INVERTIS
UNIVERSITY BAREILLY
Established by Govt. of U.P. u/s 2F of UGC Act, 1956 vide U.P. Act 22 of 2010.

Scheme of Instruction

of

Bachelor of Science

(Zoology, Botany, Chemistry)

(Based on NEP-2020)

(Effective from the academic session 2022-2023)

Faculty of Science

Invertis University

NH-24, Bareilly-Lucknow Highway, Bareilly

B.Sc. (ZBC)
First year

Sl.No.	Semester	Course Type	Course Code	Course Name	Teaching Scheme				Lecture Type
					L	T	P	Credit	Theory/Lab
1	Sem I	Major	B050101T	Cytology, Genetics and Infectious Diseases	4	0	0	4	Theory
2		Major	B050102P	Cell Biology and Cytogenetics Lab	0	0	2	2	Lab
3	Sem I	Major	B040101T	Microbiology & Plant Pathology	4	0	0	4	Theory
4		Major	B040102P	Techniques in Microbiology &Plant Pathology	0	0	2	2	Lab
5	Sem I	Major	B020101T	Fundamentals of Chemistry	4	0	0	4	Theory
6		Major	B020102P	Quantitative Analysis	0	0	2	2	Lab
7	Sem I	**Vocational**	V-I	Vocational Course will be selected from list offered by university.	3	0	0	3	Theory
8	Sem I	***Co-Curricular***	*Z010101T*	*Food, Nutrition and Hygiene*	2	0	0	2	Theory
				Total Credit	**17**		**6**	**23**	
1	Sem II	Major	B010201T	Biochemistry and Physiology	4	0	0	4	Theory
2		Major	B050202P/ R	Physiological, Biochemical & Hematology Lab	0	0	2	2	Lab
3	Sem II	Major	B040201T	Archegoniates &Plant Architecture	4	0	0	4	Theory
4		Major	B040202P	Land Plants Architecture	0	0	2	2	Lab
5	Sem II	Major	B020201T	Bioorganic and Medicinal Chemistry	4	0	0	4	Theory
6	Sem II	Major	B020202P	Biochemical Analysis (Practical)	0	0	2	2	Lab
7	Sem-II	**Minor-1**		Course offered by other faculty.	4	0	0	4	Theory
8	Sem II	**Vocational**	V-II	Vocational Course will be selected from list offered by university.	3	0	0	3	Theory
9	Sem II	***Co-Curricular***	*Z020201*	*First Aid and Health*	2	0	0	2	Theory
				Total Credit	**21**		**6**	**27**	

Note - The examination of each course will be conducted based on 25 percent internal evaluation and 75 percent external evaluation.

List of Vocational Courses

L	T	P	Credit
1	0	2	3

S.N.	CODE	Vocational Course Name	Nature
1	VOI001	Introduction of MS – Office (MS Word, MS Excel, MS Power Point)	**Independent**
2	VOI002	Mathematical Software- MATLAB, SPSS, Mathematica, Maple, LaTeX (Anyone)	**Independent**
3	VOI003	Chemical Technology & Society	**Independent**
4	VOI004	Pharmaceutical Chemistry	**Independent**
5	VOI005	Aquarium and fish keeping	**Independent**
6	VOI006	Apiculture	**Independent**
7	VOI007	Sericulture	**Independent**
8	VOI008	Retail Management	**Independent**
9	VOI011	Ethnobotany	**Independent**
10	VOI012	Intellectual Property Rights (IPR)	**Independent**
11	VOI012	MS Office and Networking	**Independent**
12	VOI012	Fundamentals Of Digital Marketing	**Independent**
13	VOI015	Banking and Finance	**Independent**
14	VOI016	Basic Computer Skill	**Independent**
15	VOI017	COMPREHENSIVE PROGRAM ON STOCK MARKET	**Independent**
16	VPA101	Handling of Electrical and Electronic Products.	**Progressive**
17	VPB101	Yoga Science	**Progressive**
18	VPC101	Multimedia and Animation	**Progressive**
19	VPD101	Agribusiness Management	**Progressive**
20	VPE101	COMPUTER OFFICE MANAGEMENT	**Progressive**
21	VPF101	Public Relation officer	**Progressive**
22	VPG101	TECHNOLOGY ADVANCEMENT BOOTCAMP	**Progressive**
23	VPH101	Electronics Technician	**Progressive**
24	VPI101	Domestic Data Entry Operator	**Progressive**
25	VPJ101	Yoga Instructor	**Progressive**

Vocational course will be opted in I, II, III and IV Semester

List of Minor Courses offered by Faculty of Science
(For students of other faculty)

L	T	P	Credit
4	0	0	4

S N	Code	Minor Course
1	FSM001	Fundamentals of Operation Research
2	FSM002	Public Health and Hygiene
3	FSM003	Biofertilizers
4	FSM004	Medicinal Botany
5	FSM005	Business Mathematics`
6	FSM006	Environmental Sciences

Minor courses will be opted in II and IV Semester

PROGRAMME OUTCOMES (POs)
PQ1: The programme has been designed in such a way so that the students get the flavour of both classical and modern aspects of Zoology/Botany/Chemsitry or Life Sciences. It aims to enable the students to study biodiversity in in Indian subcontinent, environmental science and behavioural ecology. **PQ2:** The modern areas including cell biology and genetics, molecular biology, biochemistry, physiology followed by biostatistics, Evolutionary biology, bioinformatics and genetic engineering have been included to make the study of animals more interesting and relevant to human studies which is the requirement in recent times. **PQ3:** The lab courses have been designed in such a way that students will be trained to join public or private labs. **PQ4:** The programme will produce competent plant biologists who can employ and implement their gainedknowledge in basic and applied aspects that will profoundly influence the prevailing paradigm of agriculture, industry, healthcare and environment to provide sustainable development. **PO5:** This programme increases the ability of critical thinking, development of scientific attitude, handling of problems and generating solutions, improve practical skills, enhance communication skill, social interaction, increase awareness in judicious use of plant resources by recognizing the ethical value system. **PO6:** The training provided to the students will make them competent enough for doing jobs in Govt. and private sectors of academia, research and industry along with graduate preparation for national as well as international competitive examinations, especially UGC-CSIR NET, UPSC Civil Services Examination, IFS, NSC, FCI, BSI, FRI etc. **PO7:** Certificate and diploma courses are framed to generate self- entrepreneurship and selfemployability, if multi exit option is opted. **PO8:** Lifelong learning be achieved by drawing attention to the vast world of knowledge of plants and their domestication. Students will have a firm foundation in the fundamentals and application of current chemical and scientific theories including those in analytical, Inorganic, Organic and Physical Chemistries. **PQ9:** Students will be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments. **PQ10:** Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems. **PQ11:** Students will be able to explore new areas of research in Life Sciences and allied fields of science and technology. **PQ12:** Students will appreciate the central role of chemistry in our society and use this as a basis for ethical behavior in issues facing chemists including an understanding of safe handling of chemicals, environmental issues and key issues facing our society in energy, health and medicine. **PQ13:** Students will be able to explain why chemistry is an integral activity for addressing social, economic and environmental problems, and can function interdisciplinary problem solving team member.

