

Program Handout
for B.Sc. Zoology, Botany & Chemistry

(revised w.e.f. 2020-21)



Department of Biosciences
Faculty of Science

Integral University, Lucknow

PROGRAM EDUCATIONAL OBJECTIVES (PEO's)

- **PEO1:** After completion of the B.Sc. (Zoology, Botany and Chemistry) students are able to understand the basic concepts, fundamental principles and the scientific theories related to various scientific phenomena and their relevancies in the day-to-day life.
- **PEO2:** They acquired the skills in handling scientific instruments, planning and performing in laboratory experiments.
- **PEO3:** The program also helps the student to think creatively and scientifically to propose novel ideas, and draw relational conclusions which make them self directed.
- **PEO4:** This program provides thorough knowledge about various disciplines of the subjects and equipped students with skills related to laboratory as well as field based studies.

PROGRAM OUTCOMES (PO's)

PO1. Critical Thinking: Students will demonstrate an understanding of major concepts in all disciplines of basic Biosciences. Understand the basic concepts, fundamental principles, the scientific theories related to various biological phenomena, their relevancies in the day-to-day life and their applications.

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

PO 3. Social Interaction- Development of scientific outlook not only with respect to science subjects but also in all aspects related to life

PO 4. Effective Citizenship: Imbibe moral and social values in personal and social life leading to highly cultured and civilized personality.

PO 5. Ethics: Follow the ethical principles and responsibilities to serve the society.

PO 6. Environmental Management: Understand the issues of environmental contexts and sustainable development.

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

PROGRAM SPECIFIC OUTCOMES (PSO's)

PSO1: Bachelor of Science program in ZBC enable students to acquire knowledge with facts and figures which are related to various subjects in pure sciences viz., Zoology, Botany and Chemistry.

PSO2: This program will aid the students to develop a deeper understanding of natural laws, inquiring about the reasons and logics which govern them through established methods of observation, modeling, experimentation and calculations.

PSO3: In addition program will also provide the students an in-depth understanding and training in basic sciences for three years which will opens a plethora of opportunities for teaching, research, progression to PG education in botany, Environmental science, biotechnology, bioinformatics, bio chemistry, microbiology, genetics, as well as lucrative employment opportunities across the globe.

PSO4: This program will provide the students a comprehensive understanding about the fundamentals of biology covering all the principles and perspectives in all disciplines including allied subjects



Integral University, Lucknow
Department of Biosciences
Study and Evaluation Scheme
Semester I

Program: B.Sc.-ZBC

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub. Total	Credit	Total Credits	Attributes						
				L	T	P	CT	TA	Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics
THEORIES																				
1	LN104	Essential Professional Communication	Foundation	3	1	0	40	20	60	40	100	3:1:0	4	√	√	√			√	√
2	BS161	Non chordates- I "Protozoa to Helminthes"	Core	3	1	0	40	20	60	40	100	3:1:0	4					√		
3	BS203	Cell Biology and Genetics	Core	3	1	0	40	20	60	40	100	3:1:0	4					√		
4	BS162	Algae, Fungi, Bryophyta	Core	3	1	0	40	20	60	40	100	3:1:0	4					√		
5	CH117	General Chemistry-I	Core	2	1	0	40	20	60	40	100	2:1:0	3	√		√				
PRACTICAL																				
6	BS163	Animal Diversity Lab-1	Practical	0	0	6	40	20	60	40	100	0:0:3	3	√		√		√		
7	CH118	Chemistry Practical-I	Practical	0	0	4	40	20	60	40	100	0:0:2	2	√	√	√				
Total				14	5	10	280	140	420	280	700	24	24							

Semester II

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Max. Marks	Credit	Total Credits	Attributes						
				L	T	P	CT	TA	Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics
THEORIES																				
1	ES115	Fundamentals of Environmental Science	Foundation	3	1	0	40	20	60	40	100	3:1:0	4					√	√	
2	BS171	Pteridophytes, Gymnosperms, Palaeobotany	Core	3	1	0	40	20	60	40	100	3:1:0	4					√		
3	CH119	General Chemistry-II	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√				
4	BS172	Non Chordates- II "Annelida to Echinodermata"	Core	3	1	0	40	20	60	40	100	3:1:0	4					√		
5	BS233	Animal Physiology	Core	3	1	0	40	20	60	40	100	3:1:0	4							
PRACTICAL																				
6	BS174	Plant Diversity Lab-I	Practical	0	0	4	40	20	60	40	100	0:0:2	2					√		
7	CH120	Chemistry Practical-II	Practical	0	0	4	40	20	60	40	100	0:0:2	2	√	√	√				
Total				15	5	8	280	140	420	280	700	24	24							

Semester V B.Sc. B.Sc. (Botany, zoology)

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Max. Marks	Credit	Total Credits	Attributes						
				L	T	P	CT	TA	Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics
THEORIES																				
1	BS321	Plant Anatomy and Embryology	Core	3	1	0	40	20	60	40	100	3:1:0	4							
2	BS366	Plant Ecology, Phytogeography and Economic Botany	Core	2	0	0	40	20	60	40	100	2:0:0	2			√		√		
3	BS212	Molecular Biology	Core	3	1	0	40	20	60	40	100	3:1:0	4							
4	BS361	Applied and Economic Zoology	Core	3	1	0	40	20	60	40	100	3:1:0	4	√	√	√		√		
5	BS362	Ecology and Animal Behaviour	Core	3	1	0	40	20	60	40	100	3:1:0	4					√		
6	BS363	Fundamentals of Biomolecules	Core	2	0	0	40	20	60	40	100	2:0:0	2							
PRACTICAL																				
7	BS364	Applied Zoology Lab	Practical	0	0	4	40	20	60	40	100	0:0:2	2	√	√	√		√		
8	BS365	Applied Botany lab	Practical	0	0	4	40	20	60	40	100	0:0:2	2	√	√	√		√		
Total				16	04	08	320	160	480	320	800	24	24							

Semester VI B.Sc. B.Sc. (Botany, Zoology)

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Max. Marks	Credit	Total Credits	Attributes						
				L	T	P	CT	TA	Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics
THEORIES																				
1	BS371	Immunology and Toxicology	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√		√		
2	BS372	Biology of Insecta and Pest Management	Elective	3	1	0	40	20	60	40	100	3:1:0	4	√	√	√		√		
3	BS373	Soil Science and Plant Pathology		3:1:0	4	√		√		√			√							
4	BS202	Biophysical Chemistry	Elective	3	1	0	40	20	60	40	100	3:1:0	4	√	√	√				
5	BS374	Biological Techniques and Biostatistics		4	√	√	√													
6	BS331	Computational Sciences and Bioinformatics	Core	3	0	0	40	20	60	40	100	0:0:3	3	√	√	√				
7	BS332	Plant & Animal Biotech	Core	3	0	0	40	20	60	40	100	0:0:2	2	√	√	√				
8.	BS375	Botany/Zoology Project	Core	0	0	8	00	00	00	200	200	0:0:4	4	√	√	√			√	√
Total				15	05	08	200	100	300	400	700	24	24							

Semester V B.Sc. (Botany, chemistry)

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Max. Marks	Credit	Total Credits	Attributes							
				L	T	P	CT	TA	Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
THEORIES																					
1	BS321	Plant Anatomy and Embryology	Core	3	1	0	40	20	60	40	100	3:1:0	4								
2	BS366	Plant Ecology, Phytogeography and Economic Botany	Core	2	0	0	40	20	60	40	100	2:0:0	2					√			
3	BS212	Molecular Biology	Core	3	1	0	40	20	60	40	100	3:1:0	4								
4	CH314	Advance Inorganic Chemistry	Core	3	1	0	40	20	60	40	100	2:1:0	3	√							
5	CH315	Advance Organic Chemistry	Core	2	1	0	40	20	60	40	100	2:1:0	3	√	√						
6	CH319	Basics of Chromatographic Techniques	Core	3	1	0	40	20	60	40	100	3:1:0	4								
PRACTICAL																					
7	CH316	Chemistry practical-V	Practical	0	0	4	40	20	60	40	100	0:0:3	2	√	√	√		√			
8	BOT365	Applied Botany Lab	Practical	0	0	4	40	20	60	40	100	0:0:2	2			√		√			
Total				14	05	10	320	160	480	320	800	24	24								

Semester VI B.Sc. (Botany, chemistry)

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Max. Marks	Credit	Total Credits	Attributes									
				L	T	P	CT	TA	Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics			
THEORIES																							
1	CH 308	Spectroscopic Techniques	Core	3	1	0	40	20	60	40	100	3:1:0	4	√	√	√							
2	CH309	Chemical Process Industry	Elective	3	1	0	40	20	60	40	100	3:1:0	4	√	√	√				√			
3	CH317	Chemistry of Polymers	Elective	3	1	0	40	20	60	40	100	3:1:0	4	√	√	√				√			
4	BS202	Biophysical Chemistry	Elective	3	1	0	40	20	60	40													
5	BS373	Soil Science and Plant Pathology	Elective	3	1	0	40	20	60	40										√			
6	BS331	Computational Sciences and Bioinformatics	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√							
7	BS332	Plant & Animal Biotech	Core	3	0	0	40	20	60	40	100	3:1:0	4										
8	CH318/B	Botany/ Chemistry	Core	0	0	8	00	00	00	200	200	0:0:4	4	√	√	√							

	S375	Project																		
			Total	15	05	08	200	100	300	400	700	24	24							

Semester V B.Sc. (Zoology, chemistry)

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Max. Marks	Credit	Total Credits	Attributes							
				L	T	P	CT	TA	Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
THEORIES																					
1	BS361	Applied and Economic Zoology	Core	3	1	0	40	20	60	40	100	3:1:0	4	√	√	√		√			
2	BS362	Ecology and Animal Behaviour	Core	2	1	0	40	20	60	40	100	2:1:0	4					√			
3	BS363	Fundamentals of Biomolecules	Core	2	1	0	40	20	60	40	100	2:1:0	2								
4	CH314	Advance Inorganic Chemistry	Core	3	1	0	40	20	60	40	100	3:1:0	4	√							
5	CH315	Advance Organic Chemistry	Core	2	1	0	40	20	60	40	100	2:1:0	3	√	√						
6	CH319	Basics of Chromatographic Techniques	Core	2	1	0	40	20	60	40	100	2:1:0	3	√	√	√		√			
Practicals																					
7	CH316	Chemistry practical-V	Practical	0	0	6	40	20	60	40	100	0:0:2	2								
8	BS364	Applied Zoology Lab	Practical	0	0	4	40	20	60	40	100	0:0:2	2	√	√	√		√			
				Total	14	05	10	320	160	480	320	800	24	24							

Semester VI B.Sc. (Zoology, chemistry)

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Max. Marks	Credit	Total Credits	Attributes						
				L	T	P	CT	TA	Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics
THEORIES																				
1	BS371	Immunology and Toxicology	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√		√		
2	CH-308	Spectroscopic Techniques	Core	3	1	0	40	20	60	40	100	3:1:0	4	√	√	√				
3	CH309	Chemical Process Industry	Elective	3	1	0	40	20	60	40	100	3:1:0	4	√	√	√				√
4	CH317	Chemistry of Polymers	Elective					20						√	√	√				√
5	BS372	Biology of Insecta and Pest management	Elective	3	1	0	40	20	60	40	100	3:1:0	4							
6	BS374	Biological Techniques and Biostatistics	Elective					20						√	√	√				√

7	BS332	Plant & Animal Biotech		3	1	0	40	20	60	40	100	3:1:0	4	√	√	√					
			Core																		
8	CH318/B S375	Zoology/Chemistry Project	Core	0	0	8	00	00	00	200	200	0:0:4	4	✓	✓	✓					
Total				15	05	08	200	100	300	400	700	24	24								

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 1 st year/ 1 st semester						
1. Name of the Department: Biosciences						
2. Course Name	Non Chordates-I “Protozoa to Helminthes”			L	T	P
3. Course Code	BS161			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 ()
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 general taxonomic rules on animal classification and the complex interactions among animals of different phyla. The students will acquire the knowledge about the distinguishing features of lower non chordates.						
9. COURSE OUTCOMES (CO):						
<i>After the successful course completion, learners will develop following attributes:</i>						
COURSE OUTCOME (CO)	ATTRIBUTES					
CO1	The students will learn about the diversity and classification of animals.					
CO2	The students will learn about the characteristics of lower non-chordates. They will also learn about the structure, life-cycle and control of <i>Plasmodium</i> , <i>Monocystis</i> , <i>Fasciola hepatica</i> , <i>Taenia solium</i> , <i>Ascaris</i> and <i>Ancylostoma</i> ,					
CO3	The students will learn about the locomotion in Protozoa, Canal system in sponges, Organization of coelom and its types.					
CO4	The expected outcome is to provide the students an in-depth understanding of colonial and social life in invertebrates.					
CO5	The students will learn the physiological process of lower invertebrates and the relationship of the organ system					
10. Unit wise detailed content						
Unit-1	Number of lectures = 08	Title of the unit: Classification of protozoa				
Outline of classification of animals (Chordates and non-chordates).Protozoa: General characters and classification up to classes; Locomotory Organelles and Locomotion in Protozoa; Plasmodium, Monocystis: - Structure, Life-cycle and Control						
Unit-2	Number of lectures = 08	Title of the unit: Classification of porifera				
Porifera: General characters and classification up to classes; Sycon: - Morphology, Different types of cells, Canal System in Porifera.						
Unit-3	Number of lectures = 08	Title of the unit: Classification of cnidaria				

Cnidaria: General characters and classification up to classes; Obelia: - Morphology of Obelia colony, Development Of Hydra, Polymorphism in Hydrozoa.

Unit-4	Number of lectures = 08	Title of the unit: Classification of platyhelminthes
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Platyhelminthes: General characters and classification up to classes; Fasciola hepatica, Taenia solium: - Structure, Life cycle, Pathogenicity & control measures.

Unit-5	Number of lectures = 08	Title of the unit: Classification of nematehelminthes
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Nematehelminthes: Ascaris and Ancylostoma: - Structure, Life cycle, Pathogenicity & control measures.

11. 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.

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO											
CO1	3	1				3	1	3	3	3	
CO2	3	1				2	1	3	3	3	
CO3	3	1				1	1	2	3	3	
CO4	3	1				1	1	2	3	3	
CO5	3	1				1	1	3	3	3	
BS161											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 1st year/ 1st 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 (<input checked="" type="checkbox"/>)		Foundation Course ()	Departmental Elective ()		
5. Pre-requisite (if any)	10+2 with Biology	6. Frequency (use tick marks)	Even ()	Odd (<input checked="" type="checkbox"/>)	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): <i>After the successful course completion, learners will develop following attributes:</i>						
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. 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

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO											
CO1	3	1					2	2	2	1	
CO2	3	1					2	3	2	2	
CO3	3	1					2	3	2	3	
CO4	3	1					2	3	2	3	
CO5	3	1					2	3	2	3	
BS203											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 1st year/ 1st semester							
1. Name of the Department: Biosciences							
2. Course Name	ALGAE, FUNGI, BRYOPHYTA				L	T	P
3. Course Code	BS162				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 general characteristics, habit, habitat, anatomy, morphology, thallus organization, reproduction, economic importance and Classification of algae, fungi, Lichens and Bryophytes.							
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>							
COURSE OUTCOME (CO)	ATTRIBUTES						
CO1	Have basic knowledge of classification of algae, Economic importance and life Cycle						
CO2	Learn about general features of fungi, Classification, thallus organization, cell wall composition, Reproduction and economic importance of fungi, life cycle						
CO3	Have basic knowledge of Lichens						
CO4	Identify General features of Bryophytes, Classification, Thallus organization, Reproduction and affinities of bryophytes, Economic importance of bryophytes with special reference to <i>Sphagnum</i>						
CO5	Study Marchantiophyta – <i>Marchantia</i> ; Bryophyta - <i>Pogonatum</i> ; Anthocerotophyta – <i>Anthoceros</i> .						
10. Unit wise detailed content							
Unit-1	Number of lectures = 08	Title of the unit: Classification of algae					
General features of algae, Classification, Range of thallus organization, Reproduction; Classification of algae, Economic importance and life Cycle with special reference to <i>Chlamydomonas, Oedogonium, Vaucheria, Chara and Polysiphonia.</i>							
Unit-2	Number of lectures = 08	Title of the unit: classification of fungi					

General features of fungi, Classification, range of thallus organization, cell wall composition, Reproduction, economic importance of fungi, life cycle with special reference to *Rhizopus* (Zygomycota), *Alternaria* (Ascomycota), *Puccinia*, *Agaricus* (Basidiomycota)

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

Lichens: General account, classification, thallus organization, reproduction, physiology and role in environmental pollution; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance

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

General features of Bryophytes, Classification, Thallus organization, Reproduction and affinities of bryophytes, Economic importance of bryophytes with special reference to *Sphagnum*

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

General characters and life cycle with special reference to Marchantiophyta – *Marchantia*; Bryophyta - *Pogonatum*; Anthocerotophyta – *Anthoceros*

11. Books 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
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.

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO											
CO1	3	1				2	1				
CO2	3	1				2	1				
CO3	3	1				2	1				
CO4	3	1				2	1				
CO5	3	1				2	1				
BS162											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 1st year/ 1st semester**1. Name of the Department: Chemistry**

2. Course Name	GENERAL CHEMISTRY-I			L	T	P
3. Course Code	CH117			3	1	0
4. Type of Course (use tick mark)	Core (✓)		Foundation Course		Departmental Elective ()	
5. Pre-requisite (if any)	10+2	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:** To learn about simple quantum mechanical treatments of atoms and molecules, atomic structures, periodic properties of elements, various electronic displacement effects in organic compounds, mechanisms of organic reactions. States of matters with an emphasis on the gaseous state.**9. COURSE OUTCOMES (CO):** *After the successful course completion, learners will develop following attributes:*

COURSE OUTCOME	ATTRIBUTES
CO1	Explain the atomic structures based on quantum mechanics. Can write the electronic configuration of elements.
CO2	Justify the causes of periodicity and periodic properties of the different groups of elements.
CO3	Evaluate the state of hybridization, geometry of atoms, nucleophiles, electrophiles and various electron displacement effects
CO4	Investigate the mechanisms of organic reactions, design syntheses of organic molecules.
CO5	Explain various 'gas laws' governing the physical/chemical behaviour of gases.

