Kalinga University Atal Nagar (C.G.)

SCHEME OF EXAMINATION

& SYLLABUS

of

B.Sc. Biotechnology

UNDER

Faculty of Science

w.e.f. Session 2021-22

Kalinga University, Naya Raipur

B.Sc. Biotechnology

Session-2021-2022

B.Sc. (Biotechnology)					
First Semester					
Code No.	**Subject**	**Credits**	**Internal Marks**	**External Marks**	**Total**
	(Choose Any One) 101A/101B	2	15	35	50
BSCBT101A	English				
BSCBT101B	NCC				
BSCBT102	Cell Biology	4	30	70	100
BSCBT103	Plant Diversity	4	30	70	100
BSCBT104	Conceptual Organic Chemistry	4	30	70	100
BSCBT105-P	Cell Biology-Lab	1	20	30	50
BSCBT106-P	Plant Diversity –Lab	1	20	30	50
BSCBT107-P	Conceptual Organic Chemistry-Lab	1	20	30	50
		17	**165**	**335**	**500**

B.Sc. (Biotechnology)					
Second Semester					
Code No.	**Subject**	**Credits**	**Internal Marks**	**External Marks**	**Total**
	(Choose Any One) 201A/201B	2	15	35	50
BSCBT201A	Environmental Science				
BSCBT201B	NCC				
BSCBT202	Biochemistry	4	30	70	100
BSCBT203	Animal Diversity	4	30	70	100
BSCBT204	Physical Chemistry for the Sciences	4	30	70	100
BSCBT205-P	Biochemistry-Lab	1	20	30	50
BSCBT206-P	Animal Diversity-Lab	1	20	30	50
BSCBT207-P	Physical Chemistry for the Sciences-Lab	1	20	30	50
		17	**165**	**335**	**500**

B.Sc. (Biotechnology)					
Third Semester					
Code No.	**Subject**	**Credits**	**Internal Marks**	**External Marks**	**Total**
BSCBT301	Fundamental of IT	3	30	70	100
BSCBT302	Molecular Biology	4	30	70	100
BSCBT303	Diversity of Angiosperms: Systematics, Development & Reproduction	4	30	70	100
BSCBT304	Chemical Bonding, Transition Metal & Coordination Chemistry	4	30	70	100
BSCBT305-P	Fundamental of IT-Lab	1	20	30	50
BSCBT306-P	Molecular Biology-Lab	1	20	30	50
BSCBT307-P	Diversity of Angiosperms: Systematics, Development & Reproduction-Lab	1	20	30	50
BSCBT308-P	Chemical Bonding, Transition Metal & Coordination Chemistry-Lab	1	20	30	50
		19	**200**	**400**	**600**

B.Sc. (Biotechnology)					
Fourth Semester					
Code No.	**Subject**	**Credits**	**Internal Marks**	**External Marks**	**Total**
BSCBT401	Molecular Diagnostics	4	30	70	100
BSCBT402	Recombinant DNA Technology	4	30	70	100
BSCBT403	Comparative Anatomy and Developmental Biology of Vertebrates	4	30	70	100
BSCBT404	Molecules of Life	4	30	70	100
BSCBT405-P	Molecular Diagnostics-Lab	1	20	30	50
BSCBT406-P	Recombinant DNA Technology-Lab	1	20	30	50
BSCBT407-P	Comparative Anatomy and Developmental Biology of Vertebrates-Lab	1	20	30	50
BSCBT408-P	Molecules of Life-Lab	1	20	30	50
		20	**200**	**400**	**600**

B.Sc. (Biotechnology)					
Fifth Semester					
Code No.	**Subject**	**Credits**	**Internal Marks**	**External Marks**	**Total**
BSCBT501	Basics of Forensic Science	4	30	70	100
	Elective-I Biotechnology (Any One)	4	30	70	100
BSCBT502A	Animal Biotechnology				
BSCBT502B	Plant Biotechnology				
	Elective-II Biotechnology (Any One)	4	30	70	100
BSCBT503A	Bio-Analytical Tools				
BSCBT503B	Immunology				
	Elective-I Chemistry (Any One)	4	30	70	100
BSCBT504A	Polymer Chemistry				
BSCBT504B	Analytical Methods in Chemistry				
BSCBT504C	Inorganic Materials of Industrial Importance				
	Practical	2	20	30	50
BSCBT505P		2	20	30	50
	Practical Elective -I Biotechnology (Any One)				
BSCBT506P(A)	Animal Biotechnology-Lab				
BSCBT506P(B)	Plant Biotechnology-Lab				
	Practical Elective –II Biotechnology (Any One)	2	20	30	50
BSCBT507P(B)	Bio-Analytical Tools-Lab				
BSCBT507P(B)	Immunology-Lab				
	Practical-I Elective Chemistry (Any One)	2	20	30	50
BSCBT508P(A)	Polymer Chemistry-Lab				
BSCBT508P(B)	Analytical Methods in Chemistry-Lab				
BSCBT508P(C)	Inorganic Materials of Industrial Importance-Lab				
		24	**200**	**400**	**600**

B.Sc. (Biotechnology)					
Sixth Semester					
Code No.	**Subject**	**Credits**	**Internal Marks**	**External Marks**	**Total**
BSCBT601	Enzymology	4	30	70	100
	Elective-III Biotechnology (Any One)	4	30	70	100
BSCBT602A	Genomics and Proteomics				
BSCBT602B	Bioinformatics				
BSCBT602C	Environmental Biotechnology				
	Elective-IV Biotechnology (Any One)	4	30	70	100
BSCBT603A	Bioprocess Technology				
BSCBT603B	Biostatistics				
BSCBT603C	Nanotechnology				
	Elective-II Chemistry (Any One)	4	30	70	100
BSCBT604A	Instrumental Methods of Analysis				
BSCBT604B	Novel Inorganic Solids				
BSCBT604C	Organometallics, Bioinorganic chemistry, Polynuclear hydrocarbons and UV, IR Spectroscopy				
	Practicals				
BSCBT605P	Enzymology-Lab	2	20	30	50
	Practical- Elective-III Biotechnology (Any One)	2	20	30	50
BSCBT606P(A)	Genomics and Proteomics-Lab				
BSCBT606P(B)	Bioinformatics-Lab				
BSCBT606P(C)	Environmental Biotechnology-Lab				
	Practical- Elective-IV Biotechnology (Any One)	2	20	30	50
BSCBT607P(A)	Bioprocess Technology-Lab				
BSCBT607P(B)	Biostatistics-Lab				
BSCBT607P(C)	Nanotechnology-Lab				
	Practical-II Elective Chemistry (Any One)	2	20	30	50
BSCBT608P(A)	Instrumental Methods of Analysis -Lab				
BSCBT608P(B)	Novel Inorganic Solids -Lab				
BSCBT608P(C)	Organometallics, Bioinorganic chemistry, Polynuclear hydrocarbons and UV, IR Spectroscopy-**Lab**				
BSCBT609P	Project/Dissertation	4	30	70	100

		28	**230**	**470**	**700**

PROGRAMME OUTCOMES:

Programme outcome of B.Sc. and M.Sc. Biotechnology is to produce skilled biotechnologist's who can employ and put into practice their knowledge base in quality processes and applications which will greatly influence or utilized for existing standard of agriculture, industry, healthcare and environment control to provide sustainable competitive perimeter to current society.

