

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B.Sc. (ZBC)-I Year (I Semester)**  
**B050101T: Cytology, Genetics and Immunology**

**Objective:** Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles. Study responses to environmental or physiological changes, or alterations of cell function brought about by mutation for skill development, entrepreneurship and employability.

**Unit- I: Structure and Function of Cell Organelles I**

Plasma membrane: chemical structure-lipids and proteins, Cell-cell interaction: cell adhesion molecules, cellular junctions, Endomembrane system: protein targeting and sorting, endocytosis, exocytosis, Introduction to all national Biologists (Zoologists) who have contributed/contributing to Zoological and Life Sciences as a mark of tribute to ancient and modern biology will be included as part of the Continuous Internal Evaluation (CIE) for skill development. **(6 Sessions)**

**Unit- II: Structure and Function of Cell Organelles II**

Cytoskeleton: microtubules, microfilaments, intermediate filaments, Mitochondria: Structure, oxidative phosphorylation, Peroxisome and ribosome: structure and function skilling of entrepreneurship. **(6 Sessions)**

**Unit- III: Nucleus and Chromatin Structure**

Structure and function of nucleus in eukaryotes, Chemical structure and base composition of DNA and RNA, DNA supercoiling, chromatin organization, structure of chromosomes, Types of DNA and RNA for better understanding of skill. **(8 Sessions)**

**Unit- IV: Cell cycle, Cell Division and Cell Signaling**

Cell division: mitosis and meiosis, Cell cycle and its regulation, apoptosis, Signal transduction: intracellular signaling and cell surface receptors, via G-protein linked receptors, JAK-STAT pathway for understanding of entrepreneurial skill. **(8 Sessions)**

**Unit- V: Mendelism and Sex Determination**

Basic principles of heredity: Mendel's laws, monohybrid and dihybrid crosses, Complete and Incomplete Dominance, Penetrance and expressivity, Genic Sex-Determining Systems, Environmental Sex Determination, Sex Determination in Drosophila, Sex Determination in Humans, Sex-linked characteristics and Dosage compensation for skill development and employability. **(8 Sessions)**

**Unit- VI: Extensions of Mendelism, Genes and Environment**

Extensions of Mendelism: Multiple Alleles, Gene Interaction, The Interaction Between Sex and Heredity: Sex-Influenced and Sex-Limited Characteristic, Cytoplasmic Inheritance, Genetic Maternal Effects, Genomic Imprinting, Anticipation, Interaction Between Genes and Environment: Environmental Effects on Gene Expression, Inheritance of Continuous Characteristics to provide employability and skills. **(8 Sessions)**

**Unit- VII: Human Chromosomes and Patterns of Inheritance**

Human karyotype, Chromosomal anomalies: Structural and numerical aberrations with examples, Pedigree analysis, Patterns of inheritance: autosomal dominant, autosomal recessive, X-linked recessive, X-linked dominant. Employability as Genetic Counselors. **(8 Sessions)**

**Unit- VIII: Immune System and its Components**

Historical perspective of Immunology, Innate and Adaptive Immunity, Structure and functions of different classes of immunoglobulins, Hypersensitivity, Immune system: innate and adaptive immunity, clonal selection, complement system, Humoral immunity and cell mediated immunity, Immunoglobulin and T-cell receptor genes: organization of Ig gene loci, molecular mechanism of generation of antibody diversity, HLA complex:

organization, class I and II HLA molecules, expression of HLA genes this gives knowledge for better employability in medical sector. (8 Sessions)

**Course outcomes:**

The student at the completion of the course will be able to:

**CO1:** Understand the structure and function of all the cell organelles skilling of entrepreneurship.

**CO2:** Know about the chromatin structure and its location for better understanding of skill.

**CO3:** To be familiar with the basic principle of life, how a cell divides leading to the grow of an organism and also reproduces to form new organisms and how one cell communicates with its neighboring cells for entrepreneurship.

**CO4:** Understand the basic principles of genetics and how genes (earlier called factors) are inherited from one generation to another for understanding of entrepreneurial skill.

**CO5:** Understand the Mendel’s laws and the deviations from conventional patterns of inheritance for skill development.

**CO6:** Comprehend how environment plays an important role by interacting with genetic factors for employability.

**CO7:** How to detect chromosomal aberrations in humans and study the pattern of inheritance by pedigree analysis in families for employability.

**CO8:** To have an in depth understanding about Immune System & its mechanisms for understanding of entrepreneurial skill.

**PO-CO-Mapping (Please write 3, 2, 1 where ever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	1	2	1	1	1	1	3	2	2
CO2	3	3	2	2	3	1	2	2	2	2	3	3
CO3	2	2	2	3	2	1	3	1	3	3	2	2
CO4	3	3	3	1	1	1	2	1	3	1	1	3
CO5	2	2	2	1	1	1	1	1	1	1	2	2
CO6	3	2	3	2	3	2	3	1	1	1	1	3
CO7	2	3	2	3	1	3	1	1	1	1	2	3
CO8	3	2	3	2	1	2	1	1	1	1	3	2

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	2
CO2	3	1	1
CO3	2	1	3
CO4	3	1	2
CO5	2	1	3
CO6	3	3	2
CO7	2	3	3
CO8	3	2	1

**Suggested Readings:**

- 1.Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004).
2. Alberts et al: Molecular Biology of the Cell: Garland (2002).
- 3.Cooper: Cell: A Molecular Approach: ASM Press (2000).

4. Karp: Cell and Molecular Biology: Wiley (2002).
5. Lewin B. Genes VIII. Pearson (2004).
6. Watson et al. Molecular Biology of the Gene. Pearson (2004).
7. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby Kuby Immunology. W H Freeman (2007).
8. Delves Peter J., Martin Seamus J., Burton Dennis R., Roitt Ivan M. Roitt's Essential Immunology, 13th Edition. Wiley Blackwell (2017).
9. Shetty Nandini Immunology Introductory Textbook. New Age International. (2005)

**Online Resources:**

<https://dspace.uzhnu.edu.ua/jspui/bitstream/lib/2985/1/Cytology&Genetics.pdf>

<https://www.youtube.com/watch?v=GTqhxOz1lxA>

<https://jamanetwork.com/journals/jama/article-abstract/252124>

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

[https://www.youtube.com/watch?v=CgdOa33O\\_7w](https://www.youtube.com/watch?v=CgdOa33O_7w)

<https://www.youtube.com/watch?v=mdYjo5IZyOE>

**Note: Latest editions of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B.Sc. (ZBC)-I Year (I Semester)**  
**B050102P: Cell Biology & Cytogenetics Lab**

**Objective:** The main Goal of this course is to share the knowledge to the students about the experiments. The students will get a better understanding of the concept studied by them in theory course and correlate with experimental observations for skill development, entrepreneurship and employability.

**Unit-I**

1. To study different cell types such as buccal epithelial cells, neurons, striated muscle cells using Methylene blue.
2. To study the different stages of Mitosis in root tip of onion.
3. To study the different stages of Meiosis in grasshopper testis.
4. To prepare molecular models of nucleotides, amino acids, dipeptides using bead and stick method.
5. To check the permeability of cells using salt solution of different concentrations (15 Sessions)  
to provide employability and skills.

**Unit-II**

1. To study different mammalian blood cell types using Leishman stain.
2. Determination of ABO Blood group.
3. Cell counting and viability test from splenocytes of farm bred animals/cell lines.
4. Enumeration of red blood cells and white blood cells using Haemocytometer. (15 Sessions)  
For understanding of entrepreneurial skill.

**Unit-III**

1. Study of mutant phenotypes of Drosophila.
2. Preparation of polytene chromosomes.
3. Study of sex chromatin (Barr bodies) in buccal smear and hair bud cells (Human).
4. Preparation of human karyotype and study the chromosomal aberrations with respect to number, translocation, deletion etc. from the pictures provided.
5. To prepare family pedigrees for skill development and employability. (15 Sessions)

**Unit-IV**

**Virtual Labs**

<https://www.vlab.co.in>  
<https://zoologysan.blogspot.com>  
[www.vlab.iitb.ac.in/vlab](http://www.vlab.iitb.ac.in/vlab)  
[www.onlinelabs.in](http://www.onlinelabs.in)  
[www.powershow.com](http://www.powershow.com)  
<https://vlab.amrita.edu>  
<https://sites.dartmouth.edu>

**Course outcomes:**

At the completion of the course students will learn hands-on:

- CO1:** To use simple and compound microscopes, to prepare slides and stain them to see the cell organelles skilling of entrepreneurship.
- CO2:** To be familiar with the basic principle of life, how a cell divides leading to the growth of an organism and also reproduces to form new organisms better understanding of skill.
- CO3:** The chromosomal aberrations by preparing karyotypes and know how chromosomal aberrations are inherited in humans by pedigree analysis in families for skill development and employability.
- CO4:** The antigen-antibody reaction for employability.

**PO-CO-Mapping (Please write 3, 2, 1 where ever required)****(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	3	1	1	1	1	1	3	3	2
CO2	3	3	2	2	3	3	2	2	3	2	2	3
CO3	2	2	3	3	1	2	1	1	2	1	1	2
CO4	3	3	2	2	1	1	3	1	1	1	2	2

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)****(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	3
CO2	3	1	1
CO3	2	3	2
CO4	2	3	2

**Suggested Readings:**

1. Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004).
2. Alberts et al: Molecular Biology of the Cell: Garland (2002).
3. Cooper: Cell: A Molecular Approach: ASM Press (2000).
4. Karp: Cell and Molecular Biology: Wiley (2002). Pierce B. Genetics. Freeman (2004).
5. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby Kuby Immunology. WH Freeman (2007).
6. Kesar, Saroj and Vashishta N. (2007). Experimental Physiology: Comprehensive Manual. Heritage Publishers, New Delhi.

**Note: Latest editions of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B. Sc. (ZBC)-I Year (I Semester)**  
**B040101T: Microbiology & Plant Pathology**

**Objective:** The objective of this course to enhance the knowledge of the students about viruses, bacteria and fungi, their classification, structure, growth and their economic importance for skill development.

**Unit – 1**

**(08 Sessions)**

**Introduction to Indian Ancient**, Vedic and heritage Botany and contribution of Indian Botanists, in context with the holistic development of modern science and technology, has to be taught, practiced and accessed via class interaction/ assignments / self-study mentioned under Continuous Internal Evaluation(CIE) for skill development.

**Microbial Techniques & instrumentation**

Microscopy – Light, phase contrast, electron, scanning and transmission electron microscopy, staining techniques for light microscopy, sample preparation for electron microscopy. Common equipments of microbiology lab and principle of their working – autoclave, oven, laminar air flow, centrifuge. Colorimetry and spectrophotometry, immobilization methods, fermentation and fermenters for skill development.

**Unit – 2**

**(08 Sessions)**

**Microbial world**

Cell structure of Eukaryotic and prokaryotic cells, Gram positive and Gram negative bacteria, Structure of a bacteria; Bacterial Chemotaxis and Quorum sensing, Bacterial Growth curve, factors affecting growth of microbes; measurement of growth; Batch culture, fed batch culture and continuous culture; Synchronous growth of microbes; Sporulation and reproduction and recombination in bacteria;

Viruses, general characteristics, viral culture, Structure of viruses, Bacteriophages, Structure of T4 & λ-phage; Lytic and Lysogenic cycles, viroids, Prions & myco&phytoplasma, Actinomycetes & plasmids and their economic uses for skill development.

**Unit – 3**

**(07 Sessions)**

**Phycology**

Range of thallus organization in Algae, Pigments, Reserve food –Reproduction - Classification and life cycle of – *Nostoc*; *Chlorella*, *Volvox*, *Oedogonium*, *Chara*; *Sargassum* , *Ectocarpus*, *Polysiphonia*

Economic importance of algae - Role of algae in soil fertility- biofertilizer – Nitrogen fixation- Symbiosis; Commercial products of algae –biofuel, Agar for skill development.

**Unit – 4**

**(07 Sessions)**

**Mycology**

General characteristics, nutrition, life cycle, Economic importance of Fungi, Classification upto class. Distinguishing characters of Myxomycotina: General characters. Zygomycotina– *Rhizopus*, Ascomycotina: *Saccharomyces*, *Penicillium*, *Peziza*, Basidiomycotina- *Ustilago*, *Puccinia*, *Agaricus*; Deuteromycotina – *Fusarium*, *Alternaria*, Heterothallism, Physiological specialization, Heterokaryosis

& Parasexuality for skill development.

**Unit – 5**

**(07 Sessions)**

**Mushroom Cultivation, Lichenology & Mycorrhiza for skill development**

Mushroom cultivation.

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

**Unit – 6**

**(07 Sessions)**

**Plant Pathology**

Disease concept, Symptoms, Etiology & causal complex, Primary and secondary inoculum, Infection, Pathogenicity and pathogenesis, Koch's Postulates. Mechanism of infection (Brief idea about Pre-penetration, Penetration and Post-penetration), Disease cycle (monocyclic, polycyclic and polyetic). Defense mechanism with special reference to Phytoalexin, Resistance- Systemic acquired and Induced systemic. fungicides- Bordeaux mixture, Lime sulphur, Tobacco decoction, Neem cake & oil for skill development.

**Unit – 7**

**(08 Sessions)**

**Diseases and Control**

Symptoms, Causal organism, Disease cycle and Control measures of – Early & Late blight of Potato, Brown spot of rice, Black stem rust of wheat, Stem rot of Mustard, Red rot of Sugarcane, Wilting of Arhar, mosaic diseases on tobacco and cucumber, yellow vein mosaic of bhindi; citrus canker, little leaf of brinjal; damping off of seedlings, Disease management: - Quarantine, Chemical, Biological, Integrated pest disease management for skill development.

**Unit – 8**

**(08 Sessions)**

**Applied Microbiology**

Food fermentations and food produced by microbes, amino acids, Production of antibiotics, enzymes, vitamins, alcoholic beverages, organic acid & genetic recombinant vaccines. Mass production of bacterial biofertilizers, blue green algae, Azolla and mycorrhiza. Plant growth promoting rhizobacteria & biopesticides—Trichoderma sp. and Pseudomonas, Single cell proteins, Organic framing inputs, Microbiology of water, Biopolymers, Bioindicators, biosensors, Bioremediation, Production of biofuels, biodegradation of pollutants and biodeterioration of materials & Cultural Property for skill development.

**Course outcomes:** After the completion of the course the students will be able to:

- CO1** Develop understanding about the classification and diversity of different microbes including viruses, Algae, Fungi & Lichens & their economic importance for enhancement of global knowledge.
- CO2** Develop conceptual skill about identifying microbes, pathogens, biofertilizers & lichens for skill development.
- CO3** Gain knowledge about developing commercial enterprise of microbial products for global skill development.
- CO4** Learn host-pathogen relationship and disease management for skill development and entrepreneurship.

- CO5** Learn Presentation skills (oral & writing) in life sciences by usage of computer of computer & multimedia for global skill development and entrepreneurship.
- CO6** Gain knowledge about uses of microbes in various fields for skill development.
- CO7** Understand the structure and reproduction of certain selected bacteria algae, fungi and lichens for enhancement of global knowledge.
- CO8** Gain knowledge about the economic values of this lower group of plant community for skill development at local level.

**PO-CO Mapping (Please write 3, 2, 1 wherever required)**

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	1	1	3	1	1	3	1	1	1	1	1	3
<b>CO2</b>	1	3	2	1	1	3	1	1	1	1	3	3
<b>CO3</b>	1	3	3	1	1	2	1	1	1	1	1	3
<b>CO4</b>	1	1	3	1	1	1	1	3	1	1	3	3
<b>CO5</b>	1	1	3	1	1	1	1	1	1	1	3	3
<b>CO6</b>	3	1	3	1	1	1	1	1	1	3	1	2
<b>CO7</b>	1	1	3	1	1	1	1	1	1	1	1	1
<b>CO8</b>	1	1	3	1	1	2	1	3	1	1	1	1

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)**

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	2
CO5	3	1	2
CO6	3	1	1
CO7	3	1	1
CO8	3	1	1

**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). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
4. Aggarwal, S. K. 2009. Foundation Course in Biology, A one books Pvt. Ltd., New Delhi.
5. Aneja, K. R. 1993. Experiments in Microbiology, Pathology and Tissue Culture, Vishwa Prakashan, New Delhi.



6. Annie Ragland, 2012. Algae and Bryophytes, Saras Publication, Kanyakumari, India.
7. Basu, A. N. 1993. Essentials of Plant Viruses, Vectors and Plant diseases, New Age International, New Delhi.
8. Chopra. G. L. 1984. A text book of Algae, Rastogi publications, Meerut, India.
9. Desikachari, T. V. 1959. Cyanophyta, ICAR, New Delhi.
10. Dubey, R. C. and Maheshwari. D.K. 2012. Practical Microbiology, S. Chand & Company, Pvt. Ltd., New Delhi.
11. Fritsch, R. E. 1977. Structure and Reproduction of Algae, Cambridge University Press, London.
12. Kodo, C.I. and Agarwal, H.O.1972. Principles and techniques in Plant Virology, Van Nostrand, Reinhold Company, New York.
13. Agrios, G.N. (1997). Plant Pathology, 4th edition. Cambridge, U.K.: Academic Press.
14. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, 4th edition. Singapore, Singapore: John Wiley & Sons.
15. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies. Noida, U.P.: Macmillan Publishers India Ltd.
16. Reven, F.H., Evert, R. F., Eichhorn, S.E. (1992). Biology of Plants. New York, NY: W.H. Freeman and Company.
17. Sharma, P.D. (2011). Plant Pathology. Meerut, U.P.: Rastogi Publication.
18. Webster, J., Weber, R. (2007). Introduction to Fungi, 3rd edition. Cambridge, U.K.: Cambridge University Press..
19. Pandey B.P. 2001. College Botany Volume 1, S Chand & Company Pvt.Ltd, NewDelhi.
20. Pandey. B.P. 2014 Modern Practical Botany, (Vol-I) S. Chand and Company Pvt. Ltd., NewDelhi.
21. Pelzar, 1963. Microbiology, Tata Mc Graw Hill, NewDelhi
22. Rangaswamy, G. 2009, Disease of Crop Plants in India, Prientice Hall of India, NewDelhi.
23. Sambamurty. A.V.S.S. 2006, A Text book of Algae, I. K. International Publishing House, Pvt. Ltd., NewDelhi.
24. Sharma, P. D. 2012, Microbiology and Plant Pathology, Rastogi Publication Pvt Ltd., Meerut, India.
25. Singh, R. P. 2007. Microbial Taxonomy and Culture Techniques, Kalyani Publication, NewDelhi.
26. Smith. G. M. 1996. Cryptogamic Botany Volume I, Tata Mc Graw Hill, NewDelhi.
27. SundarRajan. S. 2010. College Botany Volume I, Himalaya Publications, Mumbai.
28. Vashishta, B.R. Sinha, A.K. and Singh, V. P. 1991. Algae, S. Chand and Company, Pvt. Ltd., NewDelhi.

#### **Suggested equivalent online courses:**

1. <https://indianculture.gov.in/rarebooks/economic-botany-india>
2. <https://community.plantae.org/tags/moocfuturelearn.com/courses/teaching-biology-inspiring-students-with-plants-in-science>
3. <https://www.coursera.org/courses?query=plants>
4. <http://egyankosh.ac.in/handle/123456789/53530>
5. <https://www.classcentral.com/tag/microbiology>
6. <https://www.edx.org/learn/microbiology>
7. <https://www.mooclist.com/tags/microbiology>
8. <https://www.udemy.com/topic/microbiology/>

9. <https://ucmp.berkeley.edu/bacteria/bacteria.html>
10. <https://www.livescience.com/53272-what-is-a-virus.html>
11. <https://gclambathach.in/lms/Economic%20importance%20of%20Algae.pdf>
12. <https://www.slideshare.net/sardar1109/algae-notes-1>
13. <https://www.onlinebiologynotes.com/algae-general-characteristics-classification/>
14. <https://www.sciencedirect.com/topics/immunology-and-microbiology/fungus>
15. <https://ucmp.berkeley.edu/fungi/fungi.html>
16. <https://agrimoon.com/wp-content/uploads/Mashroomculture.pdf>
17. <http://ecoursesonline.iasri.res.in/mod/page/view.php?id=11293>
18. <http://www.hillagric.ac.in/edu/coa/ppath/lect/plpath111/Lect.%201%20%20Introduction-PI%20Path%20111.pdf>
19. [http://www.jnkvv.org/PDF/11042020102651plant\\_pathology.pdf](http://www.jnkvv.org/PDF/11042020102651plant_pathology.pdf)
21. <https://www.apsnet.org/edcenter/disimpactmngmnt/topc/EpidemiologyTemporal/Pages/ManagementStrategies.aspx>
22. <https://learn.saylor.org/course/view.php?id=23&sectionid=6821>
23. [https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microscopyhttp://physics.fe.uni-lj.si/students/predavanja/Microscopy\\_Kulkarni.pdf](https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microscopyhttp://physics.fe.uni-lj.si/students/predavanja/Microscopy_Kulkarni.pdf)
24. <https://lipidnanostructuresgroup.weebly.com/>
25. <https://zoology4civilservices.wordpress.com/2016/06/18/65/>
26. <https://microbenotes.com/laminar-flow-hood/>

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B. Sc. (ZBC)-I Year (I Semester)**  
**B040102P: Techniques in Microbiology & Plant Pathology**

**Objective:** The course aims to share the knowledge to the students about the experiments. The students will get a better understanding of the concept studied by them in theory course and correlate with experimental observations for skills of employability and entrepreneurship.

**Unit-1 (INSTRUMENTS & TECHNIQUES)**

**(07 Sessions)**

- Laboratory safety and good laboratory practices
- Principles and application of Laboratory instruments-microscope, incubator, autoclave, centrifuge, LAF, filtration unit, shaker, pH meter.
- Buffer preparation & titration
- Cleaning and Sterilization of glass-wares
- Preparation of media- Nutrient Agar and Broth
- Inoculation and culturing of bacteria in Nutrient agar and nutrient broth
- Preparation of agar slant, stab, agar plate
- Phenol Coefficient method to test the efficacy of disinfectants to develop skill of employability.

**Unit-2 (BACTERIAL IDENTIFICATION)**

**(08 Sessions)**

- Isolation of bacteria.
- Identification of bacteria.
- Staining techniques: Gram's, Negative, Endospore, Capsule and Cell Wall.
- Cultural characteristics of bacteria on NA.
- Pure culture techniques (Types of streaking).
- Biochemical characterization: IMViC test, Carbohydrate fermentation test, Mannitol motility test,
- Gelatin liquefaction test, Urease test, Nitrate reduction test, Catalase test, Oxidase test, Starch hydrolysis, Casein hydrolysis for skill development and employability.

**Unit-3 (MYCOLOGICAL STUDY)**

**(08 Sessions)**

- Isolation of different fungi: Saprophytic, Coprophilous, Keratinophilic.
- Identification of fungi by lactophenol cotton blue method. *Rhizopus Saccharomyces, Penicillium, Peziza, Ustilago, Puccinia; Fusarium, Curvularia, Alternaria.*
- *Agaricus*: Specimens of button stage and full grown mushroom; Sectioning of gills of *Agaricus*.
- Lichens: crustose, foliose and fruticose specimens for skill development.

**Unit-4 (PHYCOLOGY)**

**(07 Sessions)**

- Type study of algae and Cyanobacteria –*Spirullina, Nostoc.*
- Chlorophyceae - *Chlorella, Volvox, Oedogonium, Cladophora, and Chara*
- Xanthophyceae – *Vaucheria*
- Bacillariophyceae – *Pinnularia*
- Phaeophyceae – *Sargassum*
- Rhodophyceae – *Polysiphonia* for skill development

**Unit-5 (EXPERIMENTAL PLANT PATHOLOGY) (08 Sessions)**

- Preparation of fungal media (PDA) & Sterilization process.
- Isolation of pathogen from diseased leaf.
- Identification: Pathological specimens of Brown spot of rice, Bacterial blight of rice, Loose smut of wheat, Stem rot of mustard, Late blight of potato; Slides of uredial, telial, pycnial & Aecial stages of Puccinia, Few viral and bacterial plant diseases for skill development and employability.

**Unit-6 (PRACTICALS IN APPLIED MICROBIOLOGY-1) (08 Sessions)**

- Isolation of nitrogen fixing bacteria from root nodules of legumes.
- Enumeration of rhizosphere to non rhizosphere population of bacteria.
- Isolation of antagonistic *Pseudomonas* from soil.
- Microscopic observations of root colonization by VAM fungi.
- Isolation of *Azospirillum* sp. from the roots of grasses.
- Isolation of phyllosphere microflora.
- Isolation of P solubilizing microorganisms for skill development.

**Unit-7 (PRACTICALS IN APPLIED MICROBIOLOGY-2) (08 Sessions)**

- Wine production.
- Isolation of lactic acid bacteria from curd.
- Isolation of lipolytic organisms from butter or cheese.
- Immobilized bacterial cells for production of hydrolytic enzymes.
- Enzyme production and assay – cellulase, protease and amylase.
- Immobilization of yeast.
- Isolation of cellulolytic and anaerobic sulphate reducing bacteria.
- Isolation and characterization of acidophilic, alkalophilic and halophilic bacteria for skill development.

**Unit-8 (06 Sessions)**

- Cultivation of *Spirulina*, & *Chlorella* in lab for biofuel
- Visit to NBAIM, Mau, Varanasi(Kashi)/IMT, Chandigarh for viewing Culture Repository
- Visit to biofertilizers and biopesticides unit to understand about the Unit operation procedures
- Mushroom cultivation for Protein
- Alcohol production from Sugarcane Juice for skill development and entrepreneurship.

**Course outcomes:** After the completion of the course the students will be able:

- CO1** Understand the instruments, technique, lab etiquettes and good lab practices for working in a microbiology laboratory for enhancement of global knowledge and entrepreneurship.
- CO2** Develop skills for identifying microbes and using them for local Industrial, Agriculture and Environment purposes.
- CO3** Practical skills in the field and laboratory experiments in Microbiology & Pathology to provide employability at national level.

- CO4** Learn to identify Algae, Lichens and plant pathogens along with their Symbiotic and Parasitic associations for skill development.
- CO5** Have the knowledge of Gram staining technique for skill development.
- CO6** Gain knowledge on fixation, dehydration, hand sectioning, microtome sectioning for enhancement of global knowledge.
- CO7** Observe and identify the microbes, algae and fungi for skill development.
- CO8** Can initiate his own Plant & Seed Diagnostic Clinic Can start own enterprise on microbial products for skill development and entrepreneurship at local level.

**PO-CO Mapping (Please write 3, 2, 1 wherever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	3	1	1	3	1	1	1	1	1	3
CO2	1	3	1	1	1	3	1	1	1	1	3	3
CO3	1	3	3	1	1	1	1	1	1	1	1	3
CO4	1	1	3	1	1	1	1	3	1	1	3	3
CO5	1	1	3	1	1	1	1	1	1	1	3	1
CO6	1	1	3	1	1	1	1	1	1	1	1	1
CO7	3	1	3	1	1	1	1	1	1	1	1	1
CO8	3	1	3	1	1	1	1	3	1	1	1	1

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	2
CO2	3	1	2
CO3	3	1	2
CO4	3	1	3
CO5	3	1	3
CO6	3	1	1
CO7	3	1	1
CO8	3	1	1

**Suggested Readings:**

1. Practical Botany (Part I) ISBN #:81-301-0008-8 Sunil D Purohit, Gotam K Kukda & Anamika Singhvi Edition:2013 Apex Publishing House Durga Nursery Road, Udaipur, Rajasthan (bilingual)
2. Modern Mushroom Cultivation And Recipes (hindi) (hb)ISBN : 9788177545180Edition : 01Year : 2017Author : Singh Riti , Singh UC Publisher : Agrobios(India)
3. Biofertilizer Production Manual (hindi) (hb) ISBN : 9788177541274Edition : 01Year : 2014Author : Gehlot D Publisher : Agrobios (India)Language :Hindi
4. Aneja, K. R. 1993. Experiments in Microbiology, Pathology and Tissue Culture, VishwaPrakashan, New Delhi.
5. Dubey, R. C. and Maheshwari. D.K. 2012. Practical Microbiology, S. Chand & Company, Pvt.

Ltd., New Delhi.

6. Kodo, C.I. and Agarwal, H.O.1972. Principles and techniques in Plant Virology, Van Nostrand, Reinhold Company, NewYork.
7. MadhaveeLatha, P. 2012, A Textbook of Immunology, S. Chand & Company Pvt. Ltd., NewDelhi.
8. Pandey. B.P. 2014 Modern Practical Botany, (Vol-I) S. Chand and Company Pvt. Ltd., NewDelhi.
9. Sambamurty. A.V.S.S. 2006, A Text book of Algae, I. K. International Publishing House, Pvt.Ltd.,
10. Singh, R. P. 2007. Microbial Taxonomy and Culture Techniques, Kalyani Publication, NewDelhi.
11. <https://agrimoon.com/wp-content/uploads/Mashroom-culture.pdf>
12. <http://nhb.gov.in/pdf/Cultivation.pdf>
13. [https://www.k-state.edu/fungi/Greeting/Publications\\_files/2006%20Handbook.pdf](https://www.k-state.edu/fungi/Greeting/Publications_files/2006%20Handbook.pdf)
14. Sen, Surjit,Acharya, Krishnendu, Rai, Manjula 2019 IBSN - 978-93-88347-23-5 - Biofertilizers and Biopesticides.Technoworld,kolkatta
15. <http://www.kvkkendrapara.org/pdf/Bio%20Fertilizer%20Production%20and%20marketing.pdf>
16. <http://www.gbv.de/dms/tib-ub-hannover/751302945.pdf>
17. Hochman,Gal,Zilberman,David 2014 IBSN-1461493285-Algae Farming and Its Bio-ProductsSpringer
18. Gokare A. Ravishankar , Ranga Rao Ambati 2019 Handbook of Algal Technologies and Phytochemicals Volume II: Phycoremediation, Biofuels and Global Biomass Production Print ISBN:9780367178192
19. Amos Richmond Ph.D., Prof. Emeritus, Qiang Hu Ph.D 2013. Handbook of Microalgal Culture: Applied Phycology and Biotechnology, Second Edition Print ISBN:9780470673898

**IFTM University, Moradabad**  
**Bachelor of Science (Chemistry) Programme**  
**B.Sc. (ZBC) I Year I Semester**  
**Course Code: B020101T**  
**Course Title: Fundamentals of Chemistry**

**Objectives:**

Periodic trends, arising from the arrangement of the periodic table, provide students with an invaluable tool to quickly predict an element's properties. Reaction mechanism gives the fundamental knowledge of carrying out an organic reaction in a step-by-step manner. Students will enrich skill development to provide a broad foundation in chemistry that stresses scientific reasoning and analytical problem solving with a molecular perspective.

**UNIT – I: Molecular polarity and Weak Chemical Forces (10 Sessions)**

Introduction to Indian ancient Chemistry and contribution of Indian Chemists, in context to the holistic development of modern science and technology. Resonance and resonance energy, formal charge, Van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interaction, dipole moment and molecular Structure (Diatomic and polyatomic molecules), Percentage ionic character from dipole moment, polarizing power and polarizability. Fajan's rules and consequences of polarization. Hydrogen bonding, van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interaction. Effects of weak chemical forces, melting and boiling points, solubility, energetics of dissolution process. Lattice energy and Born-Haber cycle, solvation energy, and solubility of ionic solids.

**UNIT – II: Simple Bonding theories of Molecules (10 Sessions)**

Atomic orbitals, Aufbau principle, multiple bonding ( $\sigma$  and  $\pi$  bond approach) and bond lengths, the valence bond theory (VBT), Concept of hybridization, hybrid orbitals and molecular geometry, Bent's rule, Valence shell electron pair repulsion theory (VSEPR), shapes of the following simple molecules and ions containing lone pairs and bond pairs of electrons:  $\text{H}_2\text{O}$ ,  $\text{NH}_3$ ,  $\text{PCl}_5$ ,  $\text{SF}_6$ ,  $\text{SF}_4$ ,  $\text{ClF}_3$ ,  $\text{I}_3^-$ ,  $\text{ClF}_2^-$  and  $\text{SO}_4^{2-}$  and  $\text{H}_3\text{O}^+$ . Molecular orbital theory (MOT). Molecular orbital diagrams bond orders of homonuclear and heteronuclear diatomic molecules and ions ( $\text{N}_2$ ,  $\text{O}_2$ ,  $\text{C}_2$ ,  $\text{B}_2$ ,  $\text{F}_2$ ,  $\text{CO}$ ,  $\text{NO}$ , and their ions).

**UNIT – III: Periodic properties of Atoms (with reference to s & p-block) (05 Sessions)**

Brief discussion, factors affecting and variation trends of following properties in groups and periods. Effective nuclear charge, shielding or screening effect, Slater rules, Atomic and ionic radii, Electronegativity, Pauling's/ Allred Rochow's scales, Ionization enthalpy, Electron gain enthalpy.