10. Unit wise detailed content

Unit-1	Number of lectures = 08	Title of the unit: Atomic Structure
Idea of de Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2 , quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s, p, d orbitals. Aufbau and Pauli		
Unit-2	Number of lectures = 08	Title of the unit: Periodic Properties
Atomic and ionic radii, ionization energy, electron affinity and electronegativity definition, effective nuclear charge, methods of determination or evaluation, trends in periodic table and applications in predicting and explaining the chemical behavior.		
Unit-3	Number of lectures = 08	Title of the unit: Basic Concepts of Bonding in Organic Chemistry

Hybridisation, tetravalency of carbon, geometry of molecules; methane, ethane, ethylene, acetylene and benzene, Factors affecting covalent bond; Electron displacement effects, inductive, electromeric, resonance, hyperconjugation and steric effects.

Unit-4 Number of lectures = 08 Title of the unit: Mechanism of Organic reactions

Homolytic and heterolytic bond breaking. Types of reagents-electrophiles and nucleophiles, Types of organic reactions. Energy considerations. Reactive intermediates-carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples). Assigning

Unit-5 Number of lectures = 08 Title of the unit: Gaseous State

Postulates of kinetic theory of gases, deviation from ideal behavior, van der Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of van der Waals equation, relationship between critical constants and van der Waals constants, the law of corresponding states, reduced equation of state. Problems Molecular velocities: Root mean square, average and most

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

1. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/104101090/lec1.pdf
 2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/104106096/lec9.pdf
 3. <https://ocw.mit.edu/high-school/chemistry/exam-prep/structure-of-matter/chemical-bonding/>
 4. <https://www.youtube.com/watch?v=ZNo6gfCAgWE>
- https://nptel.ac.in/content/syllabus_pdf/104105033.pdf

12. Books recommended:

1. New Concise Inorganic Chemistry by J.D. Lee Edition III Compton Printing Ltd London.
2. Principles of Inorganic Chemistry by HR Puri, R. Sharma & S.P. Jauhar, Vishal Publications Jalandhar.
3. Organic Chemistry, S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International).
4. Modern Organic Chemistry, M. K. Jain and S.C. Sharma, Vishal Publications Jalandhar.
5. Physical Chemistry, P.W. Atkins, Oxford University Press.
6. Principles of Physical Chemistry, B.R. Puri & L.R. Sharma, Shoban Lal Nagin Chand & Co.

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO											
CO1	3	1	1		2	1	1				
CO2	3	1	1		2	1	1				
CO3	3	1	2		2	1	1				
CO4	3	1	2		2	1	1				
CO5	3	1	2		2	1	1				
CH117											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 1st year/ 1st semester							
1. Name of the Department: Biosciences							
2. Course Name	ANIMAL DIVERSITY LAB-1				L	T	P
3. Course Code	BS163				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. Total Number of Lectures, Tutorials, Practicals							
Lectures = 0		Tutorials = 0		Practical = 06			
8. COURSE OBJECTIVES: The objective of this course is to have a firm foundation in the fundamentals of different animal phyla and to understand the importance of economic zoology.							
9. COURSE OUTCOMES (CO):							
<i>After the successful course completion, learners will develop following attributes:</i>							
COURSE OUTCOME	ATTRIBUTES						
CO1	Understand how to prepare and study temporary and permanent slides						
CO2	Describe different kinds of protozoans.						
CO3	Understand and identify various animals from different phyla through specimens.						
CO4	Learn to dissect Prawn and Pila.						
CO5	Explain and differentiate between mouth parts of Anopheles and Culex.						
10. Syllabus							
Exp-01	Examination of pond water for different kinds of protozoans.						
Exp-02	Permanent preparation of gemmule of Spongilla						
Exp-03	Permanent preparation of parapodium of Neries						
Exp-04	Permanent preparations of Septal nephridia of Pheretima						
Exp-05	Permanent preparations of gill lamella of Pila						
Exp-06	Dissections: Palaemon and Pila						

Exp-07	Glycerine preparation of Proboscis of Musca
Exp-08	Mouth parts of male and female Anopheles and Culex
Exp-09	Study of the following specimens: Euplectella, Spongilla, Euspongia, Physalia, Euspongia, Corallium, Fungia, Madrepora, Metridium, Pennatula, Fungia, Neries, Heteroneries, Pheretima
Exp-10	Study of the following permanent slides: Different kinds of sponge spicules and sponging fibres of Euspongia, Amoeba, Euglena, Paramecium, Obelia, Aurelia, T.S. and L.S. of Sycon, Study of life history stages of Taenia, T.S. of Male and female Ascaris.

11. Books recommended:

1. Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition.
2. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science
3. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press. Pough H. Vertebrate life, VIII Edition, Pearson International.
4. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO											
CO1	3	3	1			1	3		2	3	3
CO2	3	3	1			2	3	3	2	2	3
CO3	3	3	1			2	3	3	2	1	3
CO4	3	3	1			1	3	3	2	3	3
CO5	3	3	1				3	3	2	1	3
BS163											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 1 st year/ 1 st semester						
1.Name of the Department: Chemistry						
2.CourseName	Chemistry Practical-I		L	T	P	
3.CourseCode	CH118		0	0	6	
4.TypeofCourse(use tick mark)		Core(<input checked="" type="checkbox"/>)	Foundation Course ()		Departmental Elective()	
5.Pre-requisite (if any)	10+2 with Chemistry	6.Frequency(use tick marks)	Even ()	Odd (<input type="checkbox"/> <input type="checkbox"/>)	Either Sem ()	EverySem()
7.TotalNumberofLectures,Tutorials,Practicals						
Lectures=00		Tutorials=00		Practical=10		
8. COURSE OBJECTIVES: The purpose of the undergraduate chemistry Lab program at the Integral University is to provide the key knowledge base and laboratory resources to prepare students for careers as professionals in the field of chemistry, and various other industries.						
9. COURSE OUTCOMES (CO):						
<i>After the successful course completion, learners will develop following attributes:</i>						
COURSE OUTCOME (CO)	ATTRIBUTES					
CO1	Understand the basic analytical and technical skills and technical skills to work effectively in the various fields					
CO2	Understand the basic titration methods and technical skills to work in the different fields of chemistry.					
CO3	Able to detect presence of elements and functional group in organic compounds.					
CO4	Remember to keep records of all performed experiments in the manner which is required in laboratory					
10.Syllabus						
Exp-01	Preparation of standard solution related to normality & molarity.					
Exp-02	Preparation of buffer solution, pH measurement.					
Exp-03	Acid - base titration.					
Exp-04	Oxidation-reduction (redox) titrations. a) To determine the strength of oxalic acid.					
Exp-05	To determine the strength of potassium permanganate solution by using sodium thiosulphate solution.					

Exp-06	To determine the strength of given copper sulphate solution by using sodium thiosulphate solution.
Exp-07	Complexometric titrations. a) To estimate the concentration of calcium ions with EDTA. b) To estimate the
Exp-08	Detection of element present in the given organic compounds.
Exp-09	Detection of functional group present in the given organic compounds. a) Carboxylic b) Phenolic c) Alcoholic
Exp-10	To determine the strength of ferrous ammonium sulphate (Mohr's salt) solution by using external indicator.
11. Brief description of self learning/ E-learning component	
https://www.fandm.edu/uploads/files/79645701812579729-genchem-reference-for-web.pdf http://file.akfarmahadhika.ac.id/E-BOOK/12-1213-akfarmahad-16-1-vogelqu-d.pdf https://faculty.psau.edu.sa/filedownload/doc-6-pdf-f06110ef2e1e1ae119cbacf71dd17732-original.pdf https://www.stem.org.uk/resources/collection/3959/practical-chemistry	
13. Books recommended:	
1. Advance Practical Chemistry: Jagdamba Singh, L.D.S Yadav, Jaya Singh, I.R. Siddiqui, Pragati Edition. 2. Practical Organic Chemistry, A.I. Vogel. 3. Practical Physical Chemistry: B. Viswanathan and P.S. Raghavan. 4. Experimental Inorganic Chemistry – W.G. Palmer.	

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO											
CO1	3	2	2		3	1	3				
CO2	3	2	2		3	1	3				
CO3	3	2	2		3	1	3				
CO4	3	2	2		3	1	3				
CO5	2	2	1		1		3				
CH 118											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 1st year/ 2nd semester						
1. Name of the Department: Biosciences						
2. Course Name	PTERIDOPHYTES, GYMNOSPERMS, PALAEOBOTANY			L	T	P
3. Course Code	BS171			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 paper deals to identify and classify the pteridophytes and gymnosperms. Understand the morphology, anatomy and life cycle of various genera of pteridophytes and gymnosperms along with their economic importance. Importance of studying this paper is highlighted reflecting on the elementary palaeobotany and geological time scale.						
9. COURSE OUTCOMES (CO)						
<i>: After the successful course completion, learners will develop following attributes:</i>						
COURSE OUTCOME (CO)	ATTRIBUTES					
CO1	Understand the general features of pteridophytes, their classification, stellar organization and economic importance.					
CO2	To understand the morphology, anatomy, development, vegetative and reproductive parts in various genera of pteridophytes.					
CO3	The students will learn about the general characteristics of gymnosperms, classification, resemblances and differences of gymnosperms with pteridophytes and angiosperms. mapping, structural and numerical aberrations					
CO4	To understand the morphology, anatomy, development, vegetative and reproductive parts in Coniferales.					
CO5	Learn elementary palaeobotany including general account, types of fossils, methods of fossilization and geological time scale.					
10. Unit wise detailed content						
Unit-1	Number of lectures = 08	Title of the unit: General features of Pteridophytes				
General features, Classification, Stellar organization; Homospory and Heterospory; Economic importance and life cycle of pteridophytes with special reference to <i>Pteris</i>.						
Unit-2	Number of lectures = 08	Title of unit: Morphology, anatomy, development, vegetative & reproductive				

Morphology, anatomy, development, vegetative and reproductive parts in Psilopsida - *Rhynia*; Lycopsida - *Selaginella*; Sphenopsida - *Equisetum*; Filicopsida - *Adiantum*, *Marsilea*..

Unit-3	Number of lectures = 08	Title of the unit: General characteristics of Gymnosperms
General characteristics of Gymnosperms, classification, resemblances and differences of Gymnosperms with Pteridophytes and Angiosperms. Economic importance and life Cycle with special reference to <i>Cycas</i> .		
Unit-4	Number of lectures = 08	Title of the unit: Morphology, anatomy, development, vegetative and reproductive parts in Coniferales –Pinus.
Morphology, anatomy, development, vegetative and reproductive parts in Coniferales – <i>Pinus</i> .		
Unit-5	Number of lectures = 08	Title of the unit: Elementary Palaeobotany
General account, types of fossils, methods of fossilization and geological time scale.		

11. Books recommended:

1. Smith G.M 1955, Cryptogamic Botany Vol.I and II, McGraw Hill.
2. Vashishta B.R 1990, Botany for Degree Students, Vol 1,2 and 3. S.Chand & Co.
3. Singh V., Pandey P.C and Jain D.K 1998, A Text book of Botany for Undergraduate
4. Parihar N.S 1967, An Introduction to Embryophyta Vol I & II, General Book Depot.
5. Sporne K.R 1976, Morphology of Pteridophytes, B1 Publications.
6. Sharma O.P: Text book of Pteridophyta II edition:McMillan India Ltd.
7. Bhatnagar, S.P. and Moitra1996. Gymnosperms. New Age International Limited, New Delhi.

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO											
CO1	3	1				1	1				
CO2	3	1				1	1				
CO3	3	1				1	1				
CO4	3	1				1	1				
CO5	3	1				1	1				
BS171											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 1st year/ 2nd semester**1. Name of the Department: Chemistry**

2. Course Name	GENERAL CHEMISTRY-II	L	T	P
3. Course Code	CH119	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. Frequency (use tick marks)	Even (✓)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practicals

Lectures = 30	Tutorials = 10	Practical = Nil
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8. COURSE OBJECTIVES: The purpose of this course is to learn the structure and properties of ionic solids, shapes & geometries of molecules and their stereochemistry. Types and properties of colloids, first law of thermodynamics and related calculations.**9. COURSE OUTCOMES (CO):***After the successful course completion, learners will develop following attributes:*

COURSE OUTCOME	ATTRIBUTES
CO1	Analyze the properties, structure of ionic solids by applying Born-Haber cycle, Fajan's rule etc.
CO2	Predict the geometry and shape of molecules by applying VB & VSEPR theories. Predict the properties of molecules by applying MO theory
CO3	Interpret the reactivity and stability of an organic molecule based on structure, including conformation and stereochemistry.
CO4	Able to prepare different types of colloids.
CO5	Understand the concepts of thermodynamics, different thermodynamic quantities such as heat and work and their measurements.

10. Unit wise detailed content

Unit-1	Number of lectures = 08	Title of the unit: Ionic Solids
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Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born-Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarizability of ions, Fajan's rule. Metallic bond-free electron, valence bond and band theories.

Unit-2	Number of lectures =08	Title of the unit: Chemical Bonding
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B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 1st year/ 2nd semester						
1. Name of the Department: Biosciences						
2. Course Name	NON CHORDATES-II “ANNELIDA TO ECHINODERMATA			L	T	P
3. Course Code	BS172			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 general taxonomic rules on animal classification and the complex interactions among animals of different phyla. The students will acquire the knowledge about the distinguishing features of higher non chordates.						
9. COURSE OUTCOMES (CO):						
<i>After the successful course completion, learners will develop following attributes:</i>						
COURSE OUTCOME	ATTRIBUTES					
CO1	The students will understand General characters and classification up to classes of annelida.					
CO2	The students will understand General characters and classification up to classes of arthropoda.					
CO3	The students will understand General characters and classification up to classes of mollusc.					
CO4	The students will understand General characters and classification up to classes of echinodermata.					
CO5	The students will understand the general characters of Protochordata, Urochordata and Cephalochordata.					
10. Unit wise detailed content						
Unit-1	Number of lectures = 08	Title of the unit: Annelida				
General characters and classification up to classes; Nereis and Hirudinaria: - Habits and Morphology; Metamerism in Annelida.						
Unit-2	Number of lectures = 08	Title of the unit: Arthropoda				
General characters and classification up to classes; Palaemon:-Habits andMorphology, Apis:-Colony; Metamorphosis in Insects						

Unit-3	Number of lectures = 08	Title of the unit: Mollusca
General characters and classification up to classes; Lamellidens and Pila:-Habits and Morphology, Torsion in Gastropods.		
Unit-4	Number of lectures = 08	Title of the unit: Echinodermata
General characters and classification up to classes; Pentaceros: - Habits and Morphology; Water-vascular system in Asteroidea		
Unit-5	Number of lectures = 08	Title of the unit: Protochordates
General features of Protochordata; General Characters of Hemichordata and Affinities of Balanoglossus.		
11. 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.		

