ETERNAL UNIVERSITY

(ESTABLISHED UNDER HIMACHAL PRADESH GOVERNMENT ACT NO.3 OF 2009)

BARU SAHIB
HIMACHAL PRADESH

WORLD PEACE THROUGH VALUE BASED EDUCATION

AKAL COLLEGE OF BASIC SCIENCES

B.Sc. (HONS. WITH RESEARCH) LIFE SCIENCES CURRICULUM (SEMESTER I TO IV)

APPROVED VIDE ANNEXURE 4.3.2 OF 87TH ACADEMIC COUNCIL MEETING HELD ON 25TH JULY, 2025

TO BE IMPLEMENTED FROM THE ACADEMIC SESSION 2025-26

Dean
Academic Affairs
Eternal University
Baru Sahib (H.P.) 173101

Registrar (Officiating)
Eternal University
Baru Sahib (H.P.) 173101

ETERNAL UNIVERSITY
BARU SAHIB

Structure of UG Multidisciplinary Program
(With Three Core Disciplines)

B.Sc. (Hons. with Research) Life Sciences

(FOUR-YEAR FULL-TIME PROGRAMME)

(EIGHT SEMESTER COURSE)

(Effective from session 2024-25 onwards)

AKAL COLLEGE OF BASIC SCIENCES

TABLE OF CONTENTS

Note: The detailed syllabus for the Semester I to Semester IV is incorporated.

1. NATURE AND EXTENT OF THE PROGRAM

The duration of B.Sc. (Hons. with Research) Life Sciences program shall be of four years consisting of eight semesters as per the National Education Policy-2020 (NEP-2020). Students will be studying Discipline Specific Core (DSC) Courses, Discipline Specific Elective (DSE) Courses, Generic Elective (GE) Courses, Skill Enhancement Courses (SEC), Value Added Courses (VAC), Ability Enhancement Courses (AEC), and Internship/Apprentice/Project/Community Outreach (IAPC) in this four year's program.

The purpose of the undergraduate B.Sc. (Hons. with Research) Life Sciences is to provide the basic concepts in Botany, Chemistry, Zoology, and various laboratory resources. The programme prepares the students for careers and as professionals in the field of Life Sciences. The programme will inculcate, observation, analytical, scientific, experimental, problem solving, logical and research skills. The students will be able to explore new areas of research in these core disciplines and allied fields of Science & Technology.

The courses included in the program offer a blend of theoretical and experimental aspects in multidisciplinary areas of Botany, Chemistry, Zoology, and other branches of sciences. Further, the present program designed with specific practical and skills will enable students to start their own entrepreneurship ventures in the field of Life Sciences and other integrated disciplines. Multidisciplinary Generic Elective courses have been incorporated to teach overall concept of the subject so that students from other departments may choose the courses according to their interest.

After completion of this programme, the graduates can avail several career options in various fields such as biopharmaceuticals, beverage industry, fertilizer and pesticide production plants, water purification industry, and healthcare industry. Besides these, quality control officer, clinical research officer, scientific content writer, laboratory analyst, research scientist, school teacher, quality assurance technologists, mentors, field experts, ecologists, conservationists, environmentalists, gardener, entrepreneurs, and clinical research associate are among other career options after pursuing B.Sc. (Hons. with Research) Life Sciences. They can also appear in various national and state-level competitive examinations such as UGC-NET, GATE, SLET, SSC, UPSC and state PSCs. If the students are interested in research, they can join Ph. D. programme and take up research in the field of Life Sciences. Ultimately, these graduates will emerge as responsible citizens poised to contribute to national progress and global leadership in the field of Life Sciences.

Graduates contribute to the advancement of science and the development of best practices via their publications, research initiatives, and creative interventions. Their efforts advance scientific understanding, meet new social demands, and influence the direction of

life science research and its implementation. To sum up, the B.Sc. (Hons. with Research) Life Sciences curriculum is extremely important and have an impact on many aspects of our lives, including health care, the environment, and medical developments. They offer insight into the nature of life, the cycle of existence, sickness, and degeneration, and also supporting sustainable development that is environment friendly.

According to Bloom's Taxonomy pedagogy, this program is intended to be run. Each course's learning objectives have been correlated with program results, and the arrangement of all the program's courses is structured around three levels of thinking.

The program has been designed as per the National Education Policy guidelines and has some specific features including:

1. Option to exit with a Certificate in Life Sciences (total credit = 44), Diploma in Life Sciences (Total credit = 88), three-year Honors Degree in Life Sciences (total credit = 132), and four years' Honors Degree with Research in Life Sciences (total Credit = 176) after one, two, three and four-year program completed successfully, respectively.
2. The curriculum of each year, with two semesters each, has been designed in such a way that after completion of each level, the student can gain a certain level of competency with specific academic components.
3. The emphasis on practical training through meaningfully designed skill-enhancement courses and project has been given for skill development.

2. PROGRAM EDUCATION OBJECTIVES (PEOs)

The Program Educational Objectives for B.Sc. (Hons. with Research) Life Sciences program describe accomplishments that graduates are expected to attain.

No.	Education Objectives
PEO1	To provide students with a comprehensive education that integrates the fundamental principles and advance concepts of the three core disciplines of Botany, Chemistry and Zoology leading to successful career in research, teaching, or entrepreneurial endeavors.
PEO2	To strengthen one's capacity for critical thought, analysis, and decision-making in order to provide socially acceptable, practically verifiable, and scientifically sound answers to pressing issues pertaining to the biological, chemical, environmental, health and sustainable developmental issues.
PEO3	To enhance written and oral communication skills to effectively articulate biological, chemical, and biochemical aspects, research findings, and theoretical perspectives; and, to develop the ability to communicate with diverse audiences, including peers, researchers, scientists, and the general public.
PEO4	To gain hands-on experience through practicals, projects, or research in academic settings or field exposure through visits to Industrial Production Plants, Clinical and Diagnostic Laboratories, Zoological Parks, Museums, Wildlife Sanctuaries, Wetlands, Botanical and Medicinal Gardens, National Herbaria, Biopharmaceutical Units, Research Institutions, and Innovation/Incubation Centers.
PEO5	To foster personal growth, responsible citizenship and ethical conduct, the course component integrates health, wellness, and sports emphasizing holistic wellbeing across physical, emotional, social and spiritual dimensions.

3. GRADUATE ATTRIBUTES

S. No.	Attributes	Description
1.	Professional / Disciplinary Knowledge	Graduates will gain a comprehensive understanding of fundamental concepts, theories, methodologies, and techniques within the field of Life Sciences.
2.	Laboratory/ Practical Skills	Graduates will be proficient in various laboratory and practical skills and tools relevant to Life Sciences, including, designing experiments, administering interventions, and analyzing data.
3.	Communication Skill	Graduates will demonstrate professional and effective verbal and written communication skills, enabling them to articulate biological and chemical concepts and findings to diverse audiences.
4.	Cooperation/Team Work	Graduates will be adept at collaborating with colleagues and stakeholders, demonstrating the ability to work effectively as part of interdisciplinary teams in professional settings.
5.	Professional Ethics	Graduates will uphold high standards of professional ethics and integrity, demonstrating awareness of ethical principles and guidelines governing biological and chemical research, practice, and professional conduct.
6.	Research / Innovation-related Skills	Graduates will possess strong research and innovation skills, including the ability to design and execute research projects, critically evaluate existing literature, and contribute to the advancement of knowledge in the field of Life Sciences and allied branches.
7.	Critical Thinking and Problem Solving	Graduates will demonstrate advanced critical thinking skills, enabling them to analyze and evaluate biochemical concepts, research data and empirical evidences, as well as to develop innovative solutions to complex problems of the society.
8.	Reflective Thinking	Graduates will engage in reflective thinking practice, critically evaluating their own beliefs, assumptions, and professional practices, and using feedback to enhance their learning and professional development.
9.	Information/Digital Literacy	Graduates will be proficient in information and digital literacy skills, including the ability to access, evaluate, and utilize information effectively and ethically using digital technologies and resources.
10	Multi-cultural Competence	Graduates will demonstrate cultural sensitivity and competence, recognizing and respecting individual and cultural diversity.
11.	Leadership Readiness/Qualities	Graduates will exhibit leadership readiness and qualities, including the ability to inspire and motivate others, facilitate change, and contribute positively to their profession and community.
12.	Lifelong Learning	Graduates will recognize the importance of lifelong learning and professional development, demonstrating a commitment to staying abreast of advancements in the field of Life Sciences and continuously improving their knowledge and skills throughout their careers.

4. QUALIFICATION DESCRIPTORS:

Qualification descriptors for B.Sc. (Hons. with Research) Life Sciences typically outline the knowledge, skills, and attributes that students are expected to demonstrate upon completion of the program. These descriptors can vary slightly depending on the institution, but here are some common qualification descriptors:

- **Knowledge and Understanding:**
  - ✓ Demonstrate a broad understanding of key theories, concepts, and methodologies in biological and chemical sciences.
  - ✓ Understand the diversity of biological world and different biochemical processes.
  - ✓ Understand the deeper concepts of Botany, Chemistry, Zoology, and allied disciplines.
  - ✓ Critically evaluate research literature and methodologies pertaining to this programme.
- **Intellectual Skills:**
  - ✓ Apply critical thinking and problem-solving skills to burning issues related to the environmental biological, and physicochemical phenomenon.
  - ✓ Formulate and test hypotheses using appropriate research methods.
  - ✓ Synthesize and integrate information from diverse sources to draw reasoned conclusions.
  - ✓ Apply ethical principles in the design, conduct, and reporting of biological research.
- **Practical Skills:**
  - ✓ Utilize skills for culture, maintenance, and safe handling of biological entities.
  - ✓ Understand the various types of organic and inorganic compounds and their applications.
  - ✓ Understand good laboratory practices and safety measures.
  - ✓ Apply skills for mushroom cultivation, bio-diversity conservation, beekeeping, vermiculturing and production of bio-insecticides.
  - ✓ Collect, analyse, and interpret quantitative and qualitative data from small projects.
  - ✓ Apply biological principles and techniques to real-world contexts in community and field settings.
  - ✓ Communicate effectively through oral presentations, written reports, and other mediums, using appropriate terminology and conventions.
- **Transferable Skills:**
  - ✓ Work effectively both independently and collaboratively in academic and professional settings.
  - ✓ Demonstrate effective time management, organization, and self-regulation skills.
  - ✓ Utilize information technology and digital resources for research, communication, and data analysis.
  - ✓ Engage in lifelong learning processes and professional development to enhance knowledge and skills in Life Sciences and concerned fields.
- **Personal and Professional Development:**
  - ✓ Demonstrate competence and sensitivity to cultural diversity in this multidisciplinary education system.
  - ✓ Develop skills for effective communication with individuals from diverse backgrounds.
  - ✓ Engage in ethical decision-making and behaviour consistent with professional standards and codes of conduct in Life Sciences.

5. PROGRAM OUTCOMES

On successful completion of B.Sc. (Hons. with Research) Life Sciences program, the students are expected to attain the following:

S. No.	Attributes	Description
PO1	Professional Knowledge	Ability to understand and apply foundational principles and theories of Life Sciences to real-world scenarios. Students are expected to learn the fundamental concepts, principles and processes underlying the academic field of Botany, Chemistry, and Zoology with allied sciences.
PO2	Clinical/ Technical Skills	Demonstrate competency in routine and specialized biological and chemical/ biochemical laboratory skills leading to foster their growth as a successful researcher and established as an entrepreneur in the field of their specialization.
PO3	Ethical Value & Professionalism	Adherence to ethical principles and codes of conduct in professional decision-making and demonstrate the ability to identify ethical issues related to bio-chemical safety and bio-chemical hazards, genetic engineering, tissue culturing and intellectual property rights. At the end of this program students will be able to develop internalise and exercise ethics in their professional as well as personal practices.
PO4	Communication	Students will be able to communicate scientific concepts, experimental data, and analytical arguments clearly and concisely, both orally and in writing.
PO5	Evidence based Practice/Learning	Students will be able to communicate scientific concepts, experimental data, and analytical arguments clearly and concisely, both orally and in writing.
PO6	Life-long Learning	Encourage them for the recognition of importance in life-long learning and professional development for maintaining competiveness, self-sustainability, employability, adapting to evolving technologies and newer trends in Life Sciences.
PO7	Entrepreneurship, Leadership and Mentorship	Capacity for innovation and entrepreneurship in developing and implementing start-ups, production units and service programs. Leadership skills for guiding and inspiring teams, advocating for the profession, and fostering collaboration within multidisciplinary settings.

6. PROGRAM SPECIFIC OUTCOMES

PSO No.	Competency
PSO1	Graduates will gain a comprehensive understanding of biological and chemical principles across multiple levels of organization, integrating knowledge from Botany, Zoology, and Chemistry. They will be able to analyze complex biological systems, including interactions between organisms and their environments, using a multidisciplinary approach.
PSO2	Graduates will be proficient in a wide range of experimental techniques commonly used in botanical, zoological, and chemical research. They will possess practical skills in laboratory and fieldwork, including specimen collection and analysis, microscopy, molecular biology techniques, and chemical analysis, enabling them to conduct rigorous scientific investigations.
PSO3	Graduates will be adept at applying the scientific method to formulate hypotheses, design experiments, and interpret data in the context of botanical, zoological, and chemical research. They will be able to critically evaluate scientific literature, identify research gaps, and develop research questions to address fundamental and applied biological problems.
PSO4	To inculcate a scientific temperament in the students and create awareness of the impact of various courses of Life Sciences on the environment and society.
PSO5	By engaging in dissertations, academic projects, entrepreneurships students will utilize critical thinking, scientific approaches and scientific knowledge to design, execute, observe, and analyze results, thereby enhancing employment opportunities.

7. ASSESSMENT CRITERIA

Total Credits	L	T	P	End term Theory Exam marks	Internal Assessment (IA) marks	Total of theory exam and IA	Duration of theory exam	Tutorial	Practical marks				Grand Total marks
								CA	CA	End term practical / written exam	Viva-voce	Total	
4	3	1	0	90	30	120	3 hours	40	0	0	0	0	160
4	3	0	1	90	30	120	3 hours	0	10	20	10	40	160
4	0	0	4	0	0	0	NA	0	40	80#	40	160	160
4	1	0	3	30	10	40	1 hour	0	30	60	30	120	160
4	2	0	2	60	20	80	2 hours	0	20	40	20	80	160
2	1	0	1	30	10	40	1 hour	0	10	20**	10	40	80
2	0	0	2	0	0	0	NA	0	20	40**	20	80	80
2	2	0	0	60	20	80	2 hours	0	0	0	0	0	80

CA - Continuous Assessment **IA** - Internal Assessment

#In case there is no end term Practical examination for any 4-credit course which has only practical component, this mark shall be added to Continuous Assessment of the Practical and the total of the CA for Practical shall be 120.

**In case of courses of two credits which have practical component, either there shall be end term practical Examination or end term written examination.

8. METHODOLOGY OF AWARDING CODES TO NEP, 2020 COURSES

Faculty code (Alphabetically):

Faculty	Code
Dr Khem Singh Gill Akal College of Agriculture	01
Akal College of Arts & Social Sciences	02
Akal College of Basic Sciences	**03**
Akal College of Economics Commerce & Management	04
Akal College of Education	05
Akal College of Engineering & Technology	06
Akal College of Health and Allied Sciences	07

Department/Discipline Code (Alphabetically):
Example

Name of Discipline/Department	Code
No Deptt.	0
Botany	**1**
Chemistry & Biochemistry	2
Mathematics	3
Microbiology	4
Physics	5
Zoology	6
And so on	

Programme of Study:

Name of programme	Code
Common programme Courses (AEC, GE, SEC, VAC, RM etc)	00
B. Sc. (Hons. with Research) Life Sciences	**01**
B. Sc. (Hons. with Research) Microbiology	02
B. Sc. (Hons. with Research) Physical Sciences	03
And so on	

Semester Code:

Semester	Code
SEM I	1
SEM II	2
SEM III	3
SEM IV	4
SEM V	5
SEM VI	6
SEM VII	7
SEM VIII	8
SEM IX (For integrated course)	9
SEM X (For integrated course)	0

Code for Category of Course:

Category of course	Code
DSC	**1**
DSE	2
GE (For other disciplines)	3
SEC	4
AEC	5
VAC	6
IAPC	7
Dissertation	8
RM (Research Methodology)	9

Code for Course Number

Course number	Code
First	01
Second	02
Third	03
Fourth	04
Fifth	05
Sixth	06
Seventh	07
……	----
------	----
Tenth	10
---	---
----	----
Nineteenth	19
Twentieth	20
And so on	

Code for type of course (Theory or practical) of course

Type of course	Code
Theory including Tutorial	0
Theory + Tutorial +Practical or Exclusive	1

An Example of Botany Discipline of ACBS Faculty

Faculty code (ACBS)	Deptt./Disc. code (Botany)	Programme of study	Semester code (SEM I)	Category of course code (DSC)	Course code (First course)	Type of course (T/P)	**Unique code**
03	**1**	**01**	**1**	**1**	**01**	**1**	**0310111011**

9. PROGRAMME STRUCTURE

SEMESTER – I

Course Category	Course Code	Course Title	Teaching Hours/Week			Credits
			L	T	P	
DSC-1B	0310111011	Plant Diversity	3	0	2	3+0+1
DSC-1C	0320111011	Basic Concepts of Organic Chemistry	3	0	2	3+0+1
DSC-1Z	0360111011	Non-Chordates-I	3	0	2	3+0+1
GE-1		GE (One from the pool)	3	0	2	3+0+1
SEC-1		SEC (One from the pool)	1	0	2	1+0+1
AEC-1		AEC (One from the pool)	1	0	2	1+0+1
VAC-1		VAC (One from the pool)	1	0	2	1+0+1
	Total		**15**	**0**	**14**	**22**

Note – L: Lecture Hour/week, T: Tutorial Hour/week, P: Practical Hour/week, C: Credits, IAE: Internal Assessment Examination, ESE: End Semester Examination, DSC – Discipline Specific Course, GE – General Electives, SEC – Skill Enhancement Course, AEC – Ability Enhancement Course, VAC – Value Addition Course.

SEMESTER – II

Course Category	Course Code	Course Title	Teaching Hours/Week			Credits
			L	T	P	
DSC-2B	0310121021	Angiosperm Taxonomy	3	0	2	3+0+1
DSC-2C	0320121021	Periodic Properties and Chemical Bonding	3	0	2	3+0+1
DSC-2Z	0360121021	Non-Chordates-II	3	0	2	3+0+1
GE-2		GE (One from the pool)	3	0	2	3+0+1
SEC-2		SEC (One from the pool)	1	0	2	1+0+1
AEC-2		AEC (One from the pool)	1	0	2	1+0+1
VAC-2		VAC (One from the pool)	1	0	2	1+0+1
	Total		**15**	**0**	**14**	**22**

Note – L: Lecture Hour/week, T: Tutorial Hour/week, P: Practical Hour/week, C: Credits, IAE: Internal Assessment Examination, ESE: End Semester Examination, DSC – Discipline Specific Course, GE – General Electives, SEC – Skill Enhancement Course, AEC – Ability Enhancement Course, VAC – Value Addition Course.

Note: If the student wishes to exit after completing one year/ two semesters, UG Certificate will be provided to the students.

SEMESTER – III

Course Category		Course Code	Course Title	Teaching Hours/Week			Credits
				L	T	P	
DSC-3B		0310131031	Plant Physiology	3	0	2	3+0+1
DSC-3C		0320131031	Chemical Energetics and Equilibria	3	0	2	3+0+1
DSC-3Z		0360131031	Chordates-I	3	0	2	3+0+1
*DSE-1 (Pool)	i)	0310132011	Plant Ecology and Environment	3	0	2	3+0+1
	ii)	0320132011	Chemistry of Acids and Bases	3	0	2	3+0+1
/	iii)	0360132011	Animal Nutrition	3	0	2	3+0+1
*GE-3 (Pool)				3	0	2	3+0+1
AEC-3			AEC (One from the pool)	1	0	2	1+0+1
IAPC-1 / SEC-3			SEC (One from the pool)	1	0	2	1+0+1
VAC-3			VAC (One from the pool)	1	0	2	1+0+1
		Total		15	0	14	22

Note – L: Lecture Hour/week, T: Tutorial Hour/week, P: Practical Hour/week, C: Credits, IAE: Internal Assessment Examination, ESE: End Semester Examination, DSC – Discipline Specific Course, GE – General Electives, SEC – Skill Enhancement Course, AEC – Ability Enhancement Course, VAC – Value Addition Course.
***Any ONE course from the pool either DSE-1 or GE-1.**

SEMESTER – IV

Course Category		Course Code	Course Title	Teaching Hours/Week			Credits
				L	T	P	
DSC-4B		0310141041	Plant Developmental Biology	3	0	2	3+0+1
DSC-4C		0320141041	Chemistry of Oxygen Based Functional Groups	3	0	2	3+0+1
DSC-4Z		0360141041	Chordates-II	3	0	2	3+0+1
*DSE-2 (Pool)	i)	0310142021	Economic Botany	3	0	2	3+0+1
	ii)	0320142021	Chemistry of Colloids and Adsorption	3	0	2	3+0+1
/	iii)	0360142021	Applied Animal Sciences	3	0	2	3+0+1
*GE-4 (Pool)				3	0	2	3+0+1
IPAC-2 / SEC-4			SEC (One from the pool)	1	0	2	1+0+1
AEC-4			AEC (One from the pool)	1	0	2	1+0+1
VAC-4			VAC (One from the pool)	1	0	2	1+0+1
		Total		15	0	14	22

Note – L: Lecture Hour/week, T: Tutorial Hour/week, P: Practical Hour/week, C: Credits, IAE: Internal Assessment Examination, ESE: End Semester Examination, DSC – Discipline Specific Course, GE – General Electives, SEC – Skill Enhancement Course, AEC – Ability Enhancement Course, VAC – Value Addition Course.
***Any ONE course from the pool either DSE-1 or GE-1.**

Note: If the student wishes to exit after completing two years/ four semesters, UG Diploma will be provided to the students.

SEMESTER – V

Course Category		Course Code	Course Title	Teaching Hours/Week			Credits
				L	T	P	
DSC-5B		0310151051	Plant Cytogenetics	3	0	2	3+0+1
DSC-5C		0320151051	Coordination Chemistry	3	0	2	3+0+1
DSC-5Z		0360151051	Animal Physiology	3	0	2	3+0+1
*DSE-3 (Pool)	i)	0310152031	Ecological Management	3	0	2	3+0+1
	ii)	0320152031	Inorganic Materials of Industrial Importance				
	iii)	0360152031	Animal Behaviour				
GE-5			GE (One from the pool)	3	0	2	3+0+1
IAPC-3 / SEC-5			SEC (One from the pool)	1	0	2	1+0+1
		Total		16	0	12	22

Note – L: Lecture Hour/week, T: Tutorial Hour/week, P: Practical Hour/week, C: Credits, IAE: Internal Assessment Examination, ESE: End Semester Examination, DSC – Discipline Specific Course, GE – General Electives, SEC – Skill Enhancement Course, AEC – Ability Enhancement Course, VAC – Value Addition Course.
***Any ONE course from the pool either DSE-3.**

SEMESTER – VI

Course Category	Course Code	Course Title	Teaching Hours/Week			Credits
			L	T	P	
DSC-6B	0310161061	Phytopathology	3	0	2	3+0+1
DSC-6C	0320161061	Quantum Chemistry and Spectroscopy	3	0	2	3+0+1
DSC-6Z	0360161061	Evolutionary Biology	3	0	2	3+0+1
DSE-4	0150069010	Research Methodology (RM)	3	0	2	3+0+1
GE-6		GE (One from the pool)	3	0	2	3+0+1
IPAC-4/ SEC-6		SEC (One from the pool)	1	0	2	1+0+1
	Total		16	0	12	22

Note – L: Lecture Hour/week, T: Tutorial Hour/week, P: Practical Hour/week, C: Credits, IAE: Internal Assessment Examination, ESE: End Semester Examination, DSC – Discipline Specific Course, GE – General Electives, SEC – Skill Enhancement Course, AEC – Ability Enhancement Course, VAC – Value Addition Course.

Note: The student who successfully complete three years or six semesters and opt to exit the programme, will be awarded Bachelor Degree in Life Sciences. The students who secure 75% marks and above in the first six semesters and wish to undertake research at under-graduate level can choose a research stream in the fourth year. They should do a research project or dissertation or academic project under the guidance of a faculty member of the department. The research project or dissertation will be in the major or minor. The students who secure 160 credits, including 12 credits from research project or dissertation or academic project are awarded UG Degree (Honours with Research).

SEMESTER – VII

Discipline Specific: Botany

Course Category		Course Code	Course Title	Teaching Hours/Week			Credits
				L	T	P	
DSC-7B		0310171071	Plant Conservation and Techniques	3	0	2	3+0+1
DSE-5B (Pool)	i)	0310172051	Plant Tissue Culture and Biotechnology	3	0	2	3+0+1
	ii)	0310172061	Plant Biochemistry	3	0	2	3+0+1
	iii)	0310172071	Plant Resource Utilization	3	0	2	3+0+1
	vi)	0310172081	Forest Management	3	0	2	3+0+1
	v)	0310172091	Medicinal and Aromatic Plants	3	0	2	3+0+1
			Dissertation on Major Or Dissertation on Minor Or Academic Project / Entrepreneurship	0	0	12	0+0+6
		Total		12	0	20	22

Discipline Specific: Chemistry

Course Category		Course Code	Course Title	Teaching Hours/Week			Credits
				L	T	P	
DSC-7C		0320171071	Analytical Methods in Chemistry	3	0	2	3+0+1
DSE-5C (Pool)	i)	0320172051	Chemical Kinetics	3	0	2	3+0+1
	ii)	0320172061	Phase Equilibria and Photochemistry	3	0	2	3+0+1
	iii)	0320172071	Introduction to Supramolecular Chemistry	3	0	2	3+0+1
	vi)	0320172081	Industrial Chemistry	3	0	2	3+0+1
	v)	0320172091	Photochemistry and Pericyclic Reactions	3	0	2	3+0+1
			Dissertation on Major Or Dissertation on Minor Or Academic Project / Entrepreneurship	0	0	12	0+0+6
		Total		12	0	20	22

Discipline Specific: Zoology

Course Category		Course Code	Course Title	Teaching Hours/Week			Credits
				L	T	P	
DSC-7Z		0360171071	Developmental Biology	3	0	2	3+0+1
DSE-5Z (Pool)	i)	0360172051	Elementary Biochemistry	3	0	2	3+0+1
	ii)	0360172061	Vertebrate Endocrinology	3	0	2	3+0+1
	iii)	0360172071	Cell Biology	3	0	2	3+0+1
	vi)	0360172081	Ecology	3	0	2	3+0+1
	v)	0360172091	Instrumentation and Bio-techniques	3	0	2	3+0+1
			Dissertation on Major Or Dissertation on Minor Or Academic Project / Entrepreneurship	0	0	12	0+0+6
		Total		12	0	20	22

SEMESTER – VIII

Discipline Specific: Botany

Course Category		Course Code	Course Title	Teaching Hours/Week			Credits
				L	T	P	
DSC-8B		0310181081	Plant Bioinformatics and Systematics	3	0	2	3+0+1
DSE-6B (Pool)	i)	0310182101	Analytical techniques in Botany	3	0	2	3+0+1
	ii)	0310182111	Environmental Pollution and Phytoremediation	3	0	2	3+0+1
	iii)	0310182121	Fungal Diseases of Plant and Management	3	0	2	3+0+1
	vi)	0310182131	Mycorrhizal Technology	3	0	2	3+0+1
	v)	0310182141	Nursery and Gardening	3	0	2	3+0+1
			Dissertation on Major Or Dissertation on Minor Or Academic Project / Entrepreneurship	0	0	12	0+0+6
		Total		12	0	20	22

Discipline Specific: Chemistry

Course Category		Course Code	Course Title	Teaching Hours/Week			Credits
				L	T	P	
DSC-8C		0320381081	Polymers, Dyes and Natural Products	3	0	2	3+0+1
DSE-6C (Pool)	i)	0320182101	Biophysical Chemistry	3	0	2	3+0+1
	ii)	0320182111	Nanoscale Materials and their Applications	3	0	2	3+0+1
	iii)	0320182121	Chemistry of Elimination and Nucleophilic Substitution Reactions	3	0	2	3+0+1
	vi)	0320182131	Electrochemistry	3	0	2	3+0+1
	v)	0320182141	Polynuclear Hydrocarbons and Organic Spectroscopy	3	0	2	3+0+1
			Dissertation on Major Or Dissertation on Minor Or Academic Project / Entrepreneurship	0	0	12	0+0+6
		Total		12	0	20	22

Discipline Specific: Zoology

Course Category		Course Code	Course Title	Teaching Hours/Week			Credits
				L	T	P	
DSC-8Z		0360181081	General Immunology	3	0	2	3+0+1
DSE-6Z (Pool)	i)	0360182101	Molecular Biology and Genetics	3	0	2	3+0+1
	ii)	0360182111	Parasitology	3	0	2	3+0+1
	iii)	0360182121	Biosystematics	3	0	2	3+0+1
	vi)	0360182131	Entomology	3	0	2	3+0+1
	v)	0360182141	Bioinformatics	3	0	2	3+0+1
			Dissertation on Major Or Dissertation on Minor Or Academic Project / Entrepreneurship	0	0	12	0+0+6
		Total		12	0	20	22

Note – Student can opt either (3 DSE) OR (2 DSE & 1 GE) OR (1 DSE & 2GE). GEs can be opted from the common pool of GEs.
Note – L: Lecture Hour/week, T: Tutorial Hour/week, P: Practical Hour/week, C: Credits, IAE: Internal Assessment Examination, ESE: End Semester Examination, DSC – Discipline Specific Course, DSE – Discipline Specific Electives, GE – General Electives.

Note – L: Lecture Hour/week, T: Tutorial Hour/week, P: Practical Hour/week, C: Credits, IAE: Internal Assessment Examination, ESE: End Semester Examination, DSC – Discipline Specific Course, DSE – Discipline Specific Electives, GE – General Electives.

Multidisciplinary Generic Electives (MGE)

Multidisciplinary Generic Electives is credited and choice-based. The students make a choice from pool of MGE offered by the Faculty under the University. (Reference: University Umbrella Multidisciplinary Generic Electives).

Value Added Courses (VAC)

Value Added Courses is credited and choice-based. The students make a choice from pool of VAC offered by the Faculty under the University. (Reference: University Umbrella Value Added Courses).

Ability Enhancement Compulsory Course (AEC)

Ability Enhancement Compulsory Courses is credited and choice-based. The students make a choice from pool of AEC offered by the Faculty under the University. (Reference: University Umbrella Ability Enhancement Compulsory Course).

Skill Enhancement Courses (SEC)

Skill Enhancement Courses is credited and choice-based. The students make a choice from pool of SEC offered by the Faculty under the University.

OVERALL CREDIT DISTRIBUTION TABLE

SEMESTER	HOURS PER WEEK				Credits
	L	T	P	Total	
SEMESTER – I	15	0	14	29	22
SEMESTER – II	15	0	14	29	22
SEMESTER – III	15	0	14	29	22
SEMESTER – IV	15	0	14	29	22
SEMESTER – V	16	0	12	29	22
SEMESTER – VI	16	0	12	29	22
SEMESTER – VII	12	0	20	32	22
SEMESTER – VIII	12	0	20	32	22
Total	**116**	**0**	**120**	**236**	**176**

Note – L: Lecture Hour, T: Tutorial Hour, P: Practical Hour, C: Credits, IAE: Internal Assessment Examination, ESE: End Semester Examination.

