if any)	10+2 with Biology	**6.Frequency(use tick marks)**	Even **(√)**	Odd ( )	Either Sem ( )	Every Sem( )
7. Total Credits = 04						

8. COURSE OBJECTIVES: The main objective of this course is to acquaint the student with various techniques used in contemporary research in biotechnology or allied areas.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	To be able to define a research problem.
CO2	To conduct bench work.
CO3	To prepare the research report and its oral demonstrations.
CO4	To coorealate theoretical knowledge of techniques with practical application
CO5	To promote lifelong learning

10. Students would carry out individual projects as in house training for ***3 months***. The detailed project report/dissertation should be submitted in the Department followed by presentation and viva.

11. CO-PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	2		1	1		3			3	
CO2	3	3	2	1	3		3			3	3
CO3	3	3	2	1	3		3			3	
CO4	3	3					3			3	
CO5	3	3					3			3	
BS315	3	3	1	1	2		3			3	1

3: Strong contribution, 2: Average contribution , 1: Low contribution

- Students are allocated a dissertation topic individually under the supervision of faculty of the department.
- The dissertation must be similar to the thesis style and encompass:
  (i) Introduction / Rationale and Review of Literature
  (ii) Materials and Methods,
  (iii) Results,
  (iv) Discussion and (v) Bibliography.
- The dissertation should be submitted in type-written, bound form to the department for record.

B. Sc. LIFE SCIENCE 3rd year/ 6th semester						
1.Name of the Department: Biosciences						
2.Course Name	**EDUCATIONAL TOUR**					
3.Course Code	**BS316**					
4.Type of Course (use tick mark)		**Core(√)**	**Foundation Course ( )**		**Departmental Elective( )**	
5.Pre-requisite (if any)	10+2 with Biology	**6.Frequency(use tick marks)**	Even **(√)**	Odd ( )	Either Sem ( )	EverySem( )
7. Total Credits = 02						

8 . COURSE OBJECTIVES: The main objective of this course is to provide the students an exposure to various research activities in the country and acquaint the student with state of the art technique/instruments used in various research institutions and industries of national repute. The student needs to submit a report after completion of the tour.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Develop understanding of state of the art techniques/instruments used in various reputed research institutions. and industries
CO2	Take part in Group discussion and learn Team work.
CO3	Enhance communication and social skills by communication with peers.
CO4	Student shall be able to plan and improve the Technical Report writing skills
CO5	Have created Interest to pursue lifelong learning.

10. The students would be taken to a national scientific laboratory or industry for one week.

11. CO-PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**1**	**1**				**3**	**1**		**3**	**3**
CO2	**3**	**2**	**2**	**1**			**3**				**3**
CO3	**3**	**2**	**2**	**1**			**3**				**3**
CO4	**3**	**2**					**3**				**3**
CO5	**3**			**1**		**2**	**3**				**3**
BS316	**3**	**2**	**1**	**1**		**1**	**3**	**1**		**1**	**3**

3: Strong contribution, 2: Average contribution , 1: Low contribution

B.Sc. Life sciences

Program Articulation Matrix: (Mapping of Courses with POs and PSOs)

PO-PSO / Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
LN104											
MT106											
PY103											
CH112											
CH113											
PY105											
BS121	3	2	2	2	1	3	3	3			
ES115											
CH114											
BS131	3	1				1	1	3			
BS132	3	1				1	1	1			
BS113	3	1				2	1	3			
CH115											
BS134	3	3	1			1	3	3			2
CH215											
BS112	3	1					1	3			
BS203	3	1					2	3			
BS221	3	1				1	1	3			
BS222	3	1				1	1	3			
BS223	3	3	1					3			2
BS224	3	3	1			2	3	3			2
BS202	3	1					2	3			1
BS212	3	1					1	3			
BS231	3	1					1	3			
BS232	3	1				1	1	3			
BS233	3	1					1	3			
BS234	33	3	1				3	3			2
BS235	33	3	1				3	3			2
BS211	3	1		1	1	1	3	3	1		1
BS303	3	1		1	1	1	1	3	2	1	3
BS321	3	1					1	3			

BS322	**3**	**1**					**1**	**3**			
BS323	**3**	**1**			**1**	**2**	**1**	**2**	**2**	**1**	**3**
BS306	**3**	**1**			**1**	**1**	**1**	**3**	**2**	**1**	**2**
BS216	**3**	**3**	**1**				**3**	**3**	**1**		**3**
BS308	**3**	**3**	**1**				**3**	**3**	**2**	**1**	**3**
BS331	**3**	**1**					**1**	**3**	**2**	**1**	**1**
BS332	**3**	**1**				**1**	**1**	**2**	**2**	**1**	**3**
BS332	**3**	**1**				**1**	**1**	**2**	**2**	**1**	**3**
BS315	**3**	**3**	**1**	**1**	**2**		**3**			**3**	**1**
BS316	**3**	**2**	**1**	**1**		**1**	**3**	**1**		**1**	**3**
B.Sc. Life Science											