FIRST YEAR

DETAILED SYLLABUS FOR

CERTIFICATE

IN

BACHELOR OF SCIENCE

Programme/Class: Certificate	Year: First	Semester: First
Subject: Zoology		
Course Code: B050101T	**Course Title: Cytology, Genetics, and Infectious Diseases**	

Course outcomes:

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

- Understand the structure and function of all the cell organelles.
- Know about the chromatin structure and its location.
- To be familiar with the basic principle of life, how a cell divides leading to the growth of an organismand also reproduces to form new organisms.
- How one cell communicates with its neighboring cells?
- Understand the basic principles of genetics and how genes (earlier called factors) are inherited fromone generation to another.
- Understand the Mendel's laws and the deviations from conventional patterns of inheritance.
- Comprehend how environment plays an important role by interacting with genetic factors.
- How to detect chromosomal aberrations in humans and study the pattern of inheritance by pedigreeanalysis in families.

Credits: 4	Core: Compulsory
Max. Marks: 25+75	**Min. Passing Marks: as per rules**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:4-0-0

Unit	Topics	Total No. of Lectures (60)
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 and international Biologists (Zoologists) who have contributed/contributing to Zoological and Life Sciences as a mark of tribute to ancient and modern biology will be includedas part of the Continuous Internal Evaluation (CIE)	**6**
II	**Structure and Function of Cell Organelles II** • Cytoskeleton: microtubules, microfilaments, intermediate filaments • Mitochondria: Structure, oxidative phosphorylation • Peroxisome and ribosome: structure and function	**6**
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 ofchromosomes • Types of DNA and RNA	**8**

IV	**Cell cycle, Cell Division and Cell Signalling** • 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	**8**
V	**Mendelism and Sex Determination** • Basic principles of heredity: Mendel's laws, monohybrid anddihybrid 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	**8**
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 Characteristics • Cytoplasmic Inheritance, Genetic Maternal Effects • Genomic Imprinting, Anticipation • Interaction Between Genes and Environment: Environmental Effectson Gene Expression, Inheritance of Continuous Characteristics	**8**
VII	**Human Chromosomes and Patterns of Inheritance** • Human karyotype • Chromosomal anomalies: Structural and numerical aberrations withexamples • Pedigree analysis • Patterns of inheritance: autosomal dominant, autosomal recessive,X-linked recessive, X-linked dominant	**8**
VIII	**Infectious Diseases** • Introduction to pathogenic organisms: viruses, bacteria, fungi,protozoa, and worms. • Structure, life cycle, pathogenicity, including diseases, causes, symptoms and control of common parasites: *Trypanosoma, Giardia* and *Wuchereria*	**8**

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. 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 KubyKuby Immunology. W HFreeman (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).

Course Books published in Hindi may be prescribed by the Universities and Colleges
Course prerequisites: To study this course, a student must have had the subject biology in class/12th
Suggested Continuous Evaluation Methods: **Total Marks: 25** **House Examination/Test**: 10 Marks **Written Assignment/Presentation/Project / Term Papers/Seminar**: 10 Marks **Class performance/Participation**: 5 Marks **25**
Further Suggestions: None

- At the End of the whole syllabus any remarks/ suggestions: None

Programme/Class: Certificate	**Year: First**	**Semester: First**
Subject: Zoology		
Course Code: B050102P	**Course Title: Cell Biology & Cytogenetics Lab**	

Course outcomes:

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

1. To use simple and compound microscopes.
2. To prepare slides and stain them to see the cell organelles.
3. To be familiar with the basic principle of life, how a cell divides leading to the growth of an organismand also reproduces to form new organisms.
4. The chromosomal aberrations by preparing karyotypes.
5. How chromosomal aberrations are inherited in humans by pedigree analysis in families.
6. The antigen-antibody reaction.

Credits: 2	**Core: Compulsory**
Max. Marks: 25+75	**Min. Passing Marks: as per rules**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-4

Unit	**Topics**	**Total No. of Lectures (60)**
I	• To study different cell typessuch asbuccal epithelial cells, neurons,striated muscle cells using Methylene blue. • To study the different stages of Mitosis in root tip of onion. • To study the different stages of Meiosis in grasshopper testis. • To prepare molecular models of nucleotides, amino acids, dipeptidesusing bead and stick method. • To check the permeability of cells using salt solution of different concentrations.	**15**
II	• Study of parasites (eg. Protozoans, helminths *etc*.) from permanentslides. • To learn the procedures for preparation of temporary and permanentstained/unstained slides.	**15**
III	• Study of mutant phenotypes of Drosophila. • Preparation of polytene chromosomes. • Study of sex chromatin (Barr bodies) in buccal smear and hair budcells (Human). • Preparation of human karyotype and study the chromosomal aberrations with respect to number, translocation, deletion etc.from the pictures provided. • To prepare family pedigrees.	**15**
IV	• **Virtual Labs (Suggestive sites)** https://www.vlab.co.in https://zoologysan.blogspot.com www.vlab.iitb.ac.in/vlab www.onlinelabs.in www.powershow.com https://vlab.amrita.edu https://sites.dartmouth.edu	**15**

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 KubyKuby Immunology. W HFreeman (2007).
6. Kesar, Saroj and Vashishta N. (2007). Experimental Physiology: Comprehensive Manual. HeritagePublishers, New Delhi

Course Books published in Hindi may be prescribed by the Universities and Colleges

Course prerequisites: To study this course, a student must have had the subject biology in class/12th

Suggested Continuous Evaluation Methods:

Total Marks: 25

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project / Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Further Suggestions: None

At the End of the whole syllabus any remarks/suggestions: University must ensure incorporation of all 04 units including virtual labs in practical evaluation.