Students will be eligible for doing jobs in various sectors of pharmaceutical, agricultural and biotechnological industry.

PROGRAMME SPECIFIC OUTCOMES:

- Students will be able design, conduct experiments, analyze and interpret data for investigating problems in Biotechnology and allied fields.
- Higher studies (M.Tech, M.Phil, Ph.D) can be pursued in order to achieve research positions. Various examinations such as CSIR-NET, ARS-NET, SET, GATE, ICMR, DBT and many other provide fellowships for pursuing Ph.D.
- Student can avail junior scientist position in various research and developmental labs.
- Students can become Production Officer and Technical Assistant in biotechnology, pharmaceutical Companies, bio fertilizer industry, aquaculture industries, environmental units, crop production units, food processing industries, and national bio-resource development firms.
- Some of the major pharmaceutical and drug companies' highering biotechnological professionals include Ranbaxy, Biocon, Genei and Dr Reddy's Labs, food processing industries, Milk industry, chemical industry and textile industry.
- Beside these industries also employ bio-technologist in their marketing sectors to enhance business.
- Beside industrial sector there are abundant opportunities in academics.
- Several career opportunities are available for students with biotechnology background abroad especially in countries like Germany, Australia, Canada, USA, and Malaysia.
- Biotechnology entrepreneur often starts with a technical background, most commonly including scientific laboratory research and may receive financial support from venture capitalists.

English

(BSCBT101A)

Course Objective

The purpose of this course is to introduce students to the theory, fundamentals and tools of communication and to develop in them vital communication skills which should be integral to personal, social and professional interactions. One of the critical links among human beings and an important thread that binds society together is the ability to share thoughts, emotions and ideas through various means of communication: both verbal and non-verbal. In the context of rapid globalization and increasing recognition of social and cultural pluralities, the significance of clear and effective communication has substantially enhanced.

CONTENTS

Unit I: Introduction: **06**

Theory of Communication, Types and modes of Communication, *Mediums and channels of communication, barriers to communication, English as a Global language, the Lingua Franca, Social influences on English*

Unit II: Language of Communication: **06**

Verbal and Non-verbal (Spoken and Written) Personal, Social and Business Barriers and Strategies Intra-personal, Inter-personal and Group communication, *Varieties of English, Language, Accent, Dialect, Colloquialism, Historical influences on English*

Unit III: Speaking Skills: **06**

Monologue Dialogue Group Discussion Effective Communication/ Mis- Communication Interview Public Speech, *Regional influences on English, Convergence and divergence, Linguistic Imperialism,*

Unit IV: Reading and Understanding- **06**

Close Reading, *Reading analysis of a text - Audience and purpose, Content and theme, Tone and Mood, stylistic devices, structure* Comprehension- Analysis and Interpretation Translation(from Indian language to English and vice-versa) Literary/Knowledge Texts

Unit V: Writing Skills **06**

Documenting Report Writing Making notes Letter writing, *Writing tabloids, diary entry, open letters, essays, newsletter and magazine articles, skits, short stories, impersonating characters*

Course outcome:

It will enhance Language of communication, various speaking skills such as personal communication, social interactions and communication in professional situations such as interviews, group discussions and office environments, important reading skills as well as writing skills such as

report writing, notetaking etc. While, to an extent, the art of communication is natural to all living beings, intoday's world of complexities, it has also acquired some elements of science. It is hoped that after studying this course, students will find a difference in their personal and professional interactions.

Recommended Readings:

1. Fluency in English - Part II, Oxford University Press, 2006.

2. Business English, Pearson, 2008.

3. Language, Literature and Creativity, Orient Blackswan, 2013.

4. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, DrRanjanaKaul, DrBrati Biswas

Cell Biology

(BSCBT102)

Course Outcome

This course presents the types and structural details of the basic unit by which all the living things are made of (the cell). Goals: To make the student to understood the concept of cell and their activities. This course presents the types and structural details of the basic unit by which all the living things are made of (the cell).To make the student to understood the concept of cell and their activities.

UNIT I **(10 Periods)**

Cell: **I**ntroduction and classification of organisms by cell structure, cytosol, Compartmentalization of eukaryotic cells, cell fractionation. Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity,

UNIT II **(15 Periods)**

Cell recognition and membrane transport. Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion.

UNIT III **(15 Periods)**

Lysosomes: Vacuoles and micro bodies: Structure and functions Ribosomes: Structures and function including role in protein synthesis. Mitochondria & Chloroplasts: Structure and function, genomes, Nucleus: Structure and function, chromosomes and their structure.

UNIT IV **(10 Periods)**

Structure and function, Genomes, biogenesis Extracellular Matrix: Composition, molecules that mediate cell adhesion, Membrane receptorsfor extra cellular matrix, Macromolecules,

UNIT V **(10 Periods)**

Regulation of receptor expression and function. Signal transduction. Cancer: Carcinogenesis, agents promoting carcinogenesis, Characteristics and molecular basis of cancer.

SUGGESTED READING

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. JohnWiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition.Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition.

ASMPress & Sunderland, Washington, D.C.; Sinauer Associates, MA.

4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7thedition. Pearson Benjamin Cummings Publishing, San Francisco.

Cell Biology-Lab

(BSCBT105P)

List of experiments:

1. Study the effect of temperature and organic solvents on semi permeable membrane.
2. Demonstration of dialysis.
3. Study of plasmolysis and de-plasmolysis.
4. Cell fractionation and determination of enzyme activity in organelles using sprouted seedor any other suitable source.
5. Study of structure of any Prokaryotic and Eukaryotic cell.
6. Microtomy: Fixation, block making, section cutting, double staining of animal tissueslike liver, oesophagus, stomach, pancreas, intestine, kidney, ovary, testes.
7. Cell division in onion root tip/ insect gonads.
8. Preparation of Nuclear, Mitochondrial & cytoplasmic fractions.

Plant Diversity

(BSCBT103)

- **Course Objective**
  - The course aims at making the students understand the diversity among algae, fungi, bryophytes ,pteridophytes and Gymnosperms.
  - To impart an insight into the modern classifications in lower forms of plants.
  - To impart basic knowledge of plant diversity.
  - To train the students to pursue further education.

UNIT I

Algae: General characters, classification and economic importance; important features and life history of Chlorophyceae – *Volvox, Oedogonium*; Xanthophyceae – *Vaucheria*; Phaeophyceae – *Ectocarpus*; Rhodophyceae – *Polysiphonia*.

UNIT II

Fungi: General characters, classification and economic importance; important features and life history of Mastigomycotina – *Phytophthora*; Zygomycotina – *Mucor*; Ascomycotina – *Saccharomyces*; Basidiomycotina – *Puccinia*; Deuteromycotina – *Colletotrichum*; geneneral account of Lichens.

