DEPARTMENT OF EDUCATION

Syllabus

For

Integrated Teacher Education Programme (ITEP)
B.Sc. B.Ed. (Secondary Level)

Hemvati Nandan Bahuguna Garhwal (Central) University
Srinagar, Uttarakhand

2024

Integrated Teacher Education Programme (ITEP) B.Sc. B. Ed.

Course-wise Detail

ITEP (B.Sc. B.Ed.)								
Sub/Sem	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**
Education								
Foundation	**EFC-101** Evolution of Indian Education (Cr-4)		**EFC-301** Child Development and Educational Psychology (Cr-4)	**EFC-401** Philosophical and Sociological Perspectives of Education-I (Cr-4)	**1. EFC-501** Inclusive Education (Cr-2)	**1. EFC-601** Assessment and Evaluation (Cr-2) **2. EFC-602** Curriculum Planning and Dev. (Cr-2)	**1. EFC-701** Education Policy Analysis (Cr-2)	**1. EFC-801** Philosophical and Sociological Perspectives of Education-II(Cr-4) **2. EFC-802** Perspectives on School Leadership and Management (Cr-2) **3. EFC-803** One Elective (Cr4
Stage Specific			**ESSCCPC-302** Stage-Specific Content -cum-Pedagogy Courses (Cr-4) Basics of Pedagogy at Secondary Stage (Cr-4)	**ESSCCPC-402** Stage-Specific Content -cum-Pedagogy Courses (Cr-4) (Any Two) A. Content cum Pedagogy of Mathematics at Secondary Stage – Course (I) (Cr-2) B. Content cum Pedagogy of Physics at Secondary Stage - Course (I) (Cr-2) C. Content cum Pedagogy of Chemistry at Secondary Stage - Course (I) (Cr-2)	**ESSCCPC-502** Stage-Specific Content -cum-Pedagogy Courses (Cr-4) (Any Two) A. Content cum Pedagogy of Mathematics at Secondary Stage – Course (II) (Cr-2) B. Content cum Pedagogy of Physics at Secondary Stage - Course (II) (Cr-2) C. Content cum Pedagogy of Chemistry at Secondary Stage - Course (II) (Cr-2)	**ESSCCPC-603** Stage-Specific Content -cum-Pedagogy Courses (Cr-4) (Any Two) A. Content cum Pedagogy of Mathematics at Secondary Stage – Course (III) (Cr-2) B. Content cum Pedagogy of Physics at Secondary Stage - Course (III) (Cr-2) C. Content cum Pedagogy of Chemistry at Secondary Stage - Course (III) (Cr-2)		

				D. Content cum Pedagogy of Zoology at Secondary Stage - Course (I) (Cr-2) E. Content cum Pedagogy of Botany at Secondary Stage - Course (I) (Cr-2)	D. Content cum Pedagogy of Zoology at Secondary Stage - Course (II) (Cr-2) E. Content cum Pedagogy of Botany at Secondary Stage - Course (II) (Cr-2)	D. Content cum Pedagogy of Zoology at Secondary Stage - Course (III) (Cr-2) E. Content cum Pedagogy of Botany at Secondary Stage - Course (III) (Cr-2)		
Ability Enhancement & Value-Added Courses	**1. EAEVAC-102** Language-I (as per the 8th schedule of the Constitution of India) (Cr-4) **2. EAEVAC-103** Art Education (Visual) (Cr-2) **3. EAEVAC-104** Understanding India (India Ethos and Knowledge System) (Cr-2) **4. EAEVAC-105** Understanding and Connecting with the Environment (Cr-2)	**1. EAEVAC-201** Language-II (Other than Language-I) (Cr-4) **2. EAEVAC-202** Understanding India (India Ethos and Knowledge System) (Cr-2) **3. EAEVAC-203** Teacher and Society (Cr-2)		**1. EAEVAC-403** Citizenship Education, Sustainability and Environment Education (Cr-2)	**1. EAEVAC-503** ICT in Education (Cr-2)	**1. EAEVAC-604** Mathematical & Quantitative Reasoning (Cr-2)	**1. EAEVAC-702** Sports, Nutrition and Fitness (Cr-2)	**1. EAEVAC-804** Yoga & Understanding Self (Cr-2) **2. EAEVAC-805** Art Education (Visual) (Cr-2)
School Exp					**ESEC-504** Pre-internship Practice (Cr-2)	**1. ESEC-605** School Observation (Cr-2) **2. ESEC-606** Creating Teaching Learning Material (Cr-2)	**1. ESEC-703** School-Based Research Project (Cr-2) **2. ESEC-704** Internship in Teaching (Cr-10)	**1. ESEC-805** Post Internship (Cr-2)
Community Engagement					**ECESC-505** Community Engag. and Services (Cr-2)			
Disciplinary								

Core 1 (Major)	**DCMJ-1 (Cr-6)**	**DCMJ-2 (Cr-6)**	**DCMJ-3 (Cr-6)**	**DCMJ-4 (Cr-6)**	**DCMJ-5 (Cr6)**	**DCMJ-6 (Cr-6)**		
Botany	**DCBOT-101** Diversity of Lower Plants (Theory and Practical) (Cr-6)	**DCBOT-201** Microbiology And Plant Pathology (Cr-6)	**DCBOT-301** Plant Physiology and Biochemistry (Theory and Practical) (Cr-6)	**DCBOT-401** Plant Taxonomy and Plant Embryology (Theory and Practical) (Cr-6)	**DCBOT-501** DSE 1-Biotechnology and Genetic Engineering Theory (Cr-4) and Practical (Cr-2)	**DCBOT-601** Biodiversity and Environmental Management Theory (Cr-4) and Practical (Cr-2)		
Botany Skill	**DCBOT-102** Mushroom Cultivation Technology (Cr-2)	**DCBOT-202** Floriculture (Cr-2)						
Zoology	**DCZOO-101** Animal Diversity-I Theory (Cr-4) and Practical (Cr-2)	**DCZOO-201** Animal Diversity-II Theory (Cr-4) and Practical (Cr-2)	**DCZOO-301** Elementary Cell Biology & Molecular Biology Theory (Cr-4) and Practical (Cr-2)	**DCZOO-401** Physiology and Elementary Biochemistry Theory (Cr-4) and Practical (Cr-2)	**DCZOO-501** **DSE (Anyone)** DSE-1. Applied Zoology DSE-2. Wildlife Conservation & Management DSE-3. Principles of Genetics & Evolutionary Biology DSE-4. Animal Behaviour & Endocrinology DSE-5. Introduction to Developmental Biology DSE-6. Basics of Biotechnology Theory (Cr-4) and Practical (Cr-2)	**DCZOO-601** **DSE (Anyone)** DSE-1. Applied Zoology DSE-2. Wildlife Conservation & Management DSE-3. Principles of Genetics & Evolutionary Biology DSE-4. Animal Behaviour & Endocrinology DSE-5. Introduction to Developmental Biology DSE-6. Basics of Biotechnology Theory (Cr-4) and Practical (Cr-2)		
Zoology Skill Students will elect one course each in the I & II Semesters	**DCZOO-102** SZ-1. Laboratory Techniques in Biology SZ-2. Basic Instrumentation SZ-3. Public Health and Hygiene	**DCZOO-202** SZ-1. Laboratory Techniques in Biology SZ-2. Basic Instrumentation SZ-3. Public Health and Hygiene						

	SZ-4. Aquarium Fish Keeping SZ-5. Medical Diagnostics SZ-6. Bioinformatics	SZ-4. Aquarium Fish Keeping SZ-5. Medical Diagnostics SZ-6. Bioinformatics						
Physics	**DCPHY-101** Mechanics and Properties of Matter Theory (Cr-4) and Practical (Cr-2)	**DCPHY-201** Electricity and Magnetism Theory (Cr-4) and Practical (Cr-2)	**DCPHY-301** Heat and Thermodynamics Theory (Cr-4) and Practical (Cr-2)	**DCPHY-401** Waves and Optics Theory (Cr-4) and Practical (Cr-2)	**DCPHY-501** Modern Physics Theory (Cr-4) and Practical (Cr-2)	**DCPHY-601** Quantum Mechanics Theory (Cr-4) and Practical (Cr-2)		
Physics Skill	**DCPHY-102** Basic Electronics (Cr-2)	**DCPHY-202** Waves and Oscillations (Cr-2)						
Chemistry	**DCCHE-101** Inorganic Chemistry -I Organic Chemistry- I Theory (Cr-4) and Practical (Cr-2)	**DCCHE-201** Physical Chemistry-I Organic Chemistry-II Theory (Cr-4) and Practical (Cr-2)	**DCCHE-301** Physical Chemistry-II Organic Chemistry - III Theory (Cr-4) and Practical (Cr-2)	**DCCHE-401** Inorganic Chemistry-II Physical Chemistry-III Theory (Cr-4) and Practical (Cr-2)	**DCCHE-501** Students can opt for any one 1. Analytical Methods in Chemistry 2. Polymer Chemistry 3. Green Chemistry Theory (Cr-4) and Practical (Cr-2)	**DCCHE-601** Students can opt for any one 1. Instrumental Methods of Chemical Analysis 2. Organometallics, Bio-inorganic, Polynuclear Hydrocarbon, UV and IR Spectroscopy 3. Molecules of Life Theory (Cr-4) and Practical (Cr-2)		
Chemistry Skill	**DCCHE-102** Basic Analytical Chemistry I OR Green Methods in Chemistry (Cr-2)	**DCCHE-202** Basic Analytical Chemistry II or Pesticidal Chemistry (Cr-2)						
Mathematics	**DCM-101** Differential Calculus Theory-6 Cr	**DCM-201** Differential Equations Theory-6 Cr	**DCM-301** Real Analysis Theory- 5Cr and Tutorial-1Cr	**DCM-401** Abstract Algebra Theory- 5Cr and Tutorial-1Cr	**DCM-501** Linear Algebra Theory-6 Cr	**DCM-601** Complex Analysis Theory-6 Cr		
Mathematics Skill	**DCM-102** Integral Calculus (Cr-2)	**DCM-202** Vector calculus (Cr-2)						

Core 2 (Minor)		**DCMN-1 (6)**	**DCMN-2 (6)**	**DCMN-3 (6)**				
Botany		**DCBOT-201** Microbiology And Plant Pathology (Cr-6)	**DCBOT-301** Plant Physiology and Biochemistry (Theory and Practical) (Cr-6)	**DCBOT-401** Plant Taxonomy and Plant Embryology (Theory and Practical) (Cr-6)				
Zoology		**DCZOO-201** Animal Diversity-II Theory (Cr-4) and Practical (Cr-2)	**DCZOO-301** Elementary Cell Biology & Molecular Biology Theory (Cr-4) and Practical (Cr-2)	**DCZOO-401** Physiology and Elementary Biochemistry Theory (Cr-4) and Practical (Cr-2)				
Physics		**DCPHY-201** Electricity and Magnetism Theory (Cr-4) and Practical (Cr-2)	**DCPHY-301** Heat and Thermodynamics Theory (Cr-4) and Practical (Cr-2)	**DCPHY-401** Waves and Optics Theory (Cr-4) and Practical (Cr-2)				
Chemistry		**DCCHE-201** Physical Chemistry- I Organic Chemistry-II Theory (Cr-4) and Practical (Cr-2)	**DCCHE-301** Physical Chemistry-II Organic Chemistry - III Theory (Cr-4) and Practical (Cr-2)	**DCCHE-401** Inorganic Chemistry-II Physical Chemistry-III Theory (Cr-4) and Practical (Cr-2)				
Mathematics		**DCM-201** Differential Equations Theory-6 Cr	**DCM-301** Real Analysis Theory- 5Cr and Tutorial-1Cr	**DCM-401** Abstract Algebra Theory- 5Cr and Tutorial-1Cr				
SEC			**SEC- 303** Life Skills and Personality Dev. (Cr-2)					
Interdisciplinary Research Project & Dissertation					**RM-506 Introduction to Research - 4 Cr**	**RM 607 Academic Writing 2 Cr**	**Dissertation -I 6 Cr Or Interdisciplinary Research 4Cr Synopsis Preparation 2Cr**	**Dissertation -II 6 Cr Or Paper Publication 4Cr Entrepreneurship Education 2Cr**

Total Credit	**22**	**22**	**22**	**22**	**22**	**22**	**22**	**22**

The students may complete one MOOC of 6 to 8 weeks in the interdisciplinary area in any semester. The certificate of completion of the MOOC should be submitted in the eighth semester.

Hemvati Nandan Bahuguna Garhwal University

Dept of Education

ITEP Curriculum

Semester-I

(B.Sc. B.Ed.)

Two-Week Student Induction Programme			
S.N.	**Code**	**Courses**	**Credit**
1.	EFC-101	Evolution of Indian Education	4
2.	EAEVAC-102	Language 1 (as per the 8th schedule of the Constitution of India) (AEC)	4
3.	EAEVAC-103	Art (Performing and Visual) & Creative Expressions (AEC)	2
4.	EAEVAC-104	Understanding India (Indian Ethos and Knowledge Systems)	2
5.	EAEVAC-105	Understanding and Connecting with the Environment	2

FOUNDATIONS OF EDUCATION

EFC-101: Evolution of Indian Education

Credits: 4

101.1 About the Course

The course seeks to develop an understanding among student teachers of the evolution of education in India that would allow student teachers to locate themselves within the larger system of education. The course aims at orienting student teachers to the historical perspective of Indian education including the development and features of education in ancient India such as the Gurukuls, post-Vedic period, during Mauryan and Gupta empires, during colonial era and post-independence period, and future perspectives about education development in India, and progression from Education 1.0 to Education 4.0 etc. This course also provides an overview of the contribution of Indian thinkers to the evolution of the Indian Education system – Savitribai and Jyotiba Phule, Rabindranath Tagore, Swami Vivekananda, Mahatma Gandhi, Sri Aurobindo, Gijubhai Badheka, Pt. Madanmohan Malaviya, Jiddu Krishnamurti, Dr. Bhima Rao Ambedkar and others.

101.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- Discuss the genesis, vision, and evolution of education in ancient India to contemporary India.
- enable themselves to shape their educational perspective to act as an effective teacher.

UNIT - I

Ancient Indian Education: Vedic Period

A. Vision, objectives and salient features of the Vedic Education System.

B. Teaching and Learning Process.

C. Development of educational institutions: Finances and Management.
D. Famous Educational Institutions and Guru-Shishya. Education at the time of the Epics: Ramayana and Mahabharata.

UNIT - II

Ancient Indian Education: Buddhist and Jain Period

A. Vision, objectives and salient features of the Buddhist and Jain Education System.
B. Teaching and Learning Process. Finance and Management of Educational Institutions.
C. Educational Institutions: Nalanda, Taxila, Vikramshila, Vallabhi, Nadia.
D. Famous Guru-Shishya.

UNIT - III

Post-Gupta Period to Colonial Period

A. Vision, objectives and brief historical development perspective.
B. Salient features of education in India.
C. Teaching and Learning Process.
D. Finance and management of educational institutions.

UNIT - IV

Modern Indian Education

A. Colonial Education in India: Woods Despatch, Macaulay Minutes and Westernisation of Indian Education
B. Shiksha ka Bhartiyakaran (Indigenous Interventions in Education)
(Bird's eye view of their contribution) Swadeshi and Nationalist attempts of educational reforms with special reference to the general contribution of Indian thinkers –

- Savitribai and Jyotiba Phule, Rabindranath Tagore, Swami Vivekananda, Mahatma Gandhi, Sri Aurobindo, Gijubhai Badheka.
- Pt. Madanmohan Malaviya, Jiddu Krishnamurti and Dr. Bhima Rao Ambedkar to the education systems of India.

UNIT - V

Education in Independent India

A. Overview of Constitutional values and educational provisions.
B. Citizenship Education: Qualities of a good citizen. Education for fundamental rights and duties.
C. Overview of 20th Century Committees, Commissions and Policies. UEE, RMSA, RTE Act 2009: Overview and impact.
D. NEP 2020: vision and implementation for a vibrant India.

101.3 Suggestive Practicum

1. Prepare a report highlighting educational reforms with special reference to school education in the light of NEP 2020.
2. Critically analyse the concept of a good citizen from the perspective of education for democratic citizenship.

3. Compare the vision, objectives, and salient features of education during different periods.
4. Working out a plan to develop awareness, attitude and practices related to Fundamental Rights or fundamental duties or democratic citizenship qualities, execute it in the class and write the details in the form of a report.
5. Sharing of student experiences (in groups) related to Indian constitutional values helps them to reshape their concept and enables them to develop vision, mission and objectives for a school and their plan to accomplish the objectives in the form of a group report.
6. Analyse the current educational strengths and weaknesses of one's own locality and write a critical report.
7. Visit places of educational significance and value centres and develop a project report.
8. Observation of unity and diversity in a social locality and matching it with unity and diversity in the class, and work out a plan for awareness for national-emotional integration for the class to develop awareness, attitudes, skills, and participatory values, execute it in the class and report the details.

101.4 Suggestive Mode of Transaction

The course content transaction will include the following:

- Planned lectures infused with multimedia /PowerPoint presentations.
- Small group discussion, panel interactions, small theme-based seminars, group discussions, cooperative teaching and team teaching, selections from theoretical readings, case studies, analyses of educational statistics and personal field engagement with educationally marginalised communities and groups, through focus group discussion, surveys, short-term project work, etc.
- Hands-on experience of engaging with diverse communities, children, and schools.

101.5 Suggestive Mode of Assessment

The assessment will be based on the tests and assignments.

Assessment and examinations will be conducted as per the criteria of HNBGU.

101.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the needs of the learners and the learning content.

EAEVAC-102: Language 1

(As per the 8th Schedule of the Constitution of India)

Credits:4

102.1 About the Course

Language has undeniable links with all kinds of learning. Language enables an individual to understand new concepts, exchange ideas and communicate thoughts with fellow beings. To appreciate fully the role of language in education, one must begin to develop a holistic perspective on language. Language needs to be examined in a multi-dimensional space, giving due importance to its structural, literary, sociological, cultural, psychological, and aesthetic aspects. The National Education Policy 2020 envisages imparting language skills

as part of holistic education. It lays thrust on the need to enhance linguistic skills for better cognitive development and the development of a rounded personality of the learners. This course aims to enable student teachers to enhance their ability to listen, speak, read, write and demonstrate linguistic skills in an effective manner. Linguistic skills - listening, speaking, reading, writing, speaking effectively - are fundamental to constructing knowledge in all academic disciplines, and. participating effectively in the world of work and creating sense in everyday life. Through this course, the students will be able to enhance proficiency in reading with comprehension, understanding, thinking, and conceptualising. The course seeks to enhance the critical thinking abilities and effective communication skills of student teachers. The course involves hands-on activities and practical sessions that help student teachers develop and use linguistic skills in a variety of situations.

102.2 Learning Outcomes

After completing the course, the student teachers will be able to:

- demonstrate knowledge and capacity for effective listening, speaking, reading, writing and critical thinking.
- recognise the link between language and cognition and use linguistic knowledge and skills for effective communication of ideas and thoughts.
- build interpersonal relationships and enhance social skills.

UNIT - I

Understanding Language, Communication and Cognition

A. Language and cognition: Definitions, characteristics and functions of language. Language, culture and society, language variation, language and dialect, Bi-/Multilingualism in India,

B. Language learning, translation, gestures, language skills (listening, speaking, reading, & writing). Language policy and language planning, language standardisation and the new-age technologies.

C. Nature and process of communication: principles, definition, and types of communication, formal and informal communication, verbal and non-verbal communication, Process of communication, barriers to communication, written and oral communication, Language as a means of communication and as a medium of cognition.

D. Context of communication, the role of decoder, face-to-face interaction, turn-taking, conversation, politeness principles, opening and closing, regional variation, social variation, and the standard language.

UNIT - II

Understanding Grammar

A. Classification of speech sounds and letters, stress, pitch, tone, intonation and juncture, parts of speech, identification of morphemes, word formation processes.

B. Sentences- simple, complex, and compound, semantics and pragmatics, lexical semantics, speech acts.

C. Production of speech sounds in languages; Suprasegmentals: stress, pitch, tone, intonation; Word formation processes; Sentence formation, semantics, and pragmatics.

D. Sound production in the language; coining new words, Speech acts.

UNIT - III

Reading Skills

A. Reading comprehension, types of reading, text, meaning and context.

B. Reading as an interactive process. Strategies for making students active readers and developing critical reading skills.

C. Understanding denotative and connotative aspects of a text, Vocabulary development through reading.

D. Features that make texts complex. Reading discipline-based texts.

UNIT - IV

Writing Skills

A. Speech versus writing; Types of writing.

B. Writing for specific purposes (essays, letters, and reports).

C. Language and style of writing; Dealing with new words (academic vocabulary building)

D. Summarising and Paraphrasing techniques.

UNIT - V

Speaking and Listening Skills

A. Speaking to learn and learning to speak; situational conversations and role plays; tasks/activities for developing speaking (speech, elocution, discussion, debate, storytelling, illustrations) and the impact of culture on speaking.

B. Presentation and speaking skills; Practising narrative skills; Body language, voice, and pronunciation; Creating interest and establishing a relationship with the audience.

C. Importance of listening. kinds of listening; Listening strategies. Need for modelling good listening behaviour.

D. Listening across the curriculum, note taking. Listening comprehension and Recorded speeches/texts; Understanding of various accents.

102.3 Suggestive Practicum

1. How do you interpret everyday life and reflect on what you read? Prepare a report.
2. Analyse a recorded video from the perspective of voice and pronunciation, and write a report.
3. Any activity assigned by the teacher.

102.4 Suggestive Mode of Transaction

Teaching this course will involve a mix of interactive lectures, tutorials, and practical involves such as discussion, role plays, projects, simulations, workshops, and language-awareness activities. The teaching intends deeper approaches to learning involving in-classroom discussion, developing the critical thinking/ problem solving abilities among the students and will also focus on situations where in our daily lives one would be performing tasks that involve a natural integration of language skills. The students are expected to read the assigned chapters/ articles before the session, and the course requires active participation from the students.

102.5 Suggestive Mode of Assessment

The assessment of the learner will be primarily based on the assessment of both linguistic and communicative skills using a battery of tests and test types, group work and projects. Assessment and examinations will be conducted as per the criteria of HNBGU.

102.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the needs of the learners and the learning content.

EAEVAC-103: Arts (Performing and Visual) and Creative Expressions

Exemplar 3 - Collage-Making

Credits: 2

103.1 About the Course

Engagement with various forms of art as self-expression and the need to develop sensibility to appreciate them have been an important concern in educational theory and practice. This concern is premised on the claim that forms of self-expression contribute immensely to the development of cognitive, affective and psycho-motor dimensions among children, as well as that through one or another art form, children come to explore ways of expressing themselves. Further, it is also the case that critical appreciation of art enables children to form judgments of a very special kind, namely, aesthetic judgment. This enables students as they grow into adults to have focused attention on making sense of and appreciating cultural productions.

Children enjoy artwork a lot. They explore and find meaning in artwork. Their psycho-motor skills develop through art. The huge element of socialisation is acquired through different forms of art. They get to know each other, understand each other, and make friends through art. They develop their peer group through getting involved in art forms. Learning to work with others is also achieved through art. It gives them space to think independently, create and reflect. It is one space where all three are involved- hand, head, and heart.

Therefore, educational practitioners that the students aim to be will need to bring an element of art into the practices that they engage in. To be able to do this, they need an appreciation of art in general, familiarity with one art form, and basic skills and capabilities to be creative and artful. Additionally, they should be familiar with some critical debates in art education, even if their work is in other subject areas.

To this end, students will do one course that aims to help them recognise and appreciate the *importance of aesthetic judgment*, *develop familiarity with an art form* and basic skills to be *creative and artful in their expressions*. Skills develop from practice. Therefore, hands-on training in doing art will be emphasised in this course. This course aims to help students develop a habit of performing skilful activities that are essentially aesthetic and artful, which is expected to contribute to other educational practices that they develop in other courses in the programme. Therefore, this course will explicitly relate this skill to activities that practitioners of education engage in, like teaching, development of teaching-learning material, and content of other subject areas, wherever possible.

Collage as a Visual Art Medium

A major aspect of college, and one that is sometimes overlooked, is the incredibly diverse array of materials and objects that can be used. Collecting interesting materials is an ongoing activity for artists and for those who teach college. But it is just as important for young people to hunt for and make decisions about materials they would like to incorporate into their work. All materials, and the alterations that artists make to them, are suggestive of ideas and concepts based on their surfaces, forms, textures, degree of transparency and opacity, colour, and other visual characteristics. Materials also connect us, through association and reference, to social and cultural worlds and places. What ideas might a scrap of newspaper, as a collage material, express? How might these meanings differ from those of, say, feathers? Or twigs? Or a thin piece of plastic cut out from a plastic bag?

Working with and creating artwork in Collage involves various aspects: selecting materials, manipulating materials, investigating materiality, closely observing materials, discovering possibilities, composing, designing the artwork, planning, finding solutions, applying solutions, thinking flexibility, decision-making, research, using imagination, expressing, taking creative risks, develop perseverance, and much more. Students will also be introduced to various aspects of art in education: The value of art and artmaking by itself, art's use as an instrument in education, social and moral dimensions of art, and the controversial perceptions around good art and bad art.

This course aims for students to understand the importance of aesthetics and art in education, the role art can play in education, and mainly to appreciate, understand and gain skills with the medium of collage and its techniques.

103.2 Learning Outcomes

After completion of this course, students will be able to:

- articulate the importance and the role of aesthetics and art in education.
- understand the medium of collage and its versatility.
- design, plan, and create an expressive self-portrait collage by applying a variety of collage techniques.
- design and set up an interactive visual art exhibition to display their artworks.
- understand and appreciate art-based learning experiences.
- develop the ability to reflect and challenge their assumptions and beliefs around art and develop new understandings.

UNIT - I

Understand the importance of Aesthetics and Art in Education (2 Sessions)

Students will be introduced to Aesthetics and Arts by engaging in experiences, discussions, and dialogues. Students will experience a session of 'Visual thinking strategy' (VTS) activity in which students will collectively view and engage in a series of artworks closely, share their observations, critically analyse their observations, listen to multiple perspectives from peers, suspend judgements, and draw their own understanding of the artwork. Students will recognise aesthetic and non-aesthetic experiences through comparison and contrast. Through this activity and unpacking of the experience, students will start making

connections and develop understandings around what aesthetics mean, the aesthetic aspects of daily life, develop aesthetic judgment, and how the arts evoke emotion and awaken.

UNIT - II

Exploring paper collage and techniques for an Expressive Self-Portrait

(6 Sessions)

Students will explore the medium of collage through viewing artworks, discussions, and hands-on activities. They will learn techniques, artistic terms, and ways to use collage for creative expression and learning. By manipulating paper and found materials, students will create unique textures and patterns, collaborate in groups, and reflect on how collage can foster critical thinking, problem-solving, and artistic growth. students will explore 3D collage by creating paper sculptures, building on their 2D experiences. They will share insights, reflect on material exploration, and discuss art-making in education. Additionally, students will engage in guided self-portrait drawing, reflecting on the process, challenges, and assumptions about talent in art.

Resource Videos

1. *Works of Deborah Roberts, William Kentridge, Wangechi Mutu, etc*
2. *Marc, Cut paper collage artist - https://www.youtube.com/watch?v=WgRZlWl-Oh0*
3. *G. Subramanian: Collage art - https://www.youtube.com/watch?v=ioRRi9R46a0*
4. *Amber Fletschock, Collage artist - https://www.youtube.com/watch?v=aa7p1vYqUc4*
5. *Arturo Herrera, artist - https://www.youtube.com/watch?v=Oagx3_NZ5HU*
6. *Resources: Handouts on Collage techniques and artist examples*
7. *Resources: JR's Face to face project (videos and readings) https://www.youtube.com/watch?v=4u_G0G6Jog4*

UNIT - III

Creation of an Expressive Self-Portrait Collage and setting up an Exhibition

(5 Sessions)

Students will create large, expressive self-portraits using the medium of paper collage. This process will involve step-by-step sketching, ideation, planning, and application of techniques learned in previous sessions. They will explore their individuality and emotions through their compositions, pushing their imagination while making independent creative choices. Throughout the activity, students will engage in problem-solving, critical thinking, and peer feedback to refine their work.

In addition to the art-making process, students will collaboratively plan and organize a public art exhibition to showcase their works. They will take on various roles such as curators, designers, and coordinators to design the layout of the exhibition space, plan the display of artworks, and decide how the audience will navigate through the space. Students will also design invitations, plan audience engagement activities, and prepare ways to present and speak about their artistic journeys. This experience will help them develop leadership, teamwork, and communication skills while celebrating their creative achievements.

Resources: Planning templates

Pedagogy

- Students will engage in hands-on art-making activities.
- Students will engage in discussions and dialogues with peers.
- Students will engage in giving and receiving peer feedback.
- Students will continually reflect on their learning through journaling.
- Students will work independently and collaboratively throughout the course.
- Students will receive reference materials and resources to broaden and deepen their understanding**.**

103.3 Suggestive Assessment

Assessments and examinations will be conducted as per the criteria of HNBGU.

103.4 Suggestive Reading Materials

Teachers may suggest books/readings as per the needs of the learners and the learning content.

EAEVAC-104: Understanding India

(Indian Ethos and Knowledge Systems)

Credits 2

104.1 About the Course

This course allows students to develop a broad understanding of India's rich epistemic traditions, values, and ethos. It will introduce students to India's knowledge systems across fields such as literature and arts, culture, management and administration, economy and polity, law and philosophy, etc. The course specialises in integrating Indian knowledge traditions into teaching, helping students to know and appreciate India's heritage and knowledge traditions and evaluate them independently through a multidisciplinary lens.

104.2 Learning Outcomes

After the completion of the course, students will be able to:

- define and explain the scope and relevance of Indian Knowledge Systems.
- understand the importance of revisiting ancient knowledge, traditions, and culture in modern contexts.
- describe key Indian dance systems, traditional Indian music, visual, and folk arts.
- appreciate the role of IKS in preserving and expressing Indian cultural heritage.
- discuss Indian Philosophy
- explain different types of government in ancient India.
- understand the basis of law in ancient India, focusing on dharma, its sources, and justice systems.
- promote IKS in different fields as a teacher.

UNIT - I

Introduction to Knowledge of India

A. Indigenous Knowledge System (IKS): Meaning (Bhartiy Gyan Parampara), scope and nature.
B. Vision, aims and objectives of IKS. Ancient India and its global connections.
C. Revisiting our ancient wisdom: Significance and relevance of traditional knowledge, culture, and practices. Exploring ancient India's knowledge domains.
D. Overview of Indian Philosophy: Shat-Darshan, Jainism, Buddhism, and Charvaka. Introduction to Vedas, Puran and Upanisads.

UNIT – II

Art, Language and Literature

A. Fine and performing arts: traditional art forms and contemporary arts. Indian dance systems, traditional Indian music, and folk arts.
B. Language: Identity, culture, and History. Languages as the building blocks to different cultures and societies.
C. Literature: Sanskrit, Sangam, Kannada, Malayalam and Bengali literature. Indian poetry and Indian fiction.
D. Ancient Indian Linguistics, oral traditions. Role of teachers in promoting IKS in the field of art and literature.

UNIT – III

Polity, Law and Economy

A. Traditional kingship & types of government (oligarchies, republics), Local and village administration.
B. Basis of Law: Dharma & its sources, criminal Justice, Chanakyaniti, tradition-driven, equitable and just polity and law system.
C. Overview of the Indian economy from the Stone Age to the Guptas, Harappan civilization, and temple economy.
D. Arthashastra: Concept, relevance of ancient Indian economics. Role of teachers in promoting IKS in polity, law and economy.

104.3 Suggestive Practicum (Any Two)

1. Create a multimedia project that explores a traditional Indian art form.
2. Organise a role-playing activity where students act as historical figures from ancient Indian governance.
3. Prepare a paper on the role of teachers in promoting IKS in different areas.
4. Any other project assigned by the teacher.

104.4 Suggestive Mode of Transaction

- Lectures will include learner-driven participatory sessions, and Guest lectures through experts and practitioners, such as fine arts and performing arts practitioners, along with contemporary poets & writers of Indian literature.
- Tutorials will include Screening of documentaries and films followed by a discussion; Learner-driven discussions in the form of focus group discussions (FGDs), Socratic Discussions, etc.; Debate/discussion can be organized to explain India’s Vaad tradition;

discuss on how some of the ancient methods of teaching are relevant in today's time; discussions that help Identify ethical dilemmas in daily lives and understanding the importance of ancient ethics and values to resolve them.

104.5 Suggestive Mode of Assessment

The approaches to learning assessment will include, for example:

- Supporting the curiosity and interest of student teachers in the selected themes through a multi-modal approach, including regular assessments and actionable feedback that enable learners to outline and interpret the processes and events of the formation & evolution of knowledge of India through a multidisciplinary lens.
- Enabling the student teachers to demonstrate critical analysis and independent thinking of the processes and events in the formulation & evolution of different traditions that help student teachers evaluate the diverse traditions of India to distinguish its achievements and limitations.
- Use of first-hand or second-hand experiences that enable student-teachers to develop and articulate an ethics-based education rooted in Indian thought to their students in the classroom context.

Assessment and examinations will be as per the criteria of HNBGU.

104.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the needs of the learners and the learning content.

EAEVAC-105: Understanding and Connecting with the Environment

Credits: 2

105.1 About the Course

The course "Understanding and Connecting with the Environment" aims to cultivate a profound and direct connection with nature. It is designed to help student teachers develop a deep, experiential relationship with the natural world. The course fosters an understanding of the symbiotic relationship between human life and the environment, promoting concern, gratitude, and ethical stewardship toward balance. Through this course, the pupil teachers will learn and understand about the environment, ecosystems, biodiversity, and anthropogenic factors. This course will empower them to constructively critique human impact on the planet. Through workshops, field and nature walks, eco-project participation, and other reflective experiences, they will learn to observe and interact with their environment. The course equips them with strategies to incorporate environmental issues in routine teaching practices, including the establishment of nature corners, the upkeep of school gardens, and the formation of eco-clubs. In alignment with NEP 2020, the course aims to cultivate a sense of environmental stewardship, sustainable thinking, and civic responsibility, encouraging proactive teaching so that children develop eco-friendly habits early on.

105.2 Learning Outcomes

After the completion of the course, students will be able to:

- examine the main elements of natural and anthropogenic environments and their interrelationships.
- outline the importance of biodiversity and regional ecosystems in maintaining an ecological balance.
- recall local plant and animal species and natural landscapes, appreciating their cultural and ecological significance.
- assess the consequences of human actions, including urban expansion and environmental pollution, on the degradation of the natural world.
- appreciate nature through reflective and hands-on active learning.
- apply local practices to construct frameworks that incorporate indigenous and traditional ecological knowledge.
- set out to encourage and implement basic sustainability initiatives at school or within the wider community.
- perform simple environmental audits (waste, water, biodiversity) in the school setting.
- develop and facilitate nature-based learning programs for school children with local materials.
- foster responsible environmental stewardship and active citizenship through project-based advocacy and awareness campaigns.

UNIT - I

Introduction to Environment

A. Environment**:** Meaning, Definitions and Components.

B. Nature and principles of the environment. Types of environments and their composition.

C. Biodiversity: Its meaning and significance.

D. Provisions described for the environment in NEP 2020.

UNIT – II

Understanding Environment

A. Services provided by the environment. Importance of a healthy environment.

B. Natural resources: Need for their conservation and protection.

C. Environmental issues and challenges. Issue of Climate change, Pollution: Meaning and types.

D. Environmental education: Meaning, definitions and objectives.

UNIT - III

Connecting with the Environment

A. Relationship between man and the environment. Issues and challenges in reference to Uttarakhand.

B. Activities and strategies to deal with the environmental issues. Ecotourism: Concept and practices.

C. Changes in lifestyle for reducing climate change and solving environmental problems.

D. Role of the individual, teachers, social groups and the Government to protect the environment. Evaluation of governmental schemes.

105.3 Suggestive Practicum (Any Two)

1. Organise a nature walk in a nearby natural area, document observations, sounds, species seen, and personal reflections in an eco-diary or journal.
2. Identify and document trees, plants, birds, and insects found in the school or neighbourhood.
3. Projects may include composting food waste, setting up a rainwater collection system, or organizing a zero-waste campaign.
4. Evaluate water use, energy consumption, waste management, and suggest improvements.
5. Any other project assigned by the teacher.

105.4 Suggestive Mode of Transaction

The course will be conducted in a workshop mode, enabling the student teachers to demonstrate critical analysis and independent thinking of the processes that help student teachers evaluate the status of the environment and their ways of participation for environmental protection.

105.5 Suggestive Mode of Assessment

The approaches to learning assessment will include the use of first-hand or second-hand experiences that enable student-teachers to develop an action-oriented approach.
Assessment and examinations will be as per the criteria of HNBGU.

105.6 Suggestive Reading Materials

- NCERT (2006). *Position Paper on Environmental Education*.
- NCF for Foundational and Preparatory Stages (2022).
- NCERT Textbooks (EVS for Classes III–V, Science for Classes VI–VIII)
- Shiva, V. (2005). *Earth Democracy: Justice, Sustainability, and Peace*.
- Tbilisi Declaration (1977) on Environmental Education.
- Local case studies, field guides, and regional flora/fauna booklets.
  Teachers may suggest books/readings as per the needs of the learners and the learning content.

Semester-I
(B.Sc. B.Ed.)

	Subject	Course	Credits
1.	**Botany (Major)**	1. Diversity of Lower Plants	4+2
	Skill (Major)	2. Mushroom Cultivation Technology	2
2.	**Zoology (Major)**	1. Animal Diversity-I (Theory-1; Practical-1)	4+2
	Skill (Major)	1. SZ-1. Laboratory Techniques in Biology 2. SZ-2. Basic Instrumentation 3. SZ-3. Public Health and Hygiene	2

	[Student will elect one course each in either I & II]	4. Fish Keeping 5. SZ-5. Medical Diagnostics 2. SZ-6. Bioinformatics	
3.	**Physics (Major)**	1. Mechanics and Properties of Matter	4+2
	Skill (Major)	2. Basic Electronics	2
4.	**Chemistry (Major)**	1. Inorganic Chemistry -I Organic Chemistry- I (Atomic Structure, Bonding and General Organic Chemistry) Code: (SOS/CHEM/CT-001) (Practical):(Code: SOS/CHEM/CP-001)	4+2
	Skill (Major)	2. Basic Analytical Chemistry- I Code: (SOS/CHEM/SKILL -001)	2
5.	**Maths (Major)**	1. Differential Calculus	4+2
	Skill (Major)	2. Integral Calculus	2

DCMJ-1: Disciplinary

Botany Major

DCBOT-101: Diversity of Lower Plants (Theory and Practical) (Cr-6)

Total No. of Lectures: 60;

Credits: 4

UNIT I

Algae (12 Lectures)

General characteristics; Ecology and distribution; Range of thallus organisation and reproduction; Classification of algae; Morphology and life-cycles of the following: *Nostoc*, *Chlamydomonas, Oedogonium, Vaucheria, Fucus, Polysiphonia*. Economic importance of algae.

UNIT II

Fungi (14 Lectures)

Introduction- General characteristics, ecology and significance, range of thallus organisation, cell wall composition, nutrition, reproduction and classification; True Fungi- General characteristics, ecology and significance, life cycle of *Rhizopus* (Zygomycota), *Penicillium*, *Alternaria* (Ascomycota), *Puccinia, Agaricus* (Basidiomycota); Symbiotic Associations.

Lichens: General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance.

UNIT III

Introduction to Archegoniate (14 Lectures)

Unifying features of archegoniates, Transition to land habit, Alternation of generations. **Bryophytes**: General characteristics, adaptations to land habit, Classification, Range of thallus organisation. Classification (up to family), morphology, anatomy and reproduction

of *Marchantia* and *Funaria*. (Developmental details not to be included). Ecology and economic importance of bryophytes with special mention of *Sphagnum*.

UNIT IV

Pteridophytes (12 Lectures)

General characteristics, classification, Early land plants (*Cooksonia* and *Rhynia*). Classification (up to family), morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris*. (Developmental details not to be included). Heterospory and seed habit, stelar evolution. Ecological and economic importance of Pteridophytes.

UNIT V

Gymnosperms (8 Lectures)

General characteristics, classification. Classification (up to family), morphology, anatomy and reproduction of *Cycas* and Pinus. (Developmental details not to be included). Ecological and economic importance.

PRACTICAL

Credits: 2

1. Study of vegetative and reproductive structures of Nostoc, *Chlamydomonas* (electron micrographs), *Oedogonium, Vaucheria, Fucus** and *Polysiphonia* through temporary preparations and permanent slides. (* *Fucus* - Specimen and permanent slides)
2. Rhizopus and Penicillium: Asexual stage from temporary mounts and sexual structures through permanent slides.
3. Alternaria: Specimens/photographs and tease mounts.
4. Puccinia: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; section/tease mounts of spores on Wheat and permanent slides of both the hosts.
5. Agaricus: Specimens of button stage and full-grown mushroom; Sectioning of gills of Agaricus.
6. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)
7. Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)
8. Marchantia- morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemma cup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).
9. Funaria- morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, l.s. capsule and protonema.
10. Selaginella- morphology, w.m. leaf with ligule, t.s. stem, w.m. strobilus, w.m. microsporophyll and megasporophyll (temporary slides), l.s. strobilus (permanent slide).
11. Equisetum- morphology, t.s. internode, l.s. strobilus, t.s. strobilus, w.m. sporangiophore, w.m. spores (wet and dry) (temporary slides); t.s rhizome (permanent slide).
12. Pteris- morphology, t.s. rachis, v.s. sporophyll, w.m. sporangium, w.m. spores (temporary slides), t.s. rhizome, w.m. prothallus with sex organs and young sporophyte (permanent slide).

13. Cycas- morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet, vs crosporophyll, w.m. spores (temporary slides), l.s. ovule, t.s. root (permanent slide).
14. Pinus- morphology (long and dwarf shoots, w.m. dwarf shoot, male and female), w.m. dwarf shoot, t.s. needle, t.s. stem, l.s./t.s. male cone, w.m. microsporophyll, w.m. microspores (temporary slides), l.s. female cone, t.l.s. & r.l.s. stem (permanent slide).

Suggested Readings

1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd., Delhi. 2nd edition.
2. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
3. Sethi, I.K. and Walia, S.K. (2011). Textbook of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
4. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley and Sons (Asia), Singapore. 4th edition.
5. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw-Hill, Delhi, India. 3
6. Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India.
7. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
8. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad

Botany Skill

DCBOT-102: Mushroom Cultivation Technology

Credits: 2

Total No. of Lectures: 30

UNIT I: (5 Lectures)

Introduction, history. Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms. Types of edible mushrooms available in India: *Volvariella volvacea, Pleurotus citrinopileatus, and Agaricus bisporus.*

UNIT II: (5 Lectures)

Cultivation Technology: Infrastructure: substrates (locally available), Polythene bag, vessels, Inoculation hook, inoculation loop, low-cost stove, sieves, culture rack, mushroom unit (Thatched house), water sprayer, tray, small polythene bag.

UNIT III: (7 Lectures)

Pure culture: Medium, sterilisation, preparation of spawn, multiplication. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the

mushroom bed preparation - Low-cost technology, Composting technology in mushroom production.

UNIT IV: (8 Lectures)

Storage and nutrition: Short-term storage (Refrigeration - up to 24 hours), Long-term Storage (canning, pickles, papads), drying, and storage in salt solutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - Vitamins.

UNIT V: (5 Lectures)

Food Preparation_: Types of foods prepared from mushrooms. Research Centres - National level and regional level. Cost-benefit ratio - Marketing in India and abroad, Export Value.

Suggested Readings

1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore. 2. Swaminathan, M. (1990). Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018. 4
3. Tewari, Pankaj Kapoor, S.C. (1988). Mushroom cultivation, Mittal Publications, Delhi.
4. Nita Bahl (1984-1988) Handbook of Mushrooms, 2nd Edition, Vol. I & Vol. II.