**UNIT – IV: Recapitulation of basics of Organic Chemistry (05 Sessions)**

Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bonding, Van der Waals interactions, inclusion compounds, Clathrates, Charge transfer complexes, hyperconjugation, Dipole moment; Electronic Displacements: Inductive, electromeric, resonance mesomeric effects and their applications. Importance of general organic chemistry in development of employability in research and academic sector.

**UNIT – V: Mechanism of Organic Reactions (10 Sessions)**

Curved arrow notation, drawing electron movements with arrows, half-headed and double-headed arrows, homolytic and heterolytic bond fission, Types of reagents – electrophiles and nucleophiles, Types of organic reactions, Energy considerations. Reactive intermediates – Carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples). Assigning formal charges on intermediates and other ionic species. Methods of determination of reaction mechanism (product analysis, intermediates, isotope effects, kinetic and stereochemical studies), Importance of organic reactions and intermediates in development of employability.

**UNIT – VI: Stereochemistry****(10 Sessions)**

Concept of isomerism, Types of isomerism; Optical isomerism – elements of symmetry, molecular chirality, enantiomers, stereogenic center, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centers, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomer, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. Geometric isomerism – determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism – conformational analysis of ethane and n-butane; conformations of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivatives, Newman projection and Sawhorse formulae, Fischer and flying wedge formulae, Difference between configuration and conformation. Importance of stereochemistry in development of employability in research and development.

**UNIT – VII: Basic Computer system (in brief)****(05 Sessions)**

Hardware and Software; Input devices, Storage devices, Output devices, Central Processing Unit (Control Unit and Arithmetic Logic Unit); Number system (Binary, Octal and Hexadecimal Operating System); Computer Codes (BCD and ASCII); development of skills for Numeric/String constants and variables. Operating Systems (DOS, WINDOWS, and Linux); Software languages: Low level and High Level languages (Machine language, Assembly language; QBASIC, FORTRAN and C++); Software Products (Office, chemsketch, scilab, matlab, hyperchem, etc.), internet application.

**UNIT – VIII: Mathematical Concepts for Chemistry****(05 Sessions)**

Logarithmic relations, curve sketching, linear graphs and calculation of slopes, differentiation of functions like  $Kx$ ,  $e^x$ ,  $X^n$ ,  $\sin x$ ,  $\log x$ ; maxima and minima, partial differentiation and reciprocity relations, Integration of some useful/relevant functions; permutations and combinations, Factorials, Probability.

**Course outcomes:**

Students completing this course will gain an understanding of

CO1: Molecular geometries, physical and chemical properties of the molecules.

CO2: Current bonding models for simple inorganic and organic molecules in order to predict structures and important bonding parameters.

CO3: The arrangement of elements in the periodic table and their periodic properties.

CO4: The most primary and utmost important knowledge and concepts of organic Chemistry.

CO5: A broader theoretical picture in multiple stages in an overall chemical reaction as well as reactive intermediates and transition states.

CO6: The clear picture of two-dimensional and three-dimensional structure of the molecules, and their role in reaction mechanism.

CO7: Skill development to understand the concepts of basic computer system, its components, operating systems and computer language for employability at local and national level.

CO8: Mathematical concepts such as logarithmic relations, differentiation and integration etc. which are useful to learn chemistry

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)****(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	2	3	2	3	3	2	1
CO2	3	3	3	3	1	2	1	1	3	2	1	2
CO3	3	2	3	2	2	2	2	3	3	2	2	2



<b>CO4</b>	3	2	3	3	2	3	2	2	1	1	3	2
<b>CO5</b>	3	3	3	3	3	2	2	2	2	2	3	3
<b>CO6</b>	3	2	2	3	2	2	2	3	2	1	3	2
<b>CO7</b>	2	3	3	2	1	1	3	1	2	3	2	1
<b>CO8</b>	2	3	3	2	2	2	3	3	2	3	2	1

### CO-Curriculum Enrichment Mapping

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
<b>CO1</b>	3	2	1
<b>CO2</b>	3	2	1
<b>CO3</b>	3	2	2
<b>CO4</b>	3	2	1
<b>CO5</b>	3	2	1
<b>CO6</b>	3	2	2
<b>CO7</b>	3	2	1
<b>CO8</b>	3	1	1

### Suggested Readings:

1. Lee, J.D. Concise Inorganic Chemistry, Pearson Education 2010
1. 2. Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K. Inorganic Chemistry, Principles of Structure and Reactivity, Pearson Education 2006.
2. Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970
3. Shriver, D.D. & P. Atkins, Inorganic Chemistry 2nd Ed., Oxford University Press, 1994.
4. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications 1962.
5. Singh J., Yadav L. D. S., Advanced Organic Chemistry, Pragati Edition
6. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
7. Carey, F. A., Giuliano, R. M. Organic Chemistry, Eighth edition, McGraw Hill Education, 2012.
8. Loudon, G. M. Organic Chemistry, Fourth edition, Oxford University Press, 2008.
9. Clayden, J., Greeves, N. & Warren, S. Organic Chemistry, 2<sup>nd</sup> edition, Oxford University Press, 2012.
10. Graham Solomons, T.W., Fryhle, C. B. Organic Chemistry, John Wiley & Sons, Inc.
11. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003

### Suggested online links:

- <http://heecontent.upsdc.gov.in/Home.aspx> 12
- <https://nptel.ac.in/courses/104/106/104106096/>
- <http://heecontent.upsdc.gov.in/Home.aspx>
- <https://nptel.ac.in/courses/104/106/104106096/>
- <https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm>
- <https://nptel.ac.in/courses/104/103/104103071/#>

**Note: Latest edition of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B.Sc. (ZBC) I Year I Semester**  
**Course Code: B020102P**  
**Course Title: Quantitative Analysis**

**Objectives:** The objective of this course is to develop skills about the chemical experiments, properly carrying out of the experiments, and appropriately record and analyze the results. Students will be able to use standard laboratory equipment, modern instrumentation, and classical techniques to carry out experiments. Students will know and follow the proper procedures and regulations for safe handling and use of chemicals to development of employability skills.

**UNIT – I: Water Quality analysis** **(16 Sessions)**

1. Estimation of hardness of water by EDTA.
2. Determination of chemical oxygen demand (COD).
3. Determination of Biological oxygen demand (BOD).

**UNIT – II: Estimation of Metals ions** **(14 Sessions)**

1. Estimation of ferrous and ferric by dichromate method.
2. Estimation of copper using thiosulphate.

**UNIT – III: Estimation of acids and alkali contents** **(14 Sessions)**

1. Determination of acetic acid in commercial vinegar using NaOH.
2. Determination of alkali content – antacid tablet using HCl.
3. Estimation of oxalic acid by titrating it with KMnO<sub>4</sub>.

**UNIT – IV: Estimation of inorganic salts and hydrated water** **(16 Sessions)**

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of calcium content in chalk as calcium oxalate by permanganometry.
3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO<sub>4</sub> Importance of titrimetric methods in development of employability in research and development.

**Course outcomes:**

Students completing this course will be able to gain knowledge and skills to understand the laboratory methods for:

CO1: Portability tests of water samples

CO2: Estimation of metals ions.

CO3: Development of skills for estimation of acids and alkali contents in commercial products for employability at local level

CO4: Estimation of inorganic salts and hydrated water in samples

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)**  
**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	3	2	3	3	3	2	2	2	2	1	3
<b>CO2</b>	3	3	2	3	3	3	2	1	2	2	2	3
<b>CO3</b>	3	3	2	3	2	1	2	2	2	2	3	2
<b>CO4</b>	3	3	2	3	2	2	2	2	1	2	3	3

## CO-Curriculum Enrichment Mapping

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	3	3
CO2	3	3	2
CO3	3	3	2
CO4	3	3	1

### Suggested Readings:

1. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
2. Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007) Chapters3-5.
3. Harris, D. C. *Exploring Chemical Analysis*, 9th Ed. New York, W.H. Freeman, 2016.
4. Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age International Publisher, 2009.
5. Skoog, D.A. Holler F.J. and Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Edition

### Suggestive online links

- <https://www.labster.com/chemistry-virtual-labs/>
- <https://www.vlab.co.in/broad-area-chemical-sciences>
- <http://chemcollective.org/vlabs>

**Note: Latest edition of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**Co-curricular course**  
**B.Sc. (ZBC) I Year I Semester**  
**Course Title: Food, Nutrition and Hygiene**

Programme/Class: Certificate	Year: First	Semester: First
Co-Curricular Course		
Course Code: Z010101T	Course Title: Food, Nutrition and Hygiene	
Course outcomes:		
<ul style="list-style-type: none"> <li>• To learn the basic concept of the Food and Nutrition</li> <li>• To study the nutritive requirement during special conditions like pregnancy and lactation</li> <li>• To learn meal planning</li> <li>• To learn 100 days Nutrition Concept</li> <li>• To study common health issues in the society</li> <li>• To learn the special requirement of food during common illness</li> </ul>		
Credits: 2		Compulsory
Max. Marks: 25+75		Min. Passing Marks:
Total No. of Lectures- Tutorials- Practical (in hours per week): L-T-P:2-0-0		
Unit	Topics	No. of Lectures Total=30
<b>I</b>	Concept of Food and Nutrition (a) Definition of Food, Nutrients, Nutrition, Health, balanced Diet (b) Types of Nutrition- Optimum Nutrition, under Nutrition, Over Nutrition (c) Meal planning- Concept and factors affecting Meal Planning (d) Food groups and functions of food	8
<b>II</b>	Nutrients: Macro and Micro RDA, Sources, Functions, Deficiency and excess of (a) Carbohydrate (b) Fats	7
	(c) Protein (d) Minerals Major: Calcium, Phosphorus, Sodium, Potassium Trace: Iron, Iodine, Fluorine, Zinc (e) Vitamins Water soluble vitamins: Vitamin B, C Fat soluble vitamins: Vitamin A, D, E, K (f) Water (g) Dietary Fibre	
<b>III</b>	1000 days Nutrition (a) Concept, Requirement, Factors affecting growth of child (b) Prenatal Nutrition (0 - 280 days): Additional Nutrients' Requirement and risk factors during pregnancy (c) Breast / Formula Feeding (Birth – 6 months of age) Complementary and Early Diet (6 months – 2 years of age)	8

<b>IV</b>	<p>Community Health Concept</p> <p>(a) Causes of common diseases prevalent in the society and Nutrition requirement in the following:</p> <ul style="list-style-type: none"> <li>Diabetes</li> <li>Hypertension (High Blood Pressure)</li> <li>Obesity</li> <li>Constipation</li> <li>Diarrhea</li> <li>Typhoid</li> </ul> <p>(b) National and International Program and Policies for improving Dietary Nutrition</p> <p>(c) Immunity Boosting Food</p>	7
<p><b>Suggested Readings:</b></p> <ol style="list-style-type: none"> <li>1. Singh, Anita, "Food and Nutrition", Star Publication, Agra, India, 2018.</li> <li>2. 1000Days-Nutrition_Brief_Brain-Think_Babies_FINAL.pdf</li> <li>3. <a href="https://pediatrics.aappublications.org/content/141/2/e20173716">https://pediatrics.aappublications.org/content/141/2/e20173716</a></li> <li>4. <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5750909/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5750909/</a></li> <li>5. Sheel Sharma, Nutrition and Diet Therapy, Peepee Publishers Delhi, 2014, First Edition.</li> </ol>		
<p>Suggested Continuous Evaluation Methods: MCQs, Practical Diet/ Meal Planning, assignments Presentations, group Discussion, Case study, Survey</p>		
<p>Suggested equivalent online courses: <a href="https://www.udemy.com/course/internationally-accredited-diploma-certificate-in-nutritionDiplomain Human Nutrition-Revised Offered by Alison">https://www.udemy.com/course/internationally-accredited-diploma-certificate-in-nutritionDiplomain Human Nutrition-Revised Offered by Alison</a></p>		

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B.Sc. (ZBC) -I Year (II Semester)**  
**B050201T: Biochemistry and Physiology**

**Objective:** Students will understand the structure of biomolecules and the mechanism for the formation of simple molecules together resulting into complex macromolecules and also to explore the complex network of these functional components for skill development and employability.

**Unit-I: Structure and Function of Biomolecules**

Structure and Biological importance of carbohydrates (Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates), Lipids (saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids, Steroids) Structure, Classification and General properties of  $\alpha$ -amino acids, Essential and non-essential  $\alpha$ -amino acids, Levels of organization in proteins, Simple and conjugate proteins provide employability and skills

**(8 Sessions)**

**Unit-II- Enzyme Action and Regulation**

Nomenclature and classification of enzymes, Cofactors, Specificity of enzyme action, Isozymes, Mechanism of enzyme action, Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions; Derivation of Michaelis Menten equation, Concept of  $K_m$  and  $V_{max}$ , Lineweaver-Burk plot; Enzyme inhibition, Allosteric enzymes and their kinetics; Regulation of enzyme action skilling of entrepreneurship.

**(8 Sessions)**

**Unit-III-Metabolism of Carbohydrates and Lipids**

Metabolism of Carbohydrates: glycolysis, citric acid cycle, gluconeogenesis, phosphate pentose pathway, Glycogenolysis and Glycogenesis, Lipids - Biosynthesis of palmitic acid; Ketogenesis,  $\beta$ -oxidation and omega - oxidation of saturated fatty acids with even and odd number of carbon atoms better understanding of skill.

**(8 Sessions)**

**Unit-IV: Metabolism of Proteins and Nucleotides** Catabolism of amino acids: Transamination, Deamination, Urea cycle Nucleotides and vitamins, Review of mitochondrial respiratory chain, Oxidative phosphorylation, and its regulation for employability.

**(6 Sessions)**

**Unit-V: Digestion and Respiration**

Structural organization and functions of gastrointestinal tract and associated glands, Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins, Histology of trachea and lung, Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood Respiratory pigments, Dissociation curves and the factors influencing it; Control of respiration for understanding of entrepreneurial skill.

**(7 Sessions)**

**Unit-VI: Circulation and Excretion**

Components of blood and their functions, Haemostasis: Blood clotting system, Blood groups: Rh factor, ABO and MN, Structure of mammalian heart, Cardiac cycle; Cardiac output and its regulation, Electrocardiogram, Blood pressure and its regulation Structure of kidney and its functional unit; Mechanism of urine formation for entrepreneurship.

**(8 Sessions)**

**Unit-VII: Nervous System and Endocrinology**

Structure of neuron, resting membrane potential, Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers, Types of synapse, Endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; hormones secreted by them, Classification of hormones; Mechanism of Hormone action for skill development, entrepreneurship and employability.

**(8 Sessions)**

### Unit-VIII: Muscular System

Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor unit, summation and tetanus for skill development and employability. (7 Sessions)

#### Course outcomes:

The student at the completion of the course will learn:

**CO1:** To develop a deep understanding of structure of biomolecules like proteins, lipids and carbohydrates provide employability and skills.

**CO2:** How simple molecules together form complex macromolecules better understanding of skill.

**CO3:** To understand the thermodynamics of enzyme catalyzed reactions for understanding of entrepreneurial skill .

**CO4:** Mechanisms of energy production at cellular and molecular levels entrepreneurship and employability.

**CO5:** To understand systems biology and various functional components of an organism skilling of entrepreneurship.

**CO6:** To acquire the knowledge hormonal disorders for employability.

**CO7:** To explore the complex network of these functional components for skill development.

**CO8:** To comprehend the regulatory mechanisms for maintenance of function in the body better understanding of skill.

**PO-CO-Mapping (Please write 3, 2, 1 where ever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	3	2	1	3	1	2	1	1	2
CO2	3	3	3	2	3	3	2	1	3	3	1	2
CO3	2	1	2	2	2	2	3	2	4	2	3	3
CO4	3	2	2	3	3	1	2	1	2	1	1	2
CO5	2	2	3	2	2	2	3	3	3	1	1	1
CO6	3	3	2	3	3	1	2	1	2	1	1	2
CO7	2	2	3	2	3	1	2	2	1	3	3	3
CO8	3	1	2	3	2	1	4	1	1	1	1	1

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	Skill Development	Employability	Entrepreneurship Development
CO1	3	3	1
CO2	3	1	2
CO3	3	1	1
CO4	1	3	3
CO5	3	1	2
CO6	1	3	1
CO7	3	1	1
CO8	2	1	1

#### Suggested Readings:

1. Nelson & Cox: Lehninger's Principles of Biochemistry: McMillan (2000)
2. Zubay *et al*: Principles of Biochemistry: WCB (1995)
3. Voet & Voet: Biochemistry Vols 1 & 2: Wiley (2004)

4. Murray *et al.*: Harper's Illustrated Biochemistry: McGraw Hill (2003) Elliott and Elliott: Biochemistry and Molecular Biology: Oxford University Press
5. Guyton, A.C. & Hall, J.E. Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company. (2006).
6. Tortora, G.J. & Grabowski, S. Principles of Anatomy & Physiology. XI Edition John Wiley & sons (2006).
7. Christopher D. Moyes, Patricia M. Schulte. Principles of Animal Physiology. 3rd Edition, Pearson Education (2016).
8. Hill, Richard W., et al. Animal physiology. Vol. 2. Sunderland, MA: Sinauer Associates, (2004).
9. Chatterjee C C Human Physiology Volume 1 & 2. 11th edition. CBS Publishers (2016).

**Online Resources:**

<https://www.youtube.com/watch?v=rD7DqDVrbV8>

<https://www.khanacademy.org/test-prep/mcat/biomolecules>

<https://www.qmul.ac.uk/library/media/library/using-the-library/media-folder-images-library/Principles-Of-Biochemistry-Introductory-Series.pdf>

[https://www.coabnau.in/uploads/1619759828\\_Biochem.2.1.pdf](https://www.coabnau.in/uploads/1619759828_Biochem.2.1.pdf)

[https://webstor.srmist.edu.in/web\\_assets/srm\\_mainsite/files/downloads/Introduction\\_To\\_Biochemistry.pdf](https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/downloads/Introduction_To_Biochemistry.pdf)

**Note: Latest editions of all the suggested readings must be used.**



**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B.Sc. (ZBC) -I Year (II Semester)**  
**B050202P: Physiological, Biochemical & Hematology Lab**

**Objective:** To make the study relevant, interesting, encouraging to the students to join the industry or to prepare them for higher studies including research. The syllabus is based on a basic and applied approach to ensure that students develop problem solving skills, laboratory skills, team skills as well as ethics for skill development, entrepreneurship and employability.

**Unit-I:** Estimation of haemoglobin using Sahli's haemoglobinometer, Preparation of haemin and haemochromogen crystals, Recording of blood pressure using a sphygmomanometer, Recording of blood glucose level by using glucometer, Preparation of molecular models of amino acids, dipeptides etc. employability in medical sector. **(15 Sessions)**

**Unit-II:** Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid, Recording of simple muscle twitch with electrical stimulation (or Virtual), Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex) provide employability and skills. **(15 Sessions)**

**Unit-III:** Ninhydrin test for  $\alpha$ -amino acids, Benedict's test for reducing sugar and iodine test for starch, Test for sugar and acetone in urine, Qualitative tests of functional groups in carbohydrates, proteins and lipids, Paper chromatography of amino acids, Action of salivary amylase under optimum conditions for entrepreneurship and employability. **(15 Sessions)**

**Unit- IV: Virtual Labs**

1. <https://www.vlab.co.in>
2. <https://zoologysan.blogspot.com>
3. [www.vlab.iitb.ac.in/vlab](http://www.vlab.iitb.ac.in/vlab)
4. [www.onlinelabs.in](http://www.onlinelabs.in)
5. [www.powershow.com](http://www.powershow.com)
6. <https://vlab.amrita.edu>
7. <https://sites.dartmouth.edu>

**Course outcomes:**

The student at the completion of the course will be able to:

**CO1:** Understand the structure of biomolecules like proteins, lipids and carbohydrates for understanding of entrepreneurial skill.

**CO2:** Perform basic hematological laboratory testing for employability.

**CO3:** Distinguish normal and abnormal hematological laboratory findings to predict the diagnosis of hematological disorders and diseases for skill development and employability.

**PO-CO-Mapping (Please write 3, 2, 1 where ever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	2	3	2	3	1	2	2	1	3
CO2	2	1	2	1	1	1	1	2	1	1	2	2
CO3	2	2	1	2	2	2	1	1	1	2	3	3

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	3
CO2	1	3	1
CO3	3	3	2

**Suggested Readings:**

1. Cox, M.M and Nelson, D.L. (2008). Lehninger's Principles of Biochemistry, V Edition, W.H. Freeman and Co., New York.
2. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). Biochemistry, VI Edition, W.H. Freeman and Co., New York.
3. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.
4. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons
5. Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins.
6. Arey, L.B. (1974). Human Histology. IV Edition. W.B. Saunders.
7. Kesar, Saroj and Vashishta N. (2007). Experimental Physiology: Comprehensive Manual. Heritage Publishers, New Delhi.

**Note: Latest editions of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B. Sc. (ZBC)-I Year (II Semester)**  
**B040201T: Archegoniates and Plant Architecture**

**Objective:** The course aims to have the understanding of classification, diversity, vegetative growth, reproduction methods algae and amphibians of plant kingdom (bryophytes), Another objective of this course is to understand their evolution, distribution, economic and ecological importance of these plants for skill development.

**Unit – 1** **(07 Sessions)**

**Introduction to Archegoniates & Bryophytes**

Unique features of archegoniates, Bryophytes: General characteristics, adaptations to land habit, Range of thallus organization. Classification (up to family), Morphology, Anatomy and Reproduction of *Riccia*, *Marchantia*, *Anthoceros* and *Sphagnum*. (Developmental details not to be included). Economic importance of bryophytes for skill development.

**Unit – 2** **(08 Sessions)**

**Pteridophytes**

General characteristics, Early land plants (*Rhynia*). Classification (up to family) with examples, Heterospory and seed habit, Stelar evolution, economic importance of Pteridophytes for skill development.

**Unit – 3** **(08 Sessions)**

**Gymnosperms**

Classification and distribution of gymnosperms; Salient features of Cycadales, Ginkgoales, Coniferales and Gnetales, their examples, structure and reproduction; economic importance for skill development.

**Unit – 4** **(08 Sessions)**

**Palaeobotany**

General account of Cycadofilicales, Bennettitales and Cordaitales; Geological time scale; Brief account of process of fossilization & types of fossils and study techniques, Contribution of Birbal Sahni for skill development.

**Unit – 5** **(07 Sessions)**

**Angiosperm Morphology (Stem, Roots, Leaves & Flowers, Inflorescence)**

Morphology and modifications of roots; Stem, leaf and bud. Types of inflorescences; flowers, flower parts, fruits and types of placentation; Definition and types of seeds for skill development.

**Unit – 6** **(07 Sessions)**

**Plant Anatomy**

Meristematic and permanent tissues, Organs (root, stem and leaf). Apical meristems & theories on apical organization - Apical cell theory, Histogen theory, Tunica - Corpus theory. Secondary growth - Root and stem- cambium (structure and function) annular rings, Anomalous secondary growth -

*Bignonia, Boerhaavia, Dracaena, Nyctanthus* for skill development.

**Unit – 7**

**(08 Sessions)**

**Reproductive Botany**

Plant Embryology, Structure of microsporangium, microsporogenesis, Structure of megasporangium and its types, megasporogenesis, Structure and types of female gametophyte, types of pollination, Methods of pollination, Germination of pollen grain, structure of male gametophyte, Fertilization, structure of dicot and monocot embryo, Endosperm, Double fertilization, Apomixis and Polyembryony for skill development.

**Unit – 8**

**(07 Sessions)**

**Palynology**

Pollen structure, pollen morphology, pollen allergy, Applied Palynology: Basic concepts, Palaeopalynology, Aeropalynology, Forensic palynology, Role in taxonomic evidences for skill development.

**Course outcomes:** After the completion of the course the students will be able to:

- CO1** Develop critical understanding on morphology, anatomy and reproduction of Bryophytes for enhancement of global knowledge.
- CO2** Develop critical understanding on morphology, anatomy and reproduction of Pteridophytes for skill development.
- CO3** Develop critical understanding on morphology, anatomy and reproduction of Gymnosperms for enhancement of global knowledge.
- CO4** Understanding of plant evolution and their transition to land habitat for skill development.
- CO5** Understand morphology, anatomy, reproduction and developmental changes therein through typological study and create a knowledge base in understanding the basis of plant diversity, economic values & taxonomy of plants for skill development at local level.
- CO6** Understand the meristems and role in plant development; primary structure of root, stem and leaf for skill development.
- CO7** Compare normal secondary growth and abnormal secondary growth for skill development.
- CO8** Understand the details of external and internal structures of flowering plants for skill development at local level.

**PO-CO Mapping (Please write 3, 2, 1 wherever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	1	1	3	1	1	1	1	2	3
CO2	1	3	1	1	1	3	1	1	1	1	3	3
CO3	1	3	3	1	1	2	1	1	1	1	1	3
CO4	1	1	3	1	1	1	1	3	1	1	3	3
CO5	1	1	3	1	1	1	1	1	1	1	3	3
CO6	3	1	3	1	3	1	1	1	1	1	1	2
CO7	3	1	3	1	3	2	1	1	1	1	1	2
CO8	3	1	3	1	3	1	1	1	1	1	1	1

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)****(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	<b>Skill Development</b>	<b>Employability</b>	<b>Entrepreneurship Development</b>
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1
CO6	3	1	1
CO7	3	1	1
CO8	3	1	1

**Suggested Readings:**

1. Gangulee H. S. and K. Kar 1992. College Botany Vol. I and II. (New Central Book Agency)
2. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
3. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.
4. Rashid A (1999) An Introduction to Pteridophyta, Vikas Publishing House Pvt. Ltd. New Delhi.
5. Sharma OP (1990) Textbook of Pteridophyta. MacMillan India Ltd. Delhi.
6. Vashishtha BR, Sinha AK and Kumar A (2010) Botany for Degree Students – Pteridophyta, S. Chand and Company,
7. Vashishtha BR, Sinha AK and Kumar A (2010) Botany for Degree Students – Gymnosperms, S. Chand and
8. Parihar NS (1976) Biology and Morphology of Pteridophytes. Central Book Depot.
9. Bhatnagar SP (1996) Gymnosperms, New Age International Publisher.
10. Pandey BP (2010) College Botany Vol II S. Chand and Company, New Delhi
11. Maheswari, P. 1971. An Introduction to Embryology of Angiosperms. McGraw Hill Book Co., London
12. Bhattacharya et. al. 2007. A textbook of Palynology, Central, New Delhi.
13. Bhojwani, S.S. and S. P. Bhatnagar. 2000. The Embryology of Angiosperms (4th Ed.), Vikas Publishing House,.
14. P.K.K. Nair- A textbook of Palynology.
15. Johri, B. M. 1984. Embryology of Angiosperms. Springer-Verlag, Berlin.
16. Dutta A.C. 2016. Botany for Degree Students. Oxford University Press.
17. E.J. Eames . Morphology of Vascular Plants, Standard University Press.
18. Dickinson, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA.
19. Fahn, A. (1974). Plant Anatomy. Pergamon Press, USA.
20. Evert, R.F. (2006) Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc.

**Suggested equivalent online courses:**

1. <https://www.anbg.gov.au/bryophyte/what-is-bryophyte.html>
2. <https://pteridoportal.org/portal/index.php><https://www.conifers.org/zz/gymnosperms.php>
3. <http://www.mobot.org/MOBOT/research/APweb/><https://milneorchid.weebly.com/plant-id-for-beginners.html><https://www.botany.org/PlantImages/PlantAnatomy.php>
4. <http://webapp1.dlib.indiana.edu/inauthors/view?docId=VAC0868&doc.view=print>
5. <https://palynology.org/>
6. <http://www2.estrellamountain.edu/faculty/farabee/biobk/Biobookflowers.html>
7. <https://www.sciencelearn.org.nz/resources/100-plant-reproduction><https://palaeobotany.org/>

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B. Sc. (ZBC)-I Year (II Semester)**  
**B040202P: Land Plants Architecture**

**Objective:** The course aims to share the knowledge to the students about the experiments. The students will get a better understanding of the concept studied by them in theory course and correlate with experimental observations for skill development.

**Unit-1 (Bryophytes) (08 Sessions)**

- *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).
- *Sphagnum*- morphology, W.M. leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, L.S. capsule and protonema for skill development.

**Unit-2 (Pteridophytes) (07 Sessions)**

- *Lycopodium*: Habit, stem T. S. , Strobilus V. S.,
- *Selaginella*: Habit, rhizophore T.S., stem T.S., axis with strobilus, V.S. of strobilus, Megasporophyll and microsporophyll.
- *Equisetum* - Habit, rhizome and stem T.S. and .S. of Strobilus.
- *Azolla* – Habitat & its structure for skill development

**Unit-3 (Gymnosperms) (08 Sessions)**

- *Cycas* – seedling, coralloid root and coralloid root T. S., T. S. of leaflet and Rachis, micro and mega sporophyll, male cone V. S., micro sporophyll T. S. , entire and V. S. of ovule..
- *Pinus* - Branch of indefinite growth, spur shoot, T. S of old stem and needle R. L .S and T. L. S. of stem, male and female cone, V .S. of male and female cone.
- *Ephedra & Thuja* - Habit, stem T. S (young and mature), leaf T. S, male and female strobilus, V. S. of male and female cone, ovule V. S. and seed for skill development.

**Unit-4 (Palaeobotany & Palynology) (06 Sessions)**

- Morphology of Rhynia and fossils gymnosperms & other groups
- Visit to Birbal Sahni Institute of Palaeobotany or virtual conference with their scientists to learn fossilization
- Mark and know about Indian geographical sites rich in plant fossils for skill development.

**Unit-5 (Angiosperm Morphology) (08 Sessions)**

- To study of diversity in leaf shape, size and other foliar features.
- To study monopodial and sympodial branching.
- Morphology of Fruits
- Inflorescence types- study from fresh/ preserved specimens

- Flowers- study of different types from fresh/ preserved specimens
- Fruits- study from different types from fresh/preserved specimens
- Study of ovules (permanent slides/ specimens/photographs)- types (anatropous, orthotropous, amphitropous and campylotropous) for skill development.
- Modifications in Roots, stems, leaves and inflorescences

#### **Unit-6 (Plant Anatomy)**

**(08 Sessions)**

- Normal & Anomalous secondary thickening - *Bignonia, Dracaena, Boerhavia diffusa, Nyctanthus*
- Study of primary and secondary growth in root and stem of monocots and dicots by section cutting and permanent slides.
- Study of internal structure of dicot and monocot leaves.
- Study of structure of stomata for skill development.

#### **Unit-7 (Reproductive Botany)**

**(08 Sessions)**

- Structure of anther, microsporogenesis and pollen grains
- Structure of ovule and embryo sac development (through slides).
- Study of embryo development in monocots and dicots.
- Vegetative propagation by means of cutting, budding and grafting exercises.
- Study of seed germination.
- Study of pollen morphology of the following plants –*Hibiscus, Vinca, Balsam, Ixora, Crotalaria, Bougainvillea* by microscopic observation.
- Calculation of pollen viability percentage using in vitro pollen germination techniques for skill development.

#### **Unit-8 (Commercial Uses and Production technology)**

**(07 Sessions)**

- Azolla production
- Production technology of Resins
- Production and propagation of Ornamental Pteris, Cycadales, Coniferales for landscaping.
- Lab method for qualitative testing/ extraction of Ephedrine, Taxol and Thuja oil for skill development.

**Course outcomes:** After the completion of the course the students will be able:

- CO1** The students will be made aware of the group of plants that have given rise to land habit and the flowering plants. Through local field study they will be able to see these plants grow in nature and become familiar with the biodiversity for skill development.
- CO2** Students would learn to create their small digital reports where they can capture the zoomed in and zoomed out pictures as well as videos in case they are able to find some rare structure or phenomenon related to these plants for skill development at local level.
- CO3** Develop an understanding by observation and table study of representative members of phylogenetically important groups to learn the process of evolution in a broad sense for enhancement of global knowledge.
- CO4** Understand morphology, anatomy, reproduction and developmental changes therein through typological study and create a knowledge base in understanding plant diversity, economic values & taxonomy of lower group of plants for skill development at local level.



- CO5** Understand the composition, modifications, internal structure & architecture of flowering plants for becoming a Botanist for skill development.
- CO6** Describe the morphology and anatomy of the vascular cryptogams and gymnosperms found at national level for skill development.
- CO7** Have understanding on evolution and affinities of Pteridophytes
- CO8** Have understanding on evolution and affinities of Gymnosperms for enhancement of global knowledge.