Programme/Class: Certificate	Year: First	Semester: First
Subject: Botany		
Course Code: B040101T	**Course Title: Microbiology & Plant Pathology**	

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

1. Develop understanding about the classification and diversity of different microbes including viruses, Algae, Fungi & Lichens &their economic importance.
2. Develop conceptual skill about identifying microbes, pathogens, biofertilizers & lichens.
3. Gain knowledge about developing commercial enterprise of microbial products.
4. Learn host –pathogen relationship and disease management.
5. Learn Presentation skills (oral & writing) in life sciences by usage of computer & multimedia.
6. Gain Knowledge about uses of microbes in various fields.
7. Understand the structure and reproduction of certain selected bacteria algae, fungi and lichens
8. Gain Knowledge about the economic values of this lower group of plant community.

Credits: **4**	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** As per rule

Total No. of Lectures-Tutorials-Practical (in hours per week): **4-0-0**

Unit	Topic	No. of Lectures (60 hrs)
I	• 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 assessed via class interaction/ assignments / self-study mentioned under Continuous Internal Evaluation (CIE). • **Microbial Techniques & instrumentation** Microscopy – Light, phase contrast, electron, scanning and transmission electron microscopy, staining techniques for light microscopy, sample preparation for electron microscopy. Common equipment of microbiology lab and principle of their working – autoclave, oven, laminar air flow, centrifuge. Colorimetry and spectrophotometry, immobilization methods, fermentation and fermenters.	8
II	**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-	8

	phage; Lyticand Lysogenic cycles, viroid, Prions & mycoplasma & phytoplasma, Actinomycetes & plasmids and their economic uses.	
III	**Phycology** • Range of thallus organization in Algae, Pigments, Reserve food –Reproduction - Classification and life cycle of – *Nostoc, Chlorella, Volvox, Hydrodictyon, Oedogonium, Chara; Sargassum, Ectocarpus, Polysiphonia.* • Economic importance of algae - Role of algae in soil fertility-biofertilizer – Nitrogen fixation- Symbiosis; Commercialproducts of algae –biofuel, Agar.	7
IV	**Mycology** • General characteristics, nutrition, life cycle, Economic importance of Fungi, Classification upto class. Distinguishing characters of Myxomycota: General characters of Mastigomycotina, Zygomycota: *Rhizopus,* **Ascomycota:** *Saccharomyces, Penicillium, Peziza*. **Basidiomycotina:** *Ustilago, Puccinia, Agaricus;* **Deuteromycotina:** *Fusarium, Alternaria*. Heterothallism, Physiological specialization, Heterokaryosis & Parasexuality	7
V	**Mushroom Cultivation, Lichenology & Mycorrhiza** • Mushroom cultivation. General account of lichens, reproduction and significance; *Mycorrhiza: ectomycorrhiza* and *endomycorrhiza* and theirsignificance.	7
VI	**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	7
VII	**Diseases and Control** • Symptoms, Causal organism, Disease cycle and Control measures of – Early & Late Blight of Potato, False Smut of Rice/ Brown spot of rice, Black Stem Rust of Wheat, *Alternaria* spot' and 'White rust of Crucifers, 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	8
VIII	**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 farming inputs, Microbiology of water, Bioploymers, Bioindicators, biosensors, Bioremediation, Production of biofuels, biodegradation of pollutants and biodeterioration of materials & Cultural Property.	8

Suggested Readings:
Course Books published in Hindi may be prescribed by the Universities.

1. Microbiology Fundamental and Applications (hindi) (pb)
2. ISBN: 9788188826230 Edition: 03Year : 2016Author : Dr. Purohit SS , Dr. Deo Publisher : Student EditionLanguage : Hindi
3. Modern Microbiology (hindi) (hb) ISBN: 9788177543599Edition : 1Year : 2018Author : Dr. Purohit SS , Dr.Singh T Publisher : Agrobios (India)
4. Suggested books "Plant pathology by R.S. Mehrotra, Tata McGraw-Hill Education" are included in readingresources list

Unit-I A:

1. https://indianculture.gov.in/rarebooks/economic-botany-india https://www.infinityfoundation.com/mandala/t_es/t_es_tiwar_ botany_frameset.htm
2. https://www.researchgate.net/publication/335715457_Ancient_Indian_rishi's_Sage s_knowledge_of_b otany_and_medicinal_plants_since_Vedic_period_was_much_older_than_the_per iod_of_Theophrastus_A_case_study-_who_was_the_actual_father_of_botany
3. https://www.scribd.com/presentation/81269920/Botany-of-Ancient-India
4. https://insa.nic.in/writereaddata/UpLoadedFiles/IJHS/Vol17_2_17_PKBhattacharyya.pdf
5. http://wgbis.ces.iisc.ernet.in/biodiversity/sahyadri/wgbis_info/botany_history.pdf
6. Ancient Botany (Sciences of Antiquity) Paperback – 1 October 2015by Gavin Hardy (Author), Laurence Totelin (Author)
7. https://www.plantsdiseases.com/p/symptoms.html
8. https://www.plantsdiseases.com/p/pathogenic-diseases-in-plants.html

UNIT-I B.

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, NewDelhi.
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., NewDelhi.
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, New Delhi.
20. Pandey. B.P. 2014 Modern Practical Botany, (Vol-I) S. Chand and Company Pvt. Ltd., New Delhi.
21. Pelzar, 1963. Microbiology, Tata Mc Graw Hill, New Delhi
22. Rangaswamy, G. 2009, Disease of Crop Plants in India, Prientice Hall of India, New Delhi.
23. Sambamurty. A.V.S.S. 2006, A Text book of Algae, I. K. International Publishing House, Pvt. Ltd., New Delhi.
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, New Delhi.
26. Smith. G. M. 1996. Cryptogamic Botany Volume I, Tata Mc Graw Hill, New Delhi.
27. Sundar Rajan. 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., New Delhi

This course can be opted as an elective by the students of following subjects: Open to all but special for

B.Sc. Biotech, B.Sc. Microbiology, B.Sc. Agriculture, B.A. (Curators), B.A. Archaeology, B.A. Geology, BAMS.

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25

Course prerequisites:

Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Biotech/ Forestry/ Microbiology/Gardening /biomedical Science.