Zoology Major

DCZOO-101: Animal Diversity-I Theory (Cr-4) and Practical (Cr-2)

UNIT I. Introduction to Non-Chordata

General characters; Outline classification up to Classes [4 Hours]

UNIT II. Protozoa

Salient features: Study of Amoeba, Euglena and Paramecium with reference to structure, locomotion, nutrition and reproduction (life history) [8 Hours]

UNIT III. Origin of Metazoa

Porifera: Salient features; Study of Sycon with reference to structure, reproduction (life history); Canal system in Syconoid sponge; Skeleton system [6 Hours]

UNIT IV. Coelenterata

Salient features: Study of Aurelia with reference to morphology and reproduction (life history); Alternation of generations in Coelenterates [6 Hours]

UNIT V. Helminthes

Salient features: Study of Taenia and Ascaris with reference to morphology, reproduction (life-cycle) and parasitic adaptations [6 Hours]

UNIT VI. Annelida

Salient features: Types and significance of coelom; Metamerism and its significance; Study of Nereis and Hirudinaria with reference to morphology and reproduction; Parasitic adaptations of Hirudinaria; Trochophore larva and its significance [8 Hours]

UNIT VII. Arthropoda

Salient features: Study of Palaemon with reference to morphology, respiration, excretion and reproduction; Zoological importance of Peripatus and Limulus; Economic importance of arthropods [8 Hours]

UNIT VIII. Mollusca

Salient features: Study of Pila and Unio with reference to morphology, respiration and reproduction (life-history) [8 Hours]

UNIT IX. Echinodermata

Salient features: Study of Asterias with reference to morphology, locomotion, water vascular system, mode of feeding and reproduction [6 Hours]

SUGGESTED READINGS

1. Barnes, R.D.: Invertebrate Zoology (4th ed.), Holt-Saunders, 1980.
2. Barrington, EJW: Invertebrate Structure and Function, Nelson, 1987.
3. Hickman, Roberts & Hickman: Integrated Principles of Zoology (7th ed) Times-Mirror, Mosby, 1984.
4. Iyer: A Manual of Zoology, Part I. Viswanathan, 1973.
5. Kotpal, RL: Modern Text Book of Zoology: Invertebrates, Rastogi Publications, 12th edition, 2019
6. Marshall & William: Text Book of Zoology, Vol I (Parker & Haswell, 7th ed), Macmillan, 1972.

Animal Diversity-I (Practical) (2 Credits)

Study of museum specimens/slides:

Protozoa: Amoeba, Euglena, Plasmodium, Paramecium, Trichomonas, Trypanosoma, Monocystis, Vorticella

Porifera: Sycon (including T.S. and L.S.), Hyalonema, Euplectella, Euspongia

Coelenterata: Obelia, Physalia, Aurelia, Tubipora, Metridium, Hydra, Gorgonia, Pennatula

Platyhelminthes: Taenia solium and study of its life history stages, Schistosoma, Fasciola

Nemathelminthes: Male and female Ascaris lumbricoides, Wuchereria, Ancylostoma

Annelida: Aphrodite, Nereis, Pheretima, Hirudinaria, Polygordias

Arthropoda: Palaemon, Cancer Limulus, Palamnaeus, Scolopendra, Julus, Periplaneta, Apis, Musca

Mollusca: Chiton, Dentalium, Pila, Unio, Loligo, Sepia, Octopus

Echinodermata: Pentaceros, Ophiura, Echinus, Cucumaria, Antedon, Holothuria, Astreas

Skill Courses

[Student will elect one course each in either I & II]

DCZOO-102: SZ-1. Laboratory Techniques in Biology

2 Credits [30 Hours]

UNIT I. Solutions Preparation

Solute, Solvent, Solution; Water-based or aqueous solution for biological application, Methods for dissolving the solute in purified water and adjusting the pH of the solution. Method for addition of the quantity sufficient (QS) to reach the desired volume; Buffer solution; Molarity, Normality [6 Hours].

UNIT II. Concentration and Measuring Volumes

Serial dilution, Use of a serial dilution to prepare standards for generating a standard curve; Serological Pipettes, Pipettors use of pipet-aid [4 Hours]

UNIT III. Measuring Mass

Analytical balance, weighing, tarring [2 Hours]

UNIT IV

Study the parts of a compound microscope - eye piece and objective lens, condenser lens, mirror, stage, coarse and fine adjustment knobs, and their basic functions. Micrometry-Measuring microscopic organisms, measuring cell size in a permanent slide, viz. protozoan, microscopic invertebrates, egg diameter, etc. Recording of microscopic images and videos using a microscopic camera [6 Hours]

UNIT V. Museum preparation

Preserving macroscopic organisms (invertebrate and vertebrate specimens). Permanent slide preparation: basic histological and histochemical techniques [6 Hours]

UNIT VI. Laboratory safety

Laboratory layout, wet lab, storage of chemicals and glassware. Maintenance of Laboratory equipment (microscopes, centrifuge, incubators, analytical and electronic balances, electrophoretic units, pH meter, turbidity meter, etc.); precautions while working in the laboratory [6 Hours]

Suggested Readings

1. Charles R Cantor, Paul R. Schimmel (2008). Biophysical Chemistry (Techniques for the Study of Biological Structure and Function), Part II, W.H. Freeman and Company, ISBN-13: 978-0716711902
2. Plummer David T. (2004). Introduction to Practical Biochemistry, 3rd edition, Tata McGraw Hill, ISBN 9780070994874 14
3. Wester John G. (2008). Bioinstrumentation, Wiley & Sons, ISBN-97881265136
4. Wilson Keith, John Walker (2010). Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, ISBN-978052173167

DCZOO-102: SZ-2. Basic Instrumentation

2 Credits [30 Hours]

UNIT I

Principles and Applications of Microscopy

Light, phase contrast, confocal, transmission electron microscopy (TEM & SEM) [2 Hours]

UNIT II

Principles and applications of the Colourimeter. Principle of UV-Visible absorption spectrophotometry, instrumentation and applications, Fluorimetry: Phenomena of fluorescence, intrinsic and extrinsic fluorescence, instrumentation and applications [6 Hours]

UNIT III

Principle of centrifugation, basic rules of sedimentation, sedimentation coefficient, various types of centrifuges, different types of rotors, differential centrifugation, density gradient centrifugation [4 Hours]

UNIT IV

Basic principles of chromatography**,** Partition coefficient, concept of theoretical plates, various modes of chromatography (paper, thin layer, column), preparative and analytical applications, LPLC and HPLC. Principles and applications of: Paper Chromatography, Thin Layer Chromatography. Molecular Sieve Chromatography, Ion Exchange Chromatography, Affinity Chromatography [8 Hours]

UNIT V

Basic Principle of electrophoresis, Paper electrophoresis, Gel electrophoresis, discontinuous gel electrophoresis, PAGE, SDS-PAGE. Agarose gel electrophoresis, buffer systems in electrophoresis. Electrophoresis of proteins and nucleic acids, protein and nucleic acid blotting, detection and identification [6 Hours]

UNIT VI

Principles and applications of pH meter, autoclave, biosafety cabinets/practices; polymerase chain reaction; Water analysis kit; Principle and application of Turbidity meter, Conductivity meter, Flow meter; Types of Owen & Incubators-BOD & COD Incubator [4 Hours]

Suggested Readings

1. Freifelder, D. (1982). Physical Biochemistry: Applications to Biochemistry and Molecular Biology, 2nd ed., W.H. Freeman and Company, New York
2. Plummer D. T. (1998). An Introduction to Practical Biochemistry, 3rd ed., Tata McGraw Hill Education Pvt. Ltd., New Delhi

DCZOO-102: SZ-3. Public Health and Hygiene

Credits: 2, 30 Hours

UNIT I

Definition of Public health; Types of hygiene; Examples of public hygiene; Importance of public health; Key elements of public health; Scope of Public health and Hygiene; Nutrition and health – classification of foods, Nutritional deficiencies - Vitamin deficiencies [6 Hours]

UNIT II

Environment and Health Hazards. Environmental degradation, Pollution and associated health hazards [4 Hours]

UNIT III

Communicable diseases and their control measures, such as Measles, Polio, Chikungunya, Rabies, Plague, Leprosy and AIDS; Pandemic-COVID-19 [6 Hours]

UNIT IV

Non-Communicable diseases and their preventive measures such as Hypertension, Coronary Heart diseases, Stroke, Diabetes, Obesity and Mental ill-health [6 Hours]

UNIT V

Health Education in India: WHO Programmes, Government and Voluntary Organisations and their health services; Precautions, First Aid and Awareness on sporadic diseases [6 Hours]

Unit VI. Relationship of environmental, social, cultural, occupational and political factors and systems on health and health care [2 Hours]

Suggested Readings

1. Bolduan, Charlest Frederick, Nils William Bolduan 1949. Public Health and Hygiene (4th ed.), Philadelphia: Saunders
2. Dass, K 2021. Public Health and Hygiene, Notion Press ISBN-10: 1639209603, ISBN-13: 978-1639209606
3. Goel, Arvind Kumar 2005. A College Textbook of Health & Hygiene, ABD Publishers, ISBN 8189011863, 9788189011864
4. Kumaresan, V, R. Sorna Raj, Public Health and Hygiene, Saras Publication ISBN: 9789386519689
5. Park, K. 2007. Preventive and Social Medicine, B.B. Publishers
6. Shanmugavel, G., Binu George 2021. Textbook of Public Health and Hygiene, Darshan Publishers, ISBN, 9386739550, 9789386739551
7. Wagh, Sudhir R., Vinod B. Kakade, Jiwan P. Sarwade Public Health and Hygiene Success Publications, ISBN 9789351585053

DCZOO-102: SZ-4. Aquarium Fish Keeping

Credits: 2, 30 Hours

UNIT I

Introduction to Aquarium Fish Keeping: Scope of Aquarium fish keeping; Types of aquaria, Aquarium setup and accessories, Aquarium filters; Criteria of selection for aquarium fishes [4 Hours]

UNIT II

Biology of Aquarium Fishes: Exotic and Endemic species of Aquarium Fishes (Exotic Aquarium Fishes–Puffer, Humphead & Siamese Tiger fish; Endemic Aquarium Fishes – Zebra Danio, Striped Panchax & Honey Gourami); Common characters and sexual dimorphism of Aquarium fishes: Fresh water (Guppy, Gold fish, Angel fish), Brackish water (Molly, Sword tail, Ray fish), and Marine (Moorish idol, Anemone fish & Butterfly fish) [8 Hours]

UNIT III

Food and feeding of Aquarium fishes: Use of live fish feed organisms. Preparation and composition of formulated fish feeds [2 Hours]

UNIT IV

Aquarium Fish Diseases: Parasitic, Bacterial, Viral, Protozoan, Fungal & Deficiency diseases [4 Hours]

UNIT V

Fish Transportation: Live fish transport - Conditioning, packing, transport and quarantine methods; Factors associated with live fish transport [4 Hours]

UNIT VI

Maintenance of Aquarium: General Aquarium maintenance; Water quality requirements: Maintenance and Temperature control; Budget for setting up an Aquarium/ ornamental Fish Farm as a Cottage Industry [8 Hours]

Suggested Readings

1. Bailey, Mary, Gina Sandford (1999). The Complete Guide to Aquarium Fish Keeping, Lorenz Books
2. Hargreaves, Vincent B. (2007). Complete Book of the Freshwater Aquarium 2007 Thunder Bay Pr., ISBN 10: 159223514X, ISBN-13: 978-1592235148
3. Saha, Sanjib (2022). Aquarium Fish Keeping, Techno World, Kolkata

DCZOO-102: SZ-5. Medical Diagnostics

2 Credits [30 Hours]

UNIT I

Introduction to Medical Diagnostics and its importance [2 Hours]

UNIT II

Diagnostic's Methods Used for Analysis of Blood, Blood composition, Preparation of blood smear and Differential Leucocyte Count (D.L.C) using Leishman's stain, Platelet count using haemocytometer, Erythrocyte Sedimentary Rate (E.S.R), Packed Cell Volume (P.C.V.) [10 Hours]

UNIT III

Diagnostic Methods Used for Urine Analysis; Urine Analysis: Physical characteristics; Abnormal constituents [8 Hours]

UNIT IV

Non-infectious Diseases: Causes, types, symptoms, complications, diagnosis and prevention of Diabetes (Type I and Type II), Hypertension (Primary and secondary), Testing of blood glucose using Glucometer/ Kit [3 Hours]

UNIT V

Infectious Diseases: Causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis [3 Hours]

UNIT VI

Tumour Types (Benign/Malignant), Detection and metastasis; Medical imaging: X-Ray of Bone fracture, PET, MRI and CT scan (using photographs) [4 Hours]

Suggested Readings

1. Cheesbrough M., J. McArthur (1976). A Laboratory Manual for Rural Tropical Hospitals, A Basis for Training Courses, Churchill Livingstone ISBN: 9780443011443
2. Godkar P.B. and Godkar D.P. (2014). Textbook of Medical Laboratory Technology, 3rd Edition, Bhalani Publishing House
3. Hall, John E. (2015). Guyton and Hall Textbook of Medical Physiology, Saunders
4. Park, K. (2007), Preventive and Social Medicine, B.B. Publishers
5. Prakash, G. (2012), Lab Manual on Blood Analysis and Medical Diagnostics, S. Chand and Co. Ltd.

DCZOO-102: SZ-6. Bioinformatics

Credits: 2, 30 Hours

UNIT I

Introduction to Bioinformatics: Introduction, Branches of Bioinformatics, Aim, Scope and Research areas of Bioinformatics [2 Hours]

UNIT II: Databases in Bioinformatics:

Introduction, Biological Databases, Classification format of Biological Databases, Biological Database Retrieval System [4 Hours]

UNIT III: Biological Sequence Databases:

National Center for Biotechnology Information (NCBI) - Tools and Databases of NCBI, Database Retrieval Tool, Sequence Submission to NCBI, Basic local alignment search tool (BLAST), Nucleotide Database, Protein Database, Gene Expression Database; EMBL Nucleotide Sequence Database (EMBL-Bank) - Introduction, Sequence Retrieval, Sequence Submission to EMBL, Sequence analysis tools. DNA Data Bank of Japan (DDBJ) - Introduction, Resources at DDBJ, Data Submission at DDBJ; Protein Information Resource (PIR) - About PIR, Resources of PIR, Databases of PIR, Data Retrieval in PIR; Swiss-Prot - Introduction and Salient Features [10 Hours]

UNIT IV: Sequence Alignments

Introduction, Concept of Alignment, Multiple Sequence Alignment (MSA), MSA by CLUSTAL W, Scoring Matrices, Percent Accepted Mutation (PAM), Blocks of Amino Acid Substitution Matrix (BLOSUM) [8 Hours]

UNIT V: Molecular Phylogeny

Methods of Phylogeny, Software for Phylogenetic Analyses, Consistency of Molecular Phylogenetic Prediction [4 Hours]

UNIT VI: Applications of Bioinformatics:

Structural Bioinformatics in Drug Discovery, Quantitative structure activity relationship (QSAR) techniques in Drug Design, Microbial genome applications, Crop improvement [2 Hours]

Suggested Readings

1. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.
2. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
3. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley Blackwell.

Major Physics

DCPHY-101: Mechanics and Properties of Matter Theory (Cr-4) and Practical (Cr-2)

Laws of Motion and conservation laws:

Frames of reference, Newton's Laws of motion, Work and energy, uniform circular motion, Conservation of energy and momentum. Conservative and non-conservative forces, Motion of a rocket, Motion of a particle in a central force field, Kepler's laws of planetary motion, Newton's Law of Gravitation, Gravitational field, potential and potential energy, Gravitational potential and field intensity for the spherical shell. Satellite, the Basic idea of the global positioning system (GPS).

Rotational Motion: Dynamics of a system of particles, Centre of mass, Angular velocity and momentum, Torque, Conservation of angular momentum, Equation of motion, Moment

of inertia, theorem of parallel and perpendicular axis, moment of inertia of rod, rectangular lamina, disc, solid sphere, spherical shell, kinetic energy of rotation, rolling along a slope.

Fluids: Surface Tension and surface energy, Excess pressure across surface: application to spherical drops and bubbles, variation of surface tension with temperature - Jaeger's method. Viscosity: Flow of liquid, equation of continuity, energy of fluid, Bernoulli's theorem, Poiseuille's equation and method to determine the coefficient of viscosity, Variations of viscosity of a liquid with temperature

Elasticity: Hooke's law, Stress –strain, Elastic potential energy, Elastic moduli: Young's, Bulk and shear modulus of rigidity, Poisson's ratio, relation between elastic constants Work done in stretching and in twisting a wire, Twisting couple on a cylinder, Strain energy in twisted cylinder, Determination of Rigidity modulus by statical and dynamical method (Barton's and Maxwell's needle), Torsional pendulum, Young's modulus by bending of beam, Determination of Y, η and σ and moment of inertia by Searle's method.

Reference Books:

1. Mechanics, Berkeley Physics course, vol.1: Charles Kittel, et al. 2007, Tata McGraw-Hill
2. Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley.
3. Mechanics: Mathur and Hemne, S Chand Publications.
4. Fundamentals of Mechanics: J. C. Upadyaya, Himalayan Publication.
5. Mechanics and General Properties of Matter: P. K. Chakraborty, Books and Allied Pvt. Ltd.
6. Elements of Mechanics, Prakash & Agrawal, Pragati Prakashan, Meerut.

List of Experiments: MECHANICS AND PROPERTIES OF MATTER

1. To determine the Modulus of Rigidity by the static method
2. To determine the Moment of Inertia of a Flywheel.
3. To determine the Moment of Inertia of an irregular body by the Inertia Table
4. To determine the Young's Modulus by the bending of the Beam Method.
5. of a Wire by Maxwell's needle.
6. To determine g by the Bar Pendulum.
7. To determine the Elastic Constants of a Wire by Searle's method.
8. To determine the Young's Modulus of a Wire by the Optical Lever Method.
9. To determine g by Kater's Pendulum.
10. To study the Motion of a spring and to determine (a) the Spring Constant, (b) the Value of g.

Reference Books:

1. Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practical, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

Physics Skill

DCPHY-102: Basic Electronics (Cr-2)

Credits: 2, 30 Hours

Diode, valve, triode Valve, Tetrode Valve, their characteristics, P-N Junction, Transistors, PNP, and NPN, their characteristics, common emitter, common base, and common base configurations. Rectifier half wave and Full wave, Filter L-section and π-section, principles of CRO, principles of operational amplifier. Boolean algebra, logic Gates, Binary, hexadecimal, octal, decimal systems, LED, Photodiode. Tunnel diode, Point contact diode, Schottky diode, SCR. Reference Books 1. Electricity and electronics – Saxena, Arora and Prakash (Pragrati Prakashan Meerut). 2. Principles of electrical engineering and electronics, V K Metha and Rohit Mehta (S Chand Publication, Delhi).

Major Chemistry

Inorganic Chemistry –I, Organic Chemistry- I (Theory)

(Atomic Structure, Bonding and General Organic Chemistry)

Code: (SOS/CHEM/CT-001)

Credits- 04

Section A: Inorganic Chemistry-1 (30 lectures)

Atomic Structure: Review of Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, and Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to atomic structure. Quantum mechanics, the time-independent Schrodinger equation and the meaning of various terms in it. Significance of ψ and ψ 2, Schrödinger equation for the hydrogen atom. Radial and angular parts of the hydogenic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers m land MS. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number(ms). Rules for filling electrons in various orbitals, electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

Chemical Bonding and Molecular Structure (14 Lectures)

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, 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. Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridisation with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral

arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination for orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO+. Comparison of VB and MO approaches.

Section B: Organic Chemistry-1 (30 Periods) Fundamentals of Organic Chemistry Physical Effects, Electronic Displacements: Inductive Effect, Electrometric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pk values. Aromaticity: Benzenoids and Huckel's rule.

Stereochemistry (8 lectures) Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (up to two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds. Threo and erythro; D and L; cis - trans nomenclature; CIP Rules: R/ S (for up to 2 chiral carbon atoms) and E/ Z Nomenclature (for up to two C=C systems).

Aliphatic Hydrocarbons (12 lectures) Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. Alkanes: (Up to 5 Carbons). Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation. Alkenes:(Up to 5 Carbons) Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk. KMnO4) and trans-addition (bromine), Addition of HX (Markownikoff's and anti Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation. Alkynes: (Up to 5 Carbons) Preparation: Acetylene from Cac2 and conversion into higher alkynes, by dehalogenation of tetrahalides and dehydrohalogenation of vicinal dihalides. Reactions: formation of metal acetylides, addition of bromine and alkaline KMnO4, ozonolysis and oxidation with hot alk. KMnO4.

Reference Books

1. Lee, J.D. Concise Inorganic Chemistry ELBS,1991.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd ed., Wiley.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry, John Wiley & Sons.
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.

5. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
6. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
7. Sykes, P.A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
8. Eliel, E.L. Stereochemistry of Carbon Compounds, Tata McGraw-Hill Education, 2000.
9. Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
10. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
11. Bahl, A. & Bahl, B. S. Advanced Organic Chemistry, S. Chand, 2010

CORE PAPER – I

Inorganic Chemistry –I, Organic Chemistry- I (Practical) (Atomic Structure, Bonding and General Organic Chemistry) Code: (SOS/CHEM/CP-001)

Credits- 02

Section A: Inorganic Chemistry- Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture. 2. Estimation of oxalic acid by titrating it with KMnO4. 3. Estimation of water of crystallisation in Mohr's salt by titrating with KMnO4. 4. Estimation of Fe(II) ions by titrating it with K2Cr2O7 using internal indicator. 5. Estimation of Cu(II) ions iodometrically using Na2S2O3.
2. Section B: Organic Chemistry 1. Detection of extra elements (N, S, Cl, Br, I) inorganic compounds (containing up to two extra elements) 2. Separation of mixtures by Chromatography: Measure the Rf value in each case (combination of two compounds to be given). Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography. Identify and separate the sugars present in the given mixture by paper chromatography.

Reference Books:

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
4. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman,1960.

5a. Skill (Chemistry) Paper – I

BASIC ANALYTICAL CHEMISTRY- I Code: (SOS/CHEM/SKILL -001)

Credits- 02

Introduction: Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of

significant figures. Analysis of soil: Composition of soil, Concept of pH and pH measurement, Complex ometric titrations, Chelation, Chelating agents, use of indicators. Determination of pH of soil samples. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration. Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, and water purification methods. Determination of pH, acidity and alkalinity of a water sample. Determination of dissolved oxygen (DO) of a water sample. Analysis of food products: Nutritional value of foods, ideas about food processing, food preservation and adulteration. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc. Analysis of preservatives and colouring matter.

5 B. Skill (Chemistry) Paper – II

Green Methods in Chemistry Code: (SOS/CHEM/SKILL -002)

Credits- 02

Introduction: Definitions of Green Chemistry. 2. Brief introduction of twelve principles of Green Chemistry with examples, special emphasis on atom economy, reducing toxicity, green solvents, Green Chemistry and catalysis and alternative sources of energy, Green energy and sustainability 3. The following real-world cases in Green Chemistry should be discussed: Surfactants for carbon dioxide–Replacing smog-producing and ozone-depleting solvents with CO2 for precision cleaning and dry cleaning of garments. 4. Designing of environmentally safe marine antifoulant. Right fit pigment: Synthetic azo pigments to replace toxic organic and inorganic pigments. An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.

Reference Books:

1. Anastas, P.T. & Warner, J.K. Green Chemistry-Theory and Practical, Oxford University Press (1998).
2. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker (2001).

Major Mathematics

CS-1: Differential Calculus (Theory)

Credits: 6

UNIT-I

Limit and Continuity (ε and δ definition), Types of Discontinuities, Differentiability of functions, Rolle's theorem, Lagrange's Mean Value theorem, Cauchy Mean Value Theorem.

UNIT-II

Successive differentiation, Leibnitz's theorem, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series of sin x, cos x, ex, log(l+x), (1+x)m

UNIT-III

Indeterminate forms, Partial Differentiation, Euler's Theorem for Homogeneous functions, Maxima and minina of functions of one and two variables.

UNIT-IV

Tangents and normals, Curvature. Asymptotes, Singular Points.

Books Recommended:

1. H. Anton, I. Bivens and S. Davis, Calculus, John Wiley and Sons, Inc., 2011.
2. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007.

Skill Course-I

Integral Calculus

Credits: 2

UNIT-I

Integration of rational and irrational functions, Properties of definite integrals. Reduction formulae for integrals of rational and trigonometric functions,

UNIT-II

Gamma and Beta functions. Areas and lengths of curves in the plane, Volumes and surfaces of solids of revolution. Double and triple integrals.

Books Recommended

1. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
2. H. Anton, I. Bivens and S. Davis, Calculus, John Wiley and Sons (Asia) P. Ltd., 2002.

Hemvati Nandan Bahuguna Garhwal University

Dept of Education

ITEP Curriculum

Semester-II

(B.A., B.Sc. & B.Com.)

Two-Week Student Induction Programme			
S.N.	**Code**	**Courses**	**Credit**
1.	**EAEVAC-201**	Language-II (Other than Language-I)	4
2.	**EAEVAC-202**	Understanding India (Indian Ethos and Knowledge Systems)	2
3.	**EAEVAC-203**	Teacher and Society	2

EAEVAC-201: Language 2 (Other than L1)

Credits: 4

201.1 About the Course

The course aims to prepare the students to teach language at the school level. It focuses on training the students in the sound systems of languages, word formation processes, sentence formation, and the semantic and pragmatic aspects of languages. The course intends to enable the learners to integrate all four language skills using different genres. The major aim of this course is to empower the learners to contribute to the discourses on various issues and themes. The course also orients the students to the use of different technologies and digital media for developing their own communicative skills, as well as the school students they will teach in the future. The course helps improve basic communication skills such as listening, speaking, reading, and writing among L2 language learners. The course is designed to enhance knowledge of the grammar of L2 and enable the students to formulate grammatically correct and contextually appropriate sentences and words, and empower the students with summarising and oral presentation skills effectively. The course also seeks to enhance students' critical thinking capacities, demonstrate effective communication skills, and provide hands-on activities to student teachers to develop their linguistic skills through practical sessions.

201.2 Learning Outcomes

After completing the course, student teachers will be able to:

- demonstrate reading, writing, listening, speaking, and thinking abilities in L2,
- recognise the link between language and mental skills and demonstrate their knowledge and skills effectively for all purposes,
- build interpersonal relationships and enhance social skills.

UNIT - I

Language, Society, and Learning

A. Bi-/Multilingualism and scholastic achievements; need to promote multilingualism.

B. Language variation and social variation; languages, dialects and varieties, cultural transmission of language, language and gender; language and identity.
C. Constitutional provisions related to language development and the National Education Policy 2020 and language development.
D. Language acquisition and Language learning; language learning from mother tongues to other tongues; advantages of learning other languages; language and education; notion of first language, second language and others.

UNIT - II

Speech and Writing

A. Writing Systems: Speech and writing.
B. Arbitrariness in language; types of writing systems.
C. Classification sessions of speech sounds: vowels, consonants, and others;
D. Suprasegmental: stress, pitch, tone, intonation, and juncture; acoustic phonetics.

UNIT – III

Basic Communication Skills in L2

A. Pronunciation and listening comprehension skills.
B. Reading and writing comprehension skills.
C. Effective writing skills, effective presentation and speaking skills.
D. Summarising and paraphrasing skills.

UNIT -IV

Critical Reading and Thinking Skills

A. Components of critical thinking and reading, high-order cognitive development.
B. Enhancing critical thinking abilities, critical interpretation, questioning and challenging own beliefs and values;
C. Developing ideas and evaluating an argument, critical thinking and problem solving, and rational inquiry.
D. Observing a problem, describing the problem, framing the problem, comparing, and evaluating a problem.

UNIT -V

Academic Writing

A. Academic writing: Meaning and components; development of academic language.
B. Developing critical, analytical, and interpretive thinking skills.
C. Learning to analyse. Evaluating academic writings.
D. Activities to develop academic writing skills.

201.3 Suggestive Practicum

1. Listen to a recorded speech and classify it based on sounds: vowels, consonants, and others; suprasegmental: stress, pitch, tone, intonation, and juncture; Acoustic phonetics.
2. Analyse sentences and their constituents as simple, complex, and compound sentences from written work.
3. Prepare a paper using academic writing skills.
4. Any other activity assigned by the teacher.

201.4 Suggestive Mode of Transaction

Teaching this course will involve a mix of interactive lectures, tutorials, and practical involves such as discussion, role plays, projects, simulations, workshops and language-awareness activities. The teaching intends deeper approaches to learning involving in-classroom discussion, developing the critical thinking/ problem solving abilities among the students and will also focus on situations where, in our daily lives, one would be performing tasks that involve a natural integration of language skills. The students are expected to read the assigned content before the session, and the course requires active participation from the students.

201.5 Suggestive Mode of Assessment

The assessment of the learner will be primarily based on the assessment of both linguistic and communicative skills using a battery of tests and test types, group work and projects.
Assessment and examinations will be conducted as per the criteria of HNBGU.

201.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the needs of the learners and the learning content.

EAEVAC-202: Understanding India (Indian Ethos and Knowledge Systems)

Credits: 2

202.1 About the Course

At a time when the world finds itself deep in dynamism, led by technological innovations and environmental changes, there is a need for an inward-looking approach to building the young minds of a country. By looking inwards, one not only finds a sociological belongingness but also a spiritual and intellectual rooting in these changing times. The course provides an overview of India's heritage and knowledge traditions across key themes of economy, society, polity, law, environment, culture, ethics, science & technology, and philosophy. It places special emphasis on the application of these knowledge traditions, helping students to not only know and appreciate India's heritage and knowledge traditions but also to independently evaluate them through a multidisciplinary lens. This evaluation would produce valuable lessons for obtaining transferable and 21st-century skills. The course requires no prerequisite knowledge or understanding. Spread over two years, the course will establish foundational knowledge and build upon it. It will allow students to have a basic understanding of the traditions of India and how it has evolved over the years. The course is designed to enable student teachers to outline and interpret the processes and events of the formation & evolution of knowledge of India through a multidisciplinary lens; to evaluate the diverse traditions of India to distinguish its achievements and limitations, and to develop and articulate an ethics-based education rooted in Indian thought to their students in the classroom context.

202.2 Learning Outcomes

After the completion of the course, students will be able to:

- recognize the vast corpus of knowledge traditions of India, while developing an appreciation for it,
- apply their acquired research and critical thinking skills in multidisciplinary themes,
- summarize and pass on their learnings to their students of different Indian traditions in an easily digestible manner.
- examine the balance between society and the environment.
- learn about India's traditional health practices.
- discuss India's contributions to natural sciences.
- understand Indian notions of time and space.

UNIT - I

Culture- Lifestyle

A. Food (regional cuisines, ayurvedic diet, food and festival, vegetarianism, Jainism in food, food and hospitality, and globalisation).
B. Clothes (traditional Indian clothing, textile arts, religious costumes, clothing status, clothing, gender, globalisation in clothing).
C. Sports (traditional Indian sports, martial arts, sports, and gender, sports & globalisation).
D. The lifestyle of Yoga: adapting ancient lifestyle – A path towards longevity.

UNIT - II

Science & Technology

A. Ancient arithmetic and logic. Great Indian Scientists. Role of teachers in promoting IKS in the scientific field.
B. Traditional knowledge in natural sciences: contributions in the areas of mathematics, physics, metallurgy, and chemistry.
C. Astronomy: India's contributions to the world. Indian notions of time and space.
D. Technology in the economy, agriculture, and transportation.

UNIT - III

Environment and Health

A. Equilibrium between society & environment: Society's perceptions of natural resources like forests, land, water, and animals.
B. India's health tradition: Ayurveda, Siddha, Ashtavaidya, Unani, and other schools of thought, Lessons from Sushruta Samhita and Charaka Samhita.
C. Mental health in ancient India: concepts of mental wellness- concept of mind, dhyana, mind-body relationship, Ayurveda, Yog darshan, atman.
D. Practical Vedanta for well-being (mindfulness, inter-connectedness, society-self relationship, etc.). Role of teachers in promoting IKS in the environment and health.

202.3 Suggestive Practicum

1. organisation of a 'Knowledge of India' day in the institution to celebrate the culture (food, clothes, etc.) that they would have explored in lectures and tutorials; interactions with family members, elders, neighbours, and other members of society about the evolution of local systems and economy, etc.
2. Organise a workshop and prepare a report on traditional Indian health systems, mental wellness and physical health.
3. Conduct a field project or group presentation on the equilibrium between society and the environment, focusing on indigenous knowledge and traditional environmental conservation practices.
4. Any other task assigned by the teacher.

202.4 Suggestive Mode of Transaction

- Lectures will include learner-driven participatory sessions, and Guest lectures by practitioners along with contemporary poets & writers of Indian literature.
- Tutorials will include Screening of documentaries and films followed by a discussion; Learner-driven discussions in the form of focus group discussions (FGDs), Socratic Discussions, etc.; Debate/discussion can be organized to explain India's Vaad tradition; discuss on how some of the ancient methods of teaching are relevant in today's time; discussions that help Identify ethical dilemmas in daily lives and understanding the importance of ancient ethics and values to resolve them.

202.5 Suggestive Mode of Assessment

Assessment and examinations will be conducted as per the criteria of HNBGU.

202.6 Suggestive Reading Materials

Teachers may suggest books/readings per the learners' needs and learning content.

EAEVAC-203: Teacher and Society

Credits: 2

203.1 About the Course

Teachers unarguably have a key role in nurturing young lives and shaping positive and inspired future generations. Emphasising the crucial role of teachers, NEP 2020 states, "Teachers truly shape the future of our children - and, therefore, the future of our nation.". "The high respect for teachers and the high status of the teaching profession must be restored to inspire the best to enter the teaching profession. The motivation and empowerment of teachers is required to ensure the best possible future for our children and our nation." (NEP Para 5.1). The NEP, in its introductory section, states, "the teacher must be at the centre of the fundamental reforms in the education system" and highlights the need to "help re-establish teachers, at all levels, as the most respected and essential members of our society, because they truly shape our next generation of citizens". (NEP 2020, Introduction). The policy also stresses the need to "do everything to empower teachers and help them to do their job as effectively as possible." It is recognized that teachers are second to mothers in having the opportunity to work with children during the most impressionable years of their lives. They shape opinions and form ideas about personal and social goals and about society and life, contributing so much to the development of both individuals and society.

The focus of the course on 'Teacher & Society' is on developing an understanding among student teachers of the roles of teachers in the emerging Indian society, including the changing roles of teachers in the context of the global flows of people, culture and resources that are shaping society, and the application of technologies that are constantly redefining not only the educational landscape but also the human relationships and social norms which are continuously undergoing change which entails a recalibration of the teacher roles aligned to the current and future realities and preparing teachers for the volatile, uncertain, complex and ambiguous world. The course enables the students to understand the roles and obligations of teachers as architects of society based on cultural ethos, traditions, and diversity. The student teachers shall be equipped with the knowledge, capacities and value system that enables them to act as agents for fostering national integration and a feeling of pride in India's cultural heritage and achievements. This course also aims to ensure that student teachers understand their responsibility for producing a future generation that undertakes its responsibility as an awakened citizen who avoids wastage of national resources and takes up a proactive role in the emergence of India as a strong and disciplined nation.

In addition to these, the course also seeks to enable each of the student teachers to respond to the needs of students from diverse cultural, linguistic, social and economic backgrounds; to be sensitive to gender issues, promote tolerance and social cohesion, provide special attention to students with learning disabilities, learn and apply new pedagogies and technologies, keep pace with current educational developments and initiatives; and keep oneself professionally engaged to update/upgrade knowledge and practice. Student teachers will be encouraged to comprehend how societal structures, context and historical patterns shape teacher identities on one hand and how teacher identities, beliefs, values, convictions and commitment shape the ethics, culture, norms and values on the other; thus, impacting the larger societal thoughts and actions. The course also explores the relationship of the teacher with education development, community and society through different course units that talk of the teacher as a person and as a professional, the socio-cultural and technological contexts of the teacher and how they impact

the teaching-learning process, the multiple roles, identities and expectations of a teacher. It invites the student teachers to be reflexive of their thoughts, beliefs and actions and continuously take a gaze inside out to engage children in a reflective dialogue unbiasedly.
The course explores the agentic role of a teacher, how it is influenced, and how it influences the education system. It concludes with the recalibration of the roles of teachers and teaching beyond the curricular boundaries as an architect of an inclusive, harmonious, and developing India.

203.2 Learning Outcomes

After completion of the course, student teachers will be able to:

- examine the relationship between teacher beliefs, values, character, life history, social and cultural context and teaching critically,
- explain the teacher roles and characteristics; the personal and professional self; the teacher as a communicator, the charismatic influencer, the reflective practitioner, competent, learner and much more and their significant role in nurturing the posterity.
- differentiate between the narrow curricular aims of education and the broader educational aims and their role in shaping self, school, and society,
- demonstrate an ability to engage in the ethic of care,
- demonstrate an ability to critically reflect on personal and collective practice so as to improve learning and teaching,
- conceptualize teacher agency, its individual, contextual, and structural dimensions and how it gets impacted and in turn shapes education.

UNIT - I

Understanding the Teacher: Exploring the Personal and Professional Teacher

A. Exploring the wider personal and general social context of the teacher: Life history, Teacher beliefs, values and aspirations, diverse identities, social contexts and commitment to learning and education.
B. Exploring the professional teacher: qualifications, education in teaching, attitude, aptitude, experience and exposure.
C. The charismatic teacher, the communicator teacher, the missionary teacher, the competent practitioner, the reflective practitioner, the learning Teacher.
D. Reflexive practice: nurturing the professional capital through collaborative and/or collective engagement with self, others, and the social context.

UNIT - II

Nurturing the Teacher: A Dialogue beyond the curricular goals, for Life and Posterity

A. Teaching: One profession, many roles
B. Holistic teacher development: nurturing the panchakoshas.
C. Teacher values, beliefs, and current philosophy of teaching: a reflective dialogue.
D. Teaching Character: nurturing teachers for human flourishing. Developing an ethic of care in teacher education: nurturing teachers towards a pedagogy of care.

UNIT - III

Understanding and Fostering Teacher Agency: Role in Shaping Education Systems of Tomorrow

A. Teacher agency: Concept and importance. Individual, cultural and structural dimensions of teacher agency.
B. Teacher discourses, philosophy, relationships, networks and professional development: shaping teacher agency and creative insubordination.
C. Challenges and issues in fostering teacher agency: performativity, non-academic engagements, systemic apathy, policy and practice gaps and others.
D. Being a critical teacher. Role of the teacher in shaping the educational policy, practice, and reforms

203.3 Suggestive Practicum

1. Take up a case study of any one teacher education Institution.
2. Write a biography of any one of your favourite teachers/ Educationists.
3. Write your current teaching philosophy based on your beliefs and values.
4. Learners would reflect on their practice as pre-service interns, knowledge, skills, and understandings, and identify opportunities.
5. Choose any one area of immediate societal concern, like environmental degradation, increasing crime against women, cybercrimes, bullying or any other and draw an action plan that you as a teacher would undertake to mobilise yourself, school and society towards betterment.
6. Critical reflections on popular debates around power relations associated with gender, ethnicity, culture, disability, class, poverty, and others.
7. Any other task assigned by the teacher.

203.4 Suggestive Mode of Transaction

Teacher and Society is a reformatory course that invites teachers to rethink teachers and teaching. The approach, therefore, would include a blend of lectures, in-class seminars, thinking exercises, critical reflections, group work, case-based approaches, and enquiry-based learning.

203.5 Suggestive Mode of Assessment

Being a very thought-provoking course, the assessment would largely include critical thinking assignments. The following are some exemplars.
Assessment and examinations will be conducted as per the criteria of HNBGU.

203.6 Suggestive Reading Materials

Teachers may suggest books/readings per the learners' needs and learning content.

Semester-II
(B.Sc.)

	Subject	Course	Credits
1.	**Botany (Major & Minor)**	1. Microbiology And Plant Pathology	4+2
	Skill (Major)	2. Floriculture	2
2.	**Zoology (Major & Minor)**	1. Animal Diversity II Theory (Cr-4) and Practical	4+2
	Skill (Major) [Student will elect one course each in either I & II]	1. SZ-1. Laboratory Techniques in Biology 2. SZ-2. Basic Instrumentation 3. SZ-3. Public Health and Hygiene 4. Fish Keeping 5. SZ-5. Medical Diagnostics 6. SZ-6. Bioinformatics	2
3.	**Physics (Major & Minor)**	1. Electricity and Magnetism Theory (Cr-4) and Practical	4+2
	Skill (Major)	2. Waves and Oscillations	2
4.	**Chemistry (Major & Minor)**	1. Physical Chemistry- I Organic Chemistry-II Theory (Cr-4) and Practical)	4+2
	Skill (Major)	2. Basic Analytical Chemistry II or Pesticidal Chemistry	2
3.	**Maths (Major & Minor)**	1. Differential Equations Theory	4+2
	Skill (Major)	2. Vector calculus	2

DCMJ-1: Disciplinary
Major Botany
Microbiology & Plant Pathology (Theory)
Code: SOLS/BOT/ C (T) -2 (MM: 30+70)

Credits: 4, Lectures: 60

UNIT I: (8 Lectures)

History and scope of Microbiology
General account, distribution and classification of microorganisms.

UNIT II: (12 Lectures)

Viruses – Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance;

UNIT III: (12 Lectures)

Bacteria – Discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance. Role of microorganisms in Nitrogen metabolism

UNIT IV: **(14 Lectures)**

History of Plant Pathology. Modes of Infection and general symptoms, physiology of parasitism, defence mechanism in plants, role of environment in disease development. Control measures of plant diseases. Disease resistance in plants.

UNIT V: (14 Lectures)

General symptoms and control measures for the following plant diseases: Citrus canker, TMV, wilt of tomato, bacterial blight of rice, mosaic of sugarcane and little leaf of brinjal. Late blight of potato, Wilt of *Cajanus cajan*, Loose smut of Wheat, Covered smut of Barley, Green ear disease of bajra, downy mildew of crucifers, rusts of pea and linseed, smut of bajra,

Microbiology & Plant Pathology (Practical)

Code: SOLS/BOT/ C (P) -2 (MM: 30+70)

Credits 2

1. EMs/Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.
2. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; Binary Fission; Conjugation; Structure of root nodule.
3. Gram staining
4. Study of plant diseases with the help of infected plant specimens - TMV, citrus canker, little leaf of brinjal, loose smut of wheat, downy mildew of crucifers, rust of pea, smut of bajra.

Suggested Readings

1. Brock Biology of Microorganisms, 13th edition (2012)
2. Stainier, R.Y. General Microbiology 5th edition (2009) Mc McMillan Press Ltd., Houndmills
3. Talaro, K.P., Chess, B., 2011. Foundation in Microbiology. 8th edition. McGraw-Hill
4. Prescott, Harley and Klein's Microbiology, 7th edition (2008). McGraw-Hill. Singapore
5. Agrios, G.N., 1988. Plant Pathology, Academic Press, London.
6. Lucas, John A., 1998. Plant Pathology and Plant Pathogens, Wiley-Blackwell, CRC Press.
7. Singh, R.S. Plant diseases, 9th edition (2009). Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi

Botany Skill-2
Floriculture

Code: SOLS/BOT/ Skill-2 (MM: 30+70)

Credits: 2, Lectures: 30

UNIT I: (2 Lectures)

Introduction: History of gardening; Importance and scope of floriculture and landscape gardening.

UNIT II: (8 Lectures)

Nursery Management and Routine Garden Operations: Sexual and vegetative methods of propagation; Soil sterilization; Seed sowing; Pricking; Planting and transplanting; Shading; Stopping or pinching; Defoliation; Wintering; Mulching; Topiary; Role of plant growth regulators.

UNIT III: (4 Lectures)

Ornamental Plants: Flowering annuals; Herbaceous perennials; Divine vines; Shade and ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents; Palms and Cycads; Ferns and Selaginellas; Cultivation of plants in pots; Indoor gardening; Bonsai.

UNIT IV: (8 Lectures)

Principles of Garden Designs: English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Flower beds, Shrubbery, Borders, Water Garden. Some Famous Gardens of India. Landscaping Places of Public Importance: Landscaping highways and educational institutions.

UNIT V: (8 Lectures)

Commercial Floriculture: Factors affecting flower production; Production and packaging of cut flowers; Flower arrangements; Methods to prolong vase life; Cultivation of Important cut flowers (Carnation, Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolus, Marigold, Rose, Lilium, Orchids). Diseases and Pests of Ornamental Plants.