10. DISCIPLINE SPECIFIC ELECTIVES (DSEs)

Course Code	Semester	Course Title	Teaching Hours/Week			Credits
			L	T	P	
Botany						
0310132011	III	Plant Ecology and Environment	3	0	2	3+0+1
0310142021	IV	Economic Botany	3	0	2	3+0+1
0310152031	V	Ecological Management	3	0	2	3+0+1
0150069010	VI	Research Methodology	3	0	2	3+0+1
0310172051	VII	Plant Tissue Culture and Biotechnology	3	0	2	3+0+1
0310172061		Plant Biochemistry	3	0	2	3+0+1
0310172071		Plant Resource Utilization	3	0	2	3+0+1
0310172081		Forest Management	3	0	2	3+0+1
0310172091		Medicinal and Aromatic Plants	3	0	2	3+0+1
0310182101	VIII	Analytical techniques in Botany	3	0	2	3+0+1
0310182111		Environmental Pollution and Phytoremediation	3	0	2	3+0+1
0310182121		Fungal Diseases of Plant and Management	3	0	2	3+0+1
0310182131		Mycorrhizal Technology	3	0	2	3+0+1
0310182141		Nursery and Gardening	3	0	2	3+0+1
Chemistry and Biochemistry						
0320132011	III	Chemistry of Acids & Bases	3	0	2	3+0+1
0320142021	IV	Chemistry of Colloids and Adsorption	3	0	2	3+0+1
0320152031	V	Inorganic Materials of Industrial Importance	3	0	2	3+0+1
0150069010	VI	Research Methodology	3	0	2	3+0+1
0320172051	VII	Chemical Kinetics	3	0	2	3+0+1
0320172061		Phase Equilibria and Photochemistry	3	0	2	3+0+1
0320172071		Introduction to Supramolecular Chemistry	3	0	2	3+0+1
0320172081		Industrial Chemistry	3	0	2	3+0+1
0320172091		Photochemistry and Pericyclic reactions	3	0	2	3+0+1
0320182101	VIII	Biophysical Chemistry	3	0	2	3+0+1
0320182111		Nanoscale Materials and their Applications	3	0	2	3+0+1
0320182121		Chemistry of Elimination and Nucleophilic Substitution reactions	3	0	2	3+0+1
0320182131		Electrochemistry	3	0	2	3+0+1
0320182141		Polynuclear Hydrocarbons and Organic Spectroscopy	3	0	2	3+0+1
Zoology						
0360132011	III	Animal Nutrition	3	0	2	3+0+1
0360142021	IV	Applied Animal Sciences	3	0	2	3+0+1
0360152031	V	Animal Behavior	3	0	2	3+0+1

0150069010	VI	Research Methodology	3	0	2	3+0+1
0360172051	VII	Elementary Biochemistry	3	0	2	3+0+1
0360172061		Vertebrate Endocrinology	3	0	2	3+0+1
0360172071		Cell Biology	3	0	2	3+0+1
0360172081		Ecology	3	0	2	3+0+1
0360172091		Instrumentation and Bio-techniques	3	0	2	3+0+1
0360182101	VIII	Molecular Biology and Genetics	3	0	2	3+0+1
0360182111		Parasitology	3	0	2	3+0+1
0360182121		Biosystematics	3	0	2	3+0+1
0360182131		Entomology	3	0	2	3+0+1
0360182141		Bioinformatics	3	0	2	3+0+1

11. GENERIC ELECTIVE (GE) COURSES OFFERED BY AKAL COLLEGE OF BASIC SCIENCES (ACBS)

Course Category	Course Code	Semester	Course Title	Teaching Hours/Week			Credits
				L	T	P	
	Botany						
GE-1B	0310023011	II	Plant Diversity Conservation for Sustainable Development	3	0	2	3+0+1
GE-2B	0310033021	III	Plant and Human Welfare	3	0	2	3+0+1
GE-3B	0310053031	V	Plant Ecology and Environment	3	0	2	3+0+1
GE-4B	0310063041	VI	Economic Botany	3	0	2	3+0+1
GE-5B	0310073051	VII	Ecological Management	3	0	2	3+0+1
	Note: All students can opt these courses except B. Sc. (Hons. with Research) Life Sciences **Zoology**						
GE-1Z	0360013011	I	Basic Zoology	3	0	2	3+0+1
GE-2Z	0360023021	II	Wildlife Conservation	3	0	2	3+0+1
GE-3Z	0360043031	IV	Aquatic Biology	3	0	2	3+0+1
GE-4Z	0360063041	VI	Insect Vector and Diseases	3	0	2	3+0+1
GE-5Z	0360083051	VIII	Economic Zoology	3	0	2	3+0+1
	Note: All students can opt these courses except B. Sc. (Hons. with Research) Life Sciences **Chemistry and Biochemistry**						
GE-1C	0320013011	I	Chemistry of Biomolecules	3	0	2	3+0+1
GE-2C	0320033021	III	Principles of Instrumental Analysis	3	0	2	3+0+1
GE-3C	0320053031	V	States of Matter	3	0	2	3+0+1
GE-4C	0320073041	VII	Basics of Polymer Chemistry	3	0	2	3+0+1
GE-5C	0320083051	VIII	Chemical Technology and Society	3	0	2	3+0+1
	Note: All students can opt these courses except B. Sc. (Hons. with Research) Life Sciences and B. Sc. (Hons. with Research) Physical Sciences **Microbiology**						
GE-1MB	0340043011	IV	Introduction to Microbiology	3	0	2	3+0+1
GE-2MB	0340053021	V	Microbes in Human Welfare	3	0	2	3+0+1
GE-3MB	0340063031	VI	Microbial Diseases and Infection Control	3	0	2	3+0+1
	Note: All students can opt these courses except B. Sc. (Hons. with Research) Microbiology **Physics**						
GE-1P	0350023011	II	Basics of Electricity and Magnetism	3	0	2	3+0+1
GE-2P	0350033021	III	Fundamentals of Mechanics	3	0	2	3+0+1
GE-3P	0350043031	IV	Essentials of Electromagnetic Waves and Optics	3	0	2	3+0+1
GE-4P	0350073041	VII	Materials Science in Daily Life	3	0	2	3+0+1
GE-5P	0350083051	VIII	Fundamentals of Waves and Vibrations	3	0	2	3+0+1

	Note: All students can opt these courses except B. Sc. (Hons. with Research) Physical Sciences **Mathematics**						
GE-1M	0330013010	I	Introductory Algebra	3	1	0	3+1+0
GE-2M	0330023021	II	Calculus and its Applications	3	0	2	3+0+1
GE-3M	0330043030	IV	Mathematical Concepts and Applications	3	1	0	3+1+0
GE-4M	0330063040	VI	Applied Vector Calculus	3	1	0	3+1+0
GE-5M	0330083051	VIII	Ordinary Differential Equations and its Applications	3	0	2	3+0+1
	Note: All students can opt these courses except B. Sc. (Hons. with Research) Physical Sciences						

12. LIST/ POOL OF (GE) COURSES OFFERED BY ETERNAL UNIVERSITY

SEMESTER – I

Course Category/ Pool	S.N.	Course Code	Course Title	Credits L+T+P	Offering Department	Semester
GE	1	0420013010	Essentials of Economics	3+1+0	Economics	I (Odd)
	2	0420013020	Sectoral Issues in Indian Economy	3+1+0	Economics	
	3	0410013010	Business & Commercial Knowledge	3+1+0	Commerce	
	4	0430013010	Fundamentals of Management	3+1+0	Management	
	5	0220013010	English Fluency – I (Mastering the Art of Communication)	3+1+0	English	
	6	0280013010	ਭਾਸ਼ਾਈ ਯੋਗਤਾ ਅਤੇ ਪੰਜਾਬੀ ਸਾਹਿਤ -।	3+1+0	Punjabi	
	7	0230013010	हिन्दी गद्य उद्भव एवं विकास- क	3+1+0	Hindi	
	8	0250013011	Hindustani Music (Vocal/ Instrumental)- 1	2+0+2	Music	
	9	0320013011	Chemistry of Biomolecules	3+0+1	Chemistry & Biochemistry	
	10	0330013010	Introductory Algebra	3+1+0	Mathematics	
	11	0360013011	Basic Zoology	3+0+1	Zoology	

SEMESTER – II

Course Category/ Pool	S.N.	Course Code	Course Title	Credits L+T+P	Offering Department	Semester
GE	1	0430023020	Agribusiness Management	3+1+0	Management	II (Even)
	2	0410023020	Basic of Accounting	3+1+0	Commerce	
	3	0420023040	Introductory Development Economics	3+1+0	Economics	
	4	0420023040	Basic Issues in Environmental Economics	3+1+0	Economics	
	5	0310023011	Plant Diversity Conservation for Sustainable Development	3+0+1	Botany	
	6	0360023021	Wildlife Conversation	3+0+1	Zoology	
	7	0350023011	Basic of Electricity and Magnetic	3+0+1	Physics	
	8	0330023021	Calculus and its Applications	3+0+1	Mathematics	
	9	0220023010	English of Fluency - I	3+1+0	English	
	10	0230023010	हिन्दी गद्य साहित्य का उद्भव एवं विकास- क	3+1+0	Hindi	
	11	0280023010	ਭਾਸ਼ਾਈ ਯੋਗਤਾ ਅਤੇ ਪੰਜਾਬੀ ਸਾਹਿਤ -।	3+1+0	Punjabi	
	12	0250023021	Hindustani Music (Vocal/Instrumental)	2+0+2	Music	
	13	0610023021	Operating System	3+0+1	CSE	
	14	0240023010	Indus Valley to Vedic Age	3+1+0	History	
	15	0270023011	Community Psychology	3+0+1	Psychology	

SEMESTER – III

Course Category / Pool	S.N.	Course Code	Course Title	Credits L+T+P	Offering Department	Semester
GE	1	0310033021	Plant and Human Welfare	3+0+1	Botany	III (Odd)
	2	0350033021	Fundamentals of Mechanics	3+0+1	Physics	
	3	0320033021	Principles of Instrumental Analysis	3+0+1	Chemistry and Biochemistry	
	4	0430033030	Entrepreneurial Skills	3+1+0	Management	
	5	0420033030	Rural Development Programmes	3+1+0	Economics	
	6	0410033030	Legal Aspects of Business	3+1+0	Commerce	
	7	0280033030	ਭਾਸ਼ਾਈ ਯੋਗਤਾ ਅਤੇ ਪੰਜਾਬੀ ਸਾਹਿਤ - III	3+1+0	Punjabi	
	8	0250033031	Hindustani Music (Vocal/ Instrumental)- III	2+0+2	Music	
	9	0220033030	Phonetics and Spoken English	3+1+0	English	
	10	0270033020	Youth, Gender and Identity	3+1+0	Psychology	
	11	0230033020	काव्य एवं प्रयोजनमूलक हिन्दी	3+1+0	Hindi	
	12	0610033031	Database Management System	3+0+1	CSE	

SEMESTER – IV

Course Category	S.N.	Course Code	Course Title	Credits L+T+P	Offering Department	Semester
GE	1	0340043011	Introduction to Microbiology	3+0+1	Microbiology	IV (Even)
	2	0420043040	Indian Economy and Governance	3+1+0	Economics	
	3	0360043031	Aquatic Biology	3+0+1	Zoology	
	4	0430043040	Business Laws	3+1+0	Management	
	5	0410024040	Fundamentals of Startup Finance	3+1+0	Commerce	
	6	0330331030	Foundation of Real Analysis	3+1+0	Mathematics	
	7	0350043031	Essentials of Electromagnetic Waves and Optics	3+0+1	Physics	
	8	0220043040	Learning English Through Literature	3+1+0	English	
	9	0250043041	Hindustani Music (Vocal / Instrumental) - 4	2+0+2	Music	
	10	0280043040	ਭਾਸ਼ਾਈ ਯੋਗਤਾ ਅਤੇ ਪੰਜਾਬੀ ਸਾਹਿਤ - IV	3+1+0	Punjabi	
	11	0610043041	Computer Networks	3+0+1	CSE	
	12	0330043030	Mathematical Concepts and Applications	3+1+0	Mathematics	

13. SEC, AEC and VAC Courses Offered by Akal College of Basic Sciences (ACBS)

SEMESTER-I

S.No	Course Category	Course Code	Course Title	Credits L+T+P	Semester	Offering Department
1	SEC-1M	0330014011	Advance Excel	1+0+1	Odd (I)	Mathematics
2	SEC-1B	0310034021	Field Botany	1+0+1	Odd (I)	Botany
3	AEC-1B	0310015011	Environmental Sciences - I	1+0+1	Odd (I)	Botany

SEMESTER-II

S. N.	Course Category	Course Code	Course Title	Credits L+T+P	Semester	Offering Department
1	SEC-1C	0320024011	Water Technology	1+0+1	II (EVEN)	Chemistry & Bio-chemistry
2	AEC-2B	0310025011	Environmental Sciences- I	1+0+1	II (EVEN)	Botany

SEMESTER-III

S. N.	Course category	Course Code	Course Title	Credits L+T+P	Semester	Offering Department
1	SEC-2M	0330034031	Introduction to Latex	1+0+1	Odd (III)	Mathematics
2	SEC-1Z	0360034011	Bee-keeping and its Management	1+0+1	Odd (III)	Zoology
3	SEC-1P	0350034011	Nanotechnology and its Applications	1+0+1	Odd (III)	Physics
4	SEC-1MB	0340034011	Microbiological Analysis of Water, Soil and Air	1+0+1	Odd (III)	Microbiology
5	SEC-2B	0310034021	Solid Waste Management	1+0+1	Odd (III)	Botany
6	SEC-2C	0320034021	Chemistry of Cosmetics and Hygiene Products	1+0+1	Odd (III)	Chemistry & Biochemistry
7	AEC-3B	0310035021	Environmental Sciences - II	1+0+1	Odd (III)	Botany

SEMESTER – IV

Sr. No.	Course category	Course Code	Course Title	Credits L+T+P	Semester	Offering Department
1	SEC-3B	0310044021	Plant Identification Techniques	1+0+1	Even (IV)	Botany
2	SEC-2MB	0340044021	Food Fermentation Techniques	1+0+1	Even (IV)	Microbiology
3	VAC-1C	0320046011	Science and society	1+0+1	Even (IV)	Chemistry & Biochemistry
4	AEC-4B	0310045021	Environmental Sciences – II	1+0+1	Even (IV)	Botany

14. LIST/ POOL OF SEC, AEC AND VAC COURSES OFFERED BY ETERNAL UNIVERSITY

SEMESTER – I

Course Category/ Pool	S.N.	Course Code	Course Title	Credits L+T+P	Offering Department	Semester
SEC	1	0140014011	Bakery, Confectionary and Snack Products	1+0+1	DKSGACA	I (Odd)
	2	0220014011	Soft Skills	1+0+1	English	
	3	0250014011	Introduction to Gurmat Sangeet (with Harmonium)- 1	1+0+1	Music	
	4	0310014011	Field Botany	1+0+1	Botany	
	5	0330014011	Advanced Excel	1+0+1	Mathematics	
	6	0410014011	Personal Financial Planning	1+0+1	Commerce	
	7	0430014011	Office Management	1+0+1	Management	
	8	0610014011	Interior Design and Decor	1+0+1	CSE	
	9	0140014021	Culinary Arts and Catering Science	1+0+1	Food Technology	
AEC	1	0220015011	Functional English-I	1+0+1	English	
	2	0280015011	ਪੰਜਾਬੀਮੁੱਢਲਾਗਿਆਨ-।	1+0+1	Punjabi	
	3	0230015011	सामान्य हिंदी भाषा और भाषा विज्ञान	1+0+1	Hindi	
	4	0310015011	Environmental Sciences-I	1+0+1	Botany	
VAC	1	0260016011	Constitutional Values and Fundamental Duties	1+0+1	Political Science	
	2	0270016011	Emotional Intelligence	1+0+1	Psychology	
	3	0290016011	Fit India	1+0+1	Sports	

SEMESTER – II

Course Category/ Pool	S. N.	Course Code	Course Title	Credits L+T+P	Offering Department	Semester
SEC	1	0170024011	Mushroom Cultivation	1+0+1	DKSGACA	II (Even)
	2	0220024021	Personality Development	1+0+1	ENGLISH	
	3	0250024021	Introduction to Gurmat Sangeet (with Harmonium)- 2	0+0+2	Music	
	4	0230024011	कार्यालयी हिन्दी	1+0+1	Hindi	
	5	0320024011	Water Technology	1+0+1	Chemistry	
	6	0330024021	Introduction to R Programming	1+0+1	Mathematics	
	7	0430024021	Event Management	1+0+1	Management	
	8	0710024011	First Aid (Basic)	1+0+1	Nursing	
	9	0710024021	Geriatric Care	1+0+1	Nursing	
	10	0610024021	Mastering Typing	1+0+1	Computer	
AEC	1	0220025011	Functional English-I	1+0+1	ENGLISH	
	2	0280025011	ਪੰਜਾਬੀ ਮੁੱਢਲਾ ਗਿਆਨ-।	1+0+1	Punjabi	
	3	0230025011	सामान्य हिंदी भाषा और भाषा विज्ञान	1+0+1	Hindi	
	4	0310025011	Environmental Sciences- I	1+0+1	Botany	
VAC	1	0110026011	National Cadet Corps -I	1+0+1	NCC UNIT	
	2	0290026021	Yoga: Philosophy and Practice	1+0+1	Sports	
	3	0220026011	Culture and Communication	1+0+1	English	

SEMESTER-III

Course Category/ Pool	S. N.	Course Code	Course Title	Credits L+T+P	Offering Department	Sem.
SEC	1	0330034031	Introduction to Latex	1+0+1	Mathematics	III (Odd)
	2	0360034011	Bee-keeping and its Management	1+0+1	Zoology	
	3	0420034011	Household Planning and Budgeting	1+0+1	Economics	
	4	0350034011	Nanotechnology and its Applications	1+0+1	Physics	
	5	0340034011	Microbiological Analysis of Water, Soil and Air	1+0+1	Microbiology	
	6	0610034031	Python for Beginners	1+0+1	Computer	
	7	0610034031	Computer System Hardware	1+0+1	Computer	
	8	0320034021	Chemistry of Cosmetics and Hygiene Products	1+0+1	Chemistry & Bichemistry	
	9	0310034021	Solid Waste Management	1+0+1	Botany	
	10	0280034011	ਪੰਜਾਬੀ ਦ੍ਰਿਸ਼ ਮੀਡੀਆ ਅਤੇ ਪਟਕਥਾ ਲੇਖਣ	1+0+1	Punjabi	
	11	0220034031	Creative and Critical Expression in English	1+0+1	English	
AEC	1	0310035021	Environmental Sciences - II	1+0+1	Botany	
	2	0280035031	ਪੰਜਾਬੀ ਮੁੱਢਲਾ ਗਿਆਨ - II	1+0+1	Punjabi	
	3	0220035021	Functional English – II	1+0+1	English	
VAC	1	0410036011	Financial Literacy	1+0+1	Commerce	
	2	0280036011	ਮੱਧਕਾਲੀ ਕਾਵਿ ਪਰੰਪਰਾ ਵਿਚ ਨੈਤਿਕਤਾ ਦਾ ਸੰਕਲਪ	1+0+1	Punjabi	
	3	0260036021	Human Rights: Theory and Practices	1+0+1	Political Science	
AEC	1	0230035021	समाचार संकलन और लेखन	1+0+1	Hindi	

SEMESTER-IV

Course Category/ Pool	S. N.	Course Code	Course Title	Credits L+T+P	Offering Department	Semester
SEC	1	0310044021	Plant Identification Techniques	1+0+1	Botany	IV (Even)
	2	0340044021	Food Fermentation Techniques	1+0+1	Microbiology	
	3	0420044021	Social Survey Methods	1+0+1	Economics	
	4	0610044041	Introduction to Web Design	1+0+1	Computer	
	5	0280044021	ਪੰਜਾਬੀ ਪੱਤਰਕਾਰੀ ਅਤੇ ਸਾਹਿਤਕ ਪੱਤਰਕਾਰੀ	1+0+1	Punjabi	
VAC	1	0280046021	ਸਾਹਿਤ ਅਤੇ ਮਨੁੱਖੀ ਚਰਿੱਤਰ ਦੀ ਨਿਰਮਾਣਕਾਰੀ	1+0+1	Punjabi	
	2	0320046011	Science and society	1+0+1	Chemistry & Biochemistry	
	3	0220046021	Digital Storytelling	1+0+1	English	
AEC	1	0280045041	ਪੰਜਾਬੀ ਮੁੱਢਲਾ ਗਿਆਨ - II	1+0+1	Punjabi	
	2	0310045021	Environmental Sciences - II	1+0+1	Botany	
	3	0220045021	Functional English – II	1+0+1	English	
	4	0230045021	समाचार संकलन और लेखन	1+0+1	Hindi	

12. SEMESTER-WISE COURSE DETAILS

Semester – I

Course Category	Course Code	Course Title	Teaching Hours/Week			Credits
			L	T	P	
DSC-1B	0310111011	Plant Diversity	3	0	2	3+0+1
DSC-1C	0320111011	Basic Concepts of Organic Chemistry	3	0	2	3+0+1
DSC-1Z	0360111011	Non-Chordates-I	3	0	2	3+0+1
GE-1		GE (One from the pool)	3	0	2	3+0+1
SEC-1		SEC (One from the pool)	1	0	2	1+0+1
AEC-1		AEC (One from the pool)	1	0	2	1+0+1
VAC-1		VAC (One from the pool)	1	0	2	1+0+1
	Total		**15**	**0**	**14**	**22**

DSC-1B (Plant Diversity)

Name of the College (Department)	Akal College of Basic Sciences (Department of Botany)
Name of the Program	B.Sc. (Hons. with Research) Life Sciences
Course Code	0310111011
Course Title	Plant Diversity
Academic Year	I
Semester	I
Number of Credits	4 (3+0+1)
Course Prerequisite	Students should have studied Biology at 10+2 level under Physics, Chemistry, Biology (PCB) scheme.
Course Synopsis	This course offers a comprehensive exploration of plant diversity, spanning from microorganisms like viruses and bacteria to higher plants such as algae, fungi, bryophytes, pteridophytes, and gymnosperms. Students will gain insights into the morphology, ecology, reproduction, and economic importance of these diverse plant groups.
Course Outcomes: At the end of the course students will be able:	
CO1	To understand the basic concept of microbes their structure and their economic importance.
CO2	To understand the basic information about the Algae and their distribution. General characteristic and their economic importance.
CO3	To understand the basic information about the fungi, their ecological significance.
CO4	To understand the basic characteristic of Bryophytes and their economic importance.
CO5	To understand the basic characteristic ecological and economic importance of Pteridophytes and Gymnosperms.

Mapping of Course Outcomes (COs) to Program Outcomes (POs)& Program Specific Outcomes:												
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	1	1	3	1	1	1	1	1	2	1
CO2	1	1	1	1	1	1	1	1	1	1	3	1
CO3	2	2	1	1	2	1	1	1	1	1	1	1
CO4	1	2	1	1	2	1	1	1	1	2	2	1
CO5	2	2	1	2	3	2	1	2	1	1	3	1
Average	**1.4**	**1.8**	**1**	**1.2**	**2.2**	**1.2**	**1**	**1.2**	**1**	**1.2**	**2.2**	**1**
1= Weak Correlation				2= Moderate Correlation						3= Strong Correlation		

Course Content				
L (Hours/ Week)	**T (Hours/ Week)**	**P (Hours/ Week)**	**CL (Hours/Week)**	**Total Hour/ Week**
3 (3 Hours/ Week)	0	1 (2 Hours/ Week)	0	5 Hours/ Week
Unit	**Content & Competencies**			
1. Heterotrophic Diversity (Lecture Hours = 12)	Plant Viruses: Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance. Bacteria: Discovery, General characteristics and cell structure; Reproduction: vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance. Fungi: Introduction: General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification; True Fungi General characteristics, ecology and significance, life cycle of *Rhizopus, Penicillium, Puccinia, Agaricus*.			
2. Autotrophic Diversity (Lecture Hours = 10)	Algae: General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae. Morphology and life-cycles of the following: *Nostoc, Oedogonium, Vaucheria, Polysiphonia*; Economic importance of algae. Lichens: General account, reproduction, and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance.			
3. Archegoniate Diversity (Lecture Hours = 12)	Bryophytes: Unifying features of archegoniates, Transition to land habit, Alternation of generations; General characteristics, adaptations to land habit. Classification, Range of thallus organization; morphology, anatomy and reproduction of *Marchantia, Anthoceros, Sphagnum* and *Funaria*; Ecology and economic importance of bryophytes.			
4. Pteridophytes & Gymnosperms (Lecture Hours =11)	Pteridophytes: General characteristics, classification, Early land plants (*Rhynia*); Classification, Morphology, Anatomy and Reproduction of *Equisetum* and *Pteris*. Heterospory and seed habit, stelar evolution. Ecological and economical importance of Pteridophytes. Gymnosperms: General characteristics, Classification, Morphology, anatomy and reproduction of *Cycas* and *Pinus*. Ecological and economical importance.			
5. Practical Component (Lab Hours = 30)	**Any 5 practical's from the below mentioned list:** 1. Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle. 2. Study of Gram staining. 3. Study of vegetative and reproductive structures *Nostoc, Oedogonium, Vaucheria*, and *Polysiphonia*. 4. Study of vegetative and reproductive structures *Rhizopus,Penicillium, Puccinia*, and *Agaricus*. 5. Study of growth forms of lichens. 6. Reproductive stages and structure through temporary mount of			

	Rhizopus,Penicillium, Puccinia, Agaricus. 7. Morphology of thallus of *Marchantia, Anthoceros, Sphagnum* and *Funaria* andsporophyte (all permanent slides).

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	45
Practical	25
Seminar/Journal Club	-
Small Group Discussion (SGD)	1
Self-directed Learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	1
Case/Project Based Learning (CBL)	-
Revision	2
Others If any:	-
Total Number of Contact Hours	**75**

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping of Assessment with COs:

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	✓	✓	✓	✓	✓
Viva-voce	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Laboratory assessment	✓	✓	✓	✓	✓
Practical Log Book/ Record Book	✓	✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓

University Examination	✓	✓	✓	✓	✓

Feedback Process	1. Student's Feedback

References:	1. Vashista, B.R., Sinha, A.K. & Singh, V.B. (2005). Botany for degree students - Algae. S. Chand Publication. 2. Vashista, B.R., Sinha, A.K. & Singh, V.B. (2005). Botany for degree Students - Bryophytes. S. Chand Publication 3. Vashista, B.R., Sinha, A.K. & Singh, V.B. (2005). Botany for degree students - Fungi. S. Chand Publication. 4. Willey, J., Sandman, K. & Wood, D. (2023). Prescott's Microbiology (12th Edition). McGraw-Hill. 5. Chess, B. (2021) Talaro's Foundations in Microbiology (11th Edition). McGraw-Hill.

DSC-1C (Basic Concepts of Organic Chemistry)

Name of the College (Department)	Akal College of Basic Sciences (Department of Chemistry and Biochemistry)
Name of the Program	B.Sc. (Hons. with Research) Life Sciences
Course Code	0320111011
Course Title	Basic Concepts of Organic Chemistry
Academic Year	I
Semester	I
Number of Credits	4 (3+0+1)
Course Prerequisite	
Course Synopsis	Organic chemistry finds applications in pharmaceuticals, materials science, and agriculture, among others. Its interdisciplinary nature bridges biology, physics, and engineering, shaping diverse fields and innovations. This course will build a foundation and interest for organic chemistry as subject. Student will learn about the concept and antiquity of organic chemistry. Students will also acquire knowledge about different concepts of organic chemistry. This will help to develop the understanding and skills to think like organic chemist.

Course Outcomes: At the end of the course students will be able to:

CO1	Define organic chemistry, outline its goals, and explain the scope of organic chemistry in our daily life.
CO2	Understanding the fundamental concepts of stereochemistry.
CO3	Frame the mechanism of organic reactions by reminding and relating the fundamental properties of the reactants involved.
CO4	Learn and identify many organic reactions.
CO5	Differentiate electrophilic addition, nucleophilic addition, nucleophilic substitution, electrophilic substitution and rearrangement reactions.

Mapping of Course Outcomes (COs) to Program Outcomes (POs)& Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	2	1	2	2	1	2	1
CO2	1	1	2	2	1	1	1	2	1	1	3	2
CO3	2	2	2	2	2	2	1	2	1	1	1	1
CO4	2	2	1	2	2	1	1	2	2	1	2	2
CO5	3	3	2	2	3	2	2	2	2	1	3	1
Average	**2.2**	**2.2**	**2**	**2.2**	**2.2**	**1.6**	**1.2**	**2**	**1.6**	**1.2**	**2.2**	**1.4**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

Course Content

L (Hours/ Week)	T (Hours/ Week)	P (Hours/ Week)	CL (Hours/Week)	Total Hour/ Week
3 (3 Hours/ Week)	0	1 (2 Hours/ Week)	0	5 Hours/ Week

Unit	Content & Competencies
1. Fundamentals of Organic Chemistry	Types of Electronic displacements: Inductive effect, Resonance effect, Hyperconjugation, Electromeric Effect. Reactive intermediates and their stability:

(Lecture Hours = 10)	carbocations, free radicals, carbanions, benzyne, carbenes. Acidity and basicity in organic compounds (comparison of carboxylic acids, alcohols, phenols, primary, secondary and tertiary aliphatic amines, aniline and its derivatives)
2. Stereochemistry (Lecture Hours = 10)	Stereoisomerism: Concept of chirality (upto two carbon atoms). Configurational isomerism: geometrical and optical isomerism; enantiomerism, diastereomerism and meso compounds). Threo and erythro; D and L; Cis-trans nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E/Z nomenclature (for upto two C=C systems). Conformational isomerism with respect to ethane, butane and cyclohexane
3. Electrophilic & Nucleophilic addition reactions (Lecture Hours = 10)	Electrophilic addition reaction (with respect to propene, propyne, 3,3-dimethyl-1-butene): Hydration, Addition of HX in the absence and presence of peroxide, Hydroboration oxidation, Addition of bromine (with stereochemistry). Nucleophilic addition reaction of carbonyl compounds: Addition of HCN, ammonia derivatives (Hydroxylamine, Hydrazine, Semicarbazide and 2,4-DNP), the addition of carbanion (Aldol condensation, Claisen Schmidt, Benzoin condensation, Perkin reaction, reactions involving Grignard reagent)
4. Nucleophilic and Elimination substitution reactions (Lecture Hours = 15)	S_N1 and S_N2 in alkyl halides, alcohols (with nucleophiles like ammonia, halides, thiols, ambident nucleophiles (cyanide and nitrite ion)), ethers (Williamson ether synthesis), Elimination reaction (E1 & E2), elimination vs substitution (*w.r.t.* potassium t-butoxide and KOH); Nucleophilic aromatic substitution in aryl halides-elimination addition reaction w.r.t. chlorobenzene, including the effect of nitro group on the reaction. relative reactivity and strength of C-X bond in alkyl, allyl, benzyl, vinyl and aryl halides towards substitution reactions. Electrophilic Aromatic substitution with mechanism (benzene)- sulphonation, nitration, halogenation, Friedel craft acylation : *o-, m-* and *p-* directive influence giving examples of toluene/nitrobenzene/ phenol/aniline/ chlorobenzene.
5. Practical Component (Lab Hours = 30)	1. Purification of an organic compound by crystallization (from water and alcohol) and distillation, Criteria of purity: Determination of M.P. 2. Determination of boiling point of liquid compounds. (Boiling point lower than and more than 100°C by distillation and capillary method) 3. Detection of extra element 4. Preparations: (Mechanism of various reactions involved to be discussed). a. Bromination of phenol/aniline. b. 2,4-Dinitrophenylhydrazone of aldehydes and ketones c. Semicarbazone of aldehydes/ ketones d. Aldol condensation reaction using green method. e. Bromination of Stilbene. 5. Acetanilide to p-Bromoacetanilide

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	45
Practical	25
Seminar/Journal Club	-
Small Group Discussion (SGD)	1
Self-directed Learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	1
Case/Project Based Learning (CBL)	-
Revision	2

Others If any:	-
Total Number of Contact Hours	**75**

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping of Assessment with COs:

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	✓	✓	✓	✓	✓
Viva-voce	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Laboratory assessment	✓	✓	✓	✓	✓
Practical Log Book/ Record Book	✓	✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓
Feedback Process	1. Student's Feedback				

References:	1. Ahluwalia, V. K., & Dhingra, S. (2024). Advanced Experimental Inorganic Chemistry. Taylor & Francis. 2. Allinger, N. L., & Eliel, E. L. (Eds.). (2009). Topics in stereochemistry. John Wiley & Sons. 3. Furniss, B. S. (Ed.). (2011). Vogel's textbook of practical organic chemistry. Pearson Education India. 4. Furniss, B. S. (Ed.). (2011). Vogel's textbook of practical organic chemistry. Pearson Education India. 5. Lin, S. K., & March, J. (2001). March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure. Molecules, 6(12), 1064-1065. 6. Sykes, P. (1986). A guidebook to mechanism in organic chemistry. Pearson Education India.