UNIT III

Bryophyta: General characteristics, Classification (up to family), morphology, anatomy and reproduction of *Marchantia* and *Funaria*. (Developmental details not to be included). Ecology and economic importance of bryophytes Outlines of classification and importance of bryophytes. Structure, reproduction and classification of Hepaticopsida (*Marchantia*); Anthocerotopsida (*Anthoceros*), Bryopsida (*Funaria*).

UNIT IV

Pteridophyta: Important characteristics of Psilopsida, Lycopsida, Sphenopsida and Pteropsida; Structure, reproduction in *Rhynia, Lycopodium, Selaginella, Equisetum* and *Marsilea*. (details not required)

UNIT V

General features of gymnosperms and their classification.
Structure and reproduction in Cycas and Pinus and Ephedra

Course Outcomes:

On completion of the course, students are able to:

- Understand the diversity among Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms.
- Understand the life cycle pattern of plant diversity.
- Know the Economic Importance of plant diversity

Suggested Readings:

- Introduction to botany – Bendre & Kumar
- Botany for degree students – Algae: Vashishtha et al.
- Botany for degree students – Bryophyta: Vashishtha et al.

- An introduction to Pteridophyta – A Rashid
- Angiosperms: G. L Chopra
- Plant Taxonomy: O. P Sharma

Plant Diversity -Lab

(BSCBT106P)

Lab Objectives: Microscopic observation and identification of algae, fungi, bryophyte, Pteridophyta and Gymnosperms. Know the technique of section cutting and staining of plant materials.

1. Study of the genera include under algae with the help of Permanent slide.
2. Study of the genera includes under fungi the help of Permanent slide.
3. Morphological study of the plant body: Genera as mentioned in theoretical syllabus and *Riccia*, *Marchantia* (With the help of specimen).

4. Study from permanent slides: *Riccia* (V.S. of thallus with sporophyte), *Marchantia* (L.S. through gemma cup, antheridiophore, archegoniophore) , *Anthoceros* (L.S. of sporophyte).
5. Morphological study of the sporophytic plant body: Genera as mentioned in the theoretical syllabus and *Selaginella, Equisetum, Lycopodium.*
6. Study of different Pteridophyta, with the help of permanent slides and also by cutting sections

7. Morphological study: Cycas (microsporophyll and megasporophyll), Pinus (female and male cone), Gnetum (female and male cone).
8. Study from permanent slides: Cycas (L.S. of ovule), Pinus (L.S. of male and female cone), Ginkgo (L.S. of female strobilus), Gnetum (L.S. of male cone and ovule).

Lab Outcome-

- Students are able to recognize types of algae and able to draw their thallus structure.
- Students get to know about primitive plants and know about their different life cycle.
- Students are able to recognize different types of fungi and diseases caused by it.

Conceptual Organic Chemistry

(BSCBT104)

Unit 1: Stereochemistry (18 Lectures)
Writing of Fischer projection, Newmann and Sawhorse projection and Wedge formulae. Interconversion of one type of structural representation into another type.
Conformations: Restricted rotation about single bonds, Various conformations of ethane, butane, ethane-1,2-diol and cyclohexane. Relative stability of different conformations in terms of energy difference is to be discussed for all these compounds.

Geometrical Isomerism: Requirements for a molecule to show geometrical isomerism, Cis-Trans and E/ Z notation along with CIP rules for geometrical isomers.

Optical Isomerism: Optical activity, specific and molar rotation, chirality, enantiomerism, diastereoisomerism, racemic mixtures and their resolution by salt formation method.

Relative and absolute configuration: D / L nomenclature system for configuration of carbohydrates (difference between d/l and D/L notations). Threo and Erythro designation. Rand S-configuration (upto two chiral centres).

Unit 2: Addition Reactions (10 Lectures)
Alkenes and Alkynes: Hydrogenation, addition of halogens, Hydrohalogenation (Markovnikov's and anti-Markovnikov's addition), hydration, hydroxylation (cis and trans), oxymercuration-demercuration, hydroboration-oxidation, ozonolysis. Reactivity of alkenes vs alkynes.

Aldehydes and ketones: (formaldehyde, acetaldehyde, benzaldehyde, acetone) Addition of sodium bisulphite, hydrogen cyanide and alcohols. Addition- elimination reactions with ammonia and its derivatives

Name reactions: Aldol, cross Aldol, Claisen, Knoevengel, Cannizzaro, cross Cannizzaro

Unit 3: Substitution Reactions (15 Lectures)
Free radical substitution reactions: Halogenation of alkanes, allylic compounds and alkyl benzenes.

Nucleophilic substitution reactions: Alkyl, allyl and benzyl halides – substitution of halogen by some common nucleophiles. Mechanism of SN1 and SN2 reactions (stereochemistry, nature of substrate, nucleophile and leaving group)

Benzene diazonium chloride: Replacement of diazo group
Alcohols, amines and phenols: Substitution of active hydrogen, replacement of hydroxyl group in alcohols (using PCl_5, $SOCl_2$ and HI)
Carboxylic acid derivatives: Hydrolysis **Ethers**: Cleavage by HI
Electrophilic Substitution Reactions (aromatic compounds): General mechanism of electrophilic substitution reactions (nitration, halogenation, sulphonation, Friedel Crafts alkylation and acylation), directive influence of substituents.

Unit 4: Elimination Reactions (6 Lectures)
Alkyl halides (dehydrohalogenation, Saytzeff's rule), vicinal dihalides (dehalogenation), alcohols (dehydration), Quaternary ammonium salts (Hofmann's elimination). Mechanism of E1

and E2 reactions (nature of substrate and base), elimination vs substitution

Unit 5: Oxidation (6 Lectures)

Aromatic side chain: Oxidation with potassium permanganate, potassium dichromate

Alcohols: Oxidation with potassium permanganate, potassium dichromate, catalytic dehydrogenation and Oppenauer oxidation. Oxidation of 1,2–diols with periodic acid and lead tetraacetate.

Aldehydes: Oxidation with potassium permanganate, chromic acid and Tollen's reagent

Ketones: Oxidation with potassium permanganate, sodium hypoiodite (iodoform reaction) and Baeyer–Villiger oxidation

Reductions (5 Lectures)

Aldeydes and Ketones: Catalytic hydrogenation, reduction with sodium borohydride, lithium aluminium hydride, Clemmensen, Wolff-Kishner

Carboxylic acids and their derivatives: Lithium aluminium hydride, sodium-ethanol and Rosenmund reduction.

Nitro compounds: Acidic, alkaline and neutral reducing agents, lithium aluminium hydride and electrolytic reduction.

Recommended Texts:

1. I. L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S.
2. R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Pearson Education.
3. Arun Bahl and B. S. Bahl : *Advanced Organic Chemistry,* S. Chand
4. Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry,* Orient Longman.
5. Eliel, E. L. & Wilen, S. H. *Stereochemistry of Organic Compounds*; Wiley: London, 1994.
6. T. W. Graham Solomon's *Organic Chemistry,* John Wiley and Sons.
7. P.S. Kalsi, *Stereochemistry, Conformation and Mechanism,* John Wiley and Sons.
8. D. Nasipuri, *Stereochemistry of Organic Compounds,* New Age International Publishers.