Suggested Readings

1. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers

Major Zoology

SOLS/ZOO/CZ-2 Animal Diversity-II

4 Credits [60 Hours]

UNIT I

Introduction to Chordata

General characters and outline classification of Chordates up to Classes. Hemichordata: General characters and classification; Balanoglossus: morphology and development [6 Hours]

UNIT II

Urochordata

General characters and classification; Herdmania: Morphology, blood vascular system, reproductive system and development [6 Hours]

UNIT III

Cephalochordata

Classification and salient features; Branchiostoma (=Amphioxus): Morphology, digestive, excretory, reproductive system and development [6 Hours]

UNIT IV

Cyclostomata

General characters and classification; External features of Petromyzon and Myxine; Comparison between Lampreys and Hagfishes [4 Hours]

UNIT V

Pisces

General characters of cartilaginous and bony fish; Dipnoi: Distribution, General characters, and affinities; External features, Digestive, Respiratory, Blood vascular, Nervous and Urinogenital system of Scoliodon; Scales and fins of fishes, respiratory organs in fish [11 Hours]

UNIT VI

Amphibia

General characters and classification, Elementary idea of parental care [3 Hours]

UNIT VII

Reptilia

Terrestrial Adaptations; General characters and distribution of Chelonia, Rhynchocephalia, Ophidia and Crocodilia; Poisonous and non-poisonous snakes; Biting mechanism in snakes; Venom and Antivenom [8 Hours]

UNIT VIII

Aves

General characters; Morphology, Digestive, Respiratory and Urinogenital System of Columba; Feathers in Birds; Aerial adaptations in birds [8 Hours]

UNIT IX

Mammalia

General organization, salient features and distribution of Prototheria, Metatheria and Eutheria [8 Hours]

Suggested Readings

1. Kotpal, R.L.: Modern Text-book of Zoology, Vertebrates. Rastogi Publication, 2007
2. Jordan, E.L. and P.S. Verma: Chordate Zoology. S. Chand & Co. Ltd., 2013
3. Hildebrand, M., Goslow, G.: Analysis of Vertebrate Structure, Wiley, 1998
4. Romer, A.S., T.S. Parsons: Vertebrate Body, Saunders (W.B.) Co Ltd; 5th Revised edition, 1977
5. Pandey, B.N., Mathur, V. Biology of Chordates. PHI Learning Pvt. Ltd., Delhi, 2019

SOLS/ZOO/CZ-2(P) Animal Diversity-II (Practical)

Credits: 2

Study of museum specimens/slides:

Protochordata: Balanoglossus, Herdmania, Branchiostoma, Agnatha: Petromyzon, Myxine

Pisces: Sphyrna, Pristis, Torpedo, Exocoetus, Anguilla, Acipenser, Latimaria, Chimaera

Amphibia: Ichthyophis/ Ureotyphlus, Salamandra, Bufo, Hyla

Reptilia: Chelone, Hemidactylus, Chamaeleon, Draco, Vipera, Naja, Crocodylus, Gavialis; Key for Identification of poisonous and non-poisonous snakes

Aves: Study of six common birds from different orders

Mammalia: Sorex, Bat, Funambulus, Loris, Platypus, Opossum, Kangaroo, Manis, Dolphin, Whale, Lutra, Camel, Polar Bear (Photographs)

An "animal album" containing photographs, cut-outs, with an appropriate write-up about the abovementioned taxa. Different taxa/ topics may be given to different sets of students for this purpose. These need not be repeated as drawings by the album maker.

Skill Courses

[Student will elect one course each in either I & II]

DCZOO-102: SZ-1. Laboratory Techniques in Biology

2 Credits [30 Hours]

UNIT I. Solutions Preparation

Solute, Solvent, Solution; Water-based or aqueous solution for biological application, Methods for dissolving the solute in purified water and adjusting the pH of the solution. Method for addition of the quantity sufficient (QS) to reach the desired volume; Buffer solution; Molarity, Normality [6 Hours].

UNIT II. Concentration and Measuring Volumes

Serial dilution, Use of a serial dilution to prepare standards for generating a standard curve; Serological Pipettes, Pipettors use of pipet-aid [4 Hours]

UNIT III. Measuring Mass

Analytical balance, weighing, tarring [2 Hours]

UNIT IV

Study the parts of a compound microscope - eye piece and objective lens, condenser lens, mirror, stage, coarse and fine adjustment knobs, and their basic functions. Micrometry-Measuring microscopic organisms, measuring cell size in a permanent slide, viz. protozoan, microscopic invertebrates, egg diameter, etc. Recording of microscopic images and videos using a microscopic camera [6 Hours]

UNIT V. Museum preparation

Preserving macroscopic organisms (invertebrate and vertebrate specimens). Permanent slide preparation: basic histological and histochemical techniques [6 Hours]

UNIT VI. Laboratory safety

Laboratory layout, wet lab, storage of chemicals and glassware. Maintenance of Laboratory equipment (microscopes, centrifuge, incubators, analytical and electronic balances, electrophoretic units, pH meter, turbidity meter, etc.); precautions while working in the laboratory [6 Hours]

Suggested Readings

1. Charles R Cantor, Paul R. Schimmel (2008). Biophysical Chemistry (Techniques for the Study of Biological Structure and Function), Part II, W.H. Freeman and Company, ISBN-13: 978-0716711902
2. Plummer David T. (2004). Introduction to Practical Biochemistry, 3rd edition, Tata McGraw Hill, ISBN 9780070994874 14
3. Wester John G. (2008). Bioinstrumentation, Wiley & Sons, ISBN-97881265136
4. Wilson Keith, John Walker (2010). Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, ISBN-978052173167

DCZOO-102: SZ-2. Basic Instrumentation

2 Credits [30 Hours]

UNIT I. Principles and Applications of Microscopy

Light, phase contrast, confocal, transmission electron microscopy (TEM & SEM) [2 Hours]

UNIT II

Principles and applications of the Colourimeter. Principle of UV-Visible absorption spectrophotometry, instrumentation and applications, Flourimetry: Phenomena of fluorescence, intrinsic and extrinsic fluorescence, instrumentation and applications [6 Hours]

UNIT III

Principle of centrifugation, basic rules of sedimentation, sedimentation coefficient, various types of centrifuges, different types of rotors, differential centrifugation, density gradient centrifugation [4 Hours]

UNIT IV

Basic principles of chromatography**,** Partition coefficient, concept of theoretical plates, various modes of chromatography (paper, thin layer, column), preparative and analytical applications, LPLC and HPLC. Principles and applications of: Paper Chromatography, Thin Layer Chromatography. Molecular Sieve Chromatography, Ion Exchange Chromatography, Affinity Chromatography [8 Hours]

UNIT V

Basic Principle of electrophoresis, Paper electrophoresis, Gel electrophoresis, discontinuous gel electrophoresis, PAGE, SDS-PAGE. Agarose gel electrophoresis, buffer systems in electrophoresis. Electrophoresis of proteins and nucleic acids, protein and nucleic acid blotting, detection and identification [6 Hours]

UNIT VI

Principles and applications of pH meter, autoclave, biosafety cabinets/practices; polymerase chain reaction; Water analysis kit; Principle and application of Turbidity meter, Conductivity meter, Flow meter; Types of Owen & Incubators-BOD & COD Incubator [4 Hours]

SUGGESTED READINGS

1. Freifelder, D. (1982). Physical Biochemistry: Applications to Biochemistry and Molecular Biology, 2nd ed., W.H. Freeman and Company, New York
2. Plummer D. T. (1998). An Introduction to Practical Biochemistry, 3rd ed., Tata McGraw Hill Education Pvt. Ltd., New Delhi

DCZOO-102: SZ-3. Public Health and Hygiene

2 Credits [30 Hours]

UNIT I

Definition of Public health; Types of hygiene; Examples of public hygiene; Importance of public health; Key elements of public health; Scope of Public health and Hygiene; Nutrition and health – classification of foods, Nutritional deficiencies - Vitamin deficiencies [6 Hours]

UNIT II

Environment and Health Hazards. Environmental degradation, Pollution and associated health hazards [4 Hours]

UNIT III

Communicable diseases and their control measures, such as Measles, Polio, Chikungunya, Rabies, Plague, Leprosy and AIDS; Pandemic-COVID-19 [6 Hours]

UNIT IV

Non-Communicable diseases and their preventive measures such as Hypertension, Coronary Heart diseases, Stroke, Diabetes, Obesity and Mental ill-health [6 Hours]

UNIT V

Health Education in India: WHO Programmes, Government and Voluntary Organisations and their health services; Precautions, First Aid and Awareness on sporadic diseases [6 Hours]

Unit VI. Relationship of environmental, social, cultural, occupational and political factors and systems on health and health care [2 Hours]

Suggested Readings

1. Bolduan, Charlest Frederick, Nils William Bolduan 1949. Public Health and Hygiene (4th ed.), Philadelphia: Saunders
2. Dass, K 2021. Public Health and Hygiene, Notion Press ISBN-10: 1639209603, ISBN-13: 978-1639209606

3. Goel, Arvind Kumar 2005. A College Textbook of Health & Hygiene, ABD Publishers, ISBN 8189011863, 9788189011864
4. Kumaresan, V, R. Sorna Raj, Public Health and Hygiene, Saras Publication ISBN: 9789386519689
5. Park, K. 2007. Preventive and Social Medicine, B.B. Publishers
6. Shanmugavel, G., Binu George 2021. Textbook of Public Health and Hygiene, Darshan Publishers, ISBN, 9386739550, 9789386739551
7. Wagh, Sudhir R., Vinod B. Kakade, Jiwan P. Sarwade Public Health and Hygiene Success Publications, ISBN 9789351585053

DCZOO-102: SZ-4. Aquarium Fish Keeping

2 Credits [30 Hours]

UNIT I

Introduction to Aquarium Fish Keeping: Scope of Aquarium fish keeping; Types of aquaria, Aquarium setup and accessories, Aquarium filters; Criteria of selection for aquarium fishes [4 Hours]

UNIT II

Biology of Aquarium Fishes: Exotic and Endemic species of Aquarium Fishes (Exotic Aquarium Fishes–Puffer, Humphead & Siamese Tiger fish; Endemic Aquarium Fishes – Zebra Danio, Striped Panchax & Honey Gourami); Common characters and sexual dimorphism of Aquarium fishes: Fresh water (Guppy, Gold fish, Angel fish), Brackish water (Molly, Sword tail, Ray fish), and Marine (Moorish idol, Anemone fish & Butterfly fish) [8 Hours]

UNIT III

Food and feeding of Aquarium fishes: Use of live fish feed organisms. Preparation and composition of formulated fish feeds [2 Hours]

UNIT IV

Aquarium Fish Diseases: Parasitic, Bacterial, Viral, Protozoan, Fungal & Deficiency diseases [4 Hours]

UNIT V

Fish Transportation: Live fish transport - Conditioning, packing, transport and quarantine methods; Factors associated with live fish transport [4 Hours]

UNIT VI

Maintenance of Aquarium: General Aquarium maintenance; Water quality requirements: Maintenance and Temperature control; Budget for setting up an Aquarium/ ornamental Fish Farm as a Cottage Industry [8 Hours]

Suggested Readings

1. Bailey, Mary, Gina Sandford (1999). The Complete Guide to Aquarium Fish Keeping, Lorenz Books
2. Hargreaves, Vincent B. (2007). Complete Book of the Freshwater Aquarium 2007 Thunder Bay Pr., ISBN 10: 159223514X, ISBN-13: 978-1592235148
3. Saha, Sanjib (2022). Aquarium Fish Keeping, Techno World, Kolkata

DCZOO-102: SZ-5. Medical Diagnostics

2 Credits [30 Hours]

UNIT I

Introduction to Medical Diagnostics and its importance [2 Hours]

UNIT II

Diagnostic's Methods Used for Analysis of Blood, Blood composition, Preparation of blood smear and Differential Leucocyte Count (D.L.C) using Leishman's stain, Platelet count using haemocytometer, Erythrocyte Sedimentary Rate (E.S.R), Packed Cell Volume (P.C.V.) [10 Hours]

UNIT III

Diagnostic Methods Used for Urine Analysis; Urine Analysis: Physical characteristics; Abnormal constituents [8 Hours]

UNIT IV

Non-infectious Diseases: Causes, types, symptoms, complications, diagnosis and prevention of Diabetes (Type I and Type II), Hypertension (Primary and secondary), Testing of blood glucose using Glucometer/ Kit [3 Hours]

UNIT V

Infectious Diseases: Causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis [3 Hours]

UNIT VI

Tumour Types (Benign/Malignant), Detection and metastasis; Medical imaging: X-Ray of Bone fracture, PET, MRI and CT scan (using photographs) [4 Hours]

Suggested Readings

1. Cheesbrough M., J. McArthur (1976). A Laboratory Manual for Rural Tropical Hospitals, A Basis for Training Courses, Churchill Livingstone ISBN: 9780443011443
2. Godkar P.B. and Godkar D.P. (2014). Textbook of Medical Laboratory Technology, 3rd Edition, Bhalani Publishing House
3. Hall, John E. (2015). Guyton and Hall Textbook of Medical Physiology, Saunders
4. Park, K. (2007), Preventive and Social Medicine, B.B. Publishers
5. Prakash, G. (2012), Lab Manual on Blood Analysis and Medical Diagnostics, S. Chand and Co. Ltd.

DCZOO-102: SZ-6. Bioinformatics

2 Credits [30 Hours]

UNIT I

Introduction to Bioinformatics: Introduction, Branches of Bioinformatics, Aim, Scope and Research areas of Bioinformatics [2 Hours]

UNIT II: Databases in Bioinformatics

Introduction, Biological Databases, Classification format of Biological Databases, Biological Database Retrieval System [4 Hours]

UNIT III: Biological Sequence Databases

National Center for Biotechnology Information (NCBI) - Tools and Databases of NCBI, Database Retrieval Tool, Sequence Submission to NCBI, Basic local alignment search tool (BLAST), Nucleotide Database, Protein Database, Gene Expression Database; EMBL Nucleotide Sequence Database (EMBL-Bank) - Introduction, Sequence Retrieval, Sequence Submission to EMBL, Sequence analysis tools. DNA Data Bank of Japan (DDBJ) - Introduction, Resources at DDBJ, Data Submission at DDBJ; Protein Information Resource (PIR) - About PIR, Resources of PIR, Databases of PIR, Data Retrieval in PIR; Swiss-Prot - Introduction and Salient Features [10 Hours]

UNIT IV: Sequence Alignments

Introduction, Concept of Alignment, Multiple Sequence Alignment (MSA), MSA by CLUSTAL W, Scoring Matrices, Percent Accepted Mutation (PAM), Blocks of Amino Acid Substitution Matrix (BLOSUM) [8 Hours]

UNIT V: Molecular Phylogeny

Methods of Phylogeny, Software for Phylogenetic Analyses, Consistency of Molecular Phylogenetic Prediction [4 Hours]

UNIT VI: Applications of Bioinformatics:

Structural Bioinformatics in Drug Discovery, Quantitative structure activity relationship (QSAR) techniques in Drug Design, Microbial genome applications, Crop improvement [2 Hours]

Suggested Readings

1. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.
2. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
3. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley Blackwell.

Major Physics

Core Physics-I: Electricity and Magnetism

4 Credits [60 hours]

Vector Analysis:

Scalar and Vector product, gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stokes' theorem of vectors (Statements only)

Electrostatics:

Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as a line integral of the electric field, potential due to a point charge, an electric dipole, a uniformly charged spherical shell and a solid sphere. Calculation of the electric field from the potential. Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condensers. Energy per unit volume in an electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics, a Parallel plate capacitor completely filled with dielectric.

Magnetism:

Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current, Divergence and curl of magnetic field, Magnetic vector potential, Ampere's circuital law.

Magnetic properties of materials:

Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferro-magnetic materials.

Electromagnetic Induction:

Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field.

Maxwell`s equations and Electromagnetic wave propagation:

Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarisation.

Reference Books:

1. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education
2. Electricity and Magnetism, J.H. Fewkes & J. Yarwood. Vol. I, 1991, Oxford Univ. Press.
3. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
4. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
5. D.J. Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin.

Core Physics-I: Electricity and Magnetism (Practical)

2 Credits

List of Experiments

1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) Dc current, and (d) checking electrical fuses.
2. Ballistic Galvanometer:
   (i) Measuring of charge and current sensitivity
   (ii) Measurement of CDR
   (iii) Determine a high resistance by Leakage Method
   (iv) To determine Self Inductance of a Coil by Rayleigh's Method
3. To compare capacitances using De'Sauty's bridge.
4. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx).
5. To study the Characteristics of a Series RC Circuit.
6. To study a series LCR circuit and determine its (a) Resonant Frequency, (b) Quality factor
7. To study parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q
8. To determine a Low Resistance by Carey Foster's Bridge
9. To verify the Thevenin and Norton Theorem
10. To verify the Superposition and Maximum Power Transfer Theorem

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing
House.
2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
3. Advanced level Physics Practical's, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.

Skill Course Physics
Waves and Oscillations

2 Credits [30 Hours]

HARMONIC OSCILLATION:

Solution of equation of harmonic motion, simple pendulum, compound pendulum, motion of a vertically loaded spring, LC circuit, energy in simple harmonic motion, addition of simple harmonic motion, damped vibrations, relaxation time, forced harmonic oscillator, sharpness of resonance.

WAVES:

Nature, production, and propagation, equation of progressive wave, forms of wave equation, longitudinal waves, superposition of waves, stationary waves, their characteristics, and their analytical treatment, phenomenon of beats, Fourier analysis,

Fourier theorem, evaluation of constants, , applications of Fourier analysis, square wave, saw tooth wave, vibration of a stretched strings, velocity, vibrations of a rectangular membrane, velocity, Doppler's shift, ultrasonic waves-definition, production and applications.

Reference Books:

1. A textbook of waves and oscillations, Ashok K Ganguli (S Chand).
2. Oscillations and waves, Satya Prakash (Pragrati Prakashan, Meerut).

Major Chemistry

Physical Chemistry- I, Organic Chemistry-II (Chemical Energetics, Equilibria & Functional Organic Chemistry) (Theory)

Code: (SOS/CHEM/CT-002)

Credits- 04, 60 Lectures

Section A: Physical Chemistry-1 (30 Lectures)

Chemical Energetics (10 Lectures)

Review of Thermodynamics and the Laws of Thermodynamics. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formation, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of the enthalpy of action with temperature– Kirchhoff's equation. Statement of the Third Law of thermodynamics and calculation of absolute entropies of substances.

Chemical Equilibrium: (8 lectures) Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between G and G o, Le Chatelier's principle. Relationships between Kp, Kc and Kx for reactions involving ideal gases.

Ionic Equilibria: (12 Lectures) Strong, moderate and weak electrolytes, degree of ionisation, factors affecting degree of ionisation, ionisation constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of the solubility product principle.

Section B: Organic Chemistry-2 (30 Lectures) Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Aromatic hydrocarbons (8 Lectures) Preparation (Casebenzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. Reactions: (Casebenzene): Electrophilic substitution: nitration, halogenations and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (up to 4 carbons on benzene). Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene)

Alkyl and Aryl Halides (8 Lectures)

Alkyl Halides (Up to 5 Carbons) Types of Nucleophilic Substitution (SN1, SN2, and SNi) reactions. Preparation: from alkenes and alcohols. Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.

Aryl Halides Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions. Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by–OH group) and the effect of the nitro substituent. Benzyne Mechanism: KNH2/NH3 (orNaNH2/NH3). Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

Alcohols, Phenols and Ethers (Up to 5 Carbons) (14 Lectures)

Alcohols: Preparation: Preparation of 1o, 2o and 3o alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. KMnO4, acidic dichromate, conc. HNO3). Oppeneauer oxidation of Diols: (Up to 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol case) Preparation: Cumene hydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenations and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten–Baumann Reaction.

Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

Aldehydes and Ketones (aliphatic and aromatic):

(Formaldehyde, acetaldehyde, acetone and benzaldehyde) Preparation: from acid chlorides and from nitriles. Reactions– Reaction with HCN, ROH, NaHSO3, NH2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-Pondorff Verley reduction.

Reference Books:

- Graham Solomon, T.W., Fryhle, C.B. & Dnyder,S.A. Organic Chemistry, John Wiley & Sons (2014).
- McMurry, J.E. Fundamentals of Organic Chemistry, 7 th Ed. Cengage Learning India Edition, 2013.
- Sykes, P.A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
- Finar, I.L. Organic Chemistry (Vol.I & II), E.L.B.S.
- Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
- Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
- Barrow, G.M. Physical Chemistry, Tata McGraw-Hill (2007).
- Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).

• Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009).
• Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
• Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).

Physical Chemistry- I, Organic Chemistry-II (Chemical Energetics, Equilibria & Functional Organic Chemistry) (Practical)

Code: (SOS/CHEM/CP-002)

Credits- 02

Section A: Physical Chemistry Thermochemistry 1. Determination of the heat capacity of the calorimeter for different volumes. 2. Determination of the enthalpy of neutralisation of hydrochloric acid with sodium hydroxide. 3. Determination of the enthalpy of ionisation of acetic acid. 4. Determination of integral enthalpy of solution of salts (KNO3, NH4Cl). 5. Determination of enthalpy of hydration of copper sulphate. 6. Study of the solubility of benzoic acid in water and determination of H. Ionic equilibria: a) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using a pH-meter. b) Preparation of buffer solutions: (i) Sodium acetate-acetic acid, (ii) Ammonium chloride-ammonium hydroxide. Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Section B:

Organic Chemistry 1. Purification of organic compounds by crystallization (from water and alcohol) and distillation. 2. Criteria of Purity: Determination of melting and boiling points. 3. Preparations: Mechanism of various reactions involved to be discussed. Recrystallisation, determination of melting point and calculation of quantitative yields to be done. (a) Bromination of Phenol /Aniline (b) Benzoylation of amines /phenols (c) Oxime and 2,4-dinitrophenyl hydrazone of aldehyde/ketone

Reference Books

• Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
• Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman,1960.
• Khosla, B.D.; Garg, V.C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co., New Delhi (2011).

5C. Skill (Chemistry) Paper – III
Basic Analytical Chemistry- II

Code: (SOS/CHEM/SKILL-003)

Credits- 02

Chromatography: Definition, general introduction on principles of chromatography, paper chromatography, TLC, etc. Paper chromatographic separation of a mixture of metal ions (Fe3+ and Al3+). To compare paint samples by the TLC method. Ion-exchange:

Column, ion-exchange chromatography, etc. Determination of ion exchange capacity of anion/cation exchangers (using batch procedure if the use of a column is not feasible). Analysis of cosmetics: Major and minor constituents and their function. Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate. Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexometric titration.

Reference Books:

Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. Instrumental Methods of Analysis. 7th Ed. Wadsworth Publishing Co. Ltd., Belmont, California, USA,1988.
Skoog, D.A., Holler, F.J., & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed. Skoog, D.A.; West, D.M. & Holler, F.J. Fundamentals of Analytical Chemistry 6th Ed., Saunders College Publishing, Fort Worth (1992). Harris, D.C. Quantitative Chemical Analysis, W.H. Freeman. Dean, J.A. Analytical Chemistry Notebook, McGraw-Hill. Day, R. A. & Underwood, A.L. Quantitative Analysis, Prentice Hall of India. Freifelder, D. Physical Biochemistry 2nd Ed., W H. Freeman and Co., N.Y., USA (1982). Cooper, T.G. The Tools of Biochemistry, John Wiley and Sons, N.Y.USA. 16 (1977). Vogel, A.I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall. Robinson, J.W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc., New York (1995).

OR

5D: Skill (Chemistry) Paper –IV
Pesticide Chemistry

Code: (SOS/CHEM/SKILL-004)

Credits- 02

General introduction to pesticides (natural and synthetic), Types: Insecticides, Herbicides, benefits and adverse effects, changing concepts of pesticides, structure-activity relationship. Biopesticides, uses and future perspectives. Pesticidal poisoning, synthesis and technical manufacture and uses of representative pesticides in the following classes: Organochlorines: Gammexene, Organophosphates (Malathion, Parathion, pyrethroids), Carbamates (Carbofuran and carbaryl); Quinones. Pheromones, repellents and rodenticides.

Reference Book: Cremlyn, R. Pesticides. Preparation and Modes of Action, John Wiley & Sons, New York,1978

Major Mathematics
Core Subject 1: Differential Equations

Credits: 6

UNIT-I

Classification of differential equations: their origin and applications, initial value problems, boundary value problems, existence of solution. Separable equation and reducible to this form.

UNIT-II

Exact differential equation, integrating factors, special integrating factor and transformations. linear differential equations and Bernoulli equations, first-order higher-degree equations solvable for x, y, p.

UNIT-III

Higher-order differential equations with constant coefficients, basic theory of linear differential equations, The Cauchy-Euler equation, Simultaneous differential equations. Wronskian and its properties. Second order linear differential equations with variable coefficients, Inspection Method, Reducible to normal form, Change of Independent Variable, Variation of Parameters. Total differential equations.

UNIT-IV

Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method.

Books Recommended

1. Shepley L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, 1984.
2. I. Sneddon, Elements of Partial Differential Equations, McGraw-Hill, International Edition, 1967.

Skill Course-II
Vector Calculus

Credits: 2

UNIT-I

Scalar and vector products of three and four vectors, Reciprocal systems of vectors, Applications of vectors to three-dimensional geometry. Differentiation of vectors, partial differentiation of vectors, Velocity and acceleration, Integration of vectors.

UNIT-II

Differential operators, Gradient of a scalar point function, Directional Derivative, divergence and curl of vectors. Line integrals, Surface integrals, Applications of Gauss's , Green's and Stokes theorems.

Books Recommended

1. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
2. H. Anton, I. Bivens and S. Davis, Calculus, John Wiley and Sons (Asia) P. Ltd. 2002.
3. P.C. Matthew's, Vector Calculus, Springer Verlag London Limited, 1998.

Hemvati Nandan Bahuguna Garhwal University

Dept of Education

ITEP Curriculum

Semester-III

(B.A., B.Sc. & B.Com.)

Two-Week Student Induction Programme			
S.N.	**Code**	**Courses**	**Credit**
1.	EFC-301	Child Development and Educational Psychology	4
2.	ESSCCPC-302	Stage-Specific Content -cum Pedagogy Courses Basics of Pedagogy at Secondary Stage	4
3.	SEC- 303	Life Skills and Personality Dev	2

EFC-301: Child Development and Educational Psychology

Credits: 4

301.1 About the Course

To enable student teachers to understand the interplay of three different processes, namely biological processes, cognitive processes, and socio-emotional processes that influence the development of a child. Biological, cognitive, and socio-emotional processes are intricately interwoven with each other. Each of these processes plays a role in the development of a child whose body and mind are interdependent.

The course seeks to provide an understanding of the developmental characteristics of a child:

- during infancy, which ranges from birth to 24 months of age,
- during the early childhood stage, which begins around age 3 and usually extends up to 6-7 years of age,
- Middle to Late Childhood stage, which begins around 6-7 years to 10-11 years of age, and
- Adolescence stage, which begins at approximately the age of 12 years, and which is a period of transition from childhood to early adulthood.

The course will introduce development across domains – physical development, cognitive development, language development, socio-emotional development, aesthetic development, and moral development – during each of the above-mentioned developmental stages of a child.

Educational Psychology component of the course:

Informs student teachers about the various theories of learning and motivational states for learning and their implications for pedagogy. It includes the study of how people learn, pedagogical approaches that are required to improve student learning, teaching-learning processes that enable learners to attain the defined learning outcomes, and individual differences in learning. It provides opportunities for student teachers to explore the

behavioural, cognitive and constructivist approaches to facilitating student learning, and the emotional and social factors that influence the learning process.

301.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- describe the meaning, concept, characteristics, and factors affecting growth and development,
- use the knowledge of the Indian concept of self,
- apply various problem-solving and learning strategies in real classroom settings,
- identify the various approaches to the process of learning,
- explain group dynamics and apply strategies to facilitate group learning.

UNIT - I

Child Development

A. Meaning and significance of understanding the process of child development, biological, cognitive, socio-emotional, and moral.
B. Developmental characteristics of a child during the infancy stage, early childhood stage, middle to late childhood stage and adolescence stage.
C. The Indian concept of self: Mind (मनस्), Intellect (बुद्धि), Memory (चित्त). Panch-koshIya Vikas (पञ्चकोशीय विकास).
D. Educational Implications.

UNIT - II

Developmental Process

A. Development across domains: Physical development, cognitive development, language development, socio-emotional development, aesthetic development, moral development, stages of a child.
B. Factors affecting development. Individual differences: Children with special needs, including developmental disorders.
C. Tools and techniques for identifying learners with different abilities.
D. Teachers' role and strategies to address the needs of learners with different learning abilities.

UNIT - III

Process of Learning

A. Conceptual clarity and significance.
B. Approaches: Behaviorist, cognitivist, constructivist, developmental, information processing model of learning, Shri Aurobindo's integral approach.
C. Problem Solving and Learning Strategies: Inquiry and problem-based learning, steps and strategies in problem solving, factors hindering problem solving.
D. How to learn: significance and strategies

UNIT - IV

Motivation and Classroom Management

A. Motivation: conceptual clarity, nature, and significance. Intrinsic and extrinsic motivation and strategies for motivation
B. Classroom management: Creating a positive learning environment, planning space for learning, and managing behavioural problems.
C. Group dynamics: Classroom as a social group, characteristics of a group.
D. Understanding group interaction-sociometry, strategies to facilitate group learning.

2.2.3 Suggestive Practicum

1. Spending a day with a child and preparing a report based on our observations of children for a day from different economic statuses (low and affluent) with focus on various factors: Physical, emotional, social, language, cultural and religious influences on the child on a daily basis.
2. Observing children to understand the learning styles of children learning process.
3. Identifying the learning difficulties of students in different learning areas and the Possible reasons for them- case study report.
4. Preparing a personalised intervention plan for students with learning difficulties.
5. Plan to use advanced technology to encourage talented/gifted children.
6. Encouraging gifted/talented students beyond the general school curriculum.
7. Familiarisation and reporting of individual psychological tests.

2.2.4 Suggestive Mode of Transaction

The course content transaction will include the following:

- Planned lectures infused with multimedia /PowerPoint presentations.
- Small group discussion, panel interactions, small theme-based seminars, group discussions, cooperative teaching and team teaching, selections from theoretical readings, case studies, analyses of educational statistics and personal field engagement with educationally marginalised communities and groups, through focus group discussion, surveys, short-term project work, etc.
- Hands-on experience of engaging with diverse communities, children, and schools.

2.2.5 Suggestive Mode of Assessment

The assessment will be based on the tests and assignments.
Assessment and examinations will be conducted as per the criteria of HNBGU.

2.2.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the needs of the learners and the learning content.

ESSCCPC-302: Basics of Pedagogy at Secondary Stage

Credits: 4

302.1 About the Course

This course deals with a diverse range of topics of the basics of pedagogy at the secondary stage that will equip student teachers with valuable knowledge, capacities and competencies. This course comprises four units and a practicum. This course prepares student teachers to understand secondary-stage learners and design teaching accordingly. This course also aims to equip teachers with the necessary tools, knowledge, and competencies to continuously evolve as professionals and create a positive and transformative impact on their students and society as a whole. In this course, a strong foundation will be established by exploring the fundamental principles and concepts that support the basics of pedagogy in light of the aims and objectives of the curriculum. This course emphasises understanding learners and their backgrounds comprehensively so that an engaging and supportive learning environment, which fosters a need for learning, can be created to facilitate learners' holistic development. This course is designed to equip student teachers with a wide array of teaching and learning strategies. It also focuses on innovative and transformative approaches to education, aiming to create lifelong learners equipped to thrive in an ever-changing world. Through professional development opportunities, student teachers will be better prepared to meet the ever-changing demands of the educational landscape and inspire the next generation of learners.

302.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- build a comprehensive understanding of secondary stage learners.
- assess the physical, mental, social, and emotional growth of secondary stage learners.
- develop skills to observe and recognise the unique capabilities and strengths of secondary stage learners.
- discuss the necessary knowledge and skills to implement effective teaching and learning strategies.
- create enriching and inclusive learning environments to foster values-based education,
- develop a deeper understanding of various pedagogical approaches and their impact on learners.
- determine the knowledge to make informed decisions about instructional practices.
- explain the crucial role of pedagogy in facilitating effective learning experiences.
- outline knowledge and skills necessary for continuous professional development.

UNIT - I

Understanding Secondary Stage Learners

A. Understanding the learners and learner background: The physical, mental, social, and emotional growth of learners.

B. Thought processes and cognitive skills of learners, observing the unique capabilities of a learner.

C. Psychological and social orientations of learners, social and academic lives of learners.

D. Characteristics of secondary stage learners, conflicts and challenges of secondary learners.

UNIT - II

Strategies of Teaching and Learning

A. Understanding teaching and learning strategies: Concept, characteristics and functions of teaching.
B. Making abstract concepts enjoyable by relating them to real-life situations, making classrooms inclusive and joyful learning spaces
C. Relationship between Aims and values of education, curriculum and pedagogy
D. Developing respect toward cultural heritage

UNIT - III

Learners Engagement

A. Promoting learner participation and engagement in learning.
B. Building values through art-integrated activities, community engagement, etc.
C. Promoting multidisciplinary learning through the integration of different disciplines
D. Promoting health and social sensitivities.

UNIT - IV

Pedagogical Approaches

A. Pedagogical approaches: constructivist approach, collaborative approach, reflective approach, and integrative approach.
B. Inquiry-based approach; other contemporary approaches, art-integrated and sports-integrated learning.
C. Types of pedagogy: social pedagogy, critical pedagogy, culturally responsive pedagogy, and Socratic pedagogy in an inclusive setup.
D. Role of pedagogy in effective learning: impact of pedagogy on the learners.

UNIT - V

Continuous Professional Development of Teachers

A. Meaning and need, professional and ethical competencies and need for updating content and pedagogical competencies to develop professional competencies.
B. Professional development activities: seminars, conferences, orientation programmes, workshops, online and offline courses, competitions, publications, development of teaching portfolio, capacity building programmes, and teacher exchange programmes.
C. Development of professional competencies to deal with gender issues, equity and inclusion, and ethical issues.
D. Environmental issues, human health and well-being, population, human rights, and various issues (emotional, mental, physical issues related to pandemic (for example, COVID-19).

302.3 Suggestive Practicum (Any Three)

1. Analyse NEP 2020 with reference to pedagogical aspects of the concerned subject.

2. Analyse and reflect on the qualities of an 'Innovative Teacher' in the Context of National Professional Standards for Teachers (NPST) and National Mentoring Mission (NMM).
3. Explore different platforms such as National Teacher's Portal, NISHTHA, DIKSHA, and SWAYAM for an online course and prepare a report.
4. Participate in a workshop or seminar to explore the concept of Continuous Professional Development (CPD), its significance in lifelong learning and prepare a write up on the findings.
5. Develop teaching learning strategies to address the needs of diverse learners in context of gender, equity and inclusion and prepare a PowerPoint presentation.
6. Raise awareness on the ethical and social challenges in education through field trip and create an e-portfolio.
7. Any other project assigned by the teacher.

302.4 Suggestive Mode of Transaction

Lecture cum discussion, project-based method, problem solving method, experiential learning, art integrated learning, sports integrated learning, ICT integrated learning, interactive methods such as group discussions, peer tutoring, workshops, observations, and presentations.

302.5 Suggestive Mode of Assessment

Portfolio creation, written tests, classroom presentations, seminars, assignments, practicum, sessional, terminal semester examinations (As per UGC norms).
Assessment and examinations will be conducted as per the criteria of HNBGU.

302.6 Suggestive Reading Materials

- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India (English and Hindi)
- National Steering Committee for National Curriculum Frameworks (2023). Draft National Curriculum Framework for School Education.
- National Policy on Education 1968, 1986 and 2020.

*Teachers may also suggest books/readings as per the needs of the learners and the learning content.

SEC- 303: Life Skills and Personality Development

Credits:2 Lectures: 30

UNIT I

Career and Professional Skills -(06)

Career and Professional Skills: Listening Skills, Reading Skills, Writing Skills, Effective Resume preparation, Interview Skills, Group Discussion Skills, Exploring Career Opportunities, Psychometric Analysis and Mock Interview Sessions Team Skills: Cognitive and Non-Cognitive Skills, Presentation Skills, Trust and Collaboration, Listening as a Team Skill, Brainstorming, Social and Cultural Etiquettes Digital Skills: Computer skills, Digital Literacy and Social Media, Digital Ethics and Cyber Security

UNIT II

Attitude and Motivation (06) Attitude

Concept, Significance, Factors affecting attitudes, Positive attitude - Advantages, Negative attitude- Disadvantages, Ways to develop a positive attitude, Difference between personalities having positive and negative attitudes. Motivation: Concept, Significance, Internal and external motives - Importance of self-motivation- Factors leading to de-motivation, Maslow's Need Hierarchy Theory of Motivation,

UNIT III

Stress-management and Development of Capabilities (06)

Development of will power, imagination through yogic lifestyle- Development of thinking, emotion control and discipline of mind through Pranayama- Improvement of memory through meditation- Stress: meaning, causes, and effects of stress in life management- Stress: psycho-physical mechanism, management of stress through Yoga.

UNIT IV

Other Aspects of Personality Development (06)

Body language - Problem-solving - Conflict and Stress Management - Decision-making skills -Leadership and qualities of a successful leader - Character-building -Teamwork - Time management -Work ethics – Good manners and etiquette.

UNIT V

Health and Hygiene (06)

Health and Hygiene- Meaning and significance for Healthy Life- 3. Exercise, Nutrition, and Immunity. Obesity- Meaning, Types and its Hazards. - Physical Fitness and Health Related Physical Fitness- Concept, Components and Tests-. Adventure Sports.

Suggested Readings:

Barun K. Mitra, "Personality Development & Soft Skills", Oxford Publishers, Third impression, 2017.

Ghosh, Shanti Kumar. 2004. Universal Values. Kolkata: The Ramakrishna Mission, Larry James, "The First Book of Life Skills"; First Edition, Embassy Books, 2016.

L. Chaito: Relaxation & Meditation Techniques,1983.

Michael Aegyle: Bodily Communication, Methuen,1975.

Mulligan J: The Personal Management (handbook).

M.L. Kamlesh (1998), "Psychology in Physical Education and Sports", Metropolitan Book Company, New Delhi.

Patra, Avinash. 2012. The Spiritual Life and Culture of India. London: Oxford University Press.
Postonjee D.M.: Stress and Coping, The Indian Experience, Sage Publication, New Delhi.
R.D. Sharma (1979), "Health and Physical Education", Gupta Prakashan, New Delhi.
Shiv Khera, “You Can Win”, Macmillan Books, New York, 2003.
Acharya Maha Pragya- Shakti ki Sadhna (Hindi medium)
Acharya Mahapragya- Naya manav, naya Vishwa, Adarsh Sahitya Sangh, Churu (Hindi medium)
Shiv Khera- Jeet Apki (Hindi medium)

Semester-III
(B.A.)

	Subject	Course	Credits
1.	**Botany (Major & Minor)**	1. Plant Physiology and Biochemistry	4+2
2.	**Zoology (Major & Minor)**	1. Elementary Cell Biology & Molecular Biology	4+2
3.	**Physics (Major & Minor)**	1. Heat and Thermodynamics	4+2
4.	**Chemistry (Major & Minor)**	1. Physical Chemistry-II Organic Chemistry - III	4+2
5.	**Mathematics (Major & Minor)**	1. Real Analysis	4

DCMJ-3: Disciplinary
Major Botany
Plant Physiology and Biochemistry (Theory)
Code: SOLS/BOT/ C (T) -3 (MM: 30+70)

Credits: 4 Lectures: 60

UNIT I

Plant-water relations (8 Lectures)
Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.

UNIT II: Mineral Nutrition (8 Lectures)
Essential elements, macro and micronutrients; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps. Sugar translocation.

UNIT III: Photosynthesis (12 Lectures)

Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction centre, antenna molecules; Electron transport and mechanism of ATP synthesis; C3, C4 and CAM pathways of carbon fixation; Photorespiration.

UNIT IV: Respiration (10 Lectures)

Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate cycle, Oxidative Pentose Phosphate Pathway.

UNIT V: Plant growth regulators (12 Lectures)

Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, and ethylene. Plant response to light and temperature (6 Lectures)

Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far-red light responses on photomorphogenesis; Vernalization.

UNIT VI: (10 Lectures)

Biologically important molecules: Carbohydrates, Amino acids, Proteins and Lipids.

Enzymes**:** Structure and properties; Mechanism of enzyme action, coenzymes, allosteric enzymes, isozymes, enzyme inhibition.

Plant Physiology and Biochemistry (Practical)

Code: SOLS/BOT/ C (P) -3 (MM: 30+70)

Credits: 2

1. Determination of osmotic potential of plant cell sap by the plasmolytic method.
2. To study the effect of two environmental factors (light and wind) on transpiration by excised twigs.
3. Calculate the stomatal index and stomatal frequency of a mesophyte and a xerophyte.
4. Demonstration of Hill reaction.
5. To study the effect of light intensity and bicarbonate concentration on O2 evolution in photosynthesis.
6. Comparison of the rate of respiration in any two parts of a plant.
7. Separation of amino acids by paper chromatography.
8. Demonstration experiments (any four)
   (i) Bolting.
   (ii) Effect of auxins on rooting.
   (iii) Suction due to transpiration.
   (iv) R.Q.
   (v) Respiration in roots.

Suggested Readings

1. Taiz, L., Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition.

2. Hopkins, W.G., Huner, N.P. (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.
3. Bajracharya, D. (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.
4. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007) Biochemistry (Sixth Edition) W.H. Freeman & Company, New York.
5. Cox, M.M. and Nelson DL (2004) Lehninger's Principles of Biochemistry (Third Edition), McGraw-Hill.
6. Dennis, D.T. & Turpin, D.H. (1993) Plant Physiology, Biochemistry and Molecular Biology. Longman Scientific & Technical, England.

Major & Minor Zoology

SOLS/ZOO/CZ-3 Elementary Cell Biology & Molecular Biology

Credits: 4 [60 Hours]

UNIT I

Introduction to Cell Theory; Comparison of a generalised Pro- & Eukaryote cell.
Elementary idea of cell fractionation; Light & Phase Contrast Microscopy, Confocal and Electron Microscopy (TEM & SEM) [8 Hours]

UNIT II.

Elementary knowledge of the structure & function of the plasma membrane, cytoplasm [4 Hours]

UNIT III.

Introduction to the organelles constituting endomembrane system (Endoplasmic reticulum, Golgi complex, Lysosome, Peroxisome); Nucleus & Nucleolus; Ribosome; Mitochondria; Chloroplast; Introduction to cytoskeleton [10 Hours]

UNIT IV

Basic features of Cell cycle; Mitosis & Meiosis [6 Hours]

UNIT V

DNA as genetic material: Structure of DNA, Types of DNA; Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, DNA polymerases; primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication [8 Hours]

UNIT VI

DNA damage and repair: Causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, recombinational repair, non-homologous end joining [6 Hours]

UNIT VII

RNA structure and types of RNA: Transcription in prokaryotes—Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains; Transcription in eukaryotes—Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing [10 Hours]

UNIT VIII

Regulation of gene expression and translation: Regulation of gene expression in prokaryotes—Operon concept (inducible and repressible system), Genetic code and its characteristics; aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides [8 Hours]

Suggested Readings

1. Alberts et al.: Molecular Biology of the Cell, Garland Pub., New York, 1989.
2. DeRobertis & DeRobertis: Cell & Molecular Biology, 1996
3. Friefelder: Molecular Biology. Narosa Publ. House, 1996
4. Sharma, V.K.: Techniques in Microscopy and Cell Biology, Tata McGraw-Hill, 1991
5. Strickberger: Genetics, Prentice Hall, 1996.
6. Verma, P.S. and Agarwal, V.K. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology (S. Chand & Co.)
7. Pandey, B.N. B.Sc. Zoology Series: Cytology, Genetics and Molecular Genetics. Tata McGraw-Hill, 2012

SOLS/ZOO/CZ-3(P) Elementary Cell Biology & Molecular Biology (Practical)

Credits: 2

1. Photographs of a prokaryotic cell
2. Photographs of cell organelles
3. Stages of Mitosis by Squash Technique
4. Photographs of the structure of DNA, RNA
5. Diagrams of translation, transcription
6. Preparation of solutions for Molecular Biology experiments.
7. Isolation of chromosomal DNA from bacterial cells.
8. Isolation of Plasmid DNA by the alkaline lysis method
9. Agarose gel electrophoresis of genomic DNA & plasmid DNA
10. Preparation of restriction enzyme digests of DNA samples
11. Demonstration of the AMES test or reverse mutation for carcinogenicity

Major & Minor Physics

Core Physics-I: Heat and Thermodynamics

Credits: 4 [60 hours]

Thermodynamic Description of the system and laws of thermodynamics:

Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law, Reversible & irreversible processes. Second law & Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero. Clausius Clapeyron Equation, Joules Law, Joule Thomson effect.