Facilities: Smart and Interactive Class

Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Charts

Suggested equivalent online courses:

https://indianculture.gov.in/rarebooks/economic-botany-india

https://community.plantae.org/tags/mooc

futurelearn.com/courses/teaching-biology-inspiring-students-

with-plants-in-science
https://www.coursera.org/courses?query=plants
http://egyankosh.ac.in/handle/123456789/53530
https://www.classcentral.com/tag/microbiology
https://www.edx.org/learn/microbiology
https://www.mooc-list.com/tags/microbiology
https://www.udemy.com/topic/microbiology/
https://ucmp.berkeley.edu/bacteria/bacteria.html
https://www.livescience.com/53272-what-is-a-virus.html
https://gclambathach.in/lms/Economic%20importance%20of%20Algae.pdf
https://www.slideshare.net/sardar1109/algae-notes-1
https://www.onlinebiologynotes.com/algae-general-characteristics-classification/
https://www.sciencedirect.com/topics/immunology-and-microbiology/fungus
https://ucmp.berkeley.edu/fungi/fungi.html
https://agrimoon.com/wp-content/uploads/Mashroom-culture.pdf
http://ecoursesonline.iasri.res.in/mod/page/view.php?id=11293
http://www.hillagric.ac.in/edu/coa/ppath/lect/plpath111/Lect.%201%20%20Introduction-Pl%20Path%20111.pdf
http://www.jnkvv.org/PDF/11042020102651plant_pathology.pdf
https://www.apsnet.org/edcenter/disimpactmngmnt/topc/EpidemiologyTemporal/Pages/ManagementStrategies.aspx
https://learn.saylor.org/course/view.php?id=23&sectionid=6821
https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microscopy
http://physics.fe.uni-lj.si/students/predavanja/Microscopy_Kulkarni.pdf
https://lipidnanostructuresgroup.weebly.com/
https://zoology4civilservices.wordpress.com/2016/06/18/65/ https://microbenotes.com/laminar-flow-hood/

Programme/Class: Certificate	Year: First	Semester: First
Subject: Botany		
Course Code: B040102P	**Course Title: Techniques in Microbiology &Plant Pathology**	

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

1. Understand the instruments, techniques, lab etiquettes and good lab practices for working in a microbiologylaboratory.
2. Develop skills for identifying microbes and using them for Industrial, Agriculture and Environment purposes.
3. Practical skills in the field and laboratory experiments in Microbiology & Pathology.
4. Learn to identify Algae, Lichens and plant pathogens along with their Symbiotic and Parasitic associations.
5. Can initiate his own Plant & Seed Diagnostic Clinic
6. Can start own enterprise on microbial products

Credits:2	Core: Compulsory
Max. Marks: 25+75	Min. Passing Marks: As per rule

Total No. of Lectures-Tutorials-Practical (in hours per week): 0-0-2

Unit	Topic * (Minimum Any three from each unit depending on facilities)	No. of Lectures(60 hrs)
I	**Instruments & Techniques** • 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 glasswares • 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 1.	**7**
II	**Bacterial Identification** • 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, Carbohydrate fermentation test, Mannitol motility test, Gelatin liquefaction test, Urease test,Nitrate reduction test, Catalase test, Oxidase test, Starch hydrolysis, Casein hydrolysis.	**8**

III	**Mycological Study** • 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 ful grown mushroom; Sectioning of gills of *Agaricus*. • Lichens: crustose, foliose and fruticose specimens.	**8**
IV	**Phycology** • Type study of algae and Cyanobacteria –*Spirullina, Nostoc.* Chlorophyceae - *Chlorella, Volvox, Oedogonium, Cladophora,*and *Chara;* Xanthophyceae –*Vaucheria;* Bacillariophyceae – *Pinnularia* Phaeophyceae – *Sargassum R*hodophyceae - *Polysiphonia*	**7**
V	**Experimental Plant Pathology** • 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 ofwheat, Stem rot of mustard, Late blight of potato; Slides of uredial, telial, pycnial & aecial stages of*Puccinia*, Few viral and bacterial plant diseases.	**8**
VI	**Practicals in Applied Microbiology-I** • 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.	**8**
VII	**Practicals in Applied Microbiology-2** • 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.	**8**
VIII	• Cultivation of *Spirulina,* & *Chlorella* in lab for biofuel • Visit to NBAIM, Mau, Varanasi (Kashi)/ IMTECH (Institute of Microbial Technology),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.	**6**

Suggested Readings:

Course Books published in Hindi may be prescribed by the Universities.

1. Practical Botany (Part I) ISBN #:81-301-0008-8 Sunil D Purohit, Gotam K Kukda & Anamika Singhvi Edition:2013Apex Publishing House Durga Nursery Road, Udaipur,

Rajasthan (bilingual)
2. Modern Mushroom Cultivation And Recipes (hindi) (hb)ISBN : 9788177545180Edition : 01Year : 2017Author : SinghRiti , Singh UCPublisher : 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, Vishwa Prakashan, 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,New York.
7. Madhavee Latha, P. 2012, A Textbook of Immunology, S. Chand & Company Pvt. Ltd., New Delhi.
8. Pandey. B.P. 2014 Modern Practical Botany, (Vol-I) S. Chand and Company Pvt. Ltd., New Delhi.
9. Sambamurty. A.V.S.S. 2006, A Textbook of Algae, I. K. International Publishing House, Pvt. Ltd.,
10. Singh, R. P. 2007. Microbial Taxonomy and Culture Techniques, Kalyani Publication, New Delhi.
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
14. Sen, Surjit,Acharya, Krishnendu, Rai, Manjula 2019 IBSN - 978-93-88347-23-5 - Biofertilizers and Biopesticides Technoworld, Kolkata
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-Products Springer
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 Phycologyand Biotechnology, Second Edition Print ISBN:9780470673898

Course prerequisites:
Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils /Diploma holder from ITI in (Biology/ Agriculture/ Biotech/ Microbiology/biomedical Science.
Facilities: Smart and Interactive Class
Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Charts
Lab Requisites: Microscopes, Stains, Dissection box, Haemocytometer, Specimens, Permanent slides, Autoclave, incubator,
Oven, laminar flow cabinet, balances, Fermenter, Anaerobic jar and Spectrophotometer.