**PO-CO Mapping (Please write 3, 2, 1 wherever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	1	1	3	1	1	1	1	1	3
CO2	1	3	1	1	1	3	1	1	1	1	3	3
CO3	1	3	3	1	1	1	1	1	1	1	1	3
CO4	1	1	3	2	1	1	1	3	1	1	3	3
CO5	1	1	3	1	1	1	2	1	1	1	3	3
CO6	2	3	3	1	1	1	1	1	1	2	1	1
CO7	2	3	3	1	1	1	1	1	1	1	1	1
CO8	2	3	3	1	1	1	1	1	1	1	1	1

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1
CO6	3	1	1
CO7	3	1	1
CO8	3	1	1

**Suggested Readings:**

1. Pandey, BP and Trivedi, P.S. 1997. Botany Vol. I (10th edition). Vikas Publishing House.
2. Pandey, BP; Misra; Trivedi, P.S. 1997. Botany Vol. II. Vikas Publishing House.
3. Pandey, BP and Chadha. 1997. Botany Vol. III. Vikas Publishing House.
4. Santra, SC and Chatterjee. 2005. College Botany Practical Vol. I. New Central Book Agency (P) Ltd.
5. Kumar, S and Kashyap. 2003. Manual of Practical Algae. Campus Books International, New

Delhi

6. Bendre and Kumar A text book of Practical Botany. Vol. I, II, Rastogi Pub. Meerut.
7. Suresh Kumar, Amar Singh Kashyap Manual of Practical Algae. Campus Books Internet. New Delhi.
8. Santra, SC. 2005. College Botany Practical Vol. II. New Central Book Agency (P) Ltd.

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B.Sc. (ZBC) I Year II Semester**  
**Course Code: B020201T**  
**Course Title: Bioorganic and Medicinal Chemistry**

**Objectives:** This course will equip students to develop skills to understand biomolecules. Students can understand the physiological function that regulates the proper growth and development of a human body. This course aims to introduce the students with basic experimental understanding of carbohydrates, amino acids, proteins, nucleic acids and medicinal chemistry. Importance of medicinal plants for employability and entrepreneurship.

**UNIT – I: Chemistry of Carbohydrates (10 Sessions)**

Classification of carbohydrates, reducing and non-reducing sugars, General Properties of Glucose and Fructose, their open chain structure. Epimers, mutarotation and anomers. Mechanism of mutarotation Determination of configuration of Glucose (Fischer's proof).Cyclic structure of glucose. Haworth projections.Cyclic structure of fructose .Interconversions of sugars (ascending and descending of sugar series, conversion of aldoses to ketoses). Lobry de Bruyn-van Ekenstein rearrangement; stepping-up (Kiliani-Fischer method) and stepping-down (Ruff's & Wohl's methods) of aldoses; end-group-interchange of aldoses Linkage between monosachharides, structure of disacharrides (sucrose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation. Importance of carbohydrates in development of employability in research and development.

**UNIT – II: Chemistry of Proteins (10 Sessions)**

Classification of amino acids, zwitter ion structure and Isoelectric point. Overview of primary, secondary, tertiary and quaternary structure of proteins. Determination of primary structure of peptides, determination of N-terminal amino acid (by DNFB and Edman method) and C-terminal amino acid (by thiohydantoin and with carboxypeptidase enzyme).Synthesis of simple peptides (upto dipeptides) by N-protection & C-activating groups and Merrifield solid phase synthesis. Protein denaturation/ renaturation 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 for employability opportunities in different chemical sectors.

**UNIT – III: Chemistry of Nucleic Acids (05 Sessions)**

Constituents of Nucleic acids: Adenine, guanine, thymine and Cytosine (Structure only), Nucleosides and nucleotides (nomenclature), Synthesis of nucleic acids, 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 – IV: Introductory Medicinal Chemistry (10 Sessions)**

Drug discovery, design and development; Basic Retrosynthetic approach. Drug action-receptor theory. Structure –activity relationships of drug molecules, binding role of –OH group,-NH<sub>2</sub> group, double bond and aromatic ring. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti- inflammatory agents (Aspirin, paracetamol); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide); antiviral agents (Acyclovir).

**UNIT – V: Solid State (05 Sessions)**

Definition of space lattice, unit cell. Laws of crystallography – (i) Law of constancy of interfacial angles,

(ii) Law of rationality of indices and iii) Symmetry elements in crystals and law of symmetry. X-ray diffraction by crystals. Derivation of Bragg equation. Determination of crystal structure of NaCl, KCl and CsCl (Laue's method and powder method).

#### **UNIT – VI: Introduction to Polymer**

**(10 Sessions)**

Monomers, Oligomers, Polymers and their characteristics, Classification of polymers: Natural synthetic, linear, cross linked and network; plastics, elastomers, fibres, Homopolymers and Co-polymers, Bonding in polymers: Primary and secondary bond forces in polymers ; cohesive energy, and decomposition of polymers. Determination of Molecular mass of polymers: Number Average molecular mass (M<sub>n</sub>) and Weight average molecular mass (M<sub>w</sub>) of polymers and determination by (i) Viscosity (ii) Light scattering method (iii) Gel permeation chromatography (iv) Osmometry and Ultracentrifuging.

#### **UNIT – VII: Kinetics and Mechanism of Polymerization**

**(05 Sessions)**

Polymerization techniques, Mechanism and kinetics of copolymerization, Addition or chain- growth polymerization, Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler- Natta polymerization and vinyl polymers, Condensation or step growth-polymerization, Polyesters, polyamides, phenol formaldehyde resins, urea formaldehyde resins, epoxyresins and polyurethanes, Natural and synthetic rubbers, Elementary idea of organic conducting polymers.

#### **UNIT – VIII: Synthetic Dyes**

**(05 Sessions)**

Colour and constitution (electronic Concept), Classification of dyes, Chemistry and synthesis of Methyl orange, Congo red, Malachite green, crystal violet, phenolphthalein. Application of dyes in development of employability in research and development and at industrial level.

#### **Suggested Readings:**

1. Davis, B. G., Fairbanks, A. J., *Carbohydrate Chemistry*, Oxford Chemistry Primer, Oxford University Press.
2. Finar, I. L. *Organic Chemistry (Volume 2)*, Dorling Kindersley (India) Pvt. Ltd.(Pearson Education).
3. Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry 7th Ed.*, W. H. Freeman.
4. Berg, J. M., Tymoczko, J. L. & Stryer, L. *Biochemistry 7th Ed.*, W. H. Freeman.
5. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6. Patrick, G. L. *Introduction to Medicinal Chemistry*, Oxford University Press, UK, 2013.
7. Singh, H. & Kapoor, V.K. *Medicinal and Pharmaceutical Chemistry*, VallabhPrakashan, Pitampura, New Delhi, 2012.
8. Atkins, P. W. & Paula, J. de Atkin's *Physical Chemistry Ed.*, Oxford University Press 13 (2006).
9. Ball, D. W. *Physical Chemistry Thomson Press, India (2007)*.
10. Castellan, G. W. *Physical Chemistry 4th Ed. Narosa (2004)*.
11. R.B. Seymour & C.E. Carraher: *Polymer Chemistry: An Introduction*, Marcel Dekker, Inc. New York, 1981.
12. G. Odian: *Principles of Polymerization*, 4th Ed. Wiley, 2004.
13. F.W. Billmeyer: *Textbook of Polymer Science*, 2nd Ed. Wiley Interscience, 1971.
14. P. Ghosh: *Polymer Science & Technology*, Tata McGraw-Hill Education, 1991.

#### **Course outcomes:**

Upon completion of this course students will able to:

CO1: Understand classification, nomenclature, preparation and properties of carbohydrates.

CO2: Develop skills to learn the synthesis, properties and mechanism of action of proteins.

- CO3: Learn about constitution, structure, synthesis and biological role of nucleic acids.  
 CO4: Understand the concept of drug discovery, design and development for employability at local and national level.  
 CO5: Understand the laws of crystallography and determine structure of crystals.  
 CO6: Understand the importance of macromolecules/polymers in day to day life and apply their knowledge in sustainable development.  
 CO7: Learn about the techniques involved in polymerization as well as mechanism and kinetics of polymerization  
 CO8: Learn about the preparation and properties of various kinds of dyes.

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)**  
 (Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	2	2	2	3	2	2	3	2
CO2	2	2	2	3	2	2	2	3	2	2	3	2
CO3	2	2	2	3	2	2	2	3	2	2	3	2
CO4	2	2	2	3	2	2	2	3	2	2	3	2
CO5	3	2	3	1	2	2	2	1	2	3	1	2
CO6	2	2	2	3	2	2	2	1	2	1	3	2
CO7	3	2	3	1	2	2	2	1	2	3	1	2
CO8	1	1	2	3	2	2	2	3	2	1	3	2

**CO-Curriculum Enrichment Mapping**

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	2	1
CO2	3	2	2
CO3	3	2	1
CO4	3	3	2
CO5	3	2	2
CO6	3	3	1
CO7	3	3	1
CO8	3	3	1

**Suggested online links:**

- <http://heecontent.upsdc.gov.in/Home.aspx>
- <https://nptel.ac.in/courses/104/105/104105124/>
- <https://nptel.ac.in/courses/103/106/105106204/>
- <https://nptel.ac.in/courses/104/105/104105034/>
- <https://nptel.ac.in/courses/104/103/104103121/>
- <https://nptel.ac.in/courses/104/102/104102016/>
- <https://nptel.ac.in/courses/104/106/104106106/>
- <https://nptel.ac.in/courses/104/105/104105120/>

**Note: Latest edition of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B.Sc. (ZBC) I Year II Semester**  
**Course Code: B020202P**  
**Course Title: Biochemical Analysis**

**Objectives:** This course will develop skills to provide basic qualitative and quantitative experimental knowledge of biomolecules such as carbohydrates, proteins, amino acids, nucleic acids drug molecules.

**UNIT – I: Qualitative and quantitative analysis of Carbohydrates (15 Sessions)**

1. Separation of a mixture of two sugars by ascending paper chromatography
2. Differentiate between a reducing/ non reducing sugar
3. Synthesis of Osazones.

**UNIT – II: Qualitative and quantitative analysis of Proteins, amino acids and Fats (20 Sessions)**

1. Isolation of protein.
2. Determination of protein by the Biuret reaction.
3. TLC separation of a mixture containing 2/3 amino acids
4. Paper chromatographic separation of a mixture containing 2/3 amino acids
5. To determine the concentration of glycine solution by formylation method.
6. To determine the saponification value of an oil/fat.
7. To determine the iodine value of an oil/fat

**UNIT – III: Determination and identification of Nucleic Acids (12 Sessions)**

1. Determination of nucleic acids
2. Extraction of DNA from onion/cauliflower

**UNIT – IV: Synthesis of Simple drug molecules (13 Sessions)**

1. To synthesize aspirin by acetylation of salicylic acid and compare it with the ingredient of an aspirin tablet by TLC and development of TLC methods for the purpose of employability in research and development and at industrial level.
2. Synthesis of propranolol

**Suggested Readings:**

1. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.*, Pearson (2012).
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education.
3. *Vogel's Qualitative Inorganic Analysis*, Revised by G. Svehla.
4. Vogel, A.I. *A Textbook of Quantitative Analysis*, ELBS. 1986
5. Furniss, B.S.; Hannaford, A.J.; Rogers, V.; Smith, P.W.G.; Tatchell, A.R. *Vogel's Textbook of Practical Organic Chemistry*, ELBS.
6. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry*, Universities Press
7. Cooper, T.G. *Tool of Biochemistry*. Wiley-Blackwell (1977).
8. Wilson, K. & Walker, J. *Practical Biochemistry*. Cambridge University Press (2009).
9. Varley, H., Gowenlock, A.H & Bell, M.: *Practical Clinical Biochemistry*, Heinemann,

**Course outcomes:**

Students completing this course will be able to:

CO1: Development of skills to understand the qualitative and quantitative analysis.

CO2: Determine qualitative and quantitative information for proteins, amino acids and fats for employability at local and national industrial sector.

CO3: Determine and extract nucleic acids.

CO4: Synthesize drug molecules such as propranolol, aspirin and barbituric acid.

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)**  
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	3	2	2	3	2	2	3	1
CO2	3	2	2	2	3	2	2	3	2	2	3	2
CO3	3	2	2	2	1	2	2	3	2	2	3	2
CO4	3	2	2	2	3	2	2	3	2	2	3	3

**CO-Curriculum Enrichment Mapping**

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	3	1
CO2	3	3	2
CO3	3	2	1
CO4	3	2	2

**Suggestive online links**

- <https://www.labster.com/chemistry-virtual-labs/>
- <https://www.vlab.co.in/broad-area-chemical-sciences>
- <http://chemcollective.org/vlabs>

**Note: Latest edition of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**Co-curricular course**  
**B.Sc. (ZBC) I Year II Semester**  
**Course Title: First Aid and Health**

Programme/Class: Certificate	Year: First	Semester: Second
Co-Curricular Course		
Course Code: Z020201	Course Title: First Aid and First Aid and Health	
Course outcomes:		
<ul style="list-style-type: none"> <li>• Learn the skill needed to assess the ill or injured person.</li> <li>• Learn the skills to provide CPR to infants, children and adults.</li> <li>• Learn the skills to handle emergency child birth</li> <li>• Learn the Basic sex education help young people navigate thorny questions responsibly and with confidence.</li> <li>• Learn the Basic sex education help youth to understand Sex is normal. It's a deep, powerful instinct at the core of our survival as a species. Sexual desire is a healthy drive.</li> <li>• Help to understand natural changes of adolescence</li> <li>• Learn the skill to identify Mental Health status and Psychological First Aid</li> </ul>		
Credits:2(1Theory+1Practical)		Compulsory
Max.Marks:25+75		Min. Passing Marks:
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:2-0-0		
Unit	Topics	No. of Lectures Total = 15Theory + 30Practical
I	<p><b>A. Basic First Aid</b></p> <ul style="list-style-type: none"> <li>• Aims of first aid &amp; First aid and the law.</li> <li>• Dealing with an emergency, Resuscitation (basic CPR).</li> <li>• Recovery position, Initial to pto to essessment.</li> <li>• Hand washing and Hygiene</li> <li>• Types and Content of a First aid Kit</li> </ul> <p><b>B. First AID Technique</b></p> <ul style="list-style-type: none"> <li>• Dressings and Bandages.</li> <li>• Fast evacuation techniques (single rescuer).</li> <li>• Transport techniques.</li> </ul> <p><b>C. First aid related with respiratory system</b></p> <ul style="list-style-type: none"> <li>• Basics of Respiration.</li> </ul>	2 (Theory) 10 (Practical)
	<ul style="list-style-type: none"> <li>• No breathing or difficult breathing, Drowning, Choking, Strangulation and hanging,</li> <li>• Swelling with in the throat, Suffocation by smoke or gases and Asthma.</li> </ul> <p><b>D. First aid related with Heart, Blood and Circulation</b></p> <ul style="list-style-type: none"> <li>• Basics of The heart and the blood circulation.</li> <li>• Chest discomfort, bleeding.</li> </ul> <p><b>D. First aid related with Wounds and Injuries</b></p> <ul style="list-style-type: none"> <li>• Type of wounds, Small cuts and abrasions</li> <li>• Head, Chest, Abdominal injuries</li> <li>• Amputation, Crush injuries, Shock</li> </ul> <p><b>E. First aid related with Bones, Joints Muscle related injuries</b></p> <ul style="list-style-type: none"> <li>• Basics of The skeleton, Joints and Muscles.</li> <li>• Fractures (injuries to bones).</li> </ul>	



<p style="text-align: center;"><b>II</b></p>	<p><b>F. First aid related with Nervous system and Unconsciousness</b></p> <ul style="list-style-type: none"> <li>• Basics of the nervous system.</li> <li>• Unconsciousness, Stroke, Fits–convulsions–seizures, Epilepsy.</li> </ul> <p><b>G. First aid related with Gastrointestinal Tract</b></p> <ul style="list-style-type: none"> <li>• Basics of the gastrointestinal system.</li> <li>• Diarrhea, Food poisoning.</li> </ul> <p><b>H. First aid related with Skin, Burns</b></p> <ul style="list-style-type: none"> <li>• Basics of the skin.</li> <li>• Burn wounds, Dry burns and scalds (burns from fire, heat and steam).</li> <li>• Electrical and Chemical burns, Sunburns, heat exhaustion and heat stroke.</li> <li>• Frostbites (cold burns), Prevention of burns, Fever and Hypothermia.</li> </ul> <p><b>I. First aid related with Poisoning</b></p> <ul style="list-style-type: none"> <li>• Poisoning by swallowing, Gases, Injection, Skin</li> </ul> <p><b>J. First aid related with Bites and Stings</b></p> <ul style="list-style-type: none"> <li>• Animal bites, Snake bites, Insects tings and bites</li> </ul> <p><b>K. First aid related with Sense organs</b></p> <ul style="list-style-type: none"> <li>• Basic of Sense organ.</li> <li>• Foreign objects in the eye, ear, nose or skin.</li> <li>• Swallowed foreign objects.</li> </ul> <p><b>L. Specific emergency satiation and disaster management</b></p> <ul style="list-style-type: none"> <li>• Emergencies at educational institutes and work</li> <li>• Road and traffic accidents.</li> <li>• Emergencies in rural areas.</li> <li>• Disasters and multiple casualty accidents.</li> <li>• Triage.</li> </ul> <p><b>M. Emergency Childbirth</b></p>	<p style="text-align: center;">2 (Theory) 10 (Practical)</p>
<p style="text-align: center;"><b>III</b></p>	<p><b>Basic Sex Education</b></p> <ul style="list-style-type: none"> <li>• Overview, ground rules, and a pre-test</li> <li>• Basics of Urinary system and Reproductive system.</li> <li>• Male puberty—physical and emotional changes</li> <li>• Female puberty—physical and emotional changes</li> <li>• Male-female similarities and differences</li> <li>• Sexual intercourse, pregnancy, and childbirth</li> <li>• Facts, attitudes, and myths about LGBTQ + issues and identities</li> <li>• Birth control and abortion</li> <li>• Sex without love —harassment, sexual abuse, and rape</li> <li>• Prevention of sexually transmitted diseases.</li> </ul>	<p style="text-align: center;">9 (Theory)</p>
<p style="text-align: center;"><b>IV</b></p>	<p><b>Mental Health and Psychological First Aid</b></p> <ul style="list-style-type: none"> <li>• What is Mental Health First Aid?</li> <li>• Mental Health Problems in the India</li> <li>• The Mental Health First Aid Action Plan</li> <li>• Understanding Depression and Anxiety Disorders</li> <li>• Crisis First Aid for Suicidal Behavior &amp; Depressive symptoms</li> <li>• What is Non-Suicidal Self-Injury?</li> <li>• Non-crisis First Aid for Depression and Anxiety</li> <li>• Crisis First Aid for Panic Attacks, Traumatic events</li> <li>• Understanding Disorders in Which Psychosis may Occur</li> <li>• Crisis First Aid for Acute Psychosis</li> <li>• Understanding Substance Use Disorder</li> <li>• Crisis First Aid for Overdose, Withdrawal</li> <li>• Using Mental Health First Aid</li> </ul>	<p style="text-align: center;">2 (Theory) 10 (Practical)</p>

**Suggested Readings:**

- Indian First Aid Manual-<https://www.indianredcross.org/publications/FA-manual.pdf>
- Red Cross First Aid/CPR/AED Instructor Manual
- <https://mhfa.com.au/courses/public/types/youthedition4>
- Finkelhor, D.(2009).The prevention of childhood sexual abuse. Durham,NH: Crimes Against Children Research Center.[www.unh.edu/ccrc/pdf/CV192.pdf](http://www.unh.edu/ccrc/pdf/CV192.pdf)
- Kantor L.& Levitz N.(2017). Parents' views on sex education in schools: How much do Democrats and Republic ansagree? PLoSONE, 12(7):e0180250.
- Orenstein, P. (2016). Girls and sex: Navigating the complicated new landscape. New York, NY: Harper.
- Schwiegershausen, E. (2015, May 28). The Cut.[www.thecut.com/2015/05/most-women-are-catcalled-before-they-turn-17.html](http://www.thecut.com/2015/05/most-women-are-catcalled-before-they-turn-17.html)
- Wiggins, G. & Mc Tighe, J.(2008).Understanding by design. Alexandria, VA: ASCD.
- <https://marshallmemo.com/marshall-publications.php#8>

**Suggested Continuous Evaluation Methods:**

Assignments, Presentation, Group Discussion, and MCQ

**Suggested equivalent online courses:**

- <https://www.redcross.org/take-a-class/first-aid/first-aid-training/first-aid-online>
- <https://www.firstaidforfree.com/>
- <https://www.coursera.org/learn/psychological-first-aid>
- <https://www.coursera.org/learn/mental-health>

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B.Sc. (ZBC)-II Year (III Semester)**  
**B050301T: Molecular Biology, Bioinstrumentation & Bio-techniques**

**Objective:** To help the students to learn and develop an understanding of a molecular biology and a clear understanding of the processes of central dogma viz. transcription, translation *etc.* This course is designed to acquire the awareness about the different molecular techniques. This gives knowledge for better employability in industry.

**Unit- I: Process of Transcription**

Fine structure of gene, RNA polymerases, Transcription factors and machinery, Formation of initiation complex, Initiation, elongation and termination of transcription in prokaryotes and eukaryotes for understanding of entrepreneurial skill. **(7 Sessions)**

**Unit- II: Process of Translation**

The Genetic code, Ribosome, Factors involved in translation, Aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, Initiation, elongation and termination of translation in prokaryotes and eukaryotes to provide employability and skills. **(7 Sessions)**

**Unit- III: Regulation of Gene Expression I**

Regulation of gene expression in prokaryotes: *lac* and *trp* operons in *E. coli*, Regulation of gene expression in eukaryotes: Role of chromatin in gene expression, Regulation at transcriptional level, Post-transcriptional, modifications: Capping, Splicing, Polyadenylation, RNA editing for skill development and employability. **(8 Sessions)**

**Unit- IV: Regulation of Gene Expression II**

Regulation of gene expression in eukaryotes: Regulation at translational level, Post-translational modifications: protein folding etc, Intracellular protein degradation, Gene silencing, RNA interference (RNAi) employability in medical sectors. **(8 Sessions)**

**Unit- V: Principle and Types of Microscopes**

Principle of Microscopy and Applications, Types of Microscopes: light microscopy, dark field microscopy, phase-contrast microscopy, Fluorescence microscopy, confocal microscopy, electron microscopy for skill development. **(6 Sessions)**

**Unit- VI: Centrifugation and Chromatography**

Principle of Centrifugation: Types of Centrifuges: high speed and ultracentrifuge, Types of rotors: Vertical, Swing-out, Fixed-angle etc., Principle and Types of Chromatography: paper, thin layer, column-ion-exchange, gel filtration, HPLC, Affinity for skill development and employability **(8 Sessions)**

**Unit- VII: Spectrophotometry and Biochemical Techniques**

Colorimetry and spectrophotometry: Beer-lambert law, absorption spectrum, Biochemical techniques: Measurement of pH, Preparation of buffers and solutions, Measurement, applications and safety measures of radio-tracer techniques to provide employability and skills. **(8 Sessions)**

**Unit- VIII: Molecular Techniques**

Nucleic acid fractionation, detection by electrophoresis, DNA sequencing, Polymerase Chain Reaction (PCR), primer designing, DNA fingerprinting, site directed mutagenesis, RFLP, Molecular cloning, genomic libraries, Gene transfer techniques: electroporation, microinjection, Detection of proteins, PAGE, ELISA, Western blotting, Hybridoma technology employability in Research Labs. **(8 Sessions)**

**Course outcomes:**

The student at the completion of the course will be able to have:

**CO1:** A detailed and conceptual understanding of molecular processes viz. DNA to trait better understanding of skill.

**CO2:** A clear understanding of the processes of central dogma viz. transcription, translation etc. underlying survival and propagation of life at molecular level for skill development and employability.

**CO3:** Understanding of how genes are ultimately expressed as proteins which are responsible for the structure and function of all organisms to provide employability and skills.

**CO4:** Learn how four sequences (3 letter codons) generate the transcripts of life and determine the phenotypes of organisms for skill development at global level.

**CO5:** How genes are regulated differently at different time and place in prokaryotes and eukaryotes for entrepreneurship.

**CO6:** To understand the basic principle of different types of Microscopes skilling of entrepreneurship.

**CO7:** To gain the knowledge of chromatography, spectrophotometry and Biochemical Techniques for employability.

**CO8:** To acquire the awareness about the different molecular techniques for understanding of entrepreneurial skill.

**PO-CO-Mapping (Please write 3, 2, 1 where ever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	1	1	2	1	2	2	2	1
CO2	3	3	1	2	1	1	1	2	1	1	1	2
CO3	1	3	2	3	2	2	2	1	2	1	1	2
CO4	2	2	1	1	3	3	1	1	1	2	2	1
CO5	3	1	2	1	1	1	1	1	1	1	1	2
CO6	3	1	2	1	1	2	2	1	2	1	2	3
CO7	2	1	1	1	1	1	1	2	1	1	1	2
CO8	1	1	2	1	1	1	2	1	1	1	2	2

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	2
CO2	3	3	1
CO3	2	3	2
CO4	3	1	1
CO5	1	1	3
CO6	1	1	3
CO7	1	3	1
CO8	1	1	3

**Suggested Readings:**

1. Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004).
2. Alberts et al: Molecular Biology of the Cell: Garland (2002).
3. Cooper: Cell: A Molecular Approach: ASM Press (2000).
4. Karp: Cell and Molecular Biology: Wiley (2002).
5. Watson et al. Molecular Biology of the Gene. Pearson (2004).
6. Lewin. Genes VIII. Pearson (2004).

7. Pierce B. Genetics. Freeman (2004).
8. Sambrook *et al* .Molecular Cloning Vols I, II, III. CSHL (2001).
9. Primrose. Molecular Biotechnology. Panima (2001).
10. Clark & Switzer. Experimental Biochemistry. Freeman (2000)

**Online Resources:**

<https://ocw.mit.edu/courses/biology/7-012-introduction-to-biology-fall-2004/video-lectures/lecture-10-molecular-biology-1/>

<https://www.youtube.com/watch?v=HpH1qhcb8gQ>

<https://www.youtube.com/watch?v=kOCcmJ3nVQ4>

<https://nptel.ac.in/courses/102/106/102106025/>

<https://isn.ucsd.edu/courses/beng186b/lectures/>

[http://fa.bme.sut.ac.ir/Downloads/AcademicStaff/3/Courses/4/Bioinstrument%201%20\(Basic\).pdf](http://fa.bme.sut.ac.ir/Downloads/AcademicStaff/3/Courses/4/Bioinstrument%201%20(Basic).pdf)

**Note: Latest editions of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B.Sc. (ZBC)-II Year (III Semester)**  
**B050302P: Bioinstrumentation & Molecular Biology Lab**

**Objective:** The main aim of this course is to share the knowledge to the students about the experiments and to understand the basic techniques for studying cells and separation of biomolecules and also about the principle of measuring the concentrations of macromolecules in solutions and to use them in Biochemistry. It gives knowledge for better employability in industry.

**Unit-I**

1. To study the working principle and Simple, Compound and Binocular microscopes.
2. To study the working principle of various lab equipments such as pH Meter, Electronic balance, vortex mixer, use of glass and micropipettes, Laminar flow, Incubator shaker, Water bath, Centrifuge, Chromatography apparatus, etc. to provide employability and skills (15 Sessions)

**Unit-II**

1. To prepare solutions and buffers.
2. To learn the working of Colorimeter and Spectrophotometer.
3. Demonstration of differential centrifugation to fractionate different components in a mixture for understanding of entrepreneurial skill. (15 Sessions)

**Unit-III**

1. To prepare dilutions of Riboflavin and verify the principle of spectrophotometry.
2. To identify different amino acids in a mixture using paper chromatography.
3. Demonstration of DNA extraction from blood or tissue samples.
4. To estimate amount of DNA using spectrophotometer employability in medical sectors. (15 Sessions)

**Unit-IV**

**Virtual Labs**

1. [www.labinapp.com](http://www.labinapp.com)
2. [www.uwlax.edu](http://www.uwlax.edu)
3. [www.labster.com](http://www.labster.com)
4. [www.onlinelabs.in](http://www.onlinelabs.in)
5. [www.powershow.in](http://www.powershow.in)
6. <https://vlab.amrita.edu>
7. [info@premiereducationaltechnologyies.com](mailto:info@premiereducationaltechnologyies.com)
8. <https://li.wsu.edu>

**Course outcomes:**

The student at the completion of the course will be able to

- CO1:** Understand the basic principles of microscopy, working of different types of microscopes for understanding of entrepreneurial skill.
- CO2:** Understand the basic techniques of centrifugation and chromatography for studying cells and separation of biomolecules for skill development and employability at national level.
- CO3:** Understand the principle of measuring the concentrations of macromolecules in solutions by colorimeter and spectrophotometer and use them in Biochemistry employability in industry.

**PO-CO-Mapping (Please write 3, 2, 1 where ever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	3	3	3	2	3	3	3	3

CO2	2	2	2	2	2	2	2	3	2	1	2	2
CO3	3	1	2	1	2	2	3	1	2	1	3	3

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	2
CO2	2	3	1
CO3	2	3	2

**Suggested Readings:**

1. Sambrook *et al* .Molecular Cloning Vols I, II, III. CSHL (2001).
2. Primrose. Molecular Biotechnology. Panima (2001).
3. Clark & Switzer. Experimental Biochemistry. Freeman (2000).

**Note: Latest editions of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B. Sc. (ZBC)-II Year (III Semester)**  
**B040301T: Flowering Plants Identification & Aesthetic Characteristics**

**Objective:** The objective of this course is to enhance the knowledge of the students about the flowering plants, their classification, and nomenclature. This course also aims to study the role of BSI, Herbarium, Botanical gardens in modern plant taxonomy for skill development.

**Unit – 1** **(07 Sessions)**

**Taxonomic Resources & Nomenclature**

Components of taxonomy (identification, nomenclature, classification); Taxonomic resources: Herbarium- functions & important herbaria, Botanical gardens, Flora, Keys- single access and multi-access. Botanical Nomenclature- Principles and rules of ICN (ranks and names; principle of priority, binomial system; type method, author citation, valid-publication) for skill development.

**Unit – 2** **(08 Sessions)**

**Types of classification & Evidences**

Artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series) angiosperm phylogeny group (APG III) classification. Taxonomic evidences from palynology, cytology ,phytochemistry & Molecular biology data (Protein and Nucleic acid homology) for skill development.

**Unit – 3** **(08 Sessions)**

**Identification of Angiospermic families -I: (Families can be chosen University wise as per local available flora)**

A study of the following families with emphasis on the morphological peculiarities and economic importance of its members (based on Bentham & Hooker's system) -Ranunculaceae, Malvaceae, Rutaceae, Fabaceae, Myrtaceae , Cucurbitaceae, Rubiaceae, Asteraceae , Apocynaceae, Acanthaceae, Asclepiadiaceae, Solanaceae for skill development.

**Unit – 4** **(07 Sessions)**

**Identification of Angiospermic families -II: (Families can be chosen University wise as per local available flora)**

A study of the following families with emphasis on the morphological peculiarities and economic importance of its members (based on Bentham & Hooker's system)-Amaranthaceae, Euphorbiaceae, Papaveraceae, Scrophulariaceae ,Orchidaceae, Liliaceae, Arecaceae, Poaceae for skill development.

**Unit – 5** **(08 Sessions)**

**Modern trends in Plant taxonomy**

Phenetics and Cladistics: Brief idea on Phenetics, Numerical taxonomy- methods, Operational Taxonomic Units, Cladistics- construction of dendrogram and primary analysis; Monophyletic, polyphyletic and paraphyletic groups; Plesiomorphy and apomorphy for skill development.



**Unit – 6****(07 Sessions)****TOOLS & SOFTWARES IN PLANT IDENTIFICATION**

GIS (Mapping of (i) Patterns (ii) Features (iii) Quantities

OP02.010H11YLIP - Free Phylogenetic Software,

Digital Taxonomy, Description Language for Taxonomy – DELTA Internet directory for botany for skill development.

**Unit – 7****(07 Sessions)****Computer Applications**

Introduction to Computers – classification, computer generation, low, medium and high level languages, software and hardware, operating systems, compilers and interpreters, personal, mini, main frame and super computers, characteristics and application, computer memory and its types, data representation and storage.

Microsoft excel, data entry, graphs, aggregate functions, formulas and functions, number systems, conversion devices, secondary storage media for skill development.

**Unit – 8****(08 Sessions)****Aesthetic Characteristics of Plants:**

Aesthetic characteristics of plants, English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Trees, shrubs and shrubberies, climbers and creepers, rockery, Flower beds, Shrubbery, Borders, Water garden). Some Famous gardens of India. Conservatory, greenhouses, Indoor garden, Roof garden, Topiary, Bonsai for skill development.