Conceptual Organic Chemistry-Lab

(BSCBT107P)

1. Purification of organic compounds by crystallization using the following solvents:
a. Water
b. Alcohol

2. Determination of the melting points of organic compounds (by Kjeldahl method and electrically heated melting point apparatus).

3. Determination of optical activity by using polarimeter

Organic preparations: Carry out the following preparations using 0.5 - 1 g of starting compound. Recrystallize the product and determine the melting point of the recrystallized sample.

4. To prepare acetanilide by the acetylation of aniline.
5. To prepare p-bromoacetanilide.
6. Benzolyation of aniline or β-naphthol by Schotten-Baumann reaction
7. Hydrolysis of benzamide or ethyl bezoate.
8. Semicarbazone derivative of one the following compounds: acetone, ethyl methyl ketone, diethylketone, cyclohexanone, benzaldehyde.
9. Nitration of nitrobenzene.
10. Oxidation of benzaldehyde by using alkaline potassium permanganate.

Recommended Texts:

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,* Longman, London & New York.
3. Ahluwalia, V.K.; Dhingra, S. & Gulati, A. *College Practical Chemistry,* Universities Press.

Environmental Science
(BSCBT201A)

Unit 1 : Introduction to Environmental Studies (6 Lecture)

- Multidisciplinary nature of environmental studies;

Scope and importance; Concept of sustainability and sustainable development.

Ecosystems

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems :
  a) Forest ecosystem
  b) Grassland ecosystem
  c) Desert ecosystem
  d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit 2 : Natural Resources : Renewable and Non---renewable Resources (6 Lecture)

- Land resources and landuse change; Land degradation, soil erosion and desertification.
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water : Use and over---exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter---state).
- Energy resources : Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit 3 : Biodiversity and Conservation (5 Lecture)

- Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots
- India as a mega---biodiversity nation; Endangered and endemic species of India
- Threats to biodiversity : Habitat loss, poaching of wildlife, man---wildlife conflicts, biological invasions; Conservation of biodiversity : In---situ and Ex---situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

Unit 4 : Environmental Pollution (9 Lecture)

- Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human health risks
- Solid waste management : Control measures of urban and industrial waste.
- Pollution case studies.

Environmental Policies & Practices

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

Unit 5 : Human Communities and the Environment (4 Lecture)

- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management : floods, earthquake, cyclones and landslides.
- Environmental movements : Chipko, Silent valley, Bishnois of Rajasthan.
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

Suggested Readings:

1. Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R.1993. *This Fissured Land: An Ecological History of India*. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999.*Global Ethics and Environment*, London, Routledge.
4. Gleick, P. H. 1993. *Water in Crisis*. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll.*Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. *Science*, 339: 36---37.
7. McCully, P. 1996. *Rivers no more: the environmental effects of dams*(pp. 29---64). Zed Books.
8. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
9. Odum, E.P., Odum, H.T. & Andrews, J. 1971.*Fundamentals of Ecology*. Philadelphia: Saunders.
10. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
11. Rao, M.N. & Datta, A.K. 1987. *Waste Water Treatment*. Oxford and IBH Publishing Co. Pvt. Ltd.
12. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012.*Environment*. 8th edition. John Wiley & Sons.
13. Rosencranz, A., Divan, S., & Noble, M. L. 2001. *Environmental law and policy in India*. *Tripathi 1992*.
14. Sengupta, R. 2003. *Ecology and economics*: An approach to sustainable development. OUP.
15. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi.

16. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. *Conservation Biology*: *Voices from the Tropics*. John Wiley & Sons.

17. Thapar, V. 1998. *Land of the Tiger*: *A Natural History of the Indian Subcontinent*.
18. Warren, C. E. 1971. *Biology and Water Pollution Control*. WB Saunders.
19. Wilson, E. O. 2006.*The Creation: An appeal to save life on earth*. New York: Norton.

20. World Commission on Environment and Development. 1987.*Our Common Future*. Oxford University Press.

BIOCHEMISTRY

(BSCBT202)

Course Outcome

This course presents the chemical reactions or metabolic functions in the living system and their regulations. Goals: To make the student to understood the concept of biochemical regulations Objectives: On successful completion of the subject the student should have understood: Basic Structure and metabolism of Biomolecule.

Unit-I **(15 Periods)**

Biochemistry: Introduction, Definition, scope and application. Carbohydrate: Structure, Classification and function of mono, oligo & polysaccharides. Carbohydrate metabolism and pathway: Glycolysis, Glyoneogenesis, Gluconeogenesis Amino acids: Classification, essential & non-essential, General properties.

Unit-II **(10 Periods)**

Proteins: Introduction, structure, classification, physical & chemical propertiesLipid: Structure, Classification, chemical properties.Biosynthesis of lipidFatty Acids: Introduction, classification.

Unit-III **(15 Periods)**

Enzymes: Introduction, Definition, Nomenclature , classification, Mechanism of enzymes action

Holoenzyme, apoenzyme, Cofactors, Coenzyme, Enzyme activity, specific activity, common features of active sites, enzyme specificity

Unit-IV **(10 Periods)**

Nucleic acids: Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines,. Biologically important nucleotides, Double helical model of DNA structure and forces responsible for A, B & Z – DNA,

Unit-V **(10 Periods)**

Vitamins: Introduction, Types, functions Water and fat soluble, deficiency and diseases of vitamin Plant hormones: Introduction, Definition, structure and function of plant hormone. Animal Hormones: Introduction, Definition, structure, and function of animal hormone.

SUGGESTED READING

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freemanand Co.
2. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology ofPlants.American Society of Plant Biologists.
3. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WHFreeman and Company, New York, USA.
4. Hopkins, W.G. and Huner, P.A. (2008) Introduction to Plant Physiology. John Wiley andSons.
5. Salisbury, F.B. and Ross, C.W. (1991) Plant Physiology, Wadsworth Publishing Co. Ltd.

BIOCHEMISTRY-Lab

(BSCBT205P)

1. To study activity of any enzyme under optimum conditions.
2. To study the effect of pH, temperature on the activity of salivary amylase enzyme.
3. Determination of - pH optima, temperature optima, Km value, Vmax value, Effect ofinhibitor (Inorganic phosphate) on the enzyme activity.
4. Estimation of blood glucose by glucose oxidase method.
5. Principles of Colorimetry**: (i)** Verification of Beer's law, estimation of protein. (**ii)** To study relation between absorbance and % transmission.
6. Preparation of buffers.
7. Separation of Amino acids by paper chromatography.
8. Qualitative tests for Carbohydrates, lipids and proteins

ANIMAL DIVERSITY

(BSCBT203)

Unit-1:

Kingdom Protista **4**

General characters and classification up to classes; Locomotory Organelles and locomotion inProtozoa