DSC-1Z (Non-Chordates-I)

Name of the College (Department)	Akal College of Basic Sciences (Department of Zoology)
Name of the Program	B.Sc. (Hons. with Research) Life Sciences
Course Code	0360111011
Course Title	Non-Chordates-I
Academic Year	I
Semester	I
Number of Credits	4 (3+0+1)
Course Prerequisite	Students should have studied Biology at 10+2 level under Physics, Chemistry, Biology (PCB) scheme.
Course Synopsis	Non-Chordates-I course is intended for students to impart the knowledge of Invertebrates, such as Protozoa, Porifera, Coelenterata, Platyhelminthes, and Aschelminthes. This course will build foundation and interest for Zoology as a subject. This course covers the detailed study including morphology, systemic position, distribution ecology, anatomy and economic importance of different animals that comes under different phylum. Practical skills are an essential part of Zoology. The experiments included in this course are intended to develop basic zoological skills related to examination of cultures of Protozoa and specimen identification.
Course Outcomes: At the end of the course students will be able:	
CO1	To learn parasitic protozoans (*Entamoeba*, *Giardia*, *Trypanosoma* and *Leishmania)*.
CO2	To know about morphology, anatomy, systematic position, morphology, distinctive characters, distribution ecology and economic importance of the Porifera and Coelenterata.
CO3	To understand morphology, anatomy, systematic position, morphology, distinctive characters, distribution ecology and economic importance of the Platyhelminthes.
CO4	To learn morphology, anatomy, systematic position, morphology, distinctive characters, distribution ecology and economic importance of the Aschelminthes.
CO5	To demonstrate laboratory skills in basic zoological techniques including culturing, staining and slide preparations.

Mapping of Course Outcomes (COs) to Program Outcomes (POs)& Program Specific Outcomes:												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	1	1	1	1	2	1	1	1	1
CO2	1	1	1	1	1	1	1	3	1	1	1	1
CO3	2	2	1	1	2	1	1	1	1	1	1	1
CO4	2	2	1	1	1	1	1	2	2	1	2	1
CO5	3	2	1	2	2	2	1	3	1	1	1	1
Average	**2.2**	**1.8**	**1**	**1.2**	**1.4**	**1.2**	**1**	**2.2**	**1.2**	**1**	**1.2**	**1**
1= Weak Correlation			2= Moderate Correlation							3= Strong Correlation		

Course Content				
L (Hours/ Week)	**T (Hours/ Week)**	**P (Hours/ Week)**	**CL (Hours/Week)**	**Total Hour/ Week**
3 (3 Hours/ Week)	0	1 (2 Hours/ Week)	0	5 Hours/ Week

Unit	Content & Competencies
1. Phylum Protozoa (Lecture Hours = 10)	Introduction to Non-chordates: Protozoa: Study of *Amoeba, Paramecium* and *Plasmodium* with respect to structure, locomotion, nutrition and reproduction. Introduction to parasitic protozoans and their life history (*Giardia, Trypanosoma* and *Leishmania*). Classification upto orders with brief ecological note and economic importance of *Opalina, Vorticella* and *Nyctotherus*.
2. Phylum Porifera and Coelenterata (Lecture Hours = 14)	Classification upto orders with brief ecological note and economic importance of poriferans: *Euplectella, Hyalonema* and *Spongilla*. Detailed study including morphology, anatomy, systematic position, distinctive characters, distribution ecology and economic importance of the *Sycon*. Classification upto orders with brief ecological note and economic importance of coelenterates: *Hydra, Sertularia, Plumularia, Tubularia, Physalia, Aurelia, Rhizostoma, Alcyonium, Tubipora, Metridium* and *Fungia*. Detailed study including morphology, anatomy, systematic position, distinctive characters, distribution ecology and economic importance of *Obelia*.
3. Phylum Platyhelminthes (Lecture Hours = 10)	Classification upto orders with brief ecological note and economic importance of the Platyhelminthes: *Dugesia*, *Schistosoma* and *Echinococcus*. Detailed study including morphology, anatomy, systematic position, life history and distinctive characters, distribution, ecology and economic importance of *Fasciola* and *Taenia*.
4. Phylum Aschelminthes (Lecture Hours = 11)	Classification upto orders with brief ecological note and economic importance of the Aschelminthes: *Oxyuris* and *Wuchereria*. Detailed study including morphology, anatomy, systematic position, distinctive characters, distribution ecology and economic importance of *Ascaris.*
5. Practical Component (Lab Hours = 30)	**Any 5 practical's from the below mentioned list:** 1. Examination of cultures of *Amoeba* and *Paramecium*. 2. Specimens study of phylum Porifera: *Sycon, Grantia, Euplectella, Hyalonema, Spongilla, Euspongia*. 3. Specimens study of phylum Coelenterata: *Hydra, Obelia, Physalia, Aurelia, Rhizostoma, Metridium, Millipora, Alcyonium, Tubipora, Zoanthus, Madrepora, Favia, Fungia and Astrangia*. 4. Specimens study of phylum Platyhelminthes: *Dugesia, Fasciola, Taenia and Echinococcus.* 5. Specimens study of phylum Aschelminthes: *Ascaris* (male and female), *Trichinella, Ancylostoma*. 6. Study of the following permanent stained preparations:- *Amoeba, Plasmodium*, *Noctiluca, Hydra* and *Obelia*, Male and Female *Ascaris*, *Pheretima*.

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	45
Practical	25
Seminar/Journal Club	-
Small Group Discussion (SGD)	1
Self-directed Learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	1
Case/Project Based Learning (CBL)	-
Revision	2
Others If any:	-

Total Number of Contact Hours	**75**

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping o Assessment with COs:

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	✓	✓	✓	✓	✓
Viva-voce	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Laboratory assessment	✓	✓	✓	✓	✓
Practical Log Book/ Record Book	✓	✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓
Feedback Process	1. Student's Feedback				

References:

1. Barnes, R.S.K., Calow, P., Olive, P.J. et al. (2002). Invertebrates: A new synthesis (3rd ed.). Blackwell Science. pp. 582.
2. Dhami, P.S. and Dhami, J.K.R. (2016). Invertebrates (39th ed.). S Chand and Company, New Delhi. pp. 789.
3. Kotpal, R.L. (2021). Modern Textbook of Zoology, Invertebrates (12th ed.). Rastogi Publications. pp. 885.
4. Jordon, E.L. and Verma, P.S.S. (2007). Invertebrate Zoology (14th ed.). Chand and Company, New Delhi. pp. 1127.
5. Willey J., Sandman K. and Wood, D. (2019). Prescott, Harley and Klein's Microbiology (11th ed.). McGraw-Hill. pp. 1101.

GENERAL ELECTIVES (GE) COURSES AS PER NEP-2020

OFFERED BY B.Sc. (HONS. WITH RESEARCH) LIFE SCIENCES PROGRAMME OF AKAL COLLEGE OF BASIC SCIENCES, FOR OTHER UG PROGRAMMES

SEMESTER – I

S.No.	Course Category	Course Code	Course Title	Credits L+T+P	Semester	Offering Department
1	GE-1Z	0360013011	Basic Zoology	3+0+1	Odd (I)	Zoology
2	GE-1C	0320013011	Chemistry of Biomolecules	3+0+1	Odd (I)	Chemistry & Biochemistry

GE-1Z (Basic Zoology)

Name of the College (Department)	Akal College of Basic Sciences (Department of Zoology)
Name of the Program	All Programmes other than B.Sc. (Hons. with Research) Life Sciences
Course Code	**0360013011**
Course Title	**Basic Zoology**
Academic Year	I
Semester	I
Number of Credits	4 (3+0+1)
Course Prerequisite	Students should have basic understanding and interest in subject of Life Sciences.
Course Synopsis	Introduces the science of invertebrate and vertebrate animals. This course is a study of zoological diversity emphasizing distribution, ecology, and economic importance of major animal phyla. This also includes molecular basis of life, structure, function and physiological process of life.

Course Outcomes:
At the end of the course students will be able:

CO1	To learn and retain information on the basics of Zoology.
CO2	To learn the importance of animal diversity their ecology, and economic importance.
CO3	To learn about the general structure and functions of cells and their constituents.
CO4	To apply their knowledge towards identification of different species of animals in their surroundings.
CO5	Enhance collaborative learning and communication skills through practical sessions, teamwork, group discussions, assignments and projects.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1												
CO2												
CO3												
CO4												
CO5												
Average												

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	CL (Hours/Week)	Total Hour/Week
3	-	2	-	**5**

Unit	Content & Competencies

1. Introduction to the living world (Lecture Hours = 10)	Introduction to Zoology, characteristics of living organisms. General information on animal cell and its constituents DNA, RNA etc. Mitotic and meiotic cell divisions.
2. Introduction to Invertebrates (Lecture Hours = 11)	Zoological nomenclature and principles of classification; Non-Chordate: General study including distribution, ecology, and economic importance of Protozoa, Porifera, Coelentrata, Platyhelminthis, Ascheihelminthes, Annelida, Mollusca and Arthropoda.
3. Introduction to Protochordates (Lecture Hours = 10)	General study including distribution, ecology, and economic importance of Protochordates (Cephalochordates, Urochordates and Hemichordates).
4. Introduction to Vertebrates (Lecture Hours = 14)	Chordates: General study including systematic position upto class, distribution ecology, and economic importance of following: Amphibians: Frog, Toads. Pisces: *Catla*, *Rohu*. Reptilia: Lizards, Snakes. Aves: Pigeon, House sparrow. Mammals: Horse, Rabbit. Physiology of respiration, composition of blood and its functions, sensory organs their structure and function.
5. Practical Component (Lab Hours = 30)	**Any 5 practical's from the below mentioned list:** 1. Study of microscope, its parts and working. 2. Study of the permanent slides of animal cells, cell division, and simple tissue. 3. To study the histology of different organs. 4. General survey and identification of local fauna. 5. Identification, classification and ecological notes on various specimens. 6. To identify the human blood groups.

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	**Contact Hours**
Lecture	45
Practical	25
Seminar/Journal Club	-
Small Group Discussion (SGD)	1
Self-directed Learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	1
Case/Project Based Learning (CBL)	-
Revision	2
Others If any:	-
Total Number of Contact Hours	**75**

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	✓	✓	✓	✓	✓
Viva	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Practical Log Book/ Record Book	x	✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓

Feedback Process:	Student's Feedback
References:	**List of Reference Books**
	1. Kotpal, R.L. (2021). Modern Textbook of Zoology, Invertebrates (12th ed.). Rastogi Publications. pp. 885. 2. Kotpal, R.L. (2022). Modern Textbook of Zoology, Vertebrates (12th ed.). Rastogi Publications. pp. 433. http://ngc.digitallibrary.co.in/jspui/handle/123456789/2283 3. Willey J., Sandman K. and Wood, D. (2019). Prescott, Harley and Klein's Microbiology (11th ed.). McGraw-Hill. pp. 1101.

GE-1C (Chemistry of Biomolecules)

Name of the College (Department)	Akal College of Basic Sciences (Chemistry and Biochemistry)
Name of the Program	All Programmes other than B.Sc. (Hons. with Research) Life Sciences and B.Sc. (Hons. with Research) Physical Sciences
Course Code	**0320013011**
Course Title	**Chemistry of Biomolecules**
Academic Year	I
Semester	I
Number of Credits	4 (3+0+1)
Course Prerequisite	Students should have basic understanding and interest in subject of Life or Chemical Sciences
Course Synopsis	This course provides a comprehensive introduction to the fundamental principles underlying the chemistry of life. It explores the structure, function and importance of biomolecules, the building blocks of life. Students will gain a deep understanding of carbohydrates, proteins, lipids, nucleic acids, vitamins and coenzymes. The course emphasizes the integration of theoretical knowledge with practical applications, fostering critical thinking and problem-solving skills. Through hands-on experiments and real-world examples, students will develop a solid foundation in biochemistry, preparing them for further studies in the biological and medical sciences.

Course Outcomes: At the end of the course students will be able to:

CO1	Classify and describe the major classes of biomolecules (carbohydrates, lipids, proteins and nucleic acids) and their structural components.
CO2	Explain the role of biomolecules in various biological processes, including energy metabolism, cell structure and genetic information transfer.
CO3	Demonstrate an understanding of the interrelationships between different classes of biomolecules and their functions within living organisms.
CO4	Apply biochemical principles to analyze and interpret experimental data related to biomolecules.
CO5	Appreciate the significance of biochemistry in fields such as medicine, agriculture and biotechnology.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1												
CO2												
CO3												
CO4												
CO5												
Average												

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	CL (Hours/Week)	Total Hour/Week
3	-	2	-	5

Unit	Content & Competencies
1. Biomolecules and Classification (Lecture Hours = 11)	Definition and classification of biomolecules: Bioorganic compounds, Bioinorganic compounds, Importance of biomolecules in living systems. Structure of biomolecules:Functional groups in biomolecules, Isomerism in biomolecules. Carbohydrates: Classification of carbohydrates, Structure and properties of monosaccharides, Oligosaccharides and Polysaccharides.
2. Amino Acids and Proteins (Lecture Hours = 11)	Amino Acids and Proteins: Structure and classification of amino acids, Essential and non-essential amino acids, Zwitterionic nature of amino acids, Isoelectric point, Peptide bond formation, Protein functions: Enzymes, Hormones, Antibodies, Structural proteins, Transport proteins
3. Lipids and Fats (Lecture Hours = 12)	Lipids: Simple lipids, complex lipids, derived lipids. Fatty acids: Structure and properties of fatty acids, Essential fatty acids. Triglycerides: Structure and properties of triglycerides, Fats and oils, Saponification. Phospholipids: Structure and properties of phospholipids, biological membranes. Steroids: Cholesterol and steroid hormones.
4. Nucleic Acids and Vitamins (Lecture Hours = 11)	Nucleic Acids: Purines and Pyrimidines, Structure and properties of nucleotides and nucleosides. Structure of DNA and RNA, Differences between DNA and RNA. Vitamins and Coenzymes: Fat-soluble and water-soluble vitamins, Vitamin A, D, E, K, B complex and vitamin C.
5. Practical Component (Lab Hours = 30)	**Any 5 practical's from the below mentioned list:** 1. Solution preparation: Dilution, mixing and concentration calculations. 2. Measurement of the pH of different solutions (acids, bases, buffers) using pH paper or a pH meter. 3. Preparing Buffer Solutions: Principles and Practical Approaches. 4. Estimation of reducing sugars in different samples. 5. Monitoring the breakdown of starch by amylase using iodine solution. 6. Determination of presence of proteins in different samples. 7. Investigation of the solubility of different lipids (fats, oils) in various solvents. 8. Preparation of soap by saponification of a fat or oil. 9. Determination of the saponification value of a fat or oil to estimate the average molecular weight of fatty acids. 10. Estimation of Vitamin C using titration method.

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	45
Practical	25
Seminar/Journal Club	-
Small group discussion (SGD)	1
Self-directed learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	1
Case/Project Based Learning (CBL)	-
Revision	2
Others If any:	-

Total Number of Contact Hours	**75**

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	✓	✓	✓	✓	✓
Viva	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Practical Log Book/ Record Book	✓	✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓

Feedback Process:	Student's Feedback
References:	**List of Reference Books**
	1. Nelson DL, Cox MM (2021). Lehninger principles of biochemistry (8th ed.). W. H. Freeman. 2. Satyanarayana U, Chakrapani U (2013). Biochemistry (4th ed.). Elsevier Health Sciences 3. Wilson K, Walker J (2018). Principles and Techniques of Biochemistry and Molecular Biology(8th ed.). Cambridge University Press.

SEC/AEC/VAC AS PER NEP-2020

OFFERED BY B.Sc. (HONS. WITH RESEARCH) LIFE SCIENCES PROGRAMME OF AKAL COLLEGE OF BASIC SCIENCES, FOR OTHER UG PROGRAMMES

SEMESTER-I

S.No	Course Category	Course Code	Course Title	Credits	Semester	Offering Department
1	SEC-1B	0310034021	Field Botany	1+0+1	Odd (I)	Botany
2	AEC-1B	0310015011	Environmental Science - I	1+0+1	Odd (I)	Botany

SEC-1B (Field Botany)

Name of the College (Department)	Akal College of Basic Sciences (Department of Botany)
Name of the Programme	
Course Code	**0310014011**
Course Title	**Field Botany**
Academic Year	I
Semester	I
Number of Credits	2 (1+0+1)
Course Prerequisite	
Course Synopsis	This course provides an introduction tothe field botany, emphasizing the importance of botanical excursions for plant identification, documentation, and conservation. Students will learn the principles and techniques of conducting field studies, the use of field equipment, and safety guidelines. The course covers methods for collecting and documenting plant specimens and explores the traditional knowledge of plants used by indigenous communities. Additionally, it includes field-based conservation approaches, with practical hands-on experience in using GPS devices, compasses, and field notebooks, as well as specimen collection and first aid procedures.

Course Outcomes: At the end of the course students will be able to:

CO1	Understand the significance of botanical excursions and field studies in plant identification, documentation, and conservation.
CO2	Demonstrate proficiency in using field equipment such as GPS devices, compasses, and field notebooks, and adhere to safety guidelines and ethical considerations.
CO3	Acquire techniques for collecting plant specimens, maintaining detailed field notebooks, and documenting plant diversity and distribution.
CO4	Explore and document traditional knowledge of plants used by indigenous communities and apply field-based conservation approaches, including habitat restoration and management.
CO5	Gain hands-on experience with plant specimen collection, pressing, and labeling, as well as first aid procedures, and prepare specimens for further examination and identification in the lab.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1												
CO2												
CO3												
CO4												
CO5												
Average												

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

Course Content:				
L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**CL (Hours/Week)**	**Total Hours/Week**
1	-	2	-	**3**
Unit	**Content & Competencies**			
1. (Lecture Hours=4)	Importance of botanical excursions and field studies in plant sciences; Role of field botany in plant identification, documentation, and conservation; Basic principles and techniques of conducting botanical excursions and field studies.			
2. (Lecture Hours=4)	Introduction to field equipment and tools used in botanical excursions; Safety guidelines and ethical considerations in field botany.			
3. (Lecture Hours=3)	Techniques for collecting plant specimens and maintaining field notebooks. Field methods for documenting plant diversity and distribution.			
4. (Lecture Hours=4)	Exploration of plant used by the indigenous communities; Collection and documentation of traditional knowledge related to plants; Field-based conservation approaches, including habitat restoration and management.			
5. Field Experiments (Lab Hours=30)	1. Demonstration and practice with field equipment such as GPS devices, compasses, and field notebooks. 2. Familiarization with basic techniques for plant specimen collection, pressing, and labeling. 3. Introduction to field safety measures and first aid procedures. 4. Collection of plant specimens for further examination and identification in the lab.			

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	15
Practical	26
Seminar/Journal Club	-
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	-
Problem Based Learning (PBL)	-
Case/Project Based Learning (CBL)	-
Revision	2
Others If any:	-
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Mid Semester Examination	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	✓	✓	✓	✓	✓
Viva	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Practical Log Book/ Record Book	✓	✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓

Feedback Process	Student's Feedback
References:	**List of Reference Books**
	1. Edwards, M., & Cheadle, V. (2019). *Field Guide to the Wildflowers of the Western Mediterranean.* Royal Botanic Gardens, Kew. 2. Krebs, C.J. (2014). *Ecology: The Experimental Analysis of Distribution and Abundance*. Pearson, UK. 3. Raven, P.H., Evert, R.F., & Eichhorn, S.E. (2005). *Biology of Plants.* W.H. Freeman and Company. 4. Ellenberg, H., & Leuschner, C. (2010). *Vegetation Ecology.* Cambridge University Press, UK.

AEC-1B (Environmental Sciences- I)

Name of the College (Department)	Akal College of Basic Sciences (Department of Botany)
Name of the Programme	
Course Code	**0310015011**
Course Title	**Environmental Sciences- I**
Academic Year	I
Semester	I
Number of Credits	2 (1+0+1)
Course Prerequisite	
Course Synopsis	The Environmental Sciences includes a multidisciplinary approach to comprehend the contemporary environmental threats. The United Nations is stressing upon the sustainable development through various conferences as well as agreements to secure the future of our coming generations worldwide. It is evident that no citizen of this global village can afford to be unaware of the deteriorating state of our environment. In Indian civilization, our ancient scriptures have stressed upon cultivating the values as well as practices for environmental conservation. In the present era, a clear understanding of environmental issues and adopting eco-friendly life styles has become even more important to save the mother earth. Keeping in view the points mentioned above, this course has been designed to promote awareness, skills, quality of life, avoiding overuse and sustainable use of natural resources among students.

Course Outcomes: At the end of the course students will be able to:

CO1	Embrace eco-friendly practices in life and promote these practices among the people in the society.
CO2	Acquire extensive knowledge about natural resources as well as processes that support life.
CO3	Evolve analytical thinking to formulate plans for environmental protection, natural resource conservation as well as sustainable development.
CO4	Cultivate attitudes as well as values for diligent involvement in resolving contemporary environmental issues and preventing the future ones.
CO5	Comprehend the consequences of human activities on the ecosystems, world economy as well as the quality of human life.

Mapping of Course Outcomes (COs) to Program Outcomes (POs)& Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	3	1	1	2	2	1	1	1	1	1	1
CO2	1	1	1.5	2	2	1	2	1.5	1	2	2	2
CO3	2	2	1	1	2	1.5	1	1	2	1	1.5	2
CO4	1	2	1.5	1	2	1	1	1.5	1	1.5	1	1.4
CO5	1	3	1	2	2	2.5	2	2	2	1	0.5	1

Average	**1.2**	**2.2**	**1.2**	**1.4**	**2**	**1.6**	**1.4**	**1.2**	**1.4**	**1.4**	**1.2**	**0.8**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	CL (Hours/Week)	Total Hour/Week
1	-	2	-	3

Unit	Content & Competencies
1. Introduction to Environmental Studies (Lecture Hours = 2)	Multidisciplinary nature of environmental studies; components of environment: atmosphere, hydrosphere, lithosphere, and biosphere, scope and importance; concept of sustainability and sustainable development.
2. Biodiversity and its conservation (Lecture Hours = 5)	Definition: Genetic, species and ecosystem biodiversity, alpha, beta and gamma diversity, biogeographical classification of India. Value of Biodiversity: Consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, national and local levels, India as mega-diversity nation, hot spots of biodiversity. Threats to biodiversity: Habitat loss, poaching of wildlife, man wildlife conflicts, endangered and endemic species of india. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.
3. Ecosystems (Lecture hours = 4)	Concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in the ecosystem, bigeochemical cycles, ecological successions, food chains, food webs and ecological pyramids. Introduction and characteristic features of the forest, grassland and desert ecosystems.
4. Natural Resources (Lecture hours = 4)	Natural resources and associated problems. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, Dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources. Energy resources: Growing energy needs, renewable and non-renewable energy sources. Food resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging and salinity. Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification Forest resources: Use and over-exploitation, deforestation and its consequences. Role of an individual in conservation of natural resources.
5 Practical Component (Lecture Hours = 30)	1. Visit to herbal garden to identify and study the significance of different medicinal plant species in the University Campus. 2. Use of environmental activity worksheets to understand interdependence and interactions between different environmental components. 3. Analysis of achievement of Sustainable Development Goals of any country. 4. Use of worksheets to identify structure and function of different ecosystems. 5. Visit to a paper recycling unit in the University campus. 6. Comparison of energy demand and consumption of a particular state over the years using graphical tools. 7. Develop and understand working model of renewable/non-renewable sources of energy. 8. Visit to a solar power plant in the University campus 9. Acquaintance with open-source databases of biodiversity. 10. Sampling of plant biodiversity of the University campus. 11. Quantify species loss across different time periods. 12. Analysis of benefits gained by any state by shifting towards organic farming. 13. Field visit to an aquatic ecosystem. 14. Identification of the floral diversity within University campus. 15. Sampling of noxious and invasive weeds in University campus.

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	15
Practical	26
Seminar/Journal Club	-
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	-
Problem Based Learning (PBL)	-
Case/Project Based Learning (CBL)	-
Revision	2
Others If any:	-
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	✓	✓	✓	✓	✓
Viva	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Practical Log Book/ Record Book	✓	✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓
Feedback Process	Student's Feedback				

References:	**List of Reference Books**
	1. Divan, S. and Rosencranz, A. (2002*). Environmental Law and Policy in India: Cases, Material & Statutes*. Oxford University Press, India 2. Gadgil, M. and Guha, R. (1993). *This Fissured Land: An Ecological History of India.* University of California Press, Berkeley, USA 3. Kumar, R and Sharma, D (2016). *Environmental Studies.* Trueman Book Company, Jalandhar. 4. McCully, P. (1996). *Rivers no more: the environmental effects of dams,* In: *Silenced Rivers: The Ecology and Politics of Large Dams.* Zed Books, New York, USA 5. Odum, E.P., Odum, H.T., and Andrews, J. (1971). *Fundamentals of Ecology.* Saunders, Philadelphia, USA. 6. Raven, P.H, Hassenzahl, D.M., Hager, M.C, Gift, N.Y., and Berg, L.R. (2015). *Environment*. Wiley Publishing, USA. 7. Singh, J.S., Singh, S.P., and Gupta, S.R. (2017). *Ecology, Environmental Science and Conservation.* S. Chand Publishing, New Delhi.

Semester – II

Course Category	Course Code	Course Title	Teaching Hours/Week			Credits
			L	T	P	
DSC-2B	0310121021	Angiosperm Taxonomy	3	0	2	3+0+1
DSC-2C	0320121021	Periodic Properties and Chemical Bonding	3	0	2	3+0+1
DSC-2Z	0360121021	Non-Chordates-II	3	0	2	3+0+1
GE-2		GE (One from the pool)	3	0	2	3+0+1
SEC-2		SEC (One from the pool)	1	0	2	1+0+1
AEC-2		AEC (One from the pool)	1	0	2	1+0+1
VAC-2		VAC (One from the pool)	1	0	2	1+0+1
	Total		**15**	**0**	**14**	**22**

DSC-2B (Angiosperm Taxonomy)

Name of the College (Department)	Akal College of Basic Sciences (Department of Botany)
Name of the Program	B.Sc. (Hons. with Research) Life Sciences
Course Code	**0310121021**
Course Title	**Angiosperm Taxonomy**
Academic Year	I
Semester	II
Number of Credits	4 (3+0+1)
Course Prerequisite	Students should have studied subject of botany in semester I at UG level under multidisciplinary or honours program.
Course Synopsis	This course aims to provide students with a comprehensive understanding of plant taxonomy, from historical perspectives to modern techniques in classification, identification, and preservation. Through theoretical lessons and practical exercises, students will develop the skills necessary to study and classify plant species effectively.
Course Outcomes: At the end of the course students will be able to:	
CO1	Understand the terminology and history of taxonomy.
CO2	Understand the principles and rules of ICN and understand the basic concept of palynology, cytology, phytochemistry in relation to taxonomy.
CO3	Understand the basic principles of Classification and identification.
CO4	Understand the herbarium techniques.
CO5	Understand the morphological and floral characters of different families.

Mapping of Course Outcomes (COs) to Program Outcomes (POs)& Program Specific Outcomes:												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	1	1	1	1	3	1	1	2	1
CO2	1	1	3	1	1	1	1	1	1	1	3	1

CO3	2	2	1	1	1	1	1	1	1	1	1	1
CO4	1	2	2	1	1	1	1	1	1	2	2	1
CO5	2	2	3	2	1	2	1	1	1	1	3	1
Average	**1.6**	**1.8**	**2.2**	**1.2**	**1**	**1.2**	**1**	**1.4**	**1**	**1.2**	**2.2**	**1**
1= Weak Correlation				2= Moderate Correlation							3= Strong Correlation	

Course Content				
L (Hours/ Week)	**T (Hours/ Week)**	**P (Hours/ Week)**	**CL (Hours/Week)**	**Total Hour/ Week**
3 (3 Hours/ Week)	0	1 (2 Hours/ Week)	0	5 Hours/ Week

Unit	Content & Competencies
1. Scientific Nomenclature (Lecture Hours = 13)	Introduction: History of taxonomy, taxonomic terminology. Description of angiosperms (type root, stem, leaves, inflorescence, fruit, and seed). Botanical Nomenclature: Principles and rules (ICN); ranks and names; binominal system. Typification, author citation, valid publication, rejection of names, principle of priority and its limitations, Taxonomic evidences.
2. Plant Systematics (Lecture Hours = 10)	Classification and Identification: Classification types - artificial, natural and phylogenetic. Bentham and Hooker system, Engler and Prantl system, Taxonomic hierarchy.
3. Morpho-taxonomy (Lecture Hours = 10)	Morphological, Floral characters of following families: Ranunculaceae, Brassicaceae, Malvaceae, Asteraceae, Lamiaceae, Poaceae. Economics importance of following families: Ranunculaceae, Brassicaceae, Malvaceae, Asteraceae, Lamiaceae, Poaceae.
4. Herbarium Techniques (Lecture Hours = 12)	Herbarium Techniques: Definitions, types and functions of herbarium; flora and its importance, monograph; important herbaria of the India and world. Modern techniques in herbarium and plant presrvations; Botanical gardens of the India and world.
5. Practical Component (Lab Hours = 30)	**Any 5 practical's from the below mentioned list:** 1. Study of vegetative and floral characters of the following families: Ranunculaceae, Brassicaceae, and Malvaceae,. 2. Study of vegetative and floral characters of the following families: Asteraceae, Lamiaceae, and Poaceae. 3. Field studies and phenolgy of local flora. Visits of Botanical Garden. 4. Collection of plants species and herbarium techniques. 5. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book). 6. Botanical excursion and feild report from the visit of a national park or wild life sanctuary.