**Course outcomes:** After the completion of the course the students will be able to:

- CO1** To gain an understanding of the history and concepts underlying various approaches to plant taxonomy and classification for enhancement of global knowledge.
- CO2** To learn the major patterns of diversity among plants, and the characters and types of data used to classify plants for enhancement of global knowledge.
- CO3** To compare the different approaches to classification with regard to the analysis of data for skill development.
- CO4** To become familiar with major taxa and their identifying characteristics, and to develop in depth knowledge of the current taxonomy of a major plant family for enhancement of global knowledge.
- CO5** What are different methods of collecting and preserving plants? What is the importance of maintaining plants in botanic gardens for skill development?
- CO6** Comparison among different flowering plants groups for skill development at local level.
- CO7** To discover and use diverse taxonomic resources, reference materials, herbarium collections, publications for enhancement of global knowledge.
- CO8** For the entrepreneur career in plants, one can establish a nursery, Start a landscaping business, Setup a farm Or Run a plantation consultancy firm at local level for skill development.

**PO-CO Mapping (Please write 3, 2, 1 wherever required)****(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	1	1	3	1	1	1	1	1	3
CO2	1	3	1	1	1	3	1	1	1	2	3	3
CO3	1	3	3	1	1	1	1	1	1	1	1	3
CO4	1	1	3	1	1	1	1	1	2	1	3	3
CO5	1	1	3	1	1	1	1	1	1	1	3	3
CO6	3	1	1	3	3	1	1	1	1	2	1	1
CO7	3	1	1	3	3	1	1	1	2	1	1	1
CO8	3	1	1	3	3	1	1	1	1	1	1	1

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)****(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1
CO6	3	1	1
CO7	3	1	1
CO8	3	1	1

**Suggested Readings:**

Propagation And Nursery Management (hindi) (hb) ISBN : 9788177546200 Edition : 01 Year : 2016 Author : Pandey S.K. , Soni N. Publisher : Agrobios (India)

Dr. Amar Singh- Plant Taxonomy (An Old and Rare Book) from the category Ayurveda in our Books collection. Uttar Pradesh Hindi Sansthan, Lucknow

Bole, P. V. and Vaghani, Y. (1986) Field guide to the common trees of India. Oxford University Press; Bombay.

Brandis, D. (1906) Indian Trees (London, 5th edition. 1971). International Book Distributors; Dehra Dun.

Dallwitz, M. J., Paine, T. A. and Zurcher, E. J. (2003). Principles of interactive keys. <http://delta-intkey.com>

<https://www.naace.co.uk/school-improvement/ict-mark/>

[K. B. Anjaria, \(2015\) "Electronic Herbarium and Digital Database Preparation of Common Trees of Anand District, Gujarat" MRP submitted to UGC, WRO, Pune 2015 \(unpublished\)](https://www.socitm.gov.uk,(2002)Learning in the 21<sup>st</sup> century Executive briefing A Socitm Insight publication, July 2002 Socitm.</a></p>
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Lizeron Eremias and R. Subash. (2013) "E-Content Development: A Milestone In The Dynamic Progress Of E- Learning" International Journal of Teacher Educational Research (IJTER) Vol.2No.1

January, 2013 ISSN:2319-4642

- Pandey, B. P. 2007. Botany for Degree Students: Diversity of Seed Plants and their Systematics, Structure, Development and Reproduction in Flowering Plants. S. Chand & Company Ltd, New Delhi.
- Stace, C. A. 1989. Plant Taxonomy and Biostatistics (2nd Ed.). Edward Arnold, London.
- Singh, G. 1999. Plant Systematics: Theory and Practice. Oxford and IBH, New Delhi.
- Dutta A.C. 2016. Botany for Degree Students. Oxford University Press.
- Davis, P. H. and V. H. Heywood. 1963. Principles of Angiosperm Taxonomy. Oliver and Boyd, London.
- Heywood, V. H. and D. M. Moore (Eds). 1984. Current Concepts in Plant Taxonomy. Academic Press, London.
- Austin, R. 2002. Elements of planting design. New York: John Wiley & Sons.
- Bertauski, T. 2005. Designing the landscape: An introductory guide for the landscape designer. Upper Saddle River, NJ: Pearson Prentice Hall.
- Thomas, H., and S. Wooster. 2008. The complete planting design course: Plans and styles for every garden. London: Octopus Publishing Group.
- Scarfone, S. 2007. Professional planting design: An architectural and horticultural approach for creating mixed bed plantings. New York: John Wiley & Sons.
- Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

**Suggested equivalent online courses:**

<https://www.easybiologyclass.com/topic-botany/>

<http://egyankosh.ac.in/handle/123456789/53530>

<https://www.delta-intkey.com/www/desc.htm>

<https://milneorchid.weebly.com/plant-id-for-beginners.html>

<https://plants.usda.gov/classification.html>

[https://www.senecaohs.org/pages/uploaded\\_files/Plant%20Classification.pdf](https://www.senecaohs.org/pages/uploaded_files/Plant%20Classification.pdf)

[https://www.ladykeanecollege.edu.in/files/userfiles/file/Dr %20S %20Nongbri%20III%20Sem%20ppt.pdf](https://www.ladykeanecollege.edu.in/files/userfiles/file/Dr%20S%20Nongbri%20III%20Sem%20ppt.pdf)

[https://www.brainkart.com/article/Bentham-and-Hooker-s-classification-of-plants---Dicotyledonae,-Gymnospermae-and-Monocotyledonae\\_1000/](https://www.brainkart.com/article/Bentham-and-Hooker-s-classification-of-plants---Dicotyledonae,-Gymnospermae-and-Monocotyledonae_1000/)

<https://libguides.rutgers.edu/c.php?g=336690&p=2267037>

<https://www.delta-intkey.com/>

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B. Sc. (ZBC)-II Year (III Semester)**  
**B040302P: Plant Identification Technology**

**Objective:** The course aims to share the knowledge to the students about the experiments. The students will get a better understanding of the concept studied by them in theory course and correlate with experimental observations to provide employability and skill development.

**Unit-1 (Herbarium: Plant collecting, Preservation and Documentation) (07 Sessions)**

Stepwise Practicing Herbarium techniques:

FIELD EQUIPMENTS, Global Positioning System (GPS) instrument & Collection of any wild 25 plant specimens

Learn to handle Herbarium making tools

Pressing and Drying of collected plant specimens

Special treatments for all varied groups of plants

Mount on standard herbarium sheets f. Label the using Standard method

Organize them and give Index Register Number to provide employability and skill development

**Unit-2 (Taxonomic Identification using plant structure) (08 Sessions)**

Classify 25 plants on the basis of Taxonomic description (Plant Morphology, Anatomy, Reproductive parts, Habit, adaptation anomalies) according to Bentham Hooker system of classification in the following families: Malvaceae, Fabaceae (Papilionaceae), Solanaceae, Scrophulariaceae, Acanthaceae, Labiatae (Lamiaceae), Rubiaceae for skill development.

**Unit-3 (Identification during excursions) (08 Sessions)**

Conducting Spot identification (Binomial, Family) of common wild plants from families included in the theoretical syllabus (list to be provided) and making FIELD NOTE BOOK and filling Sample of a page of field-book, used in Botanical Survey of India.

Describe/compare flowers in semi-technical language giving V.S. of flowers, T.S. of ovaries, floral diagrams and Floral Formulae. Identify and assign them to their respective families giving reasons to provide employability and skill development.

**Unit-4 (07 Sessions)**

Collection, preservation and storage of Algae, Fungi, Bryophytes, Pteridophytes (Two each) to provide employability and skill development.

**Unit-5 (Botanical Nomenclature & reporting Method) (07 Sessions)**

Give nomenclature to collected plants as per ICN rules and prepare labels as per BSI

**Author Citation, Effective Publication and Principle of Priority:** To show a specimen paper on Basic structure of a taxonomic Research published on a new species in taxonomic journal to provide employability and skill development

**Unit-6 (COMPUTERS)****(07 Sessions)**

Learning to use EXCEL Microsoft power point and Word., working with folder and windows utility., create and manage files and folder tree,

Practice browsing of different sites using search engine. Practice and understand different E-Mail services – Outlook, Yahoo mail, rediff mail etc. Practice Creating E-Mail accounts, Sending, Receiving & Storing of mails.

Create and Participate in virtual conferencing in an interactive Zoom Meeting to provide employability and skill development.

**Unit-7 (Computer Application in taxonomy)****(08 Sessions)**

Use Taxonomic Softwares (Dichotomous Key)

Practicals on Phylogenetic analysis

Make line drawing of Plants for description

Using of plant identification apps on android phones

**Unit-8****(08 Sessions)**

Create a Bonsai of any plant

Develop a miniature garden

Draw Layouts of various types of gardens

Plant Propagation methods practice to provide employability and skill development.

**Course outcomes:** After the completion of the course the students will be able:

**CO1** To learn how plant specimens are collected, documented, and curated for a permanent record at local level for employability and skill development.

**CO2** To observe, record, and employ plant morphological variation and the accompanying descriptive terminology for employability and enhancement of global knowledge.

**CO3** To gain experience with the various tools and means available to identify plants for employability and skill development.

**CO4** To develop observational skills and field experience for employability and skill development.

**CO5** To identify a taxonomically diverse array of native plants for enhancement of global knowledge.

**CO6** To recognize common and major plant families for employability and skill development.

**CO7** To understand aesthetic characters of flowering plants by making-landscapes, gardens, bonsai, miniatures for employability and skill development.

**CO8** Comprehend the concepts of plant taxonomy and classification of Angiosperms for enhancement of global knowledge..

**PO-CO Mapping (Please write 3, 2, 1 wherever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	1	2	3	1	1	1	1	1	3
CO2	1	3	2	1	1	3	1	1	1	1	3	3
CO3	1	3	3	1	1	1	1	1	1	1	1	3

CO4	1	1	3	1	2	1	1	3	1	1	3	3
CO5	1	1	3	1	3	3	1	3	2	1	3	3
CO6	3	1	1	1	3	3	1	1	2	1	1	1
CO7	3	1	1	1	3	3	1	1	1	1	1	1
CO8	3	1	1	1	3	3	1	1	1	1	1	1

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	<b>Skill Development</b>	<b>Employability</b>	<b>Entrepreneurship Development</b>
CO1	3	2	1
CO2	3	2	1
CO3	3	2	1
CO4	3	2	1
CO5	3	2	1
CO6	3	2	1
CO7	3	2	1
CO8	3	2	1

**Suggested Readings:**

1. Day, S.C. (2003) A Art of Miniature Plant Culture. - Agrobias. Jodhpur,India.
2. Practical Taxonomy of Angiosperms By : R K Sinha ISBN : 9789386768520 I.K International Publishing House Pvt. Ltd.
3. Day, S.C. (2003) Complete Home Gardening. (2003) Agrobias, Jodhpur,India.
4. Dhopte, A.M. (2003) Principles and Techniques for Plant Scientists. - Agrobios, Jodhpur,India.
5. Khan, M.R. (1995) Horticulture and Gardening. -Nirali Prakashan, Pune. India.
6. Pramila Mehra Gardening for every one-. Hind pocket book private limited, NewDehli.
7. Kumarsen V. Horticulture ,Saras Publication
8. Ramesh Bangia Learning Computer Fundamentals., Khanna Book Publishers
9. Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH Publishing Co., NewDelhi.
10. Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.
11. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.
12. Bole, P. V. and Vaghani, Y. (1986) Field guide to the common trees of India. Oxford University Press; Bombay.
13. Womersley, J. S. 1981. Plant collecting and herbarium development: A manual.
14. Brandis, D. (1906) Indian Trees (London, 5th edition. 1971). International Book Distributors; DehraDun.
15. Dallwitz, M. J., Paine, T. A. and Zurcher, E. J. (2003). Principles of interactive keys. <http://delta-intkey.co> <https://www.naace.co.uk/school-improvement/ict-mark/>
16. Manilal, K. S. and M. S. Muktesh Kumar (ed.) (1998) A Hand book of Taxonomy Training, DST, N.Delhi

17. Naik, V. N. (1984) *Taxonomy of Angiosperms* Tata McGraw-Hill Publication Com. Ltd., New Delhi
18. Primak, R. B. (2004) *A Primer of Conservation Biology*. Sinauer Associates, Inc. Publishers
19. Quicke, Donald, L. J. (1993) *Principles and Techniques of Commemorative Taxonomy*. Blakie, Academic and Professional, London
20. Singh, G (2004) *Plant Systematics: Theory and practice* Oxford and YBH Publishing Co. Pvt. Ltd., New Delhi.
21. Bridson, D. & L. Forman. eds. 1998. *The Herbarium Handbook*. 3rd ed. Royal Botanic Gardens, Kew (Reprinted 1999).
22. De Vogel, E.F. 1987. *Manual of Herbarium Taxonomy: Theory and Practice*. UNESCO, Jakarta.
23. Fosberg, F.R. & M.-H. Sachet. 1965. *Manual for tropical herbaria*. Int. Bur. Pl. Tax. & Nom., *Regnum Vegetabile* Vol. 39. Utrecht.
24. Jain, S.K. & R.R. Rao. 1977. *A handbook of field and herbarium methods*. Today & Tomorrow's Printers and Publishers, New Delhi.
25. Victor, J.E., M. Koekemoer, L. Fish, S.J. Smithies, M. Mossmer. 2004. *Herbarium essentials: the Southern*
26. *African Herbarium user manual*. Southern African Botanical Diversity Network Report No. 25. SABONET, Pretoria.

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B.Sc. (ZBC) II Year III Semester**  
**Course Code: B020301T**

**Course Title: Chemical Dynamics & Coordination Chemistry**

**Objectives:** The main objectives of this course is to develop the skills to learn the characteristic of the three states of matter and describe the different physical properties of each state of matter. Kinetic theory of gases, laws of crystallography, liquid state and liquid crystals, conductometric, potentiometric, optical methods, polarimetry and spectrophotometer technique to study Chemical kinetics and chemical equilibrium and development of employability and entrepreneurship.

**UNIT – I: Chemical Kinetics** **(10 Sessions)**

Rate of a reaction, molecularity and order of reaction, concentration dependence of rates, mathematical characteristic of simple chemical reactions – zero order, first order, second order, pseudo order, half-life and mean life. Determination of the order of reaction – differential method, method of integration, half-life method and isolation method. Brief outline of experimental methods of studying chemical kinetics: Conductometric, potentiometric, optical methods, polarimetry and spectrophotometer  
Theories of chemical kinetics: Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis). Expression for the rate constant based on equilibrium constant and thermodynamic aspects (no derivation ).

**UNIT – II: Chemical Equilibrium** **(05 Sessions)**

Equilibrium constant and free energy, thermodynamic derivation of law of mass action. Le-Chatelier's principle. reaction isotherm and reaction isochore – Clapeyron-Clausius equation and its applications.

**UNIT – III: PhaseEquilibrium** **(05 Sessions)**

Phase Equilibrium : Statement and meaning of the terms-phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system– water, CO<sub>2</sub> and systems. Phase equilibria of two component systems – Solid - liquid equilibria, simple eutectic – Bi-Cd, Pb-Ag systems.

**UNIT – IV: Kinetic theories of gases** **(10 Sessions)**

**Gaseous State:** Postulates of kinetic theory of gases, deviation from ideal behavior, van der Waals equation of state.

**Critical phenomena:** PV isotherms of real gases, continuity of states, the isotherms of Van der Waals equation, relationship between critical constants and Van der Waals constants, the law of corresponding states, reduced equation of state.

**Molecular Velocities:** Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule-Thomson effect).

**UNIT – V: Liquid State** **(05 Sessions)**

**Liquid State:** Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals: Difference between liquid crystal, solid and liquid. Classification, structure of nematic and cholesterol phases. Thermography and seven segment cell.

**Liquids in solids (gels):** Classification, preparation and properties, inhibition, general application.



**UNIT – VI: Coordination Chemistry****(05 Sessions)**

Coordinate bonding: double and complex salts. Werner's theory of coordination complexes, classification of ligands, ambidentate ligands, chelates, coordination numbers, IUPAC nomenclature of coordination complexes (up to two metal centers), Isomerism in coordination compounds, constitutional and stereo isomerism, geometrical and optical isomerism in square planar and octahedral complexes. Application of coordination chemistry in development of employability in research and development and at industrial level.

**UNIT – VII: Theories of Coordination Chemistry****(10 Sessions)**

**I.** Metal- ligand bonding in transition metal complexes, limitations of valence bond theory, an elementary idea of crystal field theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal-field parameters.

**II.** Thermodynamic and kinetic aspects of metal complexes: A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, stability constants of complexes and their determination, substitution reactions of square planar complexes

**UNIT – VIII: Inorganic Spectroscopy and Magnetism****(10 Sessions)**

**I)** Electronic spectra of Transition Metal Complexes

Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series, Orgel-energy level diagram for d1 and d9 states, discussion of the electronic spectrum of  $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$  complex ion.

**II)** Magnetic properties of transition metal complexes, types of magnetic behaviour, skill development for determining magnetic susceptibility, spin-only formula, L-S coupling, correlation of  $\mu_s$  and  $\mu_{\text{eff}}$  values, orbital contribution to magnetic moments, application of magnetic moment data for 3d-metal complexes. Physical properties and molecular structure : Optical activity, polarization – (Clausius - Mossotti equation), orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment-temperature method and refractivity method, dipole moment and structure of molecules, magnetic properties paramagnetism, diamagnetism and ferromagnetism, magnetic susceptibility, its measurements and its importance.

**Suggested Readings:**

1. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry Ed., Oxford University Press 13 (2006).
2. Ball, D. W. Physical Chemistry Thomson Press, India (2007).
3. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
4. Cotton, F.A, Wilkinson, G and Gaus, P. L ,Basic Inorganic Chemistry, 3<sup>rd</sup> Edition ,Wiley 1995
5. Lee, J. D, Concise Inorganic Chemistry 4<sup>th</sup> Edition ELBS,1977
6. Douglas, B, McDaniel, D and Alexander, J, Concepts of Models of Inorganic Chemistry, John Wiley & Sons; 3rd edition , 1994
7. Shriver, D. EAtkins, P.W and Langford, C. H., Inorganic Chemistry ,Oxford University Press, 1994.
8. Porterfield, W.W, Inorganic Chemistry, Addison Wesley 1984.
9. Sharpe, A .G, Inorganic Chemistry, ELBS,3<sup>rd</sup> edition ,1993
10. Miessler, G.L, Tarr, D.A, Inorganic Chemistry, 2<sup>nd</sup> edition , Prentice Hall,2001

**Course outcomes:**

Upon successful completion of this course students should be able to

CO1: Evaluate rate constant of a reaction as well as understand theories of reaction rates.

CO2: Understand the concept of equilibrium constant and free energy.

CO3: Development of skills to Learn the concept of phases, component and degree of freedom and its applications to various phase diagrams

CO4: Understand the concept of kinetic theory of gases and behavior of real gases.

CO5: Understand the basic concepts of liquid state and liquid crystals for employability at local and national level

CO6: Skill development in learning about coordination compounds of transition metal complexes and their applications.

CO7: Describe metal-ligand bonding, thermodynamic and kinetic aspects of metal complexes.

CO8: Explain the electronic spectra and magnetic behavior of transition metal complexes

### Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	2	2	3	1	3	3	1
CO2	3	2	2	3	2	2	2	2	2	3	1	2
CO3	3	1	2	3	2	2	2	2	2	3	2	2
CO4	3	2	3	3	2	2	2	2	2	3	2	2
CO5	3	2	3	3	2	2	2	2	2	3	2	1
CO6	3	3	2	3	1	3	2	2	2	1	3	1
CO7	3	3	2	3	3	1	2	2	2	2	3	3
CO8	3	3	2	3	1	3	2	2	2	2	1	1

### CO-Curriculum Enrichment Mapping

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	2	1
CO2	3	2	2
CO3	3	2	2
CO4	3	3	2
CO5	3	2	1
CO6	3	2	2
CO7	3	2	2
CO8	3	3	1

### Suggested online links:

- <https://swayam.gov.in/>
- <https://www.coursera.org/learn/physical-chemistry>
- <https://www.mooc-list.com/tags/physical-chemistry>
- <https://www.openlearning.com/courses/introduction-to-physical-chemistry/>
- <https://www.my-mooc.com/en/categorie/chemistry>
- [https://onlinecourses.swayam2.ac.in/nce19\\_sc15/preview](https://onlinecourses.swayam2.ac.in/nce19_sc15/preview)
- <https://swayam.gov.in/>
- <https://www.coursera.org/browse/physical-science-and-engineering/chemistry>

**Note: Latest edition of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B.Sc. (ZBC) II Year III Semester**  
**Course Code: B020302P**  
**Course Title: Physical Analysis**

**Objectives:** The primary objective of this course is to develop skill to make students aware of apparatus calibration, solution preparation, estimation by through volumetric analysis and analysis of phase equilibrium.

**UNIT – I: Strengths of Solution** **(20 Sessions)**

Calibration of fractional weights, pipettes and burettes. Preparation of standards solutions. Dilution – 0.1 M to 0.001 M solutions.

Mole Concept and Concentration Units: Mole Concept, molecular weight, formula weight, and equivalent weight. Concentration units: Molarity, Formality, Normality, Molality, Mole fraction, Percent by weight, Percent by volume, Parts per thousand, Parts per million, Parts per billion, pH, pOH, milli equivalents, Milli moles.

**UNIT – II: Surface Tension and Viscosity** **(06 Sessions)**

1. Determination of surface tension of pure liquid or solution
2. Determination of viscosity of liquid pure liquid or solution

**UNIT – III: Boiling point and Transition Temperature** **(14 Sessions)**

1. Boiling point of common organic liquid compounds (**ANYFIVE**) *n*-butylalcohol, cyclohexanol, ethyl methyl ketone, cyclohexanone, acetylacetone, isobutyl methyl ketone, isobutyl alcohol, acetonitrile, benzaldehyde and acetophenone. [Boiling points of the chosen organic compounds should preferably be within 180°C].
2. Transition Temperature, Determination of the transition temperature of the given substance by thermometric /dilatometric method (e.g.  $\text{MnCl}_2 \cdot 4\text{H}_2\text{O}$  /  $\text{SrBr}_2 \cdot 2\text{H}_2\text{O}$ ).

**UNIT – IV: Phase Equilibrium** **(20 Sessions)**

1. To study the effect of a solute (e.g. NaCl, succinic acid) on the critical solution temperature of two partially miscible liquids (e.g. phenol water system) and to determine the concentration of that solute in the given phenol-water system
2. To construct the phase diagram of two component (e.g. diphenylamine – benzophenone) system by cooling curve method. Role of phase equilibrium in development of employability in research and development and at industrial level.

**Course outcomes:**

Upon successful completion of this course students should be able to:

CO1: Calibrate apparatus and prepare solutions of various concentrations.

CO2: Determine surface tension and viscosity of any solution.

CO3: Development of skills to perform dilatometric experiments for a given substance for employability at local and national level.

CO4: analyze component and phase in an equilibrium

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)**

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	2	2	2	3	2	3	1	2
CO2	3	3	1	3	2	2	2	3	2	3	2	2

<b>CO3</b>	3	2	2	3	2	2	2	1	2	3	3	2
<b>CO4</b>	3	1	2	3	1	1	1	1	2	3	1	2

### CO-Curriculum Enrichment Mapping

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	<b>Skill Development</b>	<b>Employability</b>	<b>Entrepreneurship</b>
<b>CO1</b>	3	3	1
<b>CO2</b>	3	3	1
<b>CO3</b>	3	3	1
<b>CO4</b>	3	3	1

### Suggested Readings:

1. Skoog .D.A., West.D.M and Holler .F.J., “Analytical Chemistry: An Introduction”, 7th edition, Saunders college publishing, Philadelphia, (2010).
2. Larry Hargis. G “Analytical Chemistry: Principles and Techniques” Pearson©(1988 )

### Suggestive online links

- <https://www.labster.com/chemistry-virtual-labs/>
- <https://www.vlab.co.in/broad-area-chemical-sciences>
- <http://chemcollective.org/vlabs>

**Note: Latest edition of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**Co-curricular course**  
**B.Sc. (ZBC) II Year III Semester**  
**Course Title: Human Values and Environment studies**

Programme/Class: Certificate	Year: Second	Semester: Third
Co-Curricular Course		
Course Code: Z030301	Course Title: Human Values and Environment studies	
<p>Course outcomes:</p> <p>The mission of the course on Human Values and Environmental Studies is to create morally articulate solutions to be truthful and just and to become responsible towards humanity. The course seeks to establish a continuous interest in the learners to improve their thought process with intent to develop a new generation of responsible citizens capable of addressing complex challenges faced by the society due to disruptions in human interactions effecting human values. This course works towards</p> <ul style="list-style-type: none"> <li>• Building fundamental knowledge of the interplay of markets, ethics, and law,</li> <li>• Look at various challenges faced by individual to counter un ethical issues</li> <li>• Look at core concepts for business ethics</li> <li>• Look at core concepts of anti-corruption</li> <li>• Look at core concepts for a morally articulate solution evolver to management issues in general,</li> <li>• Issues of sustainable development for a better environment.</li> <li>• To know how environmental degradation has taken place.</li> <li>• Be aware of negotiations and international efforts to save environment.</li> <li>• How to develop sustainably?</li> <li>• Efforts taken up by UN in Sustainable Development.</li> <li>• Efforts taken by India in Sustainable Development.</li> </ul> <p>• The course intends to create a sense of how to be more responsible towards the environment. Upon finishing of the course students will be able to come up with using ethical reasoning for decision making and frame ethical issues as well as operational is an ethical choice. The course integrates various Facets of human values and environment.</p>		
Credits:2		
Max. Marks: 100		Min. Passing Marks:40
<p>Total No. of Lectures- Tutorials- Practical (in hours per week): L-T-P:2-0-0</p> <p>As the course requires, we are as of Human Values and Environment Studies institutions can even opt for a parallel delivery.</p>		
Unit	Topics	No. of Lectures Total=30
<b>I</b>	<b>Human Values-</b> Introduction- Values, Characteristics, Types, Developing Value System in Indian Organization, Values in Business Management, value based Organization, Trans-cultural Human values in Management. Swami Vivekananda's Philosophy of Character Building, Gandhi's concept of Seven Sins, APJ Abdul Kalam View on role of parents and Teachers.	02
	<b>Human Values and Present Practices</b> –Issues: Corruption and Bribe, Privacy Policy in Web and Social Media, Cyber threats, Online Shopping etc. Remedies	02
	<b>UK Bribery Act, Introduction to sustainable policies and practices in Indian Economy.</b>	03

	<p><b>Principles of Ethics</b>  <b>Secular and Spiritual Values in Management- Introduction-</b>Secular and Spiritual values, features, Levels of value Implementation. Features of spiritual Values,  <b>Corporate Social Responsibility-</b>Nature, Levels, Phases and Models of CSR, Corporate Governance. CSR and Modern Business Tycoons Ratan Tata, Azim Premji And Bill Gates.</p>	
	<p><b>Holistic Approach in Decision making-</b> Decision making, the decision making process, The Bhagavad Gita: Techniques in Management, Dharma and Holistic Management.  <b>Discussion through Dilemmas –</b>  <b>II</b> Dilemmas in Marketing and Pharma Organisations, moving from Public to Private– Monopoly context, Dilemma of privatisation, Dilemma on liberalization, Dilemma on Social media and cyber security, Dilemma on Organic food, Dilemma on standardization, Dilemma on Quality standards.  <b>Case Studies</b></p>	03 03 02
	<p><b>III</b> Ecosystem: Concept, structure &amp; functions of ecosystem: producer, consumer, decomposer, food web, food chain, energy flow, Ecological pyramids  Conservation of Biodiversity- In-situ &amp; Ex- situ conservation of biodiversity  Role of individual in Pollution control  Human Population &amp; Environment  Sustainable Development  India and UN Sustainable Development Goals  Concept of circular economy and entrepreneurship</p>	7
	<p><b>IV</b> Environmental Laws?  International Advancements in Environmental Conservation  Role of National Green Tribunal  Air Quality Index  Importance of Indian Traditional knowledge on environment</p>	8
	<p>Bio assessment of Environmental Quality  Environmental Management System  Environmental Impact Assessment and Environmental Audit</p>	
<p><b>Suggested Readings:</b>  1. A foundation course in Human Values and Professional Ethics by RR. Gaur, R. Sangalet.al  2. JUSTICE: What's the Right Thing to Do? Michael J. Sandel.  3. Human Values by A. N. Tripathi New Age International  4. Environmental Management by N. K. Uberoi  5. <a href="https://www.un.org/sustainabledevelopment/sustainable-development-goals/">https://www.un.org/sustainabledevelopment/sustainable-development-goals/</a>  6. <a href="https://www.india.gov.in/my-government/schemes">https://www.india.gov.in/my-government/schemes</a>  7. <a href="https://www.legislation.gov.uk/ukpga/2010/23/contents">https://www.legislation.gov.uk/ukpga/2010/23/contents</a>  8. Daniel Kahneman, Thinking, Fast and Slow; Allen Lane Nov 2011 ISBN:9780141918921</p>		
<p><b>Suggested Continuous Evaluation Methods:</b>  In addition to the theoretical inputs the course will be delivered through case studies and dilemma as . Assignments, Presentation, Group Discussions. This will in still in student a sense of decision making and practical learning. The course participants can be evaluated on the following structure.</p> <ul style="list-style-type: none"> <li>➤ Assignments(10)</li> <li>➤ Presentation(10)</li> <li>➤ Attendance (5)</li> <li>➤ Final exam (75)</li> </ul>		

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B.Sc. (ZBC)-II Year (IV Semester)**  
**B050401T: Gene Technology and Human Welfare**

**Objective:** The course is designed to understand the principles of genetic engineering, how genes can be cloned in bacteria and the various technologies involved in it. A strong emphasis will be laid on the modern tools and techniques used in biotechnology in various fields like agriculture, industry and human health for entrepreneurship and employability in industries as well as Research Labs.

**Unit-I: Principles of Gene Manipulation** **(10 Sessions)**

Recombinant DNA Technology, Restriction Enzymes, DNA modifying enzymes, Cloning Vectors, Ligation, Gene transfer techniques, Gene therapy, Selection and identification of recombinant cells. employability in industries.

**Unit-II: Applications of Genetic Engineering**

Single cell proteins, Biosensors, Biochips, Crop and live stock improvement, development of transgenic, Development of DNA drugs and vaccines employability in drug designing field. **(8 Sessions)**

**Unit-III: Enzyme Technology**

Microbial culture, Methods of enzyme production, Immobilization of enzymes, Applications, antibiotics. provide employability and skills. **(6 Sessions)**

**Unit-IV: DNA Diagnostics**

Genetic analysis of human diseases, detection of known and unknown mutations, DNA fingerprinting, Concept of pharmacogenomics and pharmacogenetics, Personalized medicine-optimizing drug therapy. employability in pharmaceuticals. **(6 Sessions)**

**Unit-V: Biostatistics I**

Calculations of mean, median, mode, variance, standard deviation, Concepts of coefficient of variation, Skewness, Kurtosis, Elementary idea of probability and application for entrepreneurship and employability. **(8 Sessions)**

**Unit-VI: Biostatistics II**

Data summarizing: frequency distribution, graphical presentation-bar, pie diagram, histogram, Tests of significance: one and two sample tests, t-test and Chi-square test skilling of entrepreneurship. **(7 Sessions)**

**Unit-VII: Basics of Computers**

Basics (CPU, I/O units) and operating systems, Concept of homepages and websites, World Wide Web, URLs, using search engines employability in networking sectors. **(7 Sessions)**

**Unit –VIII: Bioinformatics**

Databases: nucleic acids, genomes, protein sequences and structures, Bibliography, Sequence analysis (homology): pairwise and multiple sequence alignments-BLAST, CLUSTALW Phylogenetic analysis. employability in research areas. **(8 Sessions)**

**Course outcomes:**

The student at the completion of the course will be able to:

- CO1:** Understand the principles of genetic engineering, how genes can be cloned in bacteria and the various technologies involved in it employability in different industrial sectors.
- CO2:** Know the applications of biotechnology in various fields like agriculture, industry and human health employability in bioreactor industries.
- CO3:** Know the basics of industrial biotechnology for skill development and employability.
- CO4:** Get introduced to DNA testing and utility of genetic engineering in forensic sciences

employability in forensic labs at global level.