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO											
CO1	3	1				1	1	3	2		
CO2	3	1				1	1	3	2		
CO3	3	1				1	1	3	2	1	
CO4	3	1				1	1	3	2		
CO5	3	1				1	1	3	2		
BS172											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 1st year/ 2nd 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 students will gain fundamental knowledge of animal physiology.							
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>							
COURSE OUTCOME	ATTRIBUTES						
CO1	Understand the process of digestion and absorption.						
CO2	Understand blood and cardiovascular system.						
CO3	Students will gain knowledge of the muscle system, nervous system.						
CO4	Students are taught the detailed concepts of respiration, excretion and osmoregulation.						
CO5	Students 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							
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.							
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. 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 Physiology: From Cells to Systems, (Wadsworth Publishing, 2000,ISBN: 0534568262)

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO											
CO1	3	1					2	2	3	1	
CO2	3	1					2	2	3	1	
CO3	3	1					2	2	3	1	
CO4	3	1					2	2	3	1	
CO5	3	1					2	2	3	1	
BS233											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 1st year/ 2nd semester						
1. Name of the Department: Biosciences						
2. Course Name	PLANT DIVERSITY LAB-I		L	T	P	
3. Course Code	BS174		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 general characteristics, habit, habitat, anatomy, morphology, thallus organization of algae, fungi, Lichens, Bryophytes, pteridophytes and gymnosperms. Students will also understand the types and Parts of inflorescence and flowers.						
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>						
COURSE OUTCOME (CO)	ATTRIBUTES					
CO1	Identify and analyze dicot and monocot roots, stems and leaves.					
CO2	Learn about general features of algae and fungi.					
CO3	Identify and Learn basics of bryophytes, pteridophytes and gymnosperms.					
CO4	Identify types of seed and fruit.					
CO5	Study morphology of flower parts and inflorescence.					
10. Syllabus						
Exp-01	Transverse section of dicot and monocot roots					
Exp-02	Transverse section of dicot and monocot stems					
Exp-03	Transverse section of dicot and monocot leaves					
Exp-04	Study of one example each of algae and fungi					
Exp-05	Study of one example each of bryophyte, pteridophyte, gymnosperm					

Exp-06	Morphology study of flower parts, inflorescence, seed, fruit types
11. Books recommended:	
1. Bahadur, B., Rajam, M.V., Sahijram, L., Krishnamurthy, K.V. (Eds.). Plant Biology and Biotechnology. Volume I: Plant Diversity, Organization, Function and Improvement.	
2. James Bidlack, Shelley Jansky, Kingsley R Stern. Laboratory Manual for Stern's Introductory Plant Biology.	

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO											
CO1	3	1				1	1				
CO2	3	1				2	1				
CO3	3	1				2	1				
CO4	3	1				1	1				
CO5	3	1				2	1				
BS174											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 1 st year/ 2 nd semester					
1.Name of the Department: Chemistry					
2.Course Name	Chemistry Practical-II		L	T	P
3.Course Code	CH120		0	0	6
4.Type of Course (usetickmark)	Core(<input type="checkbox"/>)		Foundation Course ()		Departmental Elective()
5.Pre-requisite (if any)	10+2 with Chemistry	6.Frequency(use tick marks)	Even (<input type="checkbox"/>)	Odd (<input type="checkbox"/>)	Either Sem () EverySem()
7.TotalNumberofLectures,Tutorials,Practicals					
Lectures=00		Tutorials=00		Practical=10	
8. COURSE OBJECTIVES: The purpose of the undergraduate chemistry Lab program at the Integral University is to provide the key knowledge base and laboratory resources to prepare students for careers as professionals in the field of chemistry, and various other industries.					
9. COURSE OUTCOMES (CO):					
<i>After the successful course completion, learners will develop following attributes:</i>					
COURSE OUTCOME (CO)	ATTRIBUTES				
CO1	Remember to keep records of all performed experiments in the manner which is required in laboratory.				
CO2	Able to Evaluate water quality parameters like chloride content and alkalinity.				
CO3	Understand the basic titration methods and technical skills to work in the different fields of chemistry.				
CO4	Know about the principles of qualitative and quantitative analysis of inorganic mixtures.				
CO5	Analyze the importance of personal safety and care of equipment's and chemicals.				
10.Syllabus					
Exp-01	To determine the solubility of benzoic acid at different temperatures and to determine ΔH of the dissolution process.				
Exp-02	To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born Haber Cycle.				
Exp-03	To determine the heat of solution of KNO ₃ by solubility method.				
Exp-04	Estimation of hardness of water by EDTA.				
Exp-05	Determination of R _f values and identification of organic compounds				
Exp-06	Separation of green leaf pigments (spinach leaves may be used).				

Exp-07	Preparation of separation of 2, 4-dinitrophenylhydrazones of acetone, 2-butanone, hexan-2, and 3-one using toluene and light petroleum (40-60)
Exp-08	Determination of R _f values and identification of organic compounds: Separation of a mixture of D, L – alanine, glycine, and L-Leucine using nbutanol: acetic acid:water (4:1:5), Spray reagent – ninhydrin.
11. Brief description of self learning/ E-learning component	
https://www.fandm.edu/uploads/files/79645701812579729-genchem-reference-for-web.pdf http://file.akfarmahadhika.ac.id/E-BOOK/12-1213-akfarmahad-16-1-vogelqu-d.pdf https://faculty.psau.edu.sa/filedownload/doc-6-pdf-f06110ef2e1e1ae119cbacf71dd17732-original.pdf https://www.stem.org.uk/resources/collection/3959/practical-chemistry	
12. Books recommended:	
<ol style="list-style-type: none"> 1. Advance Practical Chemistry: Jagdamba Singh, L.D.S Yadav, Jaya Singh, I.R. Siddiqui, Pragati Edition. 2. Practical Organic Chemistry, A.I. Vogel. 3. Practical Physical Chemistry: B. Viswanathan and P.S. Raghavan. 4. Experimental Inorganic Chemistry – W.G. Palmer. 	

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO											
CO1	3	1	2		3	1	2				
CO2	3	1	1		2		2				
CO3	3	1	2		1	1	2				
CO4	3	1	1		1	1	2				
CO5	2	1	1		2	1	2				
CH120											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 2nd year/ 3rd semester						
1. Name of the Department: Biosciences						
2. Course Name	CHORDATA “AGNATHA TO MAMMALS”			L	T	P
3. Course Code	BS263			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 students will acquire the knowledge about the classification of various classes of vertebrates i.e. Pisces, Reptiles, Aves and Mammals.						
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>						
COURSE OUTCOME	ATTRIBUTES					
CO1	General features of living Agnatha and classification of cyclostome, General features of pisces and classification , fish migration, osmoregulation and locomotion.					
CO2	General features and classification of amphibia, parental care, pedogenesis.					
CO3	General features and classification of reptiles,poisonous and non-poisonous snakes.					
CO4	General features and classification of birds, migration, flight adaptations.					
CO5	General features and classification of mammals, monotremata, aquatic mammals.					
10. Unit wise detailed content						
Unit-1	Number of lectures = 08	Title of the unit: Agnatha				
Agnatha: General features of living Agnatha and classification of cyclostomes up to classes; Pisces: General features and Classification (up to orders) with examples: Osmoregulation. locomotion and migration in Fishes.						
Unit-2	Number of lectures = 08	Title of the unit: Amphibia				
General characters and classification of different classes of Amphibia (upto orders) with examples; Origin of tetrapods, parental care, paedomorphosis.						
Unit-3	Number of lectures = 08	Title of the unit: Reptiles				
General characters and Classification up to orders; Origin of reptiles, Poisonous and non-poisonous snakes, Biting mechanism in snakes.						
Unit-4	Number of lectures = 08	Title of the unit: Aves				
General features and Classification up to orders; Origin of birds, Flight adaptations and migration in birds.						

Unit-5	Number of lectures = 08	Title of the unit: Mammals
General characters and classification upto orders; general features of egg laying mammals, pouched-mammals and aquatic mammals, Origin of mammals.		
11. Books recommended:		
1. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press. 2. Pough H. 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.		

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO											
CO1	3	1				2	1	3	3	1	
CO2	3	1				2	1	3	3	1	
CO3	3	1				2	1	3	3	1	
CO4	3	1				2	1	3	3	1	
CO5	3	1				2	1	3	3	1	
BS263											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 2 nd year/ 3 rd semester						
1. Name of the Department: Chemistry						
2. Course Name	INORGANIC AND PHYSICAL CHEMISTRY-I			L	T	P
3. Course Code	CH221			2	1	0
4. Type of Course (use tick mark)	Core (✓)		Foundation Course		Departmental Elective ()	
5. Pre-requisite (if	10+2 with Chemistry	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:						
To learn about simple quantum mechanical treatments of atoms and molecules, atomic structures, periodic properties of elements, various electronic displacement effects in organic compounds, mechanisms of organic reactions. States of matters with an emphasis on the gaseous state.						
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>						
COURSE OUTCOME	ATTRIBUTES					
CO1	Explain the properties of alkali and alkaline earth metals, and their oxides, hydrides etc. Diagonal relationship					
CO2	Discuss the structure of diborane, Lewis acid nature of boron trihalides, preparation of carbides & silicones, preparation & industrial applications of nitride, hydrazine & hydroxylamine.					
CO3	Explain types of oxides and oxyacids, their structure and of interhalogen compounds, pseudo halogens & clathrate compounds					
CO4	Use thermochemical equations to relate the amount of heat energy transferred in reactions in reactions at constant pressure (ΔH) to the amount of substance involved in the reaction					
CO5	Demonstrate understanding of key concepts related to the second law of thermodynamics, including alternative statements of the second law, the internally reversible process, and the Kelvin temperature scale					
10. Unit wise detailed content						
Unit-1	Number of lectures = 08	Title of the unit: Chemistry of s Block Elements				
General characteristics: melting point, flame colour, reducing nature, diagonal relationships and anomalous behavior of first member of each group. Reactions of alkali and alkaline earth metals with oxygen, hydrogen, nitrogen and water. solvation and complex formation by						
Unit-2	Number of lectures = 08	Title of the unit: Chemistry of p Block Elements				
Comparative study (including diagonal relationship) of groups 13-17 elements, compounds like oxides, oxyacids and of group 13-16, hydrides of boron-diborane and higher boranes, borazine, fluorocarbons, silicates (structural principle), tetrasulphur tetra nitride, basic						
Unit-3	Number of lectures = 08	Title of the unit: Chemistry of Noble Gasses				
Chemical properties of the noble gases, discovery of $O_2 + Chemistry PtF_6^-$ and O_2XeF_6 . of xenon, structure, and bonding in xenon compounds.						
Unit-4	Number of lectures = 08	Title of the unit: Thermochemistry				

Standard state, standard enthalpy of formation – Hess's Law of heat summation and its applications, Heat of reaction at constant pressure and at constant volume. Enthalpy of neutralization. Bond dissociation energy and its calculation from thermo-chemical data.

Unit-5 **Number of lectures = 08** **Title of the unit: Second Law of Thermodynamics**

Need for the law, different statements of the law, Carnot's cycle and its efficiency, Carnot's theorem. Thermodynamic scale of temperature. Entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, clausius inequality, entropy as a criteria of spontaneity and equilibrium. Gibbs and Helmholtz functions: Gibbs function (G) and

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

5. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/104101090/lec1.pdf
6. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/104106096/lec9.pdf
7. <https://ocw.mit.edu/high-school/chemistry/exam-prep/structure-of-matter/chemical-bonding/>

12. Books recommended:

1. Lee, J.D. Concise Inorganic Chemistry, Pearson Education.
2. Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K. Inorganic Chemistry, Principles of Structure and Reactivity, Pearson Education 2006.
3. Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970.
4. Castellan, G. W. Physical Chemistry, Published by Narosa.
5. Physical Chemistry, Puri Sharma & Pathania. Peter, A. & Paula, J. de. Physical Chemistry 9th Ed., Oxford University Press.

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO											
CO1	3	1	1	1	2	1	3				
CO2	3	2	1	1	1	1	3				
CO3	3	1	1	1	1	1	2				
CO4	3	1	2	2	2	2	3				
CO5	2	2	2	2	2	2	3				
CH221											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 2 nd year/ 3 rd semester						
1. Name of the Department: Biosciences						
2. Course Name	ANGIOSPERM MORPHOLOGY AND TAXONOMY			L	T	P
3. Course Code	BS222			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: This course aims to impart an insight into the habit, vegetative characters and diversity of plants to understand internal structure and reproduction of the most evolved group of plants, the Angiosperms. This course is designed to help the students to understand the distinguishing features of angiosperm families and get an insight into the fruit, seed development and inflorescence.						
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>						
COURSE OUTCOME	ATTRIBUTES					
CO1	To know the phylogenetic relationship of angiosperms					
CO2	This course helps to learn the taxonomic evidences from numerical and chemical taxonomy.					
CO3	The students will learn about the organization of plant body and important modifications of stems, leaves and roots.					
CO4	Detailed description of Brassicaceae, Fabaceae, Euphorbiaceae, Malvaceae, Cucurbitaceae.					
CO5	Detailed description of Asteraceae, Solanaceae Poaceae, Liliaceae, and Orchidaceae.					
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 chemotaxonomy.						
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, Cucurbitaceae.		

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 Orchidaceae.		

11. 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.

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO											
CO1	3	1				2	1				
CO2	3	1				1	1				
CO3	3	1				1	1				
CO4	3	1				1	1				
CO5	3	1				2	1				
BS222											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 2nd year/ 3rd semester							
1. Name of the Department: Biosciences							
2. Course Name	FUNDAMENTALS OF MICROBIOLOGY				L	T	P
3. Course Code	BS113				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 microbiology, classification of microbes, control of microorganisms, microbes in extreme environments and microbial interactions and basics of Recombination in Prokaryotes.							
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>							
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 = 08	Title of the unit: History and classification of microbiology					
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 = 08	Title of the unit: Control of Microorganisms					
Control of Microorganisms: Physical agents (Autoclave, Hot air oven, Laminar airflow and membrane filter.), chemical agents (Alcohol, Halogens and Gaseous 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 (malaria).							
Unit-3	Number of lectures = 08	Title of the unit: Microbes in extreme environments and microbial					

		interactions
Microbes in extreme environments and microbial interactions: The thermophiles alkalophiles, acidophiles and symbiosis and antibiosis among microbial population, N ₂ fixing microbes in agriculture and forestry.		
Unit-4	Number of lectures = 08	Title of the unit: Recombination in Prokaryotes
Recombination in Prokaryotes: Transformation, Conjugation and Transduction.		
Unit-5	Number of lectures = 08	Title of the unit: Bacteriophage
Bacteriophage: Lytic and lysogenic cycle. Stains and staining techniques: Principles of staining, Types of stains – simple stains, structural stains and Differential stains.		
11. Books recommended:		
<ol style="list-style-type: none"> 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 manipulation, Cambridge University Press, USA 8. Lewin, B., Gene VI New York, Oxford University Press. 		

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO											
CO1	3	1				2	2				
CO2	3	1				2	2				
CO3	3	1				2	2				
CO4	3	1				3	1				
CO5	3	1				1	1				
BS113											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Unit-2	Number of lectures = 08	Title of the unit: Conformational Analysis of Alkanes and Cycloalkanes
Conformational analysis of alkanes: Relative stability and Energy diagrams. Types of cycloalkanes and their relative stability, Baeyer strain theory: Chair, Boat and Twist boat forms of cyclohexane with energy diagrams; Relative stability of mono substituted cycloalkanes, cyclopropane ring, banana bonds.		
Unit-3	Number of lectures = 08	Title of the unit: Aromatic Hydrocarbons
Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of the groups: Activating and deactivating substituents, orientation and ortho/para ratio, Side chain reactions of benzene derivatives, Birch reduction; Methods of formation and chemical reactions of alkylbenzenes, alkynylbenzenes and biphenyl,		
Unit-4	Number of lectures = 08	Title of the unit: Solutions and Colligative Properties
Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Thermodynamic derivation using chemical potential to derive relations between the four colligative properties (i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) depression of freezing point, (iv) osmotic pressure and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.		
Unit-5	Number of lectures = 08	Title of the unit: Chemical Equilibrium
Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration (Le Chatelier Principle, Quantitatively). Free energy of mixing and spontaneity. equilibrium between ideal gases and a pure condensed phase		
11. Brief description of self learning / E-learning component		
1. https://nptel.ac.in/courses/115101003/ 2. https://nptel.ac.in/courses/115105100/ 3. http://www.freebookcentre.net/physics-books-download/Atomic-and-Molecular-Physics-NPTEL.html		
12. Books recommended:		
1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. Published by Pearson Education. 2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. Published by Pearson Education. 3. Francis Carey Organic Chemistry, Published by McGraw-Hill Education. 4. Castellan, G. W. Physical Chemistry, Published by Narosa. 5. Physical Chemistry, Puri Sharma & Pathania. 6. Peter, A. & Paula, J. de. Physical Chemistry 9th Ed., Oxford University Press.		