This course can be opted as an elective by the students of following subjects: Open to all but special for
B.Sc. Biotech, B.Sc. Microbiology, B.Sc. Agriculture, B.A. (Curators), B.A. Archaeology, B.A. Geology, BAMS.

Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Minor field work/excursion/lab visit/technology dissemination etc.	8
	25

Suggested equivalent online courses:

https://community.plantae.org/tags/mooc
futurelearn.com/courses/teaching-biology-inspiring-students-with-plants-in-science
https://microbiologysociety.org/publication/education-outreach-resources/basic-practical-microbiology-a-manual.html
https://microbiologyonline.org/file/7926d7789d8a2f7b2075109f68c3175e.pdf
http://allaboutalgae.com/benefits/
https://repository.cimmyt.org/xmlui/bitstream/handle/10883/3219/64331.pdf https://www.mooc-list.com/tags/microbiology
http://www.agrifs.ir/sites/default/files/A%20text%20book%20of%20practical%20botany%201%20%7BAshok%20Bendre%7D%20%5B8 171339239%5D%20%281984%29.pdf
https://www.coursera.org/courses?query=plantshttp://egyankosh.ac.in/handle/123456789/53530
https://www.classcentral.com/tag/microbiology https://www.edx.org/learn/microbiology
https://www.mooc-list.com/tags/microbiology https://www.udemy.com/topic/microbiology/

Programme/Class: Certificate	Year: First	Semester: First
Subject: Chemistry		
Course Code:B020101T	**Course title: Fundamentals of Chemistry**	

Course outcomes:

There is nothing more fundamental to chemistry than the chemical bond. Chemical bonding is the language of logic for chemists. Chemical bonding enables scientists to take the 100-plus elements of the periodic table and combine them in myriad ways to form chemical compounds and materials. Periodic trends, arising from the arrangement of the periodic table, provide chemists with an invaluable tool to quickly predict an element's properties. These trends exist because of the similar atomic structure of the elements within their respective group families or periods, and because of the periodic nature of the elements. Reaction mechanism gives the fundamental knowledge of carrying out an organic reaction in a step-by-step manner. This course will provide a broad foundation in chemistry that stresses scientific reasoning and analytical problem solving with a molecular perspective. Students will gain an understanding of

- Molecular geometries, physical and chemical properties of the molecules.
- Current bonding models for simple inorganic and organic molecules in order to predict structures and importantbonding parameters.
- The chapter Recapitulation of basics of organic chemistry gives the most primary and utmost importantknowledge and concepts of organic Chemistry.
- This course gives a broader theoretical picture in multiple stages in an overall chemical reaction. It describes reactive intermediates, transition states and states of all the bonds broken and formed .It enables to understandthe reactants, catalyst, steriochemistry and major and minor products of any organic reaction.
- It describes the types of reactions and the Kinetic and thermodynamic aspects one should know for carrying outany reaction and the ways how the reaction mechanism can be determined.
- The chapters Steriochemistry gives the clear picture of two-dimensional and three-dimensional structure of themolecules, and their role in reaction mechanism.

Credits: 4	Compulsory
Max. Marks: 25+75	**Min. Passing Marks: As per rule**

Total No. of Lectures = 60

Unit	Topics	No. of Lectures
I	Introduction to Indian ancient Chemistry and contribution of Indian Chemists, in context to theholistic development of modern science and technology, should be included under Continues Evaluation (CIE)	10
	Molecular polarity and Weak Chemical Forces : 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.	

II	**Simple Bonding theories of Molecules** Atomic orbitals, Aufbau principle, multiple bonding (σ and π 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: H_2O, NH_3, PCl_5, SF_6, SF_4, ClF_3, I_3^-, and H_3O^+. Molecular orbital theory (MOT). Molecular orbital diagrams bond orders ofhomonuclear and heteronuclear diatomic molecules and ions (N_2, O_2, C_2, B_2, F_2, CO, NO, and their ions)	**10**
III	**Periodic properties of Atoms (with reference to s & p-block)**: 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.	**05**
IV	**Recapitulation of basics of Organic Chemistry:** Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bonding, Van der Waals interactions, inclusion compounds, Clatherates, Charge transfer complexes, hyperconjugation, Dipole moment; Electronic Displacements: Inductive, electromeric, resonance mesomeric effects and their applications	**05**
V	**Mechanism of Organic Reactions:** Curved arrow notation, drawing electron movements with allows, 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).	**10**
VI	**Steriochemistry**-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, disasteromers, threo and erythro diastereomers, meso compounds, resolution of enantionmer, inversion, retention and recemization. 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.	**10**
VII	**Basic Computer system (in brief)**-Hardware and Software; Input devices, Storage devices, Outputdevices, Central Processing Unit (Control Unit and Arithmetic Logic Unit); Number system (Binary, Octal and Hexadecimal Operating System); Computer Codes (BCD and ASCII)**;** Numeric/String constants and variables. Operating Systems (DOS, WINDOWS, and Linux); Introduction of Software languages: Low level and High Level languages (Machine language, Assembly language; QBASIC, FORTRAN) Software Products (Office, chemsketch, scilab, matlab, hyperchem, etc.), internet application.	**05**

VIII	**Mathematical Concepts for Chemistry** 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.	**05**

Suggested Readings:

1. Lee, J.D. Concise Inorganic Chemistry, Pearson Education 2010
2. Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K. Inorganic Chemistry, Principles of Structure andReactivity, Pearson Education 2006.
3. Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970
4. Shriver, D.D. & P. Atkins, *Inorganic Chemistry 2nd Ed.*, Oxford University Press, 1994.
5. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications 1962.
6. Singh J.,Yadav L.D.S.,Advanced Organic Chemistry,Pragati Edition
7. Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
8. Carey, F. A., Guiliano, R. M.*Organic Chemistry*, Eighth edition, McGraw Hill Education, 2012.
9. Loudon, G. M. *Organic Chemistry*, Fourth edition, Oxford University Press, 2008.
10. Clayden, J., Greeves, N. &Warren, S. *Organic Chemistry*, 2nd edition, Oxford University Press, 2012.
11. Graham Solomons, T.W., Fryhle, C. B. *Organic Chemistry*, John Wiley & Sons, Inc.
12. Sykes, P. *A guidebook to Mechanism in Organic Chemistry*, Pearson Education, 2003
13. Francis**, P. G.** Mathematics for Chemists, Springer, 1984

Note: For the promotion of Hindi language, course books published in Hindi may be prescribed by the University

Suggested online links:

http://heecontent.upsdc.gov.in/Home.asp
x
https://nptel.ac.in/courses/104/106/10410
6096/
http://heecontent.upsdc.gov.in/Home.asp
x
https://nptel.ac.in/courses/104/106/10410
6096/
https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm
https://nptel.ac.in/courses/104/103/104103071/#

This course is compulsory for the students of following subjects: Chemistry in 12th Class

Suggested Continuous Evaluation Methods: Students can be evaluated on the basis of score obtained in a mid-term exam, together with the performance of other activities which can include short exams, in-class or on-line tests, home assignments, group discussions or oral presentations, among others .