**CO5:** Get introduced to computers and use of bioinformatics tools employability as data scientist.

**CO6:** Enable students to get employment in pathology/Hospital.

**CO7:** Take up research in biological sciences employability in research labs.

**CO8:** To understand the various terminologies of Biostatistics for understanding of entrepreneurial skill.

**PO-CO-Mapping (Please write 3, 2, 1 where ever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	3	3	2	2	2	2	2	2
CO2	2	3	3	2	2	2	3	3	1	3	3	3
CO3	2	2	1	2	2	2	1	1	2	1	1	1
CO4	3	2	2	1	2	1	1	2	3	2	2	2
CO5	2	2	3	3	1	1	1	2	1	2	1	3
CO6	1	1	1	1	1	1	1	2	2	1	1	2
CO7	2	1	1	1	1	1	2	2	3	2	2	3
CO8	3	1	1	1	1	1	1	1	1	1	2	1

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	Skill Development	Employability	Entrepreneurship Development
CO1	2	3	2
CO2	1	3	1
CO3	3	3	2
CO4	2	2	1
CO5	2	3	3
CO6	2	3	1
CO7	2	3	2
CO8	2	1	3

### Suggested Readings:

1. Primrose & Twyman. Principles of Genome Analysis and Genomics. Blackwell (2003).
2. Hartl & Jones. Genetics: principles & Analysis of Genes & Genomes. Jones & Bartlett (1998).
3. Sambrook *et al* .Molecular Cloning Vols I, II, III. CSHL (2001).
4. Primrose. Molecular Biotechnology. Panima (2001).
5. Clark & Switzer. Experimental Biochemistry. Freeman (2000)
6. Sudbery. Human Molecular Genetics. Prentice-Hall (2002).
7. Wilson. Clinical Genetics-A Short Course, Wiley (2000).
8. Pasternak. An Introduction to Molecular Human Genetics. Fitzgerald (2000).
9. Biostatistical Analysis (Fourth Edition) by Jerrold H. Zarr, Pearson Education Inc., Delhi.
10. Statistical Methods (Eighth Edition) by G. W. Snecdecor and W. G. Cochran, Willey Blackwell
11. Biostatistics (Tenth Edition) by W.W. Daniel and C. L. Cross, Wiley
12. Introductory Biological Statistics (Fourth Edition) by John E. Havel, Raymond E. Hampton and Scott J. Meiners
13. Westhead *et al* Bioinformatics: Instant Notes. Viva Books (2003).



**Online Resources:**

- <https://www.youtube.com/watch?v=Ggwyxr5krao>
- [https://www.teachengineering.org/lessons/view/uoh\\_genetic\\_lesson01](https://www.teachengineering.org/lessons/view/uoh_genetic_lesson01)
- <https://www.britannica.com/science/genetic-engineering>
- [https://en.wikipedia.org/wiki/Genetic\\_engineering](https://en.wikipedia.org/wiki/Genetic_engineering)
- [https://www.youtube.com/watch?v=UM2\\_o37xNvg](https://www.youtube.com/watch?v=UM2_o37xNvg)
- <https://www.youtube.com/watch?v=MGex26rePe8>
- [https://www.youtube.com/watch?v=o6d4t\\_UqX4I](https://www.youtube.com/watch?v=o6d4t_UqX4I)
- <https://blog.basidialearning.com/videos/microbes-in-human-welfare-neet-questions/>

**Note: Latest editions of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B.Sc. (ZBC)-II Year (IV Semester)**  
**B050402P: Genetic Engineering Lab, Genetic Counselling & Telemedicine**

**Objective:** To make the study relevant, interesting, encouraging to the students and to get employment in Hospitals/Diagnostic and forensic labs/Counsel families with genetic disorders and enable students to take up research in biological sciences and to apply knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics existing software effectively to extract information from large databases and to use this information in computer modeling. For skill development, entrepreneurship and employability.

**Unit-I**

1. Measure the pre and post clitellar lengths of earthworms and calculate mean, median, mode, standard deviation etc.
2. Measure the height and weight of all students in the class and apply statistical measures skilling of entrepreneurship. **(10 Sessions)**

**Unit –II**

1. To perform bacterial culture and calculate generation time of bacteria.
2. To study Restriction enzyme digestion using teaching kits.
3. To study Polymerase Chain Reaction (PCR) using teaching kits.
4. Demonstration of agarose gel electrophoresis for detection of DNA.
5. Demonstration of Polyacrylamide Gel Electrophoresis (PAGE) for detection of proteins. To calculate molecular weight of unknown DNA and protein fragments from gel pictures. employability in medical sectors. **(20 Sessions)**

**Unit-III**

1. To learn the basics of computer applications
2. To learn sequence analysis using BLAST
3. To learn Multiple sequence alignment using CLUSTALW
4. To learn about Phylogenetic analysis using the programme PHYLIP.
5. To learn how to perform Primer designing for PCR using available softwares etc. This gives knowledge for better employability in research feild. **(15 Sessions)**

**Unit –IV**

**Virtual Labs**

1. Gel Documentation System- <https://youtu.be/WPpt3-FanNE>
2. Colorimeter- <https://youtu.be/v4aK6G0bGuU>
3. PCR Part 1- <https://youtu.be/CpGX1UFS14A>
4. PCR Part 2- <https://youtu.be/6IcHAYPTAEw>
5. DNA isolation Part 1- <https://youtu.be/QE7UI0JnY9A>
6. DNA isolation part 2- [https://youtu.be/-efr\\_HFeHxM](https://youtu.be/-efr_HFeHxM)
7. DNA curve- <https://youtu.be/ubL8QxTeuG4>
8. Spectrophotometer- <https://youtu.be/ubL8QxTeuG4>
9. Agarose Part 1- <https://youtu.be/7gvHPFww--g>
10. Agarose part 2- [https://youtu.be/j\\_bOZCHNsSg](https://youtu.be/j_bOZCHNsSg)

**Course outcomes:**

The student at the completion of the course will be able to:

- CO1:** Understand the principles of genetic engineering with hands-on experiments in mutation detection, testing of infectious diseases like Covid 19. To get introduced to DNA testing and utility of genetic engineering in forensic sciences employment in hospitals, research labs at global level.
- CO2:** Apply knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics existing software effectively to extract information from large databases and to use this

information in computer modeling. Bioinformatics tools is use to find out evolutionary/phylogenetic relationship of organisms using gene sequences employment as data scientist.

**CO3:** Get employment in Hospitals/Diagnostic and forensic labs/Counsel families with genetic disorders. Enable students to take up research in biological sciences.

**PO-CO-Mapping (Please write 3, 2, 1 where ever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	2	3	2	2	2	2	2	3	2
CO2	3	2	3	1	2	3	3	3	3	1	2	3
CO3	2	1	1	3	1	1	1	2	1	3	1	1

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	Skill Development	Employability	Entrepreneurship Development
CO1	2	3	2
CO2	2	3	2
CO3	1	2	1

**Suggested Readings:**

1. Primrose & Twyman. Principles of Genome Analysis and Genomics. Blackwell (2003).
2. Hartl & Jones. Genetics: principles & Analysis of Genes & Genomes. Jones & Bartlett (1998).
3. Sambrook *et al* .Molecular Cloning Vols I, II, III. CSHL (2001).
4. Primrose. Molecular Biotechnology. Panima (2001).

**Note: Latest editions of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B. Sc. (ZBC)-II Year (IV Semester)**  
**B040401T: Economic Botany, Ethnomedicine and Phytochemistry**

**Objective:** The objective of proposed course is expose to the students of centres of origin of crop plants for skill development, entrepreneurship and employability, concept of primary and secondary homes of domestication, green revolution in India with special reference to Norman E. Borlaug, M. S. Swaminathan, and economic importance of various plants and their products.

**Unit – 1** **(07 Sessions)**

**Origin and domestication of cultivated plants**

Centers of diversity of plants, origin of crop plants; Domestication and introduction of crop plants; Concepts of sustainable development; cultivation, production and uses of Cereals, legumes, Spices & beverages for skill development.

**Unit – 2** **(07 Sessions)**

**Botany of oils, Fibers, timber yielding plants & dyes**

Study of the plants with Botanical names, Family, part used and economic uses yielding Edible & essential oils; Sugar, Starch; Fibers; Paper, Fumitories & Masticatories, Rubber, Dyes, Timber, biofuel crops for skill development.

**Unit – 3** **(07 Sessions)**

**Commercial production of Flowers, Vegetables, and fruits (To be Chosen area wise)**

Commercial greenhouse cultivation of rose, Gerbera, Gladiolus, Anthurium/Lilium/lily, tomato, bell pepper, cucumber, strawberry & Exotic leafy vegetables using Hydroponics for skill development.

**Unit – 4** **(08 Sessions)**

**IPR & Traditional Knowledge**

IPR and WTO (TRIPS, WIPO), Patent Act 1970 and its amendments, TIFAC, NRDC, Rights, Procedure of obtaining patents, Working of patents, Infringement, Copyrights, Trademarks, Geographical Indications, Traditional Knowledge Digital Library, Protection of Traditional Knowledge & Protection of Plant Varieties and Biotech inventions for skill development and employability.

**Unit – 5** **(08 Sessions)**

**Ethnobotany**

Methodologies of Ethnobotanical research: Field work, Literature, Herbaria and Musea and other aspects of ethnobotany. Importance of ethnobotany in Indian systems of medicine (Siddha, Ayurveda and Unani), Role of AYUSH, NMPB, CIMAP and CARI.

Tribal knowledge towards disease diagnosis, treatment, medicinal plants, plant conservation and cultivation for skill development and employability.

## Unit – 6

(08 Sessions)

### Medicinal aspects

Study of common plants used by tribes (*Aeglemarmelos*, *Ficus religiosa*, *Cynadondactylon*, *Eclipta alba*, *Oxalis*, *Ocimum sanctum* and *Trichopus zeylanicus*) Ethnobotanical aspect of conservation and management of plant resources, Preservation of primeval forests in the form of sacred groves of individual species and Botanical uses depicted in our epics.

Plants in primary health care: common medicinal plants: *Tinospora*, *Acorus*, *Ocimum*, Turmeric and Aloe. Indian Pharmacopeia, Quality Evaluation of crude drugs & adulteration for skill development and employability.

## Unit – 7

(08 Sessions)

### Pharmacognosy

Preparation of drugs for commercial market - Organoleptic evaluation of drugs - Microscopic evaluation of drugs - Physical evaluation of drugs - Active and inert constituents of drugs - Classification of drug plants - individual drugs - drug adulteration. Sources of crude drugs – roots, rhizome, bulb, corm, leaves, stems, flowers, fruits and seeds; organoleptic study of *Adhatodavasica*, *Andrographispaniculata*, *Azadirachta indica*, *Coriandrumsativum*, *Datura metal*, *Eclipta alba*, *Embllicaofficinalis*, *Ocimum sanctum*, *Phyllanthusamarus*, *Ricinuscommunis*, *Vinca rosea* and *Zingiberofficinale* for skill development and employability.

## Unit – 8

(07 Sessions)

### Herbal Preparations & Phytochemistry

Collection of wild herbs - Capsules - compresses - Elixirs - Glycerites - Hydrotherapy or Herbal bath - Herbal oils - Liquid extracts or Tincture - Poultices - Salves - Slippery elm slurry and gruel - Suppositories - Teas. Plant natural products, general detection, extraction and characterization procedures. Glycosides and Flavonoids and therapeutic applications. Anthocyanins and Coumarins and therapeutic applications, Lignans, Terpenes, Volatile oils and Saponins, Carotenoids and Alkaloids Carotenoids and pharmacological activities for skill development and employability.

**Course outcomes:** After the completion of the course the students will be able to:

- CO1** Understand about the uses of plants–will know one plant-one employment for skill development
- CO2** Know origin of Agriculture, world centers of domesticated plants for enhancement of global knowledge.
- CO3** Understand the green revolution in India for skill development and what is the role of Norman E. Borlaug, M. S. Swaminathan at national level?
- CO4** Have the knowledge of plants as food, sugar yielding plants for skill development and employability.
- CO5** Have the knowledge of medicinal values of the plants, spices and condiments found at national level, for skill development and employability.
- CO6** Have the knowledge of non-wood forest products and non-alcoholic beverages for skill development and employability.

**CO7** Understand phyto-chemical analysis related to local medicinally important plants and economic products produced by the plants for skill development and employability.

**CO8** Know about the importance of local Medicinal plants and its useful parts, economically important plants in our daily life and also about the traditional medicines and herbs, and its relevance in modern times for skill development and employability.

**PO-CO Mapping (Please write 3, 2, 1 wherever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	1	2	3	1	1	1	1	1	3
CO2	1	3	2	1	1	3	1	1	1	1	3	3
CO3	1	3	3	1	1	1	1	1	1	1	1	3
CO4	1	1	3	1	2	1	1	3	1	1	3	3
CO5	1	1	3	1	3	3	1	3	2	1	3	3
CO6	3	1	1	1	3	3	1	1	2	1	1	1
CO7	3	1	1	1	3	3	1	1	1	1	1	1
CO8	3	1	1	1	3	3	1	1	1	1	1	1

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	2
CO2	3	1	2
CO3	3	1	1
CO4	3	3	1
CO5	3	3	1
CO6	3	3	1
CO7	3	3	1
CO8	3	3	1

**Suggested Readings:**

1. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.
2. Sambamurthy, AVSS & Subrahmanyam, NS (2000). Economic Botany of Crop Plants. Asiatech Publishers. New Delhi.
3. Singh, D.K and K.V. Peter. 2014. Protected cultivation of horticultural crops. New India Publishing Agency, India.
4. Reddy P. Parvatha. 2016. Sustainable crop protection under protected cultivation. Springer, Singapore.
5. Amit Deogirikar. 2019. A Text Book on Protected Cultivation and Secondary Agriculture. RajlaxmiPrakashan, Aurangabad, India.
6. Singh, B., B. Singh, N. Sabir and M Hasan. 2014. Advances in protected cultivation. New India Publishing Agency, India.

7. Sharma, OP. 1996. Hill's Economic Botany (Late Dr. AF Hill, adopted by OP Sharma). Tata McGraw Hill Co. Ltd., New Delhi.
8. Joe J. Hanan. 1997. Greenhouses: Advanced Technology for protected horticulture. CRC Press.
9. Krishnamurthy, K.V. (2004). An Advanced Text book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi
10. N.K. Acharya: Textbook on intellectual property rights, Asia Law House (2001).
11. Manjula Guru & M.B. Rao, Understanding Trips: Managing Knowledge in Developing Countries, Sage Publications (2003).
12. P. Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy, Tata McGraw-Hill (2001).
13. Arthur Raphael Miller, Micheal H. Davis; Intellectual Property: Patents, Trademarks and Copyright in a Nutshell, West Group Publishers (2000).
14. Jayashree Watal, Intellectual property rights in the WTO and developing countries, Oxford University Press, Oxford.
15. Jain, S. K. and V. Mudgal. 1999. A Handbook of Ethnobotany. Bishen Singh Mahendra Pal Singh, Dehradun.
16. Jeffrey, C. 1982. An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge. London.
17. Joshi, S. G. 2000. Medicinal Plants. Oxford and IBH, New Delhi.
18. Kokate, C. and Gokeale- Pharmacognacy- Nirali Prakashan, New Delhi.
19. Lad, V. 1984. Ayurveda – The Science of Self-healing. Motilal Banarasi Dass, New Delhi.
20. Lewis, W. H. and M. P. F. Elwin Lewis. 1976. Medical Botany. Plants Affecting Man's Health. A Wiley Inter science Publication. John Wiley and Sons, New York.
21. Farooqui, A. A. and Sreeraman, B. S. 2001. Cultivation of medicinal and aromatic crops. Universities Press.
22. Harborne, J. B. 1998. Phytochemical methods – a guide to modern techniques of plant analysis 3rd edition, Chapman and Hall.
23. Yesodha, D., Geetha, S and Radhakrishnan, V. 1997. Allied Biochemistry. Morgan publications, Chennai. 1. Gurdeep Chatwal, 1980. Organic chemistry of natural products. Vol. I. Himalaya Publishing house.
24. Kalsi, P. S. and Jagtap, S., 2012. Pharmaceutical medicinal and natural product chemistry. N.K. Mehra for Narosa Publishing House Pvt. Ltd. New Delhi.
25. Wallis, T. E. 1946. Text book of Pharmacognosy, J & A Churchill Ltd.
26. Roseline, A. 2011. Pharmacognosy. MJP Publishers, Chennai.
27. Jain S. K. 1989. Methods and approaches in Ethnobotany, Society of Ethnobotanists, Lucknow.
28. Sharol Tilgner, N. D. 1999. Herbal medicine - From the heart of the earth. Edn. 1, Printed in the USA by Malloy Lithographing Inc.
29. Pal, D.C. & Jain, S.K., 1998. Tribal Medicine. Naya Prakash Publishers, Calcutta.
30. Datta & Mukerji, 1952. Pharmacognosy of Indian roots of Rhizoms drugs. Bulletin No.1 Ministry of Health, Govt. of India.
31. Young Ken, H.W., 1948. Text Book of Pharmacognosy. Blakiston C., Philadelphia.
32. Shukla, R.S., 2000. Forestry for tribal development. A.H. Wheeler & Co. Ltd., India.
33. Raychudhuri, S.P., 1991. (Ed.) Recent advances in Medicinal aromatic and spice crops. Vol.1,

Today& Tomorrow's printers and publishers, NewDelhi.

34. Bajpai, P.K. 2006. Biological Instrumentation and methodology. S. Chand & Co.Ltd.

35. K. Wilson and J. Walker Eds. 2005. Biochemistry and Molecular Biology. Cambridge University Press.

36. K. Wilson and KH Goulding. 1986. Principles and techniques of Practical Biochemistry. (3 edn Edward Arnold, London.

**Suggested equivalent online courses:**

- [https://www.pnas.org/content/104/suppl\\_1/8641](https://www.pnas.org/content/104/suppl_1/8641)
- <https://www.journals.uchicago.edu/doi/pdfplus/10.1086/659998>
- <https://bsi.gov.in/page/en/ethnobotany>
- <http://www.legalserviceindia.com/article/198-Intellectual-Property-and-Traditional-knowledge.html>
- [https://www.brainkart.com/article/Economic-importance-Plants--Food,-Rice,-Oil,-Fibre,-Timber-yielding-plant\\_1095/](https://www.brainkart.com/article/Economic-importance-Plants--Food,-Rice,-Oil,-Fibre,-Timber-yielding-plant_1095/)
- <https://www.loc.gov/rr/scitech/tracer-bullets/economic-botanytb.html>
- <http://nsdl.niscair.res.in/bitstream/123456789/127/1/Fibre%20crops%20%20bamboo%20%20timber%20-%20Final.pdf>
- <https://www2.palomar.edu/users/warmstrong/econpls.htm>
- <https://www.longdom.org/proceedings/phytochemistry-and-phytoconstituents-of-herbal-drugs-and-formulations-1668.html>



**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B. Sc. (ZBC)-II Year (IV Semester)**  
**B040402P: Commercial Botany & Phytochemical Analysis**

**Objectives:**

The course aims to share the knowledge to the students about the experiments. The students will get a better understanding of the concept studied by them in theory course and correlate with experimental observations for skill development, entrepreneurship and employability.

**Unit-1 (Economic Botany & Micro techniques) (08 Sessions)**

- Cereals: Wheat (habit sketch, L.S./T.S. of grain, starch grains, micro-chemical tests); rice (habit sketch, study of paddy and grain, starch grains, micro-chemical tests) Legume: Pea or ground nut (habit, fruit, seed structure, micro-chemical tests)
- Source of sugars and starches: Sugarcane (habit sketch; cane juice- micro-chemical tests); potato (habit sketch, tuber morphology, T.S. of tuber to show localization of starch grains, W.M. of starch grains, micro-chemical tests.
- Tea- tea leaves, tests for tannin
- Mustard- plant specimen, seeds, tests for fat in crushed seeds Timbers: section of young stem.
- Jute- specimen, transverse section of stem, tests for lignin on T.S. of stem and study of fiber following maceration technique for skill development.
- Study of specimens of economic importance mentioned in Unit I & II

**Unit-2 (Commercial Cultivation) (08 Sessions)**

- Field visit to Green houses for understanding Floriculture & vegetables production Development of hydroponics nutrient solutions & running models for cultivation of vegetables
- Development of hydroponics nutrient solutions & running models for cultivation of fodder for skill development, and employability.

**Unit-3 (Cultivating Medicinal and aromatic plants & Essential oil extraction) (07 Sessions)**

- Lemon grass/ Neem/ Zinger /Rose/Mint for skill development, entrepreneurship and employability.

**Unit-4 (07 Sessions)**

- **Documentation from** Traditional Knowledge Digital Library, Mark the Geographic Indications on Map
- Understand –Nakshtra Vatika, Navgrah vatika and develop in your college
- To extract the names of the plants and Botanical uses depicted in our epics.
- Visit NISCAIR, New Delhi for skill development.

**Unit-5 (Ethnobotany) (07 Sessions)**

- Study of common plants used by tribes. *Aegle marmelos*, *Ficus religiosa*, *Cynadon dactylon*.
- Visit a tribal area and collect information on their traditional method of treatment using crude drugs.
- Familiarize with at least 5 folk medicines and study the cultivation, extraction and its medicinal

application for skill development.

- Observe the plants of ethno botanical importance in your area.
- Visit to an Ayurveda college or Ayurvedic Research Institute / Hospital

#### **Unit-6 (Instrumentation and Herbal Preparations)**

**(08 Sessions)**

- Develop Capsules of herbs, Develop Herbal oils, Develop Poulitice/cream
- Analyse some active ingredients using chromatography/Spectrophotometry for skill development, employability.

#### **Unit-7 (Pharmacognosy)**

**(08 Sessions)**

Organoleptic studies of plants mentioned in the theory for skill development:

- Morphological studies of vegetative and floral parts.
- Microscopic preparations of root, stem and leaf.
- Stomatal number and stomatal index.
- Vein islet number.
- Palisade ratio.
- Fibres and vessels (maceration).
- Starch test
- Proteins and lipid test

#### **Unit-8 (Phytochemistry)**

**(07 Sessions)**

- Determination of the percentage of foreign leaf in a drug composed of a mixture of leaves for skill development
- Dimensions of Calcium oxalate crystals in powdered crude drug.
- Preliminary phytochemical tests for alkaloids, terpenoids, glycosides, volatile oils, tannins & resins.
- Any 5 herbal preparations.

**Course outcomes:** After the completion of the course the students will be able to:

- CO1** Know about the commercial products produced from plants for skill development, entrepreneurship and employability.
- CO2** Gain the knowledge about cultivation practices of some economic crops for enhancement of global knowledge.
- CO3** Understand about the Ethnobotanical details of plants for skill development, and employability
- CO4** Learn about the chemistry of plants & herbal preparations for enhancement of global knowledge.
- CO5** Can become a protected cultivator, aromatic oil producer, Pharmacologist or quality analyst in drug Company for enhancement of global knowledge.
- CO6** Gain knowledge of food crops with special reference to carbohydrates, protein and fats on the basis of their local name, botanical name, family and their uses for skill development, entrepreneurship and employability.
- CO7** Identify and explain some local medicinal plants, Fibre yielding plants for skill development.
- CO8** Identify the woods in local area with special reference to their local name, botanical name and families to which they belong for skill development

**PO-CO Mapping (Please write 3, 2, 1 wherever required)****(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	1	1	3	1	1	1	1	1	3
CO2	1	3	2	1	1	3	1	1	1	1	3	3
CO3	1	3	3	1	1	1	1	1	1	1	1	3
CO4	1	1	3	1	1	1	1	3	1	1	3	3
CO5	1	1	3	1	1	1	1	1	1	1	3	3
CO6	1	3	3	1	1	1	3	3	1	1	1	1
CO7	1	3	3	1	1	1	3	3	1	1	1	1
CO8	1	3	3	1	1	1	3	3	1	1	1	1

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)****(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	Skill Development	Employability	Entrepreneurship Development
CO1	3	3	2
CO2	3	1	2
CO3	3	2	2
CO4	3	2	2
CO5	3	1	2
CO6	3	2	2
CO7	3	1	2
CO8	3	1	2

**Suggested Readings:**

1. Plant Ecology And Economic Botany by Dhankar - Sharma - Trivedi, RBD Publication
2. PHARMACOGNOSY ...Hindi Edition (Paperback, Hindi, Dr. Akancha Rashi, KHUSHAL JASWANI), RM Publication
3. Wallis, T. E. 1946. Text book of Pharmacognosy, J & A Churchill Ltd.
4. Roseline, A. 2011. Pharmacognosy. MJP Publishers, Chennai.
5. Jain S. K. 1989. Methods and approaches in Ethnobotany, Society of Ethno botanists, Lucknow.
6. Pal, D.C. & Jain, S.K., 1998. Tribal Medicine. Naya Prakash Publishers, Calcutta.
7. Datta & Mukerji, 1952. Pharmacognosy of Indian roots of Rhizome drugs. Bulletin No.1 Ministry of Health, Govt. of India.
8. Young Ken, H.W., 1948. Text Book of Pharmacognosy. Blakiston C., Philadelphia.
9. Shukla, R.S., 2000. Forestry for tribal development. A.H. Wheeler & Co. Ltd., India.
10. Raychudhuri, S.P., 1991. (Ed.) Recent advances in Medicinal aromatic and spice crops. Vol.1, Today & Tomorrow's printers and publishers, New Delhi.
11. Khasim S.M Botanical Micro techniques: Principles and Practice-
12. Sambamurthy, AVSS & Subrahmanyam, NS (2000). Economic Botany of Crop Plants. Asiatech Publishers. ew Delhi.
13. Singh, D.K and K.V. Peter. 2014. Protected cultivation of horticultural crops. New India Publishing Agency

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B.Sc. (ZBC) II Year IV Semester**  
**Course Code: B020401T**

**Course Title: Quantum Mechanics and Analytical Techniques**

**Objectives:** A main objective of this course is to develop basic skills to understand the atomic structure, elementary quantum mechanics, wave function and its significance; Schrodinger wave equation and its applications; Molecular orbital theory, basic ideas – Criteria for forming molecular orbital from atomic orbitals, Molecular Spectroscopy, Rotational Spectrum, vibrational Electronic Spectrum: photochemistry and kinetics of photochemical reaction. It is also of great importance to develop basic skills required for purification, solvent extraction, TLC and column chromatography.

**UNIT – I: Atomic Structure (05 Sessions)**

Idea of de-Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrödinger wave equation, significance of  $\Psi$  and  $\Psi^2$ , quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s, p, d, orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule.

**UNIT – II: Elementary Quantum Mechanics (10 Sessions)**

Elementary Quantum Mechanics : Black-body radiation, Planck's radiation law, photoelectric effect, heat capacity of solids, Bohr's model of hydrogen atom (no derivation) and its defects, Compton effect. de-Broglie hypothesis. Heisenberg uncertainty principle. Hamiltonian Operator. Schrödinger wave equation (time dependent and time independent) and its importance, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one dimensional box. Schrödinger wave equation for H-atom, separation into three equations (without derivation), quantum numbers and their importance, hydrogen like wave functions, radial wave functions, angular wave functions. Molecular orbital theory, basic ideas – Criteria for forming MO from AO, construction of MO by LCAO –  $H_2^+$  ion, calculation of energy levels from wave functions, physical picture of bonding and anti-bonding wave functions, concept of  $\sigma$ ,  $\sigma^*$ ,  $\pi$ ,  $\pi^*$  orbitals and their characteristics.

**UNIT – III: Molecular Spectroscopy (10 Sessions)**

Introduction: Electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the Born-Oppenheimer approximation, degrees of freedom

**Rotational Spectrum:** Diatomic molecules. Energy levels of a rigid rotor (semi-classical principles), selection rules, spectral intensity, distribution using population distribution (Maxwell-Boltzmann distribution) determination of bond length, qualitative description of non-rigid rotor, isotope effect.

**Vibrational Spectrum:** Infrared spectrum: Energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, development of skills for force constant and qualitative relation of force constant and bond energies, effect of anharmonic motion and isotope on the spectrum, idea of vibrational frequencies of different functional groups.

**Raman spectrum:** Concept of polarizability, pure rotational and pure vibrational, Raman spectra of diatomic molecules, selection rules. Electronic Spectrum: Concept of potential energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rules and Franck-Condon principle. Application of molecular spectroscopy in interpretation and employability in research and industries.

**UNIT – IV: UV-Visible Spectroscopy (05 Sessions)**

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules. Types of electronic transitions,  $\lambda_{max}$ , chromophores and auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; application of Woodward Rules for calculation of  $\lambda_{max}$  for

the conjugated dienes: alicyclic, homoannular and heteroannular; extended conjugated systems distinction between cis and trans isomers.

**UNIT – V: Infrared Spectroscopy (05 Sessions)**

Fundamental and non-fundamental molecular vibrations; Hooke's law selection rule, IR absorption positions of various functional groups; Effect of H-bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance; application in functional group analysis and interpretation of I.R. spectra of simple organic compounds.

**UNIT – VI: <sup>1</sup>H-NMR Spectroscopy (PMR) (10 Sessions)**

NMR Spectroscopy: introduction; nuclear spin; NMR active molecules; basic principles of Proton Magnetic Resonance; choice of solvent and internal standard; equivalent and non-equivalent protons; chemical shift and factors influencing it; ring current effect; significance of the terms: up-/downfield, shielded and deshielded protons; spin coupling and coupling constant (1st order spectra); relative intensities of first-order multiplets: Pascal's triangle; chemical and magnetic equivalence in NMR; anisotropic effects in alkene, alkyne, aldehydes and aromatics; NMR peak area, integration; relative peak positions with coupling patterns of common organic compounds; interpretation of NMR spectra of simple compounds. Applications of IR, UV and NMR spectroscopy for identification of simple organic molecules. Application of NMR Spectroscopy in interpretation of compounds and employability in research and development.

**UNIT – VII: Introduction to Mass Spectrometry (03 Sessions)**

Principle of mass spectrometry, the mass spectrum, mass spectrometry diagram, molecular ion, metastable ion, fragmentation process, McLafferty rearrangement.

**UNIT – VIII: Separation Techniques: Solvent Extraction (07 Sessions)**

Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique 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 the aqueous and non-aqueous media.

Chromatography: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods.

**Suggested Readings:**

1. Alberty, R A, Physical Chemistry, 4th edition Wiley Eastern Ltd, 2001.
2. Atkins, PW, The elements of physical chemistry, Oxford, 1991
3. Barrow, G .M, International student Edition. McGraw Hill, McGraw-Hill, 1973.
4. Cotton, F.A, Wilkinson, G and Gaus, P. L , Basic Inorganic Chemistry, 3<sup>rd</sup> Edition ,Wiley 1995
5. Lee, J.D, Concise Inorganic Chemistry 4<sup>th</sup> Edition ELBS, 1977
6. Clayden, J., Greeves, N., Warren, S., *Organic Chemistry*, Second edition, Oxford University Press 2012.
7. Silverstein, R. M., Bassler, G. C., Morrill, T. C. *Spectrometric Identification of Organic Compounds*, John Wiley and Sons, INC, Fifth edition.
8. Pavia, D. L. *et al. Introduction to Spectroscopy*, 5th Ed. Cengage Learning India Ed.
9. Willard, H.H. *et al.: Instrumental Methods of Analysis*, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
10. Christian, G.D. *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.
11. Harris, D.C.: *Exploring Chemical Analysis*, 9th Ed. New York, W.H. Freeman, 2016.
12. Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age International Publisher, 2009.

**Course outcomes:**

Upon successful completion of this course students should be able to:

CO1: Describe atomic structure, wave function and its significance; Schrodinger wave equation and its applications.

CO2: Learn elementary quantum mechanics, molecular orbital theory, basic ideas – Criteria for forming molecular orbital from atomic orbitals.

CO3: Development of basic skills to Analyze molecular Spectra such as rotational, vibrational and Raman Spectra

CO4: Learn concepts of electronic spectrum, Woodward-Fieser rules and fundamental laws of spectroscopy.

CO5: Determine various functional groups of organic molecules using IR spectra.

CO6: Determine the structure of organic molecules using NMR spectroscopic techniques for employability at local and national level.

CO7: Skill development to understand the importance of mass spectra in determination of structure of organic compounds.

CO8: Develop basic skills required for purification, solvent extraction, TLC and column chromatography

**Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)**

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	2	2	2	3	3	1	1
CO2	3	1	1	2	1	2	2	2	3	3	2	2
CO3	3	3	3	2	3	2	2	2	1	1	2	2
CO4	3	3	3	2	1	2	2	2	1	1	2	2
CO5	2	3	3	2	2	2	3	3	1	1	3	3
CO6	2	3	3	2	2	2	1	1	2	2	3	3
CO7	2	3	3	1	3	1	1	3	2	2	3	3
CO8	2	3	3	1	2	2	3	1	2	2	3	3

**CO-Curriculum Enrichment Mapping**

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	2	1
CO2	3	2	2
CO3	3	2	1
CO4	3	2	1
CO5	3	3	2
CO6	3	3	1
CO7	3	3	1
CO8	3	3	2

**Suggested online links:**

- <https://www.coursera.org/courses?query=chemistry&languages=en>
- <https://www.mooc-list.com/tags/physical-chemistry>
- <https://www.coursera.org/learn/physical-chemistry>
- <https://ocw.mit.edu/courses/chemistry/5-61-physical-chemistry-fall-2017/>
- <http://heecontent.upsdc.gov.in/Home.aspx>
- <https://nptel.ac.in/courses/104/108/104108078/>

- <https://nptel.ac.in/courses/104/108/104108124/>
- <https://nptel.ac.in/courses/104/106/104106122/>

**Note: Latest edition of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B.Sc. (ZBC) II Year IV Semester**  
**Course Code: B020402P**  
**Course Title: Instrumental Analysis**

**Objectives:** To develop skills for critical thinking and scientific inquiry in the performance, design, interpretation and documentation of laboratory experiments, at a level suitable to succeed at an entry-level position in chemical industry or a chemistry graduate program for development of employability and entrepreneurship.