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1		2	1	1				
CO2	3	1	1		2	1	1				
CO3	3	1	2		2	1	1				
CO4	3	1	2		2	1	1				

CO5	3	1	2		2	1	1				
CH222											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 2 nd year/ 3 rd semester						
1.NameoftheDepartment:Chemistry						
2.CourseName	Chemistry Practical-III			L	T	P
3.CourseCode	CH223			0	0	6
4.TypeofCourse(use tick mark)	Core(<input type="checkbox"/> <input type="checkbox"/>)		Foundation Course ()		Departmental Elective()	
5.Pre-requisite (if any)	10+2 with Chemistry	6.Frequency(usetickmarks)	Even ()	Odd (<input type="checkbox"/> <input type="checkbox"/>)	Either Sem ()	EverySem()
7.TotalNumberofLectures,Tutorials,Practicals						
Lectures=00		Tutorials=00		Practical=10		
8. COURSE OBJECTIVES: : The purpose of the undergraduate chemistry Lab program at the Integral University is to provide the key knowledge base and laboratory resources to prepare students for careers as professionals in the field of chemistry, and various other industries.						
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>						
COURSE OUTCOME (CO)	ATTRIBUTES					
CO1	Remember to keep records of all performed experiments in the manner which is required in laboratory.					
CO2	Able to Evaluate water quality parameters like chloride content and alkalinity.					
CO3	Understand the basic titration methods and technical skills to work in the different fields of chemistry.					
CO4	Know about the principles of qualitative and quantitative analysis of inorganic mixtures.					
CO5	Analyze the importance of personal safety and care of equipment's and chemicals.					
10.Syllabus						
Exp-01	Determination of acetic acid in commercial vinegar using NaOH.					
Exp-02	Determination of alkali content – antacid tablet using HCl.					
Exp-03	Estimation of calcium content in chalk as calcium oxalate by permanganometry.					
Exp-04	Gravimetric Analysis: Analysis of Cu as CuSCN and Ni as Ni (dimethylglyoxime).					
Exp-05	Detection of following functional groups present in the given mono-functional organic compounds: a)					

Exp-06	To determine the enthalpy of neutralization of a weak acid/weak base versus strong base/ strong acid and determine the enthalpy of ionization of the weak acid/weak base.
Exp-07	Chemical Equilibrium: The equilibrium between Fe ³⁺ and Fe(CNS) ₂ ⁺ .
Exp-08	Determination of molecular weight of a non-volatile solute by Rast method/ Beckmann freezing point
Exp-09	To study the effect of concentration on equilibrium.
11. Brief description of self learning/ E-learning component	
https://www.fandm.edu/uploads/files/79645701812579729-genchem-reference-for-web.pdf http://file.akfarmahadhika.ac.id/E-BOOK/12-1213-akfarmahad-16-1-vogelqu-d.pdf https://faculty.psau.edu.sa/filedownload/doc-6-pdf-f06110ef2e1e1ae119cbacf71dd17732-original.pdf https://www.stem.org.uk/resources/collection/3959/practical-chemistry	
12. Books recommended:	
13. Books recommended:	
1. Advance Practical Chemistry: Jagdamba Singh, L.D.S Yadav, Jaya Singh, I.R. Siddiqui, Pragati Edition. 2. Practical Organic Chemistry, A.I.Vogel. 3. Practical Physical Chemistry: B. Viswanathan and P.S.Raghavan. 4. Experimental Inorganic Chemistry –W.G.Palmer.	

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO											
CO1	3	1	2		3	1	2	3			
CO2	3	1	1		2		2	3			
CO3	3	1	2		1	1	2	3			
CO4	3	1	1		1	1	2	3			
CO5	2	1	1		2	1	2	2			
CH223											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 2 nd year/ 3 rd semester							
1. Name of the Department: Biosciences							
2. Course Name	ANIMAL DIVERSITY LAB-II				L	T	P
3. Course Code	BS262				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 have a firm foundation in the fundamentals of different animal phyla and to learn slide preparation and identification.							
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>							
COURSE OUTCOME	ATTRIBUTES						
CO1	Understand how to prepare and study permanent and temporary slides.						
CO2	Understand and identify Embryonic membranes-Whole mount of 72 hr chick embryo.						
CO3	Understand and identify various animals from different phyla through specimens.						
CO4	Learn to dissect Dogfish.						
CO5	Learn to differentiate poisonous and non-poisonous snakes.						
10. Syllabus							
Exp-01	External characters of <i>Scoliodon</i>						
Exp-02	Permanent stained preparation of ampullae of Lorenzini						
Exp-03	Glycerine and permanent preparation of placoid scales						
Exp-04	Dissection: <i>Scoliodon</i>						
Exp-05	Embryonic membranes-Whole mount of 72 hr chick embryo						
Exp-06	Study of poisonous and non-poisonous snakes						
Exp-07	Difference between Crocodile, <i>Alligator</i> , and <i>Gavialis</i>						

Exp-08	Study of the following specimens: <i>Herdmania, Amphioxus, Anguilla, Acipenser, Ambystoma, Rana, Varanus, Viper, Heloderma, Naja, Pavo, Psittacula, Porcupine, Platypus, Oryctolagus, Armadillo, Manis</i>
Exp-09	Study of the permanent histology (various organs) slides
11. Books recommended:	
1. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press. Pough H. Vertebrate life, VIII Edition, Pearson International. 2. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.	

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO											
CO1	3	3	1				1		3	2	
CO2	3	3	1				1	2	3	1	
CO3	3	3	1			3	1	3	3	2	
CO4	3	3	1				1		2	3	1
CO5	3	3	1			1	1	2	3	2	1
BS262											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 2nd year/ 4th semester

1. Name of the Department: Biosciences							
2. Course Name	EVOLUTIONARY BIOLOGY AND WILDLIFE				L	T	P
3. Course Code	BS271				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 have a firm foundation in the evolution of fauna and its habitat.							
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>							
COURSE OUTCOME (CO)	ATTRIBUTES						
CO1	The students will learn the animal distribution and the factors which affect their distribution.						
CO2	The students will learn about the Origin of life and its various theories.						
CO3	The students will learn about the concept of evolution and theory of natural as well as sexual selection.						
CO4	The expected outcome is to provide the students an in-depth understanding of species concept.						
CO5	The students will learn about the different wildlife habitat in natural as well as artificial environment. The students will						
10. Unit wise detailed content							
Unit-1	Number of lectures = 08	Title of the unit: Animal distribution					
Continental distribution, Aspects and Patterns of animal distribution (Continuous, Discontinuous and Bipolar), Factors affecting distribution, Geological distribution and Geographical distribution with their characteristic fauna, Wallace's line, Animal Diversity: Alpha, Beta and Gamma.							
Unit-2	Number of lectures = 08	Title of the unit: Origin of Life					
Theories of origin of life, Missing link, Natural selection (Example: Industrial melanism), Types of natural selection (Directional, Stabilizing, Disruptive), Sexual selection, Concept of genetic drift.							
Unit-3	Number of lectures = 08	Title of the unit: Evolution					

Concepts of Evolution, Theories of evolution: Lamarckism, Criticism of Lamarckism, Neo-Lamarckism, Darwinism, Theory of sexual, artificial and natural selection, Objection to Darwinism, Neo-Darwinism, Evidences of evolution.

Unit-4	Number of lectures = 08	Title of the unit: Species Concept
Speciation, Modes of speciation (Allopatric, Sympatric and Parapatric), Morphological, Genetic and Biological species concept, Monotypic and Polytypic species, Subspecies categories (Clines and Deme)		

Unit-5	Number of lectures = 08	Title of the unit: Wild life of India
Modern Concepts (IUCN categories), endangered species, Different projects launched for the preservation of animal species, Important sanctuaries, national parks of India, in-situ and ex-situ conservation of wildlife.		

11. Books recommended:

1. Biodiversity and Quality of Life. Sengupta. Mc Millan India Pvt. Ltd.
2. Biology: P. H. Raven & G. B. Jhonson
3. Organic Evolution by Veer Bala Rastogi
4. Evolution Paperback: by Douglas J. Futuyma, Mark Kirkpatrick
5. Evolutionary biology: Singh and Tomar

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO											
CO1	3	1				3	1	2	3		
CO2	3	1				1	1	2	3		
CO3	3	1				1	1	2	3		
CO4	3	1				2	1	2	3		
CO5	3	1				3	1	2	3	1	
BS271											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 2nd year/ 4th 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 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 Organizational level of Integumentary, Skeletal, Digestive, Respiratory, Circulatory, Urinogenital and Nervous System in Different Vertebrate Classes and to get an idea of the role played by evolution in their development. The students will also get an in-depth understanding of developmental processes with the help of Chick Embryo development as a model system.						
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>						
COURSE OUTCOME (CO)	ATTRIBUTES					
CO1	The students will learn about the basic organization of integumentary, skeletal and digestive systems. They will also be able to learn about its various modifications and their evolutionary importance.					
CO2	The students will learn about the functioning of physiological systems like Respiratory, Circulatory and Urinogenital system.					
CO3	The students will get an in-depth knowledge of Nervous system in various classes of vertebrates. They will also learn about the sensory systems present in different vertebrate classes.					
CO4	To provide the students an in-depth understanding of various stages involved in development of young ones from a single celled zygote.					
CO5	The students will learn about the development of chick embryos as a model system of embryo development.					
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
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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
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Comparative account of brain; Sense Organs: Types of receptors.

Unit-4	Number of lectures = 08	Title of the unit: Gametogenesis, Fertilization, Egg structure and types. Types and patterns of cleavage. Stem Cell and Its potency. Cell lineage, Genomic equivalence.
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Unit-5	Number of lectures = 08	Title of the unit: Process of Blastulation and Gastrulation
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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. 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 McGraw Hills □ Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure, 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.

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO											
CO1	3	1				1	1	3	3	1	
CO2	3	1					1	3	3	1	
CO3	3	1					1	3	3	1	
CO4	3	1					1	3	3	1	
CO5	3	1					1	3	3	1	
BS322											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 2 nd year/ 4 th semester						
1. Name of the Department: Chemistry						
2. Course Name	Organic and Physical Chemistry-II			L	T	P
3. Course Code	CH224			3	1	0
4. Type of Course (use tick mark)	Core (√)		Foundation Course		Departmental Elective ()	
5. Pre-requisite (if any)	10+2 with Chemistry	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 develop the deep understanding of general characteristic properties of transition elements, nomenclature and isomerism in coordination compounds, organometallic chemistry of transition elements, chemistry of Lanthanide and actinides, solid state chemistry and to gain the knowledge of basics of electrochemistry and construction of cells for the calculation of EMF/ Gibbs free energy value.						

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

COURSE OUTCOME	ATTRIBUTES
CO1	Student will be able to understand the approaches to the development of d block fundamental with CFT/VBT/MOT and its widespread applications.
CO2	Students will have a firm foundation in the IUPAC nomenclatures of the complexes and the bonding models, structures, reactivity, and applications of coordination complexes, boron hydrides, metal carbonyls, and organometallics.
CO3	Students will be able to understand about the key concepts of inorganic and organometallic chemistry including those related to synthesis, reaction chemistry, and structure and bonding.
CO4	Students will be able to understand about the key concepts of solid state chemistry, structure elucidation through X ray diffractions methods.
CO5	Students will have a firm foundation in the basic of the electrochemistry, transport phenomenon and conduction approaches to the development of electron transfer process for the cell reactions.

10. Unit wise detailed content

Unit-1	Number of lectures = 08	Title of the unit: Chemistry of Elements of Transition Series
Chemistry of Elements of First Transition Series: Characteristic properties of d-block elements. Binary compounds (hydrides, carbides and oxides) of the elements of the first transition series and complexes with respect to relative stability of their oxidation states, coordination number and geometry. (Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment of Zr/Hf, Nb/Ta, Mo/W in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry		
Unit-2		Title of the unit: Coordination Compounds
Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.		
Unit-3		Title of the unit: Chemistry of Elements of inner transition Series
Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, ceric ammonium sulphate and its analytical uses. Chemistry of Actinides: configuration, oxidation states and magnetic properties, chemistry of separation of Np, Pu and Am from U.		
Unit-4	Number of lectures = 08	Title of the unit: Solid States
Definition of space lattice, unit cell. X-ray diffraction by crystals, Derivation of Bragg equation, Determination of crystal structure of NaCl, KCl and CsCl (Laue's method and powder method). Defects in crystals.		
Unit-5	Number of lectures = 08	Title of the unit: Electrochemistry – I
Electrical transport - Conduction in metals and in electrolyte solutions, specific conductance, equivalent conductance, variation of equivalent and specific conductance with dilution. Kohlrausch's law, weak and strong electrolyte, Arrhenius theory of electrolyte dissociation and its limitations. Ostwald's dilution law its uses and limitations.		
11. Brief description of self learning/ E-learning component		
https://www.fandm.edu/uploads/files/79645701812579729-genchem-reference-for-web.pdf		
http://file.akfarmahadhika.ac.id/E-BOOK/12-1213-akfarmahad-16-1-vogelqu-d.pdf		
https://faculty.psau.edu.sa/filedownload/doc-6-pdf-f06110ef2e1e1ae119cbacf71dd17732-original.pdf		

12. Books recommended:

1. Lee, J.D. Concise Inorganic Chemistry, Pearson Education.
2. Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K. Inorganic Chemistry, Principles of Structure and Reactivity, Pearson Education 2006.
3. Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970.
4. Castellan, G. W. Physical Chemistry, Published by Narosa.
5. Physical Chemistry, Puri Sharma & Pathania.
6. Peter, A. & Paula, J. de. Physical Chemistry 9th Ed., Oxford University Press.

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO											
CO1	3	1	1		2	1	2				
CO2	3	1	1		2	1	2				
CO3	3	1	2		2	1	3				
CO4	3	1	2		2	1	3				
CO5	3	1	2		2	1	3				
BS224											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 2nd year/ 4th semester						
1. Name of the Department: Chemistry						
2. Course Name	Organic and Physical Chemistry-II			L	T	P
3. Course Code	CH225			3	1	0
4. Type of Course (use tick mark)	Core (✓)		Foundation Course		Departmental Elective ()	
5. Pre-requisite (if	10+2 with Chemistry	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: Students will be able to understand Alkyl and Aryl Halides, Alcohols, phenols, Aldehydes and Ketones, Chemical Kinetics, Phase Equilibrium.						
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>						
COURSE OUTCOME	ATTRIBUTES					
CO1	Comprehension of classification, methods of formation and chemical reactions of alkyl halides, Mechanism of nucleophilic substitution reaction of alkyl halides (SN ¹ and SN ² reactions) with energy profile diagrams.					
CO2	To create basic knowledge of nomenclature, methods of formation, Hydrogen bonding. Acidic nature, Reactions of alcohols, Dihydric alcohols and phenols.					
CO3	Able to evaluate different types of Synthesis of aliphatic aldehydes and ketones, alcohols, carboxylic acids and named reactions as Reimer-Tiemann reaction, gattermann-koch reaction and aromatic ketones by Friedel craft acylation.					
CO4	Analyze and compare Theories of chemical kinetics, Molecularity and order of reaction, concept of activation energy method of integration, half-life method and isolation method, Thermodynamics aspect of transition state theory.					
CO5	Understand the terms-phase, component and degree of freedom, derivation of Gibb's phase rule, one component system-water, two component system solid liquid equilibria simple eutectic – Bi-Cd, Pb-Ag systems, desilverisation of lead					
10. Unit wise detailed content						
Unit-1	Number of lectures = 08		Title of the unit: Alkyl and Aryl Halides			
Methods of formation, chemical reactions. Mechanism of nucleophilic substitution reactions of alkyl halides, SN₂ and SN₁ reactions with energy profile diagrams, Aryl halides - Methods of formation, nuclear and side chain reactions. Mechanisms of nucleophilic aromatic						
Unit-2	Title of the unit: Alcohols & Phenols					
Monohydric alcohols- nomenclature, methods of formation, reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding. Acidic nature, Reactions of alcohols and pinacol-pinacolone rearrangement. Preparation of phenols, physical properties and acidic character, Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols – electrophilic aromatic substitution, acylation and carboxylation. Fries rearrangement, Claisen rearrangement, & Reimer-Tiemann						
Unit-3	Title of the unit: Aldehydes and Ketones					
Synthesis of aliphatic aldehydes and ketones with particular reference to acid chlorides, alcohols, carboxylic acids, Grignard reagent, alkenes and 1, 3-dithianes. Synthesis of aromatic aldehydes by oxidation of alkyl benzene, Reimer-Tiemann reaction, Gattermann-Koch reaction and aromatic ketones by Friedal Craft Acylation. Aldol condensation, Cannizzaro reaction, Clemmensen reduction and Wolff-						

Unit-4	Number of lectures = 08	Title of the unit: Chemical Kinetics
<p>(i) Molecularity and order of reaction, concentration dependence of rates, integrated rate expression for- zero order, first order, second order, pseudo order reactions, half-life.</p> <p>(ii) Determination of the order of reaction: Differential method, method of integration, half-life method and isolation method.</p> <p>(iii) Theories of chemical kinetics: Arrhenius theory of reaction rate, effect of temperature on rate of reaction, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis). Thermodynamics aspect of</p>		
Unit-5	Number of lectures = 08	Title of the unit: Phase Equilibrium
<p>Statement and meaning of the terms-phase, component and degree of freedom, derivation of Gibb's phase rule, phase equilibria of one component system-water, 'CO₂' and 'S' systems. Phase equilibria of two component system – solid liquid equilibria simple eutectic – Bi-Cd, Pb-Ag systems, desilverisation of lead..</p>		
11. Brief description of self learning / E-learning component		
<p>https://www.fandm.edu/uploads/files/79645701812579729-genchem-reference-for-web.pdf http://file.akfarmahadhika.ac.id/E-BOOK/12-1213-akfarmahad-16-1-vogelqu-d.pdf https://faculty.psau.edu.sa/filedownload/doc-6-pdf-f06110ef2e1e1ae119cbacf71dd17732-original.pdf https://www.stem.org.uk/resources/collection/3959/practical-chemistry</p>		
12. Books recommended:		
<ol style="list-style-type: none"> Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. Published by Pearson Education. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. Published by Pearson Education. Francis Carey Organic Chemistry, Published by McGraw-Hill Education. Castellan, G. W. Physical Chemistry, Published by Narosa. Physical Chemistry, Puri Sharma & Pathania. Peter, A. & Paula, J. de. Physical Chemistry 9th Ed., Oxford University Press. 		