Assessment and presentation of Assignment 04 tests (Objective): Max marks of each test = 10(average of all 04 tests) Overall performance throughout the semester, Discipline, participation in different activities)	10 marks 10 marks 05 marks **25**
Course prerequisites: To study this course, a student must have had the chemistry in class 12th	
Suggested equivalent online courses:	
Further Suggestions:	

Programme: Certificate	**Year: First**	**Semester: First**
Subject: Chemistry		
Course Code: B020102P	**Course Title: Quantitative Analysis**	

Course outcomes:

Upon completion of this course the students will have the knowledge and skills to: understand the laboratory methodsand tests related to estimation of metals ions and estimation of acids and alkali contents in commercial products.

- Potability tests of water samples.
- Estimation of metal ions in samples
- Estimation of alkali and acid contents in samples
- Estimation of inorganic salts and hydrated water in samples

Credits: 2	**Elective**
Max. Marks: 25+75 = 100	**Min. Passing Marks: As per rule**

Total lectures=60 h

Unit	Topics	No of Lectures
I	**Water Quality analysis** 1. Estimation of hardness of water by EDTA. 2. Determination of chemical oxygen demand (COD). **3.** Determination of Biological oxygen demand (BOD).	**16**
II	**Estimation of Metals ions** 1. Estimation of ferrous and ferric by dichromate method. **2.** Estimation of copper using thiosulphate.	**14**
II	**Estimation of acids and alkali contents** 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 $KMnO_4$.	**14**
IV	**Estimation of inorganic salts and hydrated water** 1. Estimation of sodium carbonate and sodium hydrogen carbonate present in amixture. 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 $KMnO_4$.	**16**

Suggested Readings:

1. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
2. Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007) Chapters 3-5.
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 LearningIndia Edition

Note: For the promotion of Hindi language, course books published in Hindi may be prescribed by theUniversity

Suggestive digital platforms web links

6. https://www.labster.com/chemistry-virtual-labs/
7. https://www.vlab.co.in/broad-area-chemical-sciences
8. **http://chemcollective.org/vlabs**

This course can be opted as an elective by the students of following subjects: Chemistry in 12th Class

Suggested Continuous Evaluation Methods:

Viva voce	10 marks
Mock test	10 marks
Overall performance	05marks
	25

Course prerequisites: To study this course, a student must have had the chemistry in 12th Class

Suggested equivalent online courses:

Further Suggestions:

Programme/Class: Certificate	**Year: First**	**Semester: Second**
Subject: Zoology		
Course Code: B050201T	**Course Title: Biochemistry and Physiology**	

Course outcomes:

The student at the completion of the course will learn:

- To develop a deep understanding of structure of biomolecules like proteins, lipids and carbohydrates
- How simple molecules together form complex macromolecules.
- To understand the thermodynamics of enzyme catalyzed reactions.
- Mechanisms of energy production at cellular and molecular levels.
- To understand systems biology and various functional components of an organism.
- To explore the complex network of these functional components.
- To comprehend the regulatory mechanisms for maintenance of function in the body.

Credits: 4	**Core:** Compulsory
Max. Marks: 25+75	**Min. Passing Marks:** as per rules

Total No. of Lectures-Tutorials-Practical (in hours per week): **L-T-P:**4-0-0

Unit	Topics	Total No. of Lectures (60)
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 α-amino acids; Essential and non-essential α-amino acids, Levels of organization inproteins; Simple and conjugate proteins.	**8**
II	**Enzyme Action and Regulation** • Nomenclature and classification of enzymes; Cofactors; Specificity ofenzyme action • Isozymes; Mechanism of enzyme action • Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions; Derivation of Michaelis-Menten equation, Concept of Km and Vmax, Lineweaver-Burk plot; Enzyme inhibition; • Allosteric enzymes and their kinetics; Regulation of enzyme action	**8**

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, • β-oxidation and omega -oxidation of saturated fatty acids with even and odd number of carbon atoms	**8**
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	**6**
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	**7**
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	**8**
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	**8**
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	**7**

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, PearsonEducation (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).

Course Books published in Hindi may be prescribed by the Universities and Colleges

Course prerequisites: To study this course, a student must have had the subject biology in class/12th

Suggested Continuous Evaluation Methods:

Total Marks: 25

House Examination/Test:	10 Marks
Written Assignment/Presentation/Project / Term Papers/Seminar:	10 Marks
Class performance/Participation:	5 Marks
	25

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: None

Programme/Class: Certificate	Year: First	Semester: Second
Subject: Zoology		
Course Code: B050202P/R	**Course Title: Physiological, Biochemical & Hematology Lab**	

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

- Understand the structure of biomolecules like proteins, lipids and carbohydrates
- Perform basic hematological laboratory testing,
- Distinguish normal and abnormal hematological laboratory findings to predict the diagnosis ofhematological disorders and diseases.