Phylum Porifera **3**

Generalcharactersandclassificationup toclasses; Canal Systemin*Sycon*

Phylum Cnidaria **3**

Generalcharactersandclassificationuptoclasses;Polymorphismin Hydrozoa

Unit-II: Phylum Platyhelminthes **3**

Generalcharactersandclassificationupto classes;Lifehistoryof*Taenia solium*

Phylum Nemathelminthes **5**

Generalcharactersandclassificationuptoclasses;Lifehistoryof*Ascarislumbricoides*anditsparasiticadaptations

Phylum Annelida **3**

Generalcharactersandclassificationuptoclasses;MetamerisminAnnelida

Unit-III:Phylum Arthropoda **5**

Generalcharactersandclassificationuptoclasses;VisioninArthropoda,MetamorphosisinInsects

Phylum Mollusca

Generalcharactersandclassificationuptoclasses;Torsioningastropods

Phylum Echinodermata

Generalcharactersandclassificationuptoclasses;Water-vascularsysteminAsteroidea

Unit-IV: Protochordates

GeneralfeaturesandPhylogenyofProtochordata

Agnatha

GeneralfeaturesofAgnathaandclassificationofcyclostomesuptoclasses

Pisces

GeneralfeaturesandClassificationuptoorders;OsmoregulationinFishes

Amphibia **4**

GeneralfeaturesandClassificationuptoorders;Parentalcare

Unit1-V: Reptiles **4**

General features and Classification up to orders; Poisonous and non-poisonous snakes, Bitingmechanismin snakes

Aves **5**

GeneralfeaturesandClassificationuptoorders;Flightadaptationsinbirds

Mammals **5**

Classification up to orders; Origin of mammals

SUGGESTEDREADINGS

- RuppertandBarnes,R.D.(2006).InvertebrateZoology,VIIIEdition.HoltSaundersInternational Edition.
- Barnes,R.S.K.,Calow,P.,Olive,P.J.W.,Golding,D.W.andSpicer,J.I.(2002).TheInvertebrates: A New Synthesis,IIIEdition,BlackwellScience
- Young,J.Z. (2004).TheLifeof Vertebrates.IIIEdition.Oxforduniversitypress.
- PoughH.Vertebratelife,VIIIEdition,PearsonInternational.
- HallB.K.andHallgrimssonB.(2008).Strickberger'sEvolution.IVEdition.JonesandBartlettPublishersInc.

ANIMAL DIVERSITY-Lab

(BSCBT206P)

1. Studyof the following specimens:
   Amoeba,Euglena,Plasmodium,Paramecium,Sycon,Hyalonema,andEuplectella,Obeli Physalia, Aurelia, Tubipora, Metridium, Taenia solium, Male and female Ascarislumbricoides, Aphrodite, Nereis, Pheretima, Hirudinaria, Palaemon, Cancer, Limulus,Palamnaeus,Scolopendra,Julus,Periplaneta,Apis,Chiton,Dentalium,Pila,Unio,Loligo, Sepia,Octopus,Pentaceros,Ophiura,Echinus,CucumariaandAntedon,Balanoglossus,Herdmani a,Branchiostoma,Petromyzon,Sphyrna,Pristis,Torpedo,Labeo, Exocoetus, Anguilla, Ichthyophis/Ureotyphlus, Salamandra, Bufo, Hyla, Chelone,Hemidactylus,Chamaeleon,Draco,Vipera,Naja,Crocodylus,Gavialis,Anysixcommon birds fromdifferent orders,Sorex,Bat,Funambulus,Loris

2. Studyof the followingpermanent slides:
   T.S.andL.S.ofSycon,StudyoflifehistorystagesofTaenia,T.S.ofMaleandfemale Ascaris

3. KeyforIdentificationofpoisonousandnon-poisonoussnakes

   An “animal album” containing photographs, cut outs, with appropriate write up about theabovementionedtaxa.Differenttaxa/topicsmaybegiventodifferentsetsofstudentsforthispurpose.

Physical Chemistry for the Sciences

(BSCBT204)

Unit 1: Chemical Energetics (10 Lectures)
Review of the Laws of Thermodynamics.
Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formation, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data.
Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.
Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

Unit 2: Chemical Equilibrium (20 Lectures)
Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG^{o}, Le Chatelier's principle. Relationships between K_p, K_c and K_x for reactions involving ideal gases.

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

Unit 3: Chemical Kinetics (8 Lectures)
The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero and first order reactions. Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation. Enzyme kinetics.

Unit 4: Spectroscopy (16 Lectures)
Introduction to spectroscopy: Electromagnetic radiation, fundamental definitions, electromagnetic spectrum, introduction to concepts of absorption and emission spectroscopy, Beer-Lambert law.

IR Spectroscopy: Fundamental and non-fundamental molecular vibrations, IR spectrum, fingerprint and group frequency regions and their significance, Hooke's law and vibrational frequency. Factors affecting vibrational frequency.
Characterization of functional groups: alkanes, alkenes, alkynes (only alicyclic systems), aldehydes, ketones, carboxylic acids and their derivatives, hydroxy compounds and amines. Study of hydrogen bonding.
Electronic Spectroscopy: Electronic transitions, singlet and triplet states, dissociation and predissociation.
UV spectroscopy: Types of electronic transitions, UV spectrum, λ_{max}, ε_{max}, chromophores, auxochromes, bathochromic shift, hypsochromic shift (definitions and elementary examples) and solvent effect. Characteristic UV transitions in common functional groups.
General applications of UV spectroscopy including distinction between cis-trans isomers.
Woodward rules for calculating λ_{max} in the following systems:
□ □ Conjugated dienes: alicyclic, homoannular, heteroannular.
□ □ α,βUnsaturated aldehydes and ketones.
□ □ Extended conjugatedsystems: dienes, aldehydes and ketones.
PMR spectroscopy: Basic principles of NMR spectroscopy, PMR scale, chemical shifts (concept of shielding and deshielding), factors influencing chemical shifts, simple spin-spin couplings, coupling constant, chemical shift equivalence, anisotropic effects in alkenes, alkynes, aldehydes and aromatics. Interpretation of PMR spectra of simple compounds.
Application of UV, IR and PMR in solving structures of simple molecules.

Unit 5: Photochemistry (6 Lectures)
Laws of photochemistry. Fluorescence and phosphorescence. Quantum efficiency and reasons for high and low quantum yields. Primary and secondary processes in photochemical reactions. Photochemical and thermal reactions.

Recommended Texts:
1. Atkins, P. W. & Paula, J. de *Atkin's Physical Chemistry 9*th Ed., Oxford University Press (2011).
2. Ball, D. W. *Physical Chemistry* Thomson Press, India (2007).
3. Castellan, G. W. *Physical Chemistry* 4th Ed. Narosa (2004).
4. Mortimer, R. G. *Physical Chemistry* 3rd Ed. Elsevier: NOIDA, UP (2009).
5. Chang, R. *Physical Chemistry for the Biosciences.* University Science Books (2005).

Physical Chemistry for the Sciences-Lab

(BSCBT207P)

(I) Thermo chemistry

1. Determination of heat capacity of a calorimeter for different volumes.
2. Determination of the enthalpy of neutralization of hydrochloric acid with sodium hydroxide.