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO											
CO1	3	1	1		2	1	1				
CO2	3	1	1		2	1	1				
CO3	3	1	2		2	1	1				
CO4	3	1	2		2	1	1				
CO5	3	1	2		2	1	1				
CH225											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 2 nd year/ 4 th 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 any)	10+2 with Biology	6. Frequency (use tick marks)		Even (✓)	Odd ()	Either Sem ()
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		Tutorials = 10		Practical = 00		
8. COURSE OBJECTIVES: The purpose of this course is to develop the deep understanding of plant water relations. The understanding of nutrition in plants, morphology and physiology of plants and plant growth, plant hormones and its relation with plant growth and development.						
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>						
COURSE OUTCOME (CO)	ATTRIBUTES					
CO1	Students will have an understanding of movement of water and solutes in plant, ascent of sap and transpiration.					
CO2	Have knowledge of Essential elements, their absorption, transport and role in plants and translocation in phloem.					
CO3	Know about basics of C assimilation, Photosynthesis, Photorespiration and Nitrogen metabolism specially Biological nitrogen fixation.					
CO4	Inculcate basic knowledge about Enzymes and Plant growth regulators, Seed dormancy and germination.					
CO5	Comprehend the response of plant to light, temperature and stress, specially 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. 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		

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO											
CO1	3	1					1				
CO2	3	1					1				
CO3	3	1				1	1				
CO4	3	1					1				
CO5	3	1					1				
BS203											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 2nd year/ 4th semester							
1. Name of the Department: Biosciences							
2. Course Name	CYTOGENETICS AND ANGIOSPERM TAXONOMY LAB				L	T	P
3. Course Code	BS272				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	Every Sem	

any)				()	Sem ()	()
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		Tutorials = 10		Practical = 00		
8. COURSE OBJECTIVES The objective of this course is to have a firm foundation in cytogenetics and develop understanding of angiosperms and their economic importance.						
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>						
COURSE OUTCOME (CO)	ATTRIBUTES					
CO1	Learn to measure cell size in micrometer scale with the help of a microscope, know about polytene chromosomes and Barr bodies.					
CO2	Learn, understand and demonstrate mitotic and meiotic cell division in plants, and understand the structure of chromosomes and importance of karyotyping.					
CO3	Learn, understand and demonstrate vegetative and floral characters of different families of angiosperm.					
CO4	Understand the structure and importance of different reproductive parts of plants including flowers, fruits and seeds.					
CO5	To recognize different kinds of plant based on their vegetative and floral characters.					
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 slide					
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).					

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO											
CO1	3	3	1				1				
CO2	3	3	1				1				
CO3	3	3	1			3	1				
CO4	3	3	1			2	1				
CO5	3	3	1			2	1				
BS272											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 2 nd year/ 4 th semester						
1.Name of the Department: Chemistry						
2.Course Name	Chemistry Practical-III			L	T	P
3.Course Code	CH226			0	0	6
4.Type of Course (use tick mark)	Core(<input type="checkbox"/> <input type="checkbox"/>)		Foundation Course ()		Departmental Elective()	
5.Pre-requisite (if any)	10+2 with Chemistry	6.Frequency(use tick marks)	Even (<input type="checkbox"/>)	Odd (<input type="checkbox"/>)	Either Sem ()	EverySem()
7.TotalNumberofLectures,Tutorials,Practicals						
Lectures=00		Tutorials=00		Practical=10		
8. COURSE OBJECTIVES: Students will have a firm foundation in the fundamentals and application of current chemical and scientific theories including those in analytical, inorganic, organic and physical chemistry along with the laboratory safety, use of an analytical balance for mass measurement, use of thermometers and temperature probes, use of graduated cylinders, graduated pipettes, and volumetric pipettes for volumetric measurement, titrations, the calibration and use simple spectrophotometers, pH meters, centrifuges						
9. COURSE OUTCOMES (CO):						
<i>After the successful course completion, learners will develop following attributes:</i>						
COURSE OUTCOME (CO)	ATTRIBUTES					
CO1	Student will be able to understand the approaches to sample analysis with acid base titrimetric method.					
CO2	Students will have a firm foundation in the preparation of coordination complexes and duple salts.					
CO3	Students will be able to understand about the key concepts of conductometric titrations.					
CO4	Students will be able to understand about the key concepts of compexometric titrations.					
CO5	Students will have a firm foundation in the basic of the electrochemistry, transport phenomenon and conduction approaches to the development of electron transfer process for the cell reactions.					
10.Syllabus						
Exp-01	Acetylation of salicylic acid, aniline, glucose and hydroquinone, Benzoylation of aniline and phenol					
Exp-02	Oxidation: Preparation of benzoic acid from toluence Reduction: Preparation of aniline from nitrobenzene					
Exp-03	To study the effect of concentration on the rate of reaction between sodium thiosulphate and hydrochloric acid.					
Exp-04	To determine the pKa of acetic acid					

Exp-05	Determination Critical Solution Temperature (CST) for the Phenol – Water System.
Exp-06	Inorganic Chemistry: Preparation of the following: 1. Chrome Alum, 2.Potash Alum , 3.Sodium Ferrioxalate
Exp-07	Aliphatic electrophilic substitution: Preparation of iodoform from ethanol and acetone
Exp-08	To determine the strength of given acetic acid solution conductometrically by titrating against a standard solution.
11. Brief description of self learning/ E-learning component	
https://www.fandm.edu/uploads/files/79645701812579729-genchem-reference-for-web.pdf http://file.akfarmahadhika.ac.id/E-BOOK/12-1213-akfarmahad-16-1-vogelqu-d.pdf https://faculty.psau.edu.sa/filedownload/doc-6-pdf-f06110ef2e1e1ae119cbacf71dd17732-original.pdf https://www.stem.org.uk/resources/collection/3959/practical-chemistry	
12. Books recommended:	
1. Advance Practical Chemistry: Jagdamba Singh, L.D.S Yadav, Jaya Singh, I.R. Siddiqui, Pragati Edition. 2. Practical Organic Chemistry, A.I.Vogel. 3. Practical Physical Chemistry: B. Viswanathan and P.S.Raghavan. 4. Experimental Inorganic Chemistry –W.G.Palmer.	

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO											
CO1	3	1	2		3	1	2	3			
CO2	3	1	1		2		2	3			
CO3	3	1	2		1	1	2	3			
CO4	3	1	1		1	1	2	3			
CO5	2	1	1		2	1	2	3			
BS203											

1- Low Correlation;
2- Moderate
3- Substantial Correlation

Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 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 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 paper deals to understand the scope and importance of plant anatomy and embryology of angiosperm plant. This paper provides information of various tissue systems, anomalous secondary growth in plants. To understand structure and development in microsporangium and megasporangium, the process of microsporogenesis and megasporogenesis, fertilization, endosperm and embryogeny.						
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>						
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 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	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: Governmental Regulations				
Introduction, Food laws and standards: Indian food safety laws and standards; Quality and safety assurance in food industry; BIS Laboratory Services and Certification by BIS.						
Unit-2	Number of lectures = 08	Title of the unit: Constituents of Food and their Nutritive Aspects				
Carbohydrates, Proteins, Fats and oils, Vitamins and Minerals.						
Unit-3	Number of lectures = 08	Title of the unit: Food Processing Techniques				
Common unit operations, Food deterioration and their control; Heat preservation and processing, Cold preservation and processing Food dehydration, Food concentration & food packaging.						
Unit-4	Number of lectures = 08	Title of the unit: Food Additives				
Preservatives, Antioxidants, Chelating agents, Surface active agents, Stabilizing and Thickening agents, Buffering agents, Colouring agents, Sweetening agents & Flavoring agents.						
Unit-5	Number of lectures = 08	Title of the unit: Food Safety, Risks and Hazards				

Food related Hazards, Microbiological Considerations in food safety, Effects of processing and storage on microbial safety, Chemical hazards associated with foods, Prevention methods from food born disease.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	To evaluate the structural organization of flower and the process of pollination and fertilization, structure and development of dicot and monocot embryos.	3	1				1	1
CO2	Course component will provide an understanding on the evolution of concept of organization of shoot and root apex.	3	1				1	1
CO3	To understand the basic concepts with ability to identify and distinguish various features related to anatomy and embryology.	3	1				1	1
CO4	To understand the scope and importance of plant anatomy and embryology of angiospermic plant.	3	1				1	1
CO5	To understand structure and development in microsporangium and megasporangium, process of microsporogenesis and megasporogenesis.	3	1				1	1

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

12. Books recommended:

1. Food Chemistry, Belitz and Gosch, Springer – Verlag Bertin Heiderberg, 2nd Edition, 1999
2. Principles of Human Nutrition, Martin Eastwood, Chapman and Hall, London, I Edition, 1997.
3. Food – The Chemistry of its Components, T.P. Coultate, Royal Soc. Chemistry, 4th Edition, 2002.
4. Food additives, Branam, Alfred Larry, Davidson P. Michae, Food Science and Technology series (35), Morcel Dekker, Inc, 1990.
5. Introduction to food science, Rick Parker, Delmar Learning, U.S.A, I Edition, 2003.
6. Nutrition Science and application, Lori Smolin L.A., Saunders College Publishing, 3rd Edition.
7. Human Nutrition and dietetics, J.S. Barrow, W.P.T James, Churchill Livingstone, 9th Edition, 1993.

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	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			
CH226											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 3st year/ 5th semester

1. Name of the Department: Biosciences

2. Course Name	PLANT ECOLOGY, PHYTOGEOGRAPHY AND ECONOMIC	L	T	P
3. Course Code	BS366	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 paper is to develop the understanding of basics of ecology, phytogeography and economic botany.**9. COURSE OUTCOMES (CO):***After the successful course completion, learners will develop following attributes:*

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Understand the basics of Ecosystem and Ecology
CO2	Concept, components, Fundamental of dynamics of ecology.
CO3	Have knowledge about pollution, renewable and non-renewable, management problem of depletion of natural vegetation.
CO4	Understand phytogeography and Plant ecological adaptations.
CO5	Learn about the economic importance of plants.

10. Unit wise detailed content

Unit-1	Number of lectures = 08	Title of the unit: Plant Ecology
Definition, scope, branches, Ecological factor affecting the vegetation. Ecosystem: Structure, its biotic and abiotic components, food chain and food web, ecological pyramids, energy flow, biogeochemical cycles..		
Unit-2	Number of lectures = 08	Title of the unit: Productivity
Primary and secondary productivity and their measurements. Plant succession: causes. Process types: Hydrosere, Xerosere (Lithosere and Psammosere). Community: Structure and development		
Unit-3	Number of lectures = 08	Title of the unit: Pollution of air, water, Noise, their causes,
Renewable and non-renewable, management problem of depletion of natural vegetation; endangered plants. Red data book. National parks and sanctuaries.		
Unit-4	Number of lectures = 08	Title of the unit: Plant adaptations
Hydrophytes, Xerophytes and Halophytes (morphological, anatomical and physiological adaptations). Phytogeography: Introduction, continuous and discontinuous distribution, Phytogeography of India, Plant indicators.		
Unit-5	Number of lectures = 08	Title of the unit: Economic importance of plants
Use of plants as food as Cereals, Legumes, Spices, Beverages, feed and fodder. Plants as a source of wood, fiber, paper and pulp and medicines.		
11. Books recommended:		
1. Odum Ecology		
2. P. D. Sharma, Ecology		

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO											
CO1	3	1				3	1				
CO2	3	1				3	1				
CO3	3	1		1		3	1				
CO4	3	1				3	1				
CO5	3	1		1		3	1				
BS366											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 3rd year/ 5th 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 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 understand what is 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): <i>After the successful course completion, learners will develop following attributes:</i>		
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	Translation in prokaryotes and eukaryotes and post translational modifications.	
CO5	Concept of regulation of gene expression in prokaryotes using Lac operon and in eukaryotes.	
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.		
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. Books recommended:		
1. Howe.C. (1995) Gene Cloning and manipulation, Cambridge University Press, USA 2. Lewin, B., Gene VI New York, Oxford University Press. 3. Sambrook et 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 & Biotechnology (Indian Edition) Royal Society of Chemistry U.K 5. Karp.G (2002) Cell & Molecular Biology, 3rd Edition, John Wiley & Sons; INC.		

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO											
CO1	3	1					1	1	3	1	
CO2	3	1					1	1	3	1	
CO3	3	1					1	1	3	1	
CO4	3	1					1	1	3	1	
CO5	3	1					1	1	3	1	
BS212											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 3rd year/ 5th semester						
1. Name of the Department: Biosciences						
2. Course Name	APPLIED AND ECONOMIC ZOOLOGY			L	T	P
3. Course Code	BS361			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 give students in depth knowledge about the economic importance of various animal species. The students will also be made aware about the diseases caused by parasites.			
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>			
COURSE OUTCOME (CO)	ATTRIBUTES		
CO1	The students will learn about the transmission, prevention and control of diseases like Dengue, Malaria, Amoebiasis etc		
CO2	The students will get an indepth knowledge of life cycle and pathogenicity of animal and human parasites like Trypanosoma, Giardia, Wucheraria etc.		
CO3	The students will learn about the life cycle and control of various vectors and pests		
CO4	The expected outcome is to provide the students an in-depth understanding of integrated pest management.		
CO5	The students will learn about the culturing of economically important species like fishes, honeybees etc.		
10. Unit wise detailed content			
Unit-1	Number of lectures = 08	Title of the unit: Epidemiology of infectious diseases	
Transmission, prevention and control of diseases: Tuberculosis, Amoebiasis, Dengue, Malaria, and Swine flu. Brief account of Rickettsia, Borellia, Treponema and Leptospira			
Unit-2	Number of lectures = 08	Title of the unit: Structure, life cycle and Pathogenicity	
including diseases, causes, symptoms and control of the following parasites of domestic animals and humans: Trypanosoma, Giardia, Diphylobothrium, Hymenolepis, Dracunculus, Wuchereria, Faciolopsis and Paragonimus. Plant Nematodes, nature of their damage and control measures including Meloïdogyne			
Unit-3	Number of lectures = 08	Title of the unit: Vectors and pests	
Vectors like mosquito, house fly, bed bug, louse and their control. Pest, types, characteristic features, life cycle, nature of damage and control of termite, cockroach, cloth moth, grain moth, wax moth, gundhi bug, sugarcane leaf-hopper and rodents			
Unit-4	Number of lectures = 08	Title of the unit: Bionomics and control of stored grain pests and their	
Corcyra, Trogoderma, Callosobruchus and Sitophilus. Classification of insect control with reference to chlorinated hydrocarbons, organophosphates, carbamates and synthetic pyrethroid, General aspects of Integrated Pest Management (IPM)			
Unit-5	Number of lectures = 08	Title of the unit: Animal culture	
Aquaculture, Pisciculture, Poultry, Sericulture, Apiculture, Lac-culture			
11. Books recommended:			

1. Park, K. (2007) Preventive and social medicine. XVI Edition. B.B Publisher.
2. Arora, D.R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributers.
3. Chaudhury, S.K. (1996) Practice of fertility Control, A Comprehensive Textbook. B.I.Churchill Livingston Pvt Ltd, India.
4. Hafez, E. S. E. (1962). Reproduction in Farm Animals. Lea & Fabiger Publisher.
5. Hafez, E. S. E. and Evans, T. N. (1973). Human Reproduction: Contraception and Conception. Harper and Row, New York.
6. Atwal, A. S. (1993) Agricultural Pests of India and South East Asia. Kalyani Publishers, New Delhi.
7. Pradhan, S (1983) Insect Pests of Crops. National Book Trust, India.
8. Prost, P.J. (1962) Apiculture. Oxford and IBH, New Delhi.
9. Knobil, E. & Neill, J.D. (2006) The Physiology of Reproduction, Vol. 2, Elsevier Pub.
10. Srivastava, C.B.L. (1999) Fishery Science and Indian Fisheries. Kitab Mahal publications, India.
11. Dunham R.A. (2004) Aquaculture and Fisheries Biotechnology Genetic Approaches. CABI publications, U.K