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	45
Practical	25
Seminar/Journal Club	-
Small Group Discussion (SGD)	1
Self-directed Learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	1

Case/Project Based Learning (CBL)	
Revision	2
Others If any:	-
Total Number of Contact Hours	**75**

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping of Assessment with COs:

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	✓	✓	✓	✓	✓
Viva-voce	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Laboratory assessment	✓	✓	✓	✓	✓
Practical Log Book/ Record Book	✓	✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓
Feedback Process	1. Student's Feedback				

References:	1. Bawa, K.S., Primack, R.B. & Oommen, M.A. (2011) Conservation Biology: A primer from South Asia, Universities Press (Ltd.), Hyderabad. 2. Joshi, P.C. & Joshi, N. (2004) Biodiversity and Conservation, A. P. H. Publishing Corporation, New Delhi. 3. Krishnamurthy, K.V. (2004). An Advanced Textbook of Biodiversity: Principles and Practices, Oxford and IBH Publications Co. Pvt. Ltd., New Delhi. 4. Menta, C. (2016) Biodiversity Vol. I. ISBN Publishers, New Delhi. 5. Pullaiah, T. (2016) Biodiversity in India (Vol. 8). Bio Green Books, New Delhi. 6. Primack, R.B. (2002) Essential of Conservation Biology, Third Edition. Sinauer Associates, Inc, Massachusetts USA.

DSC-2C (Periodic Properties and Chemical Bonding)

Name of the College (Department)	Akal College of Basic Sciences (Department of Chemistry and Biochemistry)
Name of the Program	B.Sc. (Hons. with Research) Life Sciences
Course Code	0320121021
Course Title	Periodic Properties and Chemical Bonding
Academic Year	I
Semester	II
Number of Credits	4 (3+0+1)
Course Prerequisite	
Course Synopsis	The course would provide the basic information about the periodicity in properties with reference to the s, p and d block, which is necessary in understanding their group chemistry. It provides basic understanding about ionic, covalent and metallic bonding underlining the fact that chemical bonding is best regarded as a continuum between the three cases. The course provides an overview of hydrogen bonding and van der Waal's forces which influence the melting points, boiling points, solubility and energetics of dissolution of compounds.
Course Outcomes: At the end of the course students will be able to:	
CO1	Understand the trends in periodic table for ionization enthalpy, electron gain enthalpy, electronegativity and enthalpy of atomization.
CO2	Understand different oxidation state, colour, metallic character, magnetic and catalytic properties and ability to form complexes.
CO3	Comprehend the concept of lattice energy using Born-Landé expression.
CO4	Draw the structures of molecules using VSEPR theory.
CO5	Understand Molecular orbitals diagrams.

Mapping of Course Outcomes (COs) to Program Outcomes (POs)& Program Specific Outcomes:												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	2	1	2	2	1	2	1
CO2	1	1	2	2	1	1	1	2	1	1	3	2
CO3	2	2	2	2	2	2	1	2	1	1	1	1
CO4	2	2	1	2	2	1	1	2	2	2	2	2
CO5	3	3	2	2	3	2	2	2	2	1	3	1
Average	**2.2**	**2.2**	**2**	**2.2**	**2.2**	**1.6**	**1.2**	**2**	**1.6**	**1.2**	**2.2**	**1.4**
1= Weak Correlation			2= Moderate Correlation							3= Strong Correlation		

Course Content				
L (Hours/ Week)	**T (Hours/ Week)**	**P (Hours/ Week)**	**CL (Hours/Week)**	**Total Hour/ Week**
3 (3 Hours/ Week)	0	1 (2 Hours/ Week)	0	5 Hours/ Week
Unit	**Content & Competencies**			
1. Periodic Properties (Lecture Hours = 10)	Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy, inert pair effect. General group trends of s, p and d block elements with special reference to Ionization Enthalpy, Electron Gain Enthalpy,			

	Electronegativity, oxidation state, colour, metallic character, magnetic and catalytic properties, ability to form complexes.
2. Ionic Bonding (Lecture Hours = 10)	Ionic Bonding: General characteristics of ionic bonding, Lattice Enthalpy and Solvation Enthalpy and their relation to stability and solubility of ionic compounds, Born-Lande equation for calculation of Lattice Enthalpy (no derivation), Born-Haber cycle and its applications, polarizing power and polarizability, Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.
3. Covalent Bonding (Lecture Hours = 10)	Covalent Bonding: Valence Bond Approach, Hybridization and VSEPR Theory with suitable examples, Concept of resonance and resonating structures in various inorganic and organic compounds.
4. Molecular Orbital Theory (Lecture Hours = 15)	Molecular Orbital Approach: Rules for the LCAO method, bonding, nonbonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, MO treatment of homonuclear diatomic molecules of 1^{st} and 2^{nd} periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+.
5. Practical Component (Lab Hours = 30)	**Any 5 practical's from the below mentioned list:** 1. Preparation of standard solutions. 2. Estimation of Sodium carbonate using HCl by acid base titration. 3. Estimation of carbonate and hydroxide present together in a mixture. 4. Estimation of carbonate and bicarbonate present together in a mixture. 5. Estimation of free alkali present in different soaps/detergents. 6. Estimation of oxalic acid using $KMnO_4$ by redox titration. 7. Estimation of Mohr's salt using $KMnO_4$ by redox titration. 8. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal and external indicators. 9. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	45
Practical	25
Seminar/Journal Club	-
Small Group Discussion (SGD)	1
Self-directed Learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	1
Case/Project Based Learning (CBL)	
Revision	2
Others If any:	-
Total Number of Contact Hours	**75**

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination

Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping of Assessment with COs:

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	✓	✓	✓	✓	✓
Viva-voce	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Laboratory assessment	✓	✓	✓	✓	✓
Practical Log Book/ Record Book	✓	✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓
Feedback Process	1. Student's Feedback				

References:

1. Atkins, P. (2010). Shriver and Atkins' inorganic chemistry. Oxford University Press, USA.
2. Crichton, R. R. (2012). Biological inorganic chemistry: a new introduction to molecular structure and function. Elsevier.
3. Douglas, B. E., McDaniel, D. H., & Alexander, J. J. (1994). Concepts and models of inorganic chemistry, John Wiley & Sons.
4. Huheey, J. E., Keiter, E. A., Keiter, R. L., & Medhi, O. K. (2006). Inorganic chemistry: principles of structure and reactivity. Pearson Education India.
5. Kaim, W., Schwederski, B., & Klein, A. (2013). Bioinorganic Chemistry - Inorganic Elements in the Chemistry of Life: An Introduction and Guide. John Wiley & Sons.
6. Lee, J. D. (2008). Concise inorganic chemistry. John Wiley & Sons.
7. Vogel, A. I., & Jeffery, G. H. (1989). Vogel's textbook of quantitative chemical analysis, John Wiley, and Sons.

DSC-2Z (Non-Chordates-II)

Name of the College (Department)	Akal College of Basic Sciences (Department of Zoology)
Name of the Program	B.Sc. (Hons. with Research) Life Sciences
Course Code	0360121021
Course Title	Non-Chordates-II
Academic Year	I
Semester	II
Number of Credits	4 (3+0+1)
Course Prerequisite	Students should have studied Non-Chordates-I in semester-I.
Course Synopsis	Non-Chordates-II course is intended for students to impart the knowledge of Invertebrates, such as Annelida, Arthropoda, Mollusca and Echinodermata. This course will build foundation and interest for Zoology as a subject. This course covers the detailed study including morphology, systemic position, distribution ecology, anatomy and economic importance of different animals that comes under different phylum. Practical skills are an essential part of Zoology. The experiments included in this course are intended to develop basic Zoological skills related to the permanent stained preparations of trachea and mouth parts of insects.

Course Outcomes: At the end of the course students will be able to:

CO1	Learn about the importance of systematics, taxonomy and structural organization of Annelids along with detailed study of *Pheretima*.
CO2	Introduction and classification up to orders of phylum Arthropoda with detail study of *Periplaneta* and to study the social organization in insects.
CO3	To know about morphology, anatomy, systematic position, morphology, distinctive characters, distribution ecology and economic importance of the Echinodermata.
CO4	Acquire knowledge of phylum Mollusca, their classification, distinctive characters, distribution ecology and economic importance.
CO5	Enhance collaborative learning and communication skills through practical sessions, teamwork, group discussions, assignments and projects.

Mapping of Course Outcomes (COs) to Program Outcomes (POs)& Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	1	1	1	1	2	1	1	1	1
CO2	1	1	1	1	1	1	1	3	1	1	1	1
CO3	2	2	1	1	2	1	1	1	1	1	1	1
CO4	2	2	1	1	1	1	1	2	2	1	2	1
CO5	3	2	1	2	2	2	1	3	1	1	1	1
Average	**2.2**	**1.8**	**1**	**1.2**	**1.4**	**1.2**	**1**	**2.2**	**1.2**	**1**	**1.2**	**1**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

Course Content

L (Hours/ Week)	T (Hours/ Week)	P (Hours/ Week)	CL (Hours/Week)	Total Hour/ Week
3 (3 Hours/ Week)	-	1 (2 Hours/ Week)	-	5 Hours/ Week
Unit	**Content & Competencies**			

1. Phylum Annelida (Lecture Hours = 12)	Classification upto orders with brief ecological note and economic importance of the Annelida: *Nereis*, *Hirudinaria, Eunice*, *Arenicola*, *Aphrodite* and *Tubifex*. Detailed study including anatomy, systematic position, distinctive characters, distribution ecology and economic importance of *Pheretima*.
2. Phylum Arthropoda (Lecture Hours = 12)	Classification up to orders with ecological notes and economic importance of Arthropoda**:** *Peripatus, Palaemon*, *Lobster, Cancer*, *Sacculina, Eupagurus, Lepas, Balanus, Apis, Lepisma, Schistocerca, Poecilocerus, Gryllus*, *Mantis*, *Cicada, Forficula*, Dragon fly, bug, moth, beetle, *Polistes*, *Bombyx*, *Millipedes, Scolopendra* and *Palamnaeus*. Detail study including morphology, anatomy, systematic position, distinctive characters, distribution ecology and economic importance of *Periplaneta*. Social organization in insects.
3. Phylum Mollusca (Lecture Hours = 10)	Classification up to orders with ecological notes and economic importance of Mollusca: *Chiton, Anodonta, Mytilus, Ostrea, Cardium, Pholas, Solen* (razor Fish), *Pecten, Holiotis, Patella, Aplysia, Doris, Limax, Loligo, Sepia, Octopus, Nautilus* and *Dentalium.* Detail study including morphology, anatomy, systematic position, distinctive characters, distribution ecology and economic importance of *Pila.*
4. Phylum Echinodermata (Lecture Hours = 11)	Classification up to orders with ecological notes and economic importance of Echinodermata: Starfish, Sea urchin, Sea cucumber and Brittle star. Detail study including morphology, anatomy, systematic position, distinctive characters, distribution ecology and economic importance of *Asterias*.
5. Practical Component (Lab Hours = 30)	**Any 5 practical's from the below mentioned list:** 1. Specimens study of Annelida: *Pheretima*, *Nereis*, *Polynoe*, *Eunice*, *Aphrodite*, *Chaetopterus*, *Arenicola*, *Tubifex* and *Pontobdella.* 2. Specimen study of Arthropoda: *Peripatus, Palaemon*, *Lobster, Cancer*, *Sacculina, Eupagurus, Lepas, Balanus, Apis, Lepisma, Schistocerca, Poecilocerus, Gryllus*, and *Mantis*. 3. Examination of representative specimens from the phylum Arthropoda, including *Cicada, Forficula*, Dragon fly, termite queen, bug, moth, beetle, *Polistes*, *Bombyx*, *Millipedes, Scolopendra* and *Palamnaeus.* 4. Specimen study of Mollusca: *Anodonta, Mytilus, Ostrea, Cardium, Pholas, Solen, Pecten, Holiotis,* and *Patella.* 5. Examination of representative specimens from the phylum Mollusca, including *Aplysia*, *Doris*, *Limax*, *Loligo*, *Sepia*, *Octopus*, *Nautilus*, *Chiton*, and *Dentalium*. 6. Specimen study of Echinodermata: *Asterias, Echinus, Ophiothrix* and *Antedon*.

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	45
Practical	25
Seminar/Journal Club	-
Small Group Discussion (SGD)	1
Self-directed Learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	1
Case/Project Based Learning (CBL)	
Revision	2
Others If any:	-
Total Number of Contact Hours	**75**

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping of Assessment with COs:

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	✓	✓	✓	✓	✓
Viva-voce	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Laboratory assessment	✓	✓	✓	✓	✓
Practical Log Book/ Record Book	✓	✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓
Feedback Process	1. Student's Feedback				

References:

1. Barnes, R.S.K., Calow, P., Olive, P.J. et al. (2002). Invertebrates: A new synthesis (3rd ed.). Blackwell Science. pp. 582.
2. Dhami, P.S. & Dhami, J.K.R. (2016). Invertebrates (39th ed.). S Chand and Company, New Delhi. pp. 789.
3. Kotpal, R.L. (2021). Modern Textbook of Zoology, Invertebrates (12th ed.). Rastogi Publications. pp. 958.
4. Jordon, E.L. & Verma, P.S.S. (2007). Invertebrate Zoology (14th ed.). S. Chand and Company, New Delhi. pp. 1127.

GENERAL ELECTIVES (GE) COURSES AS PER NEP-2020

OFFERED BY B.Sc. (HONS. WITH RESEARCH) LIFE SCIENCES PROGRAMME OF AKAL COLLEGE OF BASIC SCIENCES, FOR OTHER UG PROGRAMMES

SEMESTER – II

S.No.	Course Category	Course Code	Course Title	Credits L+T+P	Semester	Offering Department
1	GE-1B	0310023011	Plant Diversity Conservation for Sustainable Development	3+0+1	EVEN (I)	Botany
2	GE-2Z	0360023021	Wildlife Conversation	3+0+1	EVEN (I)	Zoology

GE-1B (Plant Diversity Conservation for Sustainable Development)

Name of the College (Department)	Akal College of Basic Sciences (Department of Botany)
Name of the Programme	
Course Code	**0310023011**
Course Title	**Plant Diversity Conservation for Sustainable Development**
Academic Year	I
Semester	II
Number of Credits	4 (3+0+1)
Course Prerequisite	Students should have basic understanding and interest in subject of Life Sciences.
Course Synopsis	This course explores plant diversity and its ecological importance, focusing on India's bio-geographic diversity and its role in sustainable development. Topics include conservation biology concepts (in-situ and ex-situ strategies), current practices, and the values of plant diversity (intrinsic, social, economic). It addresses threats like habitat loss, pollution, and climate change, categorizing conservation statuses and exploring causes. Students examine socio-economic and political influences on conservation, and study key organizations involved. Case studies highlight conservation initiatives for endangered and endemic plant species in India, promoting biodiversity and sustainable development practices.

Course Outcomes:
At the end of the course students will be able to:

CO1	Understand plant diversity and its structural aspects, alongside India's biogeographic classification, with a grasp of in-situ and ex-situ conservation strategies.
CO2	Evaluate the multifaceted values of plant diversity, including intrinsic, consumptive, and ecosystem stability, within the context of India's Mega Diversity Nation status and biodiversity hotspots.
CO3	Analyze threats to biodiversity such as habitat loss, pollution, and climate change, while categorizing conservation statuses (rare, threatened, extinct) and exploring their underlying causes.
CO4	Assess the socio-economic and political influences on conservation efforts, examining the roles of organizations like IUCN, WWF, and national bodies such as DBT and BSI in biodiversity conservation.
CO5	Engage with case studies on endangered and endemic plant species in India, exploring conservation practices, biodiversity registers, sacred groves, and community-based initiatives.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

CO1												
CO2												
CO3												
CO4												

CO5												
Average												
1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation												

Course Content:				
L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**CL (Hours/Week)**	**Total Hour/Week**
3	0	2	0	**5**

Unit	**Content & Competencies**
1. Plant Diversity & Conservation (11 Hours)	Introduction- Plant (/biological) diversity, its structural and functional aspects; Bio-geographic classification of India. Basic concepts of conservation biology (*In-situ* and *ex-situ* conservation), plant-diversity conservation, and current practice in conservation.
2. Plant diversity & Sustainable development (11 Hours)	Plant diversity and ecology for sustainable development; Value of plant-diversity (Intrinsic, consumptive, productive use, social, ethical, aesthetic, breeding). Plant-diversity in relation to stability of ecosystem functioning; India as a Mega Diversity Nation, and Hotspots.
3. Threats to Biodiversity (11 Hours)	Threats to Biodiversity- Habitat loss, pollution, species introduction, global climate change, overexploitation, invasive species; Conservation categories, cause of rare, threatened, and extinction of species; social factors, economics, politics and action; Endangered and endemic plant species of India.
4. Resource Conservation & Activities (12 Hours)	Organizations involved in resource conservation IUCN, WWF, UNEP, UNESCO, Biodiversity International, IPGRI, FAO, BSI. General account on activities of DBT, BSI, NBPGR, FSI, and NFPTCR, Sacred groves, Biodiversity register.
5. Field Experiments: (30 Hours)	**Any 5 practical's from the below mentioned list:** 1. Community Structure Study: To study communities by quadrat method and to determine % Frequency, Density and Abundance. 2. To estimate Importance Value Index for grassland species based on relative frequency, relative density, and relative dominance in an area grassland or forest area. 3. To determine the biomass of a particular area. 4. To study the characteristics of different types of soils. 5. To study the conservation categories of plants in the native area. 6. Visit tissue-culture lab and understand the concept of micropropagation.

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	**Contact Hours**
Lecture	45
Practical	25
Seminar/Journal Club	-
Small group discussion (SGD)	1
Self-directed learning (SDL) / Tutorial	1

Problem Based Learning (PBL)	1
Case/Project Based Learning (CBL)	
Revision	2
Others If any:	-
Total Number of Contact Hours	**75**

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Mid Semester Examination	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	✓	✓	✓	✓	✓
Viva	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Clinical Assessment	x	x	x	x	x
Practical Log Book/ Record Book	**x**	✓	✓	✓	✓
Mid Semester Examination 1	✓	✓	✓	✓	✓
Mid Semester Examination 2	**x**	**x**	**x**	**x**	**x**
University Examination	✓	✓	✓	✓	✓

Feedback Process	Student's Feedback

References:	List of recommended groups
	1. Fiedler P.L and Kareiva, P.M. (1997) Conservation biology. Chapman and Hall International Thompson Publishing, USA. 2. Gabriel M. (2000) Biodiversity and conservation. Oxford and IBH publishing company Pvt Ltd. New Delhi. 3. Heywood, V.H. & Watson, R.T. (1995) Global Biodiversity Assessment. Cambridge University Press. 4. Krishnamoorthy, K.V (2004) An Advanced text book on Biodiversity-principles and Practice: Oxford and IBH publishing company Pvt. Ltd. New

	Delhi. 5. Kumar, U. and Sharma, A.K (2008) Plant Biotechnology and Biodiversity conservation. Agrobios India. 6. Meerut, India. 7. Odum EP and Barrett GW (2017) Fundamentals of Ecology. Masood Books, UP (India). 8. Sharma P.D. (2003). Ecology and Environmental Sciences. Rastogi Publications (India).

GE-2 Z (Wildlife Conservation)

Name of the Department	Akal College of Basic Sciences (Department of Zoology)
Name of the Program	
Course Code	**0360023021**
Course Title	**Wildlife Conservation**
Academic Year	I
Semester	II
Number of Credits	4 (3+0+1)
Course Prerequisite	Students should have basic understanding and interest in subject of Life Sciences.
Course Synopsis	Conservation of wildlife is the act of protecting wild animal and plant species along with their natural habitat. To sustain a healthy and balanced ecosystem, wildlife conservation is of vital importance. This course teaches the essential elements, concepts and skills related to wildlife conservation and management. This includes habitat management practices and National and International rules and regulations, cause, and concern regarding human wildlife conflicts in India.

Course Outcomes:

At the end:

CO1	This course will provide a wholesome and professional understanding about the Indian wildlife and its conservation scenario to the students.
CO2	Student will understand the human wild-life conflict.
CO3	It will provide the knowledge about Sustainable Development Goals.
CO4	It will produce a strong, skilled, knowledgeable youth force who can serve as a defender of wildlife by all possible ways in recent and future days.
CO5	Enhance collaborative learning and communication skills through practical sessions, teamwork, group discussions, assignments and projects.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1												
CO2												
CO3												
CO4												
CO5												
Average												

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	CL (Hours/Week)	Total Hour/Week
3	0	2	0	**5**

Unit	Content & Competencies
1. Introduction to Wild life (Lecture Hours =10)	Introduction and importance of wild-life. Important wild animals of India (mammals and birds). Major factors in wild life management: Water, soil and exotic animals.
2. Conservation Strategies (Lecture Hours = 12)	Wild-life conservation practices: *In-situ* conservation and *Ex-situ* conservation. Wild-life protection act: Hunting of wild animals. Concept of schedule in wildlife protection.
3. National and International Protection Measures (Lecture Hours = 12)	Sanctuaries and National parks. Central Zoo authority. IUCN Red list of Threatened Species. Trade in wild animals. Species conservation projects in India (Tiger, Rhino, Lion, Turtles, Crocodiles, Birds, and Coral reefs).
4. Human Wild-life Interaction (Lecture Hours = 11)	Man and wild-life conflict. Eco-tourism, Wild-life crimes. Concept of sustainability: Sustainable development and Sustainable Development Goals (SDGs).
5. Practical Component (Lab Hours = 30)	**Any 5 practical's from the below mentioned list:** 1. To deliver a seminar on a topic related to wild-life conservation. 2. To prepare a report on the latest events concerning wild animals at the National and International level. 3. To observe the behaviour of one wild animal and to write a report on it. 4. To visit a wild-life National Park and to submit a report on it. 5. Identification and study of important wild animals of India. 6. Preparation of a checklist of mammals and birds found in a local wildlife sanctuary.

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	45
Practical	25
Seminar/Journal Club	-
Small Group Discussion (SGD)	1
Self-directed Learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	1
Case/Project Based Learning (CBL)	
Revision	2
Others If any:	-
Total Number of Contact Hours	**75**

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)

Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Quiz	✓	✓	✓	✓	✓
Viva	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Clinical Assessment					
Practical Log Book/ Record Book		✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓

Feedback Process	1. Student's Feedback

References:	List of recommended books
	1. Mccomb, B.C. (2007) Wildlife Habitat Management (3rd ed.), CRC press. 2. Sinclair, A.R.E. and Fryxell, J.M. (2009) Wildlife Ecology Conservation and Management (1st ed.). Wiley. 3. Bruaude, S., and Low B.S. (ed.) (2010). An Introduction to Methods and Models in Ecology, Evolution, and Conservation Biology. Princeton University Press. 4. S.S. Negi (1993) Biodiversity and its Conservation in India, Indus Publications, New Delhi.

SEC/AEC/VAC AS PER NEP-2020

OFFERED BY B.Sc. (HONS. WITH RESEARCH) LIFE SCIENCES PROGRAMME OF AKAL COLLEGE OF BASIC SCIENCES, FOR OTHER UG PROGRAMMES

SEMESTER-II

S.No	Course Category	Course Code	Course Title	Credits	Semester	Offering Department
1	SEC-1C	0320024011	Water Technology	1+0+1	II (EVEN)	Chemistry & Bio-chemistry
2	AEC-2B	0310025011	Environmental Science- I	1+0+1	II (EVEN)	Botany

SEC-1C (Water Technology)

Name of the College (Department)	Akal College of Basic Sciences (Department of Chemistry and Biochemistry)
Name of the Program	
Course Code	**0320024011**
Course Title	**Water Technology**
Academic Year	I
Semester	II
Number of Credits	2 (1+0+1)
Course Prerequisite	
Course Synopsis	Water technology involves calculating various physical, chemical, and biological characteristics of water to determine its quality and suitability for specific purposes. This process typically includes testing parameters such as pH, turbidity, dissolved oxygen and conductivity. By understanding the composition and condition of water, analysts can evaluate its safety for drinking, industrial use, agricultural irrigation, and ecological health, ensuring compliance with regulatory standards.

Course Outcomes:
At the end of the course students will be able to:

CO1	Define hardness of water, types of hardness, and explain the scope of water technology.
CO2	Understand water softening techniques.
CO3	Understand characteristics and roles of potable water.
CO4	Demonstrate laboratory skills in basic water technology techniques.
CO5	The various properties of water such as pH value, alkalinity and DO etc. and their determination can be understood by the students after the completion of the course.

Mapping of Course Outcomes (COs) to Program Outcomes (POs)& Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	1	1	1	2	1	1	2	1	1	1
CO2	1	1	2	2	1	1	2	1.5	2	2	1.5	2
CO3	2	2	1.5	1	2	1.5	1	1	2	1	1	2
CO4	2	1	1	1	1	1	1	1.5	2	1.5	1.5	1.4
CO5	3	1	0.5	2	2	2.5	2	2	2	1	1	1
Average	**2.2**	**1.2**	**1.2**	**1.4**	**1.4**	**1.6**	**1.4**	**1.2**	**2**	**1.4**	**1.2**	**0.8**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	CL (Hours/Week)	Total Hour/Week
1		2		3

Unit	Content & Competencies
1. Introduction to Water Technology (4 Hours)	Importance and Scope, Common impurities, Hardness of water, Units of hardness, Quality of potable water, Purification of water, sedimentation, filtration and disinfection.
2. Industrial Problems due to Hard Water (4 Hours)	Industrial problems, Boiler troubles: Scale and Sludge formation, Internal treatment methods, Priming and Foaming, Boiler corrosion and Caustic embrittlement.
3. **Water Softening Techniques** (4 Hours)	Lime-Soda process, Zeolite (Permutit) process and Demineralization process.
4. Water Analysis (3 Hours)	pH, Conductivity, Turbidity, Alkalinity, DO (Dissolve oxygen), BOD (Biological oxygen demand) and COD (Chemical oxygen demand).
5. Practical Component (Hours = 30)	1. Determination of temporary hardness of tap water. 2. Determination of permanent hardness of tap water. 3. Determination of dissolved oxygen of water. 4. Determination of alkalinity of the water. 5. Determination of BOD of the given water sample.

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	15
Practical	26
Seminar/Journal Club	-
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	-
Problem Based Learning (PBL)	-
Case/Project Based Learning (CBL)	-
Revision	2
Others If any:	-
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce

Professional Activity	
Assignment	

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	✓	✓	✓	✓	✓
VIVA	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Clinical assessment					
Clinical/Practical Log Book/ Record Book	✓	✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓

Feedback Process	1. Student's Feedback

References:	List of reference books:
	1. Jain, P. C., & Jain, M. (2007). Engineering chemistry. Dhanpat Rai & Sons, Delhi. 2. Atkins, P. W., De Paula, J., & Keeler, J. (2023). Atkins' physical chemistry. Oxford university press. 3. Banwell, C. N. (1972). Fundamentals of Molecular Spectroscopy: By CN Banwell. New York, McGraw-Hill. 4. Vollhardt, K. P. C., & Schore, N. E. (2003). Organic chemistry: structure and function. Macmillan. 5. Mahan, B.M. (2009). University Chemistry. Pearson.

AEC-2B (Environmental Sciences- I)

Name of the Department	Botany
Name of the Programme	
Course Code	**0310025011**
Course Title	**Environmental Sciences- I**
Academic Year	I
Semester	II
Number of Credits	2 (1+0+1)
Course Prerequisite	
Course Synopsis	The Environmental Sciences includes a multidisciplinary approach to comprehend the contemporary environmental threats. The United Nations is stressing upon the sustainable development through various conferences as well as agreements to secure the future of our coming generations worldwide. It is evident that no citizen of this global village can afford to be unaware of the deteriorating state of our environment. In Indian civilization, our ancient scriptures have stressed upon cultivating the values as well as practices for environmental conservation. In the present era, a clear understanding of environmental issues and adopting eco-friendly life styles has become even more important to save the mother earth. Keeping in view the points mentioned above, this course has been designed to promote awareness, skills, quality of life, avoiding overuse and sustainable use of natural resources among students.

Course Outcomes:
At the end of the course students will be able to:

CO1	Embrace eco-friendly practices in life and promote these practices among the people in the society.
CO2	Acquire extensive knowledge about natural resources as well as processes that support life.
CO3	Evolve analytical thinking to formulate plans for environmental protection, natural resource conservation as well as sustainable development.
CO4	Cultivate attitudes as well as values for diligent involvement in resolving contemporary environmental issues and preventing the future ones.
CO5	Comprehend the consequences of human activities on the ecosystems, world economy as well as the quality of human life.

Mapping of Course Outcomes (COs) to Program Outcomes (POs)& Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	3	1	1	2	2	1	1	1	1	1	1
CO2	1	1	1.5	2	2	1	2	1.5	1	2	2	2
CO3	2	2	1	1	2	1.5	1	1	2	1	1.5	2
CO4	1	2	1.5	1	2	1	1	1.5	1	1.5	1	1.4
CO5	1	3	1	2	2	2.5	2	2	2	1	0.5	1
Average	**1.2**	**2.2**	**1.2**	**1.4**	**2**	**1.6**	**1.4**	**1.2**	**1.4**	**1.4**	**1.2**	**0.8**

1= Weak Correlation	2= Moderate Correlation	3= Strong Correlation		
Course Content:				
L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**CL (Hours/Week)**	**Total Hour/Week**
1		2		3

Unit	Content & Competencies
1. Introduction to Environmental Studies (Lecture Hours = 2)	Multidisciplinary nature of environmental studies; components of environment: atmosphere, hydrosphere, lithosphere, and biosphere, scope and importance; concept of sustainability and sustainable development.
2. Biodiversity and its conservation (Lecture Hours = 5)	Definition: Genetic, species and ecosystem biodiversity, alpha, beta and gamma diversity, biogeographical classification of India. Value of Biodiversity: Consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, national and local levels, India as mega-diversity nation, hot spots of biodiversity. Threats to biodiversity: Habitat loss, poaching of wildlife, man wildlife conflicts, endangered and endemic species of india. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.
3. Ecosystems (Lecture hours = 4)	Concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in the ecosystem, bigeochemical cycles, ecological successions, food chains, food webs and ecological pyramids. Introduction and characteristic features of the forest, grassland and desert ecosystems.
4. Natural Resources (Lecture hours = 4)	Natural resources and associated problems Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, Dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources. Energy resources: Growing energy needs, renewable and non renewable energy sources. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging and salinity. Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification Forest resources: Use and over-exploitation, deforestation and its consequences. Role of an individual in conservation of natural resources.

5 Practical Component (Hours = 30)	1. Visit to herbal garden to identify and study the significance of different medicinal plant species in the University Campus. 2. Use of environmental activity worksheets to understand interdependence and interactions between different environmental components. 3. Analysis of achievement of Sustainable Development Goals of any country. 4. Use of worksheets to identify structure and function of different ecosystems. 5. Visit to a paper recycling unit in the University campus. 6. Comparison of energy demand and consumption of a particular state over the years using graphical tools. 7. Develop and understand working model of renewable/non-renewable sources of energy. 8. Visit to a solar power plant in the University campus 9. Acquaintance with open-source databases of biodiversity. 10. Sampling of plant biodiversity of the University campus. 11. Quantify species loss across different time periods. 12. Analysis of benefits gained by any state by shifting towards organic farming. 13. Field visit to an aquatic ecosystem. 14. Identification of the floral diversity within University campus. 15. Sampling of noxious and invasive weeds in University campus.

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	**Contact Hours**
Lecture	15
Practical	26
Seminar/Journal Club	-
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	-
Problem Based Learning (PBL)	-
Case/Project Based Learning (CBL)	-
Revision	2
Others If any:	-
Total Number of Contact Hours	**45**

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce

Professional Activity	
Assignment	

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	✓	✓	✓	✓	✓
VIVA	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Clinical assessment					
Clinical/Practical Log Book/ Record Book	✓	✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓

Feedback Process	1. Student's Feedback

References:	List of recommended books:
	1. Divan, S. and Rosencranz, A. (2002*). Environmental Law and Policy in India: Cases, Material & Statutes*. Oxford University Press, India 2. Gadgil, M. and Guha, R. (1993). *This Fissured Land: An Ecological History of India.* University of California Press, Berkeley, USA 3. Kumar, R and Sharma, D (2016). *Environmental Studies.* Trueman Book Company, Jalandhar. 4. McCully, P. (1996). *Rivers no more: the environmental effects of dams,* In: *Silenced Rivers: The Ecology and Politics of Large Dams*. Zed Books, New York, USA 5. Odum, E.P., Odum, H.T., and Andrews, J. (1971). *Fundamentals of Ecology.* Saunders, Philadelphia, USA. 6. Raven, P.H, Hassenzahl, D.M., Hager, M.C, Gift, N.Y., and Berg, L.R. (2015). *Environment*. Wiley Publishing, USA. 7. Singh, J.S., Singh, S.P., and Gupta, S.R. (2017). *Ecology, Environmental Science and Conservation.* S. Chand Publishing, New Delhi.