3. Determination of integral enthalpy of solution of salts (endothermic and exothermic).

(III) pH-metric and potentiometric measurements

4. Preparation of sodium acetate-acetic acid buffer solutions and measurement of their pH.
5. Potentiometric titrations of (i) strong acid *vs* strong base (ii) weak acid *vs* strong base
6. Determination of dissociation constant of a weak acid.

(IV) Study the kinetics of the following reactions:

7. Initial rate method: Iodide-persulphate reaction
8. Integrated rate method:

a. Acid hydrolysis of methyl acetate with hydrochloric acid.
b. Saponification of ethyl acetate

(V) Colourimetry

9. Verification of Lambert-Beer's Law for potassium dichromate/ potassium permanganate solution.
10. Determination of pK (indicator) for phenolphthalein.
11. Study the kinetics of interaction of crystal violet with sodium hydroxide colourimetrically.

Recommended Texts:

1. Khosla, B.D.; Garg, V.C.; Gulati, A. & Chand, R. *Senior Practical Physical Chemistry*, New Delhi.

BSCZBC	Total Marks: 100
Semester-I	Internal Marks: 30
Paper Code. BSCBT301	External Marks: 70
Fundamentals of IT	No. of Hours: 40
Objectives: This is a basic course for commerce students to familiarize with computer and it's applications in the relevant fields and exposes them to other related courses of IT.	Total Credits: 03

Unit No.	Details	Nos. of Hours
1	**1.1 Introduction to Computers:** 1.1.1 The evolution of computers – Computer Generation 1.1.2 Classifications of Computers – 1.1.3 Micro 1.1.4 Mini, 1.1.5 Mainframe 1.1.6 Super Computers 1.1.7 Distributed Computer System 1.1.8 Parallel Computers 1.1.9 Computer Hardware – Major Components of a Digital Computer 1.1.10 Block Diagram of Computer 1.1.11 Input devices 1.1.12 Output devices 1.1.13 Description of Computer IPO Cycle 1.1.14 CPU **1.2 Computer Memory:** 1.2.1 Memory Types, 1.2.2 Units of memory 1.2.3 Read Only Memory, 1.2.4 Random Access Memory, 1.2.5 Serial Access Memory, 1.2.6 Physical Devices Used to construct Memories, 1.2.7 Hard disk, 1.2.8 Floppy Disk Drives, 1.2.9 CD, DVD, Flash Drives, 1.2.10 Magnetic Tape Drives.	**08**
2	**2.1 Number System:** 2.1.1 Decimal, 2.1.2 Binary, 2.1.3 Octal, 2.1.4 Hexa-decimal. 2.1.5 Conversion - Decimal to all other number systems, 2.1.6 Binary to octal and Hexa Decimal, **3.1 Computer Software:** 3.1.1 System software, 3.1.2 Operating Systemconcepts, 3.1.3 Different types of operating systems, 3.1.4 Assemblers, 3.1.5 Compilers, 3.1.6 Interpreters, 3.1.7 linkers,	**08**

	3.1.8 Application Software, 3.1.9 Firmware Software,	
3	**3.1 Introduction of Internet and Objectives** **3.2 Basic of Computer Networks** 3.2.1 Local Area Network (LAN) 3.2.2 Wide Area Network (WAN) **3.3 Internet** 3.3.1 Concept of Internet 3.3.2 Applications of Internet 3.3.3 Connecting to the Internet 3.3.4 Troubleshooting **3.4 World Wide Web (WWW)** **3.5 Web Browsing Software** 3.5.1 Popular Web Browsing Software **3.6 Search Engines** 3.6.1 Popular Search Engines / Search for content 3.6.2 Accessing Web Browser 3.6.3 Using Favorites Folder 3.6.4 Downloading Web Pages 3.6.5 Printing Web Pages **3.7 Understanding URL** **3.8 Surfing the web** 3.8.1 Using e-governance website	**08**
4	**4.1 Word Processor:** 4.1.1 Word Processor and its features, 4.1.2 Editing of Text, 4.1.3 Find and Replace, 4.1.4 Bullets and Numbering, 4.1.5 Spell Checker, 4.1.6 Grammar Checker, 4.1.7 Auto Correct, 4.1.8 Auto Complete, 4.1.9 Auto Text, 4.1.10 Header and footer, 4.1.11 tables, 4.1.12 mail merge, 4.1.13 border and shading, 4.1.14 page setup, 4.1.15 Printing. **4.2 Spread sheet:** 4.2.1 Spread sheet and its features, 4.2.2 Entering Information in Worksheet, 4.2.3 Editing Cell Entry, 4.2.4 Moving and Copying Data, 4.2.5 deleting or Inserting Cells, 4.2.6 Rows and Columns, 4.2.7 Custom 4.2.8 Numeric Formats, 4.2.9 Using Formulas and functions, 4.2.10 Creating charts.	**08**
5	**5.1 Presentation Software** 5.1.1. Presentation Software and its uses,	**08**

	5.1.2. steps for creating Power Point Presentation, 5.1.3. PowerPoint Views, 5.1.4. Assigning Slide Transitions, 5.1.5. Using Preset Animations, 5.1.6. Hiding Slides, 5.1.7. Slide Show, 5.1.8. Controlling the Slide Show with a Keyboard, 5.1.9. Setting Slide Show Timings.	

Text Books:

1. Alex Leon & Mathews Leon, "Fundamentals of Information Technology", LeonTechworld, 1999.
2. Vikas Gupta, "Comdex Computer Kit", Wiley Dreamtech, Delhi, 2004
3. P. K. Sinha & Priti Sinha , "Computer Fundamentals", BPB Publications, 1992.

Reference Books:

1. V. Raja Raman, "Introduction to Computers", PHI, 1998.
2. Alex Leon & Mathews Leon, "Introduction to Computers", Vikas Publishing House, 1999.
3. Norton Peter, "Introduction to computers", 4th Ed., TMH, 2001.

BSCZBC	Total Marks: 50
Semester – I	Internal Marks: 20
Paper Code. BSCBT305P	External Marks: 30
Fundamentals of IT-LAB	No. of Hours: 30
Objectives: This is a basic course for Commerce students to familiarize with computer and it's applications in the relevant fields and exposes them to other related courses of IT.	Total Credits: 01

nit No.	**Details**	**No s. of Hours**
	MS-WORD 1. Text Manipulations 2. Usage of Numbering, Bullets, Tools and Headers 3. Usage of Spell Check and Find and Replace 4. Text Formatting 5. Picture Insertion and Alignment 6. Creation of Documents Using Templates` 7. Creation of Templates 8. Mail Merge Concept 9. Copying Text and Picture From Excel 10. Creation of Tables, Formatting Tables 11. Splitting the Screen 12. Opening Multiple Document, Inserting Symbols in Documents **MS-EXCEL** 1. Creation of Worksheet and Entering Information 2. Aligning, Editing Data in Cell 3. Excel Function (Date, Time, Statistical, Mathematical, Financial Functions) 4. Changing of Column Width and Row Height (Column and Range of Column) 5. Moving, copying, Inserting and Deleting Rows and Columns 6. Formatting Numbers and Other Numeric Formats 7. Drawing Borders Around Cells 8. Creation of Charts Raising Moving 9. Changing Chart Type 10. Controlling the Appearance of a Chart **MS -POWER POINT** Working With Slides 1. Creating, saving, closing presentation 2. Adding Headers and footers 3. Changing slide layout 4. Working fonts and bullets 5. Inserting Clip art: working with clipart, 6. Applying Transition and animation effects 7. Run and Slide Show	**30**

MOLECULAR BIOLOGY
(BSCBT302)

Course Outcome

Molecular biology is the basic science that has as its goal an explanation of life processes at the sub cellular and molecular level. Recent years have seen explosive advances in the study of DNA and molecular genetics, including gene cloning, sequencing and mapping. Developments in molecular biology have opened new areas of study and provided powerful techniques that are revolutionizing the pharmaceutical, health, and agricultural industries. They have spawned new industries in biotechnology, and opened avenues for answering basic and applied questions in all of the life sciences.