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO											
CO1	3	1				1	1	1	3	2	1
CO2	3	1				1	1	1	3	2	1
CO3	3	1				1	1	1	3	2	1
CO4	3	1		1		1	1	1	3	2	1
CO5	3	1				1	1	1	3	2	1
BS361											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 3rd year/ 5th semester

1. Name of the Department: Biosciences

2. Course Name: ECOLOGY AND ANIMAL BEHAVIOUR

3. Course Code: BS362

L	T	P
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 ecology, chronobiology and animal behaviour.						
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>						
COURSE OUTCOME (CO)	ATTRIBUTES					
CO1	Autecology and Synecology, Levels of organization, Laws of limiting factors, Study of physical factors.					
CO2	Concept, components, Fundamental of dynamics of ecology.					
CO3	Introduction to Ethology and different Patterns of Behaviour.					
CO4	Social Behaviour, Concept of Society; Communication and the senses, sexual selection.					
CO5	Introduction and history of chronobiology, biological rhythms, photoperiodism, biological clocks and human health.					
10. Unit wise detailed content						
Unit-1	Number of lectures = 08	Title of the unit: History of Ecology				
Autecology and Synecology, Levels of organization, Laws of limiting factors, Study of physical factors.						
Unit-2	Number of lectures = 08	Title of the unit: Ecosystem				
Concept, components, Fundamental operations, Ecological pyramids and Ecological efficiencies, energy flow, foodchain, food webs and trophic levels, ecological niche. Types of ecosystem (one example in detail), Ecological succession. Adaptation: Aquatic, terrestrial, aerial and arboreal.						
Unit-3	Number of lectures = 08	Title of the unit: Introduction to Ethology				
Patterns of Behaviour-Stereotyped Behaviours (Orientation, reflexes), individual behavioral patterns, Instinct Vs learnt behavior, Learning: Imprinting, habituation and sensitization, associative learning: punishment and reward learning, trial and error learning; taste aversion learning, cache retrieval; social learning, gene- environmental effect on behaviour						
Unit-4	Number of lectures = 08	Title of the unit: Social Behaviour				
Concept of Society; Communication and the senses; Altruism; Insects' society with Honey bee as example; Foraging in honey bee and advantages of the waggle dance. Sexual Behaviour: Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice), Sexual conflict in parental care						
Unit-5	Number of lectures = 08	Title of the unit: Chronobiology				
Introduction and history of chronobiology, biological rhythms: definition, type and their characteristics, free run, entrainment, seasonal rhythms, photoperiodism, biological clocks and human health.						
11. Books recommended:						

1. Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings.
2. Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
3. Robert Leo Smith Ecology and field biology Harper and Row publisher
4. Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Pres
5. David McFarland, Animal Behaviour, Pitman Publishing Limited, London, UK.
- Manning, A. and Dawkins, M. S, An Introduction to Animal Behaviour, Cambridge, University Press, UK.
- 6 John Alcock, Animal Behaviour, Sinauer Associate Inc., USA.
7. Chronobiology Biological Timekeeping: Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO											
CO1	3	1				3	1	2	3	1	
CO2	3	1				3	1	2	3	1	
CO3	3	1	2			3	1	2	3	1	
CO4	3	1	2	1		3	1	2	3	1	
CO5	3	1				3	1	2	3	1	
BS362											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 3 rd year/ 5 th semester						
1. Name of the Department: Biosciences						
2. Course Name	FUNDAMENTALS OF BIOMOLECULES			L	T	P
3. Course Code	BS363			2	1	0
4. Type of Course (use tick mark)	Core (<input checked="" type="checkbox"/>)		Foundation Course	Departmental Elective ()		
5. Pre-requisite (if any)	10+2 with Biology	6. Frequency (use tick marks)	Even ()	Odd (<input checked="" type="checkbox"/>)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 20		Tutorials = 10		Practical = 00		
8. COURSE OBJECTIVES: The objective of this course is to learn about biomolecules						
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>						
COURSE OUTCOME (CO)	ATTRIBUTES					
CO1	Learn about Biomolecules understand Structure, classification and types of Carbohydrates.					
CO2	Have knowledge of Amino acids and Proteins: Structure, Classification and properties of amino acids, Peptide bond, Proteins- primary, secondary, tertiary and quaternary structures.					
CO3	Study Lipids: Structure, function, classification and properties of Fatty acids, Glycerolipid, Cholesterol, Sphingolipid, Phospholipids, Lipoproteins, Glycoproteins.					
CO4	Have knowledge of Nucleic acids- Purines and pyrimidines, nucleosides, nucleotides, polynucleotides, DNA types- A DNA, B DNA and Z DNA and their function .					
CO5	Have knowledge of RNA types- mRNA, rRNA and tRNA and their function, Forces stabilizing nucleic acid structure, sources, dietary requirements, function and deficiency disorders of water and fat soluble vitamins.					
10. Unit wise detailed content						
Unit-1	Number of lectures = 08	Title of the unit: Introduction to Biomolecules Carbohydrates- Structure, classification and properties of Monosaccharides, Disaccharides and Polysaccharides.				
Unit-2	Number of lectures = 08	Title of the unit: Amino acids and Proteins Structure, Classification and properties of amino acids, Peptide bond, Proteins- primary, secondary, tertiary and quaternary structures.				
Unit-3	Number of lectures = 08	Title of the unit: Lipids Structure, function, classification and properties of Fatty acids, Glycerolipid, Cholesterol, Sphingolipid, Phospholipids, Lipoproteins, Glycoproteins.				
Unit-4	Number of lectures = 08	Title of the unit: Nucleic acids Purines and pyrimidines, nucleosides, nucleotides, polynucleotides, DNA types- A DNA, B DNA and Z DNA and their function.				
Unit-5	Number of lectures = 08	Title of the unit: RNA types mRNA, rRNA and tRNA and their function, Forces stabilizing nucleic acid structure. Sources, dietary requirements, function and deficiency disorders of water and fat soluble vitamins.				
11. Books recommended:						

1. Principles of Biochemistry- Albert L. 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

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO											
CO1	3	1					1	1	3	1	1
CO2	3	1					1	1	3	1	1
CO3	3	1					1	1	3	1	1
CO4	3	1					1	1	3	1	1
CO5	3	1					1	1	3	1	1
BS363											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 3rd year/ 5th semester**1. Name of the Department: Biosciences**

2. Course Name	APPLIED ZOOLOGY LAB	L	T	P
3. Course Code	BS364	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 importance of economic and applied zoology.**9. COURSE OUTCOMES (CO):***After the successful course completion, learners will develop following attributes:*

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Temporary and permanent preparation of various animal groups
CO2	Collection and identification of pests.
CO3	Life history of silkworm, honeybee and lac insect.
CO4	Different types of important edible fishes of India.
CO5	Demonstration of counting of cells by haemocytometer, haemoglobinometer, pH meter, Colorimeter. Dissection: Wallago- Afferent and efferent branchial vessels, Cranial nerves

10. Syllabus

Exp-01	Permanent Preparation of: <i>Euglena, Paramecium</i> and rectal protozoans from frog
Exp-02	Study of prepared slides/ specimens of <i>Entamoeba, Giardia, Leishmania, Trypanosoma, Plasmodium, Fasciola, Cotugnia, Taenia, Rallietina, Polystoma Paramphistomum, Schistosoma, Echinococcus, Dipylidium, Enterobius, Ascaris and Ancylostoma</i>
Exp-03	Permanent Preparation of <i>Cimex</i> (bed bug), <i>Pediculus</i> (Louse), <i>Haematopinus</i> (cattle louse), ticks/mites
Exp-04	Permanent mount of wings, mouth parts and developmental stages of mosquito and house fly
Exp-05	Collection and identification of pests
Exp-06	Life history of silkworm, honeybee and lac insect
Exp-07	Different types of important edible fishes of India
Exp-08	Prepared slides of plant nematodes
Exp-09	Demonstration of counting of cells by haemocytometer, haemoglobinometer, pH meter, Colorimeter.
Exp-10	Dissection: <i>Wallago</i> - Afferent and efferent branchial vessels, Cranial nerves

11. Books recommended:

1. Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition
2. Barnes, R.S.K., Calow, P., Olive, P. J. W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO											
CO1	3	3			1	3	3	1	3	2	3
CO2	3	3					3	1	3	2	3
CO3	3	3		1			3	1	3	3	3
CO4	3	3		1			3	1	3	3	3
CO5	3	3		2	3		3	1	3	3	3
BS364											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

1. Name of the Department: Biosciences							
2. Course Name	APPLIED BOTANY LAB				L	T	P
3. Course Code	BS365				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 the understanding of importance of economic and applied Botany.							
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>							
COURSE OUTCOME (CO)	ATTRIBUTES						
CO1	Learn about Preparation of plant culture media and its sterilization.						
CO2	Have knowledge of In vitro germination of seeds and initiation and maintenance of Callus and suspension Culture.						
CO3	Know process of Isolation of genomic/plasmid DNA from Plant/Bacteria.						
CO4	Have knowledge of Restriction digestion of DNA and Agarose Gel Electrophoresis.						
CO5	Have knowledge of PCR.						
10. Syllabus							
Exp-01	Preparation of plant culture media and its sterilization						
Exp-02	<i>In vitro</i> germination of seeds						
Exp-03	Initiation and maintenance of Callus and suspension Culture						
Exp-04	Isolation of genomic/plasmid DNA from Plant/Bacteria						
Exp-05	Restriction digestion of DNA						
Exp-06	Agarose Gel Electrophoresis						
Exp-07	Demonstration of PCR						

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO											
CO1	3	3					3				
CO2	3	3				1	3				
CO3	3	3					3				
CO4	3	3					3				

CO5	3	3					3				
BS365											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 3rd year/ 5th semester												
1. Name of the Department: Chemistry												
2. Course Name	ADVANCE INORGANIC CHEMISTRY-III						L	T	P			
3. Course Code	CH314						3	1	0			
4. Type of Course (use tick mark)				Core (✓)			Foundation Course		Departmental Elective ()			
5. Pre-requisite (if	10+2 with Chemistry			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 main objective of this course is to understand the bonding in coordination compounds, electronic spectra and magnetic behaviour of the coordination compounds and some important inorganic compounds. The other important objective is to study the reaction mechanism in coordination compounds and importance of inorganic metals in Bio-inorganic chemistry.												
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>												
COURSE OUTCOME		ATTRIBUTES										
CO1		Understand the concept of coordination chemistry with different theories.										
CO2		Understand and evaluate the electronic spectra and magnetism of transition metal complexes.										
CO3		Study of some important inorganic compounds and their applications										
CO4		Understand the different reaction mechanisms in coordination compounds.										
CO5		Understand the concept of Bio-inorganic chemistry and the role of metal ions in human body.										
10. Unit wise detailed content												
Unit-1	Number of lectures = 08				Title of the unit: Bonding in Coordination compounds							
Electronic configuration (3d, 4d, 5d) and general periodic trends, comparative study of first/second/third transition series elements, IUPAC nomenclature of coordination compounds, VBT (hybridization/magnetism/geometry) of Ni(CN) ₄ ²⁻ , Ni(CO) ₄ , Ni(Cl) ₄ ²⁻ , Fe(CN) ₆ ³⁻ , Fe(CN) ₆ ⁴⁻ . Elementary Crystal Field Theory: splitting of dn configurations in octahedral, square planar and tetrahedral fields, factors affecting 10 Dq value, crystal field stabilization energy, pairing energy, Magnetic moment from crystal field theory, high spin and low spin complexes,												
Unit-2					Title of the unit: spectra and magnetism of transition metal							
Spectro-chemical series of ligands, Laporte's selection rule, colour of complexes, spectroscopic ground states, selection rules for electronic spectral transitions, charge transfer spectra, LS coupling. Types of magnetism and temperature dependence of magnetic susceptibility, Curie and Curie-Weiss law, Measurement of magnetic susceptibility by Gouy method, Faraday method.												
Unit-3					Title of the unit: Selected topics in advanced inorganic compounds							
Structure/synthesis/various chemical reactions of potassium dichromate, potassium permanganate, potassium chromate, sodium thiosulphate. Structure/synthesis/various chemical reactions of fluorides and oxides of xenon, Zeise's salt, silicones, borazine, phosphazene. S ₄ N ₄ , P ₄ , P ₄ O ₆ , P ₄ O ₁₀ . Extractive metallurgy for self reduction method (Copper and lead), cyanide process and chemical												
Unit-4	Number of lectures = 08				Title of the unit: Reaction mechanism of ligand displacement reactions							

Substitution reaction in square planar complexes (Trans effect), mechanism of substitution reaction, Electron transfer reactions and its classification. Outer sphere electron transfer mechanism, chemical activation, Marcus theory, cross-reactions, thermodynamical/kinetic parameters, inner-sphere electron transfer mechanisms, effect of the nature of metal/ligands, bridging group effects, cross reactions.

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

Biological role of inorganic metals in human body (description only), Electron transfer proteins, Metal ion transport and storage, Ferritin and its structure, Oxygen transport by heme proteins, hemoglobin and myoglobin, Dioxygen transport (hemoglobin, hemocyanin and Blue copper proteins), Biomineralization (ferritin), zinc finger protein, Carbonic anhydrase, carboxy peptidase, carboxypeptidase A/B.

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

<https://nptel.ac.in/courses/104/105/104105033/>

<https://ocw.mit.edu/courses/chemistry/5-112-principles-of-chemical-science-fall-2005/video-lectures/lecture-32-coordination-complexes-and-ligands/>

<https://www.chem.tamu.edu/rgroup/marcetta/chem362/lectures/Lecture%2029%20subset%20of%20TM%20lecture%20notes.pdf>

12. Books recommended:

1. Inorganic Chemistry: Structure and Reactivity, James E. Huheey, Harper and Row Publishers, New York

2. Advanced Inorganic Chemistry: F.A. Cotton and G. Wilkinson, Interscience.

3. Inorganic Reaction Mechanism, Basolo and R.G. Pearson, John Willey.

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO											
CO1	3	2	1		1		3				
CO2	2	2	1		2		3				
CO3	3	3	1		1		3				
CO4	2	3	1		1		3				
CO5	2	2	1		1		3				
CH314											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 3rd year/ 5th semester						
1. Name of the Department: Chemistry						
2. Course Name	ADVANCE ORGANIC CHEMISTRY-III			L	T	P
3. Course Code	CH315			3	1	0
4. Type of Course (use tick mark)		Core (✓)	Foundation Course ()		Departmental Elective ()	
5. Pre-requisite (if	10+2 with Chemistry	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 main objective of this course is to study the nomenclature of organic compounds, structure and bonding of organic molecules considering inductive effect, hyperconjugation, mesomeric effects, hydrogen bonding etc., and mechanism of various types of organic reactions.						
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>						
COURSE OUTCOME	ATTRIBUTES					
CO1	Analyze structure and chemical reactions of organomagnesium and organolithium compounds.					
CO2	Understand and evaluate the structure and related reactions of heterocyclic compounds.					
CO3	Understand and analyze the classification, configuration and conformation of carbohydrates.					
CO4	Understand and evaluate the structure of amino acids, peptides, proteins and nucleic acids..					
CO5	Understand and analyze the structure and classification of dyes.					
10. Unit wise detailed content						
Unit-1	Number of lectures = 08	Title of the unit: Organometallic and Organosulphur Compounds				
Organomagnesium Compounds: the Grignard reagents, structure and chemical reactions Organolithium Compounds :formation and chemical reactions. Nomenclature, methods of formation and chemical reaction of thiols, sulphonic acids.						
Unit-2		Title of the unit: Heterocyclic Compounds				
Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Comparison of basicity of pyridine, piperidine and pyrrole. Methods of synthesis and chemical reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Nepieralski synthesis.						
Unit-3		Title of the unit: Carbohydrates				
Carbohydrates: classification and configuration and conformation of monosaccharides, Erythro and threodiastereomers, mechanism of osazone formation, Interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Formation of glycosides, ether and esters. Cyclic structure of D(+) glucose. An introduction to disaccharides (maltose, sucrose, lactose) and polysaccharides/starch						
Unit-4	Number of lectures = 08	Title of the unit: Acids, peptides, proteins and Nucleic acids				
Classification, structure and stereochemistry of amino acids, isoelectric point. Classification of proteins, peptides, structure determination, and end group analysis. Nucleic acids: Introduction –Classification of Nucleic Acids Ribonucleosides and Ribonucleotides. The double helical structure of DNA.						