**UNIT – I: Molecular Weight Determination (10 Sessions)**

1. Determination of molecular weight of a non-volatile solute by Rast method/ Beckmann freezing point method.
2. Determination of the apparent degree of dissociation of an electrolyte (e.g., NaCl) in aqueous solution at different concentrations by ebullioscopy

**UNIT – II: Spectrophotometry (20 Sessions)**

1. To verify Beer – Lambert Law for  $\text{KMnO}_4/\text{K}_2\text{Cr}_2\text{O}_7$  and determining the concentration of the given solution of the substance from absorption measurement
2. Determination of pKa values of indicator using spectrophotometry.
3. Determination of chemical oxygen demand (COD).
4. Determination of Biological oxygen demand (BOD).

**UNIT – III: Spectroscopy (10 Sessions)**

1. Assignment of labelled peaks in the IR spectrum of the same compound explaining the relative frequencies of the absorptions (C-H, O-H, N-H, C-O, C-N, C-X, C=C, C=O, N=O,  $\text{C}\equiv\text{C}$ ,  $\text{C}\equiv\text{N}$  stretching frequencies; characteristic bending vibrations are included. Spectra to be provided).
2. Assignment of labelled peaks in the  $^1\text{H}$  NMR spectra of the known organic compounds explaining the relative  $\delta$ -values and splitting pattern.
3. Identification of simple organic compounds by IR spectroscopy and NMR spectroscopy (Spectra to be provided). Application of Spectroscopy in interpretation of synthesized compounds and employability in research and development.

**UNIT – IV: Chromatographic Separations (20 Sessions)**

1. Paper chromatographic separation of following metal ions: i. Ni (II) and Co (II) ii. Cu(II) and Cd(II)
2. Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer Chromatography (TLC)
3. Separation and identification of the amino acids present in the given mixture by paper chromatography. Reporting the Rf values
4. TLC separation of a mixture of dyes (fluorescein and methylene blue) Application of TLC methods of compounds and employability in research and development.

**Suggested Readings:**

1. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6<sup>th</sup> Ed.*, Pearson, 2009.
2. Willard, H.H. *et al.: Instrumental Methods of Analysis*, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.



- Christian, G.D. *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.
- Harris, D.C. *Exploring Chemical Analysis*, 9th Ed. New York, W.H. Freeman, 2016.
- Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age International Publisher, 2009.
- Skoog, D.A. Holler F.J. and Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Edition.
- Mikes, O. & Chalmes, R.A. *Laboratory Handbook of Chromatographic & Allied Methods*, Elsevier Harwood Ltd. London.
- Ditts, R.V. *Analytical Chemistry: Methods of separation*. Van Nostrand, New York, 1974.

### Course outcomes:

Upon completion of this course will be able to:

CO1: To develop methods for determine molecular weight of a non-volatile solute.

CO2: Apply Beer – Lambert Law for determination of concentration as well as evaluate BOD, COD of any sample.

CO3: Determine the structure of organic molecules using IR and NMR spectroscopic techniques for employability at local and national level.

CO4: Develop basic skills required for purification, solvent extraction, TLC and column chromatography.

### Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	2	1	1	2	1	1	3	3	2
CO2	1	2	3	2	3	3	2	2	2	2	3	1
CO3	1	2	3	2	3	3	2	2	2	2	3	3
CO4	1	2	3	2	1	3	1	2	1	2	3	3

### CO-Curriculum Enrichment Mapping

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	3	1
CO2	3	3	3
CO3	3	3	2
CO4	3	3	1

### Suggestive online links

- <https://www.labster.com/chemistry-virtual-labs/>
- <https://www.vlab.co.in/broad-area-chemical-sciences>
- <http://chemcollective.org/vlabs>

**Note: Latest edition of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**Co-Curricular Course**  
**B.Sc. (ZBC) II Year IV Semester**  
**Course Title: Physical Education and Yoga**

Programme: Certificate	Year: First	Semester: Fourth
Co-Curricular Course		
Course Code: Z040401	Course Title: Physical Education and Yoga	
<b>Course outcomes:</b> Students will earn the introduction of Physical Education, Concept of fitness and wellness, Weight management and life style of an individual. The student will also learn about the relation of Yoga with mental health and value Education. In this course student will also learn about the aspects of the Traditional games of India.		
Credits: 2	Compulsory	
Max. Marks: 25+75	Min. Passing Marks: 40	
Total No. of Lectures-Tutorials- Practical (in hours per week): L-T-P:2-0-0		
Unit	Topics	No. of Lectures Total=30
I	<b>Physical Education:</b> <ul style="list-style-type: none"> <li>• Meaning, Definition, Aim and Objective.</li> <li>• Misconception About Physical Education.</li> <li>• Need, Importance and Scope of Physical Education in the Modern Society.</li> <li>• Physical Education Relationship with General Education.</li> <li>• Physical Education in India before Independence.</li> <li>• Physical Education in India after Independence.</li> </ul>	6 Theory
II	<b>Concept of Fitness and Wellness:</b> <ul style="list-style-type: none"> <li>• Meaning, Definition and Importance of Fitness and Wellness.</li> <li>• Components of Fitness.</li> <li>• Factor Affecting Fitness and Wellness.</li> </ul> <b>Weight Management:</b> <ul style="list-style-type: none"> <li>• Meaning and Definition of Obesity.</li> <li>• Causes of Obesity.</li> <li>• Management of Obesity.</li> <li>• Health problems due to Obesity.</li> </ul> <b>Lifestyle:</b> <ul style="list-style-type: none"> <li>• Meaning, Definition, Importance of Lifestyle.</li> <li>• Factor affecting Lifestyle.</li> <li>• Role of Physical activity in the maintains of Healthy Lifestyle.</li> </ul>	5 Theory 3Practical

<b>III</b>	<p><b>Yoga and Meditation:</b></p> <ul style="list-style-type: none"> <li>• Historical aspect of yoga.</li> <li>• Definition, types scopes &amp; importance of yoga.</li> <li>• Yoga relation with mental health and value education.</li> <li>• Yoga relation with Physical Education and sports.</li> <li>• Definition of Asana, differences between asana and physical exercise.</li> <li>• Definition and classification of pranayama.</li> <li>• Difference between pranayama and deep breathing.</li> <li>• <b>Practical:</b> Asana, Surya-Namaskar, Bhujang Asana, Naukasana, Halasana, Vajrasana, Padmasana, Shavasana, Makrasana, Dhanurasana, Tad Asana. Pranayam: Anulom, Vilom.</li> </ul>	2 Theory 6 Practical
<b>IV</b>	<p><b>Traditional Games of India:</b></p> <ul style="list-style-type: none"> <li>• Meaning; Types of Traditional Games- Gilli-Danda, Kanche, Stapu, Gutte, etc.</li> <li>• Importance/Benefits of Traditional Games.</li> <li>• How to Design Traditional Games.</li> </ul> <p><b>Recreation in Physical Education:</b></p> <ul style="list-style-type: none"> <li>• Meaning, Definition of Recreation.</li> <li>• Scope and Importance of Recreation.</li> <li>• General Principles of Recreation.</li> <li>• Types of Recreational Activities.</li> <li>• Aerobics and Zumba (Fir India Movement)</li> </ul>	2 Theory 6 Practical
<p><b>Suggested Readings:</b></p> <ul style="list-style-type: none"> <li>• Singh, Ajmer, Physical Education and Olympic Abhiyan, “Kalayani Publishers”, New Delhi, Revised Addition, 2006</li> <li>• Patel, Shrikrishna, Physical Education, “Agrawal Publishers”, Agra, 2014-15 Panday, Preeti, Sharirik Shiksha Sankalan, “Khel Sanskriti Prakashan, Kanpur</li> </ul>		
<ul style="list-style-type: none"> <li>❖ Kamlesh M. L., “Physical Education, Facts and foundations”, Faridabad P.B. Publications.</li> <li>❖ B.K.S. Yengar, &amp; quot; Light and Yog. Yoga Deepika &amp; quot;, George Allen of Unwin Ltd., London, 1981. Braj Bilari Nigam, Yoga Power &amp; quot; The Kpath of Personal achievement &amp; quot; Domen and Publishers, New Delhi, 2001.</li> <li>❖ Indira Devi, &amp; quot; Yoga for You &amp; quot;, Gibbs, Smith Publishers, Salt Lake City, 2002 Domen and Publishers, New Delhi-2001.</li> <li>❖ Jack Peter, &amp; quot; Yoga Master the Yogic Powers &amp; quot;, Abhishek Publications, Chandigarh, 2004. Janice Jerusalem, &amp; quot; A Guide To Yoga &amp; quot;, Parragon Bath, Baiihe-2004.</li> </ul>		
<p><b>Suggested Continuous Evaluation Methods:</b></p> <ul style="list-style-type: none"> <li>• Assignments(10)</li> <li>• Presentation(10)</li> <li>• Attendance( 5)</li> <li>• Final exam (75)</li> </ul>		
<p><b>Suggested equivalent online courses:</b></p> <ul style="list-style-type: none"> <li>• IGNOU.</li> <li>• Rajarshi Tandan Open University.</li> </ul>		
<p>Further Suggestions:.....</p>		

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B. Sc. (ZBC)-III Year (V Semester)**  
**BZO-501: Ecology and Toxicology**

**Objective:** The primary aim of the syllabus is to sensitize the students about the paramount role and importance of nature. The study of Ecology imparts us the knowledge about the judicious use of existing ecological resources for sustainable development. Ecology is the only branch of science which briefs us on the ways and means of living with nature for mutual benefit for skill development and employability.

**Unit I:** Ecosystem: Definition and types, pond ecosystem, Food chain, food web and ecological pyramids, Energy flow in an ecosystem, Single channel, Y- shape and Universal model for better understanding of skill. **(08 Sessions)**

**Unit II:** Population, Community, Ecological niche, Ecological Succession. Adaptation: Aquatic, Terrestrial, Aerial and Arboreal for skill development. **(10 Sessions)**

**Unit III:** Concepts, sources, types (air, water, soil, noise and radiation) Effect and control of environmental pollutions, Adaptation: Aquatic, Terrestrial, Aerial and Arboreal for understanding of entrepreneurial skill. **(08 Sessions)**

**Unit IV:** Exposure of toxicants (Routes of exposure and duration and frequency of exposure) Dose response relationships, Categories of toxic effects this gives knowledge for better employability in industry. **(08 Sessions)**

**Unit V:** Toxic effect of heavy metals (lead, cadmium and mercury) – Bioaccumulation and biomagnification to provide employability and skills. **(06 Sessions)**

**Course Outcomes:**

After successfully completing this course, the students will be able to:

- CO1:** Know the evolutionary and functional basis of animal ecology for skill development.
- CO2:** Demonstrate an understanding of key concepts in ecology with emphasis on historical perspective, role of physical factors and concept of limiting factors for understanding of entrepreneurial skill.
- CO3:** Comprehend the population characteristics, dynamics, growth models and interactions for better understanding of skill.
- CO4:** Understand the community characteristics, ecosystem development and climax theories to build up skills.
- CO5:** Gain knowledge about the toxicants, and heavy metal toxicity it provide employability and skills.

**PO-CO-Mapping (Please write 3, 2, 1 where ever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	1	1	1	1	2	2	1	1	1	1	1
<b>CO2</b>	1	2	1	1	1	1	1	2	3	2	1	1
<b>CO3</b>	2	1	1	2	3	1	1	1	1	1	2	2
<b>CO4</b>	2	2	1	1	1	1	1	1	1	1	1	1
<b>CO5</b>	2	1	1	1	1	1	1	1	1	1	1	1

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)  
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	<b>Skill Development</b>	<b>Employability</b>	<b>Entrepreneurship Development</b>
<b>CO1</b>	3	1	1
<b>CO2</b>	2	2	3
<b>CO3</b>	1	1	2
<b>CO4</b>	1	1	1
<b>CO5</b>	2	3	1

**Suggested Readings:**

1. Odum, E.P. 1983: Basic Ecology, Saunders, Philadelphia.
2. Sharma, P.D. (2010) Ecology and Environment, (8th Ed.) Rastogi Publications, Meerut.
3. Singh, J.S., Singh, S.P. and Gupta, S. (2006) Ecology Environment and ResourceConservation. Anamaya Publications, New Delhi

**Online Resources**

- Swayam (MHRD) Portal
- [https://en.wikipedia.org/wiki/Population\\_ecology](https://en.wikipedia.org/wiki/Population_ecology)
- [https://www.tutorialspoint.com/environmental\\_studies/environmental\\_studies\\_ecological\\_pyramid.html](https://www.tutorialspoint.com/environmental_studies/environmental_studies_ecological_pyramid.html)

**Note: Latest editions of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B. Sc. (ZBC)-III Year (V Semester)**  
**BZO-502: Animal Behavior and Biostatistics**

**Objective:** The course is aimed at introducing the application of bioinformatics and statistics in biology. It provides foundation on statistical methods to enable students to compute and interpret basic statistical parameters for skill development, entrepreneurship and employability.

**Unit- I:** Introduction to Ethology - definition, historical out line, patterns of behaviour, objectives of behaviour, Orientation primary and secondary orientation; kinesis – orthokinesis, klinokinesis; taxis – different kinds of taxis; sun-compass orientation for understanding of entrepreneurial skill . **(08 Sessions)**

**Unit-II:** Fixed action pattern: mechanism, deprivation experiment, controversies. FAP- characteristics and evolutionary features. Learning and instincts: conditioning, habituation, sensitization and reasoning, Motivation: models of motivation, measuring motivation. Communication- chemical (pheromones) Hormones and pheromones influencing behaviour of animals for skill development. **(10 Sessions)**

**Unit-III:** Biological Rhythms - Ultradian, Tidal/ Lunar, Circadian and Circannual rhythms; Migration in Fishes and Birds. This gives knowledge for better employability. **(08 Sessions)**

**Unit-IV:** Sampling, Measures of central tendency (mean, median and mode) for better understanding of skill. **(06 Sessions)**

**Unit-V:** Dispersion (variance, standard deviation and standard error); Correlation and Regression skilling of entrepreneurship. **(06 Sessions)**

**Course Outcomes:**

After successfully completing this course, the students will be able to:

**CO1:** Learn a wide range of theoretical and practical techniques used to study animal behavior for employability.

**CO2:** Develop skills, concepts and experience to understand all aspects of animal behavior for understanding of entrepreneurial skill.

**CO3:** Understand and evaluate information about animal behaviour and ecology encountered in our daily lives for skill development.

**CO4:** Gain the basic knowledge of Biostatistics for skill development and employability.

**CO5:** Understand and be able to objectively evaluate the role of behaviour in the protection and conservation of animals in the wild this gives knowledge for better employability in Research field.

**PO-CO-Mapping (Please write 3, 2, 1 where ever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	2	2	2	2	2	1	1	1
CO2	2	1	1	1	3	3	1	1	2	1	2	1
CO3	3	2	2	2	1	1	1	1	3	2	1	1
CO4	1	1	1	1	1	1	1	3	1	1	2	2
CO5	1	1	1	1	1	1	1	1	2	1	2	1

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)  
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	<b>Skill Development</b>	<b>Employability</b>	<b>Entrepreneurship Development</b>
<b>CO1</b>	1	3	1
<b>CO2</b>	1	1	3
<b>CO3</b>	3	1	2
<b>CO4</b>	2	3	1
<b>CO5</b>	1	3	1

**Suggested Readings:**

1. Animal Behaviour, David McFarland, Pitman Publishing Limited, London.
2. Animal Behaviour, John Alcock, Sinauer Associates Inc., USA
3. An Introduction to Animal Behaviour, A. Manning and M.S. Dawkins, Cambridge University Press, U.K.
4. Animal Behavior, Reena Mathur, Rastogi Publications, Meerut.
5. Principles of Biostatistics, Pagano M., Gauvreau, K, (2000), Duxbury Press, USA

**Online Resources:**

- <https://oer.galileo.usg.edu>
- <http://www.biologycorner.com>

**Note: Latest editions of all the suggested readings must be used**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B. Sc. (ZBC)-III Year (V Semester)**  
**BZO-551: Zoology Lab-5**

**Objective:** To make the study relevant, interesting, encouraging to the students to join the industry or to prepare them for higher studies including research. The new and updated syllabus is based on a basic and applied approach to ensure that students develop problem solving skills, laboratory skills, chemistry communication skills, team skills as well as ethics.

**List of Experiments:**

(20 Sessions)

1. To study Pyramid of numbers.
2. To study Pyramid of biomass.
3. To study Pyramid of energy.
4. To study and comment upon the adaptive and structural modifications in animals due to ecological conditions.
5. To determine the biomass of the given area.
6. To study the community by quadrat method by determining frequency, density and abundance of different species present in the community.
7. To study the pond ecosystems, its biotic components.
8. To study the soil profile.
9. To estimate pH of water sample by pH meter.
10. To study the geotaxis behavior of earthworm.
11. To demonstrate the phenomenon of photo-taxis in housefly.
12. Exercise based on Biostatistics

**Course Outcomes:**

After successfully completing this course, the students will be able to:

**CO1:** Know about the types of ecosystems, food chains, food webs, energy models, and ecological efficiencies skilling of entrepreneurship.

**CO2:** Engage in field-based research activities to understand well the theoretical aspects taught besides learning techniques for gathering data in the field for understanding of entrepreneurial skill.

**CO3:** Analyse a biological problem, derive testable hypotheses and then design experiments and put the tests into practice to provide employability and skills.

**CO4:** Solve the environmental problems involving interaction of humans and natural systems at local or global level skilling of entrepreneurship.

**CO5:** Inculcate scientific quantitative skills, evaluate experimental design and read graphs for entrepreneurship and employability.

**PO-CO-Mapping (Please write 3, 2, 1 where ever required)**

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

Cos/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	2	1	1	1	1	1	1	1
CO2	1	1	1	1	1	2	1	1	2	1	1	1
CO3	1	2	2	3	1	1	2	1	1	1	1	3
CO4	1	1	2	2	1	2	2	2	1	2	1	2
CO5	1	1	1	1	2	1	1	2	1	1	2	1

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)**

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	1	1	3
CO2	1	1	3



<b>CO3</b>	2	3	2
<b>CO4</b>	1	1	1
<b>CO5</b>	2	3	2

**Suggested Readings:**

1. Practical Ecology-by K. S. Rao
2. Practical Methods in Ecology- by Peter A. Henderson

**Online Resources**

- Swayam (MHRD) Portal
- [https://www.tutorialspoint.com/environmental\\_studies/environmental\\_studies\\_ecological\\_pyramid.html](https://www.tutorialspoint.com/environmental_studies/environmental_studies_ecological_pyramid.html)

**Note: Latest editions of all the suggested readings must be used.**

# IFTM University, Moradabad

## Bachelor of Science Programme B. Sc. (ZBC)-III Year (V Semester) BBO-501: PLANT PHYSIOLOGY

**Objective:** This course aims to familiarize the students with various physiological processes, water absorption, transpirations, ascent of sap, photosynthesis and respiration. The main objective of this course is to understand the growth hormones and their role in plant's physiology for skill development.

### UNIT-I

(08 Sessions)

Water relation of plants: imbibitions, diffusion, osmosis, Plasmolysis, water potential, water absorption, loss of water and ascent of sap for skill development.

Mineral nutrition of plants: Physiological role and deficiency symptoms of micro and macronutrients to provide skills.

### UNIT-II

(08 Sessions)

Photosynthesis: structure of chloroplast, absorption of light, transfer of light energy, electron transport, photophosphorylation, C<sub>3</sub>, C<sub>4</sub>, CAM pathways of carbon fixation for skill development.

### UNIT-III

(08 Sessions)

Transport of solutes: sugar translocation.

Respiration: aerobic and anaerobic, glycolysis. Krebs cycle, Electron Transport System (ETS), factors affecting respiration, respiratory quotient (RQ) and its measurement for skill development.

### UNIT-IV

(10 Sessions)

Plant growth hormones: physiological role of auxins, gibberellins, cytokinins, abscisic acid and ethylene.

Plant movements: movements of locomotion -spontaneous and induced (Tactic) and movements of curvature-spontaneous and induced (Tropic & Nastic) for skill development.

### UNIT-V

(08 Sessions)

Physiology of flowering: photoperiodism and vernalization.

Seed dormancy and germination for skill development.

### Course Outcomes:

#### On completion of the course, students will be able to:

CO1: Understand the plants and plant cells in relation to water, the movement of sap and absorption of water in plant body for skill development.

CO2: Know micro and macronutrients and their role in plant developments for skill development.

CO3: Understand the process of photosynthesis in higher plants with particular emphasis on light and dark reactions, C<sub>3</sub> and C<sub>4</sub> pathways for skill development.

CO4: Understand the respiration in higher plants with particular emphasis on aerobic and anaerobic respiration for skill development.

CO5: Understand the plant movements, physiology of flowering, seed dormancy and germination for skill development.

#### PO-CO Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	1	1	3	1	1	1	1	2	3
CO2	1	3	2	1	1	3	1	1	1	1	3	3
CO3	1	3	3	1	1	2	1	1	1	1	1	3
CO4	1	2	3	1	1	1	1	3	1	1	3	3
CO5	1	1	3	1	1	1	1	1	1	1	3	3

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)****(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1

**Suggested Reading:**

1. Hopkins, W.G. and Huner, P.A. 2008 Introduction to Plant Physiology. John Wiley and Sons.
2. Nelson, D.L., Cox, M.M. 2004 Lehninger Principles of Biochemistry, 4th edition, W.H. Freeman and Company, New York, USA.
3. Salisbury, F.B. and Ross, C.W. 1991 Plant Physiology, Wadsworth Publishing Co. Ltd.
4. Taiz, L. and Zeiger, E. 2006 Plant Physiology, 4th edition, Sinauer Associates Inc .MA, USA.
5. Dennis, D.T., Layzell, D.B., Lefebvre, D.D. and Turpin, D.H. (1997) Plant Metabolism. Addison Wesley Longman.
6. Salisbury, F.B. and Ross, C.W. (1991) Plant Physiology, Wadsworth Publishing Co. Ltd.
7. S.K. Verma, A text book of Plant Physiology, Biochemistry & Biotechnology, S. Chand & Company.
8. H.N. Srivastava, Plant Physiology, Pradeep Publication, Jhalandhar
9. S.N. Pandey & B.K. Sinha, Plant Physiology, Vikas Publication, Delhi
10. C.P. Malik. Plant Physiology

**Website Sources:**

- [www.pdfdrive.com/botany-books.html](http://www.pdfdrive.com/botany-books.html)
- [www.digitalbookindex.org](http://www.digitalbookindex.org)
- [www1.biologie.uni-hamburg.de](http://www1.biologie.uni-hamburg.de)
- [www.topfreebooks.org](http://www.topfreebooks.org)
- [www.pdf.com](http://www.pdf.com)
- [en.wikipedia.org](http://en.wikipedia.org)
- [www.yourarticlelibrary.com](http://www.yourarticlelibrary.com)
- [www.freebookcentre.net](http://www.freebookcentre.net)

**Note: Latest editions of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B. Sc. (ZBC)-III Year (V Semester)**  
**BBO-502: PLANT BIOCHEMISTRY**

**Objective:** The main objective of this course to familiarize the students with enzymes, mechanism of enzymes, synthesis and biological role of ATP, Chemistry of Nucleic acid, general account of vitamins, biomolecules and their significance as well as nitrogen metabolism for skill development.

**UNIT-I** **(08 Sessions)**  
 Enzymes: classification, nomenclature, mechanism of action (binding to substrate, lowering of activation energy), factors controlling enzyme activity, Coenzymes.  
 ATP, its synthesis and biological role for skill development.

**UNIT-II** **(08 Sessions)**  
 Nucleic Acid: Introduction, Nitrogenous Bases, Chemistry of structure of Bases, Pentose sugar, Phosphoric acid; Nucleoside; Nucleotide; Structure of DNA; Mechanism of DNA replication in eukaryotes.  
 Vitamins: General account of water- and fat-soluble vitamins for skill development.

**UNIT-III** **(06 Sessions)**  
 Carbohydrates: Introduction, classification of carbohydrates, chemistry of monosaccharide; some important reactions of monosaccharides; Reducing and non-reducing sugar; significances of carbohydrates for skill development.

**UNIT-IV** **(08 Sessions)**  
 Proteins: Introduction; classification of protein; structure of protein-primary, secondary and tertiary; denaturation and renaturation of protein.  
 The Lipids: Introduction; Classification of lipids/fatty acids; properties of fatty acid and fats; waxes; Derived lipids (Steroids); importance of lipids for skill development.

**UNIT-V** **(06 Sessions)**  
 Nitrogen metabolism: N<sub>2</sub> fixation (Symbiotic and Asymbiotic); assimilation into Amino-acids for skill development.

**Course Outcomes:**

**On completion of the course, students will be able to:**

- CO1: Understand the structure of atoms, chemical bonding of molecules for skill development.
- CO2: Explain the structure and functions of biomolecules for skill development.
- CO3: Learn bioenergetics processes in plants for skill development.
- CO4: Understand the principles of enzymes, enzyme kinetics, enzyme regulation and mechanism of enzyme action for skill development.
- CO5: Students will also learn metabolism of biomolecules for skill development.

**PO-CO Mapping (Please write 3, 2, 1 wherever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	1	1	3	1	1	1	1	1	3
CO2	1	3	1	1	1	3	1	1	1	2	3	3
CO3	1	3	3	1	1	1	1	1	1	2	2	3
CO4	1	1	3	1	1	1	1	3	1	1	3	3
CO5	1	1	3	1	1	1	1	1	1	1	3	3

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)****(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1

**Suggested Readings:**

1. Davies P J. (2004) Plant Hormones: Biosynthesis, Signal Transduction, Action. 3rd Edition, Kluwer Academic Publisher, Dordrecht, The Netherlands.
2. Jordan BR. (2006) The Molecular Biology and Biotechnology of Flowering, 2nd Edition, CAB International, Oxfordshire, U.K.
3. Lodish H, Berk A, Kaiser CA and Krieger M. (2008) Molecular Cell Biology, 6th Edition, W.H. Freeman and Company, New York, USA.
4. Lehninger (2004). Principles of Biochemistry, 4th Edition, Freeman and Company, New York, USA.
5. Taiz L and Zeiger E. (2006) Plant Physiology, 4th Edition, Sinauer Associates Inc. Publishers, Massachusetts, USA.
6. Jain, J. L. A text book of Biochemistry, S. Chand Publication, New Delhi.
7. Voet and Voet. Biochemistry. John Willey and Sons, Delhi.

**Website Sources:**

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- [www.digitalbookindex.org](http://www.digitalbookindex.org)
- [www1.biologie.uni-hamburg.de](http://www1.biologie.uni-hamburg.de)
- [www.topfreebooks.org](http://www.topfreebooks.org)
- [www.pdf.com](http://www.pdf.com)
- [en.wikipedia.org](http://en.wikipedia.org)
- [www.yourarticlelibrary.com](http://www.yourarticlelibrary.com)
- [www.freebookcentre.net](http://www.freebookcentre.net)

**Note: Latest editions of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B. Sc. (ZBC)-III Year (V Semester)**  
**BBO-503: INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY**

Objective: This course aims to transform agriculture to build locally relevant food systems that strengthen the economic viability of rural areas without damaging the natural ecosystems.

**Unit I** **(05 Sessions)**

Scope of microbes in industry and environment for skill development.

**Unit II** **(12 Sessions)**

Microbial production of industrial products: Microorganisms involved, media, fermentation conditions, downstream processing and uses; Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, estimation (qualitative and quantitative) of Enzyme: amylase or lipase activity, Organic acid (citric acid or glutamic acid), alcohol (Ethanol) and antibiotic (Penicillin) for skill development.

**Unit III** **(12 Sessions)**

Microorganisms for industrial applications and hands on screening microorganisms for casein hydrolysis; starch hydrolysis; cellulose hydrolysis. Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes (glucose isomerase and penicillin acylase) for skill development.

**Unit IV** **(06 Sessions)**

Microbes and quality of environment: Distribution of microbes in air; Isolation of microorganisms from soil, air and water skill development.

**Unit V** **(10 Sessions)**

Microbial flora of water: Water pollution, role of microbes in sewage and domestic waste water treatment systems. Determination of BOD, COD, TDS and TOC of water samples; Microorganisms as indicators of water quality, check coliform and fecal coliform in water samples for skill development.

**Course Outcomes:**

On completing this course, the students will be able to:

CO1: Understand about chemical processes, physical and edaphic factors affecting crops for skill development, employability, entrepreneurship development,

CO2: Gain the knowledge about the role of nitrogen in agroecosystem, weed ecology and weed management for skill development.

CO3: Learn about agricultural pests and their management for skill development

CO4: Understand about plant diseases and conservation genetic resources to develop skills of employability

CO5: Understand about cropping systems and agroecosystems in the landscape for skill development

**PO-CO Mapping (Please write 3, 2, 1 wherever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	1	1	3	1	1	1	1	1	3
CO2	1	3	2	1	1	3	1	1	1	1	3	3
CO3	1	3	3	1	1	1	1	1	1	1	2	3
CO4	1	2	3	1	1	1	1	3	1	1	3	3
CO5	1	2	3	1	1	1	1	1	1	1	3	3

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)****(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	2	1
CO5	3	1	1

**Suggested Readings:**

1. Pelzar, M.J. Jr., Chen E.C. S., Krieg, N.R. (2010). Microbiology: An application based approach. Tata McGraw Hill Education Pvt. Ltd., Delhi.
2. Tortora, G.J., Funke, B.R., Case. C.L. (2007). Microbiology. Pearson Benjamin Cummings, San Francisco, U.S.A. 9th edition.

**Website Sources:**

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- [www.digitalbookindex.org](http://www.digitalbookindex.org)
- [www1.biologie.uni-hamburg.de](http://www1.biologie.uni-hamburg.de)
- [www.topfreebooks.org](http://www.topfreebooks.org)
- [www.pdf.com](http://www.pdf.com)
- [en.wikipedia.org](http://en.wikipedia.org)
- [www.yourarticlelibrary.com](http://www.yourarticlelibrary.com)
- [www.freebookcentre.net](http://www.freebookcentre.net)

**Note: Latest editions of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B. Sc. (ZBC)-III Year (V Semester)**  
**BBO-504: PLANTS QUARANTINE**

**Objective:** The objective of this course is to provide knowledge on recent technological advances like molecular biology, biotechnology, plant physiology and biochemistry to provide the entrepreneurship and skills.

**UNIT-I** **(08 Sessions)**

Plant quarantine: Introduction to Plant Quarantine Information System (PQIS) and objective to provide the entrepreneurship and skills

**UNIT-II** **(08 Sessions)**

Imports: Plant Quarantine Order and Amendments, Issuance of the Import Permit, Import inspection and clearance, Procedures of PEQ inspection, Time schedules for clearance, Permits required for import of Germplasm, Transgenic or Genetically Modified Organisms, live insects and microbial cultures, plants and plant products, Requirement of Import of Wood and Timber: Special conditions of Import Special conditions for import of plant species for skill development

**UNIT-III** **(08 Sessions)**

Exports: Export inspection and certification procedure: Time schedules for clearance, Fees and Charges, Circular issued to Export Certification Authorities to provide skills.

**UNIT-IV** **(08 Sessions)**

Post-entry Quarantine: Appeal and Revision, Power of Relaxation, issuance of import permit, import inspection, inspection authorities Fees and charges, commodities not requiring Plant Quarantine clearance . Phytosanitary Agreement, national standards for phytosanitary measures, accredit treatment facilities, Quarantine Disinfestation Treatment to provide skills.

**UNIT-V** **(08 Sessions)**

Laws: The Destructive Insects and Pests Act, 1914 and amendments, The Plant Quarantine Order 2003 - Amendments, International Plant Protection Convention, WTO-SPS Agreement, International Standards Phytosanitary Measures (ISPMs) for skill development.

**Course Outcomes:**

**On completing this course, the students will be able to:**

CO1: Learn introduction to plant quarantine information system for skill development.

CO2: Learn what are Plant Quarantine Order and Amendments for skill development.

CO3: Understand export inspection and certification procedure for skill development.

CO4: Learn Phytosanitary Agreement, national standards for phytosanitary measures, accredit treatment facilities, and quarantine disinfestation treatment for entrepreneurship and skill development.

CO5: Know legal aspects for plant quarantine to provide skill development.

**PO-CO Mapping (Please write 3, 2, 1 wherever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	1	1	3	1	1	1	1	2	3
CO2	1	3	2	1	1	3	1	1	1	1	3	3
CO3	1	3	3	1	1	1	1	2	1	1	2	3
CO4	1	1	3	1	1	1	1	3	1	1	1	3
CO5	1	1	3	1	1	1	1	2	1	1	1	3



**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1

**Suggested Readings**

1. Muthaiyan, M.C. (2009). Principles and Practices of Plant Quarantine. Lucknow, U.P.: Allied publishers private limited.
2. Ebbels, D.L. (2003). Principles of Health and Quarantine, Bristol, UK; CABI Publishing

**Website Sources:**

- <https://onlinecourses.swayam2.ac.in/>
- <http://onlinecourses.nptel.ac.in>
- <https://lab-training.com/>
- <https://www.omicsonline.org>
- <en.wikipedia.org>

**Note: Latest editions of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B. Sc. (ZBC)-III Year (V Semester)**  
**BBO -551: PRACTICAL LAB -5**

**Objective:** The main Goal of this subject is to share the knowledge to the students about the experiments. The students will get a better understanding of the concept studied by them in theory course and correlate with experimental observations for skill development.

**List of Experiments:**

**(20 Sessions)**

**1. Plant Physiology** for skill development:

- i. Demonstration of Endosmosis, Exosmosis, Plasmolysis and Imbibition.
- ii. Measurement of transpiration, photosynthetic rate and R. Q. of different respiratory substrates.
- iii. Effect of temperature & light on the germination of seeds.

**2. Biochemistry** for skill development:

- i. Colour tests, microtests for carbohydrates, proteins and lipids.
- ii. Paper chromatography of chlorophyll pigments and amino-acids.
- iii. The study of Azolla and Rhizobium as biofertilizers.

**Course Outcomes:**

On completing this course, the students will be able to:

CO1: Understand how water is absorbed by the plants through the osmosis and what is Plasmolysis and imbibitions for skill development?

CO2: Find out the transpiration rate, respiration quotient of different respiratory substrates, photosynthesis rate under different conditions for skill development.

CO3: Know how do light and temperature effect the germination of seeds for skill development?

CO4: Observe the carbohydrates, protein and lipids in plant products for skill development.

CO5: Identify and explain the type of chlorophyll and amino acid present for skill development.

**PO-CO Mapping (Please write 3, 2, 1 wherever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	1	1	3	1	1	1	1	2	3
CO2	1	3	2	1	1	3	1	1	1	1	3	3
CO3	1	3	3	1	1	1	1	2	1	1	2	3
CO4	1	1	3	1	1	1	1	3	1	1	1	3
CO5	1	1	3	1	1	1	1	2	1	1	1	3

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1

**Suggested Readings:**

1. Practical Botany II by O.P Sharma
2. A text Book of Practical Botany<sup>2</sup> by Bendre and Kumar
3. Modern Practical Botany Vol. III by B.P. Pandey

**Website Sources:**

- <https://oer.galileo.usg.edu>
- <http://www.biologycorner.com>

**Note: Latest editions of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B.Sc. (ZBC) III Year (V Semester)**  
**BCHE-501 -INORGANIC CHEMISTRY**

**Objectives:** This course develops skills for production, chemistry and properties of the transition metals, lanthanides and actinides. Specifically, the class introduces electron configurations for the elements and oxidation state trends for each group. Including bonding and isomerism in coordination compounds, crystal field theory, and electronic properties of ligands. Also cover metal bonding in clusters, the HSAB concept, chelate effect, and complex stability.

**Unit – I** **(09 Sessions)**

Transition Metal Complexes:

Limitations of valence bond theory, an elementary idea of crystal field theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal-field parameters.

Stability of metal complexes and factors affecting the stability, stability constants of complexes and their determination. Role of transition metals in employability in manufacturing industries.

**Unit – II** **(09 Sessions)**

Magnetic Properties of Transition Metal Complexes:

Types of magnetic behavior, methods of determining magnetic susceptibility, spin-only formula, L-S coupling, orbital contribution to magnetic moments, application of magnetic moment data for 3d metal complexes.

**Unit – III** **(09 Sessions)**

Metal carbonyls, Silicones and Phosphazenes

Metal carbonyls: 18 electron rule, preparation, structure and nature of bonding in the mononuclear carbonyls. Silicones and phosphazenes as examples of inorganic polymers.

**Unit – IV** **(09 Sessions)**

Hard and Soft Acids and Bases (HSAB)

Classification of acids and bases as hard and soft, Pearson's HSAB concept, acid-base strength and hardness and softness, Symbiosis, theoretical basis of hardness and softness, electro negativity and hardness and softness. Water softening methods and its importance for employability in industries

**Suggested Readings:**

1. Inorganic Chemistry by J. E. Huheey.
2. Basic Inorganic Chemistry by Cotton and Wilkinson.
3. Concise Inorganic Chemistry by J. D. Lee.
4. The Organometallic Chemistry of Transition Metals: John Wiley.

**Course Outcomes:**

Students completing this course will be able to:

CO1: Gain knowledge of crystal field theory & relative stability about coordination complexes.

CO2: Describe the magnetic behavior of transition metal complexes

CO3: Understand nature and bonding in metal carbonyl, silicones and phosphazenes.

CO4: Apply the concept of hard and soft acids and bases to explain feasibility of reactions for skill development to get local employability

**CO/PO Mapping**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>
<b>CO1</b>	2	3	3	3	2	3	2	2	3	2	2	2
<b>CO2</b>	2	2	3	3	2	3	2	2	3	3	2	2
<b>CO3</b>	2	2	3	3	2	3	2	2	3	2	2	1
<b>CO4</b>	2	1	3	3	3	3	1	1	3	3	2	2

**CO- Curriculum Enrichment Mapping**

	<b>Skill Development</b>	<b>Employability</b>	<b>Entrepreneurship</b>
<b>CO1</b>	3	2	1
<b>CO2</b>	3	2	2
<b>CO3</b>	3	2	1
<b>CO4</b>	3	2	1

**Web Sources:**

- [www.chem.tamu.edu](http://www.chem.tamu.edu)
- [www.academia.edu](http://www.academia.edu)
- [www.amu.ac.in](http://www.amu.ac.in)
- [www.chem.tamu](http://www.chem.tamu)

**Note: Latest edition of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B.Sc. (ZBC) III Year (V Semester)**  
**BCHE-502: ORGANIC CHEMISTRY**

**Objective:** To Predict and explain patterns in shape, structure of organic compounds. To give idea about synthesis and reactivity for carbohydrates. To provide explanation of the chemistry of amino acids and proteins to understand the concepts of organic chemical structure and bonding and stability found in fats and oils and its importance for employability in food & chemical sector.

**Unit – I**

**(09 Sessions)**

**Spectroscopy**

Nuclear magnetic resonance (NMR) spectroscopy, Proton magnetic resonance ( $^1\text{H}$ - NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of  $^1\text{H}$  NMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1, 1, 2-tribromoethane, ethyl acetate, toluene and acetophenone, Problems pertaining to the structures elucidation of simple organic compounds using UV, IR and  $^1\text{H}$  NMR spectroscopic techniques. Application of NMR to develop employability in research and development.

**Unit – II**

**(09 Sessions)**

**Carbohydrates**

Classification and nomenclature, Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Conversion of glucose into mannose, Skill development in formation of glycosides, Determination of ring size of monosaccharides, Structures of ribose and deoxyribose.

An introduction to disaccharides (maltose, sucrose and lactose)

**Unit – III**

**(09 Sessions)**

**Amino Acids, Peptides and Proteins:**

Classification, structure and stereochemistry of amino acids, Acid-base behavior isoelectric point and electrophoresis, Preparation and reactions of  $\alpha$ - amino acids, classification and structure of proteins, selective hydrolysis of peptides, Protein denaturation/renaturation.

**Unit – IV**

**(09 Sessions)**

**Fats, Oils and Detergents**

Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides, hydrogenation of unsaturated oils, Saponification value, iodine value, acid value, Soaps, synthetic detergents. Importance for employability in research and development and entrepreneurship.

**Suggested Readings:**

1. Biochemistry: L. Steyer, Freeman and Co. New York.
2. Organic Synthesis: M. B. Smith, McGraw Hill, New York.
3. Advanced Organic Chemistry Reaction, Mechanism and Structure, M.B. Smith and J. March, John Wiley and Sons, New York.

**Course Outcomes:**

Students completing this course will able to:

CO1: Development of skills to analyze the structure of organic compound based on UV, IR and  $^1\text{H}$  NMR spectroscopy for employability in local and national industries

CO2: Understand classification, nomenclature, preparation of monosaccharides and its role in employability.

CO3: Learn the synthesis and properties of amino acids, peptides and proteins.

CO4: Explore the knowledge about effects of fats, oils and detergents for useful applications and its role in entrepreneurship.

**CO/PO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	2	3	3	2	3	2	2	3	3	2	3
<b>CO2</b>	2	2	3	3	2	3	3	2	3	2	2	2
<b>CO3</b>	2	3	3	3	2	3	3	1	3	2	2	2
<b>CO4</b>	2	2	3	3	1	3	2	3	3	3	2	3

**CO- Curriculum Enrichment Mapping**

	Skill Development	Employability	Entrepreneurship
<b>CO1</b>	3	2	2
<b>CO2</b>	3	2	2
<b>CO3</b>	3	2	2
<b>CO4</b>	3	3	3

**Web Sources:**

- [www.structbio.ptt.edu>notes>nmr\\_ref\\_notes-2011](http://www.structbio.ptt.edu>notes>nmr_ref_notes-2011)
- [www.academia.edu>CHE\\_320\\_organic\\_spectroscopy](http://www.academia.edu>CHE_320_organic_spectroscopy)
- [www.chtf.stuba.sk>files>Carbohydrates\\_Boudreaux](http://www.chtf.stuba.sk>files>Carbohydrates_Boudreaux)
- <https://nptel.ac.in/content/storage2/courses/104103071/pdf/mod11.pdf>

**Note: Latest edition of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B.Sc. (ZBC) III Year (V Semester)**  
**BCHE-503A: Surface Chemistry**  
**Elective Course**

**Objectives:** To familiarize students with the concepts of surface chemistry for their skill development. The students will learn about methods for the characterization of surfaces to get employability.

**UNIT-I** **(09 Sessions)**

The gas-solid interphase, types of adsorption. Heat of adsorption and its determination, differences between chemisorptions and physisorption for skill development.

**UNIT-II** **(09 Sessions)**

Adsorption isotherms - Freundlich and Langmuir isotherms. Thermodynamic and statistical derivation of Langmuir adsorption isotherm. Multilayer adsorption-the BET theory and Harkins-Jura theory.

**UNIT-III** **(09 Sessions)**

Determination of surface area of solids-Harkins-Jura absolute method, point B method, Langmuir method and BET method. Surface films-different types, surface pressure and its measurement.

**UNIT-IV** **(09 Sessions)**

Adsorption from solutions: Gibb's adsorption equation and its verification. Adsorption with dissociation. Adsorption with interaction between adsorbate molecules.

**Suggested Readings:**

1. The Surface Science of Metal Oxides, Victor E. Henrich, P. A. Cox, Cambridge University Press; New Ed edition, 1996.
2. Current Trends of Surface Science and Catalysis, Jeong Young (Ed.) Park (Author), Jeong Young Park(editor), 1st Edition, Springer, 2013.
3. Handbook of Heterogenous Catalysis, G. Ertl, H. Knozinger, F. Schuth, J. Weitkamp, WILEY-VCH Verlag GmbH & Co. KGaA, ISBN 978-3-527-31241-2
4. Nanotechnology in Catalysis, Spinger,; ISBN-0387-34687-2; Edited by G A Somorjai Vol-1-3
5. Nanostructures and Nanomaterials, Cao and Wang, 2nd Edition, World Scientific Publishing Company, 2011.

**Course Outcomes:**

Students completing this course will able to:

CO1: Develop skills to determine the heat of adsorption and differentiate chemisorption and physisorption

CO2: Understand Freundlich, Langmuir and BET isotherm and their role in employability.

CO3: Learn the methods of determination of surface area of solids.

CO4: Understand Gibb's adsorption equation and its verification and and its employability applications.

**CO/PO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	2	3	2	2	3	3	2	3
CO2	2	2	3	3	2	3	3	2	3	2	2	2
CO3	2	3	3	3	2	3	3	1	3	2	2	2
CO4	2	2	3	3	1	3	2	3	3	3	2	3



### CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship
CO1	3	2	2
CO2	3	2	2
CO3	3	2	2
CO4	3	3	3

### Website Sources:

- <http://www.chemguide.co.uk/>
- <https://freebookcentre.net/>

**Note: Latest edition of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B.Sc. (ZBC) III Year (V Semester)**  
**BCHE-504A: Metal-Pi Complex & Cluster**  
**Elective Course**

**Objectives:** After studying this module, students will be able to know about metal cluster compounds, preparative methods for metal cluster compounds, various types of reactions of metal cluster compounds for employability skills.

**UNIT-I**

**(09 Sessions)**

Electronic Spectra and Magnetic Properties of Transition Metal Complexes -I Electronic arrangements of microstates, calculation of the number of microstates in various electronic arrangements, spectroscopic term symbols, vector diagrams to indicate coupling of orbital angular momenta in  $p^2$ ,  $p^3$ ,  $d^2$  configurations and spin orbit coupling for  $p^2$  arrangement, spectroscopic terms, spectral terms of  $d^2$  to  $d^8$  metal ions, determining the ground state terms - Hund's rules, derivation of the term symbol for a closed subshell.

**UNIT-II**

**(09 Sessions)**

Electronic Spectra and Magnetic Properties of Transition Metal Complexes -II Interpretation of electronic spectra, Orgel diagrams, Tanabe-Sugano diagrams for transition metal complexes ( $d^1 - d^9$  states), calculations of  $Dq$ ,  $B$  and  $\beta$  parameters, charge transfer spectra, spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereochemical information, magnetic moment calculations spin only, orbital contribution quenching of magnetic moment, anomalous magnetic moments, magnetic exchange coupling and spin crossover.

**UNIT-III**

**(09 Sessions)**

Metal  $\pi$ -Complexes Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls; preparation, bonding, structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes; Carbonyl cations and anions and carbonyl hydrides; tertiary phosphine as ligand.

**UNIT-IV**

**(09 Sessions)**

Metal Clusters: Higher boranes, structure types, nido, arachano, closo etc structure prediction of boranes using STYX formulae, Wades rule, Wades Mingo rules, Isolobal analogy, carboranes, metalloboranes and metallocarboranes. Metal carbonyl and halide clusters, compounds with metal-metal

**Suggested Readings:**

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harper & Row.
3. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
4. Chemistry of the Elements, N.N. Greenwood and A. Earnshaw, Pergamon.
5. Introduction to Ligand fields; B.N. Figgis, Wiley, New York.
6. Modern Aspects of Inorganic Chemistry; H.J. Emeleus and Sharpe.
7. Introduction to Ligand Field Theory; C. J. Ballahyen, McGraw Hill, New York.
8. Organometallic Chemistry; R.C.Mehrotra and A.Singh, New Age International.

**Course Outcomes:**

Students completing this course will be able to:

CO1: Develop skills to determine the magnetic properties of transition metal complexes

CO2: Interpret electronic spectra, Orgel diagrams, Tanabe-Sugano diagrams for skill development.  
 CO3: Learn the vibrational spectra of metal carbonyls for bonding and structural elucidation.  
 CO4: Predict structure of boranes using STYX formulae.

#### CO/PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	2	3	2	2	3	3	2	3
CO2	2	2	3	3	2	3	3	2	3	2	2	2
CO3	2	3	3	3	2	3	3	1	3	2	2	2
CO4	2	2	3	3	1	3	2	3	3	3	2	3

#### CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship
CO1	3	2	2
CO2	3	2	2
CO3	3	2	2
CO4	3	3	3

#### Website Sources:

- <https://nptel.ac.in/course.html>
- <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5>

**Note: Latest edition of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B.Sc. (ZBC) III Year (V Semester)**  
**BCHE-505A: Structure & Reactivity**  
**Elective Course**

**Objectives:** To develop an understanding and appreciation of both structure and chemical transformations of organic molecules. Students will acquire basic concepts of electronic structure and be able to apply them to solve problems from various areas of organic chemistry, including stereochemistry, reactivity patterns and synthesis for skill development.

**UNIT-I**

**(09 Sessions)**

Nature of Bonding in Organic Molecules: Localised and Delocalized covalent bonds, Delocalised chemical bonding conjugation, cross conjugation, hyper conjugation, Tautomerism. Aromaticity: Concept of Aromaticity for skill development, Aromaticity of five membered, six membered rings and fused systems.- Non benzenoid aromatic compounds-cyclopropenyl cation, Cyclobutadienyl dication, cyclopentadienyl anion-tropyllium cation and cyclooctatetraenyl dianion. Homo aromaticity, Anti aromaticity and pseudo aromaticity.

**UNIT-II**

**(09 Sessions)**

Reactive Intermediates: Generation, Structure, Stability, Detection and Reactivity of Carbocations, Carbanions, Free radicals, Carbenes, Nitrenes and Arynes. B) Reactive Species: Generation and reactivity of Electrophiles, Nucleophiles, Dienophiles, Ylids, Enophiles.

**UNIT-III**

**(09 Sessions)**

Aliphatic Nucleophilic Substitutions: The  $SN^2$ ,  $SN^1$ , mixed  $SN^1$  and  $SN^2$  and  $SN^i$  reactions: Mechanism, factors effecting substitution reactions. The neighbouring group mechanism, anchimeric assistance by  $\sigma$  and  $\pi$  bonds.

**UNIT-IV**

**(09 Sessions)**

Additions: Addition to carbon – carbon multiple bonds, HX,  $X_2$ , stereo chemistry of addition, formation and reaction of epoxides, syn and anti-hydroxylation, hydrogenation (catalytic and Non catalytic), Cram's rule, Synthetic Reactions involving C-O and C-N bond.

**Suggested Readings:**

1. Advanced organic chemistry, Reaction, mechanism and structure, Jerry March, John Wiley.
2. Advanced organic chemistry, F.A.Carey and R.J.Sundberg, Springer, New York.
3. A guide book to Mechanism in organic chemistry, Peter Sykes, Longman.
4. Organic chemistry, I.L.Finar, Vol. I & II, Fifth ed. ELBS, 1975.
5. Organic chemistry, Hendrickson, Cram and Hammond (McGraw – Hill).
6. Modern organic Reactions, H.O.House, Benjamin.
7. Structure and mechanism in organic chemistry, C.K.Ingold, Cornell University Press.
8. Principles of organic synthesis, R.O.C.Norman and J.M.Coxon, Blakie Academic & Professional.

**Course Outcomes:**

Students completing this course will be able to:

CO1: Develop skills to predict the aromatic nature of a molecule

CO2: Understand various kinds of reaction intermediates and their properties.

CO3: Learn various aspects of aliphatic nucleophilic substitution reactions for employability.

CO4: Understand the mechanism and reactions for addition to carbon – carbon multiple bonds.

**CO/PO Mapping**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>
<b>CO1</b>	3	2	3	3	2	3	2	2	3	3	2	3
<b>CO2</b>	2	2	3	3	2	3	3	2	3	2	2	2
<b>CO3</b>	2	3	3	3	2	3	3	1	3	2	2	2
<b>CO4</b>	2	2	3	3	1	3	2	3	3	3	2	3

**CO- Curriculum Enrichment Mapping**

	<b>Skill Development</b>	<b>Employability</b>	<b>Entrepreneurship</b>
<b>CO1</b>	3	2	2
<b>CO2</b>	3	2	2
<b>CO3</b>	3	2	2
<b>CO4</b>	3	3	3

**Website Sources:**

- <http://www.chemguide.co.uk/>
- <https://freebookcentre.net/>

**Note: Latest edition of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B.Sc. (ZBC) III Year (V Semester)**  
**BCHE-551-CHEMISTRY PRACTICAL**

**Objectives:** Chemistry lab includes basic laboratory operation, separation and purification of organic compounds for honors students. Skill development to identify simple and fractional distillation, precipitation and crystallization, sublimation, solid-liquid and liquid-liquid extraction, and chromatography and role in entrepreneurship and employability.

**(20 Sessions)**

1. Estimation of Copper by gravimetric method.
2. Estimation of Nickel by gravimetric method.
3. Synthesis of hydrogel by co-precipitation method.
4. Synthesis of metal nanoparticles.
5. Determination of saponification value of an oil or Fat.
6. Determination of Iodine value of an oil or fat.
7. Preparation of Aspirin/Ibuprofen.
8. Preparation of Antacid.
9. Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide
10. Photoreduction of benzophenone to benzopinacol in the presence of sunlight.

**Course outcomes:**

Students completing this course will be able to:

CO1: Estimate metal ions in a solution using gravimetric analysis.

CO2: Skill development to understand the synthetic process of nano materials for employability at local and national industrial sector.

CO3: Learn the synthesis of drugs.

**CO/PO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	1	2	2	3	3	2	3
CO2	3	3	2	2	2	3	2	2	3	3	2	3
CO3	3	3	3	2	1	1	3	2	3	3	2	3

**CO- Curriculum Enrichment Mapping**

	Skill Development	Employability	Entrepreneurship
CO1	3	3	1
CO2	3	3	2
CO3	3	3	2

**Suggested readings:**

1. A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
2. A.I. Vogel: Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
3. A.I. Vogel: Textbook of Practical Organic Chemistry, Prentice Hall, 5th Edn.
4. F. G. Mann & B. C. Saunders: Practical Organic Chemistry, Orient Longman (1960). MUniversity.

### Web Sources

- <http://www.freebookcentre.net/Chemistry/InOrganic-Chemistry-Books.html>
- <http://www.freebookcentre.net/Chemistry/InOrganic-Chemistry-Books.html>
- <http://onlinelabs.in/chemistry>

**Note: Latest edition of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B. Sc. (ZBC)-III Year (VI Semester)**  
**BZO-601: Biotechnology, Immunology, Biological Tools and Techniques**

**Objective:** This course is designed to enable understanding the molecular and cellular basis of the development and function of the immune system and identification of its biological, clinical and therapeutic implications. The diverse techniques from microscopy to spectroscopy, calorimetry, chromatography ELISA, tissue culture to cloning etc. are included to make the student well versed with these protocols and methods for skill development, entrepreneurship and employability in Industries, Research labs.

**Unit I:** Genetic Engineering (concept and technology) and its applications in agriculture and medical areas and energy production. Biotechnology of food processing, pharmaceuticals (e.g. use of microbes in insulin production) and fermentation for skill development and employability. **(10 Sessions)**

**Unit II:** Concept of Immunology, types of immunity, Antigen and Antibodies, Types of Immunoglobulins and their applications employability in pathology. **(10 Sessions)**

**Unit III:** Vaccine, Vaccines of different diseases and immunological reactions and their types this gives knowledge for better employability in industry. **(06 Sessions)**

**Unit IV:** Principle and uses of instruments: pH Meter, Calorimeter, Microtome, Spectrophotometer and Centrifuge, ELISA for skill development and employability. **(08 Sessions)**

**Unit V:** Microscopy (light, transmission and Scanning electron microscopy) Chromatography and Electrophoresis for skill development. **(08 Sessions)**

**Course Outcomes:**

After successfully completing this course, the students will be able to:

- CO1:** Describe the basic mechanisms, distinctions and functional interplay of innate and adaptive immunity skilling of entrepreneurship.
- CO2:** Relate to errors occurring during development leading to congenital disorders and human diseases for skill development and employability.
- CO3:** Understand the purpose of the technique, its proper use and possible modifications employability in pathology.
- CO4:** Learn the accuracy of technique of Microscopy for skill development.
- CO5:** Learn the use of different laboratory instruments for understanding of entrepreneurial skill.

**PO-CO-Mapping (Please write 3, 2, 1 where ever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	3	1	1	2	1	1	1	1	1	2
CO2	2	1	1	3	1	1	1	2	1	2	1	1
CO3	1	3	1	1	1	1	3	1	2	1	2	1
CO4	1	1	1	1	2	1	2	2	1	1	1	2
CO5	1	1	1	1	1	1	1	3	1	2	1	1



**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)  
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	<b>Skill Development</b>	<b>Employability</b>	<b>Entrepreneurship Development</b>
<b>CO1</b>	3	1	2
<b>CO2</b>	2	3	1
<b>CO3</b>	3	1	1
<b>CO4</b>	2	1	1
<b>CO5</b>	3	1	2

**Suggested Readings:**

1. Instant notes in Immunology, (P. M. Lydyard, A. Whelam& M.W. Franger) , Publishers:BIOS Scientific
2. Kuby Immunology, Richard, Thomas, Barbara, Janis, (5th Ed., 2003), W. H. Freeman andcompany, New York, USA
3. Gene Cloning,T. A. Brown
4. Biotechnology, B.D. Singh,Kalyani Publication
5. Biotechnology, R. C. Dubey, S. Chand Publication, New Delhi

**Online Resources**

- <https://sjce.ac.in/wp-content/uploads/2018/04/Cell-Biology-Genetics-Laboratory-Manual-17-18.pdf>
- <https://oer.galileo.usg.edu>
- <http://www.biologycorner.com>

**Note: Latest editions of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B. Sc. (ZBC)-III Year (VI Semester)**  
**BZO-602: Applied and Economic Zoology**

**Objective:** The course is unique in highlighting the commercial and industrial significance/value of animals. It discusses the techniques/ methods of rearing of animals for commercial usage and the prerequisites for their successful maintenance and sustenance for skill development, entrepreneurship and employability.

**Unit-I:** Structure, Life cycle, Pathogenicity including diseases, Symptoms and control of following Parasites of domestic and humans, *Trypanosoma*, *Giardia*, *Plasmodium*, *Echinococcus*, *Schistosoma*, and *Wuchereria bancrofti* employability in pathology labs. **(08 Sessions)**

**Unit-II:** A detail study of the Life cycle and control of the Following: Gundhi Bug (Rice weevil), *Pyrilla* (Sugar cane leafhopper), Grasshoppers, Cotton bollworms, Aphids, Red flour Beetle, Rodents, Termites and Mosquitoes and their control to provide employability and skills. **(08 Sessions)**

**Unit-III:** Brief account of Aquaculture and Pisciculture, Polutry & Livestock (Cattle & Buffaloes). employability in fishery sectors. **(08 Sessions)**

**Unit-IV:** A brief account of Sericulture, Apiculture and Lac culture and their economic importance. employability in Beekeeping sectors and silk rearing industries. **(08 Sessions)**

**Unit-V:** A detailed account of endangered Species, Important Sanctuaries & National Parks of India. Different Projects launched for the preservation of animal species; in-situ and ex-situ conservation of wild life, Wild life Organizations, Wild Life in India. employability in wildlife sectors. **(06 Sessions)**

**Course Outcomes:**

After successfully completing this course, the students will be able to:

**CO1:** Understand the culture techniques of prawn, pearl and fish employability in fishery sectors.

**CO2:** Understand silkworms rearing and their products employability in silk rearing industries.

**CO3:** Understand the Bee keeping equipments and apiary management employability in Beekeeping sectors.

**CO4:** Understand dairy animal's management, the breeds and diseases of goats employability in Animal husbandry.

**CO5:** Learn the testing of egg and milk quality for understanding of entrepreneurial skill.

**PO-CO-Mapping (Please write 3, 2, 1 where ever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	2	1	2	1	1	1	2	1	1
CO2	2	1	2	1	1	3	1	1	2	1	1	2
CO3	1	1	1	1	2	1	2	2	1	2	1	1
CO4	1	2	1	3	1	1	1	1	1	1	1	1
CO5	1	3	1	1	3	1	1	2	1	1	1	1

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)  
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	<b>Skill Development</b>	<b>Employability</b>	<b>Entrepreneurship Development</b>
<b>CO1</b>	2	3	2
<b>CO2</b>	1	3	1
<b>CO3</b>	2	3	2
<b>CO4</b>	2	3	2
	<b>2</b>	1	3

**Suggested Readings:**

1. Applied and economic Zoology ,Dr.Veer Bala Rastogi, Kedar Nath Ram Nath
2. A Hand Book of Sericulture by Iyonemura& M. N. RamaRao.
3. Bee keeping by J. E. Eckert and F. R. Shaw.
4. Economic Zoology by G.S. Shukla & V.B. Upadhya

**Online resources**

- [www.digitalbookindex.org](http://www.digitalbookindex.org)
- [www1.biologie.uni-hamburg.de](http://www1.biologie.uni-hamburg.de)
- [www.topfreebooks.org](http://www.topfreebooks.org) ›
- [www.pdf.com](http://www.pdf.com)

**Note: Latest editions of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B. Sc. (ZBC)-III Year (VI Semester)**  
**BZO-651: Zoology Lab –6**

**Objective:**

To make the study relevant, interesting, encouraging to the students to join the industry or to prepare them for higher studies including research. The new and updated syllabus is based on a basic and applied approach to ensure that students develop problem solving skills, laboratory skills, chemistry communication skills, team skills as well as ethics. This gives knowledge for better employability in industry.

**List of Experiments:**

**(20 Sessions)**

1. Study of histological slides of organs of immune system – Thymus, Lymph nodes and Spleen
2. Determination of blood groups (ABO and Rh) in humans.
3. Antigen – Antibody interaction by double diffusion method (Ouchterlony)
4. Introduction to basic laboratory instruments and equipments- Autoclave, Centrifuge and pHmeter, Micropipettes, Digital balance, Electrophoresis apparatus.
5. Study of prepared slides/specimens of *Entamoeba*, *Giardia*, *Leshmania*, *Trypanosoma*, *Plasmodium*, *Fasciola*, *Taenia*, *Polystoma*, *Paraamphi-stomum*, *Schistosoma*, *Echinococcus*, *Entrobilus*, *Ascaris* and *Ancylostoma*.
6. Larval stages of Helminthes and Arthropods.
7. Permanent mount of wings, mouthparts and developmental stages of Mosquito and Collection and identification of pests.
8. Life history of Silkworm, Honeybee and Lac insects.
9. Different types of important edible fishes of India.

**Course Outcomes:**

After successfully completing this course, the students will be able to:

**CO1:** Study of animals which will improve their observation skills, data collection skills, critical thinking and analytical skills of students for skill development, entrepreneurship and employability.

**CO2:** Describe the basic mechanisms, distinctions and functional interplay of innate and Adaptive immunity for skill development and employability.

**PO-CO-Mapping (Please write 3, 2, 1 where ever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	1	2	1	3	3	1	1	2	2
CO2	3	1	1	1	3	1	1	1	2	1	1	1

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 where ever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	Skill Development	Employability	Entrepreneurship Development
CO1	2	3	2
CO2	2	3	2

**Suggested Readings:**

1. A manual of practical zoology: biodiversity, cell biology, genetics & developmental biology part 1 (M.M. Trigunayat).
2. Practical Zoology Invertebrate by S.S. Lal
3. Practical Zoology Invertebrate by P.S.Verma, S.Chand Publication

**Online Resources:**

- E-content on e-PG Pathshala portal of Government of India:<https://epgp.inflibnet.ac.in/Fundamentals>
- <https://www.asmscience.org/content/book>

**Note: Latest editions of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B. Sc. (ZBC)-III Year (VI Semester)**  
**BBO-601: FUNDAMENTALS OF BIOTECHNOLOGY**

**Objective:** This course aims to introduce to the students with basics concepts of biotechnology and its role in agriculture, medical field, functional foods and nutraceuticals for skill development.

**UNIT-I** **(08 Sessions)**

Introduction, Recombinant DNA technology: Restriction enzymes and cleavage; Agarose Gel Electrophoresis; Cloning vectors for skill development.

**UNIT-II** **(08 Sessions)**

Isolation of cellular DNA; Methods to obtain passenger DNA through genomic library, polymerase chain reaction; Ligation of passenger DNA into a vector for skill development.

**UNIT-III** **(06 Sessions)**

Transfer of recombinant DNA into bacterial cell (host); downstream processing for skill development.

**UNIT-IV** **(08 Sessions)**

Application of Biotechnology in agriculture; Pest resistant crops Bt crops, RNAi mediated crops; functional food and nutraceuticals for skill development

**UNIT-V** **(08 Sessions)**

Herbicide resistant transgenic plants; transgenic microbes; medical applications; production of enzymes, vitamins and antibiotics for skill development

**Course Outcomes:**

**Students, who successfully complete this course will be able to:**

CO1: Describe bio-catalysis, pathway engineering, bioprocess control and downstream processing for skill development.

CO2: Demonstrate their ability to reason both inductively and deductively with experimental information and data for skill development.

CO3: Explain the theory and practice of recombinant DNA technology for skill development.

CO4: Select and apply experimental procedures to the spectrum of fields making use of biotechnology for skill development.

CO5: Understand methods/procedures and different tools and techniques applied for proteome analysis for skill development.