Thermodynamic Potentials:

Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations & applications. Clausius-Clapeyron Equation, Expression for (CP – CV), CP/CV, TdS equations.

Kinetic Theory of Gases:

Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases, mono-atomic and diatomic gases.

Theory of radiation:

Black body radiation, Spectral distribution, Concept of energy density, Derivation of Planck's law, Dedication of Wien's distribution law, Rayleigh Jeans law, Stefan Boltzmann law and Wien's displacement law from Planck's law. Maxwell-Boltzmann law- distribution of velocity-Quantum statistics, Phase space, Fermi-Dirac distribution law, electron gas, Bose-Einstein distribution law, photon gas, comparison of three statistics.

Reference Books:

1. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
2. A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press.
3. Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
4. Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W. Sears &G. L. Salinger. 1988, Narosa
5. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

Core Physics-I: Heat and Thermodynamics (Practical)

Credits:2

List of Experiments:

1. To determine the Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. Measurement of Planck's constant using black body radiation.
3. To determine Stefan's Constant.
4. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.

5. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
6. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
7. To determine the temperature coefficient of resistance using a Platinum resistance thermometer.
8. To study the variation of thermo-emf across two junctions of a thermocouple with temperature.
9. To record and analyse the cooling temperature of a hot object as a function of time using a thermocouple and a suitable data acquisition system
10. To calibrate Resistance Temperature Device (RTD) using Null Method/Off-Balance Bridge

Reference Books:

1. Advanced Practical Physics for students, B. L. Flint & H. T. Workshop, 1971, Asia Publishing House.
2. Advanced level Physics Practical, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition,2011, Kitab Mahal, New Delhi.
4. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal,1985, Vani Publication.

Major & Minor Chemistry

Physical Chemistry-II, Organic Chemistry- III

(Solutions, Phase Equilibrium, Conductance, Electrochemistry & Functional Group Organic Chemistry-II) (Theory)

Code: (SOS/CHEM/CT-003)

Credits- 04

Section A

Physical Chemistry (30 Lectures) Solutions (8 Lectures) Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law– non-ideal solutions. Vapour pressure- composition and temperature composition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes. Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids: Principle of steam distillation. Nernst distribution law and its applications, solvent extraction.

Phase Equilibrium (8 Lectures)

Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of the Clausius-Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur) and two-component systems involving eutectics, congruent and incongruent melting points (lead-silver, FeCl3-H2O and Na-K only).

Conductance, Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch's law of independent migration of ions. Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations (only acid-base).

Electrochemistry (6 Lectures)

Reversible and irreversible cells. Concept of EMF of a cell. Measurement of the EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: G, H and S from EMF data. Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge. pH determination using a hydrogen electrode and a quinhydrone electrode. Potentiometric titrations –qualitative treatment (acid-base and oxidation-reduction only).

Section B

Organic Chemistry-3 (30 Lectures)

Functional group approach for the following reactions (preparations& reactions) to be studied in context to their structure.

Carboxylic acids and their derivatives. Carboxylic acids (aliphatic and aromatic). Preparation: Acidic and Alkaline hydrolysis of esters. Reactions: Hell–Vohlard-Zelinsky Reaction.

Carboxylic acid derivatives (aliphatic): (Up to 5 carbons) (6 Lectures)

Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion. Reactions: Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation.

Amines and Diazonium Salts (6 Lectures)

Amines (Aliphatic and Aromatic): (Up to 5 carbons)

Preparation: from alkylhalides, Gabriel's Phthalimide synthesis, and Hofmann Bromamide reaction. Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO_2, Schotten–Baumann Reaction. Electrophilic substitution (caseaniline): nitration, bromination, sulphonation. Diazonium salts: Preparation: from aromatic amines. Reactions: conversion to benzene, phenol, dyes.

Amino Acids, Peptides and Proteins (10 Lectures)

Preparation of Amino Acids: Strecker synthesis using Gabriel's phthalimide synthesis. Zwitterion, Isoelectric Point and Electrophoresis. Reactions of Amino Acids: ester of –COOH group, acetylation of–NH_2 group, complexation with Cu^{2+} ions, and the ninhydrin test. Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins. Determination of the Primary structure of Peptides by degradation, Edmann degradation (N-terminal) and C-terminal (thiohydantoin and with the carboxypeptidase enzyme. Synthesis of simple peptides

(up to dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid-phase synthesis.

Carbohydrates (8 Lectures)

Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disaccharides (sucrose, cellobiose, maltose, lactose) and polysaccharides (starch and cellulose), excluding their structure elucidation.

Reference Books:

• Barrow, G.M. Physical Chemistry, Tata McGraw-Hill (2007). • Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).

• Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry, Cengage Learning India Pvt. Ltd.: New Delhi (2009).

• Mahan, B.H. University Chemistry, 3rd Ed. Narosa (1998).

• Petrucci, R.H. General Chemistry, 5th Ed., Macmillan Publishing Co.: New York (1985).

• Morrison, R. T. & Boyd, R.N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

• Finar, I.L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

• Finar, I.L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

• Nelson, D.L. & Cox, M.M. Lehninger's Principles of Biochemistry 7th Ed., W.H. Freeman.

• Berg, J.M., Tymoczko, J.L. & Stryer, L. Biochemistry, W.H. Freeman, 2002.

Physical Chemistry-II, Organic Chemistry-III (Practical)

(Solutions, Phase Equilibrium, Conductance, Electrochemistry & Functional Group Organic Chemistry-II)

Code: (SOS/CHEM/CP-003)

Credits: 2

Section A: Physical Chemistry

Distribution Study of the equilibrium of one of the following reactions by the distribution method: I2(aq)+I- (aq)I3 - (aq) Cu2+(aq) +xNH2(aq) [Cu (NH3) x] 2+

Phase equilibria

a) Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.

b) Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it.

c) Study of the variation of mutual solubility temperature with concentration for the phenol-water system and determination of the critical solubility temperature.

Conductance

I. Determination of cell constant

II. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.

III. Perform the following conductometric titrations: i. Strong acid vs. strong base ii. Weak acid vs. strong base Potentiometry

Perform the following potentiometric titrations: i. Strong acid vs. strong base

ii. Weak acid vs. strong base

iii. Potassium dichromate vs. Mohr's salt

Section B: Organic Chemistry

I Systematic Qualitative Organic Analysis of Organic Compounds possess in mono functional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative. II 1. Separation of amino acids by paper chromatography

2. Determination of the concentration of glycine solution by the formylation method.

3. Titration curve of glycine

4. Action of salivary amylase on starch

5. Effect of temperature on the action of salivary amylase on starch.

6. Differentiation between a reducing and a non-reducing sugar.

Reference Books:

- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman,1960.
- Khosla, B. D.; Garg, V.C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
- Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry, Universities Press.

Major & Minor Mathematics-III(CS-1)

Real Analysis (Theory)

Credits: 6

UNIT I

Finite and infinite sets, Examples of countable and uncountable sets, Real line, Bounded sets, Supremum and infimum, Completeness property of R, Archimedean property of R, intervals, Concept of limit points, closed sets, statement of Bolzano-Weierstrass theorem.

UNIT II

Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences, Cauchy's theorem on limits, order preservation, squeeze theorem, monotone sequences, and their convergence, and the monotone convergence theorem.

UNIT III

Infinite series. Cauchy convergence criterion for series, Positive term series, Geometric series, Comparison test, p-test, Root test, Ratio test, Alternating series, Leibniz's test, Cauchy Condensation test, absolute and conditional convergence.

UNIT IV

Riemann integral: Definition and examples, Properties of Riemann integrals, Necessary and sufficient conditions for integrability, Fundamental theorem of Calculus.

Books Recommended

1.T. M. Apostol, Calculus (Vol. I), John Wiley and Sons (Asia) P. Ltd., 2002.

2. R.G. Bartle and D. R Sherbert, Introduction to Real Analysis, John Wiley and Sons (Asia) P. Ltd., 2000.

3. K.A. Ross, Elementary Analysis- The Theory of Calculus Series- Undergraduate Text in Mathematics, Springer Verlag, 2003.

Hemvati Nandan Bahuguna Garhwal University

Dept of Education

ITEP Curriculum

Semester-IV

(B.Sc. B.Ed.)

Two-Week Student Induction Programme			
S.N.	**Code**	**Courses**	**Credit**
1.	EFC-401	Philosophical and Sociological Perspectives of Education-I	4
2.	ESSCCPC-402 Stage-Specific Content -cum Pedagogy Courses (Any Two)	A. Content cum Pedagogy of Mathematics at Secondary Stage – Course (I)	2
		B. Content cum Pedagogy of Physics at Secondary Stage - Course (I)	2
		C. Content cum Pedagogy of Chemistry at Secondary Stage - Course (I)	2
		D. Content cum Pedagogy of Zoology at Secondary Stage - Course (I)	2
		E. Content cum Pedagogy of Botany at Secondary Stage - Course (I)	2
3.	EAEVAC-403	Citizenship Education, Sustainability and Environment Education	2

EFC-401: Philosophical and Sociological Perspectives of Education-I

Credits: 4

401.1 About the Course

The course aims at enabling student teachers to explore educational philosophy, including the concept, nature and scope; the aims of educational philosophy; relationship between philosophy and education; Indian philosophical traditions and their implications for education; some of the key philosophical schools of thought such as idealism, naturalism, pragmatism, progressivism and existentialism and their implication for educational practices. The course would also provide an analysis of the Western schools of philosophy and their approaches, etc.

401.2 Learning Outcomes

- to encourage students to explore the nature of knowledge, the nature of human beings, the nature of society and its aims and the educational implications of these understandings.
- to engage the prospective teachers to read and acquaint themselves with the meaning of terms like vidya, avidya, shiksha, education etc. and to facilitate them to understand and differentiate them through reflections on these terms on the basis of ancient Indian texts.
- to facilitate prospective teachers to engage themselves in peer groups for sharing of their real-life reflective experiences regarding socio-cultural and philosophical living, and facilitate them to conceptualise the meaning of terms like philosophical, social and cultural traditions in the Indian educational context.
- to orient and engage prospective teachers to read, observe and understand the vision of some great Indian and global educators and categorically reflect on vision/aim, process of education and the contemporary relevance.

UNIT - I

Education and Philosophy

A. Conceptual clarity, nature and relationships.
B. Aims of studying the philosophical perspective of education.

C. Branches of Philosophy and their educational implications: Metaphysics (तत्त्वमीमांसा), Epistemology (ज्ञानमीमांसा), Axiology (मूल्यमीमांसा)

UNIT – II
Indian and Western Perspectives of Education

A. Understanding the Indian perspective of education: Meaning, nature and aims of education with special reference to Vedic, Buddhist, Jain, Sikh and Islamic traditions.
B. Understanding the terms Darshana, Para and Apara Vidya, Avidya, Shiksha, Samvaad, Panchkosha.
C. Concepts of Gurukulam, Acharya, Guru, Shishya, Upadhyaya, Jigyasa, Swadhyaya.
D. Understanding the Western perspective of education: Meaning, Nature and aims of education with reference to Cognitive, Behaviourist and Developmental theories of Education.

UNIT - III
Philosophical Schools and Education

A. Conceptual clarity of the following schools of thought, with their implications for educational practices:
- Bharatiya: Samakhya, Yoga, Nyaya, Vaisheshika, Mimansa, Vedanta
- Western: Idealism, Naturalism, Pragmatism, Progressivism.

UNIT - IV
Educational Thinkers

A. Deliberations on aims, process and educational institutions developed on the thoughts of the following thinkers and practitioners:
- Bharatiya**:** Swami Vivekananda, Sri Aurobindo Ghosh, Gurudev Rabindra Nath Tagore, J. Krishnamurti, Mahamana Madan Mohan Malaviya, Mahatma Gandhi, Gijubhai Badheka.
- Western**:** J. Rousse, Maria Montessori, Friedrich Froebel, John Dewey.

UNIT - V
Value Education

A. Conceptual clarity, significance and types of values. Indian traditional values.
B. Guru-shishya-parampara and educational values. Convocation message in Taittiriya Upanishad.
C. Values enshrined in the Indian Constitution.
D. NEP, 2020 and values with special reference to the 21st Century. Pedagogical issues.

401.3 Suggestive Practicum

1. Individual/group assignments/tasks in various forms like writing small paragraphs/brief notes, conceptualisations on specific terms, etc.
2. Institutional visits in small groups in coordination with institutions related to different thinker/s and preparation of a report, followed by individual/group presentation.

3. Sharing of student experiences (in groups) related to readings on great thinkers helps them to reshape their concept and enables them to develop vision, mission and objectives for a school and their plan to accomplish the objectives in the form of a group report.
4. Identification and reporting of the Indian perspective related to educational aims, student-teacher characteristics, methods, evaluation procedure, convocation, etc., based on the critical study of the life and thoughts of thinkers.

401.4 Suggestive Mode of Transaction

The course content transaction will include the following:

- Organised lectures using a variety of media.
- Small group discussion, panel interactions, small theme-based seminars, group discussions, cooperative teaching and team teaching, engagement of in reading of primary or secondary sources of literature (Original texts, reference books etc.) related to different aspects of life and education of Great Educators, case studies, short term project work etc.

401.5 Suggestive Mode of Assessment

The assessment will be based on the tests and assignments.
Assessment and examinations will be conducted as per the criteria of HNBGU.

401.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the needs of the learners and the learning content.

ESSCCPC-402: Stage-Specific Content -cum-Pedagogy Courses (Any Two)

402-A: Content cum Pedagogy of Mathematics at the Secondary Stage – Course (I)

Credits: 2

402-A.1 About the Course

Mathematics is an important school subject, and students are expected to master computational and problem-solving skills with the help of mathematical concepts and reasoning during their studies. Teaching of Mathematics is not only concerned with the computational know-how of the subject, but is also concerned with pedagogical content knowledge and communication leading to its meaningful learning amongst students. This course enables the student-teachers to understand the nature of mathematical knowledge and the mathematics curriculum at the secondary stage. The objectives of teaching Mathematics should not be limited to the development of computational skills, but also to enable mathematical reasoning to solve problems of life. Student teachers will develop skills to formulate classroom objectives as well as plan for the development of values through Mathematics. Student teachers will have a thorough understanding of the mathematics content and their relevant specific pedagogy for the effective learning of Mathematics. They would be exposed to various pedagogical approaches, methods, and techniques so that they will be able to create a learner-friendly classroom environment.

402-A.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- appraise the contribution of Indian Knowledge Systems in the development of Mathematics.
- explain the nature of Mathematics as an important subject for human development.
- interpret the recommendations of the various policy documents in Mathematics education.
- classify the aims and objectives of teaching Mathematics.
- formulate objectives based on learning outcomes for Mathematics teaching.
- select and demonstrate various approaches and methods of teaching Mathematics.
- plan strategies to inculcate values through teaching Mathematics.

UNIT - I

Nature, Scope and Historical Perspective of Mathematics

A. Development of Mathematics from a historical perspective.
B. Nature of Mathematical Knowledge – Axioms and Postulates, Conjectures, Proofs in Mathematics: inductive-deductive reasoning, theorems, mathematical modelling.
C. Importance of Mathematics knowledge in everyday life.
D. Recommendations of various committees, commissions and policies related to Mathematics education at the Secondary stage (especially in National Education Policies and National Curriculum Frameworks).

UNIT - II

Aims and Objectives of Teaching Mathematics

A. Aims and objectives of teaching Mathematics at the secondary stage.
B. Learning outcomes and competencies of teaching Mathematics at the secondary stage.
C. Linkages of Mathematics with other school subjects and its place in the school curriculum.
D. Inculcation of values through teaching of Mathematics.

UNIT - III

Pedagogical Aspects of Mathematics

A. Implication of various approaches of teaching Mathematics – inductive deductive, analytical, synthetic, constructivist, blended learning, experiential learning, transdisciplinary, interdisciplinary, and multidisciplinary.
B. Learner-centric and participative methods of teaching of Mathematics: lecture cum demonstration, problem-solving, laboratory, project based.
C. Analytical pedagogical concerns in teaching of Mathematics for higher order thinking skills, such as critical, creative, decision making, reflective, collaborative, and cooperative.
D. Techniques of teaching learning Mathematics: oral, written, drill work, homework, self-study, group study, supervised study, concept-mapping, learning, art and sports integrated learning.

402-A.3 Suggestive Practicum (Any Three)

1. Prepare a collage/ biographic sketch on the contribution of the Indian mathematician.

2. Present a paper on the comparison of the nature of mathematical knowledge with other school subjects.
3. Formulate objectives based on learning outcomes and experiential learning for any one unit of secondary mathematics.
4. Develop a strategy to connect any 3 topics for value inculcation for teaching mathematics.
5. Analyse the content of one chapter of a mathematics textbook and develop concept maps at the secondary stage.
6. Select and list approaches and methods for teaching various topics of mathematics.
7. Any other project assigned by the teacher.

402-A.4 Suggestive Mode of Transaction

Demonstration, field-based experience, library visits, classroom discussions, self-study, field observations, assignment preparation, classroom presentations, discussion forums, observation, research report, engaging in dialogue, flipped classroom.

402-A.5 Suggestive Mode of Assessment

Written test, classroom presentation, workshop, assignments, practicum, sessional and terminal semester examination (As per UGC norms).

Assessment and examinations will be conducted as per the criteria of HNBGU.

402-A.6 Suggestive Reading Material

- MESE 001(2003) Teaching and Learning Mathematics. IGNOU series
- NCERT Publications: Pedagogy of Mathematics (Code-13074)

*Teachers may also suggest books/readings as per the needs of the learners and the learning content.

402-B: Content cum Pedagogy of Physics at the Secondary Stage - Course (I)

Credits: 2

402-B.1 About the Course

The focus of the National Education Policy (NEP) 2020 is on the holistic development of students. To achieve the objectives, interventions from quality teachers are vital. Sound pedagogical content knowledge and teaching methods are the determinants of a teacher's quality and professionalism. The teacher education programme strongly emphasises pedagogy, its principles, and the practices of teaching and learning. Pedagogical knowledge and approaches refer to the specialised knowledge of the teacher for creating an active, child-centred, and inclusive teaching-learning environment for the students and need to be developed among the student teachers. This pedagogical course in Physics is intended to enhance the pedagogical content knowledge of student teachers through different learning approaches and methods. This course comprises three units and a practicum. The course is devoted to developing an understanding of the nature and scope of Physics, its aims and objectives and linkages with other disciplines. Historical/policy perspectives of physics are discussed in the second unit. Physics is conceptualised in very broad terms by relating it to technology, society, humans, and sustainable development. It also focuses on the place of physics in the school curriculum,

including an emphasis on how to build inclusive classrooms. It focuses on pedagogical concerns of physics. Critical, creative, and analytical pedagogical concerns in teaching physics with special reference to higher-order thinking are placed in the third unit.

402-B.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- explain the nature, scope and importance of physics.
- illustrate the aims and objectives of teaching physics.
- outline linkages between physics and other subjects.
- identify the values and importance of physics and alternative knowledge systems.
- summarize the historical/policy perspective of physics.
- examine pedagogical concerns of physics.
- categorize approaches and methods of teaching and learning physics.
- apply appropriate pedagogy in teaching and learning the concepts of Physics.

UNIT - I

Nature, Scope and Historical Perspective of Physics

A. Nature, scope, and importance of Physics and its historical perspectives.
B. Contributions of Indian (ancient and modern) and other scientists.
C. Physics, society and human and sustainable development.
D. Recommendations of various committees, commissions, and policies in reference to physics.

UNIT - II

Aims and Objectives of Physics

A. Aims and objectives of teaching Physics.
B. Learning outcomes and competencies of teaching Physics at the secondary stage.
C. Linkages of Physics with other school subjects and the place of Physics in the school curriculum.
D. Values of Physics: scientific attitude and appreciating other systems of knowledge/ alternative knowledge systems.

UNIT - III

Pedagogical Aspects of Physics

A. Implication of various approaches - inductive, deductive, constructivist, experiential learning, art-integrated learning, sports-integrated learning, blended learning, interdisciplinary and multidisciplinary approaches in teaching Physics.
B. Analytical pedagogical concerns in teaching of Physics for higher order thinking skills, such as critical, creative, communication, decision making, and reflective.
C. Methods of teaching learning Physics: learner-centric and group-centric, lecture cum demonstration, activity based, discussion, problem-solving.
D. Laboratory, stem and steam, project-based, scientific inquiry, hands-on activity, discovery, experimentation, concept-mapping, collaborative and cooperative learning.

402-B.3 Suggestive Practicum (Any Three)

1. Explore contributions of Indian scientists in the development of physics, and make presentations on the historical development of physics.
2. Analyse recommendations of policies/commissions in the context of physics.
3. Develop concept maps on different concepts of physics.
4. Identify and integrate values in physics concepts.
5. Demonstrate different pedagogical approaches and strategies for teaching physics.
6. Prepare write-ups on the teaching of science using interdisciplinary and multidisciplinary approaches as recommended in NEP 2020.
7. Any other project.

402-B.4 Suggestive Mode of Transaction

Lecture cum discussion/demonstration, hands-on activities, experiential learning, art and environment integrated learning, sports integrated learning.

402-B.5 Suggestive Mode of Assessment

Written tests, classroom presentations, workshops, seminars, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).
Assessment and examinations will be conducted as per the criteria of HNBGU.

402-B.6 Suggestive Reading Material

- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India.
- National Steering Committee for National Curriculum Frameworks (2023). National Curriculum Framework for School Education.
- NCERT, Textbooks of Physics at the secondary stage.

*Teachers may also suggest books/readings as per the needs of the learners and the learning content.

402-C: Content cum Pedagogy of Chemistry at the Secondary Stage - Course (I)

Credits: 2

402-C.1 About the Course

The focus of the National Education Policy (NEP) 2020 is on the holistic development of students. To achieve the objectives, interventions from quality teachers are vital. Sound pedagogical content knowledge and teaching methods are the determinants of a teacher's quality and professionalism. The teacher education programme strongly emphasises pedagogy, its principles, and the practices of teaching and learning. Pedagogical knowledge and approaches refer to the specialised knowledge of the teacher for creating an active, child-centred, and inclusive teaching-learning environment for the students and need to be developed among the student teachers. This pedagogical course in Physics and Chemistry is intended to enhance the pedagogical content knowledge of student teachers through different learning approaches and methods. This course comprises three units and a practicum. The course is devoted to

developing an understanding of the nature and scope of Chemistry, the aims and objectives of teaching Chemistry, and their linkages with other disciplines. Historical/policy perspectives of Chemistry are discussed in the second unit. Chemistry is conceptualised in very broad terms by relating them to technology, society, humans, and sustainable development. It also focuses on the place of Chemistry in the school curriculum, including an emphasis on how to build inclusive classrooms. It focuses on pedagogical concerns of Chemistry. Critical, creative, and analytical pedagogical concerns in teaching Chemistry with special reference to higher-order thinking are also placed in the third unit.

402-C.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- explain the nature, scope and importance of Chemistry,
- illustrate the aims and objectives of teaching Chemistry.
- outline linkages between Chemistry and other subjects,
- identify the values and importance of Chemistry and alternative knowledge systems,
- summarize the historical/policy perspective of Chemistry.
- examine pedagogical concerns of Chemistry,
- categorize approaches and methods of teaching and learning Chemistry.
- apply appropriate pedagogy in teaching and learning the concepts of Chemistry.

UNIT - I

Nature, Scope and Historical Perspective of Chemistry

A. Nature, scope, and importance of Chemistry and its historical perspective.
B. Contributions of Indian (ancient and modern) and other scientists.
C. Chemistry, society and human and sustainable development.
D. Recommendations/suggestions of various committees, commissions, and policies in reference to Chemistry.

UNIT - II

Aims and Objectives of Chemistry

A. Aims and objectives of teaching Chemistry.
B. Learning outcomes and competencies of teaching Chemistry at the secondary stage.
C. Linkages of Physics and Chemistry with other school subjects and the place of Chemistry in the school curriculum.
D. Values of Chemistry: scientific attitude and appreciating other systems of knowledge / alternative knowledge systems.

UNIT - III

Pedagogical Aspects of Chemistry

A. Implication of various approaches - inductive, deductive, constructivist, experiential learning, art-integrated learning, sports-integrated learning, blended learning, interdisciplinary and multidisciplinary approaches in Chemistry.
B. Analytical pedagogical concerns in teaching of Chemistry for higher order thinking skills such as critical, creative, communication, decision making, and reflective.

C. Methods of teaching learning Chemistry: learner-centric and group-centric, lecture cum demonstration, activity based, discussion, problem-solving.
D. Laboratory, stem and steam, project-based, scientific inquiry, hands-on activity, discovery, experimentation, concept-mapping, collaborative and cooperative learning.

402-C.3 Suggestive Practicum (Any Three)

1. Explore contributions of Indian scientists in the development of chemistry and make presentations on the historical development of chemistry.
2. Analyse recommendations of policies/commissions in the context of chemistry.
3. Develop concept maps on different concepts of chemistry.
4. Identify and integrate values in chemistry concepts.
5. Demonstrate different pedagogical approaches and strategies for teaching chemistry.
6. Prepare write-ups on the teaching of science using interdisciplinary and multidisciplinary approaches as recommended in NEP 2020.
7. Any other project.

402-C.4 Suggestive Mode of Transaction

Lecture cum discussion/demonstration, hands-on activities, experiential learning, art and environment integrated learning, sports integrated learning.

402-C.5 Suggestive Mode of Assessment

Written tests, classroom presentations, workshops, seminars, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).
Assessments and examinations will be conducted as per the criteria of HNBGU.

402-C.6 Suggestive Reading Material

- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India.
- National Steering Committee for National Curriculum Frameworks (2023). National Curriculum Framework for School Education.
- NCERT, Textbooks of chemistry at the secondary stage.

*Teachers may also suggest books/readings as per the needs of the learners and the learning content.

402-D: Content cum Pedagogy of Zoology at the Secondary Stage - Course (I)

Credits: 2

402-D.1 About the Course

Biology is an inseparable part of human life, and hence learning biological concepts and principles is given ample importance in school curricula. Knowledge of zoology enables students to recognise and value the diverse living forms, their structure and method of functioning, co-existence and how they harmoniously blend with other natural/physical factors that constitute the complex environment. To enable school students to adequately learn these aspects, teachers must design and adopt appropriate teaching-learning methods

for teaching zoology. It offers us the unique facility of seeing, touching and observing materials. This course aims to educate student teachers to learn the various methods and strategies in teaching zoology. The course comprises three units describing the aims and scope of zoology at the Secondary level. A glimpse of the history of zoology is dealt with, ancient and modern Indian and international contributions in the study of biological methods and practices in building the modern-day zoology. Salient features of selected earlier curricular exercises with special reference to biology at the secondary level are also emphasised.

402-D.2 Learning Outcomes

After completion of this course, Student teachers will be able to:

- explain the nature, scope, and importance of zoology.
- illustrate the aims and objectives of teaching zoology for sustainable development.
- outline linkages between zoology and other subjects.
- identify the values and importance of zoology and alternative knowledge systems.
- summarise the historical/policy perspective of zoology.
- examine pedagogical concerns of zoology.
- categorize and apply approaches and methods of teaching and learning zoology.
- apply proper pedagogy in teaching and learning the concepts of zoology.
- realize the importance of studying zoology as part of the school curriculum,
- identify the values and significance of zoology in school curricula,

UNIT - I

Nature, Scope and Historical Perspective of Zoology

A. Nature, scope, and importance of zoology. Historical perspective of zoology.
B. Contributions of Indian (ancient and modern) and other scientists.
C. Zoology for sustaining self, society, environment, and world.
D. Recommendations/suggestions of various committees, commissions, and policies in reference to zoology.

UNIT - II

Aims and Objectives of Zoology

A. Aims and objectives of teaching zoology as a component of multidisciplinary science.
B. Learning outcomes and competencies of teaching zoology at the secondary stage.
C. Linkages of zoology with other school subjects and the place of zoology in the school curriculum.
D. Values of zoology: ethical, environmental and sustainability concerns.

UNIT - III

Pedagogical Aspects of Zoology

A. Implication of various approaches – inductive, deductive, constructivist, experiential, art-integrated, blended learning, interdisciplinary and multidisciplinary approaches, stimulating the spirit of investigation and enquiry.
B. Analytical pedagogical concerns in teaching of zoology for higher order thinking skills such as critical, creative, communication, decision making, and reflective.

C. Methods of teaching learning zoology: learner-centric and group-centric, lecture cum demonstration, activity based, discussion, problem-solving.
D. Laboratory and hands-on activity-based, sports-integrated, project-based, inquiry, discovery, experimentation, concept-mapping, collaborative and cooperative learning; STEM and STEAM concept.

402-D.3 Suggestive Practicum (Any Three)

1. Plot a timeline of the development of zoology from ancient to modern times, mentioning the important developments.
2. Analyse and prepare a report on the pedagogy of zoology with reference to NEP 2020.
3. Develop concept maps on different concepts of zoology.
4. Demonstrate different pedagogical approaches and strategies for teaching zoology.
5. Any other projects

402-D.4 Suggestive Mode of Transaction

Lecture cum discussion, demonstration, hands-on activities, experiential learning, inquiry, Group work, Presentations, multimedia.

402-D.5 Suggestive Mode of Assessment

Written tests, classroom presentations, workshops, seminars, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).
Assessment and examinations will be conducted as per the criteria of HNBGU.

402-D.6 Suggestive Reading Material

- National Council of Educational Research and Training. (April 2022). Mandate documents guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India
- National Steering Committee for National Curriculum Frameworks (2023). National Curriculum Framework for School Education.
- NCERT, textbooks of zoology at the secondary stage.

*Teachers may also suggest books/readings as per the needs of the learners and the learning content.

402-E: Content cum Pedagogy of Botany at the Secondary Stage - Course (I)

Credits: 2

402-E.1 About the Course

Biology is an inseparable part of human life, and hence learning biological concepts and principles is given ample importance in school curricula. Knowledge of botany enables students to recognise and value the diverse living forms, their structure and method of functioning, co-existence and how they harmoniously blend with other natural/physical factors that constitute the complex environment. To enable school students to adequately learn these aspects, teachers must design and adopt appropriate teaching-learning methods for teaching botany. Botany offers us the unique facility of seeing, touching and observing

materials. This course aims to educate student teachers to learn the various methods and strategies in teaching botany. The course comprises three units describing the aims and scope of botany at the secondary level. A glimpse of the history of botany is dealt with, ancient and modern Indian and international contributions in the study of biological methods and practices in building the modern-day botany. Salient features of selected earlier curricular exercises with special reference to biology at the secondary level are also emphasised.

402-E.2 Learning Outcomes

After completion of this course, Student teachers will be able to:

- explain the nature, scope, and importance of botany.
- illustrate the aims and objectives of teaching botany for the sustainable development of society,
- outline linkages between botany and other subjects,
- identify the values and importance of botany and alternative knowledge systems,
- summarize the historical/policy perspective of botany.
- examine pedagogical concerns of Botany,
- categorize approaches and methods of teaching and learning Botany.
- apply proper pedagogy in teaching and learning the concepts of Botany,
- realize the importance of studying botany as part of the school curriculum.
- identify the values and significance of botany in school curricula,
- apply appropriate method/s in teaching concepts of botany.

UNIT - I

Nature, Scope and Historical Perspective of Botany

A. Nature, scope, and importance of botany and the historical perspective of botany.
B. Contributions of Indian (ancient and modern) and other scientists.
C. Botany for sustaining self, society, environment, and world.
D. Recommendations/suggestions of various committees, commissions, and policies in reference to botany.

UNIT - II

Aims and Objectives of Botany

A. Aims and objectives of teaching botany as a component of multidisciplinary science.
B. Learning outcomes and competencies of teaching botany at the secondary stage.
C. Linkages of botany with other school subjects and the place of Botany in the school curriculum.
D. Values of botany: ethical, environmental and sustainability concerns.

UNIT - III

Pedagogical Aspects of Botany

A. Implication of various approaches – inductive, deductive, constructivist, experiential, art-integrated, blended learning, interdisciplinary and multidisciplinary approaches, stimulating the spirit of investigation and enquiry.
B. Analytical pedagogical concerns in teaching of botany for higher order thinking skills such as critical, creative, communication, decision making, and reflective.

C. Methods of teaching learning botany: learner-centric and group-centric, lecture cum demonstration, activity based, discussion, problem-solving.

D. Laboratory and hands-on activity-based, sports-integrated, project-based, inquiry, discovery, experimentation, concept-mapping, collaborative and cooperative learning; STEM and STEAM concept.

402-E.3 Suggestive Practicum (Any Three)

1. Plot a timeline of the development of botany from ancient to modern times, mentioning the important developments.
2. Analyse and prepare a report on the pedagogy of botany with reference to NEP 2020.
3. Prepare a write-up on ancient Indian contributions and practices in Ayurveda/Herbal medicines.
4. Develop concept maps on different concepts of botany.
5. Demonstrate different pedagogical approaches and strategies for teaching botany.
6. Any other projects

402-E.4 Suggestive Mode of Transaction

Lecture cum discussion, demonstration, hands-on activities, experiential learning, inquiry, Group work, Presentations, multimedia.

402-E.5 Suggestive Mode of Assessment

Written tests, classroom presentations, workshops, seminars, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).

Assessment and examinations will be conducted as per the criteria of HNBGU.

402-E.6 Suggestive Reading Material

- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.

National Education Policy 2020, MoE, Government of India

- National Steering Committee for National Curriculum Frameworks (2023). National curriculum framework for school education.
- NCERT, Textbooks of botany at the secondary stage.

*Teachers may also suggest books/readings as per the needs of the learners and the learning content.

EAEVAC-403: Citizenship Education, Sustainability and Environment Education

Credits: 2

403.1 About the Course

This course seeks to orient student teachers to the Constitution of India with a particular emphasis on Fundamental Rights and Fundamental Duties, and to prepare them for their roles and responsibilities as responsible, productive, and effective citizens of India. The course also seeks to enable student teachers to understand the interconnected and interdependent world, India's rich heritage and philosophical foundation of *"Vasudaiva*

Kutumbakam" (Whole world is one family), acquire the knowledge, capacities, values, and dispositions needed to understand global issues and become active promoters of more peaceful, harmonious and sustainable societies. The course also seeks to create among student teachers an awareness of responsible global citizenship required for responding to contemporary global challenges.

The sustainability aspect of the course seeks to develop among student teachers an understanding of the idea of 'Sustainability' in all fields of human activities, including achieving sustainable development in its three dimensions – economic, social, and environmental - in a balanced manner. The environmental education component of the course aims at creating an awareness among student teachers of environmental issues, including actions required for mitigating the effects of climate change, environmental degradation and pollution, and initiatives required for effective waste management, conservation of biological diversity, management of biological/natural resources, forest and wildlife conservation, and sustainable development and living. The course will also deepen the knowledge and understanding of India's environment in its totality, its interactive processes, and effects on the future quality of people's lives.

403.2 Learning Outcomes

After completion of the course, student teachers will be able to:

- explain the concept of citizenship and citizenship education,
- describe the aims of and approaches to citizenship education,
- explain the concept and aims of Global Citizenship and Global Citizenship Education,
- describe the aims of and approaches to global citizenship education,
- explain the concept of 'Sustainability' in all fields of human activities, and approaches to achieving sustainable development in its three dimensions – economic, social and environmental – in a balanced manner,
- demonstrate an awareness of environmental issues, and actions required for mitigating the effects of climate change, environmental degradation and pollution, and initiatives required for effective waste management, conservation of biological diversity, management of biological/natural resources, forest and wildlife conservation, and sustainable development and living.

UNIT - I

Citizenship Education

A. Concept of citizenship and citizenship education. Aims of and approaches to citizenship education.
B. Concept of global citizenship and global citizenship education.
C. Aims of and approaches to global citizenship education.
D. Concept of *Vasudhaiva Kutumbakam*, its importance in the development of a holistic perspective towards local and global communities.

UNIT - II

Sustainability

A. Concept of 'Sustainability' in all fields of human activities. Approaches to achieving sustainable development in its three dimensions – economic, social, and environmental.
B. Sustainable development goals. Education for sustainable development

C. Sustainable management of natural resources.
D. School- and community-based activities.

UNIT - III

Environmental Education

A. Environmental issues. Actions required for mitigating the effects of climate change, reducing environmental degradation, pollution, etc.
B. Initiatives required for effective waste management, conservation of biological diversity, management of biological/natural resources, forest and wildlife conservation, and sustainable development and living.
C. Approaches to delivering environmental education. School and community-based environmental education activities.
D. Role of mass media and technology in delivering environmental education. Roles of Governmental and Non-Governmental organisations in promoting environmental education.

403.3 Suggestive Practicum

1. Write a report on the roles of governmental and non-governmental organisations in promoting environmental education.
2. Any other activity assigned by the teacher.

403.4 Suggestive Mode of Transaction

Lecture-cum- discussion, Focus Group discussions, in-class seminars, Library Work, Assignments, Project Work, Lesson Plan Development, Interaction with different stakeholders, ICT-based educational materials, Group Work, critical reflections, case-based approaches, and enquiry-based learning.

403.5 Suggestive Mode of Assessment

Assessment of practicum and assessment of reflective level readings.
Assessment and examinations will be conducted as per the criteria of HNBGU.

403.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the needs of the learners and the learning content.

Semester-IV

(B.Sc. B.Ed.)

SN	Subject	Course	Credits
1.	**Botany (Major & Minor)**	1. Plant Taxonomy and Plant Embryology (Theory and Practical) Plant Taxonomy and Plant Embryology (Theory and Practical)	4+2
2.	**Zoology (Major & Minor)**	• Physiology and Elementary Biochemistry Theory (Cr-4) and Practical	4+2
3.	**Physics (Major & Minor)**	1. DCPHY-401 Waves and Optics Theory (Cr-4) and Practical (Cr-2)	4+2

4.	**Chemistry (Major & Minor)**	• Inorganic Chemistry-II Physical Chemistry- III Theory (Cr-4) and Practical (Cr-2)	4+2
5.	**Mathematics (Major & Minor)**	1. Abstract Algebra Theory- 5Cr and Tutorial-1Cr	6

Botany Major & Minor
Plant Taxonomy and Plant Embryology

Code: SOLS/BOT/ C

Credits: 4, 60 Lectures

UNIT I

Introduction to plant taxonomy (10 Lectures)

Identification, Classification, Nomenclature. Taxonomic hierarchy, Ranks, categories and taxonomic groups Identification. Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora, Keys: single access and multi-access. Taxonomic evidence from palynology, cytology, phytochemistry and molecular data.

UNIT II

Botanical Nomenclature (12 Lectures)

Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations.

Classification: Types of classification- artificial, natural and phylogenetic. Bentham and Hooker (up to series), Engler and Prantl (up to series).

Biometrics, numerical taxonomy and cladistics: Characters, variations, OTUs, character weighting and coding, cluster analysis, phenograms, cladograms (definitions and differences).

UNIT III

Taxonomy, important distinguishing characters, classification, and economic importance of the following families: (10 Lectures)

Ranunculaceae, Papaveraceae, Caryophyllaceae, Malvaceae, Brassicaceae, Rutaceae, Fabaceae, Apiaceae, Asteraceae, Solanaceae, Apocyanaceae, Asclepidiaceae, Acanthaceae, Lamiaceae, Euphorbiaceae, Orchidaceae, Liliaceae, Poaceae.

UNIT IV

Structural Organization of Flower (14 Lectures)

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

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

UNIT V

Embryo and endosperm (14 Lectures)

Endosperm types, structure and functions; Dicot and monocot embryo; Embryo endosperm relationship.

Apomixis and polyembryony: Definition, types and practical applications.

PLANT TAXONOMY AND PLANT EMBRYOLOGY PRACTICAL
Code: SOLS/BOT/ C (P)

Credits: 2

1. Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification): Brassicaceae -Brassica, Alyssum / Iberis; Asteraceae -Sonchus/Launaea, Vernonia/Ageratum, Eclipta/Tridax; Solanaceae -Solanum nigrum, Withania; Lamiaceae -Salvia, Ocimum; Liliaceae - Asphodelus / Lilium / Allium; Poaceae – Wheat/ Rice/ Barley/ Maize
2. Mounting of a properly dried and pressed specimen of any wild plant with a herbarium label (to be submitted in the record book; 15 plant specimens minimum).
3. Taxonomic treatment of plant species belonging to families mentioned in the syllabus.
4. Study of taxonomic terminology
5. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides).
6. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous.
7. Female gametophyte: Polygonum (monosporic) type of Embryo sac Development (Permanent slides/photographs).
8. Ultrastructure of mature egg apparatus cells through electron micrographs.
9. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).
10. Dissection of embryo/endosperm from developing seeds.
11. Calculation of the percentage of viable germinated pollen in a given medium.

Suggested Readings

1. Simpson, M.G. (2006). Plant Systematics. Elsevier Academic Press, San Diego, CA, U.S.A.
2. Singh, G. (2012). Plant Systematics: Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.
3. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.

Zoology Major & Minor

Physiology and Elementary Biochemistry Theory (Cr-4) and Practical

Credits: 4, 60 Hours

A. Physiology

UNIT I

Nerve and muscle: Introduction to CNS, PNS, ANS; Structure of a neuron, Types of neurons; Types of muscle, Ultrastructure of skeletal muscle, Molecular and chemical basis of muscle contraction [6 Hours]

UNIT II

Digestion: Comparative Physiology of vertebrate digestion e.g., Digestion in different segments of the alimentary canal; Absorption of carbohydrates, proteins, lipids. Ruminant stomach in ungulates [8 Hours]

UNIT III

Respiration: Comparative account of vertebrate respiration; Transport of oxygen and carbon dioxide in blood [6 Hours]

UNIT IV

Osmoregulation and thermoregulation: Osmoregulation in fishes, structure of nephron, mechanism of urine formation. Thermoregulation in poikilotherms, homeotherms and heterotherms. Aestivation and Hibernation [8 Hours]

UNIT V

Cardiovascular system: Blood: Comparative account of circulatory system (Open and Closed), Composition of Blood, Lymph, tissue fluid, comparative anatomy of vertebrate heart and aortic arches. Homeostasis, Heart structure, Origin and conduction of the cardiac impulse, cardiac cycle [6 Hours]

UNIT VI

Reproduction and Endocrine Glands: Autocrine, paracrine, juxtacrine and endocrine mode of action; Introduction to Endocrine glands: Structure and function of hypothalamus, pituitary, thyroid, parathyroid, pancreas, adrenal and gonads' Reproductive physiology of male and female fertility [6 Hours]

B. Biochemistry

UNIT VII

Introduction to Biomolecules: Carbohydrates, Proteins, Lipids: structure, types and functions [6 Hours]

UNIT VIII

Introduction to Enzymology: Mechanism of action, Kinetics, inhibition and regulation [6 Hours]

UNIT IX

Introduction to metabolism of Carbohydrate, Protein and Lipids: Glycolysis, Kreb's cycle, pentose phosphate pathway, glycogen metabolism, electron transport chain, transamination, deamination, urea cycle, □- oxidation in fatty acids [8 Hours]

Suggested Readings

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H. Freeman and Co.
2. Hall, John E. (2015). Guyton and Hall Textbook of Medical Physiology, W.B. Saunders Company
3. Jain, A.K. (2018). Textbook of Physiology, Arya Publications B.Sc. Second Year (IV Semester)14
4. Murray, R. K., Granner, D. K., Mayes, P. A. and Rodwell, V. W. (2009). Harper's Illustrated Biochemistry. XXVIII Edition. Lange Medical Books/McGraw-Hill
5. Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). Principles of Biochemistry. IV Edition. W.H. Freeman and Co.

6. Schmidt-Nielsen, Knut (1997). Animal Physiology: Adaptation and Environment, Cambridge University Press
7. Singh, HR and N. Kumar Animal Physiology and related Biochemistry, SL, Nagin Chand and Co, Delhi
8. Tortora, G.J.& Derrickson, B.H. (2009). Principles of Anatomy and Physiology, 12th edn., John Wiley &Sons, Inc.
9. Widmaier, E.P., Raff, H. & Strang, K.T. (2008) Vander's Human Physiology, 11th edn., McGraw Hill.