Unit-5	Number of lectures = 08	Title of the unit: Dyes
<p>Dyes: Introduction of the history of dyes. Landmarks in the historical development from Natural to synthetic dyes. Introduction and classification of dyes on the basis of structure Colour and chemical constitution of dyes. Structure and uses of phenolphthalein, fluorescein , Eosin, Malachite green, Methylene blue , Indigo. Napthol yellow-S, Crystal violet.</p>		
11. Brief description of self learning / E-learning component		
<p>https://www.khanacademy.org/science/organic-chemistry https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Map%3A_Organic_Chemistry_(Smith)/Chapter_06%3A_Understanding_Organic_Reactions https://www.dummies.com/education/science/biology/the-basics-of-organic-chemistry/ https://www.toppr.com/guides/chemistry/organic-chemistry/</p>		
12. Books recommended:		
<p>1. Advanced Organic Chemistry, Bahl&Bahl, S. Chand & Co. Ltd. 2. Organic Chemistry Vol.I& II, I.L. Finar 3. Fundamentals of Organic Chemistry, NafisHaider, S. Chand & Co. Ltd. 4. A text book of Organic Chemistry, Bahl&Bahl, S. Chand & Co. Ltd. 5. Organic Chemistry Vol.I, II & III, Dr. Jagdamba Singh, L.D.S. Yadav, PragatiPrakashan.</p>		

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO											
CO1	3	2	1		1		3				
CO2	2	2	1		2		3				
CO3	3	3	1		1		3				
CO4	2	3	1		1		3				
CO5	2	2	1		1		3				
CH315											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 3st year/ 5th semester						
1. Name of the Department: Chemistry						
2. Course Name	Basics of Chromatographic Techniques			L	T	P
3. Course Code	CH319			3	1	0
4. Type of Course (use tick mark)	Core (✓)		Foundation Course ()		Departmental Elective ()	
5. Pre-requisite (if any)	10+2 with Chemistry	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: Students able to understand Separation techniques such as Thin layer chromatography, Paper chromatography, Gas chromatography, High performance Liquid Chromatography and Ion exchange chromatography						
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>						
COURSE OUTCOME	ATTRIBUTES					
CO1	Understand the chromatographic techniques and its classification.					
CO2	Evaluate Thin layer chromatography; principle and its applications. Paper chromatography and its applications. Separation of amino acid mixture.					
CO3	Comprehension of Principles of gas-liquid chromatography, Instrumentation and its Industrial applications.					
CO4	Able to discuss Normal and reverse phase HPLC, Isocratic and gradient elution, Instrumentation; mobile phase reservoir, column and detector and Industrial applications of HPLC.					
CO5	Analyze the action of resins, experimental techniques, applications, separation of metal ions, separation of chloride and Bromide ions - removal of interfering radicals.					
10. Unit wise detailed content						
Unit-1	Number of lectures = 08	Title of the unit: Separation techniques				
Chromatography, Classification of Chromatographic methods, Elution in column chromatography, chromatograms, distribution constant, retention time, stationary phase, mobile phase, principle of adsorption and partition chromatography, column chromatography; principle, adsorbents used, preparation of column, adsorption, elution.						
Unit-2		Title of the unit: Thin layer chromatography				
principle, choice of adsorbent and solvent, Rf value, applications. Paper chromatography; solvents used, principle, Rf value, factors influencing Rf value, applications. Separation of amino acid mixture.						
Unit-3		Title of the unit: Gas chromatography				
Introduction, Principles of gas-liquid chromatography, Instrumentation; Carrier gas system, Sample injection, Columns, Stationary phase, Detectors (Flame Ionization, Electron capture and Thermal conductivity) and Industrial applications.						
Unit-4	Number of lectures = 08	Title of the unit: High performance Liquid Chromatography				

Introduction of HPLC, Normal and reverse phase HPLC, Isocratic and gradient elution, Instrumentation; mobile phase reservoir, column and detector (UV-visible absorption, Electrochemical) and Industrial applications of HPLC.

Unit-5 | **Number of lectures = 08** | **Title of the unit: Ion exchange chromatography**

principle, resins, action of resins, experimental techniques, applications, separation of metal ions, separation of chloride and Bromide ions - removal of interfering radicals.

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

<https://microbenotes.com/chromatography-principle-types-and-applications/>
<https://www.khanacademy.org/science/class-11-chemistry-india/xfbb6cb8fc2bd00c8:in-in-organic-chemistry-some-basic-principles-and-techniques/xfbb6cb8fc2bd00c8:in-in-methods-of-purification-of-organic-compounds/v/basics-of-chromatography>
<https://www.slideshare.net/nadeemakhter7374/chromatography-34247423>
<http://www.biologydiscussion.com/biochemistry/chromatography-techniques/top-12-types-of-chromatographic-techniques-biochemistry/12730>

12. Books recommended:

1. Chemical Thermodynamics by R.P.Rastogi et al
2. Principles of physical chemistry by Puri Sharma and Pathan
3. Essentials of Physical Chemistry, Bahl & Tuli, S. Chand & Co. Ltd.
4. Principles of Physical Chemistry, Puri, Sharma & Pathania, Vishal Publishing Co.
5. Simplified course in Physical Chemistry, Madan & Tuli, S. Chand & Co. Ltd.
6. Atkin's Physical Chemistry, Atkin, Oxford Press.

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO											
CO1	3	1	1	2	2	1	2				
CO2	3	1	1	2	2	1	2				
CO3	3	1	1	2	2	1	2				
CO4	3	1	1	2	2	1	2				
CO5	3	1	1	2	2	1	2				
CH319											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 3 rd year/ 5 th semester						
1.NameoftheDepartment: Chemistry						
2.CourseName	CHEMISTRY PRACTICAL- V			L	T	P
3.CourseCode	CH316			0	0	4
4.Type of Course (use tick mark)		Core(<input type="checkbox"/> <input type="checkbox"/>)		Foundation Course ()		Departmental Elective()
5.Pre-requisite (if any)	10+2 with Chemistry	6.Frequency(use tick marks)	Even ()	Odd (<input type="checkbox"/> <input type="checkbox"/>)	Either Sem ()	EverySem()
7.TotalNumberofLectures,Tutorials,Practicals						
Lectures=00		Tutorials=00		Practical=10		
8. COURSE OBJECTIVES: Student will be able to work effectively and safely in a laboratory environment, practical/technical/communication skills, concepts to solve qualitative and quantitative problems,transferable skills like ability to work in teams as well as independently.						
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>						
COURSE OUTCOME (CO)	ATTRIBUTES					
CO1	Remember to keep records of all performed experiments in themanner which is required in laboratory.					
CO2	Able to Evaluate water quality parameters like chloride content and alkalinity.					
CO3	Understand the basic titration methods and technical skills to work in the different fields of chemistry.					
CO4	Know about the principles of qualitative and quantitative analysis of inorganic mixtures.					
CO5	Analyze the importance of personal safety and care of equipment's and chemicals.					
10.Syllabus						
Exp-01	Synthesis and Analysis of the Potassium trioxalatoferrate (III), $K_3[Fe(C_2O_4)_3]$ and determination of its					
Exp-02	Preparation of cis-and trans –bisoxalatodiaqua chromate (III) ion.					
Exp-03	To verify Beer-Lambert law for $KMnO_4/K_2Cr_2O_7$ and determine the concentration of the given solution					
Exp-04	Determination of Fe^{3+} content by thiocyanate method.					
Exp-05	Separation of Fluorescein and methylene blue by column chromatography.					
Exp-06	Separation of leaf pigments from leaves					
Exp-07	Resolution of racemic mixture of (+) mandelic acid					
Exp-08	Diazotization/coupling: Preparation of methyl orange and methyl red					
Exp-09	Oxidation: Preparation of benzoic acid from toluence					
Exp-10	Reduction: Preparation of aniline from nitrobenzene					

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

<https://www.fandm.edu/uploads/files/79645701812579729-genchem-reference-for-web.pdf>
<http://file.akfarmahadhika.ac.id/E-BOOK/12-1213-akfarmahad-16-1-vogelqu-d.pdf>
<https://faculty.psau.edu.sa/filedownload/doc-6-pdf-f06110ef2e1e1ae119cbacf71dd17732-original.pdf>

12. 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 Hemme, S. Chand.
3. **B. Sc. Practical Physics by CL Arora, S Chand & Company**
4. **Practical Physics by Kumar P.R.S., Prentice Hall India Learning Private Limited**

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO											
CO1	3	2	2		3	1	3				
CO2	3	2	2		3	1	3				
CO3	3	2	2		3	1	3				
CO4	3	2	2		3	1	3				
CO5											
CH316											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 3st year/ 6th semester						
1. Name of the Department: Biosciences						
2.	IMMUNOLOGY AND TOXICOLOGY			L	T	P
3.	BS371			3	1	0
4. Type of Course (use tick mark)	Core (✓)		Foundation Course		Departmental Elective ()	
5. Pre-	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 general and advanced features of the Vertebrate Immune system. The students will also acquire the knowledge about the toxic effects of xenobiotics on the environment and individuals.						
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>						
CO	ATTRIBUTES					
CO 1	Learn about the basic features of vertebrate immune systems, types of immune cells, innate and adaptive immune responses.					
CO 2	The students will get an in-depth knowledge of antibody types and its various applications in diagnostics and health care.					
CO 3	The students will learn about the Major Histocompatibility complex and complement system. They will also be able to understand its role in immune defenses.					
CO 4	The expected outcome is to provide the students an in-depth understanding of the effects of exposure to toxicants. They will also learn about tests that are available to determine the toxicity of a compound.					
CO	The students will learn about the biochemical and physiological effects of xenobiotics.					
10. Unit wise detailed content						
Uni	Number of lectures = 08	Title of the unit: Overview of Immune System, Innate and Adaptive Immunity				
Cardinal features of vertebrate immune system, Hematopoiesis, Cells and organs of the Immune system. Anatomical barriers, Inflammation, Cell and molecules involved in innate Immunity, Adaptive Immunity (Cell-						
U	Number of lectures = 08	Title of the unit: Antigens and Immunoglobulins				
Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cell epitopes Structure and functions of different classes of immunoglobulins, Antigen-antibody interactions (Precipitation reactions, Agglutination reactions, Immunofluorescence and ELISA), Polyclonal sera, Hybridoma technology: Monoclonal antibodies in therapeutics and diagnosis.						

Unit	Number of lectures = 08	Title of the unit: Major Histocompatibility Complex and Complement system
Structure and functions of MHC molecules (MHC I and II), Endogenous and exogenous pathways of antigen processing and presentation, Components and pathways of complement activation, Biological consequences of complement activation		
Unit	Number of lectures = 08	Title of the unit: Exposure of toxicants
Different routes/methods of exposure, Frequency & duration of exposure Human exposure Dose-response relationship. Selective toxicity: Concept, Significance, Basic mechanisms of selective toxicity. Toxicity Tests: Bioassay, Acute toxicity tests for terrestrial and aquatic animals, Chronic toxicity tests, Concept of Maximum Acceptable Toxicant Concentration (MATC) and safe concentration. Factors affecting toxicity: Factors related to the		
Unit	Number of lectures = 08	Title of the unit: Toxic effects of Xenobiotics
Local and systemic effects, Immediate and delayed effects Reversible and irreversible effects, Biochemical and physiological effects of xenobiotics, Nanotoxicology Toxicogenomics, Bioaccumulation of Xenobiotics- Concept of bioconcentration & Bioaccumulation and biomagnifications, Bioconcentration factor, Biotransformation of		
11. Books recommended:		
1. Kuby Immunology by J.A. Owen, J. Punt , S.A. Stranford. 7th edition. WH Freeman. 2013 2. Cellular and Molecular Immunology by A.K. Abbas, A.H. Lichtman, S. Pillai. 9th edition. Saunders Elsevier. 2018 3. Janeway's Immunobiology by K. Murphy and W. Casey. 9th edition. Garland Science Publishing 2017. 4. Review of Medical Microbiology and Immunology by W.Levinson. 15th edition. Lange Publication. 2018. 5. Fundamental Immunology by W.E. Paul. 7th edition. Lippincott Williams and Wilkins. 2013 4. Roitt's Essential Immunology by P.J. Delves, S.J. Martin, D.R. Burton, I.M. Roitt. 13th edition. Blackwell Publishing. 2017		

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO											
CO1	3	1					1	1	3	1	
CO2	3	1		2			1	1	3	1	
CO3	3	1		1			1	1	3	2	
CO4	3	1		1			1	1	3	2	
CO5	3	1				2	1	1	3	2	
BS371											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 3rd year/ 6th semester							
1. Name of the Department: Biosciences							
2.	BIOLOGY OF INSECTA AND PEST MANAGEMENT				L	T	P
3.	BS372				3	1	0
4. Type of Course (use tick mark)	Core ()		Foundation Course ()		Departmental Elective (√)		
5. Pre-	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 develop the understanding of basics of insect diversity, its physiology along with integrated pest management.							
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>							
COURSE OUTCOME	ATTRIBUTES						
CO1	General Features of Insects Distribution and Success of Insects on the Earth, Basis of Insect classification, Classification of Insects up to orders						
CO2	External Features, Head – Eyes, Types of antennae, Mouth parts w.r.t. Feeding habits, Thorax- Wings and wing articulation, Types of Legs adapted to diverse habitat Abdominal appendages and genitalia.						
CO3	Structure and physiology of Insect body systems, Sensory receptors, Growth and Metamorphosis.						
CO4	Definition and its ecology, Pest status, features responsible for evolutionary success of Insect species, Economic threshold, Action threshold, Pest spectrum, Pest complex, Secondary pest outbreak, Pest surveillance and Sampling.						
CO5	History, Different phases of pest control, Quarantine, Physical, Cultural, Chemical, Biological control, Genetic and Biotechnological methods of control. Pheromones- Production and their use in pest surveillance and						
10. Unit wise detailed content							
Unit-1	Number of lectures =	Title of the unit: Introduction					
General Features of Insects Distribution and Success of Insects on the Earth, Basis of Insect classification, Classification of Insects up to orders							
Unit-2	Number of lectures =	Title of the unit: General Morphology of Insects					
External Features, Head – Eyes, Types of antennae, Mouth parts w.r.t. Feeding habits, Thorax- Wings and wing articulation, Types of Legs adapted to diverse habitat Abdominal appendages and genitalia.							

Unit-3	Number of lectures =	Title of the unit: Physiology of Insects
Structure and physiology of Insect body systems - Integumentary, Digestive, Excretory, Circulatory, Respiratory, Endocrine, Reproductive and Nervous system, Sensory receptors, Growth and Metamorphosis.		
Unit-4	Number of lectures =	Title of the unit: Pest
Definition and its ecology, Pest status, features responsible for evolutionary success of Insect species, Factors responsible for achieving the status of pest, Economic injury level, Economic threshold, Action threshold, Pest spectrum, Pest complex, Carrying capacity, Secondary pest outbreak, Pest surveillance and Sampling.		
Unit-5	Number of lectures =	Title of the unit Integrated Pest Management
History, Different phases of pest control, Quarantine, Physical, Cultural, Chemical, Biological control, Genetic and Biotechnological methods of control. Pheromones- Production and their use in pest surveillance and management.		
11. Books recommended:		
1. The Insects: Structure and function, Chapman, R. F., Cambridge University Press, UK 2. Principles of Insect Morphology, Snodgrass, R. E., Cornell Univ. Press, USA 3. The Insect Societies, Wilson, E. O., Harvard Univ. Press, UK 4. Insect Physiology and Biochemistry, Nation, J. L., CRC Press, USA 5. Entomology & Pest Management, Pedigo, L. P., Prentice Hall, New Jersey, USA 6. Concepts of IPM, Norris, Caswell-Chen and Kogan, Prentice-Hall, USA 7. Agricultural Insects pests of the tropics and their control, Hill, D. S., Cambridge University Press, UK		

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO											
CO1	3	1				2	1	3	3	3	
CO2	3	1					1	3	3	3	
CO3	3	1					1	2	3	3	
CO4	3	1				3	1	2	3	3	2
CO5	3	1		1	1	3	1	2	3	3	3
BS372											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 3 rd year/ 6 th semester						
1. Name of the Department: Biosciences						
2.	SOIL SCIENCE AND PLANT PATHOLOGY			L	T	P
3.	BS373			3	1	0
4. Type of Course (use tick mark)		Core ()	Foundation Course		Departmental Elective (√)	
5. Pre- requisites	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 develop the understanding of basics of soil science and plant diseases.						
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>						
COURSE OUTCOMES	ATTRIBUTES					
CO1	Have knowledge of Soil, its components and soil formation.					
CO2	Understand basics of soil profile and its physical properties and chemical properties.					
CO3	Have knowledge of soil reaction, organic matter and Bio-fertilizers.					
CO4	Understand the concept of plant disease, their general types, host pathogen relationship and Plant disease resistance.					
CO5	Study some representative plant diseases, their transmission, symptomatology and management.					
10. Unit wise detailed content						
Unit-1	Number of lectures = 08		Title of the unit Soil			
Pedological and Edaphological concept and components of soil, Important soil forming minerals and rocks, weathering of rocks and minerals, Soil forming factors and processes.						
Unit-2	Number of lectures = 08		Title of the unit: Development of soil profile			
Physical properties of soil and their significance, Chemical properties of soil, cation and anion exchange phenomenon and their importance in agriculture. Soil air: Definition, composition and factors affecting the composition of soil air. Soil water: Retention potential, soil moisture constant, movement of soil water, Soil colloids- Nature, structure, properties, types, chemical composition and their importance.						
Unit-3	Number of lectures = 08		Title of the unit: Soil's reaction			
Factors controlling pH of soil and influence of soil reaction on availability of nutrients. Soil organic matter: composition and their maintenance in soil, humus formation and its importance in soil fertility management, Bio-fertilizers.						

Unit-4	Number of lectures = 08	Title of the unit: Concept of plant disease
Definition and terms, Classification of plant diseases, Identification of Plant diseases: Koch's Postulates. Types of plant diseases. Introduction to Flor's hypothesis, disease triangle surveillance, disease epidemics and epidemiology, Host pathogen relationship; Plant immunity- innate and acquired Plant disease resistance.		
Unit-5	Number of lectures = 08	Title of the unit Plant diseases: transmission, symptoms and management
Bacterial blight of rice, Late blight of potato, Downy mildew of bajra (Green ear disease), White rust of crucifers, Rust and Loose smut of wheat, Tikka disease of groundnut, Red rot of sugarcane.		
11. Books recommended:		
1. Soil Science: Brady 2. Soil Science and Ecology; P. D. Sharma 3. Plant Pathology; Mehrotra and Aneja 4. Plant Pathology; Ainsworth		

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO											
CO1	3	1				2	1				
CO2	3	1				1	1				
CO3	3	1				1	1				
CO4	3	1				1	1				
CO5	3	1				1	1				
BS373											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 3rd year/ 6th semester						
1. Name of the Department: Biosciences						
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: This course is designed to develop the understanding of electromagnetic radiation, absorption spectrum, Beer's law and Lambert's law, Principle, working and applications of spectrophotometer, 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): <i>After the successful course completion, learners will develop following attributes:</i>						
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. 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.

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO											
CO1	3	1					2		3	3	
CO2	3	1					2		3	3	
CO3	3	1					2		3	3	
CO4	3	1					2		3	3	
CO5	3	1					2		3	3	
BS202											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 3rd year/ 6th semester						
1. Name of the Department: Biosciences						
2. Course Name	BIOLOGICAL TECHNIQUES AND BIostatISTICS			L	T	P
3. Course Code	BS374			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 main objective of the course is to provide students the knowledge about various biological techniques and their applications. Students will also know about biostatistics and its importance in data analysis.						
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>						
COURSE OUTCOME (CO)	ATTRIBUTES					
CO1	Understand the basics of different types of microscopy, their principles and applications.					
CO2	Gain knowledge about Principles, types, instrumentation and application of various instruments used in laboratories.					
CO3	Develop understanding about the concepts of Electrophoretic and chromatographic techniques.					
CO4	Understand the concepts of sampling, measures of tendency and measures of dispersion.					
CO5	Acquire knowledge about testing hypothesis, errors of inference and distribution-free test.					
10. Unit wise detailed content						
Unit-1	Number of lectures = 08	Title of the unit Principles of microscopy				
Light microscopy, Fluorescence microscopy, Confocal microscopy, Transmission and Scanning electron microscopy.						
Unit-2	Number of lectures = 08	Title of the unit: Principles, types, instrumentation and application of instruments				
pH Meter, Colorimeter, Microtome, Spectrophotometer and Centrifuge.						
Unit-3	Number of lectures = 08	Title of the unit: Electrophoresis				
Principles and applications (PAGE and Agarose gel electrophoresis), Principle and application of Paper chromatography: Column chromatography, HPLC, Molecular sieve chromatography; Affinity chromatography.						
Unit-4	Number of lectures = 08	Title of the unit: Sampling, Measures of central tendency				
Arithmetic mean, mode, median, Measures of dispersion: Range, variance, standard deviation and standard error.						
Unit-5	Number of lectures = 08	Title of the unit Overview of testing				

11. Books recommended:

1. Narayanan, P (2000) Essentials of Biophysics, New Age Int. Pub. New Delhi.
2. Keith Wilson and John Walker (2010). Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press.
3. Bliss, C.J.K (1967) Statistics in Biology, Vol. Ic Graw Hill, New York.
4. Campbell R.C (1974) Statistics for Biologists, Cambridge Univ. Press, Cambridge.
5. Roy R.N. (1999) A Text Book of Biophysics New Central Book Agency.

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO											
CO1	3	1					1		3	3	
CO2	3	1					1		3	3	
CO3	3	1					1		3	3	
CO4	3	1					1		3	3	2
CO5	3	1					1		3	3	2
BS374											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 3rd year/ 6th semester						
1. Name of the Department: Biosciences						
2. Course Name	COMPUTATIONAL SCIENCES & 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 provide basic knowledge of computer networking and internet working devices, fundamental concepts of Internet and web technologies, biological databases, algorithms and flowchart design, sequence alignment and data mining.						
9. COURSE OUTCOMES (CO):						
<i>After the successful course completion, learners will develop following attributes:</i>						
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 make use of biological databases. Design and develop a website with limited features. Have a strong foundation of knowledge about the structure of computer system.					
10. Unit wise detailed content						
Unit-1	Number of lectures = 08	Title of the unit: 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: 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: 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 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
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. Books recommended:		
1. Reilly “Developing Bioinformatics computer skills”. 2 .J.F. Griffiths “An intro to generic Analysis” 3. Andreas D. Baxevanis “Bioinformatics: A practical Guide to the analysis of genes and proteins”		

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO											
CO1	3	1					1		3	1	2
CO2	3	1				1	1		3	1	2
CO3	3	1					1		3	1	2
CO4	3	1		1			1		3	1	2
CO5	3	1		1			1		3	1	2
BS331											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 3rd year/ 6st 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 course has been designed to make students aware of basic plant biotechnology techniques and their applications in plant growth and development, and large scale production of natural products from plant source. The course also imparts information on basic animal biotechnology techniques, their applications in Cell culture, production of transgenics and expression of cloned proteins and vaccines.							
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes</i>							
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	get proper knowledge about media preparation for In-vitro propagation of plants and aseptic techniques used.						
CO5	The students will 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					
Aseptic Techniques, Nutrient media, and use of growth regulators (Auxins, Cytokinins and Gibberellins). Callus and suspension culture.							
Unit-2	Number of lectures = 08	Title of the unit: 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					

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: Cell lines**
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 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. 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 Micropropagation (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”

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO											
CO1	3	1				1	1				
CO2	3	1				1	1				
CO3	3	1		1	1	1	1				
CO4	3	1				1	1				
CO5	3	1				1	1				
BS332											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 3rd year/ 6st semester						
1. Name of the Department: Chemistry						
2. Course Name	SPECTROSCOPIC TECHNIQUES			L	T	P
3. Course Code	CH308			3	1	0
4. Type of Course (use tick mark)	Core (<input checked="" type="checkbox"/>)		Foundation Course (<input type="checkbox"/>)	Departmental Elective (<input type="checkbox"/>)		
5. Pre-requisite (if any)	10+2 with Chemistry	6. Frequency (use tick marks)	Even (<input checked="" type="checkbox"/>)	Odd (<input type="checkbox"/>)	Either Sem (<input type="checkbox"/>)	Every Sem (<input type="checkbox"/>)
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		Tutorials = 10		Practical = 00		
8. COURSE OBJECTIVES: Students able to understand the interaction of electromagnetic radiation with the materials, spectroscopic techniques like Ultraviolet, FT-IR, Nuclear Magnetic Resonance spectroscopy and mass spectrometry.						
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>						
COURSE OUTCOME	ATTRIBUTES					
CO1	Understanding Wave-like propagation of light, electronic transitions, instrumentation, conjugated systems and transition energies, Woodward – Fieser rules for calculation of wave length.					
CO2	Comprehension of absorption in the infrared region, theory of infrared spectroscopy, instrumentation, molecular vibrations, factors affecting vibrational frequencies, characteristic absorptions in common classes of compounds.					
CO3	To create basics of NMR spectroscopy, instrumentation, chemical shift, equivalent and nonequivalent protons, spin-spin splitting and vicinal coupling.					
CO4	Able to evaluate the NMR spectra of some representative compounds: Hydrocarbons, Aldehydes, Ketones, Acids and Alcohols, Applications of NMR spectroscopy.					
CO5	Analyze the theory, instrumentation, important useful terms in mass spectrometry; molecular ion peak, metastable peak, fragmentation patterns of various functional groups (alkanes, alkenes, alkynes, alcohols, ketones, aldehydes), McLafferty rearrangements.					
10. Unit wise detailed content						
Unit-1	Number of lectures = 08	Title of the unit: UV Spectroscopy				
Wave-like propagation of light, absorption of electromagnetic radiation by organic molecules allowed and forbidden transitions, instrumentation, conjugated systems and transition energies, Woodward – Fieser rules; unsaturated carbonyl compounds, conjugated						
Unit-2		Title of the unit: IR Spectroscopy				
Introduction, absorption in the infrared region, theory of infrared spectroscopy, instrumentation, molecular vibrations, factors affecting vibrational frequencies, characteristic absorptions in common classes of compounds, characteristic vibrational frequencies of some organic compounds.						
Unit-3		Title of the unit: NMR Spectroscopy				
Introduction, theory of NMR spectroscopy, instrumentation, chemical shift, equivalent and nonequivalent protons, spin-spin splitting, vicinal coupling,, Interpretation of NMR spectra of some representative compounds.						

Unit-4	Number of lectures = 08	Title of the unit: Mass Spectrometry
Introduction, basic theory, instrumentation, important useful terms in mass spectrometry, fragmentation patterns of various functional groups (alkanes, alkenes, alkynes, alcohols, ether, phenols and amines, ketones, aldehydes, esters, acids, anhydrides), molecular ion peak, metastable peak, McLafferty rearrangements, Nitrogen rule.		
Unit-5	Number of lectures = 08	Title of the unit: Atomic Absorption Spectrophotometry
Introduction, Principle, Instrumentation, Sample preparation, Internal standard and standard addition, calibration and applications of AAS.		
11. Brief description of self learning / E-learning component		
https://www.youtube.com/watch?v=2Y8pSoS0d1g http://www.infocobuild.com/education/audio-video-courses/chemistry/ApplicationOfSpectroscopicMethods-IIT-Madras/lecture-25.html https://scrippslabs.com/summary-of-spectroscopic-techniques/ https://nptel.ac.in/content/storage2/courses/102103044/pdf/mod2.pdf		
12. Books recommended:		
<ol style="list-style-type: none"> 1. Introduction to spectroscopy: Pavia, Lampman & Kriz, 3rd Ed, Books/cole. 2. Spectroscopic methods in organic chemistry: H. Williams and Ian fleminig, V Edition Tata Mc Grawhills 3. Organic spectroscopy: William Kemp, 3rd Edition, Palgrave publications. 4. Fundamentals of Analytical chemistry, Douglas A. Skoog, Donald M. West, F. James Holler, 7th edition, Harcourt college publications. 5. Principles and practice of analytical chemistry, F. W. Fifiield, D. Kealey, 5th edition, Blackwell publication. 6. Analytical chemistry, Gary D. Christian, 6th edition, Wiley and sons publication. 7. Spectrometric identification of organic compounds, R. M. Silverstein, 6th edition, John Wiley and sons. 8. Basic concepts of analytical chemistry, S. M. Kopper, New Age International Publishers. 		

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO											
CO1	3	1	2		2	1	2				
CO2	3	1	2		2	1	2				
CO3	3	1	2		2	1	3				
CO4	3	1	1		2	1	3				
CO5	3	1	1		2	1	3				
CH308											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

1. Name of the Department: Chemistry						
2. Course Name	CHEMICAL PROCESS INDUSTRY			L	T	P
3. Course Code	CH309			3	1	0
4. Type of Course (use tick mark)	Core ()		Foundation Course ()		Departmental Elective (√)	
5. Pre-requisite (if any)	10+2 with Chemistry	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 main objective of this course is to study the composition, preparation, properties and uses of ammonia, nitric acid, phosphorus chemical, glass, cement, ceramics and refractories and their related toxic hazards on the health of consumer.						
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>						
COURSE OUTCOME	ATTRIBUTES					
CO1	Evaluate different preparation processes for the manufacture of ammonia, nitric acid, ammonium nitrate and ammonium sulphate and their related quality control, hazards, safety and effluent management.					
CO2	Evaluate different manufacturing methods of caustic soda and phosphorus chemicals and their properties and uses.					
CO3	Understand the composition of glass and their types, properties and uses.					
CO4	Analyze the composition, types, properties and preparation of cement and its setting time.					
CO5	Understand the classification, properties and uses of ceramics and refractoriness and their respective characteristics.					
10. Unit wise detailed content						
Unit-1	Number of lectures = 08	Title of the unit: Synthetic Nitrogen products				
Ammonia, nitric acid, ammonium nitrate and ammonium sulphate their manufacture with reference to; consumption Pattern, Raw materials, Production process, Quality control, Hazards and safety and Effluent management.						
Unit-2	Number of lectures = 08	Title of the unit: Chlor-alkali Industrial products				
Caustic soda Chlorine. Phosphorus chemicals; Phosphorus, phosphoric acid, ammonium phosphate, superphosphate, triple superphosphate, Lime, gypsum, Silicon, calcium carbide.						
Unit-3	Number of lectures = 08	Title of the unit: Glass				
Introduction, Classification and General Properties of Glass , Characteristics, raw Materials, Chemical Reactions, Methods of Manufacture, Uses.						
Unit-4	Number of lectures = 08	Title of the unit: Cement				
Introduction, Composition, Types of cement, Portland cement; raw Materials, manufacture of Cement by wet & Dry process, Reaction in the Kiln, setting of cement, Testing & Uses of cement.						
Unit-5	Number of lectures = 08	Title of the unit: Ceramics and Refractories				
Introduction, Types of ceramics materials, properties and applications. Refractories, classification of refractories, characteristics of refractories materials, properties of refractories. Neutral refractories; Silicon carbide. Acid refractories; High Alumina refractories.						

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

<https://encyclopedia2.thefreedictionary.com/chemical+process+industry>

<https://www.youtube.com/watch?v=RjZJineJ5fk>

<https://www.chemicalprocessing.com/>

<https://www.britannica.com/science/phosphorus-chemical-element>

12. Books recommended:

1. Shreve R.N. Brink. J.A., Chemical Process Industries, International student edition, Pubs: McGraw Hill Book Co. New York, 1960.
2. Grogins P.M., Unit Process in Organic Synthesis, 5th edition, International student edition, Pubs: McGraw-Hill Book Co., New York, 1998.
3. Dryden's outlines of Chemical Technology, edited and revised by Gopala Rao M. and Marshall S, Pubs: East-West Press, New Delhi, 2004.
4. Industrial Chemistry B.K.Sharma, goel publishing house.
5. Chemical process industries N.R Nerris shreve.
6. Chemical process principles: part 1 & II – O.A / Hougen, K.M Watson RA Ragatz (CBS)
7. **Shrev's Chemical process Industries: 5th edition – George T. Austin, Mc Graw Hill.**

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO											
CO1	3	2	3	3	2	3	2				
CO2	3	2	3	3	1	3	2				
CO3	3	2	3	3	1	3	2				
CO4	3	2	3	3	1	3	2				
CO5	3	2	3	3	1	3	2				
CH309											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 3 rd year/ 6 th semester						
1.Name of the Department: Biosciences						
2.Course Name		PROJECT & TRAINING				
3.Course Code		BS375				
4.Type of Course (use tick mark)			Core(√)		Foundation Course ()	Departmental Elective()
5.Pre-requisite (if any)		0+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): <i>After the successful course completion, learners will develop following attributes:</i>						
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 coorelate 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.						
<ul style="list-style-type: none"> • Students are allocated a dissertation topic individually under the supervision of faculty of the Biosciences or Chemistry departments. • The dissertation must be similar to the thesis style and encompass: <ul style="list-style-type: none"> (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. 						

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO											
CO1	3	2		1	1		3				
CO2	3	3	2	1	3		3				
CO3	3	3	2	1	3		3				
CO4	3	3					3				
CO5	3	3					3				
BS375											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 3rd year/ 6th semester

1. Name of the Department: Chemistry

2. Course Name UG Chemistry Project **L** **T** **P**

3. Course Code **CH318** 0

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

5. Pre-requisite (if any) 10+2 with Chemistry 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 main objective is to enhance the technical skills and to provide students industrial exposure.

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

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Hands on training
CO2	Integrate class room theory with laboratory scale practice.
CO3	Understanding professional ethics of industry and code of conduct.

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO											
CO1	3	2	3	2	3	3	3				
CO2	3	2	2	3	3	3	3				
CO3	3	2	2	2	3	3	3				