SEMESTER-WISE COURSE DETAILS

SEMESTER – III

Course Category		Course Code	Course Title	Teaching Hours/Week			Credits
				L	T	P	
DSC-3B		**0310131031**	**Plant Physiology**	3	0	2	3+0+1
DSC-3C		**0320131031**	**Chemical Energetics and Equilibria**	3	0	2	3+0+1
DSC-3Z		**0360131031**	**Chordates-I**	3	0	2	3+0+1
***DSE-1 (Pool)**	**i)**	0310132011	Plant Ecology and Environment	3	0	2	3+0+1
	ii)	0320132011	Chemistry of Acids and Bases	3	0	2	3+0+1
/	**iii)**	0360132011	Animal Nutrition	3	0	2	3+0+1
***GE-1 (Pool)**				3	0	2	3+0+1
AEC-3			AEC (One from the pool)	1	0	2	1 + 1
IAPC-1 / SEC-3			SEC (One from the pool)	1	0	2	1+ 1
VAC-3			VAC (One from the pool)	1	0	2	1 + 1
		Total		**15**	**0**	**14**	**22**

Note – L: Lecture Hour/week, T: Tutorial Hour/week, P: Practical Hour/week, C: Credits, IAE: Internal Assessment Examination, ESE: End Semester Examination, DSC – Discipline Specific Course, GE – General Electives, SEC – Skill Enhancement Course, AEC – Ability Enhancement Course, VAC – Value Addition Course. *Any ONE course from the pool either DSE-1 or GE-1.

SEMESTER – IV

Course Category		Course Code	Course Title	Teaching Hours/Week			Credits
				L	T	P	
DSC-4B		**0310141041**	**Plant Developmental Biology**	3	0	2	3+0+1
DSC-4C		**0320141041**	**Chemistry of Oxygen Based Functional Groups**	3	0	2	3+0+1
DSC-4Z		**0360141041**	**Chordates-II**	3	0	2	3+0+1
***DSE-2 (Pool)**	**i)**	0310142021	Economic Botany	3	0	2	3+0+1
	ii)	0320142021	Chemistry of Colloids and Adsorption	3	0	2	3+0+1
/	**iii)**	0360142021	Applied Animal Sciences	3	0	2	3+0+1
***GE-4 (Pool)**				3	0	2	3+0+1
IPAC-2 / SEC-4			SEC (One from the pool)	1	0	2	1 + 1
AEC-4			AEC (One from the pool)	1	0	2	1 + 1
VAC-4			VAC (One from the pool)	1	0	2	1 + 1
		Total		**15**	**0**	**14**	**22**

Note – L: Lecture Hour/week, T: Tutorial Hour/week, P: Practical Hour/week, C: Credits, IAE: Internal Assessment Examination, ESE: End Semester Examination, DSC – Discipline Specific Course, GE – General Electives, SEC – Skill Enhancement Course, AEC – Ability Enhancement Course, VAC – Value Addition Course. *Any ONE course from the pool either DSE-1 or GE-1.

Note: If the student wishes to exit after completing two years/ four semesters, UG Diploma will be provided to the students.

SEMESTER – III

Course Category		Course Code	Course Title	Teaching Hours/Week			Credits
				L	T	P	
DSC-3B		**0310131031**	**Plant Physiology**	3	0	2	3+0+1
DSC-3C		**0320131031**	**Chemical Energetics and Equilibria**	3	0	2	3+0+1
DSC-3Z		**0360131031**	**Chordates-I**	3	0	2	3+0+1
***DSE-1 (Pool)**	**i)**	0310132011	Plant Ecology and Environment	3	0	2	3+0+1
	ii)	0320132011	Chemistry of Acids and Bases	3	0	2	3+0+1
/	**iii)**	0360132011	Animal Nutrition	3	0	2	3+0+1
***GE-1 (Pool)**				3	0	2	3+0+1
AEC-3			AEC (One from the pool)	1	0	2	1 + 1
IAPC-1 / SEC-3			SEC (One from the pool)	1	0	2	1+ 1
VAC-3			VAC (One from the pool)	1	0	2	1 + 1
		Total		**15**	**0**	**14**	**22**

Note – L: Lecture Hour/week, T: Tutorial Hour/week, P: Practical Hour/week, C: Credits, IAE: Internal Assessment Examination, ESE: End Semester Examination, DSC – Discipline Specific Course, GE – General Electives, SEC – Skill Enhancement Course, AEC – Ability Enhancement Course, VAC – Value Addition Course. *Any ONE course from the pool either DSE-1 or GE-1.

DSC-3B (Plant Physiology)

Name of the College (Department)	Akal College of Basic Sciences (Department of Botany)
Name of the Program	B.Sc. (Hons. with Research) Life Sciences
Course Code	**0310131031**
Course Title	**Plant Physiology**
Academic Year	II
Semester	III
Number of Credits	4 (3+0+1)
Course Prerequisite	Students should have studied subjects of Botany in 1st Year (Semester-1 and Semester-2) at UG level under multidisciplinary or honours program.
Course Synopsis	This course explores key physiological processes in plants, including water relations, mineral nutrition, and photosynthesis; respiration, and stress responses. Emphasis is placed on understanding the underlying mechanisms that regulate plant growth, development, and adaptation to environmental stimuli.

Course Outcomes: At the end of the course students will be able to:

CO1	Explain the principles of plant water relations, including water potential, transpiration, and solute transport mechanisms.
CO2	Describe the process of photosynthesis and respiration, including bioenergetics, pathways, and regulatory factors.
CO3	Analyze the role of mineral nutrients and plant hormones in growth, development, and reproductive physiology.
CO4	Evaluate the molecular and physiological mechanisms involved in seed dormancy, germination, and signal transduction.
CO5	Assess plant physiological responses to various biotic and abiotic stresses, highlighting strategies for stress tolerance.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	1	1	1	1	2	1	1	1	1
CO2	1	1	1	1	1	1	1	3	1	1	1	1
CO3	2	2	1	1	2	1	1	1	1	1	1	1
CO4	2	2	1	1	1	1	1	2	2	1	2	1
CO5	3	2	1	2	2	2	1	3	1	1	1	1
Average	**2.2**	**1.8**	**1**	**1.2**	**1.4**	**1.2**	**1**	**2.2**	**1.2**	**1**	**1.2**	**1**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

Course Content

L (Hours/ Week)	T (Hours/ Week)	P (Hours/ Week)	CL (Hours/Week)	Total Hour/ Week
3 (3 Hours/ Week)	0	1 (2 Hours/ Week)	0	5 (Hours/ Week)

Unit	Content & Competencies
1. Plant Water Relations and Solute Transport (Lecture Hours = 11)	Plant water relations: Physical properties of water; diffusion and water potential components (osmotic, pressure, matric, and gravitational). Solute transport: Mechanisms of water and solute transport (Phloem translocation, transpiration, bulk flow, aquaporins, and active-passive transports) Plant responses to water stress, hydraulic conductance, and adaptations for water use efficiency.
2. Photosynthesis and Respiration in Plants (Lecture Hours = 11)	Photosynthesis: Pigment system, concept of oxygenic and anoxygenic photosynthesis, Mechanism of Photosynthesis, Factors affecting photosynthesis; Carbon fixation cycles: C3, C4, CAM and C2 cycles; Photosynthesis and Xenobiotic chemical.

	Plant respiration: Mechanism, Glycolysis and TCA cycle, Chemiosmatic regeneration of ATP, Electron transport chain (ETC), Pentose phosphate pathway (PPP), CN- resistant respiration and metabolic inhibitors.
3. Mineral Nutrition and Plant Growth Regulation (Lecture Hours = 11)	Minerals nutrition: Minerals nutrients, their role and deficiency symptoms. Nitrogen metabolism, biological nitrogen fixation, Nodule formation and nod factors; nif genes; nitrate and ammonium assimilation, sulphur and phosphorus uptake, transport and assimilation. Plant growth Regulation: Role of Phytochromes, Phytoharmones, Regulators and Elicitors, their physiological effects and mechanism of action.
4. Seed Physiology, Signal Transduction and Stress Responses (Lecture Hours = 12)	Seed Physiology: Physiology of seed dormancy and germination, Concept of Photoperiodism, cryptochromes, Vernalization. Signal transduction: Signal transduction in plant physiological processes, receptors and G-proteins, calcium-calmodulin cascades. Stress physiology: Plant responses to biotic and abiotic stress, mechanisms of stress tolerance, drought resistance, salinity stress, metal toxicity, temperature stress.
5. Practical Component (Lab Hours = 30)	**Any 5 practical's from the below mentioned list:** 1. Study of the ascent of sap in plants using the eosin dye method to trace water movement through xylem vessels. 2. Study the osmotic potential of vacuolar sap in plant cells using the plasmolytic method. 3. Study of photosynthesis in aquatic plants (*Hydrilla* or *Ceratophyllum*) by measuring oxygen evolution and bubble formation under different light conditions. 4. Determination of absorption spectra and Rf values of plant pigments by paper chromatography. 5. Study of transpiration rate under different environmental conditions using potometer and cobalt chloride paper method. 6. Bioassay of plant hormone/s using appropriate plant material. 7. To test the viability of seeds by using Tetrazolium (TZ) staining method. 8. To study the percentage and rate of seed germination under controlled conditions. 9. To study the effect of environmental factors on seed germination. 10. Determination of seed moisture content to assess suitability for storage.

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	45
Practical	25
Seminar/Journal Club	-
Small Group Discussion (SGD)	1
Self-directed Learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	1
Case/Project Based Learning (CBL)	-
Revision	2
Others If any:	-
Total Number of Contact Hours	**75**

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	

Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping and Assessment with COs:

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	✓	✓	✓	✓	✓
Viva-voce	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Laboratory assessment	✓	✓	✓	✓	✓
Practical Log Book/ Record Book	✓	✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓
Feedback Process	1. Student's Feedback				

References:

List of recommended books:

1. Bhatla, S. C., & Lal, M. A. (2023). Plant physiology, development and metabolism. Springer Nature.
2. Devi, P. (2000). Principles and methods of plant molecular biology, biochemistry, and genetics. Agrobios.
3. Devlin. (2017). Devlin's outline of plant physiology. Medtech.
4. Hopkins, W. G. (2008). Introduction to plant physiology (4th ed.). John Wiley & Sons.
5. Jain. (2017). Fundamentals of plant physiology. S. Chand.
6. McDonald, M. (2003). Photobiology of higher plants. John Wiley & Sons.
7. Taiz, L., Moller, I. M., Murphy, A., & Peer, W. A. (2024). Fundamentals of plant physiology. Oxford University Press.
8. Taiz, L., Zeiger, E., Moller, I. M., & Murphy, A. (2015). Plant physiology and development. Sinauer Associates.
9. Taiz, L., Zeiger, E., Moller, I. M., & Murphy, A. (2018). Plant physiology and development. Oxford University Press.

DSC-3C (Chemical Energetics and Equilibria)

Name of the College (Department)	Akal College of Basic Sciences (Department of Chemistry and Biochemistry)
Name of the Program	B.Sc. (Hons. with Research) Life Sciences
Course Code	**0320131031**
Course Title	**Chemical Energetics and Equilibria**
Academic Year	II
Semester	III
Number of Credits	4 (3+0+1)
Course Prerequisite	Students should have studied subjects of Chemistry in 1st Year (Semester-1 and Semester-2) at UG level under multidisciplinary or honours program.
Course Synopsis	The course would provide an integrated understanding of how energy changes and equilibrium principles govern chemical reactions, law of thermodynamics, behaviour of electrolytes and their solutions, chemical and ionic equilibrium. This will make students learn about the conditions for maximum yield in industrial processes, dissociation of electrolytes and solubility product of sparingly soluble salts with applications of solubility product principle.

Course Outcomes: At the end of the course students will be able to:

CO1	Understand the laws of thermodynamics, thermochemistry and equilibria
CO2	Quantify and analyze energy changes, which is essential for understanding chemical systems
CO3	Use the concepts of electrolytes and electrolytic solutions
CO4	Understand important governing laws for chemical reactions
CO5	Compare weak and strong electrolytes on the basis degree of ionization for electrolytes and explain the various factors which affecting degree of dissociation of electrolytes.

Mapping of Course Outcomes (COs) to Program Outcomes (POs)& Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	2	2	2	2	1	2	1
CO2	2	1	2	2	1	1	1	2	1	2	3	2
CO3	3	2	2	2	2	2	-	2	1	3	1	2
CO4	2	2	1	2	2	1	2	3	2	1.5	2	2
CO5	3	3	2	2	3	2	2	2	2	2	3	1
Average	**2.6**	**2.2**	**2**	**2.2**	**2.2**	**1.6**	**1.5**	**2.2**	**1.6**	**1.9**	**2.2**	**1.7**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

Course Content

L (Hours/ Week)	T (Hours/ Week)	P (Hours/ Week)	CL (Hours/Week)	Total Hour/ Week
3 (3 Hours/ Week)	0	1 (2 Hours/ Week)	0	5 (Hours/ Week)

Unit	Content & Competencies
1. Basic concepts and first law of thermodynamics (Lecture Hours = 10)	Scope of thermodynamics, thermodynamic terms and basic concepts, types of thermodynamic systems, recapitulation of intensive and extensive variables, state and path functions. First law of thermodynamics: Concept of heat (Q), work (W), internal energy (U), and statement of first law, enthalpy (H), relation between heat capacities for ideal gas, Joule's experiment, calculations of Q, W, ΔU and ΔH for reversible expansion of ideal gases under isothermal conditions.
2. Thermochemistry, second and third law (Lecture Hours = 10)	Enthalpy of a system, Enthalpy of reaction and types, Hess's law, bond energy, Born Haber's cycle (NaCl/ KCl). Concept of spontaneity, entropy, statement of the second law of thermodynamics (Kelvin and Clausius), Calculation of entropy change for

	reversible processes (for ideal gases). Free Energy Functions: Gibbs and Helmholtz energy (Non-PV work and the work function); Free energy change. Statement of third law, qualitative treatment of absolute entropy of molecules (examples of NO, CO), concept of residual entropy.
3. Chemical Equilibrium (Lecture Hours = 10)	Chemical equilibrium and its characteristics, law of mass action, thermodynamic derivation of the law of chemical equilibrium, equilibrium constant, Free energy change in a chemical reaction and relationship between Kp, Kc and Kx for reactions involving ideal gases, Le-Chatelier's principle, conditions for maximum yield in industrial processes (Haber's and contact processes).
4. Ionic Equilibria (Lecture Hours = 15)	Weak, strong and moderate electrolytes, degree of ionization, factors affecting degree of ionization, Ostwald's dilution law, theory of strong electrolytes: Debye-Huckel theory, Degree of dissociation, common-ion effect, factors affecting degree of dissociation, Buffer solutions, Henderson-Hasselbach equation, Conductometric titrations, Solubility and solubility product of sparingly soluble salts –applications of solubility product principle.
5. Practical Component (Lab Hours = 30)	**Any 5 practical's from the below mentioned list:** 1. Preparation of buffer solutions: (i) Sodium acetate-acetic acid or (ii) Ammonium chloride-ammonium acetate. Measurement of the pH of buffer solutions and comparison of the values with theoretical values. 2. Study the effect of addition of HCl/NaOH on pH of the buffer solutions (acetic acid, and sodium acetate). 3. pH metric titration of strong acid with strong base. 4. pH metric titration of weak acid with strong base 5. Estimation of free alkali present in different soaps/detergents. 6. Study of the solubility of benzoic acid in water and determination of ΔH 7. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide. 8. Determination of the enthalpy of ionization of acetic acid.

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	**Contact Hours**
Lecture	45
Practical	25
Seminar/Journal Club	-
Small Group Discussion (SGD)	1
Self-directed Learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	1
Case/Project Based Learning (CBL)	-
Revision	2
Others If any:	-
Total Number of Contact Hours	**75**

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)

Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping of Assessment with COs:

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Quiz	✓	✓	✓	✓	✓
Viva-voce	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Laboratory assessment	✓	✓	✓	✓	✓
Practical Log Book/ Record Book	✓	✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓
Feedback Process	1. Student's Feedback				

References:	List of recommended books:
	1. Batra, S. K., Kapoor, V., & Gulati, S. (2017). Experiments in physical chemistry (1st ed.). Book Age Series. 2. Castellan, G. W. (2004). Physical chemistry. Narosa. 3. Kapoor, K. L. (2015). A textbook of physical chemistry. McGraw Hill Education. 4. Kapoor, K. L. (2019). A textbook of physical chemistry (Vol. 7, 1st ed.). McGraw Hill Education. 5. Khosla, B. D., Garg, V. C., & Gulati, A. (2015). Senior practical physical chemistry. R. Chand & Co. 6. Puri, B. R., Sharma, L. R., & Pathania, M. S. (2020). Principles of physical chemistry. Vishal Publishing Co.

DSC-3Z (Chordates-I)

Name of the College (Department)	Akal College of Basic Sciences (Department of Zoology)
Name of the Program	B.Sc. (Hons. with Research) Life Sciences
Course Code	**0360131031**
Course Title	**Chordates-I**
Academic Year	II
Semester	III
Number of Credits	4 (3+0+1)
Course Prerequisite	Students should have studied subjects of Zoology in 1st Year (Semester-1 and Semester-2) at UG level under multidisciplinary or honours program.
Course Synopsis	This course offers an in-depth understanding of the evolutionary origin and classification of chordates and hemichordates, highlighting their key anatomical and physiological traits. Students will study the structural and functional biology of primitive chordates such as *Balanoglossus*, *Branchiostoma*, and *Herdmania*, along with their classification and ecological roles. A detailed exploration of vertebrates, with emphasis on class Pisces, includes the classification, morphology, and physiology of representative fishes like *Scoliodon* and *Labeo*. The course also compares cartilaginous and bony fishes (Chondrichthyes and Osteichthyes), focusing on their distinct structural adaptations. Additionally, it covers the evolutionary origin and diversity of scales, fins, and caudal tails, and examines important adaptive features such as accessory respiratory organs, osmoregulation mechanisms, parental care strategies, and migratory behaviors in fishes, providing a comprehensive view of their functional biology and ecological adaptations.

Course Outcomes:
At the end of the course students will be able to:

CO1	Understand general features and classification upto orders of Hemichordates with detail study of *Balanoglossus*.
CO2	Know about morphology, anatomy, systematic position, morphology, distinctive characters, distribution ecology and economic importance of the *Branchiostoma*.
CO3	Learn about the importance of systematics, taxonomy and structural organization of Urochordates along with detailed study of *Herdmania.*
CO4	Acquire knowledge of class Pisces, their classification, distinctive characters, distribution ecology and economic importance.
CO5	Enhance collaborative learning and communication skills through practical sessions, teamwork, group discussions, assignments and projects.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	2	1	1	1	1	1	1	2	1	1	1	2
CO2	2	1	1	1	1	1	1	2	1	1	1	2
CO3	2	1	1	1	1	1	1	2	1	1	1	2
CO4	2	1	1	1	1	1	1	2	1	1	1	2
CO5	1	1	2	2	1	1	2	2	1	1	1	2
Average	**2**	**1**	**1.5**	**1.5**	**1**	**1**	**1.5**	**2**	**1**	**1**	**1**	**2**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

Course Content:				
L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**CL (Hours/Week)**	**Total Hour/Week**
3 (3 Hours/ Week)	0	1 (2 Hours/ Week)	0	5 (Hours/ Week)

Unit	Content & Competencies
1. Origin of Chordates and Hemichordates (Lecture Hours = 10)	Origin of chordates. Classification of phylum chordata upto order. Hemichordata: General characteristics, classification and detailed study including habit and habitat, morphology, anatomy and physiology of *Balanoglossus*.
2. Introduction to Cephalochordata and Urochordata (Lecture Hours = 11)	Cephalochordata: General characteristics, classification and detailed study including habit and habitat, morphology, anatomy and physiology of *Branchiostoma*. Urochordata: General characteristics, classification and detailed study including habit and habitat, morphology, anatomy and physiology of *Herdmania*.
3. Introduction to Pisces (Lecture Hours = 12)	General characteristics and classification of class pisces upto order with examples. General characters and detailed study including habit and habitat, morphology, anatomy and physiology of *Scolidon* and *Labeo.*
4. Fish Adaptations and Comparisons (Lecture Hours = 12)	Comparison between Chondrithyes and Osteichthyes. Origin of scales and their types. Origin of fins and their types. Types of caudal fins and tails. Accessory respiratory organs in fishes. Parental care in fishes and fish migration. Osmoregulation in fishes.
5. Practical Component (Lab Hours = 30)	**Any 5 practical's from the below mentioned list:** 1. Specimen study of Urochordata: *Herdmania*, *Molgula* and *Pyrosoma*. 2. Study of representative specimens of Urochordates: *Doliolum*, *Salpa*, *Oikopleura* and Cephalochordate *Amphioxus*. 3. Study of preserved specimens of Cyclostomata: *Myxine*, *Petromyzon* and Ammocoetus larva. 4. Morphological observation and identification of Chondrichthyes: *Zygaena*, *Pristis* and *Narcine*. 5. Specimen examination and identification of Chondrichthyes: *Trygon*, *Rhinobatus* and *Chimaera*. 6. Specimen study of Osteichthyes: *Polypterus*, *Acipenser*, *Lepidosteus*, *Muraena*, *Mystus* and *Catla*. 7. Study of preserved specimens of Osteichthyes: *Hippocampus*, *Syngnathus* and Exocoetus. 8. Morphological observation and identification of Osteichthyes: *Anabas*, *Diodon*, *Tetradon* and *Polypterus*.

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	45
Practical	25
Seminar/Journal Club	-
Small Group Discussion (SGD)	1
Self-directed Learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	1
Case/Project Based Learning (CBL)	-
Revision	2
Others If any:	-
Total Number of Contact Hours	**75**

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	✓	✓	✓	✓	✓
Viva	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Laboratory Assessment	✓	✓	✓	✓	✓
Practical Log Book/ Record Book	✓	✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓
Feedback Process	1. Student's Feedback				

References:	List of recommended books:
	1. Hildebrand, M., & Goslow, G. (2016). Analysis of vertebrate structure. Wiley. 2. Jordan, E. L., & Verma, P. S. (2013). Chordate zoology. S. Chand & Co. Ltd. 3. Kotpal, R. L. (2019). Modern text-book of zoology: Vertebrates. Rastogi Publications. 4. Pandey, B. N., & Mathur, V. (2018). Biology of chordates. PHI Learning Pvt. Ltd. 5. Romer, A. S., & Parsons, T. S. (1986). The vertebrate body (5th rev. ed.). W. B. Saunders Co. Ltd.

DSE-1B (Plant Ecology and Environment)

Name of the College (Department)	Akal College of Basic Sciences (Department of Botany)
Name of the Program	B.Sc. (Hons. with Research) Life Sciences
Course Code	**0310132011**
Course Title	**Plant Ecology and Environment**
Academic Year	II
Semester	III
Number of Credits	4 (3+0+1)
Course Prerequisite	Students should have studied subjects of Biology at 12th level / subjects of Botany in UG 1st Year under multidisciplinary or honours program.
Course Synopsis	This course focuses on key environmental issues such as pollution, climate change, biodiversity loss, and ecosystem degradation. It emphasizes understanding ecological principles, conservation strategies, and sustainable management practices to address current environmental challenges.

Course Outcomes: At the end of the course students will be able to:

CO1	Identify types, sources, effects, and control measures of air, water, and soil pollution, along with understanding the impacts of climate change.
CO2	Explain levels, patterns, and global distribution of biodiversity, and apply strategies for its conservation based on IUCN guidelines.
CO3	Analyze the stability of ecosystems, concepts of resistance and resilience, and evaluate the impact of ecological disturbances.
CO4	Interpret the concept and importance of ecosystem services and apply the principles of Environmental Impact Assessment (EIA).
CO5	Assess sustainable development practices, ecosystem management concepts, and indicators for environmental sustainability and restoration.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	1	1	1	1	1	2	1	1	1
CO2	1	3	1	1	1	1	1	1	1	1	1	1
CO3	2	1	1	1	1	1	1	1	2	1	2	1
CO4	2	2	2	1	2	1	1	1	2	1	1	1
CO5	3	3	1	1	1	1	1	1	2	2	2	2
Average	**2.2**	**2.2**	**1.2**	**1**	**1.2**	**1**	**1**	**1**	**1.8**	**1.2**	**1.4**	**1.2**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

Course Content

L (Hours/ Week)	T (Hours/ Week)	P (Hours/ Week)	CL (Hours/Week)	Total Hour/ Week
3 (3 Hours/ Week)	0	1 (2 Hours/ Week)	0	5 (Hours/ Week)

Unit	Content & Competencies
1. Environmental Pollution and Climate Change (Lecture Hours = 11)	Environmental pollution: Air, Water and Soil: Kinds, sources quality parameters, effects and control. Climate change: Greenhouse gases, Global warming; Ozone layer and its depletion, and consequences on climate change.
2. Biodiversity and Conservation Strategies (Lecture Hours = 12)	Biodiversity and conservation: Levels of biodiversity, Distribution and regional patterns; Hypotheses for global patterns of distribution; Hot Spots of Biodiversity, Biodiversity Conservation; IUCN categories, strategies for conservation.

3. Ecosystem Stability and Environmental Assessment (Lecture Hours = 11)	Ecosystem stability: concept of resistance and resilience, Ecosystem services, ecological perturbation and their impact on plants and ecosystems; Environmental Impact Assessment (EIA): Baseline conditions, impacts, mitigation measures, impact identification, analysis, and Environmental Management Plan (EMP).
4. Ecosystem Management and Sustainability (Lecture Hours = 11)	Ecosystem Management: Concept, objectives, and holistic approaches; sustainable development: definition, principles, and importance in managing ecosystems; sustainability indicators: environmental, economic, and social; ecosystem: definition, biotic and abiotic components, and ecological functions.
5. Practical Component (Lab Hours = 30)	**Any 5 practical's from the below mentioned list:** 1. Estimation of Air Quality Parameters (SPM/PM10/PM2.5) 2. Analysis of Water Quality (pH, DO, BOD, and COD) 3. Field Visit to a Biodiversity Hotspot or Local Forest Area 4. Preparation of Herbarium and Identification of Local Plant Species 5. Preparation and Analysis of a Mock Environmental Impact Assessment (EIA) Report 6. Study of Soil Microbial Activity as an Indicator of Ecosystem Health 7. Survey of Sustainability Practices in Local Agriculture or Industry 8. Restoration Activity: Plantation or Vermicomposting Unit Setup

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	45
Practical	25
Seminar/Journal Club	-
Small Group Discussion (SGD)	1
Self-directed Learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	1
Case/Project Based Learning (CBL)	-
Revision	2
Others If any:	-
Total Number of Contact Hours	**75**

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping and Assessment with COs:

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	✓	✓	✓	✓	✓
Viva-voce	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Laboratory assessment	✓	✓	✓	✓	✓
Practical Log Book/ Record Book	✓	✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓
Feedback Process	1. Student's Feedback				

References:	List of recommended books:
	1. Curtis, J.T., and Cottom, G. (1956). Plant Ecology Workbook: Laboratory Field Reference Manual. Burgess Publishing Company, Minnesota. 2. Krishnamurthy K.V. (2003). Textbook of Biodiversity. CRC Press, Taylor & Francis group. 3. Mishra, R. (1968). Ecology Workbook. Oxford and IBH Publishing Co., New Delhi. 4. Monson R.K. (2014). Ecology and the Environment (The Plant Sciences Book 8). Springer. 5. Odum, E.P. (1983). Basic Ecology. W.B. Saunders, Philadelphia. 6. Pandey Y.N., Dutt A., Saxena S. and Singh A. (2025). Plant Ecology and Environment B.Sc. Sem-VI Paper-II. Ram Prasad Publication. 7. Sharma P.D. (2022). Ecology and Environment (13th edition). Rastogi Publications. 8. Subrahmanyam N.S. and Sambamurty S.S. (2001). Ecology. Narosa Publishing House.

DSE-1C (Chemistry of Acids and Bases)

Name of the College (Department)	Akal College of Basic Sciences (Department of Chemistry and Biochemistry)
Name of the Program	B.Sc. (Hons. with Research) Life Sciences
Course Code	**0320132011**
Course Title	**Chemistry of Acids and Bases**
Academic Year	II
Semester	III
Number of Credits	4 (3+0+1)
Course Prerequisite	Students should have studied subjects of Chemistry at 12th level /subjects of Chemistry in UG 1st Year under multidisciplinary or honours program.
Course Synopsis	The course would provide fundamental concepts and applications of acids and bases. Moreover, understands the concept of buffers, pH, complex formations, hardness and softness in acids and bases.

Course Outcomes: At the end of the course students will be able to:

CO1	Understand concepts of acids and bases with their applications
CO2	Use the concepts of acidity parameters, buffers and indicators
CO3	Understand redox reactions, electrochemical series and various potential diagrams
CO4	Understand complex behaviour of metal ions and their applications in biological processes
CO5	Understand the precipitation reactions and their application in metal ions analysis

Mapping of Course Outcomes (COs) to Program Outcomes (POs)& Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	2	2	2	2	1	2	1
CO2	2	1	2	2	1	3	1	2	1	2	3	2
CO3	3	2	2	2	2	2	-	2	1	3	1	2
CO4	2	2	1	2	2	1	2	3	2	1	2	2
CO5	3	3	2	2	3	2	2	2	3	2	3	1
Average	**2.6**	**2.3**	**2**	**2.2**	**2.2**	**2.1**	**1.5**	**2.2**	**1.9**	**1.9**	**2.2**	**1.7**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

Course Content				
L (Hours/ Week)	**T (Hours/ Week)**	**P (Hours/ Week)**	**CL (Hours/Week)**	**Total Hour/ Week**
3 (3 Hours/ Week)	0	1 (2 Hours/ Week)	0	5 (Hours/ Week)
Unit	**Content & Competencies**			
1. Concepts of acids and bases (Lecture Hours = 10)	Concepts: Arrhenius, Bronsted-Lowry and strength of Bronsted acids and bases, Lewis's acids and bases, Hard and soft acids and bases, HSAB principle, Drago-wayland equation Relative strengths of acids and bases, factors affecting relative strengths of acids and bases, solvent levelling, superacids and superbases.			

2. Acidity, buffers and indicators (Lecture Hours = 10)	Thermodynamic acidity parameters, gas phase acidity and proton affinity, acid-base equilibria in aqueous solution (proton transfer equilibria in water), Buffers (NH_4OH/NH_4Cl, NaOAc/HOAc, boric acid and borate, Phosphate buffers, Universal Buffer), buffer capacity, calculation of pH of buffer solutions, pH calculation using Handerson-Hasselbalch equation, Applications of Acids & Bases and buffers in biological processes, acid-base neutralisation curve, indicator, choice of indicators.
3. Redox reactions (Lecture Hours = 10)	Elementary idea on standard redox potentials with sign conventions, Nernst equation, standard potentials and spontaneity, trends in standard potentials, electrochemical series, Redox stability of species in aqueous solutions (influence of pH, effect of solvation, redox reaction with water, disproportionation), Latimer diagrams, Frost diagrams and Pourbaix diagrams their significance, Applications of redox reactions in quantitative analysis: permanganate, dichromate & iodine titrations, Examples of Redox reactions in biological processes
4. Complex ions and precipitation reactions (Lecture Hours = 15)	Complexation behaviour of metal ions: Lewis acid – base type (d block), electrostatic interactions based (s block elements with crown ethers and cryptates), stabilisation of oxidation states by complexation (Cu(I), Mn(III)). Applications of complexes in biological systems with special mention of metallo-enzymes Precipitation: Insoluble salts with anions like S^{2-}, SO_4^{2-}, PO_4^{3-}, halides, OH-, $C_2O_4^{2-}$, CO_3^{2-} and their application in metal ions analysis.
5. Practical Component (Lab Hours = 30)	**Any 5 practical's from the below mentioned list:** 1. Preparation of acetylacetonato complexes of: (a) Cu(II), (b) Fe(III). 2. Preparation of Potassium trioxalatochromate(III). 3. Preparation of Potassium trisoxalatomanganate(III). 4. Determination of available chlorine in bleaching powder iodometrically. 5. Determination of strength of oxalate ions and oxalic acid in a mixture titrimetrically. 6. Preparation of a phosphate buffer solution and measurement of its pH using pH meter. 7. Determination of buffer capacity of phosphate buffer. 8. pH metric titration of a strong acid with a strong base.

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	45
Practical	25
Seminar/Journal Club	-
Small Group Discussion (SGD)	1
Self-directed Learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	1
Case/Project Based Learning (CBL)	-
Revision	2
Others If any:	-
Total Number of Contact Hours	**75**

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping of Assessment with COs:

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Quiz	✓	✓	✓	✓	✓
Viva-voce	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Laboratory assessment	✓	✓	✓	✓	✓
Practical Log Book/ Record Book	✓	✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓
Feedback Process	1. Student's Feedback				

References:	List of recommended books:
	1. Atkins, P.W., Overton, T.L., Rourke, J.P., Weller, M.T., Armstrong, F.A. (2010). Inorganic Chemistry, 5th Edition, W. H. Freeman and Company. 2. Jeffery, G.H., Bassett, J., Mendham, J., Denney, R.C. (1989). Vogel's Textbook of Quantitative Chemical Analysis. John Wiley and Sons. 3. Lee, J.D. (2010). Concise Inorganic Chemistry. Wiley India. 4. Lehninger, A. L., Nelson, D. L., Cox, M. M., Cox, M. M. (2005). Lehninger principles of biochemistry. Macmillan India. 5. Miessler, G. L. (2008). Inorganic chemistry. Pearson Education India. 6. Sharpe, A. G. (1992). Inorganic chemistry. Longman Publishing Group. 7. Shriver, D.D., Atkins, P., Langford, C.H. (1994). Inorganic Chemistry 2nd Ed. Oxford University Press. 8. Svehla, G. (2008). Vogel qualitative inorganic analysis. Pearson Education India.

DSE-1Z (Animal Nutrition)

Name of the College (Department)	Akal College of Basic Sciences (Department of Zoology)
Name of the Program	B.Sc. (Hons. with Research) Life Sciences
Course Code	**0360132011**
Course Title	**Animal Nutrition**
Academic Year	II
Semester	III
Number of Credits	4 (3+0+1)
Course Prerequisite	Students should have studied subjects of Biology at 12th level /subjects of Zoology in UG 1st Year under multidisciplinary or honours program.
Course Synopsis	This course introduces the fundamentals of human nutrition, including the classification, functions, and sources of major nutrients- carbohydrates, proteins, and lipids. It explains the processes of digestion, absorption, and assimilation of these nutrients in the human body. Students learn the types, sources, and significance of dietary fiber in maintaining health. Vitamins and minerals are studied in detail, focusing on their roles, requirements, sources, and deficiency-related issues. The course covers malnutrition, minimum nutritional needs, and the formulation of Recommended Dietary Allowances (RDA). It emphasizes the nutritional requirements of reference individuals and the importance of proper nutrition in human growth and development.

Course Outcomes:

At the end of the course students will be able to:

CO1	Identify and classify the major nutrients (carbohydrates, proteins, lipids) and explain their sources, functions, and daily requirements in human health.
CO2	Describe the processes of digestion, absorption, and assimilation of macronutrients and evaluate their role in overall nutritional balance.
CO3	Assess the significance of dietary fiber, vitamins, and minerals in human physiology, including their bioavailability, deficiencies, and health impacts.
CO4	Interpret and apply concepts of malnutrition, RDA, and dietary guidelines using the "Reference Man and Woman" model and adult consumption units.
CO5	Demonstrate understanding of nutrition's role in promoting growth, development, and disease prevention through monitoring and health planning strategies.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	2	2	1	1	2	1	1	2	1	1	2	2
CO2	2	2	1	1	2	1	1	2	1	1	2	2
CO3	2	2	1	1	2	1	1	1	1	2	1	2
CO4	1	1	1	1	2	1	1	1	1	2	1	2
CO5	1	1	1	1	2	1	2	1	1	2	2	2
Average	**1.6**	**1.6**	**1**	**1**	**2**	**1**	**1.2**	**1.4**	**1**	**1.6**	**1.6**	**2**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

Course Content:				
L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**CL (Hours/Week)**	**Total Hour/Week**
3 (3 Hours/ Week)	0	1 (2 Hours/ Week)	0	5 (Hours/ Week)

Unit	Content & Competencies
1. Basic concept Nutrition and Nutrients (Lecture Hours = 12)	Introduction to nutrition and nutrients. Classification of nutrients, carbohydrates, lipid and proteins-Definition and types, sources, daily requirements and functions. Their digestion, absorption and assimilation.
2. Dietary Fibre (Lecture Hours = 10)	Dietary fibre- Definition, composition and types of dietary fibers, sources, physicochemical properties and mechanism of dietary fibers, daily requirements and their significance. Health benefits of dietary fibres.
3. Vitamins and Minerals (Lecture Hours = 10)	Vitamins and minerals: Types of vitamins and their functions. Types of minerals and their functions, Bio-chemical and physiological role, bio-availability and requirements, sources, vitamin and mineral deficiencies and supplements.
4. Nutrition and Health (Lecture Hours = 13)	Malnutrition and health: Scope of nutrition. Minimum nutritional requirement and Recommended Dietary Allowance (RDA): Formulation of RDA and dietary guidelines reference man and woman, adult consumption unit, importance of nutrition for ensuring adequate development, growth monitoring and promotion.
5. Practical Component (Lab Hours = 30)	**Any 5 practical's from the below mentioned list:** 1. Clinical assessment and signs of nutrient deficiencies specially PEM (Kwashiorkor, Marasmus). 2. Study of common nutritional deficiency diseases: Vitamin A deficiency, Anaemia, Rickets, and B-complex deficiencies. 3. Planning and preparation of adequate meal for different age groups with special reference to different physiological conditions: infants, pre-schooler, school children, adolescents, adults, pregnancy, lactation and old age. 4. Determination of ash content in food. 5. Detection of moisture content in food. 6. Determination of calcium, iron, and Vitamin C content in foods. 7. Detection of carbohydrates, proteins and lipids.

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	45
Practical	25
Seminar/Journal Club	-
Small Group Discussion (SGD)	1
Self-directed Learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	1
Case/Project Based Learning (CBL)	-
Revision	2
Others If any:	-
Total Number of Contact Hours	**75**

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	✓	✓	✓	✓	✓
Viva	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Laboratory assessment	✓	✓	✓	✓	✓
Practical Log Book/ Record Book	✓	✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓
Feedback Process	Student's Feedback				

References:	List of recommended books:
	1. Joshi, S.A. (2017). Nutrition and dietetics. McGraw-Hill Education. 2. Mann, J., & Truswell, A.S. (2017). Essentials of human nutrition (3rd ed.). Oxford University Press. 3. Nelson, D.L., Cox, M.M., & Lehninger, A.L. (2017). Lehninger principles of biochemistry. Macmillan. 4. Ross, A.C., Caballero, B., Cousins, R.J., & Tucker, K.L. (2023). Modern nutrition in health and disease. Jones & Bartlett Learning 11th or 12th ed.). Lippincott Williams & Wilkins.

GENERAL ELECTIVES (GE) COURSES AS PER NEP-2020

OFFERED BY B.Sc. (HONS. WITH RESEARCH) LIFE SCIENCES PROGRAMME OF AKAL COLLEGE OF BASIC SCIENCES, FOR OTHER UG PROGRAMMES

SEMESTER – III

Sr. No.	Course Category	Course Code	Course Title	Credits L+T+P	Semester	Offering Department
1	GE-2B	0310033021	Plant and Human Welfare	3+0+1	III (Odd)	Botany
2	GE-2C	0320033021	Principles of Instrumental Analysis	3+0+1	III (Odd)	Chemistry & Biochemistry

SEMESTER – IV

Sr. No.	Course Category	Course Code	Course Title	Credits L+T+P	Semester	Offering Department
1	GE-3Z	0360043031	Aquatic Biology	3+0+1	IV (Even)	Zoology

SEMESTER – III

Sr. No.	Course Category	Course Code	Course Title	Credits L+T+P	Semester	Offering Department
1	GE-2B	0310033021	Plant and Human Welfare	3+0+1	III (Odd)	Botany
2	GE-2C	0320033021	Principles of Instrumental Analysis	3+0+1	III (Odd)	Chemistry & Biochemistry

GE-2B (Plant and Human Welfare)

Name of the College (Department)	Akal College of Basic Sciences (Department of Botany)
Name of the Program	
Course Code	**0310033021**
Course Title	**Plant and Human Welfare**
Academic Year	II
Semester	III
Number of Credits	4 (3+0+1)
Course Prerequisite	Students should have basic understanding and interest in subject of Life or Plant Sciences.
Course Synopsis	This course introduces students to the diversity, uses, and cultivation practices of medicinal and aromatic plants (MAPs), with special emphasis on their historical, cultural, and economic importance. It also explores conservation strategies, herbal biotechnology, policy frameworks, and the role of MAPs in herbal and cosmetic industries.
Course Outcomes: At the end of the course students will be able to:	
CO1	Explain the importance, status, and conservation strategies of Medicinal and Aromatic Plants (MAPs), including in-situ and ex-situ conservation methods.
CO2	Evaluate the economic and industrial potential of MAPs in pharmaceuticals, cosmetics, and nutraceuticals, and understand the role of certification, and regulatory frameworks.
CO3	Analyze the ecological roles of plants in ecosystem stability, biodiversity conservation, and climate change mitigation through environmental impact and biodiversity assessment tools.
CO4	Identify and classify significant plant species of India (e.g., medicinal, sacred, aesthetic, and industrial) based on their systematics, distribution, cultivation, and ethnobotanical uses.
CO5	Apply knowledge of plant-based resources and sustainability principles to promote conservation, ecosystem services, and human welfare through informed and ethical practices.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1												
CO2												
CO3												

CO4												
CO5												
Average												
1= Weak Correlation				2= Moderate Correlation						3= Strong Correlation		

Course Content				
L (Hours/ Week)	**T (Hours/ Week)**	**P (Hours/ Week)**	**CL (Hours/Week)**	**Total Hour/ Week**
3 (3 Hours/ Week)	0	1 (2 Hours/ Week)	0	5 Hours/ Week
Unit	**Content & Competencies**			
1. Introduction to Medicinal and Aromatic Plants and Their Conservation (Lecture Hours = 11)	Introduction and importance of Medicinal and Aromatic plants (MAPs), Past and present status of Medicinal Plants in the world and India. Medicinal plant conservation areas (MPCA): Concept and Importance, In-situ and ex-situ strategies, habitat restoration, sustainable use, impact on biodiversity and local communities.			
2. Promotion and Industrial Aspects of Medicinal Plants (Lecture Hours = 11)	Strategies for promoting medicinal plants, role of certification programs (GAP, GMP) and branding. Importance of MAPs and economic value plants in pharmaceuticals, cosmetics, and nutraceuticals. Applications in cosmetics, packaging, and marketing. Outline - objectives and functions of regulatory frameworks – e.g. WHO, FDA, National Medicinal Plants Board (NMPB), Drugs and Cosmetics Act (1940), Ayush Standards, Herbal Products Regulations, and commercialization.			
3. Ecosystem Stability and Environmental Assessment (Lecture Hours = 12)	Role of Plants in Ecosystem Health: Ecological significance in maintaining biodiversity and ecosystem balance. Importance of native plants in habitat restoration and soil conservation. Plants as a source of ecosystem services: water regulation, carbon sequestration, soil fertility, etc., their role in climate change mitigation. Methods for assessing the environmental impact of plant harvesting and cultivation. Tools for biodiversity assessment and monitoring ecosystem health in regions with high plant diversity.			
4. Medicinal and Aromatic Plant Diversity of India (Lecture Hours = 11)	Important plants (food, fibre, fodder, fuel, forest, medicinal, industrial, sacred, avenue and aesthetic plants) of India with their systematics, geographical distribution, cultivation and uses.			
5. Practical Component (Lab Hours = 30)	1. Sample collection of the selected species as per the course content and herbarium preparations. 2. Enlist and study some important plants (Food, fibre, Fodder, fuel, Forest, medicinal, industrial, sacred, avenue and aesthetic plants) from your locality. 3. Enlist and study some endangered plant species from your locality. 4. Taxonomic identification of poisons plants in your locality.			

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	45
Practical	25
Seminar/Journal Club	-
Small Group Discussion (SGD)	1
Self-directed Learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	1
Case/Project Based Learning (CBL)	-
Revision	2
Others If any:	-
Total Number of Contact Hours	**75**

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	

Mapping and Assessment with COs:

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	√	√	√	√	√
Viva-voce	√	√	√	√	√
Assignment / Presentation	√	√	√	√	√
Professional Activity	√	√	√	√	√
Laboratory assessment	√	√	√	√	√
Practical Log Book/ Record Book	√	√	√	√	√
Class Tests	√	√	√	√	√
University Examination	√	√	√	√	√
Feedback Process	1. Student's Feedback				
References:	List of recommended books:				

	1. Bhattacharjee, S.K. (2019). Handbook of Aromatic Plants. Pointer Publishers, India. 2. Kala, C.P. (2012). Medicinal Plants of Uttarakhand: Diversity, Livelihood, and Conservation. Biotech Books, New Delhi, India. 3.Samant, S.S., Dhar, U., and Palni, L.M.S. (2002). Medicinal Plants of Indian Himalaya: Diversity Distribution Potential Values. Gyanodaya Prakashan, Nainital. 4.Pratap, A., and Singh, D.R. (2018). Handbook of Medicinal and Aromatic Plants. Biotech Books, New Delhi, India. 5.Trivedi, P.C. (2009). Indian Medicinal Plants. Aavishkar Publishers & Distributors, India. 6. Dhumal K.N., Iliyas S., Admuthe N.B., Deshmukh R.L. and Prakashan N. (2024). Plants and human welfare for FY BSc (Botany) Semester 1. Nirali Prakashan. 7. Pandey A.K., Ranjan S. and Soni C. (2021). Medicinal Plants of India. Swaraj Prakashan

GE-2C (Principles of Instrumental Analysis)

Name of the College (Department)	Akal College of Basic Sciences (Chemistry and Biochemistry)
Name of the Program	
Course Code	**0320033021**
Course Title	**Principles of Instrumental Analysis**
Academic Year	II
Semester	III
Number of Credits	4 (3+0+1)
Course Prerequisite	Students should have basic understanding and interest in subject of Life or Chemical Sciences.
Course Synopsis	This course provides a comprehensive introduction to essential biophysical techniques used in modern biological research. Students will gain a solid understanding of the underlying principles, instrumentation and applications of chromatography, electrophoresis, centrifugation, spectroscopy and radio isotopic methods. Through a combination of theoretical lectures and hands-on laboratory experiments, students will develop critical thinking, problem-solving and experimental skills. The course emphasizes the application of these techniques to address biological questions and challenges.

Course Outcomes: At the end of the course students will be able to:

CO1	Understand basic concepts, applications, merits and limitations of various bio separation techniques like chromatography, electrophoresis, and centrifugation.
CO2	Understand the main components, working principles and applications of spectroscopy and radio isotopic techniques
CO3	Apply biophysical techniques to separate, purify and characterize biological molecules such as proteins, nucleic acids and lipids.
CO4	Design and conduct experiments using biophysical techniques to address specific biological questions.
CO5	Evaluate the suitability of different techniques for specific research problems and justify the choice of methodology.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1												
CO2												
CO3												
CO4												
CO5												
Average												

1= Weak Correlation	2= Moderate Correlation	3= Strong Correlation		
Course Content				
L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**CL (Hours/Week)**	**Total Hour/Week**
3(Hours/Week)	0	2(Hours/Week)	0	5(Hours/Week)

Unit	**Content & Competencies**
1. Chromatographic techniques (Lecture Hours = 12)	General principles, distribution coefficient. Types of chromatography: Planar chromatography (paper & thin-layer chromatography) and Column chromatography (liquid & gas chromatography). Specialized chromatographic techniques: Ion exchange, Affinity and Size exclusion chromatography.
2. Electrophoresis (Lecture Hours = 11)	Basic principles, Electrophoresis of Proteins: Native and SDS-PAGE, Isoelectric focusing, 2D-PAGE and molecular weight determination. Electrophoresis of nucleic acid: Agarose gel electrophoresis of DNA and RNA.
3. Centrifugation techniques (Lecture Hours = 12)	Basic principles of sedimentation and sedimentation coefficient. Types of centrifuges and Rotors. Differential centrifugation and Density gradient centrifugation, Applications of centrifugation. Radio isotopic techniques: Isotopes and nature of radioactivity, Radioactivity units. Types and rate of radioactive decay, half-life, Radioactive counters. Radioisotopes in biology: Applications and precautions.
4. Spectroscopy (Lecture Hours = 10)	Basic Principles, Electromagnetic radiation, Absorption, emission and scattering. UV-Visible Spectroscopy, Infrared Spectroscopy, Optical rotatory dispersion and circular dichroism. Nuclear magnetic resonance (NMR) and Electron spin resonance (ESR). Atomic spectrometry, mass spectroscopy.
5. Practical Component (Laboratory Hours = 30)	Any 5 practical from below mentioned list: 1. Separation of plant pigment by paper chromatography 2. Separation of compounds by thin layer chromatography 3. Separation of proteins by Native PAGE 4. Separation of proteins by SDS PAGE 5. Determination of molecular weight of a protein by SDS PAGE 6. Agarose gel electrophoresis of DNA 7. Use of benchtop centrifuge for sample separations 8. Determination of the concentration of a substance in a solution using spectrophotometer. 9. Determination of absorption maxima in a sample.

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	**Contact Hours**
Lecture	45
Practical	25
Seminar/Journal Club	-
Small group discussion (SGD)	1
Self-directed learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	1
Case/Project Based Learning (CBL)	-
Revision	2

Others If any:	-
Total Number of Contact Hours	**75**

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping of Assessment with Cos

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	√	√	√	√	√
Viva	√	√	√	√	√
Assignment / Presentation	√	√	√	√	√
Professional Activity	√	√	√	√	√
Practical Log Book/ Record Book	√	√	√	√	√
Class Tests	√	√	√	√	√
University Examination	√	√	√	√	√

Feedback Process	1. Student's Feedback

References:	List of recommended books:
	1. Wilson K, Walker J (2018). *Principles and Techniques of Biochemistry and Molecular Biology* (8th ed.). Cambridge University Press. 2. Upadhyay A, Upadhyay K & Nath N (2000). *Biophysical Chemistry* (1st ed.). Himalaya Publishing. 3. Sawhney SK & Singh R (2005). *Introductory Practical Biochemistry* (2nd). Narosa Publishers.

LIST OF SEC / AEC / VAC AS PER NEP, 2020

OFFERED BY B.Sc. (HONS. WITH RESEARCH) LIFE SCIENCES PROGRAMME OF AKAL COLLEGE OF BASIC SCIENCES, FOR OTHER UG PROGRAMMES

SEMESTER-III

Sr. No	Course category	Course Code	Course Title	Credits L+T+P	Semester	Offering Department
1	SEC-1Z	0360034011	Bee-keeping and its Management	1+0+1	Odd (III)	Zoology
2	SEC-2B	0310034021	Solid Waste Management	1+0+1	Odd (III)	Botany
3	SEC-2C	0320034021	Chemistry of Cosmetics and Hygiene Products	1+0+1	Odd (III)	Chemistry & Biochemistry
4	AEC-3B	0310035021	Environmental Science - II	1+0+1	Odd (III)	Botany

SEMESTER – IV

Sr. No.	Course category	Course Code	Course Title	Credits L+T+P	Semester	Offering Department
1	SEC-3B	0310044021	Plant Identification Techniques	1+0+1	Even (IV)	Botany
2	VAC-1C	0320046011	Science and Society	1+0+1	Even (IV)	Chemistry & Biochemistry
3	AEC-4B	0310045021	Environmental Science – II	1+0+1	Even (IV)	Botany

SEMESTER-III

Sr. No	Course category	Course Code	Course Title	Credits L+T+P	Semester	Offering Department
1	SEC-1Z	0360034011	Bee-keeping and its Management	1+0+1	Odd (III)	Zoology
2	SEC-2B	0310034021	Solid Waste Management	1+0+1	Odd (III)	Botany
3	SEC-2C	0320034021	Chemistry of Cosmetics and Hygiene Products	1+0+1	Odd (III)	Chemistry & Biochemistry
4	AEC-3B	0310035021	Environmental Science - II	1+0+1	Odd (III)	Botany

SEC-1Z (Bee-keeping and its Management)

Name of the Department	Zoology
Name of the Program	
Course Code	0360034011
Course Title	Bee-keeping and its Management
Academic Year	II
Semester	III
Number of Credits	2 (1+0+1)
Course Prerequisite	-
Course Synopsis	Bee-keeping and its management course is intended for students to impart the knowledge of apiculture, different bee species such as *Apis cerana, Apis indica, Apis mellifera, Apis dorsata* and *Apis florea*. After completion of this course the student would obtained the training, in collection, identification and various aspects of bee rearing. The students will understand the significance of bee keeping in the diversification of agriculture for the rural communities to increase their income and create employment opportunities. At the same time it will develop entrepreneurial skills required for self employment in the bee keeping sector.

Course Outcomes:
At the end of the course:

CO1	The students will understand the different species of honey bees, their biology, behavior and role in agriculture.
CO2	The students will learn the techniques of honey bee rearing, honey extraction and processing.
CO3	The students will learn about bee diseases/ predators and their management practices.
CO4	Students will develop entrepreneurial skills necessary for self employment.
CO5	The students will enhance collaborative learning and communication skills through practical sessions, teamwork, group discussions, assignments and projects.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	2	1	1	1	1	1	2	1	1	1	1
CO2	1	1	1	1	1	1	1	3	1	1	1	1

CO3	2	2	1	1	2	1	1	1	1	1	1	1
CO4	2	2	1	1	1	1	1	2	2	1	2	1
CO5	3	2	1	2	2	2	1	3	1	1	1	1
Average	**2.2**	**1**	**1**	**1.2**	**1.4**	**1.2**	**1**	**2.2**	**1.2**	**1**	**1.2**	**1**
1= Weak Correlation				2= Moderate Correlation					3= Strong Correlation			

Course Content:				
L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**CL (Hours/Week)**	**Total Hour/Week**
1	0	2	0	**3**
Unit	**Content & Competencies**			
1. Biology of Honey Bees (Lecture Hours = 4)	Introduction and history of beekeeping, Social organization of bee colony, Importance of bee keeping. Artificial bee rearing, bee hives and bee flora, Selection of bee species for apiculture (*Apis cerana, Apis indica,* and *Apis mellifera*).			
2. Rearing of Bees (Lecture Hours = 4)	Bee keeping equipment, methods of extraction of honey (indigenous and modern) and processing, its medicinal properties, application in various fields and other valuable byproducts of honeybees.			
3. Apiary Management (Lecture Hours = 3)	Bee enemies and diseases. Their control and preventive measures.			
4. Entrepreneurship in Apiculture (Lecture Hours = 4)	Beekeeping industries, recent advancements, employment opportunities, scope for women entrepreneur in bee keeping sector, development programs and funding agencies involved in bee keeping in India. Role of bees in pollination in horticulture and agriculture.			
5. Practical Component (Lab Hours = 30)	1. Study of morphological features of different castes of honey bee. 2. Equipments used in apiary. 3. Identification of different castes of bee colony. 4. Visit to an apiary/honey processing unit/ institute and submission of report. 5. Identification of honey bee diseases and predators (insects and non insects).			

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	**Contact Hours**
Lecture	15
Practical	26
Seminar/Journal Club	-
Small Group Discussion (SGD)	2
Self-directed Learning (SDL) / Tutorial	-
Problem Based Learning (PBL)	-
Case/Project Based Learning (CBL)	-
Revision	2

Others If any:	-
Total Number of Contact Hours	**45**

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	✓	✓	✓	✓	✓
Viva	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Clinical Assessment					
Practical Log Book/ Record Book		✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓

Feedback Process	1. Student's Feedback

References:	List of recommended books:
	1. Abrol, D.P. (2013). Beekeeping: A compressive guide to bees and beekeeping. Scientific publishers. 2. Gupta J.K. (2016). Apiculture. ICAR, New Delhi. 3. Kishan Tej, M., Aruna, R., Mishra, G., & Srinivasan, M. R. (2017). Beekeeping in India. Industrial entomology, 35-66. 4. Singh, D. (2020). Commercial Beekeeping. Scientific Publishers. 5. Tarpy, D.R. (2021). Apiculture. In: *Encyclopedia of Social Insects* (pp. 72-79). Cham: Springer International Publishing.

SEC-2B [Solid Waste Management (SWM)]

Name of the College (Department)	Akal College of Basic Sciences (Department of Botany)
Name of the Program	
Course Code	**0310034021**
Course Title	**Solid Waste Management (SWM)**
Academic Year	II
Semester	III
Number of Credits	2 (1+0+1)
Course Prerequisite	Students should have basic understanding and interest in any subject of interdisciplinary programme.
Course Synopsis	This course provides a comprehensive overview of the principles and practices of solid waste management, emphasizing the environmental, technical, legal, and social aspects of waste handling. Students will explore the sources, classification, collection, transportation, treatment, and disposal of solid wastes, including municipal, industrial, biomedical, hazardous, and electronic wastes. The course integrates sustainable waste management practices such as segregation at source, recycling, composting, and waste-to-energy technologies. Emphasis is placed on current challenges, regulatory frameworks, and innovative approaches for minimizing waste and promoting resource recovery. Through case studies, field visits, and practical sessions, students will gain hands-on experience and develop critical thinking for designing sustainable waste management systems.

Course Outcomes: At the end of the course students will be able to:

CO1	Understand the sources, types, and characteristics of solid waste.
CO2	Explore and compare methods of collection, transportation, and segregation of waste.
CO3	Examine the treatment and disposal technologies for solid waste.
CO4	Comprehend the management of electronic waste (e-waste), its environmental risks, and emerging recycling
CO5	Understand the legal and policy frameworks of solid waste management.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1												
CO2												
CO3												
CO4												
Avg.												

1= Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	CL (Hours/Week)	Total Hours / Week
1(Hours/Week)	-	2(Hours/Week)	-	3 (Hours/Week)

Course Content:				
L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**CL (Hours/Week)**	**Total Hours / Week**
1(Hours/Week)	-	2(Hours/Week)	-	3 (Hours/Week)

U	Content & Competencies
1. Concepts of Solid Waste, Management and Legislative Measures. (Lecture Hours = 4 Hours)	Solid waste management: Concept and current scenario. Sources and classification of solid waste. Factors affecting the generation of solid waste. Legislative measures related to solid waste management.
2. Solid Waste-Collection and Processing Techniques (Lecture Hours = 4 Hours)	Handling and segregation of solid waste at source and methods of separation. Solid waste reduction techniques. Collection of solid waste (equipment, methods, and factors affecting collection). Transfer and transportation of solid waste. Solid waste processing methods (storage, conveying, compacting, shredding, pulping, Pelletizing, etc.).
3. Solid Waste Management Techniques (Lecture Hours = 5 Hours)	Management of organic waste: a) Composting, b) Vermicomposting, c) Farmyard manure, d) Biogas plants. Solid waste Disposal: a) Sanitary landfill, b) Incineration, c) Pyrolysis, d) Gasification
4. E-waste (2 Hours)	Management of E-waste. Site selection and siting criteria for sanitary landfills. Community participation in solid waste management.
Practical Component (Lab Hours = 30)	**List of Practical:** 1. Experimental/laboratory demonstration of vermicomposting. 2. Experimental/laboratory demonstration of aerobic composting. 3. Analysis of physical and chemical properties of solid waste. 4. Sampling and analysis of leachate from solid waste or compost piles. 5. Identification and categorization of e-waste items; awareness survey of users on e-waste disposal. 6. Field visit to waste dumping/disposal site. 7. Steps in Qualitative and Quantitative estimation of solid waste from household/commercial/institutional areas. 8. Field visit to Solid Liquid Resource Management (SLRM). 9. Field visit to SWM plant Baru Sahib. 10. Steps in cost estimation of recyclable waste generated from house holds /commercial/ institutional areas. 11. Field visit to the paper recycling unit. 12. Field visit to the plastic recycling unit or any other recycling unit. 13. Provisions for construction and working of incinerators/biogas plants. 14. Preparation of brief report on visits to different sites. 15. Steps in planning for site selection and siting criteria for sanitary landfills.

Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	15
Practical	26
Seminar/Journal Club	-
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	-
Problem-Based Learning (PBL)	-
Case/Project Based Learning (CBL)	-
Revision	2
Others If any:	-
Total Number of Contact Hours	45

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Test	University Examination
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	
Problem-Based Learning (PBL)	

Journal Club	
Professional Activity	
Assignment	

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz					
VIVA					
Assignment / Presentation					
Professional Activity					
Laboratory assessment					
Clinical/Practical Log Book/ Record Book					
Class Tests					
University Examination					
Feedback Process	1. Student's Feedback				
Suggested Readings:	List of reference books:				
	1. Anonymous (2014). Waste to resources- A waste management hand-book. The Energy and Resources Institute (TERI), New Delhi. http://www.teriin.org/ 2. Bhatia S.C. (2007). Solid and hazardous waste management. Atlantic Publishers, New Delhi. 3. Khan, I.H. and Ahsan, N. (2011). Textbook of solid waste management. CBS Publishers, New Delhi 4. Mishra, S.G. and Mani D. (1993). Pollution through solid waste. Ashok Publishing House, New Delhi. 5. Tchobanoglous, G. and Kreith, F. (2002). Handbook of solid waste management: McGraw Hill Handbooks, New York				

SEC-2C (Chemistry of Cosmetics and Hygiene Products)

Name of the College (Department)	Akal College of Basic Sciences (Department of Chemistry and Biochemistry)
Name of the Program	For other Colleges
Course Code	**0320034021**
Course Title	**Chemistry of Cosmetics and Hygiene Products**
Academic Year	II
Semester	III
Number of Credits	2 (1+0+1)
Course Prerequisite	XII with Science
Course Synopsis	Cosmetic chemistry helps students to understand the basics of cosmetics and applications. Students can also formulate the products like skin care products, hair care products etc. Learners would be aware of the herbs and excipient in cosmetics and hygiene product formulations.

Course Outcomes:
At the end of the course students will be able to:

CO1	Define cosmetics, Scope, Classification of cosmetics.
CO2	Understand the formulation of cosmetic products.
CO3	Understand the herbs role in cosmetics.
CO4	Understand the excipients of cosmetics.
CO5	Understand the use of basic terms in cosmetics.