Physiology and Elementary Biochemistry (Practical)

SOLS/ZOO/CZ-4(P)

Credits: 2

A. Physiology

1. Preparation of hemin crystals
2. Examination of permanent histological sections of mammalian pituitary, thyroid, parathyroid, pancreas, adrenal.
3. Examination of permanent slides of the spinal cord, duodenum, liver, lung, kidney, bone, cartilage, and blood cells
4. Models/ Photographs: Structure of neurons, types, and structure of muscles, the structure of the heart.
5. Charts/ Photographs: Glycolysis, Kreb's cycle, electron transport chain

B. Biochemistry

1. Identification of unknown carbohydrates in given solutions (Starch, Sucrose, Lactose, Galactose, Glucose, Fructose)
2. Colour reactions to identify the functional group in the given solution of proteins
3. Study of the activity of salivary amylase under optimum conditions

Physics Major & Minor

Waves and Optics Theory

Credits: 4, 60 hours

Superposition of Two Collinear Harmonic Oscillations: Linearity and Superposition Principle. (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats). Superposition of Two Perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures (1:1 and 1:2) and their uses. Waves Motion- General: Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves, Spherical waves, Wave intensity.

Oscillations: Simple harmonic motion. Differential equation of SHM and its solutions, Kinetic and Potential Energy, Total Energy and their time averages, Damped oscillations.

Sound: Simple harmonic motion - forced vibrations and resonance - Fourier's Theorem, Application to saw tooth wave and square wave - Intensity and loudness of sound - Decibels -

Intensity levels - musical notes - musical scale. Acoustics of buildings: Reverberation and time of reverberation - Absorption coefficient - Sabine's formula - measurement of reverberation time - Acoustic aspects of halls and auditorium.

Wave Optics: Electromagnetic nature of light, Definition and Properties of wave front, Huygens Principle.

Interference:
Division of amplitude and division of wavefront, Young's Double Slit experiment, Lloyd's Mirror and Fresnel's Biprism, Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes, Fringes of equal thickness (Fizeau Fringes). Newton's Rings: measurement of wavelength and refractive index.

Michelson's Interferometer:
(1) Idea of the form of fringes (no theory needed),
(2) Determination of wavelength,
(3) Wavelength difference,
(4) Refractive index,
(5) Visibility of fringes.

Diffraction: Fraunhofer diffraction: Single slit; double Slit. Multiple slits & Diffraction grating, Fresnel Diffraction: Half-period zones. Zone plate, Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis.

Polarization: Transverse nature of light waves. Plane polarised light – production and analysis, Circular and elliptical polarisation.

Reference Books:
1. Fundamentals of Optics, F A Jenkins and H E White, 1976, McGraw-Hill.
2. Principles of Optics, B.K. Mathur, 1995, Gopal Printing.
3. Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, S. Chand Publication.
4. University Physics, F W Sears, M. W. Zemansky, and H. D. Young.

Waves and Optica (Practical)

Credits: 2
List of Experiments:
1. To investigate the motion of coupled oscillators.
2. To determine the Frequency of an Electrically Maintained Tuning Fork byMelde's Experiment and to verify λ2 – T Law.
3. To study Lissajous Figures.
4. Familiarization with Schuster`s focusing; determination of angle of prism.
5. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
6. To determine the Refractive Index of the Material of a given Prism using Sodium Light.

7. To determine Dispersive Power of the Material of a given Prism using Mercury Light.
8. To determine the value of Cauchy Constants of a material of a prism.
9. To determine the Resolving Power of a Prism.
10. To determine the wavelength of sodium light using the Fresnel Biprism.
11. To determine the wavelength of sodium light using Newton's Rings.
12. To determine the wavelength of Laser light using Diffraction of Single Slit.
13. To determine the wavelength of (1) Sodium & (2) Mercury light using a plane diffraction Grating. To determine the Resolving Power of a Plane Diffraction Grating.
14. To measure the intensity using photosensor and laser in diffraction patterns of single and double slits.

Reference Books:

1. Advanced Practical Physics for students, B. L. Flint & H. T. Workshop, 1971, Asia Publishing House.
2. Advanced level Physics Practical, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

Chemistry Major & Minor
Inorganic Chemistry-II Physical Chemistry- III Theory
Coordination Chemistry, States of Matter & Chemical Kinetics Code: (SOS/CHEM/CT-004)

Credits- 4, 60 Lectures

Transition Elements (3dseries) (12 Lectures)

General group trends with special reference to electronic configuration, Variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu. Lanthanoids and actinoids: Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion exchange method only).

Coordination Chemistry (8 Lectures)

Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordination numbers 4 and 6. Drawbacks of VBT. IUPAC system of nomenclature.

Crystal Field Theory (10 Lectures)

Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for Oh and Th complexes, Tetragonal distortion of octahedral geometry. Jahn-Teller distortion, Square planar coordination.

Section B:

Physical Chemistry-3 (30 Lectures)

Kinetic Theory of Gases (8 Lectures) Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Deviation of real gases from ideal behaviour, compressibility factor, and causes of deviation. Vander Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from the van der Waals equation. Andrews isotherms of CO2. Maxwell-Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation–derivation not required) and their importance. Temperature dependence of these distributions. Most probable, average, and root mean square velocities (no derivation). Collision cross section, collision number, collision frequency, collision diameter, and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).

Liquids (6 Lectures)

Surface tension and its determination using a stalagmometer. Viscosity of a liquid and determination of the coefficient of viscosity using the Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).

Solids (8 Lectures)

Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X–ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl (qualitative treatment only). Defects in crystals. Glasses and liquid crystals.

Chemical Kinetics (8 Lectures)

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half–life of a reaction. General methods for the determination of the order of a reaction. Concept of activation energy and its calculation from Arrhenius equation. Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only)

Reference Books:

1. Barrow, G.M. Physical Chemistry, Tata McGraw-Hill (2007).
2. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009).
4. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
5. Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).
6. Cotton, F.A. & Wilkinson, G. Basic Inorganic Chemistry, Wiley.
7. Shriver, D.F. & Atkins, P.W. Inorganic Chemistry, Oxford University Press.
8. Wulfsberg, G. Inorganic Chemistry, Viva Books Pvt. Ltd.
9. Rodgers, G.E. Inorganic & Solid-State Chemistry, Cengage Learning India Ltd.,2008.

Inorganic Chemistry-II, Physical Chemistry- III Coordination Chemistry, States of Matter & Chemical Kinetics (Practical)

Code: (SOS/CHEM/CP-004)

Credits: 2

Section A:

Inorganic Chemistry Semi- micro qualitative analysis using H2S of mixtures-not more than four ionic species (two anions and two cations and excluding insoluble salts) out of the following: Cations: NH4 +, Pb2+, Ag+, Bi3+, Cu2+, Cd2+, Sn2+, Fe3+, Al3+,Co2+, Cr3+, Ni2+, Mn2+, Zn2+, Ba2+, Sr2+, Ca2+, K+ Anions: CO3 2–, S 2–, SO2, S2O3 2-, NO3–, CH3COO–, Cl–, Br –, I–, NO3–, SO4 2-, PO4 3-, BO3 3-, C2O4 2-, F-. (Spot tests should be carried out wherever feasible.)

1. Estimate the amount of nickel present in a given solution as bis (dimethyl glyoximato) nickel (II) or aluminium as oximate in a given solution, gravimetrically.
2. Draw a calibration curve (absorbance at λ max vs. concentration) for various concentrations of a given-coloured compound (KMnO4/ CuSO4) and estimate the concentration of the same in a given solution.
3. Determine the composition of the Fe3+ -salicylic acid complex solution by Job's method.
4. Estimation of (i) Mg2+ or (ii) Zn2+ by complexometric titrations using EDTA.
5. Estimation of total hardness of a given sample of water by complexometric titration.
6. Determination of concentration of Na+ and K + using Flame Photometry.

Section B: Physical Chemistry

I) Surface tension measurement (use of organic solvents excluded).

a) Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.

b) Study of the variation of surface tension of a detergent solution with concentration.

II) Viscosity measurement (use of organic solvents excluded).

a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald viscometer.

b) Study of the variation of viscosity of an aqueous solution with concentration of solute.

III) Chemical Kinetics

Study the kinetics of the following reactions.

1. Initial rate method: Iodide-persulphate reaction
2. Integrated rate method:
   a. Acid hydrolysis of methyl acetate with hydrochloric acid.
   b. Saponification of ethyl acetate.
   c. Compare the strengths of HCl and H2SO4 by studying the kinetics of hydrolysis of methyl acetate.

Reference Books:

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
3. Khosla, B.D.; Garg, V.C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).

Mathematics Major & Minor

Abstract Algebra

Credits:6

UNIT I

Definition and examples of groups, Abelian groups, the groups of integers under addition and multiplication modulo n, Subgroups, Necessary and sufficient conditions, Examples of subgroups including the centre of a group, Groups of complex roots of unity.

UNIT II

The general linear group GLn (n, R), Groups of symmetries of
(i) an isosceles triangle,
(ii) an equilateral triangle,
(iii) a rectangle, and
(iv) a square. Permutation groups, even and odd permutations, Group of quaternions.

UNIT III

Homomorphism and isomorphism of groups, Order of an element, Cyclic groups and their properties, Cosets, Index of subgroup, Lagrange's theorem., Cayley's theorem.

UNIT IV

Normal subgroups: Definition and examples. Definition and examples of rings, Examples of commutative and non-commutative rings, the ring of integers modulo n, the Ring of matrices, Subrings and ideals, Integral domains and fields with examples.

Books Recommended

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
3. Joseph A Gallian, Contemporary Abstract Algebra, 4th Ed, Narosa, 1999.

Hemvati Nandan Bahuguna Garhwal University

Dept of Education

ITEP Curriculum

Semester-V

(B.Sc. B.Ed.)

S.N.	Code	Courses	Credit
1.	EFC-501	Inclusive Education	4
2.	ESSCCPC-502-A	Content cum Pedagogy of Mathematics at Secondary Stage – Course (II)	2
3.	ESSCCPC-502-B	Content cum Pedagogy of Physics at Secondary Stage – Course (II)	2
4.	ESSCCPC-502-C	Content cum Pedagogy of Chemistry at Secondary Stage – Course (II)	2
5.	ESSCCPC-502-D	Content cum Pedagogy of Zoology at Secondary Stage – Course (II)	2
6.	ESSCCPC-502-E	Content cum Pedagogy of Botany at Secondary Stage – Course (II)	2
7.	EAEVAC-503	ICT in Education	2
8.	ESEC-504	Pre-internship Practice	2
9.	ECESC-505	Community Engagement and Services	2
10.	RM-506	Introduction to Research	4

EFC-501: Inclusive Education

Credits: 2

501.1 About the Course

This course seeks to orient student teachers to the approaches to bridging gender and social category gaps in participation rates and student learning levels at all levels of school education. The course will provide orientation to the strategies pursued and required to improve participation and learning levels of children from Socio-Economically Disadvantaged Groups (SEDGs) that can be broadly categorised based on gender identities, particularly female and transgender individuals, socio-cultural identities (such as Scheduled Castes, Scheduled Tribes, OBCs, and minorities), geographical identities (such as students from remote locations, villages, small towns, and aspirational districts), disabilities (including learning disabilities), linguistic identities, and socio-economic conditions (such as migrant communities, low-income households, children in vulnerable situations, including orphans and the urban poor).

501.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- ensure inclusion and equal participation in the education of children with disabilities in the regular schooling process that allows students with and without disabilities to learn together, ensuring their retention in the school system and enabling them to achieve the defined learning outcomes.
- adapt teaching and learning process to meet the learning needs of different students with disabilities, including providing education and opportunities for participating in arts, sports, and vocation-related activities, making school buildings and compounds as well as other facilities barrier free and accessible for children with disabilities, supporting activities that help the provision of individualized learning environment and learning activities/resources, making available assistive devices and appropriate technology-based tools, as well as adequate and language-appropriate teaching-learning materials (e.g., textbooks in accessible formats such as large print and Braille) to help children with disabilities integrate more easily into classrooms and engage with teachers and their peers, using appropriate modes and means of communication, detecting specific learning disabilities in children at the earliest and taking appropriate measures to overcome them, monitoring completion of education and learning levels of students with disabilities etc.

UNIT - I

Inclusion and Education

A. Conceptual Clarity, relation, and significance with special reference to:
   - UNCRPD, 2006,
   - RPWD Act, 2016,

   With special reference to the Indian Context.

B. Clarity of various terms and phrases associated with Inclusive Education: Integrated Education, Special Education, Impairment and Disability, Assessment and Evaluation, Curriculum, adaptation, modification and differentiation, universal design of learning

C. Shifting from Disability to the Inclusive View. Shifting Paradigms from Bio-centric to Human Rights.

D. Introductory reference of Policies/Acts with reference to educational implications for Children with Disabilities: Right to Education Act, 2009/ 2012; RPWD Act, 2016; UNCRPD, National Trust Act, 1999; National Educational Policy, 2020.

UNIT - II

Children with Disabilities and Marginalised Groups

A. Nature and needs of children with sensory impairments: cognitive impairments and intellectual disability, physical disabilities, cerebral palsy, multiple disabilities.

B. Specific needs of children with behavioural and emotional learning disabilities

C. Health Problems.

D. Educational needs of children belonging to Marginalized Groups.

UNIT - III

Pedagogical Issues

A. Conceptual clarity and significance.

B. Meeting the specific needs of Children with Disabilities with special reference to:

- education and opportunities for participating in arts, sports, and vocation-related activities,
- making school buildings and compounds, as well as other facilities, barrier-free and accessible
- supporting the learning activities and resources for the individualised learning environment
- making available assistive devices and appropriate technology-based tools,
- language-appropriate teaching-learning materials (e.g., textbooks in accessible formats such as large print and Braille)
- assessing strategies

C. Designing strategies for assessment in inclusive classrooms.

501.3 Suggestive Practicum

1. Developing a checklist for identifying the various needs of children with disabilities.
2. Visit schools of different categories, talk to parents, teachers, and children with and without disabilities, and list the problems these children and their families face at the local level in gaining access to education.
3. Analysing the RPWD Act 2016 and listing its implications for CWD in inclusive settings.
4. Outlining the problems faced by children with Visual Disabilities while learning mathematics and EVS.
5. Give a few exemplary adaptations based on the Preparatory Level textbooks.
6. Outlining the problems children with hearing impairments face while learning language. Give a few exemplary adaptations based on the primary-level textbooks.
7. Students work in small groups of 10 or so to prepare a street play highlighting the meaning and provisions of inclusive education.
8. Analysing the Context of NPE 2020 in the Light of Inclusive Education.

501.4 Suggestive Mode of Transaction

The course content transaction will include the following:

- Planned lectures infused with multimedia /PowerPoint presentations.
- Small group discussion, panel interactions, small theme-based seminars, group discussions, cooperative teaching and team teaching, selections from theoretical readings, case studies, analyses of educational statistics and personal field engagement with educationally marginalised communities and groups through focus group discussion, surveys, short-term project work, etc.
- Hands-on experience engaging with diverse communities, children, and schools.

501.5 Suggestive Mode of Assessment

The assessment will be based on the tests and assignments.

501.6 Suggestive Reading Materials

Teachers may suggest books/readings per the learners' needs and learning content.

ESSCCPC-502: Stage-Specific Content -cum-Pedagogy Courses (Any Two)
502-A: Content cum Pedagogy of Mathematics at Secondary Stage – Course (II)

Credits: 2

502-A.1 About the Course

The teaching and learning of Mathematics is a complex activity, and many factors determine the success of this activity. The nature and quality of instructional material, the presentation of content, the pedagogic skills of the teacher, and the learning environment. Students at this stage are keen on exploring and constructing their own knowledge, so providing resources is important for the school teacher. This course will provide illustrative exposure to the resource materials for Mathematics teaching learning. Teaching Mathematics requires a thorough understanding of the pedagogical content knowledge. It is the integration or the synthesis of teachers' pedagogical knowledge and their subject matter knowledge that comprises pedagogical content knowledge. Planning of the learning experiences is a must for the quality learning outcome and the better use of resources. This course provides skills to develop the planning of Mathematics teaching and learning for the classroom. This course also extends the support of technology integration for the enhancement of pedagogical planning. The course will be helpful for Student teachers in knowing how the mathematical content knowledge is organised and used in the teaching and learning process with the support of technological tools.

502-A.2 Learning Outcomes

After completion of the course, student teachers will be able to:

- discuss the nature and functions of various instructional resources,
- explore and utilise the teaching and learning resources to support pedagogical experiences of Mathematics,
- organize and manage supportive activities for the development of the mathematical aptitude of secondary school students,
- plan appropriate experiences for teaching Mathematics,
- explore diverse backgrounds and interests' children bring to set up the inclusive classroom for Mathematics learning,
- elaborate technological tools for teaching and learning of Mathematics,
- integrate technology to judiciously facilitate learning for enhancing an inclusive environment.

UNIT - I

Teaching Learning Resources

A. Teaching learning materials: meaning and importance for secondary school Mathematics.
B. Types of teaching learning resources: print media (Mathematics textbook, teachers' manual/ handbook, laboratory manual), non-print and digital media (charts, 2-D and 3-D models, games, web resources, interactive boards, animations, videos, images, simulations) for offline/ online classroom teaching and learning
C. Identification and use of learning resources in Mathematics from the local environment, community resources and pooling of resources.
D. Mathematics resource room/ laboratory – equipment and management, concept of virtual laboratories. Organisation of Mathematics club, fairs, exhibitions, and learner community.

UNIT - II

Content Analysis and Planning for Teaching Mathematics

A. Analysis for identification of axioms, concepts, rules, formulas, theorems, corollaries; pedagogical content knowledge of arithmetic, algebra, geometry, mensuration, and trigonometry of the secondary stage.
B. Planning and evaluating learning experiences in an inclusive setup based on learning outcomes and competencies, building a community of mathematicians in classrooms.
C. Developing annual plan, unit plan, lesson plan – need, main consideration, and format.
D. Strategies for method-based lesson plan for secondary classes - inductive-deductive, analytical- synthetical, lecture cum demonstration, problem-solving, laboratory, and project based.

UNIT - III

ICT Integration and Applications in Teaching of Mathematics

A. Scope and importance of ICT for teaching and learning Mathematics.
B. Use of ICT (digital repository, Augmented Reality (AR), Virtual Reality (VR) and Artificial Intelligence (AI) based digital resources, open education resources, blogs, forums, interactive boards, and devices) in the teaching, learning, assessment and resource management of secondary Mathematics.
C. Use of tools, software, and platforms such as GeoGebra, Khan Academy, along with the national teachers' portal, DIKSHA, and SWAYAM.
D. Developing ICT-integrated lesson plans using Technological Pedagogical Content Knowledge (TPCK) for Mathematics classroom and online teaching.

502-A.3 Suggestive Practicum (Any Three)

1. Develop learning resources for Mathematics teaching and learning.
2. Prepare an annual plan for any secondary class.
3. Prepare a unit plan from the mathematics textbook at the secondary stage.

4. Prepare a learning outcomes-based lesson plan using experiential learning for any one topic of Mathematics at the secondary stage.
5. Develop a lesson plan on a topic of Mathematics at the secondary stage by integrating ICT tools.
6. Write a script for developing e-content on any one topic of Mathematics for online teaching.
7. Any other Project assigned by HEI.

502-A.4 Suggestive Mode of Transaction

Lecture cum discussion, group work, ICT enabled methods, Activity based and Art Integrated Demonstration, Field-based experiences, Library Visits, Self-study, Field observations, Assignment preparation. Classroom presentations, Discussion forums, Observation, Flip classroom, and use of digital platforms.

502-A.5 Suggestive Mode of Assessment

Written test, classroom presentation, workshop, assignments, practicum, sessional, and terminal semester examination (As per UGC norms).

502-A.6 Suggestive Reading Materials

- NCERT: A Handbook for Designing Mathematics Laboratory in Schools (Code- 1555)
- NCERT: Manual for Higher Secondary Mathematics Kit (Code- 3165)

*Teachers may also suggest books/readings as per the needs of the learners and the learning content.

502-B: Content cum Pedagogy of Physics at Secondary Stage - Course (II)

Credit: 2

502-B.1 About the Course

This course comprises three units and the practicum. The course is devoted to introducing various teaching aids, material types, and uses for teaching the concepts of Physics at the secondary stage. Enough space is provided to discuss different types of teaching aids/materials for teaching learning concepts of Physics. It focuses on learning resources in Physics to enable student teachers to make use of available learning resources and generate new resources for teaching and learning the concepts of Physics. It also focuses on textbook analysis and planning for teaching Physics. and its pedagogical issues in the light of NEP 2020. Student teachers are expected to identify various concepts and processes, list learning and outcomes, and find out about various activities and experiments. Accordingly, they are expected to develop a lesson plan based on learning outcomes and experiential learning for classroom and online teaching.

502-B.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- identify teaching learning aids/materials and illustrate their importance in teaching learning the concepts of Physics,
- categorize teaching aids/materials/learning resources,
- develop teaching learning aids/material/kits/learning resources for teaching learning the concepts of Physics,
- utilize teaching aids/materials/learning resources for teaching learning the concepts of Physics,
- analyze the content of Physics textbooks at the secondary stage,
- develop a lesson plan based on learning outcomes and experiential learning using appropriate strategies.

UNIT - I
Teaching Learning Resources

A. Teaching learning aids/materials: concept, definition, role and importance in classroom teaching learning Physics.

B. Types of teaching learning aids/ materials: print media such as textbook, teachers' manual/ handbook, laboratory manual and other print materials, non-print and digital media such as radio, TV, websites, animations, audios, videos, images, simulations, digital repository, Augmented Reality (AR), Virtual Reality (VR) and Artificial Intelligence (AI) based digital resources and Open Educational Resources (OERs) for offline/ online classroom teaching learning reflective journals, charts, 2-D and 3-D models, games, cards, worksheets, multimedia.

C. Identification and use of learning resources in Physics from the local environment.

D. Resource room/ laboratory/ library, virtual laboratories, teaching learning kits, Physics clubs, fairs, exhibitions, educational parks, excursions, community resources and pooling of resources.

UNIT - II
Content Analysis and Planning for Teaching Physics

A. Pedagogical analysis of content, taking examples from topics of Physics textbooks at the secondary stage, identification of concepts, listing learning outcomes and competencies, planning, and evaluating learning experiences in an inclusive setup.

B. Concept, types and importance of unit and lesson planning.

C. Developing unit plans and lesson plans based on learning outcomes and experiential learning by selecting topics from textbooks of Physics at the secondary stage.

UNIT - III
ICT Integration and Applications

A. Scope and importance of ICT in Physics.

B. Use of ICT such as Artificial Intelligence, machine learning, and smart boards in teaching, learning, assessment, and resource management.
C. Tools, software, and platforms for teaching and learning Physics at the secondary stage.
D. Developing ICT-integrated lesson plans by taking topics of Physics at the secondary stage using Technological Pedagogical Content Knowledge (TPCK) for classroom and online teaching.

502-B.3 Suggestive Practicum (Any Three)

1. Develop e-content for the concepts of Physics at the Secondary Stage.
2. Analyze the content of textbooks of Physics (Classes 9-12).
3. Identify the learning resources for transitioning the concepts of Physics.
4. Develop teaching aids/teaching materials for teaching concepts of Physics at the secondary stage.
5. Develop learning outcomes for the concepts of Physics at the secondary stage.
6. Prepare learning outcomes and an experiential learning-based lesson plan for the concepts of Physics.
7. Develop a project on the concepts of Physics using interdisciplinary and multidisciplinary approaches as recommended in NEP 2020.
8. Any other project.

502-B.4 Suggestive Mode of Transaction

Lecture cum discussion/demonstration, hands-on activities, demonstration, discovery approach, project approach, inquiry approach, experimentation, problem-solving, concept mapping, experiential learning and ICT integrated approach.

502-B.5 Suggestive Mode of Assessment

Written test, classroom presentations, workshops, seminars, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).

502-B.6 Suggestive Reading Materials

- Draft National Curriculum Framework for School Education,
- Laboratory Manual of Science (Grade 9 & 10), NCERT.
- National Education Policy 2020, MoE, Government of India.
- National Steering Committee for National Curriculum Frameworks (2023).
- NCERT Laboratory Manuals.
- NCERT Textbooks, Chemistry for Class XI and XII.
- NCERT Textbooks, Physics for Class XI and XII.
- NCERT Textbooks, Science for Class IX and XI.

*Teachers may also suggest books/readings as per the needs of the learners and the learning content.

502-C: Content cum Pedagogy of Chemistry at Secondary Stage - Course (II)

Credit: 2

502-C.1 About the Course

This course comprises three units and the practicum. The course is devoted to introducing various teaching aids, material types, and uses for teaching the concepts of Chemistry at the secondary stage. Enough space is provided to discuss different types of teaching aids/materials for teaching learning concepts of Chemistry. It focuses on learning resources in Chemistry to enable student teachers to make use of available learning resources and generate new resources for teaching and learning the concepts of Chemistry. It also focuses on textbook analysis and planning for teaching Chemistry. and its pedagogical issues in the light of NEP 2020. Student teachers are expected to identify various concepts and processes, list learning and outcomes, and find out about various activities and experiments. Accordingly, they are expected to develop a lesson plan based on learning outcomes and experiential learning for classroom and online teaching.

502-C.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- identify teaching learning aids/materials and illustrate their importance in teaching learning the concepts of Chemistry,
- categorize teaching aids/materials/learning resources,
- develop teaching learning aids/material/kits/learning resources for teaching learning the concepts of Chemistry,
- utilize teaching aids/materials/learning resources for teaching learning the concepts of Chemistry,
- analyze the content of Chemistry textbooks at the secondary stage,
- develop a lesson plan based on learning outcomes and experiential learning using appropriate strategies.

UNIT - I

Teaching Learning Resources

A. Teaching learning aids/materials: concept, definition, role and importance in classroom teaching learning Chemistry.

B. Types of teaching learning aids/ materials: print media such as textbook, teachers' manual/ handbook, laboratory manual and other print materials, non-print and digital media such as radio, TV, websites, animations, audios, videos, images, simulations, digital repository, Augmented Reality (AR), Virtual Reality (VR) and Artificial Intelligence (AI) based digital resources and Open Educational Resources (OERs) for offline/ online classroom teaching learning reflective journals, charts, 2-D and 3-D models, games, cards, worksheets, multimedia.

C. Identification and use of learning resources in Chemistry from the local environment.

D. Resource room/ laboratory/ library, virtual laboratories, teaching learning kits, Chemistry clubs, fairs, exhibitions, educational parks, excursions, community resources and pooling of resources.

UNIT - II
Content Analysis and Planning for Teaching Chemistry

A. Pedagogical analysis of content, taking examples from topics of Chemistry textbooks at the secondary stage, identification of concepts, listing learning outcomes and competencies.
B. Planning and evaluating learning experiences in an inclusive setup.
C. Concept, types and importance of unit and lesson planning.
D. Developing unit plans and lesson plans based on learning outcomes and experiential learning by selecting topics from textbooks of Chemistry at the secondary stage.

UNIT - III
ICT Integration and Applications

A. Scope and importance of ICT in Chemistry.
B. Use of ICT such as Artificial Intelligence, machine learning, and smart boards in teaching, learning, assessment, and resource management.
C. Tools, software, and platforms for teaching and learning Chemistry at the secondary stage.
D. Developing ICT-integrated lesson plans by taking topics of Chemistry at the secondary stage using Technological Pedagogical Content Knowledge (TPCK) for classroom and online teaching.

502-C.3 Suggestive Practicum (Any Three)

1. Develop e-content for the concepts of Chemistry at the Secondary Stage.
2. Analyze the content of textbooks of Chemistry (Classes 9-12).
3. Identify the learning resources for transitioning the concepts of Chemistry.
4. Develop teaching aids/teaching materials for teaching concepts of Chemistry at the secondary stage.
5. Develop learning outcomes for the concepts of Chemistry at the secondary stage.
6. Prepare learning outcomes and an experiential learning-based lesson plan for the concepts of Chemistry.
7. Develop a project on the concepts of Chemistry using interdisciplinary and multidisciplinary approaches as recommended in NEP 2020.
8. Any other project.

502-C.4 Suggestive Mode of Transaction

Lecture cum discussion/demonstration, hands-on activities, demonstration, discovery approach, project approach, inquiry approach, experimentation, problem-solving, concept mapping, experiential learning and ICT integrated approach.

502-C.5 Suggestive Mode of Assessment

Written test, classroom presentations, workshops, seminars, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).

502-C.6 Suggestive Reading Materials

- Draft National Curriculum Framework for School Education,
- Laboratory Manual of Science (Grade 9 & 10), NCERT.
- National Education Policy 2020, MoE, Government of India.
- National Steering Committee for National Curriculum Frameworks (2023).
- NCERT Laboratory Manuals.
- NCERT Textbooks, Chemistry for Class XI and XII.
- NCERT Textbooks, Physics for Class XI and XII.
- NCERT Textbooks, Science for Class IX and XI.

*Teachers may also suggest books/readings as per the needs of the learners and the learning content.

502-D: Content cum Pedagogy of Zoology at Secondary Stage - Course (II)

Credits: 2

502-D.1 About the Course

A wide array of teaching-learning resources is available to modern-day teachers. This course comprises three units that aim to introduce various resources and discuss their appropriate utilisation in teaching. In this course, student teachers are introduced to different units and lesson plan based on learning outcomes and experiential learning. Requisite skills such as the use of print media, non-print media and digital resources are discussed in the course. This course also focuses on familiarising student teachers with ICT integration in teaching and preparing ICT-based lesson plans for online teaching using suitable tools. This course aims to prepare student teachers for teaching Zoology using different dimensions of pedagogical and technological aspects.

502-D.2 Learning Outcomes

After completion of this course, Student teachers will be able to:

- categorize different teaching and learning resources and plan their appropriate usage in teaching and learning concepts of Zoology,
- develop simple teaching learning materials using easily available/local materials,
- analyze the content of Zoology textbooks at the secondary stage,
- review various methods and strategies for teaching Zoology,
- develop a learning outcome-based lesson plan to promote experiential learning and higher order thinking skills,
- develop unit plans and lesson plans on different chapters in biology (Grades IX to XII).

UNIT - I

Teaching Learning Resources

A. Teaching learning aids/materials: concept, definition, role, and importance in classroom teaching learning Zoology.

B. Types of teaching learning aids/ materials: print media such as textbook, teachers' manual/ handbook, laboratory manual and other print materials, non-print and digital media such as museum, aquarium, terrarium, TV, websites, animations, audios, videos, simulations; Zoology mobile apps, digital repository, Augmented Reality (AR), Virtual Reality (VR) and Artificial Intelligence (AI) based digital resources and Open Educational Resources (OERs) for offline/ online classroom teaching learning (reflective journals, charts, 2-d and 3-d models, games, cards, worksheets, multimedia etc.

C. Identification and use of learning resources in Zoology from the local environment - using nature as a laboratory; biology laboratory - designing, management and safe practices; virtual laboratories and museums.

D. Resource room/ laboratory/ library, virtual laboratories, teaching learning kits, science clubs, fairs, exhibitions, science parks, zoo, botanical gardens, excursions, community resources and pooling of resources.

UNIT - II

Content Analysis and Planning for Teaching Zoology

A. Pedagogical analysis of content taking examples from topics of Zoology textbooks at the secondary stage, identification of concepts, listing learning outcomes and competencies, planning, and evaluating learning experiences in an inclusive setup.

B. Concept, types and importance of unit and lesson planning.

C. Developing unit plans and lesson plans based on learning outcomes and experiential learning by selecting topics from textbooks of Zoology at secondary stage.

UNIT - III

ICT Integration and Application

A. Scope and benefits of using IT in teaching learning process; Artificial Intelligence, machine learning, smart boards.

B. Specific features and limitations of using ICT.

C. Open Educational Resources in Zoology – BIOIDAC, MOOC, National Teachers Portal, DIKSHA, SWAYAM.

D. Developing ICT-integrated lesson plans by taking topics of physical sciences at the secondary stage using Technological Pedagogical Content Knowledge (TPCK) for classroom and online teaching.

502-D.3 Suggestive Practicum (Any Three)

1. Analyze the content of textbooks of Zoology (Classes 9-12).
2. Develop e-content for the concepts of Zoology at the Secondary Stage.

3. Develop unit plans for selected chapters of the Textbooks of Zoology.
4. Prepare learning outcomes and an experiential learning-based lesson plan for the concepts of Zoology.
5. Developing ICT-integrated lesson plans for offline and online classes.
6. Explore a course in Zoology of MOOC and prepare a write-up.
7. Any other projects.

502-D.4 Suggestive Mode of Transaction

Lecture cum discussion, demonstration, Hands-on activities, experiential learning, inquiry, Group work, Presentations, multimedia.

502-D.5 Suggestive Mode of Assessment

Written tests, classroom presentations, workshops, seminars, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).

502-D.6 Suggestive Reading Material

- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India.
- National Steering Committee for National Curriculum Frameworks (2023). Draft National Curriculum Framework for School Education.
- NCERT, Textbooks of Zoology at Secondary Stage.

*Teachers may also suggest books/readings as per the needs of the learners and the learning content.

502-E: Content cum Pedagogy of Botany at Secondary Stage - Course (II)

Credits: 2

502-E.1 About the Course

A wide array of teaching-learning resources is available to modern-day teachers. This course comprises three units that aim to introduce various resources and discuss their appropriate utilisation in teaching. In this course, student teachers are introduced to different units and lesson plans based on learning outcomes and experiential learning. Requisite skills such as the use of print media, non-print media and digital resources are discussed in the course. This course also focuses on familiarising student teachers with ICT integration in teaching and preparing ICT-based lesson plans for online teaching using suitable tools. This course aims to prepare student teachers for teaching Botany using different pedagogical and technological aspects.

502-E.2 Learning Outcomes

After completion of this course, Student teachers will be able to:

- categorise different teaching and learning resources and plan their appropriate usage in teaching and learning concepts of Botany.

- develop simple teaching learning materials using easily available/local materials,
- analyze the content of Botany textbooks at the secondary stage,
- review various methods and strategies for teaching Botany,
- develop a learning outcome-based lesson plan to promote experiential learning and higher-order thinking skills,
- develop unit plans and lesson plans on different chapters in biology (Grades IX to XII).

UNIT - I
Teaching Learning Resources

A. Teaching learning aids/materials: concept, definition, role, and importance in classroom teaching learning Botany.
B. Types of teaching learning aids materials: print media such as textbook, teachers' manual/ handbook, laboratory manual and other print materials, non-print and digital media such as museum, aquarium, terrarium, TV, websites, animations, audios, videos, simulations; Botany mobile apps, digital repository, Augmented Reality (AR), Virtual Reality (VR) and Artificial Intelligence (AI) based digital resources and Open Educational Resources (OERs) for offline/ online classroom teaching learning (reflective journals, charts, 2-d and 3-d models, games, cards, worksheets, multimedia etc.
C. Identification and use of learning resources in Botany from the local environment - using nature as a laboratory; biology laboratory - designing, management and safe practices; virtual laboratories and museums.
D. Resource room/ laboratory/ library, virtual laboratories, teaching learning kits, Botany clubs, fairs, exhibitions, science parks, zoo, botanical gardens, excursions, community resources and pooling of resources.

UNIT - II
Content Analysis and Planning for Teaching Botany

A. Pedagogical analysis of content taking examples from topics of Botany textbooks at the secondary stage, identification of concepts, listing learning outcomes and competencies,
B. Planning and evaluating learning experiences in an inclusive setup.
C. Concept, types and importance of unit and lesson planning.
D. Developing unit plans and lesson plans based on learning outcomes and experiential learning by selecting topics from textbooks of Botany at the secondary stage.

UNIT - III
ICT Integration and Application

A. Scope and benefits of using IT in the teaching and learning process; Artificial Intelligence, machine learning, smart boards.
B. Specific features and limitations of using ICT.
C. Open Educational Resources in Botany – BIOIDAC, MOOC, National Teachers Portal, DIKSHA, SWAYAM.
D. Developing ICT-integrated lesson plans by taking topics of physical sciences at the secondary stage using Technological Pedagogical Content Knowledge (TPCK) for classroom and online teaching.

502-E.3 Suggestive Practicum (Any Three)

1. Analyze the content of textbooks of Botany (Classes 9-12).
2. Develop e-content for the concepts of Botany at the Secondary Stage.

3. Develop unit plans for selected chapters of the Textbooks of Botany.
4. Prepare learning outcomes and an experiential learning-based lesson plan for the concepts of Botany.
5. Developing ICT-integrated lesson plans for offline and online classes.
6. Explore a course in Botany of MOOC and prepare a write-up.
7. Any other projects.

502-E.4 Suggestive Mode of Transaction

Lecture cum discussion, demonstration, Hands-on activities, experiential learning, inquiry, Group work, Presentations, multimedia.

502-E.5 Suggestive Mode of Assessment

Written tests, classroom presentations, workshops, seminars, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).

502-E.6 Suggestive Reading Material

- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India.
- National Steering Committee for National Curriculum Frameworks (2023). Draft National Curriculum Framework for School Education.
- NCERT, Textbooks of Botany at Secondary Stage.

*Teachers may also suggest books/readings as per the needs of the learners and the learning content.

EAEVAC-503: ICT in Education

Credits: 2

503.1 About the Course

The present course focuses on moving beyond computer literacy and ICT-aided learning to help student teachers interpret and adapt ICTs in line with educational aims and principles. The paper will orient the learners about the need for and importance of ICT in education. It will describe the importance of open-source software in education. Students will be given exposure to the various approaches and stages towards the use of ICT in education. Students are expected to develop reasonably good ICT skills in terms of the use of various computer software and ICT tools.

503.2 Learning Outcomes

On completion of this course, student teachers will be able to:

- explain the concept, nature, and scope of ICT in education,
- describe the importance of open-source software in education,
- list and explain various approaches to the adoption and use of ICT in education.
- describe the importance of various emerging technologies in education.
- See the relationship between the social, economic, and ethical issues associated with the use of ICT,

- list out the challenges of educational technology in India.
- use various technological tools for improving teaching-learning and assessment processes.

UNIT - I
Introduction to ICT in Education

A. Meaning, Nature, importance of Information Technology, Communication Technology & Information and Communication Technology (ICT) and Instructional Technology,
B. Educational Technology and ICT in Education (Difference, Scope of ICT- Teaching, learning, Research & Publication, Educational Administration and Assessment). Technology & Engagement: Internet, Collaborative learning through Online Discussion Forums, group assignments & Peer reviews,
C. Meaning and Uses of Systems Approach in instructional design. Models of Development of Instructional Design (ADDIE, ASSURE, Dick and Carey Model Mason's),
D. Flanders' Interaction Analysis Category System (FIACS), Challenges Relating to Educational Technology.

UNIT - II
Emerging Technologies in Education

A. E-learning Concept, methods, and media (LMS, Virtual Universities, Massive Open Online Course (MOOCs), Indian MOOCs, Types of MOOCs: cMOOCs, xMOOCs & LMOOCs).
B. Open Education Resources (Creative Commons, Concept, and application). Augmented reality, Virtual reality, Artificial intelligence, Mixed Reality & Gamification in education (Meaning, history, importance, tools and uses).
C. Cloud Computing & Internet of Things - Meaning, importance and uses.
D. Ethical issues & safety in ICT- (Teaching, Learning and Research, Cyber bullying, Cyber security literacy & data protection, Online identity and privacy).

UNIT - III
ICT in Teaching-Learning & Assessment

A. Concept, Approaches to integrating ICT in teaching and learning: Technological Pedagogical Content Knowledge (TPCK), Technology Integration Matrix (TIM).
B. Implication of Learning Theories in ICT in Education: Behaviourism, Cognitivism & Constructivism.
C. Developing functional skills to use discipline-specific ICT tools (Geogebra, PhET, Stellarium, Open Street Map, Marble, Turtle Art, Technological tools for Mind mapping, etc.).
D. ICT and Assessment- Electronic assessment portfolio – Concept and types; e-portfolio tools. Online and offline assessment tools – Rubrics, survey tools, puzzle makers, test generators, reflective journal, question bank. ICT applications for Continuous and Comprehensive Evaluation (CCE).

503.3 Suggestive Practicum

1. Prepare an assessment tool on any one chapter of the textbook.
2. Explore one online platform for MOOCs and prepare a report highlighting its structure and courses.

503.4 Suggestive Mode of Transaction

The pedagogy for the course ICT in Education should be designed to ensure that students have a good understanding of how to use technology for improving teaching-learning-assessment processes. It should provide a balance between theoretical knowledge and practical skills. The approaches to curriculum transaction may include the following:

- Active learning encourages student teachers to participate in discussions, brainstorming sessions, and problem-solving activities that help them develop critical thinking and problem-solving skills.
- Collaborative learning involves group projects and tasks that encourage student teachers to work collaboratively and learn from each other.
- Experiential learning involving Hands-on activities, field trips, and real-life scenarios that will give student teachers the opportunity to apply their knowledge and skills in a practical setting.
- Use of multimedia tools such as videos, interactive simulations, and animations that help enhance learning and make it more engaging.
- Self-directed and self-managed learning activities that encourage students to take charge of their learning process through independent research, self-reflection, and self-assessment which can promote lifelong learning.

503.5 Suggestive Mode of Assessment

The assessment for the course ICT in Education should evaluate students' knowledge, capacities, and attitudes towards the use of technology in education. The assessment methods will include the following:

- Project-based assessments involving projects that require student teachers to create an instructional/learning resource that incorporates ICT tools and then assess the quality of the resource.
- Peer assessment helps students develop their critical thinking and evaluative capacities through group tasks requiring assessment by a group of the work of another group.
- Reflective journals require student teachers to maintain a reflective journal and to reflect on their learning experience involving the use of ICT tools in education.
- Online quizzes and tests involving online quizzes and tests that can assess students' knowledge of the theoretical aspects of ICT in education.
- Observation and feedback involving observation of the performance of student teachers during classroom activities and providing feedback that helps assess their practical skills in using ICT tools for improving teaching-learning-assessment processes.

503.6 Suggested Reading Materials

Teachers may suggest books/readings as per the needs of the learners and the learning content.

ESEC-504: SCHOOL EXPERIENCE

Pre-internship Practice: Orientation and preparation in the Institute

Credits: 2

Field engagement is an integral part of a teacher education programme. In the field engagement of a pre-service teacher education programme, the student teachers are engaged in different kinds of practical tasks or activities relating to the teaching profession in a supervised condition. Through field engagement, the student teachers understand school processes, participate in activities, and internalize school-related ethics, values, and norms. School experience is integral to the Integrated Teacher Education Programme (ITEP); it allows student teachers to experience the school environment and apply theoretical learning.

Objectives

The School Experience will help the student teachers:

1. To understand on the roles of different personnel associated with the academics, resources, and the school system's management.
2. To be conscious of their duties as teachers concerning students, school, community, and other stakeholders.
3. To reflect on diverse school contexts and to appreciate the role of school teachers.
4. To understand and participate in different curricular activities like school assemblies, games and sports, cultural activities, and other events.
5. To participate in different programmes of school like parental engagement, motivating the students from the socio-economically disadvantaged group, and promoting inclusion and equity.
6. To develop skills associated with the profession - adaptation, collaboration, problem-solving, and participative decision-making.
7. To develop contextual learning competencies, skills, and attitudes for becoming effective teachers.
8. To develop ICT and research skills.

504.1 About the Course

Pre-Internship is a vital component of the Teacher Education Programme. It is a prerequisite for student teachers to experience a simulated classroom environment to prepare them for real-life situations. Student teachers get exposure in a conducive, guided environment to manage a classroom and learn pedagogic and classroom management skills and get an opportunity to have hands-on experience.

504.2 Learning Objectives:

After completion of the course, student teachers will be able to:

- acquainted with various pedagogic practices, classroom management skills, assessment tools and learning standards,
- get experience of conducting classes by observing lessons transacted by teacher educators (demonstration lessons),
- develop lesson plans to teach them using appropriate pedagogies and learning resources,
- develop and practice teaching skills in a guided environment to be an effective teacher,
- be prepared for the school internship.

504.3 Suggestive Mode of Transaction

- Demonstration lesson (minimum 1 in each pedagogical subject)
- Peer Group teaching and peer observation (minimum 5 in each pedagogical subject)
- Observation of lessons by teacher educators during peer group teaching
- Reflective group discussions/workshops/seminars
- Preparation and presentation of the video content illustrating best classroom practices.

504.4 Content

The pre-internship will include activities relating to the stage-specific pedagogy courses, ability enhancement and value-added courses and foundation courses transacted during previous semesters. It will also include knowledge of pedagogy, formats of lesson plans, different ICT tools, schooling systems in India, principles of classroom management, assessment, and other relevant content.

504.5 Activities to be conducted:

- Observation of lessons transacted by teacher educators to identify pedagogic skills.
- Exposure to various types of lesson plans through workshops.
- Development of relevant Teaching Learning Materials (TLMs).
- Participation in screening and discussion of educational videos on pedagogy and assessment.
- Learning about inclusiveness in school education
- Orientation for Action Research/case study

504.5 Secondary Stage

- Orientation of student teachers to different pedagogic approaches like storytelling, art-integrated, sports-integrated, project-based, and ICT-integrated for developing critical thinking, attention to life aspirations, and greater flexibility and classroom management skills.
- Observation of the lesson is demonstrated by teacher educators/experts in the institute.
- Designing guided activities, including a laboratory for each class/subject based on learning outcomes.
- Study Secondary Stage Learning Standards in the NCF
- Content analysis and development of the unit plan, concept map and lesson plan.

- Discussion on unit plan and lesson plan with teacher educators/experts
- Preparation of a Portfolio (for self-work) that the student-teacher will use to keep all her/his work.
- Participate in discussions/reflective sessions for conceptualising teaching-learning practices.
- Exploring available learning resources and educational videos
- Developing local, low-cost, and innovative TLMs.
- Reading and reflecting on inspiring books on pedagogic practices

504.6 Assessment

Competence/Artefact	Method of assessment	Assessed By	Credits
Classroom teaching skills and assessment tools (including learning standards)	Simulated Presentation	Teacher-Educator	1
Reflective group discussions/workshop	Observations	Teacher-Educator	0.5
Artefacts (Lesson Plans, TLM, Curated Videos) and action research procedures.	Evaluation	Teacher-Educator	0.5

504.7 Outcomes

After completion of the course, student teachers will be able to:

1. describe the prerequisites of the internship.
2. demonstrate knowledge of pedagogic practices, classroom management skills, assessment tools and learning standards,
3. develop lesson plans and relevant Teaching Learning Materials (TLMs),
4. develop readiness to take up an internship programme.

ECESC-505 Community Engagement and Services

Credit: 2

505.1 About the Course

The curricular component of 'community engagement and service' seeks to expose student teachers to the socio-economic issues in society and community-supported development activities so that classroom learning can be supplemented by life experiences to generate solutions to real-life problems. This course is designed to develop insights into the functions of the community, enhance the ability of student teachers to enlist community support to and participation in school-related activities, make the community aware of the importance of

education, issues associated with schooling, gender inequity, health & wellness of children, initiatives for supporting lifelong education etc. It aims at sensitizing the student teachers to initiate actions with the support of the community members to address the social, cultural and educational problems, and develop social leadership skills through community service. The component seeks to enable student teachers to be acquainted with various community development initiatives and organise activities such as street plays, advocacy activities, door-to-door campaigns, and prabhat-phereis, etc., to mobilise community participation in development initiatives.

This curricular component envisages participation of student-teachers in activities undertaken under the National Service Scheme (NSS), New India Literacy Programme, Student mentoring initiatives, etc. Some of the activities include: Survey of community resources for participation in different school activities, Study of the situation with regard to school dropout and the reason thereof (Stage wise); Survey of a specific settlement to study the socioeconomic and educational status; Survey of non-literates in a specific settlement, including identification of 4-5 non-literate adults who will be supported by student teachers to become literate; training of local youth in First-Aid and other relevant activities; assessment of the situation with regard to Health and wellness of children in a locality, creating awareness of the importance of sustainable development, making the community members aware of the importance of environmental protection, creating awareness of rainwater harvesting, mentoring school students with learning deficits, guidance and counselling to school students etc.

505.2 Learning Outcomes

On successful completion of the 'Community Engagement and Service' programme, the student-teacher should be able to:

- recognize the socio-economic issues in the community and identify initiatives that could help solve problems faced by the community,
- demonstrate an awareness of the functions of the community, and the measures required for enlisting community participation in school-related activities,
- undertake initiatives that are required to make the community aware of the importance of education, issues associated with schooling, gender inequity, health & wellness of children, illiteracy among youth and adults in the community etc.,
- suggest actions in collaboration with community members to address the social, cultural and educational problems in the community,
- organize activities such as *street plays*, *advocacy activities, door-to-door campaigns, and prabhat-pheris* etc. to mobilize community participation in development initiatives,
- demonstrate social leadership quality through community services,
- organize interactions between schools and local communities for generating solutions to problems such as dropout and learning deficits,
- facilitate partnerships between local communities to enhance participation of the community in school-related activities such as PTA meetings,

- recognize the fault lines of the society, such as casteism, social taboos and superstitions etc. and work towards bridging them to establish harmony in the society,
- demonstrate positive feelings towards the local community and appreciate traditional knowledge and practices,
- Recognize the values of public service and active citizenship.

505.3 Approach to curriculum transaction

The student teachers will be provided opportunities to have exposure to community life for ten days in total, two days in Preparation for Community Engagement & Service in the institution, seven days working with the community, and the last day in the institution for sharing their experiences and reflections. The activities may be conducted in groups or individually as appropriate.

Days 1-2: Preparation for community services (In the institution)

- Orientation of student teachers on Community Engagement & Services through discussion and group activities.
- Workshop for developing tools for different activities during the programme.

Days 3-9: Engagement with the community (Mandatory onsite stay with the community)

Students will be divided into smaller groups; They will participate in the planned activities with defined roles for seven days on a rotation basis. These activities include:

- participation of student teachers in activities undertaken under the National Service Scheme (NSS), New India Literacy Programme, Student mentoring initiatives, etc.
- Survey of community resources for supporting school activities.
- Study of the situation regarding school dropout and the reasons thereof (Stage-wise).
- Survey of specific settlement to assess the situation about non-literates in the settlement, including identification of 4-5 non-literate youth and adults who will be supported by student teachers to become literate.
- Training of local youth in First Aid and other relevant interventions,
- Assessment of the situation regarding the Health and wellness of children in a locality,
- Creating awareness of the importance of sustainable development, and making the community members aware of the need to support initiatives to ensure environmental protection, creating awareness of rainwater harvesting, mentoring school students with learning deficits, guidance and counselling to school students, etc.)
- Visit and interact with local artisans and craftspersons.

The above activities typically will include working with the community, collecting data, playing local games, community awareness programmes like nukkad natak, rallies, organizing and participating in the cultural programmes with the community members etc.

The student teachers shall conduct different pre-scheduled activities throughout the day. Morning sessions will be used for activities with the community and data collection. The afternoon session will be devoted to data analysis and preparation of the report, and

participation in games & sports activities. The evening session will involve cultural activities with community members.

Day 10: Feedback session and Reflection **(**In the Institution)

- Sharing experiences and discussing activities carried out.
- Presentation and submission of a report on the activities carried out.
- Evaluation of the activities by collecting feedback on the effectiveness of the campaign from the mentor and the students.
- Reflection of experience (individual/group) of organising community service

505.4 Assessment components and weightage

- Involvement and active participation in activities relating to Community Engagement and Service: (Assessment method: Observation by teacher educator, teacher and community members); Weightage: 75%; Assessed by the teacher educator, teacher and community members),
- Group Report & Reflections: Method of assessment: Presentation by student teachers); Weightage: 25% (Assessed by Teacher Educator)

505.5 Suggestive Links

- Ministry of Education (2021).Vidyanjali: Guidelines for Promoting Community and Voluntary Participation for Enhancing Quality School Education, Government of India. https://vidyanjali.education.gov.in/assets/pdf/Final_Guidelines_Vidyanjali_%20December.pdf
- RIE Bhubaneswar (2020). Handbook on Field Engagement in Pre-service Teacher Education, Bhubaneswar, Regional Institute of Education.

RM-506: Introduction to Research

Credit: 4

506.1 About the Course

The "Introduction to Research" course prepares students at the undergraduate level to develop the basic foundational skills needed to inquire into different areas systematically. It provides an all-inclusive overview of the steps involved in research, including constructing research questions, performing a literature review, designing a study, collecting and analysing data, and upholding ethical standards. Students tackle both qualitative and quantitative approaches and learn to choose appropriate methods for different scenarios. Emphasis is placed on the mastery of research communication skills, critical thinking, and advanced analysis. Students utilise practical methods and projects to gain firsthand experience in designing and executing research studies. This positions them for further academic study and professional research positions. At the conclusion of the course, students will understand the complete process involved in research, from conceptualisation to

dissemination, and appreciate the significance of research for advancing knowledge and contributing towards societal development.

506.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- Discuss the core principles, classifications, and aims of research in theoretical as well as practical contexts.
- Articulate and precisely define research issues, goals, and questions or hypotheses.
- Undertake a simple literature review utilising scholarly search engines and cite the references utilising accepted citation formats such as APA style.
- Determine suitable research strategies, sample selection procedures, and tools for gathering information to answer various research questions.
- Use simple statistical computations and methods to describe and analyze qualitative and quantitative information.
- Observe ethical norms of conduct and academic honesty in all stages of proposing, implementing, and reporting the research.
- Formulate and defend a complete research proposal or prepare a mini-project report using generally accepted academic standards and structures.

Unit – I

Introduction to Research

A. Meaning, purpose, and importance of research
B. Research in academic and professional contexts
C. Types of research: Basic, Applied, and action research. Quantitative, Qualitative, Mixed Methods
D. Characteristics and limitations of scientific research. Nature of Interdisciplinary research.

Unit – II

Literature Review

A. Purpose and techniques of reviewing literature
B. Sources of knowledge: Primary and secondary
C. Tools: Google Scholar, Research Gate, databases (JSTOR, Scopus, etc.)
D. Finding and writing the research gap.

Unit – III

Research Design

A. Types of research design: Exploratory, descriptive, experimental, randomized.
B. Research problem identification and formulation
C. Objectives: Formulation of objectives.
D. Hypotheses: Meaning, types and importance.

Unit- IV

Research Process

A. Steps in the research process.
B. Population and sample. Qualities of a good sample.
C. Sampling techniques: Probability and non-probability, Sample size determination
D. Data collection methods: Surveys, interviews, observations, experiments. Design of questionnaires and interview schedules.

Unit- V

Data Analysis and Interpretation

A. Types of data: Qualitative vs Quantitative
B. Coding and tabulation, data analysis, and interpretation.
C. Introduction to statistical techniques: mean, median, mode, SD, ANOVA and correlation.
D. Using software: Excel/SPSS/R (introductory)

506.3 Suggestive Practicum (Any three)

- Identify a research topic relevant to the area and frame a clear research problem.
- Based on the selected problem, draft specific research objectives and formulate testable hypotheses (if applicable).
- Conduct a mini literature review using Google Scholar, JSTOR, or other databases and compile a bibliography using APA or MLA format.
- Prepare a data collection tool (e.g., survey, interview guide) appropriate for the selected research problem.
- Choose and justify an appropriate sampling method and simulate the selection of a sample from a target population.
- Collect data from a small sample (real or hypothetical) using the designed tool.
- Input collected data into Excel or SPSS, calculate basic statistics (mean, median, SD), and present findings using graphs or tables.
- Prepare a short research report (5–10 pages) summarizing the entire research process and present the findings in class using slides or posters.

506.4 Suggestive Mode of Transaction

The following strategies will be used during the school-based research project:

- Discussions with teacher educator, school head, mentors, and peers for identification of the problem and development of intervention(s).
- Finalise the school-based research project proposal outline through discussion with mentor teachers/teacher educators.
- Document analysis, interaction with all stakeholders, and field visits.
- Sharing and presentation of the outcomes of the research project.

506.5 Suggestive Mode of Assessment

Assessment and examinations will be conducted as per the criteria of HNBGU.

506.6 Suggestive Reading Material

1. American Psychological Association (APA) Style Guide (7th ed.). APA Style
2. Best, J. W., & Kahn, J. V. (2014). *Research in Education* (10th ed.). Pearson Education.
3. Binkerhoff, C. (2019). *Doing Research: A Student's Guide to Finding & Using the Best Sources*. Kwantlen Polytechnic University.
4. Creswell, J. W. (2018). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (5th ed.). SAGE Publications.
5. Kothari, C. R., & Garg, G. (2019). *Research Methodology: Methods and Techniques* (4th ed.). New Age International Publishers.
6. Kumar, R. (2019). *Research Methodology: A Step-by-Step Guide for Beginners* (5th ed.). SAGE Publications.
7. Modern Language Association (MLA) Handbook (9th ed.). MLA Style Centre.
8. Sheppard, V. (2020). *Research Methods for the Social Sciences: An Introduction*. BC campus.
9. Walliman, N. (2011). *Your Research Project: Designing and Planning Your Work* (3rd ed.). SAGE Publications.

Semester-V
(B.Sc. B.Ed.)

	Subject	Course	Credits
1.	**Botany (Major)**	1. DSE 1-Biotechnology and Genetic Engineering Theory and Practical	4+2
2.	**Zoology (Major)**	1. DCZOO-501 DSE (Anyone) • DSE-1. Applied Zoology • DSE-2. Wildlife Conservation & Management • DSE-3. Principles of Genetics & Evolutionary Biology • DSE-4. Animal Behaviour & Endocrinology • DSE-5. Introduction to Developmental Biology • DSE-6. Basics of Biotechnology: Theory and Practical	4+2
3.	**Physics (Major)**	1. Modern Physics Theory and Practical	4+2
4.	**Chemistry (Major)**	1. Students can opt for any one • Analytical Methods in Chemistry • Polymer Chemistry • Green Chemistry Theory and Practical	4+2
5.	**Mathematics (Major)**	1. Linear Algebra Theory	6

DCMJ-501: Disciplinary
Major Botany
DSE 1-Biotechnology and Genetic Engineering
SOLS/BOT/DSE-1 (T)

Credits: 04, Lectures: 60

UNIT I

Concept: Definition of Biotechnology, history and the multidisciplinary nature of Biotechnology, applications of Biotechnology, Biotechnology and developing countries, commercialization of Biotechnology in a developing country.

UNIT II

Biotechnology in Food: Introduction, dairy products, fish and meat products, food enzymes, sweeteners, bakery products, food wastes, microbial products, oriental fermented foods, drinks, alcoholic and non-alcoholic beverages.

UNIT III

Enzymology and Enzyme Technology: Definition of enzyme, enzymology and enzyme technology, nature of the enzymes, applications of enzymes, the technology of enzyme production, and immobilisation of enzymes.

UNIT IV

Recombinant DNA Technology: Concepts of Recombinant DNA, biological tools of Recombinant DNA technology, modification of the gene, methods of gene transfer, transgenic organisms.

UNIT V

DNA Structure and Manipulation - Techniques for DNA isolation and purification. Methods for quantification and characterization of DNA samples. RNA Analysis and Gene Expression- Methods for RNA isolation and purification. Analysis of gene expression.

UNIT VI

Gene Manipulation Techniques – Methods of gene delivery. Physical, chemical, and biological methods. Transformation, transfection, electroporation and micro-injection. Gene knockout techniques in bacterial and eukaryotic organisms.

UNIT VII

Genome Editing - Introduction to genome editing techniques- Principles and applications of genome editing techniques. CRISPR-Cas9, site-directed mutagenesis, and other genome editing methods.

Books

1. Bilgrami and Pandey. 1990. Introduction to Biotechnology. CBS Publishers, India.
2. Bullock, J. and Uritiansen, B. 1995. Basic Biotechnology. Academic Press, UK.
3. Dubey, R. C. 2014. A Textbook of Biotechnology. S. Chand and Co. Pvt. Ltd. New Delhi, India, ISBN: 81-219-2608-4.
4. Jack, G. Chirikjian. 1995. Biotechnology: Theory and Techniques Volume I. Jones and Bartlett Publishers, Boston, London, Singapore.
5. Natesh, S. 1993. Biotechnology in Agriculture. Oxford and IBM Pvt. Ltd., India.
6. Smith, J. E. 1988. Biotechnology. Edward Arnold Pub. NY, UK.

DSE 1-Biotechnology and Genetic Engineering (Practical)

SOLS/BOT/DSE-1(P)

Credits: 2

1. Demonstration of Agarose Gel Electrophoresis.
2. Confirmation of plasmid by restriction digestion and Agarose Gel Electrophoresis
3. Ligation of the DNA insert and the plasmid vector backbone using the DNA ligase enzyme.
4. Transformation of plasmid DNA in *E. coli* cells by the Calcium Chloride method.
5. Isolation of plasmid DNA from bacterial cells by the alkaline lysis method.
6. Screening of plasmid DNA transformed colonies by the Blue-white method.
7. Confirmation of gene integration by polymerase chain reaction (PCR).
8. Micropropagation of plant organs, i.e Leaf, stem, shoot tips and axillary buds.

Suggested Readings:

1. E. Pullaiah, T., Rao, M.V. Subba, Sreedevi 2017. Plant Tissue Culture: Theory and Practicals 2nd Edition.
2. P V G K Sarma, 2021. A Practical Textbook of Genetic Engineering in Bacteria.
3. B.D. Singh, 2015. Biotechnology.

Major Zoology

SOLS/ZOO/DSE-1 Applied Zoology

Credits: 4, 60 Hours

UNIT I

Introduction to Host-parasite Relationship: Host, Definitive host, Intermediate host, Parasitism, Symbiosis, Commensalism, Reservoir, Zoonosis [4 Hours]

UNIT II

Epidemiology of Diseases: Transmission, Prevention and control of diseases—Tuberculosis, swine flu, typhoid, Covid-19 [5 Hours]

UNIT III

Rickettsiae and Spirochaetes: Brief account of Rickettsia prowazekii, Borrelia recurrentis and Treponema pallidum [4 Hours]

UNIT IV

Parasitic Protozoa: Life history and pathogenicity of Entamoeba histolytica, Plasmodium vivax, Leishmania donovani and Trypanosoma gambiense [5 Hours]

UNIT V

Parasitic Helminthes: Life history and pathogenicity of Schistosoma haematobium, Ancylostoma duodenale and Wuchereria bancrofti [5 Hours]

UNIT VI

Insects of Economic Importance: Biology, Control and damage caused by Helicoverpa armigera, Pyrilla perpusilla and Papilio demoleus, Callosobruchus chinensis, Sitophilus oryzae and Tribolium castaneum; Safe storage of stored grains [8 Hours]

UNIT VII

Insects of Medical Importance: Life cycle, medical importance and control of Pediculus humanus corporis, Anopheles, Culex, Aedes, Xenopsylla cheopis, Phlebotomus argentipes [10 Hours]

UNIT VIII

Animal Husbandry: Domestic animals of economic importance; Preservation and artificial insemination in cattle; Induction of early puberty and synchronization of estrus in cattle [8 Hours]

UNIT IX

Poultry Farming: Principles of poultry breeding, Management of breeding stock and broilers, Processing and preservation of eggs [6 Hours]

UNIT X

Fish Technology: Genetic improvements in the aquaculture industry; Induced breeding and transportation of fish seed [5 Hours]

Suggested Readings

1. Arora, D. R and Arora, B. (2001). Medical Parasitology. II Edition. CBS Publications and Distributors.

2. Atwal, A.S. (1986). Agricultural Pests of India and South East Asia, Kalyani Publishers.
3. Dennis, H. (2009). Agricultural Entomology. Timber Press (OR).
4. Dunham R.A. (2004). Aquaculture and Fisheries Biotechnology: Genetic Approaches. CABI publications, U.K.
5. Hafez, E. S. E. (1962). Reproduction in Farm Animals. Lea & Fabiger Publisher
6. Kumar, Vinay et al. (2014). Robbins And Cotran Pathologic Basis of Disease South Asia Edition
7. Park, K. (2007). Preventive and Social Medicine. XVI Edition. B.B. Publishers.
8. Pedigo, L.P. (2002). Entomology and Pest Management, Prentice Hall.

SOLS/ZOO/DSE-1(P) Applied Zoology (Practical)

Credits:2

1. Study of Plasmodium vivax, Entamoeba histolytica, Trypanosoma gambiense, Ancylostoma duodenale, Leishmania donovani and Wuchereria bancrofti and their life stages through permanent slides/photomicrographs or specimens.
2. Study of arthropod vectors associated with human diseases: Pediculus, Culex, Anopheles, Aedes and Xenopsylla.
3. Study of insect damage to different plant parts/stored grains through damaged products/photographs.
4. Identifying feature and economic importance of Helicoverpa armigera, Papilio demoleus, Pyrilla perpusilla, Callosobruchus chinensis, Sitophilus oryzae and Tribolium castaneum
5. Visit to poultry farm or animal breeding centre and submission of visit report.
6. Preparation and maintenance of freshwater aquarium.

Wildlife Conservation & Management

SOLS/ZOO/DSE-2

Credits: 4, 60 Hours

UNIT I

Wildlife - Values of wild life; Our conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies [4 Hours]

UNIT II

Habitat analysis; Evaluation and management of wildlife - Physical parameters (Topography, Geology, Soil and Water); Biological Parameters (food, cover, forage, browse and cover estimation); Standard evaluation procedures: remote sensing and GIS [8 Hours]

UNIT III

Management of habitats - Setting back succession; Grazing logging; Mechanical treatment; Advancing the successional process; Cover construction; Preservation of general genetic diversity [6 Hours]

UNIT IV

Population estimation: Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio computation; Faecal analysis of ungulates and carnivores: Faecal samples, slide preparation, Hair identification, Pug marks and census method [10 Hours]

UNIT V

National Organisations involved in wildlife conservation; Wildlife Legislation – Wildlife Protection Act - 1972, its amendments and implementation; CITES; IUCN Red Data Book [6 Hours]

UNIT VI

Management planning of wildlife in protected areas; Estimation of carrying capacity; Ecotourism /wildlife tourism in forests; Concept of climax persistence; Ecology of disturbance [8 Hours]

UNIT VII

Management of excess population and translocation; Bio-telemetry; Care of injured and diseased animals; Quarantine; Common diseases of wild animals [6 Hours]

UNIT VIII

Zoogeographic areas of the Indian Subcontinent; Protected Areas: National Parks/ Sanctuaries/Biosphere Reserves of Indian subcontinent; Important features of protected areas in India; Tiger conservation – Tiger reserves in India; Management challenges in the Tiger reserve [12 Hours]

Suggested Readings

1. Sharma, BD: High Altitude Wildlife of India. Oxford 7 IBH Publ. Co. Pvt. Ltd. 1994.
2. Negi, SS: Himalayan Wildlife: Habitat and Conservation. Indus Publ. Company, New Delhi 1992.
3. Pullin, AS: Conservation Biology, Cambridge University Press, 2002.

Wildlife Conservation & Management (Practical)

SOLS/ZOO/DSE-2(P)

Credits: 2

1. Identification of flora, mammalian fauna, avian fauna, and herpetofauna
2. Demonstration of basic equipment needed in wildlife studies, use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses)
3. Familiarisation and study of animal evidence in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers, etc.
4. Demonstration of different field techniques for flora and fauna

5. PCQ, Ten tree method, Circular, Square & rectangular plots, Parker's 2 Step and other methods for ground cover assessment, Tree canopy cover assessment, Shrub cover assessment.
6. Trail/ transect monitoring for abundance and diversity estimation of mammals and birds (direct and indirect evidence)
7. Photograph of wild animals.
8. Zoogeographic areas of the Indian Subcontinent.
9. National Parks/ Sanctuaries/Biosphere Reserves of the Indian subcontinent.
10. Population estimation: capture-recapture method.

Principles of Genetics & Evolutionary Biology

SOLS/ZOO/DSE-3

Credits: 4, 60 Hours

A. Genetics

UNIT I

Mendel's law; Exceptions to Mendel's law; Chromosomal theory of Inheritance; Sex-linked inheritance & genetic disorders; Linkage & Crossing Over [8 Hours]

UNIT II

Chromosome structure; Euchromatin; Heterochromatin; Polytene and lampbrush chromosomes. Chromosome banding, Karyotyping; Fine structure of gene and allelism; Sex determination and Sex Linkage [10 Hours]

UNIT III

Cytoplasmic Inheritance, Polygenic Inheritance, Mutation, population and evolution genetics, Hardy-Weinberg Principle [10 Hours]

B. Evolution

UNIT IV

Historical development of the concept of evolution. Theories of organic evolution: Lamarckism (Neo-Lamarckism); Darwinism (Neo-Darwinism); Modern synthetic theory.
Evidence in favour of evolution: Comparative anatomy, Comparative Embryology, Palaeontology, Biochemistry & Genetics [10 Hours]

UNIT V

Processes of Evolutionary Change: Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism); Types of natural selection (Directional, Stabilising, Disruptive), Artificial selection. Species Concept: Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric) [10 Hours]

UNIT VI

Palaeontology: Fossils and fossilization, Incompleteness of fossil record, Dating of fossils, Significance of fossil record; Geological distribution of animals; Mass extinction (Causes, five major extinctions, K-Textinction in detail), Role of extinction in evolution; Evolution of Horse [12 Hours]

Suggested Readings

1. Allendorf, Fred W., Gordon H. Luikart, Sally N. Aitken (2012). Conservation and the Genetics of Populations,2nd edition, Wiley-Blackwell
2. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring, Harbour Laboratory Press.
3. Benjamin A. Peirce (2017). Genetics: A Conceptual Approach, W.H. Freeman and Company
4. Brown, TA (2020). Gene Cloning and DNA Analysis and Introduction, 8th edition, Wiley-Blackwell
5. Daniel L. Hartl, Elizabeth W. Jones (2004). Genetics Analysis of Genes and Genomes, 6th edition, Jones and Bartlett Publishers
6. Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.
7. Gardner, Gimmons and Snustad (2006). Principles of Genetics, 8th edition, John Wiley & Sons.
8. Hall, B. K. and Hallgrimsson, B. (2008). Evolution. IV Edition. Jones and Bartlett Publishers
9. Minkoff, E. (1983). Evolutionary Biology. Addison-Wesley
10. Reece, Jane B. (2011). Campbell Biology, 9th Edition, Pearson
11. Ridley, M. (2004). Evolution. III Edition. Blackwell Publishing
12. Robert, H. Tamarin (2009) Principles of Genetics, Tata McGraw Hill Education Pvt. Ltd.
13. Strickberger, M.W. (1989). Evolution, Jones and Bartlett Publishers
14. William S. Klung Cummings, Spencer and Palldino (2019). Concepts of Genetics, Pearson Education, Pearson

Principles of Genetics & Evolutionary Biology (Practical)

SOLS/ZOO/DSE-3(P)

Credits:2

A. Genetics

1. Study of Mendelian Inheritance and gene interactions (Non-Mendelian Inheritance) using suitable examples. Verify the results using the Chi-square test.
2. Study of Linkage, recombination, and gene mapping using the data.
3. Study of Human Karyotypes (normal and abnormal).

B. Evolution

1. Study of fossil evidence from plaster cast models and pictures

2. Study of homology and analogy from suitable specimens/ pictures
3. Charts:
   a. Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors
   b. Darwin's Finches with diagrams/cut-outs of beaks of different species
4. Visit to the Natural History Museum, submission of report.

Animal Behaviour & Endocrinology

SOLS/ZOO/DSE-4

Credits: 4, 60 Hours

A. Animal Behaviour

UNIT I

The science of behaviour: History, scope and terminology. Proximate and ultimate causes of behaviour. Instinct: Definition and characteristics (sign stimuli and Fixed Action Pattern). Learning behaviour: Definition. Spatial learning. Associative learning, classical conditioning, operant conditioning, and language learning. Imprinting. Kin recognition. Instinct versus learning behaviour. Timing of behaviour: Biological rhythms. The Biological Clock. Circadian rhythm and its synchronisation with seasonal rhythms. Photoperiodism [12 Hours]

UNIT II

Communication: Visual, olfactory, acoustic (bird songs, amphibian calls); echolocation in bats, electrolocation in fish. Chemoreception: Chemicals (pheromones) as signals in insects, fish and mammals. Role of olfaction in communication behaviour (territorial, sex recognition, feeding, etc) in fish and mammals. Neural control of behaviour: Components of the brain involved in various behaviours. Neural control of drinking, learning, eating, activity & rest, sleep, aggression, sexual behaviour. Hormonal Control of behaviour: Hormone brain relationships. Sexual behaviour in mammals (e.g. rat). Sociobiology: Elements of sociality and social grouping in animals [15 Hours]

B. Endocrinology

UNIT III

Endocrine messengers: hormones, neurohormones, hormone-like substances (neuronal peptides, autocoids, pheromones, neurosecretion). Hormones and Physiological actions of the endocrine glands in mammals: Pituitary, Thyroid, Parathyroid, Pancreas, Gastro-intestinal tract, Adrenal cortex and Medulla, Thymus and Pineal. Hormone biosynthesis: Protein peptide hormones (gonadotropins, thyrotropin, corticotropin, steroids and catecholamines). Mechanism of action of Protein hormones and Catecholamines: membrane-bound receptors, G-protein and control of adenylate cyclase, Cyclic nucleotide cascade [18 Hours]

UNIT IV

Organisation & physiological actions of the Testis: Androgen binding protein (ABP), Inhibin. Neuroendocrine control of testicular functions (Gn RH regulation, FSH- effects on germinal epithelium, LH- effects on Leydig cells, negative feedback regulation). Organization & physiological actions of the Ovary: Folliculogensis, Ovulation, Luteinization, Ovarian cycles; Seasonal reproductive cycles; sexual dysfunctions in man [15 Hours]

Suggested Readings

1. Alcock, John: Animal Behaviour, 4th edition, Sinauer Associates, Inc., 1989.
2. Bentley P.J.: Comparative Vertebrate Endocrinology S. Chand & Company Ltd, Ram Nagar, New Delhi, 1980

Animal Behaviour & Endocrinology (Practical)

SOLS/ZOO/DSE-4(P)

Credits: 2

1. Animal Behaviour photographs/videos/models
2. Slides & Photographs of Endocrine Disorders
3. Examination of histological sections from photomicrographs/ permanent slides of rat/human endocrine glands
4. Cholesterol estimation from a serum sample
5. Glucose estimation from a blood sample

Introduction to Developmental Biology

SOLS/ZOO/DSE-5

Credits: 4, 60 Hours

UNIT I

Basic concepts in developmental biology; Gametogenesis: Events in spermatogenesis. Morphology of mature mammalian spermatozoon; Events in Oogenesis, Significance of Oogenesis. Vitellogenesis in birds: Comparison between Spermatogenesis & Oogenesis
Fertilisation: Mechanism of fertilisation; Capacitation, Molecular events - Block to polyspermy. Egg activation: An Elementary idea of parthenogenesis.

UNIT II

Types of eggs and cleavage. Role of yolk during cleavage; Products of cleavage (Morula and Blastula). Fate map: fate map of the early blastula of the Frog, Fate of germ layers. Types of morphogenetic movements. Gastrulation in sea urchin, frog, chick and mammal. Neurogenesis & Notogenesis.

UNIT III

Extra Embryonic Foetal Membrane (Chick). Development of the chick embryo up to 72 hours. Types, formation and function of the Placenta in mammals. Metamorphic events in the frog life cycle and their hormonal regulation.

UNIT IV

Elementary concept of primary organizer; Induction; nature and its mechanism of action; Development of eye and limbs; Totipotency; Teratogenesis; Drosophila development up to gastrulation; Differential expression of genes in Drosophila.

Suggested Readings

1. Berrill, NJ: Developmental Biology, Tata McGraw-Hill Publishing Co. Ltd., 1979
2. Gilbert, SF: Developmental Biology, 3rd edition, Sinauer Associates, 1991
3. Twyman, R.M.: BIOS Instant Notes in Developmental Biology, Taylor & Francis, 2000

Introduction to Developmental Biology (Practical)

SOLS/ZOO/DSE-5(P)

Credits: 2

1. Frog - Study of developmental stages - whole mounts and sections through permanent slides – cleavage stages, blastula, gastrula, neurula, tail bud stage, tadpole external and internal gill stages.
2. Chick- Study of developmental stages - sections through permanent slides – cleavage stages, primitive streak stage, 24, 36, 48, 72 hours of incubation
3. Study of the different types of placentae- histological sections through permanent slides or photomicrographs.
4. Study of placental development in humans by ultrasound scans.
5. Examination of gametes - frog/rat - sperm and ova through permanent slides or photomicrographs.

Basics of Biotechnology

SOLS/ZOO/DSE-6

Credits:4, 60 Hours

UNIT I

What is Biotechnology? Historical inputs. Biotechnology as a `tool' not a `product'. Interdisciplinary nature. Foundation of Biotechnology: Importance of basic Biology disciplines eg, Human, Animal and Plant Physiology, Genetics, Cell and Molecular Biology, Microbiology, Biochemistry, Immunology and Chemical engineering [12 Hours]

UNIT II

Introduction to Genetic Engineering. Tools and techniques.

Enzymes, Restriction endonuclease. Ligases, Alkaline phosphatase, Reverse transcriptase, DNA polymerase, Vectors-plasmids, phages, cosmids. Biotechnology hazards and safety. Social, moral and ethical issues [12 Hours]

UNIT III

Biotechnology in health care. Therapeutic products (Hormones, regulatory proteins, antibiotics). Prenatal diagnosis of genetic diseases. Vaccines, Immunodiagnostics (RIA, ELISA, IRMA) and DNA probes for disease identification. Gene therapy. Human Genome and Biomedicine [12 Hours]

UNIT IV

Introduction to Environmental Biotechnology. Bioprocessing Techniques. Enzyme Biotechnology. Single-cell proteins. Food and Beverage Biotechnology. Biotechnology in animal agriculture. Biotechnology in plant agriculture [12 Hours]

UNIT V

Genetics and Biotechnology: Introduction, Animal Cloning (therapeutic and Reproductive), Genetic manipulation at the organism level: Transgenesis, Knock-in and Knock-out models (Cre-Lox P system), CRISPR-Cas9 technology, genome editing in nature and artificial species improvement of plants and animals. Genetic manipulation at the cellular and molecular level, transfection technologies, adenoviral and lentiviral-based methods; Industrial genetics; Cell fusion and hybridoma techniques [12 Hours]

Suggested Readings

1. Das H.K.: Textbook of Biotechnology, Wiley India Pvt. Limited, ISBN 8126505567, 2004
2. Dubey R.C.: A Textbook of Biotechnology, S. Chand Publishing, 1993
3. Thieman, William, Michael A. Palladino: Introduction to Biotechnology, Pearson Education India; 3rd edition, ISBN-10: 9789332535060, 2014

Basics of Biotechnology (Practical)

SOLS/ /ZOO/DSE-6(P)

Credits:2

1. Isolation of plasmid DNA from E. coli.
2. Transformation of E. coli (pUC 18/19) and calculation of transformation efficiency.
3. Restriction Endonuclease Digestion of plasmid DNA.
4. Ligation of Target DNA
5. Gene amplification using PCR
6. DNA sequencing: Interpretation of sequence from the data provided.
7. Analysis of DNA fingerprint
8. Separation of proteins by SDS-PAGE

Major Physics
Modern Physics

Credits: 4, 60 hours

Wave–Particle Duality

Planck's quantum theory, photo-electric effect, Compton scattering, pair production, De Broglie hypothesis and matter waves, phase and group velocities, Davisson-Germer experiment, Heisenberg uncertainty principle, energy-time uncertainty.

Atomic Structure

Rutherford and Bohr's models, atomic spectra, Bohr's quantisation rule and atomic stability, energy level and spectra, atomic excitation, electron spin, Pauli's exclusion principle, fine structure, spin-orbit coupling, L-S and J-J couplings, total angular momentum.

Atoms in Electric and Magnetic Fields

Electron Angular Momentum, Space Quantisation, electron Spin and Spin Angular Momentum, Larmor's Theorem, Spin Magnetic Moment, Stern-Gerlach Experiment, Normal and Anomalous Zeeman Effect, Stark effect, Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton.

Nuclear Properties and Transformation

Size and structure of nucleus, non-existence of electrons in the nucleus, atomic weight, binding energy, semi-empirical mass formula, nature of nuclear force. Radioactivity: stability of nucleus, law of radioactive decay, half-life and Mean lifetime, α-Decay, β-decay, energy released, γ-ray emission, fission and fusion, mass deficit and generation of energy, elementary idea of nuclear reactors, thermonuclear reactions.

Reference Books

1. Concepts of Modern Physics. Arthur Beiger, 4th Edition. 2019, Tata McGraw-Hill
2. Modern Physics for Scientists and Engineers. John R. Taylor, Chris D. Zafiratos, Michael A. Dubson, 2nd Edition, 2015, University Science Books, U.S.
3. Six Ideas that Shaped Physics: Particles Behave like Waves. Thomas A. Moore, 3rd Edition, 2016. Tata McGraw-Hill.
4. Quantum Physics, Berkeley Physics Course Vol. 4. E.H. Wichman, 2008, Tata McGraw-Hill
5. Modern Physics. R.A. Serway. C.J. Moses, and C.A. Moyer. 3rd Edition, 2012. Cengage Learning
6. Modern Physics. R Murugeshan, Kiruthiga Sivaprasath, 18th Edition, 2016, S. Chand & Company Pvt Ltd.
7. Modern Physics. Kenneth S. Krane, 4th Edition, 2019,

Modern Physics (Practical)

Credits: 2

List of Experiments:

1. To determine the value of the Boltzmann constant using the V-l characteristic of the PN diode.
2. To determine the work function of the material of the filament of the directly heated vacuum diode.
3. To determine the value of Planck's constant using LEDs of at least 4 different colours.
4. To determine the ionisation potential of mercury.
5. To determine the wavelength of the H-alpha emission line of the Hydrogen atom.
6. To determine the absorption lines in the rotational spectrum of Iodine vapour.
7. To study the diffraction patterns of single and double slits using laser source and measure its intensity variation using Photosensor and compare with incoherent source - Na light.
8. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
9. To determine the value of e/m by magnetic focusing.
10. To set up the Millikan oil drop apparatus and determine the charge of an electron.

Reference Books:

1. Advanced Practical Physics for students. B.L. Worsnop & H.T. Flint,1971, Asia Publishing House.
2. Advanced level Practical Physics. Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985.Heinemann Educational Publishers
3. A Text Book of Practical Physics. Indu Prakash, Ramakrishna, A.K. Jha, 11th Edition, 2012, Kitab Mahal, New Delhi.

Major Chemistry

Students can opt for any one of the following papers:

1. **Analytical Methods in Chemistry**
2. **Polymer Chemistry**
3. **Green Chemistry**

Analytical Methods in Chemistry

Credits: 04, 60 Lectures

Qualitative and quantitative aspects of analysis

Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data, F, Q and t test, rejection of data, and confidence intervals. (5 Lectures)

Optical methods of analysis

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.

UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument;

Basic principles of quantitative analysis: Estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method.

Infrared Spectrometry: Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques.

Structural illustration through interpretation of data, Effect and importance of isotope substitution.

Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace levels of metal ions from water samples. (25 lectures)

Thermal methods of analysis

Theory of thermogravimetry (TG), basic principle of instrumentation. Techniques for quantitative estimation of Ca and Mg from their mixture. (5 lectures)

Electroanalytical methods

Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pKa values. (10 lectures)

Separation techniques

Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation.

Techniques of extraction: batch, continuous and counter-current extractions.

Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from aqueous and nonaqueous media.

Chromatography: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange.

Development of chromatograms: frontal, elution and displacement methods.

Qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC, TLC and HPLC.

Stereoisomeric separation and analysis: Measurement of optical rotation, calculation of Enantiomeric excess (ee)/ diastereomeric excess (de) ratios and determination of enantiomeric composition using NMR, Chiral solvents and chiral shift reagents. Chiral chromatographic techniques using chiral columns (GC and HPLC).

Role of computers in instrumental methods of analysis. (15 Lectures)

Reference Books:

- Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. *Vogel's Textbook of Quantitative Chemical Analysis*, John Wiley & Sons, 1989.
- Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed.
- Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
- Christian, G.D; *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.
- Harris, D. C. *Exploring Chemical Analysis*, Ed. New York, W.H. Freeman, 2001.
- Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age, International Publisher, 2009.
- Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
- Mikes, O. *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.
- Ditts, R.V. *Analytical Chemistry; Methods of Separation*, van Nostrand, 1974.

Analytical Methods in Chemistry: Practical

Credits: 02

I. Separation Techniques

1. Chromatography:

(a) Separation of mixtures

(i) Paper chromatographic separation of Fe^{3+}, Al^{3+}, and Cr^{3+}.

(ii) Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the Rf values.

(b) Separate a mixture of Sudan yellow and Sudan Red by the TLC technique and identify them on the basis of their Rf values.

(c) Chromatographic separation of the active ingredients of plants, flowers and juices by TLC

II. Solvent Extractions:

(i) To separate a mixture of Ni^{2+} & Fe^{2+} by complexation with DMG and extracting the Ni^{2+} - DMG complex in chloroform, and determine its concentration by spectrophotometry.

(ii) Solvent extraction of zirconium with Amberlite LA-1, separation from a mixture of iron and gallium.

3. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.
4. Determination of Na, Ca, Li in cola drinks and fruit juices using flame photometric techniques.
5. Analysis of soil:

   (i) Determination of pH of soil.

(ii)Total soluble salt (iii) Estimation of calcium, magnesium, phosphate, nitrate

6. Ion exchange:
   (i) Determination of exchange capacity of cation exchange resins and anion exchange resins.
   (ii)Separation of metal ions from their binary mixture.
   (iii) Separation of amino acids from organic acids by ion exchange chromatography.

III Spectrophotometry

1Determination of pKa values of indicator using spectrophotometry.
2 Structural characterisation of compounds by infrared spectroscopy.
3 Determination of dissolved oxygen in water.
4 Determination of chemical oxygen demand (COD).
5 Determination of Biological Oxygen Demand (BOD).
6 Determine the composition of the Ferric-salicylate/ ferric-thiocyanate complex by Job's method.

Reference Books:

- Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. *Vogel's Textbook of Quantitative Chemical Analysis*, John Wiley & Sons, 1989.
- Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
- Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
- Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
- Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009.
- Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed.
- Mikes, O. Laboratory Handbook of Chromatographic & Allied Methods, Elsevier Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.
- Ditts, R.V. Analytical Chemistry; Methods of Separation, van Nostrand, 1974.

Polymer Chemistry

Credits: 04, 60 Lectures

Introduction and history of polymeric materials:

Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers. (4 Lectures)

Functionality and its importance

Criteria for synthetic polymer formation, classification of polymerisation processes, Relationships between functionality, extent of reaction and degree of polymerisation. Bi-functional systems, Polyfunctional systems. (8 Lectures).

Kinetics of Polymerisation

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques. (8 lectures).

Crystallization and crystallinity

Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point. (4 lectures).

Nature and structure of polymers

Structure Property relationships. (2 lectures)

Determination of the molecular weight of polymers

(*Mn*, *Mw*, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index. (8 Lectures).

Glass transition temperature (Tg) and determination of Tg,

Free volume theory, WLF equation, Factors affecting glass transition temperature (Tg). (8 Lectures)

Polymer Solution

Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymer solutions, Flory-Huggins theory, Lower and Upper critical solution temperatures. **(**8 Lectures).

Properties of Polymers

(Physical, thermal, Flow & Mechanical Properties).

Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly (vinyl chloride) and related polymers, poly (vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes, Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly (p-phenylene sulphide polypyrrole, polythiophene)]. (10 Lectures).

Reference Books:

- Seymour, R.B. & Carraher, C.E. *Polymer Chemistry: An Introduction,* Marcel Dekker, Inc., New York, 1981.
- Odian, G. *Principles of Polymerization*, 4th Ed. Wiley, 2004.
- Billmeyer, F.W. *Textbook of Polymer Science*, 2nd Ed. Wiley Inter science, 1971.
- Ghosh, P. *Polymer Science & Technology*, Tata McGraw-Hill Education, 1991.
- Lenz, R.W. *Organic Chemistry of Synthetic High Polymers.* Inter science Publishers, New York, 1967.

Polymer Chemistry Practical

Credits: 02

Polymer synthesis

1. Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA) / Acrylic acid (AA).
   a. Purification of monomer
   b. Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bis-isobutylonitrile (AIBN)
2. Preparation of nylon 66/6
   1. Interfacial polymerization, preparation of polyester from isophthaloyl chloride (IPC) and phenolphthalein
      a. Preparation of IPC
      b. Purification of IPC
      c. Interfacial polymerization
3. Redox polymerization of acrylamide
4. Precipitation polymerization of acrylonitrile
5. Preparation of urea-formaldehyde resin
6. Preparations of novalac resin/resold resin.
7. Microscale Emulsion Polymerization of Poly(methylacrylate).