**PO-CO Mapping (Please write 3, 2, 1 wherever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	1	1	3	1	1	2	1	1	3
CO2	1	3	2	1	1	3	1	1	1	2	3	3
CO3	1	3	3	1	1	1	1	1	1	1	3	3
CO4	1	1	3	1	1	1	1	3	1	2	3	3
CO5	1	1	3	1	1	1	1	1	1	2	3	3

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)****(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1

**Suggested Readings:**

1. Slater, A., Scott, N.W. & Fowler, M.R. 2008 Plant Biotechnology: The Genetic Manipulation of Plants, Oxford University Press.
2. Bhojwani, S.S. and Razdan 2004 Plant Tissue Culture and Practice.
3. Chrispeel, M.J. and Sadava, D.E. 1994 Plants, Genes and Agriculture. Jones and Barlett Publishers.
4. Reinert, J. and Bajaj, Y.P.S. 1997 Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture. Narosa Publishing House.
5. Smith, R. 2000 Plant Tissue Culture: Techniques and Experiments, 2nd edition, Academic.
6. Gardner, E.J. Simmonns, M.J. Snustad, D.P. 2008 8th edition Principles of Genetics. Wiley India.
7. Russell, P.J. 2009 Genetics – A Molecular Approach. 3rd edition. Benjamin Co.
8. Raven, P.H., Johnson, GB., Losos, J.B. and Singer, S.R. 2005 Biology. Tata MC Graw Hill.
9. Brown, T. A. Gene cloning and DNA analysis: An Introduction. Blackwell Publication.
10. Sambrook & Russel. Molecular Cloning: A Laboratory manual. (3rd edition)
11. B. D. Singh. Biotechnology. Kalyani Publications.
12. H. D. Kumar, Molecular Biology and Biotechnology, Vikas Publication, Delhi.
13. S. K. Verma. Plant Physiology, biochemistry & biotechnology. S. Chand & Co., New Delhi.
14. K. G. Ramawat. Plant Biotechnology, S. Chand & Co., New Delhi.

**Website Sources:**

- [www.pdfdrive.com/botany-books.html](http://www.pdfdrive.com/botany-books.html)
- [www.digitalbookindex.org](http://www.digitalbookindex.org)
- [www1.biologie.uni-hamburg.de](http://www1.biologie.uni-hamburg.de)
- [www.topfreebooks.org](http://www.topfreebooks.org) ›
- [www.pdf.com](http://www.pdf.com)
- [en.wikipedia.org](http://en.wikipedia.org)
- [www.yourarticlelibrary.com](http://www.yourarticlelibrary.com)
- [www.freebookcentre.net](http://www.freebookcentre.net)

**Note: Latest editions of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B. Sc. (ZBC)-III Year (VI Semester)**  
**BBO -602: PLANT ECOLOGY**

**Objective:** This course aims to familiarize the students with environment and its factors and to know the interrelationship between organisms in populations and communities and to aware the students regarding environmental issues and problems at local, national and international levels. The main theme of the study of plant ecology is to know the structure and functions of ecosystems for skill development,

**UNIT-I** **(10 Sessions)**

Introduction to Ecology: Definition; scope and importance; levels of organization.

Environment: Introduction; environmental factors- climatic (water, light, temperature), edaphic (soil profile, physico-chemical properties), topographic and biotic factors (species interaction) for skill development.

**UNIT-II** **(08 Sessions)**

Ecosystem: Structure (components) and functions (trophic levels, food chains, food webs, ecological pyramids and energy flow)

Biogeochemical cycles: carbon and nitrogen; Phosphorus cycle for skill development.

**UNIT-III** **(08 Sessions)**

Plant adaptations: Xerophytes, Hydrophytes, Halophytes, mangrove vegetation and Epiphytes.

Ecological succession: Xerosere and Hydrosere, climax concept.

Ecological nich; genecology with reference to ecads and ecotypes for skill development

**UNIT-IV** **(06 Sessions)**

Phytogeography: Phytogeographical regions of India; vegetation types of India (forests) for skill development.

**UNIT-V** **(08 Sessions)**

Environmental pollution: Sources, types and control of air and water pollution Global change: Greenhouse effect and greenhouse gases; impact of global warming for skill development.

**Course Outcomes:**

**On completion this course, students will be able to:**

CO1: Explain the ecological interconnectedness of life on earth by tracing energy and nutrient flow through the environment for skill development.

CO2: Understand the effects of the physical features of the environment on the structure of populations, communities, and ecosystems for skill development.

CO3: Describe the plant succession and plant adaptations for skill development.

CO4: Understand the environmental pollution and its effects for skill development.

CO5: Develop the understanding of student about the successive development of plant community and structure and function of some Indian ecosystems for skill development.

**PO-CO Mapping (Please write 3, 2, 1 wherever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	1	1	3	1	1	1	1	1	3
CO2	1	3	1	1	1	3	1	1	1	1	3	3
CO3	1	3	3	1	1	1	1	1	1	1	1	3
CO4	1	1	3	1	1	1	1	3	1	1	3	3
CO5	1	1	3	1	1	1	1	1	1	1	3	3



## CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)

(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1

### Suggested Readings:

1. Odum, E.P. 1983: Basic Ecology, Saunders, Philadelphia.
2. Kormondy, E.J. 1996: Concepts of Ecology, Prantice-Hall of India Pvt. Ltd., New Delhi.
3. Mackenzie, A. et al. 1999: Instant Notes in Ecology, Viva Books Pvt. Ltd., New Delhi.
4. Joseph, B., Environmental studies, Tata Mc Graw Hill.
5. Chapman, J.L., Reiss, M.J. 1999. Ecology: Principles and applications (2nd edition) Cambridge University Press.
6. Sinha, S. 2010. Handbook on Wildlife Law Enforcement in India. TRAFFIC, India.
7. Singh, J.S., Singh, S.P. and Gupta, S. (2006) Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi
8. Wilkinson, D.M. (2007). Fundamental Processes in Ecology. An Earth System Approach. Oxford.
9. Daubenmier, R.F. (1970). Plants and Environment: A text book of Plant Autoecology, Wiley Eastern Private Limited
10. Daubenmier, R.F. (1970), Plant Communities, Wiley Eastern Private Limited.
11. Odum, E. (2008) Ecology. Oxford and IBH Publisher.
12. Sharma, P.D. (2010) Ecology and Environment, (8th Ed.) Rastogi Publications, Meerut.
13. Shukla and Chandel; Ecology and Soil Science, S. Chand Publication,

### Website Sources:

- [www.pdfdrive.com/botany-books.html](http://www.pdfdrive.com/botany-books.html)
- [www.digitalbookindex.org](http://www.digitalbookindex.org)
- [www1.biologie.uni-hamburg.de](http://www1.biologie.uni-hamburg.de)
- [www.topfreebooks.org](http://www.topfreebooks.org)
- [www.pdf.com](http://www.pdf.com)
- [en.wikipedia.org](http://en.wikipedia.org)
- [www.yourarticlelibrary.com](http://www.yourarticlelibrary.com)
- [www.freebookcentre.net](http://www.freebookcentre.net)
- [onlinecourses.nptel.ac.in](http://onlinecourses.nptel.ac.in)

**Note: Latest editions of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B. Sc. (ZBC)-III Year (VI Semester)**  
**BBO-603: BIOINFORMATICS**

**Objectives:** This course aims to get introduced to the basic concepts of Bioinformatics and its significance in Biological data analysis, biological databases and database systems; understand the structural organisation, structural properties and various techniques employed in the structure determination of Biological macromolecules – DNA, Protein and Carbohydrates for skill development.

**UNIT-I**

**(08 Sessions)**

Introduction to Bioinformatics: Introduction, Branches of Bioinformatics, Aim, Scope and Research areas of Bioinformatics. Databases in Bioinformatics: Introduction, Biological Databases, Classification format of Biological Databases, Biological Database Retrieval System for skill development.

**UNIT-II**

**(10 Sessions)**

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 for skill development, employability.

**UNIT-III**

**(12 Sessions)**

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 for skill development, employability.

**UNIT-IV**

**(08 Sessions)**

Sequence Alignments: Introduction, Concept of Alignment, Multiple Sequence Alignment (MSA), MSA by CLUSTALW, Scoring Matrices, Percent Accepted Mutation (PAM), Blocks of Amino Acid Substitution Matrix (BLOSUM) for skill development, employability.

**UNIT-V**

**(10 Sessions)**

Molecular Phylogeny: Methods of Phylogeny, Software for Phylogenetic Analyses, Consistency of Molecular Phylogenetic Prediction. Applications of Bioinformatics: Structural Bioinformatics in Drug Discovery, Quantitative structure-activity relationship (QSAR) techniques in Drug Design, Microbial genome applications, Crop improvement for skill development, employability.

**Course Outcomes:**

**Students, who successfully complete this course will be able to:**

CO1: Understand aims, scope and research areas of Bioinformatics for skill development.

CO2: Learn about biological sequence databases for skill development and employability.

CO3: Understand the sequence analysis tools for skill development employability.

CO4: Understand the concept of alignment for skill development employability

CO5: Understand the methods of phylogeny and software for phylogenetic analyses for skill development.

**PO-CO Mapping (Please write 3, 2, 1 wherever required)****(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	1	1	3	1	1	2	1	1	3
CO2	1	3	2	1	1	3	1	1	1	2	3	3
CO3	1	3	3	1	1	1	1	1	1	1	3	3
CO4	1	1	3	1	1	1	1	3	1	2	3	3
CO5	1	1	3	1	1	1	1	1	1	2	3	3

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)****(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	Skill Development	Employability	Entrepreneurship Development
CO1	3	2	1
CO2	3	2	1
CO3	3	2	1
CO4	3	2	1
CO5	3	2	1

**Suggested Readings:**

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

**Website Sources:**

- [www.pdfdrive.com/botany-books.html](http://www.pdfdrive.com/botany-books.html)
- [www.digitalbookindex.org](http://www.digitalbookindex.org)
- [www1.biologie.uni-hamburg.de](http://www1.biologie.uni-hamburg.de)
- [www.topfreebooks.org](http://www.topfreebooks.org)
- [www.pdf.com](http://www.pdf.com)
- [en.wikipedia.org](http://en.wikipedia.org)
- [www.yourarticlelibrary.com](http://www.yourarticlelibrary.com)
- [www.freebookcentre.net](http://www.freebookcentre.net)

**Note: Latest editions of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B. Sc. (ZBC)-III Year (VI Semester)**  
**BBO-603: WEED SCIENCE**

**Objective:** This course aims to familiarize the students with weeds, their effects and control measures.

**UNIT-I** **(08 Sessions)**

Biology of Weeds: Ecology of weeds, competition, reproduction of weeds, Seed biology for skill development.

**UNIT-II** **(08 Sessions)**

Weed Management Practices: Mechanical Practices, Cultural Practices, Biological control for skill development.

**UNIT-III** **(10 Sessions)**

Chemical Weed Control: Herbicide classification, Selectivity of herbicides, absorption and translocation of herbicides, Mode of action of herbicides, Detoxification mechanisms of herbicides. Weed resistance to herbicides for skill development.

**UNIT-IV** **(08 Sessions)**

Weed Control Methods: Weed control in wheat, rice and vegetable crops. Control of five abnoxious weeds for skill development.

**UNIT-V** **(08 Sessions)**

Shift of weed flora in cropping systems, Problematic weeds and their control, control of weed in non-cropped situations for skill development

**Course Outcomes:**

CO1: Understand the means of weeds and how they compete with crop plants for skill development.

CO2: Enhance weed management skill.

CO3: gain knowledge about chemical methods of weeds for skill development.

CO4: know how to control of weeds in crop plants for skill development

CO5: Know about crop rotation practices to control weeds for skill development.

**PO-CO Mapping (Please write 3, 2, 1 wherever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	1	1	3	1	1	1	1	2	3
CO2	1	3	2	1	1	3	1	1	1	1	3	3
CO3	1	3	3	1	1	2	1	1	1	1	1	3
CO4	1	1	3	1	1	1	1	3	1	1	3	3
CO5	1	1	3	1	1	2	1	1	1	1	3	3

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	1

### **Suggested Readings:**

1. Dawson, C. (2002). Practical research methods. UBS Publishers, New Delhi.
2. Stapleton, P., Yondewei, A., Mukanyange, J., Houten, H. (1995). Scientific writing for agricultural research scientists – a training reference manual. West Africa Rice Development Association, Hong Kong.
3. Ruzin, S.E. (1999). Plant microtechnique and microscopy. Oxford University Press, New York, U.S.A.

### **Website Sources:**

- <https://onlinecourses.swayam2.ac.in/>
- <http://onlinecourses.nptel.ac.in>
- <https://lab-training.com/>
- <https://www.omicsonline.org>
- [en.wikipedia.org](http://en.wikipedia.org)
- [www.pdfdrive.com/botany-books.html](http://www.pdfdrive.com/botany-books.html)
- [www.digitalbookindex.org](http://www.digitalbookindex.org)
- [www1.biologie.uni-hamburg.de](http://www1.biologie.uni-hamburg.de)
- [www.topfreebooks.org](http://www.topfreebooks.org) ›

**Note: Latest editions of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B. Sc. (ZBC)-III Year (VI Semester)**  
**BB)-651: BOTANY LAB-6**

**Objective:** The main Goal of this subject is to share the knowledge to the students about the experiments. The students will get a better understanding of the concept studied by them in theory course and correlate with experimental observations for skill development.

**List of Experiments:**

**(20 Sessions)**

**Biotechnology:**

1. Plasmid DNA isolation: Mineprep
2. Agrose gel electrophoresis of isolated plasmid.

**Ecology:**

1. Study of vegetation by Quadrat method; study of parameters such as – Density, abundance, Frequency and Relative Frequency.
2. Study of morphology and anatomy of hydrophytes, Xerophytes and Halophytes.
3. Study of polluted water and saline water on seed germination and seedling growth of a given crop.
4. Identification of Soil texture - clay, sand, loamy.
5. Measurement of pH of soil using pH meter.
6. Study of water holding capacity of different soils.
7. Study of qualitative presence of CO<sub>3</sub>, NO<sub>3</sub>, SO<sub>4</sub>& Cl in soil.

**Course Outcomes:**

**On completing this course, the students will be able to:**

CO1: Isolate plasmid DNA for skill development

CO2: Know the practical aspects of Agrose gel electrophoresis for skill development

CO3: Find out Density, abundance, Frequency and Relative Frequency of plant species in given area by quadrat method for skill development.

CO4: Know what effects of polluted water and saline water are on seed germination and seedling growth for skill development.

CO5: Find out water holding capacity and qualitative presence of some mineral ions for skill development and entrepreneurship.

CO6: Identify the hydrophytes, xerophytes and halophytes on the basis of their morphological and anatomical features for skill development.

**PO-CO Mapping (Please write 3, 2, 1 wherever required)**

**(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	1	1	3	1	1	1	1	2	3
CO2	1	3	1	1	1	3	1	1	1	1	3	3
CO3	1	3	3	1	1	1	1	1	1	1	2	3
CO4	1	1	3	1	1	1	1	3	1	1	3	3
CO5	1	1	3	1	1	1	1	1	1	1	3	3
CO6	1	3	1	1	1	1	1	1	1	1	1	1

**CO-Curriculum Enrichment Mapping (Please write 3, 2, 1 wherever required)****(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)**

	Skill Development	Employability	Entrepreneurship Development
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	1	1
CO5	3	1	2
CO6	3	1	1

**Suggested Readings:**

1. Practical Agronomy by R. B. Tiwari
2. A text Book of Practical Botany2 by Bendre and Kumar
3. Sharma, P.D. (2010) Ecology and Environment, (8th Ed.) Rastogi Publications, Meerut.
4. Shukla and Chandel; Ecology and Soil Science, S. Chand Publication,

**Website Sources:**

- <https://onlinecourses.swayam2.ac.in/>
- <http://onlinecourses.nptel.ac.in>
- <https://lab-training.com/>
- <https://www.omicsonline.org>
- [www.pdfdrive.com/botany-books.html](http://www.pdfdrive.com/botany-books.html)

**Note: Latest editions of all the suggested readings must be used**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B.Sc. (ZBC) III Year (VI Semester)**  
**BCHE-601: PHYSICAL CHEMISTRY**

**Objectives:** To develop basic skills to understand concepts regarding the physical properties and molecular structure. To derive the expressions for Schrödinger wave equation and its importance. To study the concept, interaction of radiation with matter and Laws of photochemistry and role in employability.

**Unit – I** **(09 Sessions)**

Physical Properties and Molecular Structure:

Optical activity, polarization – (Clausius-Mossotti equation), orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment-temperature method and refractivity method, dipole moment and structure of molecules, magnetic properties paramagnetism, diamagnetism and ferromagnetism.

**Unit – II** **(09 Sessions)**

Quantum Mechanics:

Schrödinger wave equation and its importance, postulates of quantum mechanics, particle in a one dimensional box., calculation of energy levels from wave functions, Hybrid orbitals –  $sp$ ,  $sp^3$ ,  $sp^2$ , calculation of coefficients of A.O's used in  $sp$  and  $sp^2$  hybrid orbitals and interpretation of geometry.

**Unit – III** **(09 Sessions)**

Spectroscopy:

Introduction: electromagnetic radiation, regions of the spectrum.

Rotational *Spectrum*-

Diatomic Molecules:

energy levels of a rigid rotor (semi-classical principles), selection rules, determination of bond length, qualitative description of non-rigid rotor, isotope effect.

Infrared Spectrum: Energy levels of simple harmonic oscillator, selection rules, determination of force constant and qualitative relation of force constant and bond energies, effect of anharmonic motion & isotope on the spectrum, idea of vibrational frequencies of different functional groups.

**Unit – IV** **(09 Sessions)**

Photochemistry:

Interaction of radiation with matter, Laws of photochemistry: Grothus–Draper law, Stark – Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non- radiative processes (internal conversion, intersystem crossing), quantum yield.

**Course outcomes:**

Students completing this course will able to:

CO1: Develop basic and advance concepts of the physical properties & molecular structure for employability at local and national level.

CO2: Skill development to derive mathematical expressions for different energy levels from wave functions.

CO3: Explain the Infra Red spectra of diatomic molecules.

CO4: Explain the concept of Jablonski diagram depicting various processes occurring in the excited state.



**CO/PO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	3	3	3	2	2	3	2	1	2
CO2	2	3	3	3	3	3	3	2	3	2	2	2
CO3	1	2	3	3	3	3	2	2	3	3	2	2
CO4	2	2	3	3	3	3	2	1	3	3	2	2

**CO- Curriculum Enrichment Mapping**

	Skill Development	Employability	Entrepreneurship
CO1	3	2	1
CO2	3	2	2
CO3	3	2	1
CO4	3	1	2

**Suggested Readings:**

1. Text Book of Physical Chemistry by S. Glasstone.
2. Advanced Physical Chemistry by Gurudeep Raj.
3. Modern Electrochemistry J.O. M. Bockris and A. K. M. Reddy, Plenum Press New York.
4. Physical Chemistry: Atkins, Oxford University Press, New York.
5. Physical Chemistry, I.N. Levine: Tata McGraw Hill Publication New Delhi.

**Web Sources:**

- <http://www.freebookcentre.net/Chemistry/Chemistry-Books-Online.html>
- <https://guides.lib.umich.edu/c.php?g=282900&p=1885122>

**Note: Latest edition of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B.Sc.(ZBC) III Year (VI Semester)**  
**BCHE-602: -POLYMER CHEMISTRY**

**Objectives:** To develop skills for polymeric materials and their classification and to learn about different mechanisms of polymerization along with polymerization techniques To determine chain length of polymers based on their kinetic mechanism To learn about different methods of finding out average molecular weight of polymers and transition temperature ( $T_g$ ) and crystalline melting point ( $T_m$ ) Determination of  $T_g$  and  $T_m$ .

**Unit – I** **(09 Sessions)**

Introduction and nomenclature:

Characteristic, Classification, Nomenclature of Polymer, Functionality, Physical Properties of Polymer, Mechanism of Polymerization (Addition Polymerization) and application in industries and employability.

**Unit-II** **(09 Sessions)**

Molecular Weight Determination:

Molecular weight, Determination of molecular weight of polymers by osmotic pressure and viscosity method and its practical significance, Viscometry, Chemical and geometrical structure of Polymers.

**UNIT-III** **(09 Sessions)**

Characterization:

Glass-transition temperature ( $T_g$ ) of polymer, factors that affect the value of  $T_g$ ,  $T_g$  and molecular weight, melting point, Importance of  $T_g$ , Brief idea of crystallinity.

**Unit-IV** **(09 Sessions)**

Processing of Polymers:

Processing of Polymers (Calendaring, Die casting, Film casting, Moulding), High Performance Polymers (PPS, PES, PEEK, Polyamides), Classification and application of composites. Importance of polymer in employability in research and development.

**Course Outcomes:**

Students completing this course will able to:

CO1: Understand the importance of macromolecules/polymers in day to day life and apply their knowledge in sustainable development.

CO2: Development of skills to apply the learned fundamental instrumental techniques in the polymer characterization for employability at local and national level.

CO3: Explain crystalline melting temperature and glass transition temperature, including the flow properties of polymer melts and polymer solutions, with respect to temperature and molecular weight both.

CO4: Acquire knowledge of processing of polymers, high performance polymers and new polymer related applications.

**CO/PO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	3	2	3	2	2	3	2	2	2
CO2	3	2	3	3	2	3	2	3	3	3	2	3
CO3	2	2	3	3	2	3	2	2	3	2	1	2
CO4	2	2	3	3	2	3	2	2	3	3	2	3

### CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship
CO1	3	2	3
CO2	3	3	2
CO3	3	3	2
CO4	3	3	3

#### Suggested Readings:

1. Text Book of Polymer Science, F. W. Billmeyer, Wiley Science New York.
2. Principles of Polymerization, J. Odien, John Wiley, Singapore
3. Principles of Polymer Science, P. Bahadur and N. V. Shashtri, Narosa Publishing House, New Delhi.
4. Polymer Sciences, V.R. Gowarikar and J. Sridhar, Wiley Eastern New Delhi.

#### Web Sources

- <https://guides.lib.umich.edu/c.php?g=282900&p=1885122>
- <http://www.freebookcentre.net/Chemistry/Chemistry-Books-Online.html>

**Note: Latest edition of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B.Sc. (ZBC) III Year (VI Semester)**  
**BCHE-603A: Statistical Mechanics**  
**Elective Course**

**Objectives:** To understand the properties of macroscopic systems using the knowledge of the properties of individual particles for skill development and employability.

**UNIT-I** **(09 Sessions)**

The Statistical Basis of Thermodynamics: The macroscopic and microscopic states, contact between statistics and thermodynamics, classical ideal gas, Gibbs paradox and its solution.

**UNIT-II** **(09 Sessions)**

Ensemble Theory: Phase space and Liouville's Theorem, The microcanonical ensemble theory and its application to ideal gas of monatomic particles, Partition function, Classical ideal gas in canonical ensemble theory, Energy fluctuations, Equipartition and virial theorems, A system of harmonic oscillators as canonical ensemble, Thermodynamics of magnetic systems and negative temperatures, The grand canonical ensemble and significance of statistical quantities. Classical ideal gas in grand canonical ensemble theory. Density and energy fluctuations.

**UNIT-III** **(09 Sessions)**

Ideal Bose Systems: Basic concepts and thermodynamic behavior of an ideal Bose gas, Bose Einstein condensation, Discussion of gas of photons (the radiation fields) and phonons (The Debye field), Liquid helium and super fluidity.

**UNIT-IV** **(09 Sessions)**

Ideal Fermi Systems: Thermodynamic behavior of an ideal Fermi gas, Discussion of heat capacity of a free-electron gas at low temperatures, Pauli paramagnetism.

**Course outcomes:**

Students will have achieved the ability to:

- CO1: find the connection between statistics and thermodynamics.
- CO2: differentiate between different ensemble theories used to explain behavior of systems.
- CO3: differentiate between classical statistics and quantum statistics.
- CO4: explain the statistical behavior of ideal Bose and Fermi systems

**CO/PO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	2	2	3	3	2	3	2	2	3	2	2	2
<b>CO2</b>	3	2	3	3	2	3	2	3	3	3	2	3
<b>CO3</b>	2	2	3	3	2	3	2	2	3	2	1	2
<b>CO4</b>	2	2	3	3	2	3	2	2	3	3	2	3

## CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship
CO1	3	2	3
CO2	3	3	2
CO3	3	3	2
CO4	3	3	3

### Suggested Readings:

1. Pathria, R.K., Statistical Mechanics, Butterworth-Heinemann, (1996).
2. Reif, F., Fundamentals of Statistical and Thermal Physics, Waveland, (2008).

### Website Sources:

- <http://www.chemguide.co.uk/>
- <https://freebookcentre.net/>

**Note: Latest edition of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B.Sc. (ZBC) III Year (VI Semester)**  
**BCHE-604A: Paper & Pulp Technology**  
**Elective Course**

**Objectives:** Gain a more complete understanding of papermaking terms, equipment, process technology, science, and engineering fundamentals, operations, and variables for skill development and employability in paper industries.

**Unit-I (08 Sessions)**  
 Wood Chemistry: Chemical composition- cellulose, hemi cellulose, lignin, wood extractives, raw material. Quality parameters under evaluation for skill development. Yield of raw material. Pulping: General principle of pulping. Types of pulping processes: mechanical, chemical, semi-chemical, sulphate process, Kraft process. Process calculations. Raw material utility requirements. Process flow sheet and description. Washing and bleaching. Common unit operation. Wood treatment, digestion, evaporation, drying with equipment used.

**Unit -II (08 Sessions)**  
 Treatment of Pulp: Screening, washing, refining, thickening of pulp. Bleaching- conventional and non-conventional bleaching techniques. Paper Making: Preliminary operations on pulp. Beating and refining of pulp. Non-fibrous materials. Fillers and loading material. Internal sizing. Wet and additive surface treatment. Paper coloring. Surface sizing for skill development and employability in paper industries.

**Unit-III (10 Sessions)**  
 Paper Quality of Grades: Different grades of paper quality. Parameters and their evaluation. Saturation of paper. Special grade papers. Recycling of waste papers for skill development and employability.

**Unit –IV (10 Sessions)**  
 Supportive Operations: Chemical recovery-water balance, oxidation, evaporation of black liquor, lime recovery. Quality control and safety aspects. Environmental Aspects: Effluent characteristics of pulp and paper industries. Treatment methods.

**Course outcomes:**

Students will have achieved the ability to:

- CO1: Understand the chemical composition and quality parameters of wood and paper.
- CO2: Learn screening, washing, refining, thickening of pulp for skill development and employability in paper industries
- CO3: differentiate between different grades of paper quality and evaluation parameters.
- CO4: explain the characteristics of effluent of pulp and paper industries

**CO/PO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	3	2	3	2	2	3	2	2	2
CO2	3	2	3	3	2	3	2	3	3	3	2	3
CO3	2	2	3	3	2	3	2	2	3	2	1	2
CO4	2	2	3	3	2	3	2	2	3	3	2	3

**CO- Curriculum Enrichment Mapping**

	Skill Development	Employability	Entrepreneurship
CO1	3	2	3
CO2	3	3	2

<b>CO3</b>	3	3	2
<b>CO4</b>	3	3	3

**Suggested Readings:**

1. Pulp and Paper Chemistry and Technology, Casey, J.P., 2nd edn, Inter Science, 1960.
2. Handbook For Pulp & Paper Technologists, 3rd Edition.

**Website Sources:**

- <http://www.chemguide.co.uk/>
- <https://freebookcentre.net/>

**Note: Latest edition of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science (PCM/ZBC) Programme**  
**B.Sc. (PCM/ZBC) III Year (VI Semester)**  
**BCHE-605A: Food Analysis**  
**Elective Course**

**Objectives:** To provide an optimum environment for students to develop skills to examine chemical bases of food components. To provide an opportunity for students to test various approaches for manipulating the chemical and/or functional properties of foods for employability in food industries.

**Unit-I (08 Sessions)**  
 Human nutrition, Basic food groups, Balanced diet. Food processing, preservation and storage for skill development. Physico-chemical properties of food, enzymes in food

**Unit – II (08 Sessions)**  
 Food adulteration, toxication of food, prevention of food borne diseases  
 Nutritional value of food. AGMARK, ISI and FPO importance and license obtaining procedures.

**Unit-III (10 Sessions)**  
 Fermented food products. Production of nutrient rich foods. Agro-product preservation methods for skill development and employability.

**Unit –IV (10 Sessions)**  
 Quality of animal feed and poultry feed Quality control in food processing. Quality control for exportable foods. Food microbiology – Contamination of food, spoilage of food & their prevention.

**Course outcomes:**

Students will have achieved the ability to:

- CO1: Understand the methods of food processing, preservation and storage.
- CO2: Learn about food adulteration, toxication of food, prevention of food borne diseases for skill development and employability in food industries
- CO3: Understand the production of nutrient rich foods for employability in food industries.
- CO4: Explain the contamination of food, spoilage of food & their prevention.

**CO/PO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	2	2	3	3	2	3	2	2	3	2	2	2
<b>CO2</b>	3	2	3	3	2	3	2	3	3	3	2	3
<b>CO3</b>	2	2	3	3	2	3	2	2	3	2	1	2
<b>CO4</b>	2	2	3	3	2	3	2	2	3	3	2	3

**CO- Curriculum Enrichment Mapping**

	Skill Development	Employability	Entrepreneurship
<b>CO1</b>	3	2	3
<b>CO2</b>	3	3	2
<b>CO3</b>	3	3	2
<b>CO4</b>	3	3	3

**Suggested Readings:**

1. A first course in food analysis by A. Y. Sathe.
2. Hand book of analysis and quality control for fruit & vegetable products by S. Ranganathan.
3. Handling and storage of food grains by S. V. Pingale.



4. Food science chemistry & experimental food By Dr. M. Swaminathan.
5. Food chemistry by William Hogland Meyer.
6. Food adulteration By Thankamma Jacob.
7. Food Microbiology by William C. Frazier.
8. Preservation of Fruits and Vegetables by Giridharilal.

**Website Sources:**

- <https://nios.ac.in/media/documents/srsec321newE/321-E-Lesson-4.pdf>
- <https://www.learnchem.net/>

**Note: Latest edition of all the suggested readings must be used.**

**IFTM University, Moradabad**  
**Bachelor of Science Programme**  
**B.Sc. (ZBC) III Year (VI Semester)**  
**BCHE-651: CHEMISTRY PRACTICAL**

**Objectives:** Development of skills to understand the objective of their chemical experiments, properly carry out the experiments, and appropriately record and analyze the results. Students will be able to use standard laboratory equipment, modern instrumentation, and classical techniques to carry out experiments.

**PRACTICALS**

**(20 Sessions)**

- 1) Determination of rate constant of acid catalyzed hydrolysis of an ester.
- 2) Determination of order of hydrolysis of an ester by sodium hydroxide.
- 3) Verify Beer – Lambert Law for  $\text{KMnO}_4$  /  $\text{K}_2\text{Cr}_2\text{O}_7$  and determining the concentration of the given solution of the substance from absorption measurement.
- 4) Preparation of a Rubber Ball from Rubber Latex and its importance in employability in research and manufacturing sector.
- 5) Preparation of casein glue from milk and testing of its activity.
- 6) Preparation of talcum powder/face cream.
- 7) Preparation of nail polish and nail polish remover
- 8) Preparation of shampoo.
- 9) Paper chromatographic separation of  $\text{Fe}^{3+}$ ,  $\text{Al}^{3+}$  and  $\text{Cr}^{3+}$  OR  $\text{Ni}^{2+}$ ,  $\text{Co}^{2+}$ ,  $\text{Mn}^{2+}$  and  $\text{Zn}^{2+}$
- 10) Preparation of any of the following complexes
  - I. Tetra ammine carbonate cobalt (III) nitrate
  - II. Tetra ammine copper (II) sulphate
  - III. Potassium tri oxalate ferrate (III) trihydrate

**Course outcomes:**

Students completing this course will able to:

CO1: Understand the qualitative and quantitative analysis.

CO2: Perform the synthetic process of commercial chemical materials like cosmetics for employability at local and national level.

CO3: Skill development to prepare transition metal complexes.

CO4: Determine rate constant/order in hydrolysis of ester. Determine concentration of the given solution using Beer–Lambert Law.

**CO/PO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	2	3	2	2	3	3	2	3
CO2	2	2	3	3	2	3	2	3	3	3	2	3
CO3	3	2	3	3	2	3	2	2	3	3	3	2
CO4	1	3	3	3	3	3	2	2	3	3	2	2

**CO- Curriculum Enrichment Mapping**

	Skill Development	Employability	Entrepreneurship
CO1	3	3	1
CO2	3	3	3

<b>CO3</b>	3	2	2
<b>CO4</b>	3	2	2

**Suggested readings:**

1. A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
2. A.I. Vogel: Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
3. A.I. Vogel: Textbook of Practical Organic Chemistry, Prentice Hall, 5th Edn.
4. F. G. Mann & B. C. Saunders: Practical Organic Chemistry, Orient Longman (1960).M University

**Web Sources:**

- <https://sp-sg.libguides.com/c.php?g=377339&p=6724406>
- <https://chemistscorner.com/top-10-book-cosmetic-science-book-resources/>

**Note: Latest edition of all the suggested readings must be used.**