Molecular biology students complete a comprehensive curriculum in the fundamentals of science and are prepared to address problems in the biochemical, biological and agricultural sciences. The requirements of the molecular biology major assure competence in the broad scientific theory and application of molecular biology, while allowing flexibility for students to develop strength in their biochemical, biological or agricultural discipline.

UNIT I: (15 Periods)

DNA as genetic material, Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, DNA polymerases, The replication complex: Pre-primming proteins, primosome, replisome, Rolling circle replication,

UNIT II: (10 Periods)

Unique aspects of eukaryotic chromosome replication, Fidelity of replication.
DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair,

UNIT III (10 Periods)

Translesion synthesis, recombinational repair, nonhomologous end joining. Homologous recombination:models and mechanism.

RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains

UNIT IV: (15Periods)

Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5’ cap formation, polyadenylation, splicing, rRNA and tRNA splicing.

UNIT V: (10 Periods)

Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible

system), Genetic code and its characteristics, Prokaryotic and eukaryotic translation: ribosome structure and assembly, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors oftranslation.

SUGGESTED READING

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. JohnWiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIIIEdition. Lippincott Williams and Wilkins, Philadelphia.
3. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell.VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
4. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.

MOLECULAR BIOLOGY-Lab
(BSCBT306P)

1. Preparation of solutions for Molecular Biology experiments.
2. Isolation of chromosomal DNA from bacterial cells.
3. Isolation of Plasmid DNA by alkaline lysis method
4. Agarose gel electrophoresis of genomic DNA.
5. Agarose gel electrophoresis of genomic plasmid DNA
6. Preparation of restriction enzyme digests of DNA samples
7. Demonstration of AMES test or reverse mutation for carcinogenicity
8. To study DNA damages by ultraviolet radiation.

Diversity of Angiosperms: Systematics, Development & Reproduction

(BSCBT303)

UNIT I

Systematics Principles of classification, nomenclature; comparative study of different classification systems, viz. Bentham & Hooker, Engler & Prantl, Hutchinson, and Cronquist. Herbarium techniques and important Botanic Gardens.

UNIT II

Taxonomic study of following families and their economic importance: Ranunculaceae Brassicaceae, Rutaceae, Apiaceae, Asclepiadaceae, Solanaceae, Lamiaceae, Euphoricaceae, Liliaceae and Poaceae.

UNIT III

The root system: root apical meristem; differentiation of tissues; modification of roots. **The shoot system**: shoot apical meristem; Anatomy of primary shoot in monocotyledons (*Zea mays*) and dicotyledons (*Helianthus anus*); Secondary Growth, characteristics of growth rings, sapwood and heart wood; secondary phloem; periderm.

UNIT IV

Leaf: origin, development, Structure, arrangement and diversity in size and shape, senescence and abscission.

Flower: Structure and function of anther and pistil. Development of male and female gametophytes.

UNIT V

Pollination, self incompatibility, double fertilization, formation of seed, endosperm and embryo; fruit: development and maturation, Seed dormancy, vegetative propagation.

Suggested Readings:

1. The Embryology of Angiosperms: Bhojwani and Bhatnagar.
2. Anatomy of Seed Plants: Esau, K. John Wiley and Son, USA.
3. Embryology of Angiosperms: Johri, B.M. Springer-Verleg, Berlin.
4. Pollination biology: Kapil, R.P. Inter India Publishers, New Delhi.
5. An Introduction to Embryology of Angiosperms: Maheswari.P
6. Botany for Degree Students: Pandey, B.P. -Diversity of Seed Plants and their Systematics, Structure,
Development and Reproduction in Flowering Plants. S. Chand & Company Ltd., New Delhi.

Diversity of Angiosperms: Systematics, Development & Reproduction –Lab

(BSCBT307P)

1. Study of representative plants of family Ranunculaceae, Brassicaceae, Malvaceae.
2. Study of representative plants of family Rutaceae, Apiaceae, Asclepidaceae,
3. Study of representative plants of family Solanaceae, Limiaceae, Euphorbiaceae and Liliaceae.
4. Study of different types of leaves.
5. Study Arrangement of leaves.
6. Internal structure of monocot and dicot stem.
7. Internal structure of monocot and dicot leaves.
8. Study of Pollen-grains of different species.
9. Study dehiscence mechanism in anthers of various seasonal flowers.
10. Study of different types of fruits.
11. Vegetative propagation, grafting, layering etc.

Chemical Bonding, Transition Metal & Coordination Chemistry

(BSCBT304)

Unit 1: The covalent bond and the structure of molecules (10 Lectures)
Valence bond approach, Concept of resonance in various organic and inorganic compounds, Hybridization and structure, equivalent and non-equivalent hybrid orbitals, Bent's rule and its applications, VSEPR model for predicting shapes of molecules and ions containing lone pairs, sigma and pi bonds.

Unit 2: Molecular Orbital Approach (10 Lectures)
LCAO method, symmetry and overlap for s-s ,s-p and p-p combinations, MO treatment ofhomonuclear diatomic molecules of 2nd period (B_2, C_2 ,N_2, O_2 , F_2) and heteronuclear di-atomicmolecules (CO, NO) and their ions.

Intermolecular forces: (8 Lectures)
van der Waals forces, Hydrogen bonding and its applications, effects of these forces on elting point, boiling point and solubility.

Unit 3: Transition Elements (10 Lectures)
General group trends with special reference to electronic configuration, variable valency,colour, magnetic and catalytic properties, ability to form complexes and stability of variousoxidation states (Latimer diagrams) for Mn, Fe and Cu.Lanthanoids and actinoids: Electronic configurations, oxidation states, colour, magneticproperties, lanthanide contraction, separation of lanthanides (ion exchange method only).