Credits: 2	**Core:Compulsory**
Max. Marks: 25+75	**Min. Passing Marks: as per rules**

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-4

Unit	Topics	Total No. of Lectures (60)
I	• Estimation of haemoglobin using Sahli'shaemoglobinometer • Preparation of haemin and haemochromogen crystals • Counting of RBCs and WBCs using Haemocytometer • To study different mammalian blood cell types using Leishman stain. • Recording of blood pressure using a sphygmomanometer • Recording of blood glucose level by using glucometer	20
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 (orVirtual) • Demonstration of the unconditioned reflex action (Deep tendonreflex such as knee jerk reflex)	15
III	• Ninhydrin test for α -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 andlipids. • Action of salivary amylase under optimum conditions.	10
IV	**Virtual Labs (Suggestive sites)** • https://www.vlab.co.in • https://zoologysan.blogspot.com • www.vlab.iitb.ac.in/vlab • www.onlinelabs.in • www.powershow.com • https://vlab.amrita.edu • https://sites.dartmouth.edu	15

Suggested Readings:

1. Cox, M.M and Nelson, D.L. (2008). Lehninger's Principles of Biochemistry, V Edition, W.H. Freeman andCo., 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. HeritagePublishers, New Delhi

Course Books published in Hindi may be prescribed by the Universities and Colleges

Course prerequisites: To study this course, a student must have had the subject biology in class/12th

Suggested Continuous Evaluation Methods:

Total Marks: 25

House Examination/Test:	10 Marks
Written Assignment/Presentation/Project / Term Papers/Seminar:	10 Marks
Class performance/Participation:	5 Marks
	25

Further Suggestions: None

At the End of the whole syllabus any remarks/ suggestions: University must ensure incorporation of all 04 units including virtual labs in practical evaluation.

Programme /Class: Certificate	**Year: First**	**Semester: Second**
Subject: Botany		
Course Code: B040201T	**Course Title: Archegoniates and Plant Architecture**	

Course outcomes:

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

1. Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes andGymnosperms
2. Understanding of plant evolution and their transition to land habitat.
3. Understand morphology, anatomy, reproduction and developmental changes therein through typological study andcreate a knowledge base in understanding the basis of plant diversity, economic values & taxonomy of plants
4. Understand the details of external and internal structures of flowering plants.

Credits: 4	**Core : Compulsory**
Max. Marks: 25+75	**Min. Passing Marks: As per rule**

Unit	**Topic**	**Lectures (60hrs)**	
I	**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 .	**7**	
II	**Pteridophytes** • General characteristics, Early land plants (*Rhynia*). Classification (up to family) with examples, Heterospory and seed habit, stelar evolution, economic importance of Pteridophytes.	**8**	
III	**Gymnosperms** • Classification and distribution of gymnosperms; Salient features of Cycadales, Ginkgoales, Coniferales and Gnetales, their examples, structure and reproduction; economic importance	**8**	
IV	**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	**8**	
V	**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.	**7**	
VI	**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,Nyctanthes*	**7**	

VII	**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. •	**8**
VIII	**Palynology** • Pollen structure, pollen morphology, pollen allergy, Applied Palynology: Basic concepts, Palaeopalynology, Aeropalynology, Forensic palynology, Role in taxonomic evidences.	**7**

Total No. of Lectures-Tutorials-Practical (in hours per week): 4-0-0

Suggested Readings:

Course Books published in Hindi may be prescribed by the Universities.

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-Verleg, 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. Pergmon 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.

This course can be opted as an elective by the students of following subjects: Open to all but special for B.Sc. Biotech,
B.Sc. Forestry, B.Sc. Agriculture, B. Pharma, B.A. (Curators), B.A. Archaeology, B.A. Geology, BAMS

Suggested Continuous Evaluation Methods:
Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25

Course prerequisites:

Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 4 from Sector SkillCouncils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry).
Facilities: Smart and Interactive Class , wifi facility
Other Requisites: : Videos, Books, CDs, Flora, Herbarium, Access to On-line resources, Display Charts

Suggested equivalent online courses:

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

Programme/Class: Certificate	**Year: First**	**Semester:** Second
Subject: Botany		
Course Code: B040202P	**Course Title: Land Plants Architecture**	

Course outcomes:

1. The students will be made aware of the group of plants that have given rise to land habit and the flowering plants.Through field study they will be able to see these plants grow in nature and become familiar with the biodiversity.
2. Students would learn to create their small digital reports where they can capture the zoomed in and zoomed outpictures as well as videos in case they are able to find some rare structure or phenomenon related to these plants.
3. Develop an understanding by observation and table study of representative members of phylogenetically importantgroups to learn the process of evolution in a broad sense.
4. Understand morphology, anatomy, reproduction and developmental changes therein through typological study andcreate a knowledge base in understanding plant diversity, economic values & taxonomy of lower group of plants
5. Understand the composition, modifications, internal structure &architecture of flowering plants for becoming aBotanist.

Credits: 2	**Core : Compulsory**
Max. Marks: 25+75	**Min. Passing Marks: As per rule**

Total No. of Lectures-Tutorials-Practical (in hours per week): 0-0-2

Unit	Topic	No. of Lectures
I	**Bryophytes** • *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.	8
II	**Pteridophytes** • *Lycopodium*: Habit, stem T. S. stobilus 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 V. S. of strobilus. • *Azolla* – Habitat & its structure	7
III	**Gymnosperms** • *Cycas* – seedling, coralloid root and coralloid root T. S., T. S. of leaflet and Rachis, micro and megasporophyll, male cone V. S., microsporophyll T. S. entire and V. S. of ovule. *Pinus* - Branch of indefinite growth, spur shoot, T. S of old stemand 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 andfemale strobilus, V. S. of male and female cone, ovule V. S. and seed.	8
IV	**Palaeobotany & Palynology** • Morphology of *Rhynia* and fossils gymnosperms & other groups. • Visit Birbal Sahni Institute of Palaeosciences or virtual conference with their scientisto learn fossilization. • Mark and know about Indian geographical sites rich in plant fossils.	6

V	**Angiosperm Morphology** • To study 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) • Modifications in Roots,stems, leaves and inflorescences	**8**
VI	**Plant Anatomy** • Normal & Anomalous secondary thickening - *Bignonia, Dracaena, Boerhaavia diffusa,Nyctanthes* • Study of primary and secondary growth in the root and stem of monocots and dicots bysection cutting and permanent slides. • Study of internal structure of dicot and monocot leaves.Study of structure of stomata.	**8**
VII	**Reproductive Botany** • 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.	**8**
VIII	**Commercial Uses and Production technology** • *Azolla* production • Production technology of Resins • Production and propagation of Ornamental *Pteris*, Cycadales, Coniferales forlandscaping. • Lab method for qualitative testing/ extraction of Ephedrine Taxol and *Thuj*a oil.	**7**

Suggested Readings:

Course Books published in Hindi may be prescribed by the Universities.

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

This course can be opted as an elective by the students of following subjects:

Open to all but special for B.Sc. Biotech, B.Sc. Forestry, B.Sc. Agriculture, B. Pharma, B.A.