Mapping of Course Outcomes (COs) to Program Outcomes (POs)& Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1												
CO2												
CO3												
CO4												
CO5												
Average												

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	CL (Hours/Week)	Total Hour/Week
1		2		3

Unit	Content & Competencies

1: Basics of cosmetics	Definition, History and scope of cosmetics, Applications, Classifications, Limitations, Good manufacturing practices.
2: Principles and Formulation of cosmetic products	• Skin care products • Hair care products • Oral hygiene products • Nail care products • Advantages and Disadvantages • Common cosmetic formulation
3: Role of Herbs in cosmetics	Common Herbal Ingredients and their uses: skin care, hair care, fragrance and aromatherapy; cleansing and detoxification.
4: Cosmetic excipients	Cosmetic excipients: surfactants, rheology modifiers, preservatives, emollients, humectants. principles of cosmetic evaluation, basic terms: comedogenic, non-comedogenic, dermatitis.
Practical Component (Hours = 30)	1. To Prepare samples of shampoo. 2. Preparation of hand wash. 3. Preparation of soaps. 4. Preparation of face cream. 5. Preparation of toothpaste. 6. Preparation of talcum powder

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	**Contact Hours**
Lecture	15
Practical	26
Seminar/Journal Club	-
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	-
Problem Based Learning (PBL)	-
Case/Project Based Learning (CBL)	-
Revision	2
Others If any:	-
Total Number of Contact Hours	45

Assessment Methods:

Formative	**Summative**

Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping of Assessment with Cos

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Quiz	✓	✓	✓	✓	✓
VIVA	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Clinical assessment					
Clinical/Practical Logbook/ Record Book	✓	✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓

Feedback Process	1. Student's Feedback

References:	List of recommended books:
	1. Barel, A.O., Paye, M., Maibach, H.I. (2014). *Handbook of Cosmetic Science and Technology*. CRC Press. 2. Butler, H. (2000). *Poucher's Perfumes, Cosmetic and Soap*. Springer. 3. Garud, A., Sharma, P.K., Garud, N. (2012). *Textbook of Cosmetics*. Pragati Prakashan. 4. Gupta, P.K., Gupta, S.K. (2011). *Pharmaceutics and Cosmetics*. Pragati Prakashan 5. Kumari, R. *Chemistry of Cosmetics*. Prestige Publishers. 6. Moore, R. J., Wilkinson, J. B. (1982). *Harry's Cosmeticology*. Chemical Publishing company, Seventh Edition. 7. Nanda, S., & Khar, R. K. *Textbook of Cosmetiology*. Tata Publishers. 8. Romanowski, P. (2009). *Beginning Cosmetic Chemistry*. Allured Pub Corp. 9. Sharma, P. P. *Cosmetics – Formulations, Manufacturing and Quality Control.* 4th Edition, Vandana Publications Pvt. Ltd., Delhi.

AEC-3B (Environmental Science-II)

Name of the Department	Botany
Name of the Program	
Course Code	**0310035021**
Course Title	**Environmental Science - II**
Academic Year	II
Semester	III
Number of Credits	2 (1+0+1)
Course Prerequisite	
Course Synopsis	Environmental conservation has become a global concern nowadays. The Environmental Studies includes an integration of multiple fields to understand the current environmental issues. Every global citizen must have an in-depth understanding of various environmental problems and their possible solutions so that our mother earth can be saved. Environment conservation is an integral part of Indian civilization and culture also. This course has been designed to train the students for adopting eco-friendly practices and encourage others to do so in order to promote the sustainable development.

Course Outcomes:
At the end of the course students will be able to:

CO1	Attain comprehensive information about global environmental issues and international strategies to combat those issues.
CO2	Adopt the pollution mitigation strategies in life and educate others about these strategies.
CO3	Gain an in-depth knowledge about important environmental laws in India.
CO4	Comprehend the role of an individual as well as the communities in disaster management.
CO5	Understand the issues related to human communities and their possible solutions.

Mapping of Course Outcomes (COs) to Program Outcomes (POs)& Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1												
CO2												
CO3												
CO4												
CO5												
Average												

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	CL (Hours/Week)	Total Hour/Week
1		2		3

Unit	Content & Competencies
1.Environmental Pollution (Lecture Hours = 5)	Definition, causes, effects and control measures of air, water, soil, marine, noise and thermal pollutions. Water and air quality standards. Solid waste Management: causes, effects and control measures of urban, industrial, biomedical, hazardous and E-waste. Nuclear hazards and health risks Role of an individual in prevention of pollution.
2. Global environmental threats and strategies to combat (Lecture Hours = 4)	Global environmental issues: causes, impacts and international agreements to combat climate change, global warming, acid rain and ozone layer depletion. Environmental laws: Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation. Environmental ethics: Issues and possible solutions.
3.Human communities and the environment (Lecture Hours =3)	Environmental movements: Chipko movement, Appiko movement, Silent valley movement, Bishnois of Rajasthan. Environmental justice: National Green Tribunal and its importance Diaster management: causes, impacts and mitigation measures of floods, earthquakes, cyclones and landslides.
4. Sustainable solutions and public awareness (Lecture Hours =3)	Stubble burning: meaning and reason for stubble burning, In-situ and ex-situ management of stubble, environmental and health effects of stubble burning, policies to control stubble burning. Environmental communication and public awareness: case studies (e.g. , CNG vehicles in Delhi, Swachh Bharat Abhiyan etc.)
5. Practical Component (Lecture Hours = 30)	1. Develop and maintain vermicompost bins using biodegradable waste in the university. 2. Assessment of carbon foot-print of different countries using online databases and mathematical tools. 3. Visit to marginalized localities for environmental education and environmental awareness. 4. Formulation of questionnaire/online surveys for assessment of the impact of environmental education. 5. Visit to any developmental project affected locality for assessing the impacts of economic development on human lives. 6. Correlation analysis of human population growth and impacts on the environment and human health. 7. Depict temperature/precipitation trend of a given study area using online data. 8. Formulate questionnaire/online surveys for assessment of the impact of climate change on people. 9. Assess Nationally Determined Contributions (NDCs) of developed and developing countries. 10. Identify carbon footprint of your college/home/locality (refer wwf@envis.nic.in). 11. Analyze the status of at least 3 sustainable development goals in your neighbourhood and write a proposal to help achieve them at global standard. 12. Visit to a solid waste management plant in the University campus. 13. Determine water quality of a given location using rapid pollution monitoring kits. 14. Assess air quality index (AQI) of any location using real-time air quality parameters. 15. Visit to a wastewater treatment plant in the University campus.

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	15
Practical	26
Seminar/Journal Club	
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	
Problem Based Learning (PBL)	
Case/Project Based Learning (CBL)	
Revision	2
Others If any:	
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz					
VIVA					
Assignment / Presentation					
Professional Activity					
Laboratory assessment					
Clinical/Practical Log Book/ Record Book					
Class Tests					
University Examination					
Feedback Process	3. Student's Feedback				
References:	List of reference books:				
	1. Divan, S. and Rosencranz, A. (2002). *Environmental Law and Policy in India: Cases, Material & Statute.* Oxford University Press, India 2. Gadgil, M. and Guha, R. (1993). *This Fissured Land: An Ecological History of India.* University of California Press, Berkeley, USA 3. Kumar, R and Sharma, D (2016). *Environmental Studies*. Trueman Book Company, Jalandhar. 4. McCully, P. (1996). *Rivers no more: the environmental effects of dams,* In: *Silenced Rivers: The Ecology and Politics of Large Dams.* Zed Books, New York, USA. 5. Odum, E.P., Odum, H.T., and Andrews, J. (1971). Fundamentals of Ecology. Saunders, Philadelphia, USA. 6. Raven, P.H, Hassenzahl, D.M., Hager, M.C, Gift, N.Y., and Berg, L.R. (2015). Environment. Wiley Publishing, USA. 7. Singh, J.S., Singh, S.P., and Gupta, S.R. (2017). Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.				

SEMESTER – IV

Course Category		Course Code	Course Title	Teaching Hours/Week			Credits
				L	T	P	
DSC-4B		**0310141041**	**Plant Developmental Biology**	3	0	2	3+0+1
DSC-4C		**0320141041**	**Chemistry of Oxygen Based Functional Groups**	3	0	2	3+0+1
DSC-4Z		**0360141041**	**Chordates-II**	3	0	2	3+0+1
***DSE-2 (Pool)**	**i)**	0310142021	Economic Botany	3	0	2	3+0+1
	ii)	0320142021	Chemistry of Colloids and Adsorption	3	0	2	3+0+1
/	**iii)**	0360142021	Applied Animal Sciences	3	0	2	3+0+1
***GE-4 (Pool)**				3	0	2	3+0+1
IPAC-2 / SEC-4			SEC (One from the pool)	1	0	2	1 + 1
AEC-4			AEC (One from the pool)	1	0	2	1 + 1
VAC-4			VAC (One from the pool)	1	0	2	1 + 1
		Total		**15**	**0**	**14**	**22**

Note – L: Lecture Hour/week, T: Tutorial Hour/week, P: Practical Hour/week, C: Credits, IAE: Internal Assessment Examination, ESE: End Semester Examination, DSC – Discipline Specific Course, GE – General Electives, SEC – Skill Enhancement Course, AEC – Ability Enhancement Course, VAC – Value Addition Course. *Any ONE course from the pool either DSE-1 or GE-1.

Note: If the student wishes to exit after completing two years/ four semesters, UG Diploma will be provided to the students.

DSC-4B (Plant Developmental Biology)

Name of the College (Department)	Akal College of Basic Sciences (Department of Botany)
Name of the Program	B.Sc. (Hons. with Research) Life Sciences
Course Code	**0310141041**
Course Title	**Plant Developmental Biology**
Academic Year	II
Semester	IV
Number of Credits	4 (3+0+1)
Course Prerequisite	Students should have studied subjects of Botany in Semester-1st to 3rd at UG level under multidisciplinary or honours program.
Course Synopsis	This course delves into the developmental biology of angiosperms, focusing on the organization and differentiation of meristems, reproductive structures, and processes involved in fertilization and seed formation. It emphasizes both classical and molecular approaches to understanding plant growth, reproduction, and embryogenesis.

Course Outcomes: At the end of the course students will be able to:

CO1	Describe the organization and function of shoot and root apical meristems and the process of vascular differentiation.
CO2	Explain the mechanisms of vegetative and sexual reproduction, including microsporogenesis, pollen development, and male sterility.
CO3	Analyze the development of female reproductive structures, including ovule development, embryo sac formation, and pollination mechanisms.
CO4	Evaluate processes involved in fertilization, self-incompatibility, and in-vitro fertilization in flowering plants.
CO5	Interpret the developmental stages of fruit and seed formation, including embryogenesis, storage proteins, polyembryony, and apomixis.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	1	2	1	1	1	3	2	1	1	1	1
CO2	1	1	1	1	1	1	1	3	1	1	1	1
CO3	1	1	2	1	2	1	2	1	1	1	1	1
CO4	1	1	2	1	1	1	2	2	2	1	2	1
CO5	1	1	2	2	2	2	3	3	1	1	1	1
Average	**1**	**1**	**1.8**	**1.2**	**1.4**	**1.2**	**2.2**	**2.2**	**1.2**	**1**	**1.2**	**1**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

Course Content

L (Hours/ Week)	T (Hours/ Week)	P (Hours/ Week)	CL (Hours/Week)	Total Hour/ Week
3 (3 Hours/ Week)	0	1 (2 Hours/ Week)	0	5 (Hours/ Week)

Unit	Content & Competencies
1. Meristem Organization and Vascular Differentiation (Lecture Hours = 11)	Organization of the shoot apical meristem (SAM); Cytological and molecular analysis of SAM; Organization of root apical meristem (RAM); vascular tissue differentiation; lateral roots; root hairs; Anomalous secondary growth in Angiosperm.
2. Male Reproductive Development and	Vegetative and sexual reproduction; Floral parts and it's development; Structure of anthers; Microsporogenesis, Pollen development, pollen viability, male sterility;

Hybridization (Lecture Hours = 11)	Sperm dimorphism, hybridization and hybrid seed production.
3. Female Reproductive Development and Fertilization Mechanisms (Lecture Hours = 11)	Structure of the Pistil; Ovule development and Megasporogenesis; Organization of the embryo sac, Pollination, Pollen-Pistil / stigma interactions and fertilization, self-incompatibility; double fertilization; *In-vitro* fertilization.
4. Fruit and Seed Development (Lecture Hours = 12)	Endosperm type and development; Embryogenesis, storage proteins (Vegetative and seed storage proteins); Polyembryony; Apomixes; Embryo culture; Dynamics of fruit growth; Biology of fruit growth and seed development.
5. Practical Component (Lab Hours = 30)	**Any 5 practical's from the below mentioned list:** 1. Study of loving shoot apices by dissections using aquatic plants such as *Ceratophyllum* and *Hydrilla*. 2. Study of cytohistological zonation in shoot apical meristem (SAM) using double-stained permanent slides (e.g., Coleus, Kalanchoe, Tobacco). 3. Examinations of monocot shoot apices in T.S. and L.S. to observe leaf primordia origin and arrangement. 4. Study of anomalous secondary growth through the T.S. of stems. 5. Microscopic examination of leaf anatomy of C3 and C4 plants. 6. Study of epidermal peels of leaves from the plants to study the different types of stomata and calculation stomatal index. 7. Study of shoot and roots in monocots and dicots (including leguminous roots) from the various sectioned permanent slides. 8. To study the types of angiosperm pollen, pollen viability and pollen germination potential. 9. Field study of different types of flowers with different pollination mechanisms (wind pollination, air pollination, bee/butterfly pollination, bird pollination). 10. Study of seed dormancy and methods to breaking seed dormancy.

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	45
Practical	25
Seminar/Journal Club	-
Small Group Discussion (SGD)	1
Self-directed Learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	1
Case/Project Based Learning (CBL)	-
Revision	2
Others If any:	-
Total Number of Contact Hours	**75**

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)

Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping and Assessment with COs:

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	✓	✓	✓	✓	✓
Viva-voce	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Laboratory assessment	✓	✓	✓	✓	✓
Practical Log Book/ Record Book	✓	✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓
Feedback Process	1. Student's Feedback				

References:	List of recommended books:
	1. Beck, C. B. (2010). An introduction to plant structure and development: Plant anatomy for the twenty-first century. Cambridge University Press. 2. Minelli, A. (2018). Plant evolutionary developmental biology: The evolvability of the phenotype. Cambridge University Press. 3. Ranjan, P. K. (2014). Plant anatomy. New Central Book Agency. 4. Sharma, T. (2022). Developmental biology of flowering plants. Pinakin Publication. 5. Sinha, P. (2016). Plant anatomy and physiology. Bio Green Books.

DSE-4C (Chemistry of Oxygen Based Functional Groups)

Name of the College (Department)	Akal College of Basic Sciences (Department of Chemistry and Biochemistry)
Name of the Program	B.Sc. (Hons. with Research) Life Sciences
Course Code	**0320141041**
Course Title	**Chemistry of Oxygen Based Functional Groups**
Academic Year	II
Semester	IV
Number of Credits	4 (3+0+1)
Course Prerequisite	Students should have studied subjects of Chemistry in Semester-1st to 3rd at UG level under multidisciplinary or honours program.
Course Synopsis	This course explores the structure, reactivity, and mechanisms of organic compounds containing oxygen-based functional groups. Emphasis is placed on alcohols, aldehydes, ketones, carboxylic acids, and related derivatives. Students will examine how electronic and steric factors influence reactivity, and how these compounds participate in key organic reactions such as nucleophilic substitution, oxidation-reduction, and condensation. Real-world applications, including pharmaceuticals, biomolecules, and industrial processes, are discussed to highlight the relevance of organic chemistry. Through lectures, problem-solving sessions, and laboratory experiments, students will gain both theoretical knowledge and practical skills essential for advanced organic chemistry and related disciplines. This course serves as a foundation for further study in medicinal, environmental, and industrial chemistry.

Course Outcomes:
At the end of the course students will be able to:

CO1	Define oxygen-based compounds, outline its goals, and explain the scope of organic chemistry in our daily life.
CO2	Understanding the fundamental concepts of carbonyl compounds.
CO3	Frame the mechanism of organic reactions by reminding and relating the fundamental properties of the reactants involved.
CO4	Learn and identify many organic reactions of oxygen containing molecules.
CO5	Differentiate and ethe oxygen based functional groups.

Mapping of Course Outcomes (COs) to Program Outcomes (POs)& Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	1	1	2	3	2	2	1
CO2	2	3	1	2	2	2	1	3	3	2	1	2
CO3	3	2	2	2	2	2	2	1	2	1	1	1
CO4	3	1	2	2	1	2	2	2	2	2	2	2
CO5	3	3	2	2	2	2	2	3	2	2	2	1
Average	**2.8**	**2.4**	**2**	**2.2**	**2**	**2**	**1.6**	**2.2**	**2.4**	**1.8**	**1.6**	**1.4**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	CL (Hours/Week)	Total Hour/Week
3(Hours/Week)	0	2 (Hours/Week)	**0**	5 (Hours/Week)

Unit	Content & Competencies
1. Alcohols Compounds and their De-	Alcohols: Classification and nomenclature of Monohydric alcohols – nomenclature, methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen

rivatives (aliphatic and aromatic) (Lecture Hours = 10)	bonding. Acidic nature. Reactions of alcohols. Dihydric alcohols – nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$] and HIO_4 and pinacol-pinacolone rearrangement.
2. Carbonyl Compounds and their Derivatives (aliphatic and aromatic) (Lecture Hours = 10)	Aldehydes and Ketones: Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations.
3. Name reaction with mechanism (Lecture Hours = 10)	Condensation with ammonia and its derivatives. Wittig reaction. Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions. Halogenation of enolizable ketones. An introduction to α,β-unsaturated aldehydes and ketones.
4. Carboxylic Compounds and their Derivatives (aliphatic and aromatic) (Lecture Hours = 15)	Carboxylic Acids: Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides. Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of formation and chemical reactions of unsaturated mono-carboxylic acids. Dicarboxylic acids: methods of formation and effect of heat and dehydrating agents.
5. Practical Component (Lecture Hours = 30)	**Any 5 practical's from the below mentioned list:** 1. Determination of Rf value and purity of organic compounds by use of thin layer chromatography. 2. To analyze the analgesic drug APC by thin layer chromatography. 3. Separation of mixture of *o*-nitroaniline and *p*-nitroaniline by column Chromatography 4. Synthesis of organic compounds: Acetylation/benzolyation of salicylic acid. 5. Preparation of m-dinitrobenzene from nitrobenzene. 6. Preparation of p-nitroacetanilide from acetanilide. 7. Preparation of p-bromoacetanilide from acetanilide.

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	45
Practical	25
Seminar/Journal Club	-
Small group discussion (SGD)	1
Self-directed learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	1
Case/Project Based Learning (CBL)	-
Revision	2
Others If any:	-
Total Number of Contact Hours	**75**

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	✓	✓	✓	✓	✓
VIVA	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Laboratory assessment	✓	✓	✓	✓	✓
Practical Log Book/ Record Book	✓	✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓
Feedback Process	1. Student's Feedback				

References:	List of recommended books:

1. Ahluwalia, V. K., & Dhingra, S. (2024). Advanced experimental inorganic chemistry. Taylor & Francis.
2. Ahluwalia, V. K., Bhagat, P., Aggarwal, R., & Chandra, R. (2005). Intermediate for organic synthesis. I.K. International.
3. Carey, F. A. (2003). Organic chemistry. McGraw-Hill.
4. Furniss, B. S. (Ed.). (2011). Vogel's textbook of practical organic chemistry. Pearson Education India.
5. Mukerji, S. M., Singh, S. P., & Kapoor, R. P. (1985). Organic chemistry (Vols. I/II). Wiley Eastern Ltd.
6. Nickon, A., & Silversmith, E. F. (2013). Organic chemistry: The name game—Modern coined terms and their origins. Elsevier.
7. Solomons, T. W. G., Fryhle, C. B., & Snyder, S. A. (2016). Organic chemistry (12th ed.). Wiley.

DSC-4Z (Chordates-II)

Name of the College (Department)	Akal College of Basic Sciences (Department of Zoology)
Name of the Program	B.Sc. (Hons. with Research) Life Sciences
Course Code	**0360141041**
Course Title	**Chordates-II**
Academic Year	II
Semester	IV
Number of Credits	4 (3+0+1)
Course Prerequisite	Students should have studied subjects of Zoology in Semester-1st to 3rd at UG level under multidisciplinary or honours program.
Course Synopsis	This course covers the major vertebrate classes-Amphibia, Reptilia, Aves, and Mammalia-focusing on their classification and key features. Students will study representative species such as *Rana tigrina, Uromastix, Columba livia*, and *Rattus rattus.* It explores adaptive traits like amphibian parental care, reptilian terrestrial adaptations, and bird flight mechanisms. Differences between poisonous and non-poisonous snakes and their biting mechanisms are discussed. The course includes the origin of mammals and characteristics of Prototheria, Metatheria, and Eutheria. Overall, it emphasizes comparative anatomy, physiology, and evolutionary adaptations across vertebrate groups.

Course Outcomes:
At the end of the course students will be able to:

CO1	Understand and Classify the major vertebrate groups-Amphibia, Reptilia, Aves, and Mammalia.
CO2	Analyze the morphology, anatomy, physiology, habit, and habitat of key representative species such as *Rana tigrina*, *Uromastix*, *Columba livia*, and *Rattus rattus*.
CO3	Explain adaptive features in vertebrates including amphibian parental care.
CO4	Differentiate between poisonous and non-poisonous snakes.
CO5	Understand evolutionary trends and specialization through comparative study of Prototheria.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	2	1	1	1	1	1	1	2	1	1	1	2
CO2	2	1	1	1	1	1	1	2	1	1	1	2
CO3	2	1	1	1	1	1	1	2	1	1	1	2
CO4	2	1	1	1	1	1	1	2	1	1	1	2
CO5	1	1	2	2	1	1	2	2	1	1	1	2
Average	**1.8**	**1**	**1.2**	**1.2**	**1**	**1**	**1.2**	**2**	**1**	**1**	**1**	**2**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	CL (Hours/Week)	Total Hour/Week
3 (3 Hours/ Week)	0	1 (2 Hours/ Week)	0	5 (Hours/ Week)

Unit	Content & Competencies
1. Amphibian Features and Classification (Lecture Hours = 10)	Amphibia: General characters and classification upto orders. Elementary idea of parental care. Detailed study including habit and habitat, morphology, anatomy and physiology of *Rana tigrina*.
2. Reptilian Adaptations and Classification (Lecture Hours = 11)	Reptilia: General features and classification upto orders. Terrestrial adaptations: Structural, respiratory, excretory, reproductive, behavioral, and sensory adaptations enable survival on land. Poisonous and non-poisonous snakes; Biting mechanism in snakes.

	Detailed study including habit and habitat, morphology, anatomy and physiology of *Uromastix.*
3. Avian Classification and Flight Adaptations (Lecture Hours = 12)	Aves: General characters and classification upto orders. Detailed study including habit and habitat, morphology, anatomy and physiology of *Columba livia*. Feathers in birds. Flight adaptations in birds.
4. Mammalian Classification and Evolutionary Features (Lecture Hours = 12)	Mammalia: General characters and classification upto orders. Origin of mammals. Salient features and distribution of Prototheria, Metatheria and Eutheria. Detailed study including habit and habitat, morphology, anatomy and physiology of *Rattus rattus*.
5. Practical Component (Lab Hours = 30)	**Any 5 practical's from the below mentioned list:** 1. Specimen study of Amphibia: *Uraeotyphlus, Necturus, Amphiuma,* and *Amblystoma.* 2. Identification of *Triton, Bufo, Hyla,* and *Rhacophoru*. 3. Specimen study of Reptilia: *Chelone*, *Testudo*, *Uromastrix, Hemidactylus, Calotes*, and *Draco*. 4. Identification of *Varanus, Phrynosoma, Chamaeleon, Typhlops, Python,* and *Eryx*. 5. Model-based morphological study of *Bungarus, Naja, Hydrus, Vipera, Crocodilus, Gavialis* and Alligator. 6. Keys for the identification of poisonous and non-poisonous snakes. 7. Specimen study of Aves: *Arden, Columba, Milvus, Pavo, Tyto, Alcedo, Eudynamis* and *Casuarius.* 8. Study of external features of selected Mammals through specimens and models: *Ornithorhynchus, Echidna, Didelphis, Macropus*, *Loris,* and *Macaca.* 9. Observation and identification of *Hystrix, Funambulus, Canis, Herpestes, Capra,* and *Pteropus.*

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	45
Practical	25
Seminar/Journal Club	-
Small Group Discussion (SGD)	1
Self-directed Learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	1
Case/Project Based Learning (CBL)	-
Revision	2
Others If any:	-
Total Number of Contact Hours	**75**

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	✓	✓	✓	✓	✓
Viva	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓

Laboratory Assessment	✓	✓	✓	✓	✓
Practical Log Book/ Record Book	✓	✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓
Feedback Process	Student's Feedback				

References:	List of recommended books:
	1. Hildebrand, M., & Goslow, G. (2001). Analysis of vertebrate structure. Wiley. 2. Jordan, E.L., & Verma, P.S. (2011). Chordate zoology. S. Chand & Co. Ltd. 3. Kotpal, R.L. (2023). Modern text-book of zoology: Vertebrates. Rastogi Publication. 4. Pandey, B.N., & Mathur, V. (2022). Biology of chordates. PHI Learning Pvt. Ltd. 5. Romer, A.S., & Parsons, T.S. (1977). The vertebrate body. W. B. Saunders Co. Ltd. 6. Young, J.Z. (2008). The life of vertebrates. Oxford University Press.

DSE-2B (Economic Botany)

Name of the College (Department)	Akal College of Basic Sciences (Department of Botany)
Name of the Program	B.Sc. (Hons. with Research) Life Sciences
Course Code	**0310142021**
Course Title	**Economic Botany**
Academic Year	II
Semester	IV
Number of Credits	4 (3+0+1)
Course Prerequisite	Students should have studied subjects of Biology at 12th level / Subjects of Botany in UG 1st Year under multidisciplinary or honours program.
Course Synopsis	This course provides an in-depth understanding of economically important plants and their contributions to food, fiber, fuel, medicine, and industry. It emphasizes plant-based resources that support human civilization, focusing on their origin, cultivation, processing, and socio-economic value.

Course Outcomes: At the end of the course students will be able to:

CO1	Understand the historical and economic importance of cultivated plants in human society.
CO2	Identify major food, medicinal, industrial, and beverage plants and explain their origin, botanical features, and uses.
CO3	Describe the economic importance of plant-based fibers, oils, gums, resins, and timbers.
CO4	Evaluate the role of ethnobotany and traditional knowledge in the utilization of plants.
CO5	Demonstrate practical skills in identifying and analyzing plant products of economic importance.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	1	1	1	1	3	2	1	1	2	1	1
CO2	1	1	1	1	1	1	3	1	1	1	1	1
CO3	1	1	1	1	1	2	1	1	1	2	1	2
CO4	1	2	1	1	1	2	2	2	1	2	1	1
CO5	1	1	1	1	1	3	3	1	1	2	2	2
Average	**1**	**1.2**	**1**	**1**	**1**	**2.2**	**2.2**	**1.2**	**1**	**1.8**	**1.2**	**1.4**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

Course Content

L (Hours/ Week)	T (Hours/ Week)	P (Hours/ Week)	CL (Hours/Week)	Total Hour/ Week
3 (3 Hours/ Week)	0	1 (2 Hours/ Week)	0	5 (Hours/ Week)

Unit	Content & Competencies
1. Origin and Domestication of Cultivated Plants (Lecture Hours = 11)	Ethnobotany: Scope, significance, and examples from tribal and traditional practices, Centers of origin (Vavilov's concept); Domestication and diversification of major food crops: cereals (wheat, rice, maize), pulses (gram, lentil), millets (sorghum, pearl millet), Legumes and their importance.
2. Plants as Sources of Oils, Fibers, and Sugars (Lecture Hours = 12)	Oil-yielding Plants: Study of important species such as mustard, groundnut, coconut, sunflower, and soybean — their oil content and economic significance. Fiber Plants: Overview of cotton, jute, flax, and coir — types of fibers and their uses. Sugar-producing Plants: Study of sugarcane and sugar beet — sources of sugar and their industrial importance. Economic and Industrial Applications: Role of these plants in agriculture, industry, and

	economy.
3. Medicinal and Beverage Plants (Lecture Hours = 11)	Medicinal Plants: Study of important species (*Rauvolfia serpentina*, *Withania somnifera*, *Azadirachta indica*, *Ocimum sanctum*), their active principles, and medicinal uses. Beverage Plants: Overview of tea, coffee, and cocoa — their origin, active compounds, and economic importance. Herbal Drugs and Pharmaceutical Industry: Role of herbal medicines in healthcare and contribution of pharmaceutical industries in drug development.
4. Forest Resources and Ethnobotany (Lecture Hours = 11)	Timber Plants: Study of key species such as teak, sal, deodar, and pine — their wood properties and uses. Gums and Resins: Overview of gum arabic, asafoetida, dammar, and turpentine — their sources and industrial applications. Tannins and Dyes: Study of catechu, indigo, and henna — their extraction and use in tanning and dyeing industries. Study of economically important spices and condiments, such as saffron, black pepper, and cardamom, focusing on their botanical characteristics and uses. Bioprospecting and Intellectual Property Rights (IPRs): Exploration of plant-based resources for pharmaceuticals and biotechnology; role of IPRs in protecting traditional knowledge and innovations. Conservation of Economically Important Plants: Strategies for the conservation of plants with significant economic value.
5. Practical Component (Lab Hours = 30)	**Any 5 practical's from the below mentioned list:** 1. Study of economically important cereals, pulses and oil yielding seeds: Identify and compare their grain morphometric quality and uses. 2. Study, identification and use of natural fibers and fiber yielding plants. 3. Study of the agronomic characteristics, processing methods, and economic value of beverage plants (e.g., tea, coffee, and cocoa). 4. Study the nature, type (/ microscopic sectioned slides) and importance of woods/timber yielding plants. 6. Study and identification of poisons and natural dye yielding plants in your locality. 7. Extraction, identification, and solubility testing of gums and resins from plant samples (e.g., gum arabic, dammar, asafoetida). 8. Identification and collection of samples from the locally available plants as a source of crude drug (e.g. roots, leaves, bark, or seeds) or spices and condiments. 9. Ethnobotanical field survey or case study presentation – Traditional plant use among local communities. 10. Enlist and study some endangered plant species from your locality, their identification, and conservation strategies (*in-situ* and *ex-situ*).

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	45
Practical	25
Seminar/Journal Club	-
Small Group Discussion (SGD)	1
Self-directed Learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	1
Case/Project Based Learning (CBL)	-
Revision	2
Others If any:	-
Total Number of Contact Hours	**75**

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping and Assessment with COs:

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	✓	✓	✓	✓	✓
Viva-voce	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Laboratory assessment	✓	✓	✓	✓	✓
Practical Log Book/ Record Book	✓	✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓
Feedback Process	1. Student's Feedback				

References

List of recommended books:

1. Das K. (2025). Economic Botany for FYUGP NEP. Mahaveer Publications.
2. Hill A.F. & Sharma O.P. (2024). Hill's Economic Botany (6th ed). Medtech Science Press.
3. Hill, A.F. (1952) – Economic Botany: A Textbook of Useful Plants and Plant Products. McGraw-Hill
4. Kochhar, S.L. (2020) – Economic Botany in the Tropics. Macmillan Publishers India
5. Pandey, B.P. (2018) – Economic Botany. S. Chand & Company Pvt. Ltd.
6. Sambamurty, A.V.S.S. (2005) – Economic Botany. I.K. International Publishing House
7. Singh, V. & Jain, D.K. (2016) – Economic Botany. Rastogi Publications
8. Wickens, G.E. (2001) – Economic Botany: Principles and Practices. Springer

DSE-2C (Chemistry of Colloids and Adsorption)

Name of the College (Department)	Akal College of Basic Sciences (Department of Chemistry and Biochemistry)
Name of the Program	B.Sc. (Hons. with Research) Life Sciences
Course Code	**0320142021**
Course Title	**Chemistry of Colloids and Adsorption**
Academic Year	II
Semester	IV
Number of Credits	4 (3+0+1)
Course Prerequisite	XII with Science
Course Synopsis	This course offers a comprehensive understanding of colloidal systems and adsorption phenomena. It covers the classification, properties, and preparation of colloids, including lyophilic, lyophobic, macromolecular, and associated colloids (micelles). Key concepts like Tyndall effect, Brownian motion, coagulation, electrophoresis, and dialysis are discussed along with the Schulze–Hardy rule. The course introduces emulsification, surfactant selection (HLB), and colloids in food and biomedical applications. Students explore the distinction between adsorption and absorption, types of adsorptions (physisorption and chemisorption), and isotherms (Freundlich and Langmuir). Emphasis is placed on real-world applications such as catalysis, drug delivery, water purification, and chromatography.

Course Outcomes: At the end of the course students will be able to:

CO1	Differentiate between true solutions, colloids, and suspensions based on particle size, visibility, filtration behavior, and stability, and classify colloidal systems based on the nature of the dispersed phase and medium.
CO2	Understand the types, formation, and stability of colloidal systems, including multimolecular, macromolecular, and associated colloids (micelles), and apply the concepts of Hydrophile–Lyophile Balance (HLB) in the context of emulsification.
CO3	Describe the methods of colloid preparation and purification (condensation, dispersion, electrophoresis, dialysis), and interpret key properties such as Tyndall effect, Brownian motion, coagulation, and the Schulze–Hardy rule.
CO4	Understand the principles of adsorption, differentiate between physisorption and chemisorption, analyze adsorption isotherms (Freundlich and Langmuir), and explain the factors influencing adsorption of gases and solutions on solid surfaces.
CO5	Identify and evaluate the real-life applications of colloids and adsorption, including their roles in food chemistry, drug delivery, catalysis, water purification, chromatography, and environmental and industrial processes.

Mapping of Course Outcomes (COs) to Program Outcomes (POs)& Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	2	1	2	2	1	2	1
CO2	1	1	2	2	1	1	1	2	1	1	3	2
CO3	2	2	2	2	2	2	-	2	1	1	1	1
CO4	2	3	1	2	2	1	1	2	2	1	2	2
CO5	3	2	2	2	3	2	2	2	2	1	3	1
Average	**2.3**	**2.3**	**2**	**2.3**	**2.2**	**1.6**	**1.2**	**2**	**1.6**	**1.2**	**2.2**	**1.4**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

Course Content				
L (Hours/ Week)	**T (Hours/ Week)**	**P (Hours/ Week)**	**CL (Hours/Week)**	**Total Hour/ Week**
3 (3 Hours/ Week)	0	1 (2 Hours/ Week)	0	5 (Hours/ Week)
Unit	**Content & Competencies**			
1. Colloidal State (Lecture Hours = 15)	Distinction among true Solutions, Colloids, and Suspensions: Comparative study based on particle size, visibility, filtration, and stability. Components and Classification of Colloids: Dispersed phase and dispersion medium; classification into lyophilic and lyophobic colloids. Hydrophile–Lyophile Balance (HLB): Concept and significance in emulsification and surfactant behavior. Types of Colloidal Systems: Multimolecular Colloids – formed by aggregation of atoms or molecules. Macromolecular Colloids – formed by large molecules dispersed in a medium. Associated Colloids (Micelles): Critical micelle concentration (CMC), formation, and behavior in aqueous solution.			
2. Preparation and Properties of Colloids (Lecture Hours = 10)	Methods of preparation of colloids: condensation and dispersion techniques, Stabilization of colloidal systems Tyndall effect, Brownian movement, coagulation and flocculation; electrophoresis, dialysis. Schulze–Hardy Rule: Influence of ionic charge on coagulation of colloids. Emulsification by surfactants, selection of surfactants as emulsifying agent, colloidal phenomenon in food chemistry, Protein based functional colloids.			
3. Applications of Colloids and Adsorption (Lecture Hours = 10)	Applications of colloids: Applications of Adsorption phenomenon in living systems. Industrial (paints, inks, rubber), medicinal (drug delivery), environmental (waste treatment). Applications of adsorption: Catalysis, gas masks, purification of water, chromatography, Role of colloids and adsorption in biological and technological processes.			
4. Surface Chemistry (Lecture Hours = 10)	Adsorption, Distinction between adsorption and absorption, Types of Adsorptions, Physisorption and chemisorption along with their key characteristics and comparative analysis, factors affecting adsorption of gases on solids – Freundlich and Langmuir adsorption isotherms, Adsorption from solutions.			
5. Practical Component (Lab Hours = 30)	**Any 5 practical's from the below mentioned list:** 1. Preparation of colloidal solution of Starch/Gum. 2. Preparation of colloidal solution of Ferric chloride (condensation method). 3. Verification of the Schulze–Hardy Law (study the effect of electrolyte valency on the coagulation of colloidal solutions). 4. To verify the Freundlich's Adsorption isotherms. 5. Study of adsorption of Oxalic acid on charcoal and prove the validity of Langmuir's adsorption isotherms. 6. Preparation of colloidal solution of Aluminum hydroxide. 7. To study of Adsorption of Acetic Acid (HAc) on Activated Charcoal and Verification of Langmuir's Adsorption Isotherm. 8. Study of Tyndall Effect in Different Colloidal Systems (to observe light scattering and verify colloidal dispersion through the Tyndall effect). 9. Emulsification and Demulsification of Oil-Water Emulsions (study the formation of emulsions and the role of surfactants as emulsifying agents).			

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	**Contact Hours**
Lecture	45
Practical	25
Seminar/Journal Club	-
Small Group Discussion (SGD)	1
Self-directed Learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	1

Case/Project Based Learning (CBL)	-
Revision	2
Others If any:	-
Total Number of Contact Hours	**75**

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping of Assessment with COs:

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Quiz	✓	✓	✓	✓	✓
Viva-voce	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Laboratory assessment	✓	✓	✓	✓	✓
Practical Log Book/ Record Book	✓	✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓
Feedback Process	1. Student's Feedback				

References:

List of recommended books:

1. Adamson A.W. and Gast A., (1967) Physical Chemistry of Surfaces (Main text) (6th ed.), John Wiley & Sons Inc.
2. Berg, J.C. (2010). An Introduction to Interfaces & Colloids, Hackensack.
3. Evans D.F., Wenner Ström's, (1999) The Colloidal Domain, (2nd ed.), John Wiley & Sons Inc.
4. Giri, S; Bajpai, D.N.; Pandey, O.P. (1972) Practical Chemistry, S. Chand Limited.
5. Israelachvili, J.N., (2011) Intermolecular and Surface Forces, Elsevier Inc.
6. Kapoor K.L., (2015) Textbook of Physical Chemistry, Vol. 4, McGraw Hill Education (India) Private Limited, Chennai, India.
7. Khosla, B.D.; Garg, V.C.; Gulati, A. (2015), Senior Practical Physical Chemistry, R. Chand & Co.
8. Puri B.R., Sharma L.R. and Pathania M.S., (2020) Principles of Physical Chemistry, Vishal Publishing Co. Jalandhar, Punjab, India.
9. Singhal, A. (2009). Physical chemistry for the IIT JEE. Pearson Education India.

DSE-2Z (Applied Animal Sciences)

Name of the College (Department)	Akal College of Basic Sciences (Department of Zoology)
Name of the Program	B.Sc. (Hons. with Research) Life Sciences
Course Code	**0360142021**
Course Title	**Applied Animal Sciences**
Academic Year	II
Semester	IV
Number of Credits	4 (3+0+1)
Course Prerequisite	Students should have studied subjects of Biology at 12th level /Subjects of Zoology in UG 1st Year under multidisciplinary or honours program.
Course Synopsis	This course introduces students to key animal-based industries such as sericulture, apiculture, lac culture, aquaculture, poultry, and cattle management. It covers the life cycles and rearing of silkworms (*Bombyx mori* and *Antheraea mylitta*) and cocoon processing techniques. Apiculture includes bee species, hive culture, and economic uses of bee products. Lac culture explores the life cycle of *Laccifer lacca*, lac processing, and its commercial importance. Aquaculture topics include pond management, polyculture, cage culture, and fish preservation. Poultry breeding and egg processing are studied along with cattle reproductive technologies. The course blends theory with practical skills for sustainable livestock and aquaculture practices.

Course Outcomes:

At the end of the course students will be able to:

CO1	Identify and explain the life cycles and rearing practices of commercially important insects like silkworms, honey bees, and lac insects.
CO2	Demonstrate understanding of cocoon, lac, and honey processing techniques and evaluate their economic significance.
CO3	Analyze and apply methods of pond management and aquaculture systems, including integrated and sewage-fed fish farming.
CO4	Develop practical knowledge of poultry breeding and management, including broiler care and egg preservation methods.
CO5	Understand and evaluate cattle reproductive technologies such as artificial insemination and estrus synchronization for improved livestock production.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	2	2	1	1	2	2	1	2	2	2	2	2
CO2	2	2	1	1	2	2	2	2	2	2	2	2
CO3	2	2	1	1	2	2	2	2	2	2	2	2
CO4	2	2	1	1	2	2	2	2	2	2	2	2
CO5	2	2	1	1	2	2	2	2	2	2	2	2
Average	**2**	**2**	**1**	**1**	**2**	**2**	**1.8**	**2**	**2**	**2**	**2**	**2**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

Course Content:				
L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**CL (Hours/Week)**	**Total Hour/Week**
3 (3 Hours/ Week)	0	1 (2 Hours/ Week)	0	5 (Hours/ Week)
Unit	**Content & Competencies**			
1. Sericulture (Lecture Hours = 11)	Sericulture- Types of silkworm. Life cycle and rearing of mulberry silkworm, *Bombyx mori*. Life cycle and rearing of non-mulberry silkworm (Tasar), *Antheraea mylitta* ; Brief idea of coccon processing for silk fabric- coccon boiling, reeling, rereeling, winding, doubling, twisting and weaving.			
2. Apiculture (Lecture Hours = 12)	Apiculture- Types of honey bees. Life cycle, culture, movable frame hive, bee product and its economic importance. Lac culture- Lac insect, *Laccifer lacca*- Life cycle, lac processing, lac products and economic importance.			
3. Aquaculture (Lecture Hours = 11)	Site selection and construction, pre stocking and post stocking management of nursery, rearing and stocking ponds. Brief study of freshwater aquaculture system. Polyculture, cage culture, sewage fed fish culture, integrated fish farming. Fish products and by-products, and fish preservation.			
4. Poultry Farming & Animal Husbandry (Lecture Hours = 11)	Principles of poultry breeding, management of breeding stock and broilers, processing and preservation of eggs. Preservation and artificial insemination in cattle. Induction of early puberty and synchronization of estrus cycle in cattle.			
5. Practical Component (Lab Hours = 30)	**Any 5 practical's from the below mentioned list:** 1. Identification and study of locally available beneficial insects of economic importance. 2. Practical observation and report on poultry farm visit. 3. Study tour to apiary unit for understanding apiculture practices. 4. Practical observation and report on aquaculture practices at farmer's field. 5. Visit to University campus dairy farm: Practical observation and report preparation. 6. Observation and report on vermicomposting unit established at University campus. 7. Study tour to sericulture unit for understanding sericulture practices.			

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	45
Practical	25
Seminar/Journal Club	-
Small Group Discussion (SGD)	1
Self-directed Learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	1
Case/Project Based Learning (CBL)	-
Revision	2
Others If any:	-
Total Number of Contact Hours	**75**

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)

Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Quiz	✓	✓	✓	✓	✓
Viva	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Laboratory assessment	✓	✓	✓	✓	✓
Practical Log Book/ Record Book	✓	✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓
Feedback Process	Student's Feedback				

References:	List of recommended books:
	1. Banu, M.G. (2023). Poultry production manual. 2. Van Emden, H. F. (2013). Handbook of agricultural entomology. John Wiley & Sons. 3. Dunham R.A. (2023). Aquaculture and fisheries biotechnology genetic approaches. CABI publications, U.K. 4. Hafez, E.S.E. (2013). Reproduction in farm animals. Lea & Fabiger Publisher. 5. Téllez-Isaías, G. (2023). Poultry farming: New perspectives and applications. BoD–Books on Demand. 6. Yucel, B., & Taskin, T. (2018). Animal husbandry and nutrition. BoD–Books on Demand.

SEMESTER – IV

Sr. No.	Course Category	Course Code	Course Title	Credits L+T+P	Semester	Offering Department
1	GE-3Z	0360043031	Aquatic Biology	3+0+1	IV (Even)	Zoology

GE-3Z (Aquatic Biology)

Name of the College (Department)	Akal College of Basic Sciences (Department of Zoology)
Name of the Program	
Course Code	**0360043031**
Course Title	**Aquatic Biology**
Academic Year	II
Semester	IV
Number of Credits	4 (3+0+1)
Course Prerequisite	Students should have basic understanding and interest in subject of Physical Sciences.
Course Synopsis	This course introduces major aquatic biomes, including freshwater and marine ecosystems. It covers lake origin, classification, morphometry, and physico-chemical properties like temperature and dissolved gases. Students will study nutrient cycles (nitrogen, phosphorus, sulfur) and their ecological roles. Stream development and adaptations of hill stream fishes are explored in detail. Marine topics include salinity, deep-sea adaptations, coral reefs, and seaweeds. The course also addresses aquatic pollution, eutrophication, conservation laws, sewage treatment, and water quality assessment.

Course Outcomes:

At the end of the course students will be able to:

CO1	Identify and describe various aquatic biomes, including freshwater and marine ecosystems, and explain their ecological significance.
CO2	Analyze lake ecosystems by understanding their origin, classification, morphometry, thermal stratification, and physico-chemical properties.
CO3	Evaluate nutrient cycling processes (nitrogen, phosphorus, sulfur) in aquatic systems and assess their role in ecosystem functioning.
CO4	Examine stream and marine adaptations, including those of hill stream fishes and deep-sea organisms, and understand the dynamics of coral reefs and seaweeds.
CO5	Assess the impact of aquatic pollution and apply knowledge of conservation strategies, nvironmental laws, water quality measures (BOD, COD), and sewage treatment techniques for sustainable aquatic ecosystem management.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1												
CO2												
CO3												
CO4												

CO5												
Average												
1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation												

Course Content:				
L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**CL (Hours/Week)**	**Total Hour/Week**
3 (3 Hours/ Week)	0	1 (2 Hours/ Week)	0	5 (Hours/ Week)

Units	**Content & Competencies**
1. Aquatic Biomes (Lecture Hours = 11)	Introduction of aquatic biomes: Freshwater ecosystem (lakes, wetlands, streams and rivers), Estuaries, Intertidal zones, oceanic pelagic zones and marine benthic zones.
2. Freshwater Biology (Lecture Hours = 12)	Lakes: Origin and classification, lake as an ecosystem, lake morphometery. Physico-chemical characteristics: Light, temperature, thermal stratification. Dissolved solids: Carbonate, bicarbonates, phosphates and nitrates, turbidity, dissolved gases (oxygen and carbon dioxide). Nutrient cycles in lakes (nitrogen, sulphur and phosphorus). Streams: Different stages of stream development, physico-chemical environment. Adaptations of hill stream fishes.
3. Marine Biology (Lecture Hours = 11)	Salinity and density of sea water, continental shelf, adaptations of deep sea organisms. Coral reefs and sea weeds.
4. Management of Aquatic resources (Lecture Hours = 11)	Aquatic pollution: Agricultural, industrial, sewage, thermal and oil spills. Eutrophication, management and conservation (legislations), sewage treatment and water quality assessment (BOD & COD).
5. Practical Component (Lab Hours = 30)	1. Determine the area of a lake using graphimetric and gravimetric methods. 2. Identify the important macrophytes, phytoplanktons and zooplanktons present in lake ecosystem. 3. Determine the amount of turbidity/transparency, dissolved oxygen, free CO_2 and alkalinity (Carbonates and bicarbonates) in water sample collected from a nearby water body. 4. Instruments used in limnology (Secchi disk, Van Dorn Bottle, Conductivity meter, Turbidity meter, PONAR, grab sampler) and their significances 5. A project report on a visit on a sewage treatment plant/ marine bio reserve/ fisheries institute.

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	**Contact Hours**
Lecture	45
Practical	25
Seminar/Journal Club	-
Small Group Discussion (SGD)	1
Self-directed Learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	1
Case/Project Based Learning (CBL)	-

Revision	2
Others If any:	-
Total Number of Contact Hours	**75**

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	√	√	√	√	√
Viva	√	√	√	√	√
Assignment / Presentation	√	√	√	√	√
Professional Activity	√	√	√	√	√
Clinical Assessment	√	√	√	√	√
Practical Log Book/ Record Book	√	√	√	√	√
Class Tests	√	√	√	√	√
University Examination	√	√	√	√	√

Feedback Process	Student's Feedback

References:	List of recommended books:
	1. Ananthakrishnan, T. N. (1982). Bioresources ecology. 2. Cole, G. A., & Weihe, P. E. (2015). Textbook of limnology. Waveland Press. 3. Odum, E. P., & Barrett, G. W. (2005). Fundamentals of ecology (5th ed.). Belmont, CA: Thomson Brooks/Cole. 4. Pawlowski, L. (Ed.). (1982). Physicochemical Methods for Water and Wastewater Treatment (Vol. 19). Elsevier. 5. Pawlowski, L. (Ed.). (1982). Physicochemical Methods for Water and Wastewater Treatment (Vol. 19). Elsevier. 6. Wetzel, R. (2001). Limnology (3rd ed.) Lake and River Ecosystems.

SEMESTER – IV

Sr. No.	Course category	Course Code	Course Title	Credits L+T+P	Semester	Offering Department
1	SEC-3B	0310044021	Plant Identification Techniques	1+0+1	Even (IV)	Botany
2	VAC-1C	0320046011	Science and society	1+0+1	Even (IV)	Chemistry & Biochemistry
3	AEC-4B	0310045021	Environmental Science – II	1+0+1	Even (IV)	Botany

SEC-3B (Plant Identification Techniques)

Name of the College (Department)	Akal College of Basic Sciences (Department of Botany)
Name of the Program	
Course Code	**0310044021**
Course Title	**Plant Identification Techniques**
Academic Year	II
Semester	IV
Number of Credits	2 (1+0+1)
Course Prerequisite	Students should have basic understanding and interest in subject of Plant Sciences.
Course Synopsis	This course provides an overview of plant identification techniques and their significance in fields such as ecology, agriculture, and horticulture. Students will learn basic plant morphology, including roots, stems, leaves, flowers, fruits, and seeds, and gain an introduction to botanical nomenclature and taxonomy. The course covers tools and resources for plant identification, such as field guides, keys, and online databases, and emphasizes the identification of plant families based on morphological characteristics. Students will also learn to use dichotomous keys and interpret plant identification guides and taxonomic literature. Hands-on practice includes the use of dissecting tools and microscopes, family key usage, plant description, and dissection of inflorescence and floral characters.

Course Outcomes:

At the end of the course students will be able to:

CO1	Recognize the significance of plant identification in various fields such as ecology, agriculture, and horticulture.
CO2	Gain a comprehensive understanding of basic plant morphology, including roots, stems, leaves, flowers, fruits, and seeds, along with an introduction to botanical nomenclature and taxonomy.
CO3	Become adept at using tools and resources for plant identification, including field guides, keys, and online databases, and will learn to interpret plant identification guides and taxonomic literature.
CO4	Identify plant families based on morphological characteristics, focusing on families such as Lamiaceae, Asteraceae, Malvaceae, Asclepiadaceae, Apocynaceae, and Poaceae, using dichotomous keys.
CO5	Develop practical skills through hands-on practice with dissecting tools and microscopes, using family keys, describing plants, and dissecting inflorescence and floral characters.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5

CO1												
CO2												
CO3												
CO4												
CO5												
Average												
1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation												

Course Content:				
L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**CL (Hours/Week)**	**Total Hour/Week**
1(Hours/Week)	0	2(Hours/Week)	0	3(Hours/Week)

Unit	**Content &**
Unit-1 (4 Hours)	Overview of plant identification techniques. Importance of plant identification in various fields (ecology, agriculture, horticulture, etc.)
Unit-2 (4 Hours)	Basic plant morphology: roots, stems, leaves, flowers, fruits, and seeds. Introduction to botanical nomenclature and taxonomy. Tools and resources for plant identification (field guides, keys, online databases, etc.).
Unit-3 (4 Hours)	Identification of plant families based on morphological characteristics (Lamiaceae, Asteraceae, Malvaceae, Asclepideaceae, Apocynaceae, Poaceae).
Unit-4 (3 Hours)	Use of dichotomous keys. Interpretation of plant identification guides and taxonomic literature.
Field Experiments (30 Hours)	1. Hands-on practice with dissecting tools and microscopes. 2. Use of family key. 3. Description of plant/s. 4. Dissection of inflorescence and floral characters.

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	**Contact Hours**
Lecture	15
Practical	26
Seminar/Journal Club	-
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	-
Problem Based Learning (PBL)	-
Case/Project Based Learning (CBL)	-
Revision	2
Others If any:	-
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	√	√	√	√	√
Viva	√	√	√	√	√
Assignment / Presentation	√	√	√	√	√
Professional Activity	√	√	√	√	√
Laboratory Assessment	√	√	√	√	√
Practical Log Book/ Record Book	√	√	√	√	√
Class Tests	√	√	√	√	√
University Examination	√	√	√	√	√

Feedback Process	1. Student's Feedback

References:	List of recommended books:
	1. Manton WP. 2022. Field Botany: A Hand-book for the Collector Containing Instructions for Gathering and Preserving Plants and The Formation of The Herbarium. Legare Street Press, Hungerford (UK). 2. Elpel TJ. 2013. Botany in a Day: The patterns Methods of Plant Identification (The herbal Field Guide to Plant Families of North America). HOPS Press, Montana (USA). 3. Hait G. 2023. Field manual of plant taxonomy. Global Net Publication, New Delhi (India). 4. Sammbamurty AVSS. 2007. A Dictionary of Botanical Terms. CBS Publishers & Distributors, New Delhi (India).

VAC-1C (Science and Society)

Name of College and (Department)	Akal College of Basic Sciences (Department of Chemistry and Biochemistry)
Name of the Program	
Course Code	**0320046011**
Course Title	**Science and society**
Academic Year	II
Semester	IV
Number of Credits	2 (1+0+1)
Course Prerequisite	-
Course Synopsis	The main goal is to encourage students for scientific temper. The course also uses a variety of examples and case studies to raise awareness about basic scientific ideas that are significant to our everyday lives. The course will create an awareness regarding important revolutions for welfare of society.

Course Outcomes:
At the end of the course students will be able to:

CO1	Students will gain a fundamental understanding of scientific methods.
CO2	Students will learn scientific advancement that has contributed significantly to the growth of human society from ancient times to the present day.
CO3	To help students to make educated decisions concerning technology advancements and their possible effects on society.
CO4	Students will also learn a close relation between science and society.
CO5	Awareness regarding important revolutions for welfare of society.

Mapping of Course Outcomes (COs) to Program Outcomes (POs)& Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1												
CO2												
CO3												
CO4												
CO5												
Average												

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	CL (Hours/Week)	Total Hour/Week

1	0	2		3
Unit	**Content & Competencies**			
1. Sociology of Science (Lecture Hours = 3)	Scope and importance; the Nature of Science. Pure vs. Applied Science; Relationship between Science and Technology; Science as a Social System.			
2. Ethos of Science (Lecture Hours = 3)	Scientific Temper; Ethics and Professionalism in Scientific Research; Social Aspects of Rise and Development of Science; Political Economy of Science & Technology.			
3. Science, Technology and Traditional Practices (Lecture Hours = 4)	Water harvesting structures and Practices; Construction, architecture and design - use of natural environment-friendly designs and materials; Agriculture including domestication of plants and animals.			
4. Science and Technology in Modern Times (Lecture Hours = 5)	Public Health: Nutrition, Hygiene, Physical and Mental Health, Vaccines and Antibiotics, Anti-microbial resistance; Food Security: Green Revolution, White Revolution; IT Revolution, E-Governance; Clean Energy, Renewable Energy; Space Science and Exploration; Evolution, Ecology and Environment.			
5. Practical component (Lab Hours = 30)	1. Visits to science laboratories in the University or neighbouring Institute. 2. Visit to science museums or planetarium. 3. Visits to botanical gardens/apiary/mushroom production unit/ waste management unit and nature walks. 4. To estimate the acidic or basic nature of fruit juices, soap, carbonated (using pH strips or pH meter). 5. To know the science of splitting colours from white light.			

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	**Contact Hours**
Lecture	15
Practical	26
Seminar/Journal Club	-
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	-
Problem Based Learning (PBL)	-
Case/Project Based Learning (CBL)	-
Revision	2
Others If any:	-
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	✓	✓	✓	✓	✓
VIVA	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Clinical assessment					
Clinical/Practical Log Book/ Record Book					
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓
Feedback Process	1. Student's Feedback				
References:	(List of reference books)				
	1. Barber, B. (1952). Science and the Social Order, New York: Free Press. 2. Gaillard, J. (1991). Scientists in the Third World, Lexington: Kentucky University Press. 3. Gaillard, J., Krishna V.V. and Waast R. (Eds.). (1997). Scientific Communities in the Developing World, New Delhi: Sage. 4. William. (1962). Scientists in Industry, Berkley: University of California Press. 5. Mallik, S.C. (1971). Management and Organization of Indian Universities, Simla: Indian Institute of Advanced Study. 6. Kumar, D. (2023). Science and society in modern India. Cambridge University Press. 7. Chattopadhyaya, D. (1978). Science and society in ancient India (Vol. 22). John Benjamins Publishing.				

AEC-4B (Environmental Science-II)

Name of the Department	Botany
Name of the Program	
Course Code	**0310045021**
Course Title	**Environmental Science - II**
Academic Year	II
Semester	IV
Number of Credits	2 (1+0+1)
Course Prerequisite	
Course Synopsis	Environmental conservation has become a global concern nowadays. The Environmental Studies includes an integration of multiple fields to understand the current environmental issues. Every global citizen must have an in-depth understanding of various environmental problems and their possible solutions so that our mother earth can be saved. Environment conservation is an integral part of Indian civilization and culture also. This course has been designed to train the students for adopting eco-friendly practices and encourage others to do so in order to promote the sustainable development.

Course Outcomes:
At the end of the course students will be able to:

CO1	Attain comprehensive information about global environmental issues and international strategies to combat those issues.
CO2	Adopt the pollution mitigation strategies in life and educate others about these strategies.
CO3	Gain an in-depth knowledge about important environmental laws in India.
CO4	Comprehend the role of an individual as well as the communities in disaster management.
CO5	Understand the issues related to human communities and their possible solutions.

Mapping of Course Outcomes (COs) to Program Outcomes (POs)& Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1												
CO2												
CO3												
CO4												
CO5												
Average												

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	CL (Hours/Week)	Total Hour/Week
1		2		3

Unit	Content & Competencies
1.Environmental Pollution (Lecture Hours = 5)	Definition, causes, effects and control measures of air, water, soil, marine, noise and thermal pollutions. Water and air quality standards. Solid waste Management: causes, effects and control measures of urban, industrial, biomedical, hazardous and E-waste. Nuclear hazards and health risks Role of an individual in prevention of pollution.
2. Global environmental threats and strategies to combat (Lecture Hours = 4)	Global environmental issues: causes, impacts and international agreements to combat climate change, global warming, acid rain and ozone layer depletion. Environmental laws: Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation. Environmental ethics: Issues and possible solutions.
3.Human communities and the environment (Lecture Hours =3)	Environmental movements: Chipko movement, Appiko movement, Silent valley movement, Bishnois of Rajasthan. Environmental justice: National Green Tribunal and its importance Diaster management: causes, impacts and mitigation measures of floods, earthquakes, cyclones and landslides.
4. Sustainable solutions and public awareness (Lecture Hours =3)	Stubble burning: meaning and reason for stubble burning, In-situ and ex-situ management of stubble, environmental and health effects of stubble burning, policies to control stubble burning. Environmental communication and public awareness: case studies (e.g. , CNG vehicles in Delhi, Swachh Bharat Abhiyan etc.)
5. Practical Component (Lecture Hours = 30)	1. Develop and maintain vermicompost bins using biodegradable waste in the university. 2. Assessment of carbon foot-print of different countries using online databases and mathematical tools. 3. Visit to marginalized localities for environmental education and environmental awareness 4. Formulation of questionnaire/online surveys for assessment of the impact of environmental education. 5. Visit to any developmental project affected locality for assessing the impacts of economic development on human lives. 6. Correlation analysis of human population growth and impacts on the environment and human health. 7. Depict temperature/precipitation trend of a given study area using online data. 8. Formulate questionnaire/online surveys for assessment of the impact of climate change on people. 9. Assess Nationally Determined Contributions (NDCs) of developed and developing countries. 10. Identify carbon footprint of your college/home/locality (refer wwf@envis.nic.in). 11. Analyze the status of at least 3 sustainable development goals in your neighbourhood and write a proposal to help achieve them at global standard. 12. Visit to a solid waste management plant in the University campus. 13. Determine water quality of a given location using rapid pollution monitoring kits. 14. Assess air quality index (AQI) of any location using real-time air quality parameters. 15. Visit to a wastewater treatment plant in the University campus.

Note: The course plan included as an annexure has the details of each unit with the number of hours and mode of delivery and pedagogical approach.

Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	15
Practical	26
Seminar/Journal Club	
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	
Problem Based Learning (PBL)	
Case/Project Based Learning (CBL)	
Revision	2

Others If any:	-
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	
Viva-voce	
Class Tests	University Examination
Mid Term Practical Examination	
Quiz	Multiple Choice Questions (MCQ)
Seminars/ Presentation	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
Professional Activity	
Assignment	

Mapping of Assessment with Cos

Nature of Assessment	CO1	CO2	CO3	CO4	CO5
Quiz	✓	✓	✓	✓	✓
VIVA	✓	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓	✓
Professional Activity	✓	✓	✓	✓	✓
Clinical assessment					
Clinical/Practical Log Book/ Record Book	✓	✓	✓	✓	✓
Class Tests	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓

Feedback Process	1. Student's Feedback
References:	List of reference books:
	1. Divan, S. and Rosencranz, A. (2002). Environmental Law and Policy in India: Cases, Material & Statute. Oxford University Press, India 2. Gadgil, M. and Guha, R. (1993). This Fissured Land: An Ecological History of India. University of California Press, Berkeley, USA 3. Kumar, R and Sharma, D (2016). Environmental Studies. Trueman Book Company, Jalandhar. 4. McCully, P. (1996). Rivers no more: the environmental effects of dams, In : Silenced Rivers: The Ecology and Politics of Large Dams. Zed Books, New York, USA 5. Odum, E.P., Odum, H.T., and Andrews, J. (1971). Fundamentals of Ecology. Saunders, Philadelphia, USA. 6. Raven, P.H, Hassenzahl, D.M., Hager, M.C, Gift, N.Y., and Berg, L.R. (2015). Environment. Wiley Publishing, USA. 7. Singh, J.S., Singh, S.P., and Gupta, S.R. (2017). Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.