Unit 4: Coordination Chemistry and Inner Transition Metals (12 Lectures)
Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordinationnumbers 4 and 6.Drawbacks of VBT. IUPAC system of nomenclature.
Coordination compounds in biological systems: Fe, Cu, Co, Mn, Ni, Zn and heavy metal ions.
Inner-Transition Elements: Lanthanide and Actinide Series: General information, physical and chemical properties, uses.
Unit 5: Crystal Field Theory (10 Lectures)

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

Suggested Texts:
1. James E. Huheey, *"Inorganic Chemistry: Principles of structure and reactivity"*, Prentice Hall, IV Edition.
2. D. S. Shriver and P.A. Atkins, *"Inorganic Chemistry"*, Oxford University Press, IV Edition.
3. Alan G. Sharpe, "*Inorganic Chemistry"*, University of Cambridge, III Edition.
4. J. D. Lee, *"A New Concise Inorganic Chemistry"*, ELBS IV Edition
5. Grey L. Miessler and Donald A. Tarr, *"Inorganic Chemistry"*, Prentice Hall, III Edition.
6. B. Douglas, D. H. McDaniel and J. J. Alexander, *"Concepts and Models of Inorganic Chemistry", John Wiley and Sons, III Edition.*
7. Rodgers, G.E. *Inorganic &Solid State Chemistry,* Cengage Learning India Ltd., 2008.

Chemical Bonding, Transition Metal & Coordination

Chemistry-Lab

(BSCBT308P)

Titrimetric Analysis:
Preparations of standard solutions (concept of primary and secondary standards), Different units of concentration (molarity, molality, normality and formality)

(A) Titrations involving Acids-Bases:

Principles of acid-base titrations, Principle behind selection of an appropriate indicator.
1. Standardization of NaOH solution (standard solution of oxalic acid to be prepared)
2. Determination of concentration of carbonate and hydroxide present in a mixture.
3. Determination of concentration of carbonate and bicarbonate present in a mixture.
4. Determination of concentration of free alkali present in soaps/detergents/shampoos.

(B) Titrations involving redox reactions:
Concept of electrode potential, principle behind selection of an appropriate indicator.
5. Standardization of $KMnO_4$ solution (standard solution of Mohr's salt to be prepared).
6. Determination of concentration of Fe(II) in Mohr's salt and/or $K_2Cr_2O_7$ using diphenylamine/ N-phenylanthranilic acid as internal indicator (standard solution of $K_2Cr_2O_7$ and /or Mohr's salt to be prepared).
1. Determination of iron content in ores / alloys using appropriate redox titration.

(C) Complexometric Titrations
Principles of complexometric titrations
8. Determination of concentration of Mg (II) & Zn (II) by titrimetric method using EDTA.
9. Determination of concentration of Ca/Mg in drugs or in food samples.
10. Determination of concentration of total hardness of a given sample of water by complexometric titration.
(At least 2 experiments from each set.)

Recommended Texts:
1. Vogel, A.I. *A Textbook of Quantitative Inorganic Analysis*, ELBS.
2. Harris, D.C. & Freeman, W.H. & Co. *Quantitative Chemical Analysis 7th Ed.*, New York.

MOLECULAR DIAGNOSTICS

(BSCBT401)

Course Outcome

On successful completion of this module the learner will be able to

1. List the key historical developments in the field of molecular diagnostics.
2. Identify the role and importance of molecular diagnostics such as real-time PCR, epidemiological genotyping, microfluidics, bio-imaging and sequencing technologies.
3. Assess the benefit of research and development practices within a biotechnology company
4. Incorporate both in silico and lab based techniques as part of a combined molecular diagnostics strategy.
5. Perform selected laboratory techniques, interpret results and prepare reports.

UNIT I **(20 Periods)**

Enzyme Immunoassays:

Comparison of enzymes available for enzyme immunoassays, conjugation of enzymes. Solid phases used in enzyme immunoassays. Homogeneous and heterogeneous enzyme immunoassays. Enzyme immunoassays after immuno blotting. Enzyme immuno histochemical techniques. Use of polyclonal or monoclonal antibodies in enzymes immuno assays. Applications of enzyme immunoassays in diagnostic microbiology

UNIT II **(10 Periods)**

Molecular methods in clinical microbiology: Applications of PCR, RFLP, Nuclear hybridization methods, Single nucleotide polymorphism and plasmid finger printing in clinical microbiology

UNIT III **(10 Periods)**

Laboratory tests in chemotherapy: Susceptibility tests: Micro-dilution and macro-dilution broth procedures. Susceptibility tests:Diffusion test procedures. Susceptibility tests: Tests for bactericidal activity. Automated procedures for antimicrobial susceptibility tests.

UNIT IV **(10 Periods)**

Automation in microbial diagnosis, rapid diagnostic approach including technical purification and standardization of antigen and specific antibodies. Concepts and methods in idiotypes. Antiidiotypes and molecular mimicry and receptors. Epitope design and applications. Immunodiagnostic tests.

UNIT V **(10 Periods)**

GLC, HPLC, Electron microscopy, Flowcytometry and cell sorting. Immuno florescence. Radioimmunoassay. Transgenic animals.

SUGGESTED READING

1. Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker
2. Bioinstrumentation, Webster
3. Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe,Kluwer Academic
4. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited byPaniker CKJ). University Press Publication.
5. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg'sMedical Microbiology. 24th edition. McGraw Hill Publication.
6. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology.4th edition. Elsevier.
7. Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology. 19th edition. Appleton-Centuary-Crofts publication.
8. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein'sMicrobiology. 7th edition. McGraw Hill Higher Education.
9. Microscopic Techniques in Biotechnology, Michael Hoppert

MOLECULAR DIAGNOSTICS-Lab

(BSCBT405P)

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated throughany other material or medium including videos/virtual labs etc.)

1. Perform/demonstrate RFLP and its analysis
2. Kirby-Bauyer method (disc-diffusion method) to study antibiotic sensitivity of a bacterialculture
3. A kit-based detection of a microbial infection (Widal test)
4. Study of Electron micrographs (any four).
5. Perform any one immuno diagnostic test of Typhoid,/Malaria)
6. To perform/ demonstrate HPLC.
7. To perform/ demonstrate GLC.
8. To perform Radioimmunoassay.

RECOMBINANT DNA TECHNOLOGY

(BSCBT402)

Course Outcome

This course presents the mechanism of gene manipulation Goals: To make the student to understood the concept of gene manipulation and gene transfer technologies Objectives: On successful completion of the subject, the student should have understood: Manipulation of genes, Transfer techniques, Expression systems and methods of selection

UNIT I **(15 Periods)**

Molecular tools and applications- restriction enzymes, ligases, polymerases, alkaline phosphatase. Gene Recombination and Gene transfer: Transformation, Episome, Plasmids and other cloning vectors, Microinjection, Electroporation, Principle and applications of Polymerase chain reaction (PCR), primer-design, and RT- (Reverse transcription) PCR.

UNIT II **(15 Periods)**

Restriction and modification system, restriction mapping. Southern and Northern hybridization. Preparation and comparison of Genomic and cDNA library, screening of recombinants, reverse transcription,. Genome mapping, DNA fingerprinting,

UNIT III **(10 Periods)**

Genetic Engineering: Applications of Genetic Engineering Genetic engineering in animals: Production and applications of transgenic mice, role of ES cells in gene targeting in mice, Therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines (one example each).

UNIT IV **(10 Periods)**

Random and site-directed mutagenesis: Primer extension and PCR based methods of site directed mutagenesis, