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)

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

PROGRAM OUTCOMES (PO's)

[PO.1] Prepares the students for immediate entry to the workplace with sound theoretical, experimental knowledge in the area of health and pharmaceuticals, biochemicals, biofuels, environment related, food and dairy, cosmetics, biopolymers and related multidisciplinary fields.

[PO.2] Overall, the course offers basic foundation in biotechnology which enables the students to understand the concepts in biochemistry, molecular biology, microbiology, genetic engineering and related industrial technology.

[PO.3] Students will be able to design, execute, record and analyse the results of experiments in field of molecular biology, genomics, Recombinant DNA technology, biochemistry, microbiology and genetic engineering.

[PO.4] Students will be able to work effectively in a group in the classroom, laboratory, industries and field- based situations.

[PO.5] Become efficient in using standard operating procedures and will be well versed with the regulations for safe handling and use of chemicals as well as IPR and biosafety issues related to experiments in field of biochemistry, microbiology and genetic engineering.

PROGRAM SPECIFIC OUTCOMES (PSO's)

[PSO1] An ability to develop scientific outlook, not only with respect to science subjects but also in all aspects related to life.

[PSO2] 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] To think creatively and scientifically to propose novel ideas, and draw relational conclusions which make them self-directed.

[PSO4] An in-depth understanding and training in basic sciences for three years which will open 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.

INTEGRAL UNIVERSITY LUCKNOW
DEPARTMENT OF BIOSCIENCES

EVALUATION SCHEME (CBCS)

B.Sc. ZBC Semester-I

												Attributes						
			L	T	P	UE	TA	Total	ESE									
LN104	Essential Professional Communication	Foundation	3	1	0	40	20	60	40	100	3:1:0	4	√	√	√			√
BS161	Non-chordates- I “Protozoa to Helminthes”	Core	3	1	0	40	20	60	40	100	3:1:0	4					√		
BS203	Cell Biology and Genetics	Core	3	1	0	40	20	60	40	100	3:1:0	4					√		
BS162	Algae, Fungi, Bryophyta	Core	3	1	0	40	20	60	40	100	3:1:0	4					√		
CH117	General Chemistry-I	Core	2	1	0	40	20	60	40	100	2:1:0	3	√		√				
BS163	Animal Diversity Lab-1	Practical	0	0	6	40	20	60	40	100	0:0:3	3	√		√		√		
CH118	Chemistry Practical-I	Practical	0	0	4	40	20	60	40	100	0:0:2	2	√	√	√				

Total	700	24

Revision effective from 2020-21 batch

INTEGRAL UNIVERSITY LUCKNOW
DEPARTMENT OF BIOSCIENCES

EVALUATION SCHEME (CBCS)

B.Sc. ZBC Semester-II

Course Code	Course Title	Type of Paper	Periods/Week			Evaluation Scheme				Max. Marks	Credits	Total Credit	Attributes						
			L	T	P	UE	TA	Total	ESE				Employability	Entrepreneurship	Skill development	Gender	Environment & sustainability	Human values	Professional ethics
ES115	Fundamentals of Environmental Science	Foundation	3	1	0	40	20	60	40	100	3:1:0	4					√	√	
BS171	Pteridophytes, Gymnosperms, Palaeobotany	Core	3	1	0	40	20	60	40	100	3:1:0	4					√		
CH119	General Chemistry-II	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√				
BS172	Non-Chordates- II “Annelida to Echinodermata”	Core	3	1	0	40	20	60	40	100	3:1:0	4					√		
BS233	Animal Physiology	Core	3	1	0	40	20	60	40	100	3:1:0	4							
BS174	Plant Diversity Lab-I	Practical	0	0	4	40	20	60	40	100	0:0:2	2					√		
CH120	Chemistry Practical-II	Practical	0	0	4	40	20	60	40	100	0:0:2	2	√	√	√				
		Total								700		24							

Revision effective from 2020-21 batch

INTEGRAL UNIVERSITY LUCKNOW
DEPARTMENT OF BIOSCIENCES

EVALUATION SCHEME (CBCS)

B.Sc. ZBC Semester-III

Course Code	Course Title	Type of Paper	Periods/Week			Evaluation Scheme				Max. Marks	Credits	Total Credit	Attributes						
			L	T	P	UE	TA	Total	ESE				Employability	Entrepreneurship	Skill development	Gender	Environment & sustainability	Human values	Professional ethics
BS263	Chordates – “Agnatha to Mammals”	Core	3	1	0	40	20	60	40	100	3:1:0	4					√		
CH221	Inorganic and Physical Chemistry-1	Core	2	1	0	40	20	60	40	100	2:1:0	3	√						
BS222	Angiosperm Morphology and Taxonomy	Core	3	1	0	40	20	60	40	100	3:1:0	4					√		
BS113	Fundamentals of Microbiology	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√		√		
CH222	Organic and Physical Chemistry-I	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√				
CH223	Chemistry Practical-III	Practical	0	0	4	40	20	60	40	100	0:0:2	2	√		√				
BS262	Animal Diversity Lab-II	Practical	0	0	6	40	20	60	40	100	0:0:4	3			√		√		
		Total								700		24							

Revision effective from 2020-21 batch

INTEGRAL UNIVERSITY LUCKNOW
DEPARTMENT OF BIOSCIENCES

EVALUATION SCHEME (CBCS)

B.Sc. ZBC Semester-IV

Course Code	Course Title	Type of Paper	Periods/Week			Evaluation Scheme				Max. Marks	Credits	Total Credit	Attributes						
			L	T	P	UE	TA	Total	ESE				Employability	Entrepreneurship	Skill development	Gender	Environment & sustainability	Human values	Professional ethics
BS271	Evolutionary Biology and Wildlife	Core	3	1	0	40	20	60	40	100	3:1:0	4					√		
BS322	Comparative Anatomy and Developmental Biology	Core	3	1	0	40	20	60	40	100	3:1:0	4			√				
CH224	Inorganic and Physical Chemistry-II	Core	3	1	0	40	20	60	40	100	3:1:0	4			√				
CH225	Organic and Physical Chemistry-II	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√				
BS232	Plant Physiology	Core	3	1	0	40	20	60	40	100	3:1:0	4					√		
BS272	Cytogenetics and Angiosperm taxonomy Lab	Practical	0	0	6	40	20	60	40	100	0:0:3	3					√		
CH226	Chemistry Practical-IV	Practical	0	0	4	40	20	60	40	100	0:0:2	2	√	√	√				
		Total								700		25							

Revision effective from 2020-21 batch

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 1st year/ 1st 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 ( )	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 lower non chordates.

9. COURSE OUTCOMES (CO):

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

COURSE OUTCOME (CO)	**ATTRIBUTES**
CO1	The students will learn about the 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 *Plasmodium, Monocystis*, *Fasciola hepatica, Taenia solium, Ascaris* and *Ancylostoma,*
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**

Platyhelminthes: General characters and classification up to classes;Fasciola hepatica, Taenia solium: - Structure, Life cycle, Pathogenecity & control measures.

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

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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
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 (√)**	**Foundation Course ()**		**Departmental Elective ()**	
5. Pre-requisite (if any)	10+2 with Biology	**6. Frequency (use tick marks)**	Even **( )**	Odd (√)	Either Sem ( )	Every Sem ( )

7. Total Number of Lectures, Tutorials, Practicals

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

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

9. COURSE OUTCOMES (CO):

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

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

10. Unit wise detailed content

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

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

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

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

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

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

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

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

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

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

11. 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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
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):

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

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Have basic knowledge of **c**lassification 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 *Sphagnum*
CO5	Study Marchantiophyta – *Marchantia;* Bryophyta - *Pogonatum*; Anthocerotophyta – *Anthoceros*.

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 Chlamydomonas, Oedogonium, Vaucheria, Chara and Polysiphonia.		
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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO1	**3**	**1**				**2**	**1**	2	**3**	1	
CO2	**3**	**1**				**2**	**1**	2	**3**	1	
CO3	**3**	**1**				**2**	**1**	2	**3**	1	
CO4	**3**	**1**				**2**	**1**	2	**3**	1	
CO5	**3**	**1**				**2**	**1**	2	**3**	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 Ψ2, quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s, p, d orbitals. Aufbau and Pauli exclusion

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 formal charges in

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 probable velocities.

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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	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**				
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):

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

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, Hetroneries, 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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
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 1st year/ 1st 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**(√)	**Foundation Course ( )**		**Departmental Elective( )**	
5.Pre-requisite (if any)	10+2 with Chemistry	**6.Frequency(use tick marks)**	Even **( )**	Odd ( )	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):

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

COURSE OUTCOME	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	idation-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 ofself learning/ E-learningcomponent

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, PragatiEdition.
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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
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
CH118											

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)

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

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, Stelar organization; Homospory and Heterospory; Economic importance and life cycle of pteridophytes with special reference to Pteris.		
Unit-2	**Number of lectures = 08**	**Title of unit: Morphology, anatomy, development, vegetative &**
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 characterstics of Gymnosperms**
General characterstics of Gymnosperms, classification, resemblances and differences of Gymnosperms with Pteridophytes and Angiosperms. Economic importance and life Cycle with special reference to Cycas.		
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 – Pinus.		

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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO1	**3**	**1**				**1**	**1**	2	**2**	1	
CO2	**3**	**1**				**1**	**1**	2	**3**	1	
CO3	**3**	**1**				**1**	**1**	2	**2**	2	
CO4	**3**	**1**				**1**	**1**	2	**3**	1	
CO5	**3**	**1**				**1**	**1**	2	**3**	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**		

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**

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**

Covalent Bond; Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH3, H3O+, SF4, ClF3, ICl2- and H2O. MO theory, homonuclear and heteronuclear (CO and NO) diatomicmolecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference.

Unit-3	**Number of lectures = 08**	**Title of the unit: Introduction to Stereochemistry of organic Compounds**

Concept of isomerism. Optical isomers, enantiomers and diastereomers, chiral and achiral molecules with two stereogeniccentres, absolute configuration, sequences rules, D & L and R & S systems of nomenclature. Geometrical isomerism - E & Z system of nomenclature, in alkenes oximes and cyclopropane derivative compounds.

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

Definition of colloids, classification of colloids. Sols: properties -kinetic, optical and electrical; stability of colloids, protectivecolloids, Hardy-Schulze rule, gold number. Emulsions: types of emulsions, preparation. Gels: classification, preparation and properties

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

First law of thermodynamics: statement, definition of internal energy and enthalpy, Heat capacity. Heat capacities at constant volume and pressure and their relationship. Joule-Thomson coefficient and inversion temperature. Calculation of w,q, dU&dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process. Problems.

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

1. https://www.youtube.com/watch?v=O82d8aiIS5Y
2. https://ocw.mit.edu/high-school/chemistry/exam-prep/structure-of-matter/chemical-bonding/
3. https://nptel.ac.in/courses/104103110/

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. Basic Inorganic Chemistry F.A. Cotton and G. Willkinson III Edition.
4. Organic Chemistry, S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International).
5. Modern Organic Chemistry, M. K. Jain and S.C. Sharma, Vishal Publications Jalandhar.
6. Physical Chemistry, P.W. Atkins, Oxford University Press.. K. Ghatak, "Physical Optics" (Tata McGrew Hill).

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

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO1	**3**	**2**	**1**	**1**	**2**	**2**	**3**				
CO2	**3**	**1**	**1**	**1**	**2**	**2**	**3**				
CO3	**3**	**2**	**1**	**1**	**1**	**1**	**3**				
CO4	**3**	**1**	**2**	**1**	**1**	**3**	**3**				
CO5	**3**	**2**	**2**	**1**	**2**	**2**	**3**				
CH119											

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	**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):

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

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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
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):

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

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 proteins.

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

Composition of blood, blood cells, plasma proteins and Rh factor; Blood coagulation – mechanism and regulation.

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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
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):

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

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, pteriodophytes 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, pteriodophyte, 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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO1	**3**	1				1	**1**		**3**	**2**	
CO2	**3**	1				2	**1**	**2**	**3**	**1**	
CO3	**3**	1				2	**1**	**3**	**3**	**2**	
CO4	**3**	1				1	**1**		**2**	**3**	**1**
CO5	**3**	1				2	**1**	**2**	**3**	**2**	**1**
BS174											

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	Chemistry Practical-II	**L**	**T**	**P**	
3.Course Code	**CH120**	0	0	6	
4.Type of Course (usetickmark)	**Core( )**	**Foundation Course ( )**	**Departmental Elective( )**		
5.Pre-requisite (if any)	10+2 with Chemistry	**6.Frequency(use tick marks)**	Even **( )**	Odd ( )	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):

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

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	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 KNO3 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 ofself learning/ E-learningcomponent

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, PragatiEdition.

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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
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):

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

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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
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 2nd year/ 3rd 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): ***After the successful course completion, learners will develop following attributes:***

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 &clatherate 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 S- block.

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 properties of

Unit-3	**Number of lectures = 08**	**Title of the unit: Chemistry of Noble Gasses**

Chemical properties of the noble gases, discovery of O2 + Chemistry PtF_6^- and O2XeF6. 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, temperature dependence of

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

Need for the law, different statements of the law, Cornot'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 Helmhotz function (A) as

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 ofStructure 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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
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 2nd year/ 3rd 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 helps the students to understand the distinguishing features of angiosperm families and get an insight in to the fruit, seed development and inflorescence.

9. COURSE OUTCOMES (CO):

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

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

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: Plant systematics**
Nomenclature of plants; the international code of botanical nomenclature. Documentation: Herbarium: Functions, preparation and management; important herbaria and botanical gardens of the world and of India; Flora; Keys; Numerical taxonomy and 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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO1	**3**	**1**				**2**	**1**	3	**3**	1	
CO2	**3**	**1**				**1**	**1**	2	**3**	1	
CO3	**3**	**1**				**1**	**1**	2	**3**	1	
CO4	**3**	**1**				**1**	**1**	3	**3**	1	
CO5	**3**	**1**				**2**	**1**	2	**3**	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): ***After the successful course completion, learners will develop following attributes:***

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

10. Unit wise detailed content

Unit-1	**Number of lectures = 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, N2 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:

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

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

B. Sc. ZOOLOGY, BOTANY & CHEMISTRY 2nd year/ 3rd semester						
1. Name of the Department: Chemistry						
2. Course Name	Organic and Physical Chemistry- I			**L**	**T**	**P**
3. Course Code	**CH222**			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 the about the chemistry of aliphatic hydrocarbons, properties, mechanism of addition and elimination reactions, conformational analysis of alkanes and cycloalkanes, stability and reactivity, aromaticity and substitution reactions of homocyclic & heterocyclic compounds, solutions and colligative properties and chemical Equilibrium.

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

COURSE OUTCOME	ATTRIBUTES
CO1	Understanding of Mechanism of eliminations, oxymercuration-demercuration, hydroboration- oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation, Allylic and benzylic bromination.
CO2	Comprehension of Conformational analysis, Relative stability and Energy diagrams of alkanes, Chair, Boat and Twist boat forms of cyclohexane with energy diagrams, analyse and compare relative stability of mono substituted cycloalkanes.
CO3	To create basics for the aromaticity, Hückel's rule, of homocyclic & heterocyclic compounds, electrophillic and substitution reactions & their mechanism, Directing effects of the groups.
CO4	Able to evaluate different types Colligative Properties like relative lowering of vapour pressure, elevation of boiling point, depression of freezing point, osmotic pressure and amount of solute.Know about lowering of vapour pressure, Raoult's and Henry's Laws and their applications,
CO5	Analyze the criteria of thermodynamic equilibrium, chemical equilibria in ideal gases, Le Chatelier Principle, equilibrium between ideal gases and a pure condensed phase.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: Chemistry of Aliphatic Hydrocarbons**

General methods of preparation, physical and chemical properties of alkenes and alkynes, Mechanism of E1, E2, E1CB reactions. Saytzeff and Hofmann eliminations. Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroboration- oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1, 2 and 1,4-addition reactions in conjugated dienes and Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene.

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, naphthalene and Anthracene..

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/
   https://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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	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 2nd year/ 3rd semester						
1.NameoftheDepartment:Chemistry						
2.CourseName	**Chemistry Practical-III**			**L**	**T**	**P**
3.CourseCode	**CH223**			0	0	6
4.TypeofCourse(use tick mark)		**Core( )**	**Foundation Course ( )**		**Departmental Elective( )**	
5.Pre-requisite (if any)	10+2 with Chemistry	**6.Frequency(usetickmarks)**	Even **( )**	Odd ( )	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):

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

COURSE OUTCOME	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	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 Fe3+ 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 ofself learning/ E-learningcomponent

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, PragatiEdition.

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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
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 2nd year/ 3rd semester

1. Name of the Department: Biosciences

2. Course Name	**ANIMAL DIVERSITY LAB-1I**	**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):

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

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 *Scoliodon*
Exp-02	Permanent stained preparation of ampullae of Lorenzini
Exp-03	Glycerine and permanent preparation of placoid scales
Exp-04	Dissection: *Scoliodon*
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, *Alligator*, and *Gavialis*
Exp-08	Study of the following specimens: *Herdmania, Amphioxus, Anguilla, Acipenser, Ambystoma, Rana, Varanus, Viper, Heloderma, Naja, Pavo, Psittacula, Porcupine, Platypus, Oryctolagus, Armadillo,Manis*
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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
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):

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

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. B**ooks 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. Evolutioary biology: Singh and Tomar

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

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
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):

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

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**
Gills, lungs and air sacs; Circulatory System: Evolution of heart and aortic arches; Urinogenital System: Succession of kidne y, Evolution of urinogenital ducts.		
Unit-3	**Number of lectures = 08**	**Title of the unit: Nervous System**
Comparative account of brain; Sense Organs: Types of receptors.		
Unit-4	**Number of lectures = 08**	**Title of the unit: Gametogenesis, Fertilization, Egg**
structure and types. Types and patterns of cleavage. Stem Cell and Its potency. Cell lineage, Genomic equivalence.		
Unit-5	**Number of lectures = 08**	**Title of the unit: Process of Blastulation and Gastrulation**

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

11. Books recommended:

1 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.

nalysis 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.

3. Weichert C.K and William Presch (1970). Elements of Chordate Anatomy, Tata McGraw Hills Hilderbrand, M and Gaslow G.E. A

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

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
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 2nd year/ 4th 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 actanides, 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, cerie 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 ofself learning/ E-learningcomponent		

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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
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): ***After the successful course completion, learners will develop following attributes:***

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 offreedom, 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 substitutions.

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 reaction.

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-Kishner reduction.

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

(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.

(ii) Determination of the order of reaction: Differential method, method of integration, half-life method and isolation method.

(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 transition state theory.

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

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..

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. 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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	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**				
CH225											

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	**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 ( )	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 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):

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

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Students will have an understanding of movement of water and solutes in plant, asent of sap and transpiration.
CO2	Have knowledge of Essential elements, their absorption, transport and role in plants and translocation in phloem.
CO3	Know about 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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
CO1	**3**	1					**1**	**3**	**3**	**1**	
CO2	**3**	1					**1**	**3**	**3**	**1**	
CO3	**3**	1				1	**1**	**3**	**3**	**1**	
CO4	**3**	1					**1**	**3**	**3**	**1**	
CO5	**3**	1					**1**	**3**	**3**	**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 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 cytogenetics and develop understanding of angiosperms and their economic importance.

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

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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
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			2	**1**		**2**	**3**	**1**
CO5	**3**	3	1			2	**1**	**2**	**3**	**2**	**1**
BS272											

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	Chemistry Practical-III	**L**	**T**	**P**
3.Course Code	**CH226**	0	0	6

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 ( ) 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):

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

COURSE OUTCOME	**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 duble 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 Oxidation: Preparation of benzoic acid from toluence
Exp-02	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 electrophlic 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 ofself learning/ E-learningcomponent

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, PragatiEdition.

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 / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	POS2	PSO3	PSO4
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 Correlation; 3- Substantial Correlation