Polymer characterization

1. Determination of molecular weight by viscometry:
   (a) Polyacrylamide-aq. $NaNO_2$ solution
   (b) (Poly vinyl propylidene (PVP) in water
2. Determination of the viscosity-average molecular weight of poly (vinyl alcohol) (PVOH) and the fraction of "head-to-head" monomer linkages in the polymer.
3. Determination of molecular weight by end group analysis: Polyethene glycol (PEG) (OH group).
4. Testing of mechanical properties of polymers.
5. Determination of the hydroxyl number of a polymer using the colourimetric method.

Polymer analysis

1. Estimation of the amount of HCHO in the given solution by the sodium sulphite method
2. Instrumental Techniques
3. IR studies of polymers
4. DSC analysis of polymers

5. Preparation of polyacrylamide and its electrophoresis

Reference Books:

- M.P. Stevens, *Polymer Chemistry: An Introduction*, 3rd Ed., Oxford University Press, 1999.
- H.R. Allcock, F.W. Lampe & J.E. Mark, *Contemporary Polymer Chemistry*, 3rd ed. Prentice-Hall (2003)
- F.W. Billmeyer, *Textbook of Polymer Science*, 3rd ed. Wiley-Interscience (1984)
- J.R. Fried, *Polymer Science and Technology*, 2nd ed. Prentice-Hall (2003)
- P. Munk & T.M. Aminabhavi, *Introduction to Macromolecular Science*, 2nd ed. John Wiley & Sons (2002)
- L. H. Sperling, *Introduction to Physical Polymer Science*, 4th ed. John Wiley & Sons (2005)
- M.P. Stevens, *Polymer Chemistry: An Introduction,* 3rd ed. Oxford University Press (2005).
- Seymour/ Carraher's Polymer Chemistry, 9th ed. by Charles E. Carraher, Jr. (2013).

Green Chemistry

Credits: 04, 60 Lectures

Introduction to Green Chemistry

What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry (4 Lectures).

Principles of Green Chemistry and Designing a Chemical Synthesis

Twelve principles of Green Chemistry with their explanations and examples, and special emphasis on the following:

Designing a Green Synthesis using these principles: Prevention of Waste/ byproducts; maximum incorporation of the materials used in the process into the final products, Atom Economy, calculation of atom economy of the rearrangement, addition, substitution and elimination reactions.

Prevention/ minimization of hazardous/ toxic products reducing toxicity. risk = (function) hazard × exposure; waste or pollution prevention hierarchy.

Green solvents– supercritical fluids, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent, PEG, solventless processes, immobilized solvents and how to compare greenness of solvents.

Energy requirements for reactions – alternative sources of energy: use of microwaves and ultrasonic energy.

Selection of starting materials; avoidance of unnecessary derivatization – careful use of blocking/protecting groups.

Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; catalysis and green chemistry, comparison of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis.

Prevention of chemical accidents designing greener processes, inherent safer design, principle of ISD "What you don't have cannot harm you", greener alternative to Bhopal Gas Tragedy (safer route to carcarbaryl) and Flixiborough accident (safer route to cyclohexanol) subdivision of ISD, minimization, simplification, substitution, moderation and limitation. Strengthening/ development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes. (30 Lectures).

Examples of Green Synthesis/ Reactions and some real-world cases

1. Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodiacetate (alternative to Strecker synthesis)
2. Microwave-assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols; microwave-assisted reactions in organic solvents: Diels-Alder reaction and Decarboxylation reaction
3. Ultrasound-assisted reactions: sonochemical Simmons-Smith Reaction (Ultrasonic alternative to Iodine)
4 Surfactants for carbon dioxide – replacing smog-producing and ozone-depleting solvents with CO_2 for precision cleaning and dry cleaning of garments.
5 Designing an environmentally safe marine antifoulant.
6 Rightfit pigment: synthetic azopigments to replace toxic organic and inorganic pigments.
7 An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.
8 Healthier fats and oils by Green Chemistry: Enzymatic interesterification for the production of no Trans-Fats and Oils
9 Development of Fully Recyclable Carpet: Cradle to Cradle Carpeting (16 Lectures).

Future Trends in Green Chemistry

Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; co-crystal controlled solid state synthesis (C_2S_3); Green chemistry in sustainable development. (10 Lectures).

Reference Books:

- Ahluwalia, V.K. & Kidwai, M.R. *New Trends in Green Chemistry*, Anamalaya Publishers (2005).
- Anastas, P.T. & Warner, J.K.: *Green Chemistry - Theory and Practical*, Oxford University Press (1998).
- Matlack, A.S. *Introduction to Green Chemistry*, Marcel Dekker (2001).
- Cann, M.C. & Connely, M.E. *Real-World cases in Green Chemistry*, American Chemical Society, Washington (2000).
- Ryan, M.A. & Tinnesand, M. *Introduction to Green Chemistry*, American Chemical Society, Washington (2002).
- Lancaster, M. *Green Chemistry: An Introductory Text* RSC Publishing, 2nd Edition, 2010.

Green Chemistry Practical

Credits: 02

1. Safer starting materials

- Preparation and characterisation of nanoparticles of gold using tea leaves.

2. Using renewable resources

- Preparation of biodiesel from vegetable/ waste cooking oil.

3. Avoiding waste

Principle of atom economy.

- Use of molecular model kit to stimulate the reaction to investigate how the atom economy can illustrate Green Chemistry.
- Preparation of propene by two methods can be studied

(I) Triethylamine ion + OH^- → propene + trimethylpropene + water H_2SO_4/D

(II) 1-propanol → propene + water

- Other types of reactions, like addition, elimination, substitution and rearrangement, should also be studied for the calculation of atom economy.

4. Use of enzymes as catalysts

- Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide.

5. Alternative Green solvents

- Extraction of D-limonene from orange peel using liquid CO2 prepared from dry ice.
- Mechanochemical solvent-free synthesis of azomethines

6. Alternative sources of energy

- Solvent-free, microwave-assisted one-pot synthesis of phthalocyanine complex of copper (II).
- Photoreduction of benzophenone to benzopinacol in the presence of sunlight.

Reference Books:

- Anastas, P.T., & Warner, J.C. *Green Chemistry: Theory and Practice,* Oxford University Press (1998).
- Kirchoff, M. & Ryan, M.A. *Greener approaches to undergraduate chemistry experiment*. American Chemical Society, Washington, DC (2002).
- Ryan, M.A. *Introduction to Green Chemistry*, Tinnes and (Ed.), American Chemical Society, Washington, DC (2002).
- Sharma, R.K.; Sidhwani, I.T. & Chaudhari, M.K. I.K. *Green Chemistry Experiment: A monograph, International Publishing House Pvt Ltd., New Delhi*. Bangalore CISBN 978-93-81141-55-7 (2013).
- Cann, M.C. & Connelly, M. E. *Real world cases in Green Chemistry*, American Chemical Society (2008).

Major Mathematics
Linear Algebra

Credits: 6

UNIT I

Vector spaces, Subspaces, Algebra of subspaces, Quotient spaces, Linear combination of Vectors, Linear span, Linear independence/dependence, Basis and dimension, Dimension of subspaces.

UNIT II

Linear transformations, Null space, Range, Rank and nullity of a linear transformation, rank-nullity theorem, Isomorphism, Isomorphism theorems, Inevitability and isomorphism's.

UNIT III

Matrix representation of a linear transformation, Algebra of linear transformations, Dual space, Dual basis, Double dual, Annihilator.

UNIT IV

Eigenvalues and eigen-vectors of Linear Transformation, Characteristic polynomial, algebraic and geometric multiplicities of eigen-value, Applications of eigen-value and eigen-vectors in finding the power of Matrix A, exp(A), sin(A), cos (A), and p(A), similar Matrices, diagonalisation of matrix.

Books Recommended

1. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., Prentice-Hall of India Pvt. Ltd., New Delhi, 2004.
2. David C. Lay, Linear Algebra and Its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.
3. S. Lang, Introduction to Linear Algebra, 2nd Ed, Springer, 2005

Hemvati Nandan Bahuguna Garhwal University

Dept of Education

ITEP Curriculum

Semester-VI

(B.Sc. B.Ed.)

S.N.	Code	Courses	Credit
1.	EFC-601	Assessment and Evaluation	2
2.	EFC-602	Curriculum Planning and Dev.	2
3.	ESSCCPC-603-A	Content cum Pedagogy of Mathematics at Sec. Stage - Course (III)	2
4.	ESSCCPC-603-B	Content cum Pedagogy of Physics at Sec. Stage - Course (III)	2
5.	ESSCCPC-603-C	Content cum Pedagogy of Chemistry at Sec. Stage - Course (III)	2
6.	ESSCCPC-603-D	Content cum Pedagogy of Zoology at Secondary Stage - Course (III)	2
7.	ESSCCPC-603-E	Content cum Pedagogy of Botany at Secondary Stage - Course (III)	2
8.	EAEVAC-604	Mathematical & Quantitative Reasoning	2
9.	ESEC-605	School Observation	2
10.	ESEC-606	Creating Teaching and Learning Materials	2

EFC-601: Assessment and Evaluation

Credits: 2

601.1 About the Course

The main thrust of this course on assessment and evaluation is to equip student teachers with the knowledge and capacities required to develop and implement approaches to assessment that are more regular and formative, more competency-based, and appropriate for assessing learning outcomes relating to all domains of learning, is suitable for testing not only subject-related learning but also generic learning outcomes such as problem-solving, critical thinking, creative thinking, communication skills, judgement and decision making, ethical and moral reasoning etc.

601.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- use different approaches to assess and evaluate student performance, such as time-constrained examinations, closed/open-book tests, problem-based assignments, practical

assignment reports, observation of practical skills, individual and group project reports, oral presentations, viva voce interviews, computerized adaptive testing, peer and self-assessment etc.,

- develop and use informal and formal diagnostic, formative, and summative assessment strategies to monitor student learning levels and help the teacher continuously revise teaching-learning processes to optimise learning and development for all students.
- develop an understanding among student teachers of the approaches to provide timely, effective, and appropriate feedback to students about their performance relative to the expected learning outcomes and organise learning enhancement initiatives that are required to bridge the gap in student learning levels.
- present report on student achievement, making use of accurate and reliable records, etc.
- develop assessments "as", "of", and "for" learning that are aligned to the expected learning outcomes,
- design the progress card of students based on a school-based assessment to make it a holistic, 360-degree, multidimensional report that reflects the progress as well as the performance of learners assessed through self-assessment and peer assessment, project-based and inquiry-based learning, quizzes, role plays, group work, portfolios, etc., along with teacher assessment that would provide students with valuable information on their strengths, areas of interest, and needed areas of improvement.

UNIT - I
Assessment and Education

A. Assessment and Evaluation
   - Meaning and significance of assessment and evaluation in the educational field.
   - Conceptual Clarity and purpose of Measurement, Assessment, Examination, Appraisal and Evaluation in Education.
   - Learning outcomes across the stages and assessment.
   - Taxonomy of Objectives (Revised in 2001) and Implications.

B. Forms of Assessment
   - Formative, Summative, diagnostic, prognostic.
   - Internal and External assessment.
   - Assessment for learning, of learning and as learning.
   - Authentic Assessment; Online Assessment.

C. Improving Assessment and Evaluation in Schools: Brief Historical Review (1975, 1988, 2000, 2005, 2020)

UNIT - II
Process of Assessment and Evaluation

A. Formative and Summative Assessment: Concept and Characteristics.

B. Approaches to assess and evaluate student performance, such as time-constrained examinations, closed/open-book tests, problem-based assignments, practical

assignment reports, observation of practical skills, individual and group project reports, oral presentations, viva-voce interviews, computerised adaptive testing, peer and self-assessment, etc.

C. Assessing Higher Order Thinking Abilities: Problem-solving, critical thinking, creative thinking, communication skills, judgement and decision making, ethical and moral reasoning.
D. Tools and Techniques
    - Observation, rating scale, checklist, anecdotes, interviews.
    - Assessment of attitudes and interests.
    - Socio-metric techniques.
    - Criteria for assessment of social and personal behaviour.
    - Self-assessment and Peer Assessment.

UNIT - III

Analysis and Interpretation

A. Analysis of students' performance and scores: credit and grading
B. Graphical representation (Histogram, Frequency Curves)
C. Interpretation of students' performance based on the analysis and their further uses in improving learners' performance: credit and grading, constructive feedback.
D. Reporting students' performance: 360-degree progress reports, cumulative records and their uses, portfolios, PTA meetings, qualitative reporting based on observations, descriptive indicators in report cards.

601.3 Suggestive Practicum

1. Review of various education commissions, Policies, reports and NCF 2005 to get a brief view of the recommendations on Assessment and Evaluation.
2. Constructing a unit test using a table of specifications.
3. Construction of any one of the tools (rating scale, checklist, observation schedule, etc.) and administering it to a group of students or using it to observe the school and classroom environment and interpreting it.
4. Analysis of question papers of various Boards.
5. Analysis of report cards - State and Central (CBSE)
6. Preparing the format of a 360-degree report Card.
7. Review of learning outcomes by NCERT in different subject areas.
8. Interviews with teachers and students to study the assessment practices, issues and problems related to it, followed by the presentation.
9. Reviewing Assessment Discussions in NPE (2020).

601.4 Suggestive Mode of Transaction

The course content transaction will include the following:

- Planned lectures infused with multimedia /PowerPoint presentations.

- Small group discussion, panel interactions, small theme-based seminars, group discussions, cooperative teaching and team teaching, selections from theoretical readings, case studies, analyses of educational statistics and personal field engagement with educationally marginalised communities and groups through focus group discussion, surveys, short-term project work, etc.
- Hands-on experience engaging with diverse communities, children, and schools.

601.5 Suggestive Mode of Assessment

The assessment will be based on the tests and assignments.

601.6 Suggestive Reading Materials

Teachers may suggest books/readings per the learners' needs and learning content.

EFC-602: Curriculum Planning and Development

Credits: 2

602.1 About the Course

The course on curriculum planning and development will introduce to student teachers to the process of designing and organizing the curriculum i.e., the totality of learning experience provided to learners through a deliberate and organized set of arrangements (the selection of subjects that are to be taught, the pedagogical approaches and practices to be pursued, books and other teaching-learning-material to be used, examinations and other forms of learning assessment, school culture and processes etc.) that contribute to the development of the knowledge, capacities, and values and dispositions that help fulfill the aims of school education derived from the purposes and goals articulated in NEP 2020.

602.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- discuss the aims of education,
- identify and formulate desirable values and dispositions,
- explain capacities and knowledge,
- outline curricular areas,
- demonstrate teaching-learning assessment processes and
- practice the relevance in terms of achieving the aims of school education.

UNIT - I

Education and Curriculum

A. Meaning, need, relationship and significance.

B. Types of Curricula: subject-centred, activity-centred, environmental-centred, community-centred

C. Relationship and difference between curriculum, curriculum framework, syllabus and textbooks.

UNIT - II

Developing the Curriculum

A. Basic principles of curriculum development

B. Concerns for developing the Curriculum - aims to be achieved, structure and nature of discipline, different perspectives on learning and their implications to curriculum development, socio–cultural aspects and aspirations of society, value transitions, social efficiency and needs,

C. Environmental concerns, gender concerns, inclusiveness, and technological advancement.

D. Impact of Globalisation.

UNIT - III

Approaches, Planning, and Implementation

A. Approaches to Curriculum Development: Learner and activity-centred, Constructivist, Knowledge Construction

B. Curriculum planning as a cyclic process.

C. Curriculum Implementation: Operationalising curriculum into learning situations, Converting curriculum into syllabus, Curriculum engagement activities, Role of school at Regional, State and National level for implementation.

D. Role of teachers in operationalising and evaluating the curriculum with special reference to: textbooks and teachers' handbooks, source books, workbooks and manuals, other learning material such as kits, AV and software materials, library, laboratory, playground, neighbourhood, etc.

602.3 Suggestive Practicum

1. Arranging a discussion on:
   - Basis of National curriculum frameworks (1975, 1988, 2000, and 2005).
   - Document: Learning without burden" by Prof. Yashpal
2. Preparing of Report based on the observation of:
   - Facilities and infrastructure to implement the present curriculum.
3. Interviewing teachers to understand their role in:
   - Implementation and assessment of the curriculum.
4. Analysis of the following in the context of principles of developing the Curriculum:
   - Guidelines of NEP, 2020.
   - Curriculum of 4 Years B.Ed. Integrated Programme
   - Learning without Burden, MHRD, and India.
   - Position paper (2006). National Focus Group on 'Curriculum, Syllabus, Textbooks', NCERT.
   - NCERT (1988) National Curriculum for Elementary and Secondary Education: A framework.

- NCERT (2000) National Curriculum Framework for School Education.
- NCERT (2005) National Curriculum Framework. NCERT publications.

602.4 Suggestive Mode of Transaction

The course content transaction will include the following:

- Planned lectures infused with multimedia /PowerPoint presentations.
- Small group discussion, panel interactions, small theme-based seminars, group discussions, cooperative teaching and team teaching, selections from theoretical readings, case studies, analyses of educational statistics and personal field engagement with educationally marginalised communities and groups, through focus group discussion, surveys, short-term project work, etc.
- Hands-on experience of engaging with diverse communities, children, and schools.

602.5 Suggestive Mode of Assessment

The assessment will be based on the tests and assignments.

602.6 Suggestive Reading Materials

Teachers may suggest books/readings as per the needs of the learners and the learning content.

SSCCPC-603: Stage-Specific Content -cum-Pedagogy Courses (Any Two)

602-A: Content cum Pedagogy of Mathematics at Secondary Stage – Course (III)

Credits: 2

602-A.1 About the Course

The development of 21st-century skills is important for Mathematics teaching and learning. Learning imagination, spatial visualisation, and mathematical reasoning is important for novice learners. The course comprises three units describing 21st century skills for learning, assessment, evaluation and research and innovative practices in teaching and learning Mathematics. This course also aims to improve skills and competencies required for Mathematics teachers to conduct effective learner assessments. The course describes various evaluation strategies and devices which can be efficiently used in the teaching learning of Mathematics and in the development of skills among the student teachers for improving student outcomes, conduct action research and school-based research in the teaching of Mathematics.

602-A.2 Learning Outcomes

After completion of the course, student teachers will be able to:

- analyze the sources of the development of 21st-century skills through Mathematics teaching and learning,

- determine the role of a teacher in facilitating learning and creating a dynamic learning environment of Mathematics.
- describe the need for and importance of assessment in the learning process of Mathematics.
- develop various types of tests for assessing students' learning in Mathematics,
- design and develop innovative strategies and techniques for successful teaching and learning Mathematics,
- conduct school-based research in Mathematics teaching.
- explain the various methods of exploring knowledge.
- explore innovative ideas for teaching and learning Mathematics.
- assess the steps of action research.

UNIT - I
21st Century Skills for Learning Mathematics

A. Need for and importance of how to learn 21st century skills, such as practising imagination, spatial visualisation, mathematical reasoning, and problem solving for learners and teachers of Mathematics.
B. Psychological, sociological, and philosophical perspective of teaching learning and development of Mathematics.
C. Qualities of a Mathematics teacher as a professional.
D. Role of a teacher in facilitating learning and creating a dynamic learning environment for Mathematics.

UNIT - II
Assessment for Learning in Mathematics

A. Meaning, need and organization of oral, written, and practical assessment in Mathematics.
B. Construction of types of questions in Mathematics: objective, short answer, long answer, considerations for the marking different types of questions in Mathematics.
C. Planning and developing teachers made tests in Mathematics - Table of Specification (TOS), question paper setting and preparing answer key.
D. Tools to identify learning difficulties and provide corrective measures in Mathematics, concept of 360° assessment, holistic progress card and assessment of mathematical aspects of students.

UNIT - III
Research and Innovative Practices in Teaching Mathematics

A. Divergent thinking for innovation in psychological, sociological, and philosophical perspectives of Mathematics for quality learning experiences.
B. Innovative practices in Mathematics.

C. Research on issues of gender, class and culture in Mathematics learning and achievement - expectations, attitudes and stereotypes; access to higher Mathematics; interrogating the notion of 'Achievement Gap'; construction of learners' identity in a Mathematics classroom.
D. Recent trends and research related to teaching learning of Mathematics – digital gaming, digital storytelling, using Artificial Intelligence for Mathematics teaching and learning.
E. Action research for solving problems of teaching and learning of Mathematics: meaning, significance, steps, and planning.

602-A.3 Suggestive Practicum (Any Three)

1. List 21st-century skills with reference to various topics of school Mathematics.
2. Writing a paper on recent trends and research related to the teaching and learning of Mathematics.
3. Prepare a scrapbook for 'Mathematics in Print Media'.
4. Prepare a small video on recent trends in Mathematics on social media.
5. Plan a teacher-made test for a unit of secondary Mathematics.
6. Prepare a report after using an innovative idea to teach a difficult topic of secondary Mathematics.
7. Plan for action research on any one problem of teaching and learning Mathematics.
8. Any other project assigned by the teacher.

602-A.4 Suggestive Mode of Transaction

Lecture cum discussion, group work, ICT enabled methods, activity based and art integrated demonstration, field-based experiences, library visits, self-study, field observations, assignment preparation, classroom presentations, discussion forums, observation, flip classroom, use of digital platform.

602-A.5 Suggestive Mode of Assessment

Written test, classroom presentation, workshop, assignments, practicum, sessional and terminal semester examination (As per UGC norms).

602-A.6 Suggestive Reading Material

- NCERT (2012). Pedagogy of Mathematics
- NCERT: Manual for Higher Secondary Mathematics Kit (Code- 3165)

*Teachers may also suggest books/readings as per the needs of the learners and the learning content.

603-B: Content cum Pedagogy of Physics at Secondary Stage - Course (III)

Credits: 2

602-B.1 About the Course

This course comprises three units and a practicum. It focuses on assessment and evaluation. It also focuses on assessment based on learning outcomes, strategies for continuous assessment, school-based assessment, formative and summative assessment, including 360◦ assessment. Student teachers are expected to identify various concepts and processes, list learning and behavioural outcomes, find out about various activities and experiments, and identify relevant evaluation techniques and strategies. It focuses on Psychological, Sociological and Philosophical Perspectives of Activity-Oriented Classrooms in Physics. The importance of planning science learning and teaching in secondary schools. In this course, student teachers will learn how to plan different types of activities in online and offline modes. It emphasises how to integrate and use ICT in the Physics classroom. Assessment serves the dual purpose of tracking the performance of the learners as well as a feedback mechanism for the effectiveness of teaching. Today's scenario emphasises competency-based assessment practices and tests higher-order thinking skills and conceptual clarity. Major reforms in assessment are needed for the hour to stay vibrant and effective in the teaching and learning of Physics.

602-B.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- explain the significance of acquiring 21st-century skills for Physics teaching,
- outline the need for and importance of assessment and evaluation in the teaching of Physics.
- appraise with various assessment strategies for continuous assessment in reference to teaching Physics.
- utilize appropriate tools and techniques for assessment and evaluation in teaching learning of Physics.
- identify recent trends in research related to teaching and learning and their implications in teaching and learning of Physics.
- prepare unit test items based on TOSS and develop different types of test items,
- construct and administer different types of tests,
- plan offline and online activities for testing higher-order thinking skills in teaching and learning of Physics,
- relate ICT integration and elaborate on its use in classroom situations,
- identify a problem in the context of Physics teaching learning, and plan action research.

UNIT - I

21st Century Skills for Learning

A. Need for and importance of how to learn 21st century skills for learners and teachers of Physics.
B. Psychological, sociological, and philosophical perspective of teaching and learning Physics.

C. Qualities of a Physics teacher as a professional for enhancing teaching and learning skills.
D. Role of a teacher in facilitating learning and creating a dynamic learning environment of Physics.

UNIT - II
Assessment and Evaluation

A. Assessment and evaluation: need for and importance of Physics.
B. Assessment based on learning outcomes, strategies for continuous assessment, school-based assessment, qualitative assessment, formative and summative assessment, formal, informal and 360◦ assessment.
C. Performance assessment: assessment of group activities, field observations, recording and reporting, creating a platform and portfolio management, assessment of laboratory skills, assignments, projects, and presentations.
D. Tools and techniques of assessment and evaluation - unit test based on Table of Specification (TOS) and its importance, basic steps of question paper setting, types of test items and preparing answer key and criteria for school, assessment, and feedback mechanism in teaching and learning the content of Physics.

UNIT - III
Research and Innovative Practices in Physics

A. Divergent thinking and innovation in psychological, sociological, and philosophical perspectives for quality learning experiences.
B. Recent trends in research related to teaching learning of Physics.
C. Action research: meaning, significance, steps and planning.
D. Evidence-based practices and reflection, school-based research in Physics.

602-B.3 Suggestive Practicum (Any Three)

1. Prepare, administer, and analyze scores of an achievement test.
2. Explore AI-based assessment tools and prepare an e-Portfolio for a student of the Secondary Stage.
3. Conduct a Simulated Teaching session for the concepts of Physics and observation by self, peer, and teacher.
4. Explore the development of multidisciplinary projects and present them using PowerPoint.
5. Interpret the concept of Physics with Psychological, Sociological and Philosophical Perspectives.
6. Apply innovative practices in classroom teaching and learning of Physics.
7. Make a presentation on the role of Physics in the sustainable development of society.
8. Plan action research for Continuous Professional Development (CPD) of Physics teachers.

9. Any other project.

602-B.4 Suggestive Mode of Transaction

Lecture cum discussion/demonstration, demonstration, discovery approach, project approach, inquiry approach, problem-solving, experiential learning.

602-B.5 Suggestive Mode of Assessment

Written test, classroom presentations, workshops, seminars, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).

602-B.6 Suggestive Reading Material

- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India
- National Steering Committee for National Curriculum Frameworks (2023). Draft National Curriculum Framework for School Education.

*Teachers may also suggest books/readings as per the needs of the learners and the learning content.

603-C: Content cum Pedagogy of Chemistry at Secondary Stage - Course (III)

Credits: 2

602-C.1 About the Course

This course comprises three units and a practicum. It focuses on assessment and evaluation. It also focuses on assessment based on learning outcomes, strategies for continuous assessment, school-based assessment, formative and summative assessment, including 360◦ assessment. Student teachers are expected to identify various concepts and processes, list learning and behavioral outcomes, find out about various activities and experiments, and identify relevant evaluation techniques and strategies. It focuses on psychological, sociological and philosophical perspectives of activity-oriented classrooms in chemistry. The importance of planning science learning and teaching in secondary schools. In this course, student teachers will learn how to plan different types of activities in online and offline modes. It emphasises how to integrate and use ICT in the chemistry classroom. Assessment serves the dual purpose of tracking the performance of the learners as well as a feedback mechanism for the effectiveness of teaching. Today's scenario emphasises competency-based assessment practices and tests higher-order thinking skills and conceptual clarity. Major reforms in assessment are needed for the hour to stay vibrant and effective in the process of teaching and learning Chemistry.

602-C.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- explain the significance of acquiring 21st-century skills for chemistry teaching,
- outline the need for and importance of assessment and evaluation in the teaching of chemistry,
- appraise with various assessment strategies for continuous assessment in reference to the teaching of chemistry.
- utilize appropriate tools and techniques for assessment and evaluation in teaching and learning of Chemistry.
- identify recent trends in research related to teaching and learning and their implications in the teaching and learning of chemistry.
- prepare unit test items based on TOSS and develop different types of test items.
- construct and administer different types of tests.
- plan offline and online activities for testing higher-order thinking skills in teaching and learning Chemistry,
- relate ICT integration and elaborate on its use in classroom situations,
- identify a problem in the context of Chemistry teaching and learning, and plan action research.

UNIT - I
21st Century Skills for Learning

A. Need for and importance of how to learn 21st century skills for learners and teachers of Chemistry.
B. Psychological, sociological, and philosophical perspective of teaching and learning Chemistry.
C. Qualities of a Chemistry teacher as a professional for enhancing teaching and learning skills.
D. Role of a teacher in facilitating learning and creating dynamic learning environment of Chemistry.

UNIT - II
Assessment and Evaluation

A. Assessment and evaluation: need for and importance of Chemistry.
B. Assessment based on learning outcomes, strategies for continuous assessment, school-based assessment, qualitative assessment; formative and summative assessment, formal, informal and 360◦ assessment.
C. Performance assessment: assessment of group activities, field observations, recording and reporting, creating platform and portfolio management, assessment of laboratory skills, assignments, projects, and presentations.
D. Tools and techniques of assessment and evaluation - unit test based on Table of Specification (TOS) and its importance, basic steps of question paper setting, types of

test items and preparing answer key and criteria for school, assessment, and feedback mechanism in teaching and learning the content of Chemistry.

UNIT - III
Research and Innovative Practices in Chemistry

A. Divergent thinking and innovation in psychological, sociological, and philosophical perspectives for quality learning experiences.
B. Recent trends in research related to teaching and learning of Chemistry.
C. Action research: meaning, significance, steps and planning.
D. Evidence-based practices and reflection, school-based research in Chemistry.

602-C.3 Suggestive Practicum (Any Three)

1. Prepare, administer, and analyze scores of an achievement test.
2. Explore AI-based assessment tools and prepare an e-Portfolio for a student of the Secondary Stage.
3. Conduct a Simulated Teaching session for the concepts of Chemistry and observation by self, peer, and teacher.
4. Explore the development of multidisciplinary projects and present using PowerPoint.
5. Interpret the concept of chemistry with psychological, sociological and philosophical perspectives.
6. Apply innovative practices in classroom teaching and learning of chemistry.
7. Make a presentation on the role of Chemistry in the sustainable development of society.
8. Plan action research for Continuous Professional Development of Chemistry teachers.
9. Any other project.

602-C.4 Suggestive Mode of Transaction

Lecture cum discussion/demonstration, demonstration, discovery approach, project approach, inquiry approach, problem-solving, experiential learning.

602-C.5 Suggestive Mode of Assessment

Written test, classroom presentations, workshops, seminars, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).

602-C.6 Suggestive Reading Material

- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India
- National Steering Committee for National Curriculum Frameworks (2023). Draft National Curriculum Framework for School Education.

*Teachers may also suggest books/readings as per the needs of the learners and the learning content.

603-D: Content cum Pedagogy of Zoology at the Secondary Stage - Course (III)

Credits: 2

602-D.1 About the Course

Assessment and Evaluation are an inseparable component of teaching and learning of Zoology. In this course, student teachers will be exposed to various assessment practices that can be followed in the assessment of Zoology. The course also deals with planning action research in classroom situations. It focuses on Psychological, Sociological and Philosophical Perspectives of Learning Zoology. The importance of planning science learning and teaching in secondary schools. In this course, student teachers will learn how to plan different types of activities in online and offline modes. It emphasizes how to integrate and use ICT in the classroom of Zoology.

602-D.2 Learning Outcomes

After completion of this course, Student teachers will be able to:

- appraise different types of assessment and strategies for continuous assessment,
- distinguish between assessment and evaluation,
- compare the merits and demerits of different types of assessment,
- develop unit test items based on TOS and develop different types of test items,
- construct and administer the achievement test,
- familiarize with basic statistical methods for analyzing performance in tests,
- plan offline and online activities for testing higher-order thinking skills,
- recognize challenges in modern-day classrooms and plan appropriate strategies,
- relate ICT integration and elaborate on its use in classroom situations.

UNIT - I

21st Century Skills for Learning

A. Need for and importance of how to learn 21st century skills for learners and teachers of Zoology.

B. Psychological, sociological, and philosophical perspective of teaching and learning Zoology.

C. Qualities of a Zoology teacher as a professional for enhancing teaching and learning skills.

D. Role of a teacher in facilitating learning and creating a dynamic learning environment of Zoology.

UNIT - II

Assessment and Evaluation

A. Assessment and evaluation: concept, need for and importance of teaching learning Zoology.

Assessment based on learning outcomes, strategies for continuous assessment, school-based assessment, qualitative assessment, formative and summative assessment, formal, informal, and 360-degree assessment

B. Performance assessment: assessment of group activities, field observations, recording and reporting, creating a platform and portfolio management, assessment of lab skills, assignments, projects, and presentations based on the concepts of Zoology.

C. Unit test based on Table of Specification (TOS) and its importance; basic steps of question paper setting of Zoology, types of test items and preparing answer key and criteria for school.

D. Feedback mechanism in teaching and learning the concepts of physical science at the secondary stage.

UNIT - III

Research and Innovative Practices in Zoology

A. Divergent thinking and innovation in psychological, sociological, and philosophical perspectives for quality learning experiences, creating a sensitive and conducive classroom environment for learning and practising life skills.

B. Recent trends in research related to teaching and learning of Zoology.

C. Action research: meaning, significance, steps, and planning.

D. Evidence-based practices and reflection, school-based research in Zoology.

602-D.3 Suggestive Practicum (Any Three)

1. Prepare, administer, and analyze scores of an achievement test.
2. Explore AI-based assessment tools and prepare an e-Portfolio for a student of the Secondary Stage.
3. Identify a topic and Plan action research at the secondary stage.
4. Conduct a Simulated Teaching session for the concepts of Zoology and observation by self, peer, and teacher.
5. Apply innovative practices in classroom teaching and learning of Zoology.
6. Any other project assigned.

602-D.4 Suggestive Mode of Transaction

Lecture cum discussion, demonstration, Hands-on activities, experiential learning, inquiry, Group work, Presentations, multimedia.

602-D.5 Suggestive Mode of Assessment

Written tests, classroom presentations, workshops, seminars, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).

602-D.6 Suggestive Reading Material

- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India.
- National Steering Committee for National Curriculum Frameworks (2023). Draft National Curriculum Framework for School Education.
- NCERT, Textbooks of Zoology at Secondary Stage.

*Teachers may also suggest books/readings as per the needs of the learners and the learning content.

603-E: Content cum Pedagogy of Botany at Secondary Stage - Course (III)

Credits: 2

602-E.1 About the Course

Assessment and Evaluation are an inseparable component of teaching and learning of Botany. In this course, student teachers will be exposed to various assessment practices that can be followed in the assessment of Botany. The course also deals with planning action research in classroom situations. It focuses on psychological, sociological and philosophical perspectives of learning botany. The importance of planning science learning and teaching in secondary schools. In this course, student teachers will learn how to plan different types of activities in online and offline modes. It emphasizes how to integrate and use ICT in the classroom of Botany.

602-E.2 Learning Outcomes

After completion of this course, Student teachers will be able to:

- appraise different types of assessment and strategies for continuous assessment,
- distinguish between assessment and evaluation,
- compare the merits and demerits of different types of assessment,
- develop unit test items based on TOS and develop different types of test items,
- construct and administer the achievement test,
- familiarize with basic statistical methods for analyzing performance in tests,
- plan offline and online activities for testing higher-order thinking skills,
- recognize challenges in modern-day classrooms and plan appropriate strategies,
- relate ICT integration and elaborate on its use in classroom situations.

UNIT - I

21st Century Skills for Learning

A. Need for and importance of how to learn 21st century skills for learners and teachers of Botany.

B. Psychological, sociological, and philosophical perspective of teaching and learning Botany.

C. Qualities of a Botany teacher as a professional for enhancing teaching and learning skills.
D. Role of a teacher in facilitating learning and creating a dynamic learning environment of Botany.

UNIT - II

Assessment and Evaluation

A. Assessment and evaluation: concept, need for and importance of teaching learning Botany.
B. Assessment based on learning outcomes, strategies for continuous assessment, school-based assessment, qualitative assessment, formative and summative assessment, formal, informal, and 360-degree assessment
C. Performance assessment: assessment of group activities, field observations, recording and reporting, creating a platform and portfolio management, assessment of lab skills, assignments, projects, and presentations based on the concepts of Botany.
D. Unit test based on Table of Specification (TOS) and its importance; basic steps of question paper setting of Botany, types of test items and preparing answer key and criteria for school, assessment, and feedback mechanism in teaching and learning the concepts of physical science at the secondary stage.

UNIT - III

Research and Innovative Practices in Botany

A. Divergent thinking and innovation in psychological, sociological, and philosophical perspectives for quality learning experiences, creating a sensitive and conducive classroom environment for learning and practising life skills.
B. Recent trends in research related to teaching and learning of Botany.
C. Action research: meaning, significance, steps, and planning.
D. Evidence-based practices and reflection, school-based research in Botany.

602-E.3 Suggestive Practicum (Any Three)

1. Prepare, administer, and analyze scores of an achievement test.
2. Explore AI-based assessment tools and prepare an e-Portfolio for a student of the Secondary Stage.
3. Identify a topic and Plan action research at the secondary stage.
4. Conduct a simulated teaching session for the concepts of botany and observation by self, peer, and teacher.
5. Apply innovative practices in classroom teaching and learning of botany.
6. Any other project assigned.

602-E.4 Suggestive Mode of Transaction

Lecture cum discussion, demonstration, Hands-on activities, experiential learning, inquiry, Group work, Presentations, multimedia.

602-E.5 Suggestive Mode of Assessment

Written tests, classroom presentations, workshops, seminars, assignments, practicums, sessional and terminal semester examinations (as per UGC norms).

602-E.6 Suggestive Reading Material

- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India.
- National Steering Committee for National Curriculum Frameworks (2023). Draft National Curriculum Framework for School Education.
- NCERT, Textbooks of Botany at Secondary Stage.

*Teachers may also suggest books/readings as per the needs of the learners and the learning content.

604-Mathematical and Quantitative Reasoning

604.1 About the Course

This course introduces the student teachers to study the basic mathematical & quantitative reasoning for their practical usage. This course is designed to provide student teachers with the knowledge and capacities required to analyze, interpret, and communicate quantitative data. Student teachers will learn to think critically about data and use quantitative reasoning to solve real-life problems.

604.2 Learning Outcomes

After completion of this course, student teachers will be able to:

- adapt mathematical reasoning to solve problems in the real world and explain some fundamental ideas and tenets in this field,
- analyze and interpret quantitative data,
- interpret & deduce the right conclusions from numerical representations like formulas, graphs, or tables,
- demonstrate critical thinking and problem-solving skills using mathematical and quantitative reasoning methods,
- evaluate operational matrix,
- analyze educational data and create an educational model & use it in decision making,
- analyze and evaluate mathematical and quantitative reasoning problems and solutions.

UNIT - I

Introduction to mathematical and quantitative reasoning

A. Meaning, nature and scope of mathematical and quantitative reasoning.

B. Importance of mathematical and quantitative reasoning in various fields.

C. Types of quantitative reasoning.
D. Usage of mathematical and quantitative reasoning. Concept of mathematization.

UNIT - II

Introduction to Data in Education

A. Data requirement, different sources of data
B. School enrolment: gross enrolment ratios, net enrolment ratios, educational progression: dropout rate, literacy: measures of literacy
C. Indian censuses, details of different items on which Indian censuses collect data.
D. Nationwide sample surveys, National family health survey, District level household survey, UDISE

UNIT - III

Data Analysis & Interpretation

A. Concept of data interpretation (equation, diagram, graph, tables)
B. Statistical analysis of data in educational context and its applications (measures of central tendency, measures of variability, percentile).
C. Visual and numerical representation of data and its application (bar diagram, histogram, pie charts)
D. Learning analytics: concept, significance, types, levels, and its applications in an educational context.

604.3 Suggestive Practicum

1. Take the last 5 years of UDISE data and analyse various indicators related to schools, teachers, and students.

604.4 Suggestive Mode of Transaction

The approaches to curriculum transaction will focus on developing the analytical and critical thinking skills of students, as well as their ability to apply mathematical and quantitative reasoning in real-life situations. Some of the approaches to curriculum transaction will include the following:

- Active Learning which involves active participation of student teachers in problem-solving situations, group discussions, and hands-on activities that help student teachers engage with the material and apply mathematical thinking and reasoning to solve problems.
- Real-World Applications involve the use of real-world examples to demonstrate the practical applications of mathematical concepts that help student teachers see the relevance of what they are learning and how it can be applied in various fields.
- Collaborative learning encourages student teachers to work together in small groups, where they can share ideas and help each other learn. This fosters a sense of community in the classroom and helps students develop teamwork and communication skills.

- Technology Integration involves the incorporation of technology tools such as calculators, spreadsheets, and interactive software to help student teachers visualize and solve mathematical problems more easily.
- Overall, a pedagogy that combines active learning, real-world applications, collaborative learning, technology integration, and effective assessment strategies that help student teachers develop a strong foundation in mathematical and quantitative reasoning.

604.5 Suggestive Mode of Assessment

Use of a variety of assessment methods, such as quizzes, exams, group projects, and presentations, to evaluate student learning. Providing timely feedback and offering opportunities for students to revise their work and improve their understanding.

604.6 Suggested Reading Materials

Teachers may suggest books/readings as per the needs of the learners and the learning content.

6.2 School Observation

6.2.1 About the Course

As school is the heart of the teacher education programme, the student teachers need to gain hands-on experiences from various activities organized by the school. School observation offers an opportunity to learn the processes and practices in a school setting. To expose the student teachers to various schooling systems (urban, rural, tribal, residential, non-residential, government, private, affiliated to different school boards like Central Board, State Board, International Board) prevailing in the country. School observation will also prepare the student teachers to build relationships with various stakeholders. The school observation by the student teachers is aimed at helping them build perspective in the schooling system, students' needs, pedagogies, and assessment.

6.2.2 Learning Objectives

After completion of the school observation program, student teachers will be able to:

- get acquainted with various schooling systems.
- experience the processes, practices, and overall environment of the school.
- establish a rapport with all the stakeholders of the school system.
- observe the process of conducting different activities in the school.
- study availability and the work of human resources, including members of the school management committee (SMC), the school head, teachers, and administrative and support staff.
- observe the existing infrastructure available in the schools (classrooms, libraries, laboratories, playground, sanitation, drinking water facility, mid-day meal facility, inclusive facilities, safety and security, rainwater harvesting).
- observe and document the availability and usage of TLM, including ICT.
- study the available physical and digital documents, including UDISE data.

- study interpersonal relationships among the stakeholders.
- study various assessment processes adopted in different types of schools for holistic development of children.
- prepare and present a comprehensive profile of the schools observed (including classroom processes)
- study the engagement of parents and other community members in school activities.

6.2.3 Suggestive Mode of Transaction

Observation, Interaction, Discussion, Reviewing the available literature on the different schooling systems, Collection of relevant documents and data.

Preparation for school observation

- Orientation on the school observation process
- Development of the observation formats/tools

School Observation (minimum three types of schools)

- Student teachers will go for school observation in small groups to observe and collect data by using the developed formats/tools.
- Analysis of the collected data
- Preparing a comprehensive profile of the schools observed

Post-school observation session

- Group-wise presentation of the school profile
- Discussion and Feedback
- Reflection on the understanding of various types of schooling systems.

6.2.4 Content

The school observation as a field-based activity will cover observation of school and classroom processes. The student teachers under the mentorship of teacher educators will visit schools, interact with teachers and students and other stakeholders, and relate the observation with the courses studied during the previous semesters, i.e. Foundations of Education, Disciplinary Courses, Pedagogy courses and Ability Enhancement & Value-Added Courses.

- Meaning and Nature of School Observation Process
- Difference between monitoring and observation
- Theory and practices of school observation components such as:
  1. Schooling system
  2. Rapport with all the stakeholders
  3. Office management procedures of different types of schools
  4. School environment from all perspectives
  5. Process of conducting curricular activities in the schooling process
  6. Existing infrastructure available in the school

7. Utility of ICT and TLM facilities
8. Interpersonal relationships among the stakeholders
9. Various assessment processes are adopted in different types of schools.
10. Engagement of parents and other community members in school activities.

6.2.5 Activities to be conducted at the Secondary Stage

- Visit three types of secondary schools with observation formats developed in the institute and get acquainted with various schooling systems. Establish rapport with all stakeholders.
- Collect information about the demography of students in classes IX to XII and understand the linkage of the secondary stage with the middle stage and higher education through interaction with teachers, students and staff.
- Observe school processes and transactions of the curriculum through experiential learning and prepare a report.
- Interact with teachers and students and report on implementing ten bag-less days and internship opportunities to learn vocational subjects.
- Study the available opportunities for learning interdisciplinary subjects.
- Observe the availability and usage of library resources, laboratories (Atal Tinkering Lab, Physics, Chemistry, Biology, Mathematics, Languages, Social Science, Computer), sports facilities, and art and music learning facilities.
- Study the provision of other student support services- guidance and counselling, NCC, NSS, health and wellness programme.
- Observe the organization of various activities like classroom teaching-learning processes, laboratory activities, library activities, sports and games, debate/elocution/essay writing and other competitions.
- Interact with School heads and subject teachers to understand how students are evaluated by following different tools and techniques of evaluation, how examinations are conducted, how answers are assessed, and how the result is communicated to parents in at least two different types of schools.

6.2.6 Assessment

Competence/Artefact	Method of assessment	Assessed By	Credits
Involvement and active participation during the school visit	Observations	Teacher Educator	0.5
Comprehensive school profile	Presentation & reflection	Teacher-Educator	1.5

6.2.7 Outcomes

Student teachers will be able to:

- describe various schooling systems,
- describe the processes, practices, and overall environment of the school,

- establish rapport with the stakeholders of the school system, state the process of conducting different activities in the school,
- describe the available school infrastructure (classrooms, libraries, laboratories, playground, sanitation, drinking water facility, mid-day meal facility, inclusive facilities, safety and security, rainwater harvesting),
- describe the availability and usage of ICT and TLMs,
- summarize the available documents in both physical and digital modes, including UDISE data,
- reflect upon relationships among the stakeholders,
- analyze various assessment processes adopted in different types of schools,
- prepare and present a comprehensive profile of the schools observed (including classroom processes).

6.2.8 Suggested Components for School Observation Report

- School information (Context, Vision and Mission, Association with the Board)
- School Infrastructure
- Provision for CWSN/Divyang Children
- Inclusiveness at all levels
- Teacher-Student Ratio
- Teaching-Learning process
  - Academic plan
  - Classroom activities
  - Assessment
- School Development Plan (SDP)
- Academic Calendar
- Administrative processes
  - Maintenance of students' records
  - Maintenance of teachers' records
- Cultural activities
- Sports activities
- Annual Day
- National and Social functions
- School Management
- School Discipline
- Interpersonal Relationships
- Understanding different types (socio-economic status, ability) of students and their needs
- Development of ICT and TLMs
- Engagement of parents and community members in the school activity
- Office Management
- The assessment process includes provision and practices for 360-degree holistic assessment.

- The overall progress of the school (planning, organizing, staffing, directing, motivating and controlling)
- Challenges faced and overcoming them.

Semester-VI
(B.Sc.B.Ed.)

	Subject	Course	Credits
1.	**Botany (Major)**	1. Biodiversity and Environmental Management. Theory and Practical	4+2
2.	**Zoology (Major)**	1. DCZOO-501 DSE (Anyone) • DSE-1. Applied Zoology • DSE-2. Wildlife Conservation & Management • DSE-3. Principles of Genetics & Evolutionary Biology • DSE-4. Animal Behaviour & Endocrinology • DSE-5. Introduction to Developmental Biology • DSE-6. Basics of Biotechnology. Theory and Practical	4+2
3.	**Physics (Major)**	1. Quantum Mechanics Theory and Practical	4+2
4.	**Chemistry (Major)**	1. Students can opt for any one • Instrumental Methods of Chemical Analysis • Organometallics, Bio-inorganic, Polynuclear Hydrocarbon, UV and IR Spectroscopy • Molecules of Life. Theory and Practical	4+2
5.	**Mathematics (Major)**	1. Complex Analysis	6

DCMJ-601: Disciplinary
Major Botany
Biodiversity and Environmental Management (Theory)
SOLS/BOT/DSE

Credits: 4, Lectures: 60

UNIT I: (10)

Concept of Environmental Management, Major Environmental Problems, Environmental Laws: The Earth summit, Environmental Protection Act, Biological Diversity Act 2002, Environmental Protection and Fundamental rights, Man and Environment, Trade and Environment.

UNIT II (10)

Natural Resources and Environmental Management, Pollution: Air pollution and management; Water Pollution Management; Waste disposal and management, Integrated solid waste

management; Soil and its types: composition, formation and types of soils, Texture of the soil, soil horizon, profiles, Soil degradation and management, Soil Pollution: soil pollutants, types, sources, effects and management.

UNIT III (10)

Environmental Impact Assessment: Planning and Significance, Legal framework for EIA; Forest fires: Assessment, Impact and Risk Zonation; Urbanisation and Industrialisation, Mining activities, GHGs, CFCs, fossil fuels; Ozone Layer Depletion; Principles of Environmental Analysis.

UNIT IV (16)

Concept of ecosystem and community, populations and communities, Habitat and niche, species interaction, Hotspots, Key stone species, Species diversity and edge effects, Energy Flow, trophic levels and Food webs; *In-situ* and *ex-situ* conservation of Biodiversity, IUCN and Red data book, UNESCO, Biodiversity legislation, Indigenous knowledge and biodiversity conservation, Loss of biodiversity: causes and its impact; Invasive species: threats and management.

UNIT V (14)

Sustainable development; Energy resources, renewable and non-renewable energy sources, Growing energy needs, Use of alternate energy sources, Urban problems related to energy; Water conservation, rain water harvesting; Watershed management: Definition and basicconcepts, Aims and Principles, Importance of integrated watershed management, Principal watershed problems of India, Biofuel plants: *Jatropha*, sugarcane and oil crops, Biofuel plantation, achievement of sustainable Biofuel production.

Biodiversity and Environmental Management (Practical) (Credits: 2)

Course Code: SOLS/BOT/DSE-3(P)

1. Study of Key Stone species with the help of Photographs with a Himalayan perspective.
2. Presentation of the procedure of Environmental Impact Assessment (EIA) through the flowchart.
3. Study of plants as pollution indicators with the help of Photographic specimens.
4. Identification of soil texture: clay, silt, sand and loamy
5. Determination of soil moisture, bulk density and porosity.
6. To study the different economic values and valuation methods for ecosystem services.
7. Morphological study of a Biofuel plant.
8. Study the impact of forest fires on regional biodiversity and the environment.

SUGGESTED READINGS

1. FAO Conservation Guide Nos. 12, 13/1, 13/3, 13/4, 13/6, 14. Rome.

2. Heywood, H.V. 1995. Global Biodiversity Assessment.
3. Lochwood, M., Worboys, G.L. and Ashish, K. 2006. Managing Protected Areas: A Global Guide.
4. Ramakrishnan, P.S., Saxena, K.G. and Chandrashekara, U.M. 1998. Conserving the Sacred for Biodiversity Management. Oxford and IBH Publ. Co. New Delhi
5. Richard, P.P. 1998. Essentials of Conservation Biology. Boston University.
6. Agarwal, K.C., 2001, Environmental Biology, Nidi Publ. Ltd. Bikaner.
7. De, A.K., Environmental Chemistry, Wiley Eastern Ltd
8. Jadhav, H.& Bhosale, V.M., 1995, Environmental Protection and Laws, HimalayaPub. House, Delhi 284 p.

Major Zoology

SOLS/ZOO/DSE-1 Applied Zoology

Credits: 4, 60 Hours

UNIT I

Introduction to Host-parasite Relationship: Host, Definitive host, Intermediate host, Parasitism, Symbiosis, Commensalism, Reservoir, Zoonosis [4 Hours]

UNIT II

Epidemiology of Diseases: Transmission, Prevention and control of diseases—Tuberculosis, swine flu, typhoid, Covid-19 [5 Hours]

UNIT III

Rickettsiae and Spirochaetes: Brief account of Rickettsia prowazekii, Borrelia recurrentis and Treponema pallidum [4 Hours]

UNIT IV

Parasitic Protozoa: Life history and pathogenicity of Entamoeba histolytica, Plasmodium vivax, Leishmania donovani and Trypanosoma gambiense [5 Hours]

UNIT V

Parasitic Helminthes: Life history and pathogenicity of Schistosoma haematobium, Ancylostoma duodenale and Wuchereria bancrofti [5 Hours]

UNIT VI

Insects of Economic Importance: Biology, Control and damage caused by Helicoverpa armigera, Pyrilla perpusilla and Papilio demoleus, Callosobruchus chinensis, Sitophilus oryzae and Tribolium castaneum; Safe storage of stored grains [8 Hours]

UNIT VII

Insects of Medical Importance: Life cycle, medical importance and control of Pediculus humanus corporis, Anopheles, Culex, Aedes, Xenopsylla cheopis, Phlebotomus argentipes [10 Hours]

UNIT VIII

Animal Husbandry: Domestic animals of economic importance; Preservation and artificial insemination in cattle; Induction of early puberty and synchronization of estrus in cattle [8 Hours]

UNIT IX

Poultry Farming: Principles of poultry breeding, Management of breeding stock and broilers, Processing and preservation of eggs [6 Hours]

UNIT X

Fish Technology: Genetic improvements in the aquaculture industry; Induced breeding and transportation of fish seed [5 Hours]

Suggested Readings

1. Arora, D. R and Arora, B. (2001). Medical Parasitology. II Edition. CBS Publications and Distributors.
2. Atwal, A.S. (1986). Agricultural Pests of India and South East Asia, Kalyani Publishers.
3. Dennis, H. (2009). Agricultural Entomology. Timber Press (OR).
4. Dunham R.A. (2004). Aquaculture and Fisheries Biotechnology: Genetic Approaches. CABI publications, U.K.
5. Hafez, E. S. E. (1962). Reproduction in Farm Animals. Lea & Fabiger Publisher
6. Kumar, Vinay et al. (2014). Robbins And Cotran Pathologic Basis of Disease South Asia Edition
7. Park, K. (2007). Preventive and Social Medicine. XVI Edition. B.B. Publishers.
8. Pedigo, L.P. (2002). Entomology and Pest Management, Prentice Hall.

SOLS/ZOO/DSE-1(P) Applied Zoology (Practical)

Credits:2

1. Study of Plasmodium vivax, Entamoeba histolytica, Trypanosoma gambiense, Ancylostoma duodenale, Leishmania donovani and Wuchereria bancrofti and their life stages through permanent slides/photomicrographs or specimens.
2. Study of arthropod vectors associated with human diseases: Pediculus, Culex, Anopheles, Aedes and Xenopsylla.
3. Study of insect damage to different plant parts/stored grains through damaged products/photographs.

4. Identifying feature and economic importance of Helicoverpa armigera, Papilio demoleus, Pyrilla perpusilla, Callosobruchus chinensis, Sitophilus oryzae and Tribolium castaneum
5. Visit to poultry farm or animal breeding centre and submission of visit report.
6. Preparation and maintenance of freshwater aquarium.

Wildlife Conservation & Management

SOLS/ZOO/DSE-2

Credits: 4, 60 Hours

UNIT I

Wildlife - Values of wild life; Our conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies [4 Hours]

UNIT II

Habitat analysis; Evaluation and management of wildlife - Physical parameters (Topography, Geology, Soil and Water); Biological Parameters (food, cover, forage, browse and cover estimation); Standard evaluation procedures: remote sensing and GIS [8 Hours]

UNIT III

Management of habitats - Setting back succession; Grazing logging; Mechanical treatment; Advancing the successional process; Cover construction; Preservation of general genetic diversity [6 Hours]

UNIT IV

Population estimation: Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio computation; Faecal analysis of ungulates and carnivores: Faecal samples, slide preparation, Hair identification, Pug marks and census method [10 Hours]

UNIT V

National Organisations involved in wildlife conservation; Wildlife Legislation – Wildlife Protection Act - 1972, its amendments and implementation; CITES; IUCN Red Data Book [6 Hours]

UNIT VI

Management planning of wildlife in protected areas; Estimation of carrying capacity; Ecotourism /wildlife tourism in forests; Concept of climax persistence; Ecology of disturbance [8 Hours]

UNIT VII

Management of excess population and translocation; Bio-telemetry; Care of injured and diseased animals; Quarantine; Common diseases of wild animals [6 Hours]

UNIT VIII

Zoogeographic areas of the Indian Subcontinent; Protected Areas: National Parks/ Sanctuaries/Biosphere Reserves of Indian subcontinent; Important features of protected areas in India; Tiger conservation – Tiger reserves in India; Management challenges in the Tiger reserve [12 Hours]

Suggested Readings

1. Sharma, BD: High Altitude Wildlife of India. Oxford 7 IBH Publ. Co. Pvt. Ltd. 1994.
2. Negi, SS: Himalayan Wildlife: Habitat and Conservation. Indus Publ. Company, New Delhi 1992.
3. Pullin, AS: Conservation Biology, Cambridge University Press, 2002.

Wildlife Conservation & Management (Practical)

SOLS/ZOO/DSE-2(P)

Credits: 2

1. Identification of flora, mammalian fauna, avian fauna, and herpetofauna
2. Demonstration of basic equipment needed in wildlife studies, use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses)
3. Familiarisation and study of animal evidence in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers, etc.
4. Demonstration of different field techniques for flora and fauna
5. PCQ, Ten tree method, Circular, Square & rectangular plots, Parker's 2 Step and other methods for ground cover assessment, Tree canopy cover assessment, Shrub cover assessment.
6. Trail/ transect monitoring for abundance and diversity estimation of mammals and birds (direct and indirect evidence)
7. Photograph of wild animals.
8. Zoogeographic areas of the Indian Subcontinent.
9. National Parks/ Sanctuaries/Biosphere Reserves of the Indian subcontinent.
10. Population estimation: capture-recapture method.

Principles of Genetics & Evolutionary Biology

SOLS/ZOO/DSE-3

Credits: 4, 60 Hours

A. Genetics

UNIT I

Mendel's law; Exceptions to Mendel's law; Chromosomal theory of Inheritance; Sex-linked inheritance & genetic disorders; Linkage & Crossing Over [8 Hours]

UNIT II

Chromosome structure; Euchromatin; Heterochromatin; Polytene and lampbrush chromosomes. Chromosome banding, Karyotyping; Fine structure of gene and allelism; Sex determination and Sex Linkage [10 Hours]

UNIT III

Cytoplasmic Inheritance, Polygenic Inheritance, Mutation, population and evolution genetics, Hardy-Weinberg Principle [10 Hours]

B. Evolution

UNIT IV

Historical development of the concept of evolution. Theories of organic evolution: Lamarckism (Neo-Lamarckism); Darwinism (Neo-Darwinism); Modern synthetic theory. Evidence in favour of evolution: Comparative anatomy, Comparative Embryology, Palaeontology, Biochemistry & Genetics [10 Hours]

UNIT V

Processes of Evolutionary Change: Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism); Types of natural selection (Directional, Stabilising, Disruptive), Artificial selection. Species Concept: Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric) [10 Hours]

UNIT VI

Palaeontology: Fossils and fossilization, Incompleteness of fossil record, Dating of fossils, Significance of fossil record; Geological distribution of animals; Mass extinction (Causes, five major extinctions, K-Textinction in detail), Role of extinction in evolution; Evolution of Horse [12 Hours]

Suggested Readings

1. Allendorf, Fred W., Gordon H. Luikart, Sally N. Aitken (2012). Conservation and the Genetics of Populations,2nd edition, Wiley-Blackwell
2. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring, Harbour Laboratory Press.
3. Benjamin A. Peirce (2017). Genetics: A Conceptual Approach, W.H. Freeman and Company
4. Brown, TA (2020). Gene Cloning and DNA Analysis and Introduction, 8th edition, Wiley-Blackwell

5. Daniel L. Hartl, Elizabeth W. Jones (2004). Genetics Analysis of Genes and Genomes, 6th edition, Jones and Bartlett Publishers
6. Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.
7. Gardner, Gimmons and Snustad (2006). Principles of Genetics, 8th edition, John Wiley & Sons.
8. Hall, B. K. and Hallgrimsson, B. (2008). Evolution. IV Edition. Jones and Bartlett Publishers
9. Minkoff, E. (1983). Evolutionary Biology. Addison-Wesley
10. Reece, Jane B. (2011). Campbell Biology, 9th Edition, Pearson
11. Ridley, M. (2004). Evolution. III Edition. Blackwell Publishing
12. Robert, H. Tamarin (2009) Principles of Genetics, Tata McGraw Hill Education Pvt. Ltd.
13. Strickberger, M.W. (1989). Evolution, Jones and Bartlett Publishers
14. William S. Klung Cummings, Spencer and Palldino (2019). Concepts of Genetics, Pearson Education, Pearson

Principles of Genetics & Evolutionary Biology (Practical)

SOLS/ZOO/DSE-3(P)

Credits:2

A. Genetics

1. Study of Mendelian Inheritance and gene interactions (Non-Mendelian Inheritance) using suitable examples. Verify the results using the Chi-square test.
2. Study of Linkage, recombination, and gene mapping using the data.
3. Study of Human Karyotypes (normal and abnormal).

B. Evolution

1. Study of fossil evidence from plaster cast models and pictures
2. Study of homology and analogy from suitable specimens/ pictures
3. Charts:
   a. Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors
   b. Darwin's Finches with diagrams/cut-outs of beaks of different species
4. Visit to the Natural History Museum, submission of report.

Animal Behaviour & Endocrinology

SOLS/ZOO/DSE-4

Credits: 4, 60 Hours

A. Animal Behaviour

UNIT I

The science of behaviour: History, scope and terminology. Proximate and ultimate causes of behaviour. Instinct: Definition and characteristics (sign stimuli and Fixed Action Pattern). Learning behaviour: Definition. Spatial learning. Associative learning, classical

conditioning, operant conditioning, and language learning. Imprinting. Kin recognition. Instinct versus learning behaviour. Timing of behaviour: Biological rhythms. The Biological Clock. Circadian rhythm and its synchronisation with seasonal rhythms. Photoperiodism [12 Hours]

UNIT II

Communication: Visual, olfactory, acoustic (bird songs, amphibian calls); echolocation in bats, electrolocation in fish. Chemoreception: Chemicals (pheromones) as signals in insects, fish and mammals. Role of olfaction in communication behaviour (territorial, sex recognition, feeding, etc) in fish and mammals. Neural control of behaviour: Components of the brain involved in various behaviours. Neural control of drinking, learning, eating, activity & rest, sleep, aggression, sexual behaviour. Hormonal Control of behaviour: Hormone brain relationships. Sexual behaviour in mammals (e.g. rat). Sociobiology: Elements of sociality and social grouping in animals [15 Hours]

B. Endocrinology

UNIT III

Endocrine messengers: hormones, neurohormones, hormone-like substances (neuronal peptides, autocoids, pheromones, neurosecretion). Hormones and Physiological actions of the endocrine glands in mammals: Pituitary, Thyroid, Parathyroid, Pancreas, Gastro-intestinal tract, Adrenal cortex and Medulla, Thymus and Pineal. Hormone biosynthesis: Protein peptide hormones (gonadotropins, thyrotropin, corticotropin, steroids and catecholamines). Mechanism of action of Protein hormones and Catecholamines: membrane-bound receptors, G-protein and control of adenylate cyclase, Cyclic nucleotide cascade [18 Hours]

UNIT IV

Organisation & physiological actions of the Testis: Androgen binding protein (ABP), Inhibin. Neuroendocrine control of testicular functions (Gn RH regulation, FSH- effects on germinal epithelium, LH- effects on Leydig cells, negative feedback regulation). Organization & physiological actions of the Ovary: Folliculogensis, Ovulation, Luteinization, Ovarian cycles; Seasonal reproductive cycles; sexual dysfunctions in man [15 Hours]

Suggested Readings

1. Alcock, John: Animal Behaviour, 4th edition, Sinauer Associates, Inc. 1989.
2. Bentley P.J.: Comparative Vertebrate Endocrinology S. Chand & Company Ltd, Ram Nagar New Delhi, 1980

Animal Behaviour & Endocrinology (Practical)

SOLS/ZOO/DSE-4(P)

Credits: 2

1. Animal Behaviour photographs/videos/models
2. Slides & Photographs of Endocrine Disorders
3. Examination of histological sections from photomicrographs/ permanent slides of rat/human endocrine glands
4. Cholesterol estimation from a serum sample
5. Glucose estimation from a blood sample

Introduction to Developmental Biology

SOLS/ZOO/DSE-5

Credits: 4, 60 Hours

UNIT I

Basic concepts in developmental biology; Gametogenesis: Events in spermatogenesis. Morphology of mature mammalian spermatozoon; Events in Oogenesis, Significance of Oogenesis. Vitellogenesis in birds: Comparison between Spermatogenesis & Oogenesis
Fertilisation: Mechanism of fertilisation; Capacitation, Molecular events - Block to polyspermy. Egg activation: An Elementary idea of parthenogenesis.

UNIT II

Types of eggs and cleavage. Role of yolk during cleavage; Products of cleavage (Morula and Blastula). Fate map: fate map of the early blastula of the Frog, Fate of germ layers. Types of morphogenetic movements. Gastrulation in sea urchin, frog, chick and mammal. Neurogenesis & Notogenesis.

UNIT III

Extra Embryonic Foetal Membrane (Chick). Development of the chick embryo up to 72 hours. Types, formation and function of the Placenta in mammals. Metamorphic events in the frog life cycle and their hormonal regulation.

UNIT IV

Elementary concept of primary organizer; Induction; nature and its mechanism of action; Development of eye and limbs; Totipotency; Teratogenesis; Drosophila development up to gastrulation; Differential expression of genes in Drosophila.

Suggested Readings

1. Berrill, NJ: Developmental Biology, Tata McGraw-Hill Publishing Co. Ltd., 1979
2. Gilbert, SF: Developmental Biology, 3rd edition, Sinauer Associates, 1991
3. Twyman, R.M.: BIOS Instant Notes in Developmental Biology, Taylor & Francis, 2000

Introduction to Developmental Biology (Practical)

SOLS/ZOO/DSE-5(P)

Credits: 2

1. Frog - Study of developmental stages - whole mounts and sections through permanent slides – cleavage stages, blastula, gastrula, neurula, tail bud stage, tadpole external and internal gill stages.
2. Chick- Study of developmental stages - sections through permanent slides – cleavage stages, primitive streak stage, 24, 36, 48, 72 hours of incubation
3. Study of the different types of placentae- histological sections through permanent slides or photomicrographs.
4. Study of placental development in humans by ultrasound scans.
5. Examination of gametes - frog/rat - sperm and ova through permanent slides or photomicrographs.

Basics of Biotechnology

SOLS/ZOO/DSE-6

Credits: 4, 60 Hours

UNIT I

What is Biotechnology? Historical inputs. Biotechnology as a `tool' not a `product'. Interdisciplinary nature. Foundation of Biotechnology: Importance of basic Biology disciplines eg, Human, Animal and Plant Physiology, Genetics, Cell and Molecular Biology, Microbiology, Biochemistry, Immunology and Chemical engineering [12 Hours]

UNIT II

Introduction to Genetic Engineering. Tools and techniques.
Enzymes, Restriction endonuclease. Ligases, Alkaline phosphatase, Reverse transcriptase, DNA polymerase, Vectors-plasmids, phages, cosmids. Biotechnology hazards and safety. Social, moral and ethical issues [12 Hours]

UNIT III

Biotechnology in health care. Therapeutic products (Hormones, regulatory proteins, antibiotics). Prenatal diagnosis of genetic diseases. Vaccines, Immunodiagnostics (RIA, ELISA, IRMA) and DNA probes for disease identification. Gene therapy. Human Genome and Biomedicine [12 Hours]

UNIT IV

Introduction to Environmental Biotechnology. Bioprocessing Techniques. Enzyme Biotechnology. Single-cell proteins. Food and Beverage Biotechnology. Biotechnology in animal agriculture. Biotechnology in plant agriculture [12 Hours]

UNIT V

Genetics and Biotechnology: Introduction, Animal Cloning (therapeutic and Reproductive), Genetic manipulation at the organism level: Transgenesis, Knock-in and Knock-out models (Cre-Lox P system), CRISPR-Cas9 technology, genome editing in nature and artificial species improvement of plants and animals. Genetic manipulation at the cellular and molecular level, transfection technologies, adenoviral and lentiviral-based methods; Industrial genetics; Cell fusion and hybridoma techniques [12 Hours]

Suggested Readings

1. Das H.K.: Textbook of Biotechnology, Wiley India Pvt. Limited, ISBN 8126505567, 2004
2. Dubey R.C.: A Textbook of Biotechnology, S. Chand Publishing, 1993
3. Thieman, William, Michael A. Palladino: Introduction to Biotechnology, Pearson Education India; 3rd edition, ISBN-10: 9789332535060, 2014

Basics of Biotechnology (Practical)

SOLS/ /ZOO/DSE-6(P)

Credits:2

1. Isolation of plasmid DNA from E. coli.
2. Transformation of E. coli (pUC 18/19) and calculation of transformation efficiency.
3. Restriction Endonuclease Digestion of Plasmid DNA.
4. Ligation of Target DNA
5. Gene amplification using PCR
6. DNA sequencing: Interpretation of sequence from the data provided.
7. Analysis of DNA fingerprint
8. Separation of proteins by SDS-PAGE

Major Physics

Credits: 4, 60 hours

Core Physics-I: Quantum Mechanics

Time Dependent Schrodinger Equation: Time dependent Schrodinger equation and dynamical evolution of a quantum state; properties of wave function, interpretation of wave function, probability and probability current densities in three dimensions, physical significance of wave functions, normalization, linearity and superposition principles, eigenvalues and eigenfunctions, position, momentum and energy operators, commutator of position and momentum operators, expectation values of position and momentum, wave function of a free particle.

Time Independent Schrodinger Equation: Hamiltonian, stationary states and energy eigenvalues, expansion of an arbitrary wavefunction as a linear combination of energy eigenfunctions, time independent Schrodinger equation and stationary states, wave packets,

application to the spread of Gaussian wave-packet for a free particle in one dimension, Fourier transforms and momentum space wavefunction, uncertainty principle: example and applications.

General Discussion of Bound States in an Arbitrary Potential: continuity of wave function, quantisation of momentum and energy, boundary condition and emergence of discrete energy levels, application to one-dimensional problem, particle in a box, potential barrier, square well potential, one-dimensional harmonic oscillator, energy levels and energy eigenfunctions.

Quantum Theory of Hydrogen-Like Atoms: Time-independent Schrodinger equation in spherical polar coordinates, separation of variables for the second-order partial differential equation, spherical harmonics, angular momentum operator, radial wavefunctions, orbital angular momentum, quantum numbers and their significance.

Reference Books:

1. Quantum Mechanics, M.C. Jain, Tata McGraw-Hill
2. Quantum Physics, H C Verma, 2nd Ed, TBS Publication
3. Quantum Mechanics: Concepts and Applications, Zettili N., 2nd Ed, John Wiley
4. Advanced Quantum Mechanics, Satya Prakash, 5th Ed, Kedarnath-Ramnath Publication
5. Quantum Mechanics, E. Merzbacher, John Wiley and Sons
6. Quantum Mechanics, V. K. Thankappan, Wiley Eastern
7. Quantum Mechanics, Satya Prakash, Pragati Prakashan, Meerut
8. A Textbook of Quantum Mechanics, P.M. Mathews, K. Venkatesan, Tata McGraw-Hill
9. Modern Quantum Mechanics, J.J. Sakurai, Addison-Wesley
10. Quantum Mechanics, A. K. Ghatak and S. Lokanathan, 3rd Ed., MacMillan
11. Quantum Mechanics, Bransden and Joachain, Pearson Education publications
12. Introduction to Quantum Mechanics, David J. Griffith, 2nd Ed. 2005, Pearson Education

Core Physics-I: Quantum Mechanics (Practical)

Credits: 2

Problem-Solving Software

1. C/C++/Scilab for solving the problems based on Quantum Mechanics Laboratory-Based Experiments
2. Use C/C++/Scilab for solving the problems based on Quantum Mechanics
3. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency.
4. Study of Zeeman effect: with external magnetic field; Hyperfine splitting
5. To study the quantum tunnelling effect with a solid-state device, e.g. tunnelling current in a backwards diode or a tunnel diode.

Reference Books

1. Schaum's Outline of Programming with C++. J. Hubbard, 2000, McGraw-Hill Publications.
2. Numerical Recipes in C: The Art of Scientific Computing, W. H. Press et al., 3rd Edn. 2007, Cambridge University Press.
3. Elementary Numerical Analysis, K. E. Atkinson, 3rd Edn, 2007, Wiley India Edition.
4. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014 Springer ISBN: 978-3319067896
5. Scilab by example: M. Affouf, 2012, ISBN: 978-1479203444
6. Scilab (A Free Software to Matlab): H. Ramchandran, A.S. Nair. 2011 S.Chand and Company, New Delhi, ISBN: 978-8121939706
7. Scilab Image Processing: Lambert M. Surhone, 2010, Betascript Publishing, ISBN: 978-6133459274A
8. Quantum Mechanics, Leonard I. Schiff, 3rd Ed. 2010, Tata McGraw-Hill.
9. Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.

Major Chemistry

Students can opt for any one of the following papers:

1. **Instrumental Methods of Chemical Analysis**
2. **Organometallics, Bio-inorganic, Polynuclear Hydrocarbon, UV and IR Spectroscopy**
3. **Molecules of Life**

Instrumental Methods of Chemical Analysis

Credits: 4, 60 Lectures

Introduction to spectroscopic methods of analysis:

Recap of the spectroscopic methods covered in detail in the core chemistry syllabus: Treatment of analytical data, including error analysis. Classification of analytical methods and the types of instrumental methods. Consideration of electromagnetic radiation.

(4 Lectures)

Molecular spectroscopy:

Infrared spectroscopy:

Interactions with molecules: absorption and scattering. Means of excitation (light sources), separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat, differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR). Samples and results expected. Applications: Issues

of quality assurance and quality control, Special problems for portable instrumentation and rapid detection.

UV-Visible/ Near IR – emission, absorption, fluorescence and photoacoustic. Excitation sources (lasers, time resolution), wavelength dispersion (gratings, prisms, interference filters, laser, placement of sample relative to dispersion, resolution), Detection of signal (photocells, photomultipliers, diode arrays, sensitivity and S/N), Single and Double Beam instruments, Interpretation (quantification, mixtures, absorption vs. fluorescence and the use of time, photoaccoustic, fluorescent tags).

(16 Lectures)

Separation techniques

Chromatography: Gas chromatography, liquid chromatography, supercritical fluids, Importance of column technology (packing, capillaries), Separation based on increasing number of factors (volatility, solubility, interactions with stationary phase, size, electrical field), Detection: simple vs. specific (gas and liquid), Detection as a means of further analysis (use of tags and coupling to IR and MS), Electrophoresis (plates and capillary) and use with DNA analysis.

Immunoassays and DNA techniques

Mass spectroscopy: Making the gaseous molecule into an ion (electron impact, chemical ionisation), making liquids and solids into ions (electrospray, electrical discharge, laser desorption, fast atom bombardment), Separation of ions on the basis of mass to charge ratio, Magnetic, Time of flight, and Electric quadrupole. Resolution, time and multiple separations, Detection and interpretation (how this is linked to excitation).

(16 Lectures)

Elemental analysis:

Mass spectrometry (electrical discharges).

Atomic spectroscopy: atomic absorption, atomic emission, and atomic fluorescence. Excitation and getting sample into gas phase (flames, electrical discharges, plasmas), Wavelength separation and resolution (dependence on technique), Detection of radiation (simultaneous/scanning, signal noise), Interpretation (errors due to molecular and ionic species, matrix effects, other interferences). **(8Lectures)**

NMR spectroscopy: **P**rinciple, Instrumentation, Factors affecting chemical shift, Spin-coupling, Applications. **(4 Lectures)**

Electroanalytical Methods: Potentiometry & Voltammetry. **(4 Lectures)**

Radiochemical Methods: (4 Lectures).

X-ray analysis and electron spectroscopy (surface analysis). (4 Lectures).

Reference books:

- Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
- Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
- P.W. Atkins: Physical Chemistry.
- G.W. Castellan: Physical Chemistry.
- C.N. Banwell: Fundamentals of Molecular Spectroscopy.
- Brian Smith: Infrared Spectral Interpretations: A Systematic Approach.
- W.J. Moore: Physical Chemistry.

Practical Instrumental Methods of Chemical Analysis

Credits: 2

1. Safety Practices in the Chemistry Laboratory
2. Determination of the isoelectric pH of a protein.
3. Titration curve of an amino acid.
4. Determination of the void volume of a gel filtration column.
5. Determination of a Mixture of Cobalt and Nickel (UV/Vis spec.)
6. Study of Electronic Transitions in Organic Molecules (i.e., acetone in water)
7. IR Absorption Spectra (Study of Aldehydes and Ketones)
8. Determination of Calcium, Iron, and Copper in Food by Atomic Absorption
9. Quantitative Analysis of Mixtures by Gas Chromatography (i.e., chloroform and carbon tetrachloride).
10. Separation of Carbohydrates by HPLC
11. Determination of Caffeine in Beverages by HPLC
12. Potentiometric Titration of a Chloride-Iodide Mixture
13. Cyclic Voltammetry of the Ferrocyanide/Ferricyanide Couple
14. Nuclear Magnetic Resonance
15. Use of fluorescence to do "presumptive tests" to identify blood or other body fluids.
16. Use of "presumptive tests" for anthrax or cocaine
17. Collection, preservation, and control of blood evidence being used for DNA testing
18. Use of capillary electrophoresis with laser fluorescence detection for nuclear DNA (Y chromosome only or multiple chromosome).
19. Use of sequencing for the analysis of mitochondrial DNA
20. Laboratory analysis to confirm anthrax or cocaine
21. Detection in the field and confirmation in the laboratory of flammable accelerants or Explosives.
22. Detection of illegal drugs or steroids in athletes
23. Detection of pollutants or illegal dumping
24. Fibre analysis

Reference Books:

- Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
- Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed.
- Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
- Cann, M. C. & Thomas, P. *Real world cases in Green Chemistry,* American Chemical Society (2008).
- Lancaster, M. *Green Chemistry: An Introductory Text,* RSC Publishing, 2nd Edition, 2010.
- Pavia, D.L., Lampman, G.M., Kriz, G.S. & Engel, R.G. *Introduction to Organic Laboratory*
- *Techniques: A Microscale and Macro Scale Approach,* W.B. Saunders, 1995.

Organometallics, Bioinorganic Chemistry, Polynuclear Hydrocarbons And UV, IR Spectroscopy

Credits: 4, 60 Lectures

Section A: Inorganic Chemistry-4 **(30 Lectures) Chemistry of 3d metals**

Oxidation states displayed by Cr, Fe, Co, Ni and Co.

A study of the following compounds (including preparation and important properties); Peroxo compounds of Cr, $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, sodium nitroprusside, $[Co(NH_3)_6]Cl_3$, $Na_3[Co(NO_2)_6]$.

(6 Lectures)

Organometallic Compounds

Definition and Classification with appropriate examples based on the nature of metal-carbon bond (ionic, s, p and multicentre bonds). Structures of methyl lithium, Zeiss salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals. p-acceptor behaviour of carbon monoxide. Synergic effects (VB approach)- (MO diagram of CO can be referred to for synergic effect to IR frequencies).

(12 Lectures)

Bio-Inorganic Chemistry

A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na^+, K^+ and Mg^{2+} ions: Na/K pump; Role of Mg^{2+} ions in energy production and chlorophyll. Role of Ca^{2+} in blood clotting, stabilization of protein structures and structural role (bones).

(12 Lectures)

Section B: Organic Chemistry-4 **(30 Lectures) Polynuclear and heteronuclear aromatic compounds:**

Properties of the following compounds with reference to electrophilic and nucleophilic substitution: Naphthalene, Anthracene, Furan, Pyrrole, Thiophene, and Pyridine.

(6 Lectures)

Active methylene compounds:

Preparation: Claisen ester condensation. Keto-enol tautomerism.

Reactions: Synthetic uses of ethyl acetoacetate (preparation of non-heteromolecular compounds having up to 6 carbon atoms).

(6 Lectures)

Application of Spectroscopy to Simple Organic Molecules

Application of visible, ultraviolet and Infrared spectroscopy in organic molecules. Electromagnetic radiations, electronic transitions, λmax & εmax, chromophore, auxochrome, bathochromic and hypsochromic shifts. Application of electronic

spectroscopy and Woodward rules for calculating λmax of conjugated dienes and α,β – unsaturated compounds.

Infrared radiation and types of molecular vibrations, functional group and fingerprint region. IR spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on

>C=O stretching absorptions).

(18 Lectures)

Reference Books:

- James E. Huheey, Ellen Keiter & Richard Keiter: *Inorganic Chemistry: Principles of Structure and Reactivity,* Pearson Publication.
- G.L. Miessler & Donald A. Tarr: *Inorganic Chemistry,* Pearson Publication.
- J.D. Lee: *A New Concise Inorganic Chemistry,* E.L.B.S.
- F.A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley & Sons.
- I.L. Finar: *Organic Chemistry* (Vol. I & II), E.L.B.S.
- John R. Dyer: *Applications of Absorption Spectroscopy of Organic Compounds,* Prentice Hall.
- R.M. Silverstein, G.C. Bassler & T.C. Morrill*: Spectroscopic Identification of Organic Compounds*, John Wiley & Sons.
- R.T. Morrison & R.N. Boyd: *Organic Chemistry,* Prentice Hall.
- Peter Sykes: *A Guide Book to Mechanism* in *Organic Chemistry,* Orient Longman.
- Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry,* S. Chand.

Practical Organometallics, Bioinorganic Chemistry, Polynuclear

Credits: 2

HYDROCARBONS AND UV, IR SPECTROSCOPY

Section A: Inorganic Chemistry

1. Separation of mixtures by chromatography: Measure the *Rf* value in each case. (Combination of two ions to be given)
   Paper chromatographic separation of Fe^{3+}, $A1^{3+}$ and Cr^{3+} or Paper chromatographic separation of Ni^{2+}, Co^{2+}, Mn^{2+} and Zn^{2+}
2. Preparation of any two of the following complexes and measurement of their conductivity:

(i) tetraamminecarbonatocobalt (III) nitrate

(ii)tetraamminecopper (II) sulphate

(iii) potassium trioxalatoferrate (III) trihydrate

Compare the conductance of the complexes with that of M/1000 solution of NaCl, $MgCl_2$ and $LiCl_3$.

Section B: Organic Chemistry

Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (- COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

Reference Books:

- Vogel, A.I.: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
- Vogel, A.I.: Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.

Molecules of Life

Credits: 4, 60 Lectures

UNIT I

Carbohydrates (10 Periods)

Classification of carbohydrates, reducing and non-reducing sugars, General Properties of Glucose and Fructose, and their open-chain structure. Epimers, mutarotation and anomers. Determination of the configuration of Glucose (Fischer proof).

Cyclic structure of glucose. Haworth projections. Cyclic structure of fructose.

Linkage between monosaccharides, structure of disaccharides (sucrose, maltose, lactose) and polysaccharides (starch and cellulose), excluding their structure elucidation.

UNIT II

Amino Acids, Peptides and Proteins (12 Periods)

Classification *of Amino Acids,* Zwitterion structure and Isoelectric point.

Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins. Determination of the primary structure of peptides, determination of the N-terminal amino acid (by DNFB and Edman method) and the C-terminal amino acid (by thiohydantoin and with carboxypeptidase enzyme).

Synthesis of simple peptides (up to dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid phase synthesis.

UNIT III

Enzymes and correlation with drug action (12 Periods)

Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, Specificity of enzyme action (Including stereospecificity), Enzyme inhibitors and their importance, phenomenon of inhibition (Competitive and non-competitive inhibition, including allosteric inhibition). Drug action-receptor theory. Structure–activity relationships of drug molecules, binding role of –OH group, $-NH_2$ group, double bond and aromatic ring.

UNIT IV

Nucleic Acids (10 Periods)

Components of Nucleic acids: Adenine, guanine, thymine and Cytosine (Structure only), other components of nucleic acids, Nucleosides and nucleotides (nomenclature), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (types of RNA), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation.

UNIT V

Lipids (8 Periods)

Introduction to lipids, classification.

Oils and fats: Common fatty acids present in oils and fats, Omega fatty acids, Trans fats, Hydrogenation, Saponification value, Iodine number.

Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol).

UNIT VI

Concept of Energy in Biosystems (8 Periods)

Calorific value of food. Standard caloric content of carbohydrates, proteins and fats. Oxidation of foodstuff (organic molecules) as a source of energy for cells. Introduction to Metabolism (catabolism, anabolism), ATP: the universal currency of cellular energy, ATP hydrolysis and free energy change.

Conversion of food into energy. Outline of catabolic pathways of Carbohydrate- Glycolysis, Fermentation, Krebs Cycle. Overview of catabolic pathways of Fats and Proteins. Interrelationships in the metabolic pathways of Proteins, Fats and Carbohydrates.

Reference Books:

- Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. *Organic Chemistry* (*Volume 2)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry 7th Ed.,* W. H. Freeman.
- Berg, J.M., Tymoczko, J.L. & Stryer, L. *Biochemistry*, W.H. Freeman, 2002.

Practical Molecules of Life

Credits: 2

1. Separation of amino acids by paper chromatography
2. To determine the concentration of glycine solution by the formylation method.
3. Study of the titration curve of glycine
4. Action of salivary amylase on starch
5. Effect of temperature on the action of salivary amylase on starch.
6. To determine the saponification value of an oil/fat.
7. To determine the iodine value of an oil/fat
8. Differentiate between a reducing and/non-reducing sugar.
9. Extraction of DNA from onion/cauliflower
10. To synthesise aspirin by acetylation of salicylic acid and compare it with the ingredients of an aspirin tablet by TLC.

Reference Books:

- Furniss, B.S.; Hannaford, A.J.; Rogers, V.; Smith, P.W.G.; Tatchell, A.R. *Vogel's Textbook of Practical Organic Chemistry*, ELBS.
- Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry,* Universities Press.

Major Mathematics
Complex Analysis

Credits: 6

UNIT I

Properties of complex numbers, Regions in the complex plane, Functions of complex variable, Limits, Continuity, differentiability of complex functions, Exponential function, Logarithmic function, Trigonometric function.

UNIT II

Differentiability and Analyticity, Cauchy-Riemann Equations, Sufficient conditions for analyticity, Harmonic Functions, Harmonic conjugate function, Applications, Examples of analytic functions.

UNIT III

Contours, Contour integrals and their examples, Upper bounds for moduli of contour integrals, Cauchy-Goursat theorem, Cauchy integral formula. Cauchy inequality, Liouville's theorem, Morera's theorem.

UNIT IV

Sequences and Series, Taylor Series, Laurent Series, Singularities, Classification of singularities, Residues and the Residue theorem.

Books Recommended

1. James Ward Brown and Ruel V. Churchill, Complex Variables and Applications, 8th Ed., McGraw-Hill International Edition, 2009.
2. JosephBak and Donald J. Newman, Complex analysis, 2nd Ed., Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., New York, 1997.
3. Dennis G. Zill and Patrick D. Shanahan, A First Course in with Applications Complex Analysis, Jones and Bartlett Publishers.

RM-602: Academic Writing

Credits: 2

RM-602.1 Course Description:

This course is designed to introduce undergraduate students to the conventions of academic writing. It focuses on developing critical thinking, coherence, clarity, and proper documentation techniques. Through structured writing tasks and guided practice, students

will learn to write essays, summaries, reports, and research-based papers appropriate for academic settings.

RM-602.2 Course Outcomes:
By the end of the course, student teachers will be able to:

1. understand and apply the conventions of academic writing.
2. construct coherent, cohesive, and grammatically accurate texts.
3. develop thesis statements and support them with evidence.
4. paraphrase, summarize, and integrate sources ethically.
5. write academic essays, reports, and research papers using appropriate referencing styles.
6. edit and revise writing for clarity, style, and accuracy.

UNIT I
Introduction to Academic Writing

- Features of academic writing
- Writing Process: Prewriting, Drafting, Revising and Paragraph Structure,
- Integrating Sources: Summarizing and Paraphrasing,
- Citation and referencing practice

UNIT II
Expository and Argumentative Writing

- Essay Structure: Introduction, Body, Conclusion
- Essay format and components, Writing Descriptive and Narrative Essays,
- Writing Expository and Argumentative Essays
- Avoiding Plagiarism: Ethical Writing Practices

UNIT III
Introduction to Research Writing

- Drafting and Revising a Research Paper, Academic Vocabulary and Formal Tone
- Writing Reports and Case Studies
- In-text Citations and References (APA/MLA, etc.)
- Final Presentation of Research Findings

Teaching Methods:
Lectures and discussions, Writing workshops, Peer review and group feedback and Use of digital tools (e.g., Grammarly, Turnitin, citation generators)

Recommended Readings:

- Bailey, S. (2018). *Academic Writing: A Handbook for International Students*. Routledge.
- Swales, J. M., & Feak, C. B. (2012). *Academic Writing for Graduate Students*. University of Michigan Press.
- Graff, G., & Birkenstein, C. (2018). *They Say / I Say: The Moves That Matter in Academic Writing*. Norton.
- OWL Purdue Online Writing Lab – https://owl.purdue.edu