Suggested Continuous Evaluation Methods: Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	6
Field work /Virtual/E-learning /Participation in group discussions	7
Industrial or Central laboratory training of two weeks in summer/winter (Compulsory)	12
	25

Course prerequisites:

Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry).

Facilities: Smart and Interactive Class

Other Requisites: Microscopes, Stains, Dissection box, Haemocytometer, Specimens, Permanent slides, Autoclave,incubator, Oven, laminar flow cabinet, balance

Suggested equivalent online courses:

https://www.easybiologyclass.com/topic-botany
http://www3.botany.ubc.ca/bryophyte/index.html
http://ecflora.cavehill.uwi.edu/bio_courses/bl14apl/practical_
3.1.htm http://mydunotes.blogspot.com/p/botany.html
http://www.fao.org/3/a-v9236e.pdf
https://iinrg.icar.gov.in/library/nrg/nrg.pdf
https://agritech.tnau.ac.in/banking/nabard_pdf/Azolla%20Cultivation/Model_projct_on_Azolla_cultivatio
n.pdf http://arnoldia.arboretum.harvard.edu/pdf/articles/1977-37-1-propagation-manual-of-selected-gymnosperms.pdf
https://www.fs.fed.us/rm/pubs_other/wo_AgricHandbook730/wo_AgricHandbook727_153_175.pdf

Programme/Class: Certificate	Year: First	Semester: Second
Subject: Chemistry		
Course Code: B020201T	**Course Title: Bioorganic and Medicinal Chemistry**	

Course outcomes: Biomolecules are important for the functioning of living organisms. These molecules perform or trigger important biochemical reactions in living organisms. When studying biomolecules, one 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 acidsand medicinal chemistry. Upon completion of this course students may get job opportunities in food, beverage and pharmaceutical industries.

Credits: 4	**Elective**
Max. Marks: 25+75	**Min. Passing Marks: As per rule**

Total No. of Lectures = 60

Unit	Topics	No. of Lectures
I	**Chemistry of Carbohydrates**: 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. Inter conversions 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.)	10
II	**Chemistry of Proteins:** 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 (byDNFB and Edman method) and C–terminal amino acid (by thiohydantoin and withcarboxypeptidase 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).	10
III	**Chemistry of Nucleic Acids:** 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	05

IV	**Introductory Medicinal Chemistry :** Drug discovery, design and development; Basic Retrosynthetic approach. Drug action-receptor theory. Structure –activity relationships of drugmolecules, binding role of –OH group,-NH_2 group, double bond and aromatic ring. Mechanism of action 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), Central Nervous System agents (Phenobarbital, Diazepam),Cardiovascular (Glyceryl trinitrate), HIV-AIDS related drugs (AZT- Zidovudine	10
V	**Solid State** 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. Determinationof crystal structure of NaCl, KCl and CsCl (powder method).	05
VI	**Introduction to Polymer** 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 (Mn) and Weight average molecular mass (Mw) of polymers and determination by (i) Viscosity (ii) Light scattering method (iii) Gel permeation chromatography (iv) Osmometry and Ultracentrifuging.**Silicones and Phosphazenes** –Silicones and phosphazenes as examples of inorganicpolymers, nature of bonding in triphosphazenes.	10
VII	**Kinetics and Mechanism of Polymerization** 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, epoxy resins and polyurethanes.	05
VIII	**Synthetic Dyes:** Colour and constitution (electronic Concept), Classification of dyes,Chemistry and synthesis of Methyl orange, Congo red, Malachite green, crystal violet,phenolphthalein, fluorescein, Alizarin and Indigo.	05

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 Bioch*emistry *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, Vallabh Prakashan, 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

Note: For the promotion of Hindi language, course books published in Hindi may be prescribed by the University

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/

This course can be opted as an elective by the students of following subjects: Chemistry in 12th Class

Suggested Continuous Evaluation Methods:

Assessment and presentation of Assignment	10 marks
04 Unit tests (Objective): Max marks of each unit test = 10 (average of all 04 unit tests)	10 marks
Overall performance throughout the semester (Discipline, participation in different activities)	05 marks
	25

Course prerequisites: To study this course, a student must have Passed Sem-I, Theory paper-1

Suggested equivalent online courses:

Further Suggestions:

Programme/Class: Certificate	Year: First	Semester: Second
Subject: Chemistry		
Course Code: B020202P	**Course Title: Biochemical Analysis**	

Course outcomes:
This course will provide basic qualitative and quantitative experimental knowledge of biomolecules such as carbohydrates, proteins, amino acids, nucleic acids drug molecules. Upon successful completion of this course students may get job opportunities in food, beverage and pharmaceutical industries.

Credits: 2	Elective
Max. Marks: 25+75 = 100	**Min. Passing Marks:** As per rule
Practical	**60-h**

Unit	Topics	No of Lectures
I	**Qualitative and quantitative analysis of Carbohydrates:** 1. Separation of a mixture of two sugars by ascending paper chromatography 2. Differentiate between a reducing/ nonreducing sugar 3. Synthesis of Osazones.	**15**
II	**Qualitative and quantitative analysis of Proteins, amino acids and Fats** 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. Action of salivary amylase on starch 6. To determine the concentration of glycine solution by formylation method. 7. To determine the saponification value of an oil/fat. 8. To determine the iodine value of an oil/fat	**20**
III	**Determination and identification of Nucleic Acids** 1. Determination of nucleic acids 2. Extraction of DNA from onion/cauliflower	**12**
IV	**Synthesis of Simple drug molecules** 1. To synthesize aspirin by acetylation of salicylic acid and compare it with theingredient of an aspirin tablet by TLC. 2. Synthesis of barbituric acid 3. Synthesis of propranolol	**13**

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 Analysi*s, ELBS. 1986
5. Furniss, B.S.; Hannaford, A.J.; Rogers, V.; Smith, P.W.G.; Tatchell, A.R. *Vogel's Textbook of PracticalOrganic Chemistry*, ELBS.
6. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry,*Universities Pres
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,

Note: For the promotion of Hindi language, course books published in Hindi may be prescribed by the University

Suggestive digital platforms web links

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

This course can be opted as an elective by the students of following subjects: Chemistry in 12th Class

Suggested Continuous Evaluation Methods:

Viva voce	10 marks
Mock test	10 marks
Overall performance	05marks
	25

Course prerequisites: To study this course, a student must have Opted Sem-II, Theory Ppaer-1**.**

Suggested equivalent online courses:

Further Suggestions: