

DEPARTMENT OF EDUCATION

Syllabus

For

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



**Hemvati Nandan Bahuguna Garhwal (Central) University,
Srinagar, Uttarakhand**

For Students Enrolled in 2025-26 Academic Session

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

Course-wise Detail

ITEP (B.Sc. B.Ed.)		
Subject	Semester I	Semester II
Education		
Foundation	EFC-101 Evolution of Indian Education (Cr-4)	
Disciplinary		
Major		
Botany Core	DCBOT-101 Microbiology And Plant Pathology (Cr-2Th+2P)	DCBOT-201 Diversity of Cryptogams (Cr-2Th+2P)
Botany MD/ID	DMDBOT-102 Microbial Techniques (Cr 2Th+2P)	DMDBOT-202 Herbarium Methodology and Plant Nomenclature (Cr 2Th+2P)
Botany Skill	DSECBOT-103 AMSC/ Communication Skill (Cr-2) Hindi/ English/ Sanskrit	DSECBOT-203 AMSC (Cr-2) 1. Plant Nursery Development and Management 2. Basic Yoga Practices 3. Physical Education and Sports Management 4. Regional Folk lores and their Cultural Context 5. Indian Traditional Music 6. Tour and Travel Operations
Zoology Core	DCZOO-101 Animal Diversity-I (Cr-2 Th + 2 P)	DCZOO-201 Animal Diversity-II Theory (Cr-2 Th + 2 P)
Zoology MD/ID	DMDZOO- 102 Laboratory techniques in biology Cr-4	DMDZOO- 202 Basic instrumentation Cr-4
Zoology Skill	DSECZOO-103 AMSC/Communication Skill – Cr-2	DSECZOO-203 AMSC Cr-2 1. Plant Nursery Development and Management 2. Basic Yoga Practices 3. Physical Education and Sports Management 4. Regional Folk lores and their Cultural Context 5. Indian Traditional Music 6. Tour and Travel Operations
Physics Core	DCPHY-101 Mechanics and Properties of Matter (Cr-2 Th + 2 P)	DCPHY-201 Electricity and Magnetism (Cr-2 Th + 2 P)
Physics MD	DMDPHY 102 Physics of the Earth & Atmosphere (Earth Structure and Dynamics) (Cr-4)	DMDPHY 202 Physics of the Earth & Atmosphere (Foundations of Atmospheric Science) (Cr-4)
Physics Skill	DSECPHY-103 Basic Electronics Communication Skill (Cr-2)	DSECPHY-203 Testing of Electric and Electronic Components (Cr-2P)
Chemistry Core	DCCHE-101 Inorganic Chemistry -I Organic Chemistry- I (Cr-2Th + 2 P)	DCCHE-201 Physical Chemistry- I Organic Chemistry-II (Cr-2Th + 2 P)
Chemistry MD	DMDCHEM – 102 Environmental Chemistry Basic of Environmental Chemistry – I Introduction to Environmental Chemistry and Air, Water and Soil Pollutions (Cr-2Th + 2 P)	DMDCHEM – 202 Environmental chemistry Basic of Environmental Chemistry- II Introduction to Atmospheric Chemistry, Green Chemistry, Noise and Radiation Pollutions (Cr-2Th + 2 P)
Chemistry Skill	DSECCHE-103 Basic Analytical Chemistry-I (Cr-2)	DSECCHE-203 Basic Analytical Chemistry-II (Cr-2)
Mathematics Core	DCM-101 Differential Calculus Cr-4	DCM-201 Differential Equations Cr-4

Mathematics MD	DMDM-101 Foundation of Applied and Computational Mathematics: Basic Equations- Cr-4	DMDM-201 Foundation of Applied and Computational Mathematics: Basic Statistics Cr-4
Mathematics Skill	DSECM-103 Integral Calculus (Cr-2)	DSECM-203 Vector calculus (Cr-2)
Minor		
Botany		DCBOT-201 Diversity of Cryptogams (Cr-2Th+2P)
Zoology		DCZOO-201 Animal Diversity-II Theory (Cr-2Th + 2 P)
Physics		DCPHY-201 Electricity and Magnetism (Cr-2 Th + 2 P)
Chemistry		DCCHE-201 Physical Chemistry- I Organic Chemistry-II (Cr-2Th + 2 P)
Mathematics		DCM-201 Differential Equations Cr-4
Ability Enhancement & Value-Added Courses	1. EAEVAC-101 Language-I (as per the 8 th schedule of the Constitution of India) (Cr-4) 2. EAEVAC-102 Understanding India (India Ethos and Knowledge System) (Cr-2) 3. EAEVAC-103 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)
SEC		SEC- 203 Life Skills and Personality Dev. (Cr-2)
Total Credit	22	22

Students may complete one MOOC, ranging from 6 to 8 weeks, in an interdisciplinary area during any semester. The certificate of completion of the MOOC should be submitted in the eighth semester.

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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-101	Language 1 (as per the 8th schedule of the Constitution of India) (AEC)	4
3.	EAEVAC-102	Understanding India (Indian Ethos and Knowledge Systems)	2
4.	EAEVAC-103	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

- Overview of Constitutional values and educational provisions.
- Citizenship Education: Qualities of a good citizen. Education for fundamental rights and duties.
- Overview of 20th Century Committees, Commissions and Policies. UEE, RMSA, RTE Act 2009: Overview and impact.
- 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-101: Language 1 **(As per the 8th Schedule of the Constitution of India)**

Credits:4

101.1 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 their 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.

101.2 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, and 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.

101.4 Suggestive Mode of Transaction

Teaching this course will involve a mix of interactive lectures, tutorials, and practical activities, including discussions, 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.

101.5 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.

Assessments and examinations will be conducted in accordance with the criteria of HN BGU.

101.6 Suggestive Reading Materials

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

EAEVAC-102: Understanding India (Indian Ethos and Knowledge Systems)

Credits 2

102.1 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.

102.2 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.

102.3 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.

102.4 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.

102.5 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 HN BGU.

102.6 Suggestive Reading Materials

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

EAEVAC-103: Understanding and Connecting with the Environment

Credits: 2

103.1 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 that leads to balance. Through this course, pupil teachers will learn about and understand 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.

103.2 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.

103.3 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.

103.4 Suggestive Mode of Transaction

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

103.5 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.

Assessments and examinations will be conducted according to the criteria of HNBGU.

103.6 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 learners and the learning content.

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

	Subject	Course	Credits
1.	Botany Core	DCBOT-101 1. Microbiology And Plant Pathology	2+2
	Botany MD/ID	DMDBOT-102 2. Microbial Techniques	2+2
	Botany Skill	DSECBOT-103 AMSC/ Communication Skill 3. Hindi/ English/ Sanskrit	2
2.	Zoology Core	DCZOO-101 1. Animal Diversity-I	2+2
	Zoology MD/ID	DMDZOO- 102 2. Laboratory techniques in biology	4
	Zoology Skill	DSECZOO-103 3. AMSC/Communication Skill	2
3.	Physics Core	DCPHY-101 1. Mechanics and Properties of Matter	2+2
	Physics MD	DMDPHY 102 2. Physics of the Earth & Atmosphere (Earth Structure and Dynamics)	4
	Physics Skill	DSECPHY-103 Basic Electronics 3. Communication Skill	2
4.	Chemistry Core	DCCHE-101 Inorganic Chemistry -I 1. Organic Chemistry- I	2+2
	Chemistry MD	DMDCHEM – 102 2. Environmental Chemistry Basic of Environmental Chemistry – I Introduction to Environmental Chemistry and Air, Water and Soil Pollutions	2+2
	Chemistry Skill	DSECCHE-103 3. Basic Analytical Chemistry-I	2
5.	Mathematics Core	DCM-101 1. Differential Calculus	4
	Mathematics	DMDM-102	4

	MD	2. Foundation of applied and Computational Mathematics: Basic Equations	
	Mathematics Skill	DSECM-103 3. Integral Calculus	2

DCMJ-1: Disciplinary

Botany Major

DCBOT-101: Microbiology and Plant Pathology

Credits: 2

UNIT-I

History and scope of Microbiology

General account, distribution and classification of microorganisms.

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

UNIT-II [8 hours]

Introduction to the Archaea, Archaeal Cell Wall, Archaeal Lipid and Membranes, Major Archaeal Groups Bacteria– Discovery, General characteristics and cell structure; Reproduction– vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance.

UNIT- III [7 hours]

Microalgae- Distribution, Classification, Ultrastructure of algal cell, nutrition, reproduction, and economic importance. Fungi-General characteristics, nutrition, Cell wall composition, ultrastructure of Fungal Cell, life cycle, Slime moulds and water moulds, Economic importance of Fungi.

UNIT- IV [7 hours]

History of Plant Pathology. Modes of Infection and general symptoms, physiology of parasitism, defense mechanism in plants, role of environment in disease development, Disease resistance in plants. Causal organisms, symptoms, disease cycle and control of 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 Arahara, 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.

Suggested Readings

1. Brock Biology of Microorganisms, 13th edition (2012)
2. VandenHeuvel. Algae: An Introduction to Phycology, Cambridge University Press, Cambridge (1997)
3. Webster, J. 1985. Introduction to Fungi. Cambridge University Press.
4. Stainier, R.Y. General Microbiology 5th edition (2009) Mc Millan Press Ltd., Hound Mills.
5. Talaro, K.P., Chess, B., 2011. Foundation in Microbiology. 8th edition. McGraw-Hill
6. Willey JM, Sherwood L, Woolverton CJ (2013) Prescott's Microbiology, 9th edition, McGraw-Hill, New York
7. Agrios, G.N., 1988. Plant Pathology, Academic Press, London.
8. Lucas, John, A., 1998. Plant Pathology and Plant Pathogens, Wiley-Blackwell, CRC Press
9. Singh, R.S. Plant diseases, 9th edition (2009). Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.

SOLS/BOT/DSC(Major)-1(P)Microbiology and Plant Pathology (Practical)

Credits: 2

1. Laboratory safety and good laboratory practices
2. EMs/Models of viruses– T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.
3. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; Binary Fission; Conjugation; Structure of root nodule.
4. Staining method of microorganisms
5. Study of Nostoc, Chlamydomonas, Chlorella and Diatoms
6. Study of Rhizopus, Penicillium, Aspergillus, Alternaria, Ustilago and Puccinia (Asexual stage from temporary mounts and sexual structures through permanent slides).
7. 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

Botany MD/ID DMDBOT-102: Microbial Techniques

Credits: 2

UNIT- I

Microscopy and specimen preparation

Principles of bright-field and fluorescence microscopy, Preparation and Staining of Specimens, Scanning and Transmission Electron Microscopy: Basics and preparation of specimens, Introduction to Confocal Microscopy and Scanning Probe.

UNIT-II

Culture techniques and measurement of microbial growth

Culture media for bacteria, microalgae and Fungi. Sterilisation process, Principles and applications of autoclave, biosafety cabinets and Incubators, Batch and Continuous Cultures, Growth Curve, Microbial growth behaviour in batch system, Influence of environmental factors on growth.

UNIT-III

Spectrophotometry and Centrifugation

UV-Visible and Fluorescence Spectrophotometry and its applications in microbial research, Differential and Density gradient centrifugation, Ultracentrifugation.

UNIT-IV

Chromatography and other techniques

Paper Chromatography, Column Chromatography, TLC, HPLC and Ion-exchange chromatography. X-ray crystallography, PCR, AGE, PAGE and SDS-PAGE, Isolation and purification of genomic DNA, plasmid and proteins.

Suggested readings:

1. Dubey R C (2013) A Text Book of Biotechnology, 4th edition, S Chand & Co Ltd, New Delhi.
2. Green M R, Sambrook J (2000) Molecular Cloning: A Laboratory Manual, 4th edition, Cold Spring Harbour Laboratory Press, Cold Spring Harbour.
3. Dubey R C, Maheshwari DK (2016) A Text Book of Microbiology, S Chand & Co Ltd, New Delhi.

4. Brown T A (2007) Gemones-3, 3rd edition, Garland Sci Publishing, New York.
5. Willey JM, Sherwood LM, Woolverton CJ (2014) Prescott's Microbiology, 9th edition, McGraw-Hill International, New York.

SOLS/BOT/MD/ID-1 (P) Microbial Techniques (Practical)

Credits:2 [30Hours]

1. Laboratory safety and good laboratory practices, Cleaning and Sterilisation of Glassware.
2. Preparation of media- Nutrient Agar and Broth
3. Inoculation and culturing of bacteria/microalgae in Nutrient agar and nutrient broth, Serial dilution
4. Study and enumeration of soil bacteria/microflora using MPN
5. Preparation of agar slant, stab, agar plate
6. Isolation and pure culture techniques
7. Isolation of lactic acid bacteria from curd.
8. Isolation of nitrogen-fixing bacteria from root nodules of legumes.
9. Study of natural microalgal community
10. Study of the growth of unicellular microorganisms by cell counting/turbidometry
11. Pathological specimens of Loose smut of wheat, Late blight of potato, White rust of crucifer, Stem gall of Coriander, Red rot of sugarcane, Slides of uredial, telial, pycnial & aecial stages of Puccinia, and a few viral and bacterial plant diseases.

Botany Skill

DSECBOT-103: AMSC/ Communication Skill

Credits: 2

'Communication Skills' course will be offered in Hindi, English and Sanskrit Languages. Students may opt for any one language to study the course.

Zoology Major

DCZOO-101: Animal Diversity-I Theory

Credit:2 [30hours]

UNIT I. Introduction to Non-Chordata

General characters; Outline classification up to Classes.

Protozoa: Salient features; Study of locomotion and nutrition in Protozoa.

UNIT-II Origin of Metazoa.

Porifera: Salient features; Study of the canal system in Syconoid sponges.

Coelenterata: Salient features; Alternation of generations in Coelenterates.

UNIT-III.

Helminthes: Salient features;

Parasitic adaptations in helminths.

Annelida: Salient features; Types and significance of coelom; Metamerism and its significance;

Trochophore larva and its significance.

UNIT-IV.

Arthropoda: Salient features; Zoological importance of Peripatus and Limulus; Economic importance of arthropods.

Mollusca: Salient features; Torsion; Pearl formation.

Echinodermata: Salient features; Study of the water vascular system in starfish.

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)

Credits: 2

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

Zoology MD/ID

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

Credit:2 [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 [7 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, Measuring Mass: Analytical balance, Weighing, tarring [7 Hours]

UNIT- III.

Study the parts of a compound microscope- eyepiece and objective lens, condenser lens, mirror, stage, coarse and fine adjustment knobs, and their basic functions. Micrometry- Measuring microscopic organisms, measuring cell size in permanent slides, viz., protozoan, microscopic invertebrates, egg diameter, etc. Recording of microscopic images and videos using a microscopic camera [8 Hours]

UNIT- IV.

Museum preparation- Preserving macroscopic organisms (invertebrate and vertebrate specimens). Permanent slide preparation: basic histological and histochemical techniques, 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 [8 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

SOLS/ZOO/MD/ID-1 (P) Laboratory Techniques in Biology (Practical)

2 Credits [30Hours]

1. Preparation of an Aqueous Solution of a Given Molarity.
2. pH Adjustment of a Buffer Solution, demonstrating the use of a pH meter and safe handling of acids/bases.
3. Performing a serial dilution of a stock protein solution.
4. Use of Pipettes, Micropipettes and pipet-aid devices.
5. Measurement of mass: demonstration of tarring, weighing, and transferring.
6. Preparation of a Buffer Solution of Specific Normality.
7. Study and Identification of Compound Microscope Parts.
8. Demonstration of Micrometre for Measuring the Diameter of a Microscopic Organism.
9. Preparation of Permanent Slides

Zoology Skill

DSECZOO-10: AMSC/ Communication Skill

Credits: 2

‘Communication Skills’ course will be offered in Hindi, English and Sanskrit Languages. Students may opt for any one language to study the course.

Major Physics

DCPHY-101: Mechanics and Properties of Matter Theory (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, Centre of mass, system of variable mass, escape velocity, motion of the rocket, Newton’s Law of Gravitation, Gravitational field, potential and potential energy, Gravitational potential and field intensity for spherical shell, solid sphere and circular disc, Kepler’s laws for planetary motion.

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.

Elasticity: Hooke's law, Elastic potential energy, Young's modulus, Bulk modulus, modulus of rigidity, Poisson's ratio, relation between elastic constants, Torsion of a cylinder, bending of a beam, cantilever, shape of Girders.

Fluid Mechanics: Surface Tension and surface energy, Excess pressure inside a curved surface, Rise of liquid in a capillary tube, Flow of liquid, equation of continuity, Bernoulli's theorem, viscosity, Flow of liquid through a capillary, Poiseuille's formula, Capillaries in series and parallel, Stokes' law.

Reference Books:

1. Fundamentals of Physics: R. Resnick, D. Halliday & J. Walker, Wiley.
2. Mechanics: D.S. Mathur and P.S. Hemne, S. Chand Publications.
3. Fundamentals of Mechanics: J. C. Upadhyaya, Himalayan Publication.
4. Mechanics and General Properties of Matter: P. K. Chakraborty, Books and Allied Pvt. Ltd.
5. Elements of mechanics: Prakash & Agrawal, Pragati Prakashan. Meerut.
6. University Physics: F.W. Sears, M.W. Zemanski, H.D. Young, Addison-Wesley
7. Mechanics: Berkeley Physics course, V.1 – C. Kittel et al., Tata McGraw-Hill.
8. University Physics: Ronald Lane Reese, Thomson Brooks/Cole.

DSC-I: Mechanics and Properties of Matter (Practical)

Credits – 02

List of Experiments:

1. To determine the Moment of Inertia of a Flywheel.
2. To determine the Moment of Inertia of an irregular body by the Inertia Table
3. To determine the Young's Modulus by the Bending of Beam Method.
4. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
5. To determine the Modulus of Rigidity by the static method
6. To determine g by 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.

DMDPHY 102: Physics of the Earth & Atmosphere (Earth Structure and Dynamics)

Credit:4

Earth's Structure & Internal Processes:

Earth's size, mass, density distribution, Seismic waves (P & S waves, surface waves), interior layering (crust, mantle, core), Heat flow, geothermal gradient, sources of internal heat (radioactivity, residual heat), Mantle convection and plate tectonics (mechanisms and surface expressions)

Solid Mechanics & Surface Dynamics:

Elastic and inelastic rock properties, stress, strain, rheology, Faulting, earthquakes, deformation processes (creep, fracture), Hydrological flow, groundwater movement, Darcy's law, stream and sediment dynamics, glacier motion, erosion, waves, tides

Gravity & Geodesy:

Earth's gravity field, geoid, gravity anomalies, isostasy, Gravimetric methods for structural mapping and resource detection, Geodetic measurements, Earth shape, plate motions, precise surveying techniques

Geomagnetism, Electromagnetics & Geophysical Methods:

Earth's magnetic field, geodynamo, secular variation, palaeomagnetism, Electromagnetic surveying, resistivity, magnetotellurics for subsurface imaging, Seismoelectrics, telluric currents, and EM field theory in geophysics

Reference Books:

1. Frank D. Stacey & Subir K. Banerjee, Physics of the Earth
2. C.M.R. Fowler, The Solid Earth: An Introduction to Global Geophysics
3. Donald L. Turcotte & Gerald Schubert, Geodynamics
4. Harsh Gupta (ed.), Encyclopedia of Solid Earth Geophysics
5. Seth Stein & Michael Wyssession, An Introduction to Seismology, Earthquakes and Earth Structure.

Physics Skill

DSECPHY-103: Basic Electronics

Communication Skill

Credits: 2, 30 Hours

Vacuum Tubes: Diode, Triode, Tetrode, Pentode, and their characteristics; Conductors, insulators, and semiconductors, Intrinsic and Extrinsic Semiconductors, n-type and p-type semiconductors, Active and passive devices, Nodal and loop circuits, Thevenin theorem, Norton Theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer Theorem, Principles of CRO.

Formation and characteristics of p-n junction diode, Diffusion of charge carriers and formation of the depletion region, Breakdown voltage, Zener diode, Schottky diode, Tunnel diode, Varactor diode, Light emitting diode, Half-wave and full-wave rectifiers, L-section, T-section, and π -section filters, Regulated power supply.

Bipolar junction transistor, p-n-p and n-p-n transistors, emitter, base, and collector regions, Input and output characteristics in common base and common emitter configurations, JFET, depletion type and enhanced-type MOSFETs, Characteristics of SCR, DIAC, TRIAC, and UJT.

Reference Books:

1. Electronic Principles: A.P. Malvino, D.J. Bates, P.E. Hoppe, McGraw-Hill
2. Electricity and electronics: Saxena, Arora, and Prakash, Pragati Prakashan Meerut
3. Electronics Devices and Circuit Theory: R.L. Boylestad and L. Nashelsky, Pearson Education India
4. Principles of electrical engineering and electronics: V K Metha and Rohit Mehta, S. Chand Publication, Delhi
5. A Textbook of Basic Electronics: J.B. Gupta, Rajeev Manglik, Rohit Manglik, S.K. Kataria & Sons

Major Chemistry
Inorganic Chemistry –I, Organic Chemistry- I (Theory)
(Atomic Structure, Bonding and General Organic Chemistry)

Credits- 02

Section A: Inorganic Chemistry-1 (30 lectures)

UNIT-I

Atomic Structure:

Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Quantum mechanics, Schrödinger equation for hydrogen atom. Time-independent Schrodinger equation and the meaning of various terms in it. Significance of ψ and ψ^2 , Radial and angular parts of the hydrogenic 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. Significance of quantum numbers, orbital angular momentum and quantum numbers. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (m_s). 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.

UNIT-II

Chemical Bonding and Molecular Structure

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 hybridization 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.

UNIT-III

Section B: Organic Chemistry-1

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.

UNIT-IV

Stereochemistry

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).

UNIT-V

Aliphatic Hydrocarbons

Alkanes: (Upto 5 Carbons). Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.

Alkenes: (Upto 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. KMnO_4) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation. **Alkynes:** (Upto 5 Carbons) Preparation: Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetrahalides and dehydrohalogenation of vicinal dihalides. Reactions: formation of metal acetylides, addition of bromine and alkaline KMnO_4 , ozonolysis and oxidation with hot alk. KMnO_4 .

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
5. Structure and Reactivity, Pearson Education India, 2006.
6. Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
7. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
8. Sykes, P. A Guide book to Mechanism in Organic Chemistry, Orient Longman, New Delhi 10 (1988).
9. Eliel, E.L. Stereochemistry of Carbon Compounds, Tata McGraw Hill education, 2000.
10. Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
11. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
12. Bahl, A. & Bahl, B. S. Advanced Organic Chemistry, S. Chand, 2010.

Inorganic Chemistry –I, Organic Chemistry- I (Practical) (Atomic Structure, Bonding and General Organic Chemistry)

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 KMnO_4 .
3. Estimation of water of crystallisation in Mohr's salt by titrating with KMnO_4 .
4. Estimation of Fe (II) ions by titrating it with $\text{K}_2\text{Cr}_2\text{O}_7$ using internal indicator.
5. Estimation of Cu (II) ions iodometrically using $\text{Na}_2\text{S}_2\text{O}_3$.

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 R_f value in each case (combination of two compounds to be given).
3. 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/thin layer chromatography.
4. Identify and separate the sugars present in the given mixture by paper/thin layer chromatography.

Reference Books:

- 1 Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
- 2 Mendham, J.V ogel'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.

DMDCHEM – 102: Environmental Chemistry
Basic of Environmental Chemistry – I
(Introduction to Environmental Chemistry and Air, Water and Soil Pollutions)

Credit:2**UNIT- I: Introduction to Environmental Chemistry and Pollution**

Environmental chemistry - introduction, Environmental segments – Lithosphere: components of soils, Hydrosphere: water resources, Biosphere, Atmosphere - regions of atmosphere – Troposphere, stratosphere, mesosphere, thermosphere. Environmental pollution – Concepts and definition – Pollutant, contaminant, receptor and sink – Classification of pollutants – Global, regional, local, persistent and non-persistent pollutants.

UNIT-II. Air Pollution

Tropospheric pollution – Gaseous air pollutants – Hydrocarbons, oxides of sulphur, nitrogen and carbon – Global warming, greenhouse effect, acid rain – Particulates – Smog: London smog and photochemical smog – effects and control of photochemical smog – stratospheric pollution - depletion of ozone layer, chlorofluorocarbons - Automobile pollution. Control of air pollution – Alternate refrigerants – Bhopal Gas Tragedy.

UNIT-III. Water Pollution

Impurities in water – cause of pollution – natural and anthropogenic – Marine water pollution – Underground water pollution. Sources of water pollution – Industrial waste, Municipal waste, Agricultural waste, Radioactive waste, Petroleum, Pharmaceutical, heavy metal, pesticides, soaps and detergents. Types of water pollutants: Biological agents, physical agents and chemical agents – Eutrophication, biomagnification and bioaccumulation. Water quality parameters: DO, BOD, COD, alkalinity, hardness, chloride, fluoride and nitrate. Toxic metals in water and their effects: Cadmium, lead and mercury – Minamata disaster, itai-itai disease, oil pollution in water. International standards for drinking water.

UNIT-IV. Soil Pollution

Soil pollution: Sources by industrial and urban wastes. Pollution due to plastics, pesticides, biomedical waste, and e-waste (source, effects and control measures) – Control of soil pollution - Solid waste Management – Open dumping, landfilling, incineration, re-use, reclamation, recycle, composting. Non degradable, degradable and biodegradable wastes. Hazardous waste.

Books Suggested:

1. A. K. De, Environmental Chemistry, 7th Edn., New Age International, 2012.
2. A. K. Ahluwalia, Environmental Chemistry, The Energy and Resources Institute, 2017.
3. Balram Pani, Textbook of Environmental Chemistry, I. K. International Pvt Ltd, 2010.
4. S. K. Banergy, Environmental Chemistry, 2nd Edn., Prentice-Hall of India Pvt. Ltd., New Delhi, 2005.
5. V. N. Bashkin, Environmental Chemistry: Asian Lessons, Springer Science & Business Media, 2003.
6. S. E. Manahan, Environmental Chemistry, 8th Edn., CRC Press, Florida, 2004.
7. A. K. Ahluwalia, Environmental Chemistry, The Energy and Resources Institute, 2017.
8. Balram Pani, Textbook of Environmental Chemistry, I. K. International Pvt. Ltd., 2010.
9. S. K. Banergy, Environmental Chemistry, 2nd Edn., Prentice-Hall of India Pvt. Ltd., New Delhi, 2005.
10. J. M. H. Selendy, Water and Sanitation-Related Diseases and the Changing Environment, John Wiley & Sons, 2011.

Chemistry (M.D./I.D., Practical) Environmental Chemistry Paper Name: Basics of Environmental Chemistry (Practical)

Credits- 02

1. Estimation of the chlorine in water using Mohr's method.
2. Determine the total hardness of water.
3. Determination of the sulphate ion in water using the turbidimetric method.
4. Estimate the biochemical oxygen demand of water.
5. Determination of the pH of soil from different places using a digital pH meter.
6. Preparation of 0.1N HCl or NaOH solution.
7. Electrical conductivity measurement of soil extract (ECe).

Reference Books:

1. A Laboratory Manual for Environmental Chemistry by R. Gopalan, Amirtha Anand, R. Wilfred Sugumar, I. K. International Pvt Ltd.
2. <https://eee.poriyaan.in/topic/5--determination-of-chloride-content-of-water-sample-by-argentometric-method--mohr-s-method--10316/>
3. <chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://egyankosh.ac.in/bitstream/123456789/43328/1/Exp-6.pdf>
4. [chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://web.iitd.ac.in/~arunku/files/CEL212_Y13/Lab7%20BOD, COD.pdf](chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://web.iitd.ac.in/~arunku/files/CEL212_Y13/Lab7%20BOD,%20COD.pdf)

SKILL (CHEMISTRY) PAPER – I DSECCE-103: Basic Analytical Chemistry-I

Credits- 02

UNIT- I. 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.

UNIT- II. Analysis of soil

Composition of soil, Concept of pH and pH measurement, Complexometric 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.

UNIT- III. 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.

UNIT- IV. 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.

Reference Books:

1. Vogel's Textbook of Quantitative Chemical Analysis, Authors: J. Mendham, R.C. Denney, J.D. Barnes, M.J.K. Thomas, Edition: 6th Edition, Publisher: Pearson Education, Publication Year: 2000.
2. Fundamentals of Analytical Chemistry, Authors: Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch, Edition: 9th Edition, Publisher: Cengage Learning, Publication Year: 2013.
3. Instrumental Methods of Chemical Analysis, Author: B.K. Sharma, Edition: 2014, Publisher: Krishna Prakashan Media (P) Ltd., Publication Year: 2014.

Major Mathematics

DCM-101: Differential Calculus (Theory)

Credits: 4

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 and their applications.

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 $\sin x$, $\cos x$, e^x , $\log(1+x)$, $(1+x)^m$, Indeterminate forms.

UNIT-III

Partial Differentiation, Euler's Theorem for Homogeneous functions, Maxima and minima of functions of two variables, Tangents and normal, Cartesian and polar subtangent and subnormal, Intercepts, Length of the tangent and normal, Length of the perpendicular from the pole on tangent.

UNIT-IV

Curvature. Cartesian, polar and parametric formulae for radius of curvature Asymptotes, Singular Points. Tracing of curves. Parametric representation of curves and tracing of parametric curves, Polar coordinates and tracing of curves in polar coordinates

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.

DMDM-102: Foundation of Applied and Computational Mathematics: Basic Equations

Credits: 4

UNIT- I: Linear Equations and Systems

Linear equations in one and two variables, Solution methods: substitution, elimination, graphical, Consistency and inconsistency in systems, Applications in Real world problems

UNIT-II: Quadratic Equations

General form and nature of roots, Factorisation method, completing the square, and quadratic formula, Discriminant and root types (real, complex, repeated), Graph of a quadratic equation, Applications in physics and economics

UNIT-III: Higher Degree Polynomial Equations

Cubic and quartic equations, Rational Root Theorem and Factor Theorem, Descartes' Rule of Signs, Symmetric functions of roots, Graphical behaviour of polynomial functions

UNIT-IV

Tools: Use of GeoGebra/Python/ MATLAB

Graphical solution of linear and quadratic equations, Visualisation of roots of polynomial equations, using software to solve systems of equations, Real-life application modelling using differential equations

Course Outcomes:

After completing this course, students will be able to:

1. Identify and classify various types of equations.
2. Solve algebraic equations of different degrees using analytical methods.
3. Understand the concept of systems of equations and solve them using various techniques.
4. Apply equations in real-world contexts, including physics, chemistry, and economics.
5. Use mathematical software/tools to solve and graph equations.

Books Recommended:

1. KOC. Sinha, Algebra (Vol. I & II). R.S. Aggarwal, Higher Algebra
2. George Simmons, Differential Equations with Applications and Historical Notes
3. Schaum's Outline Series, College Algebra Teaching

Skill Course-I

DSECM-103: 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.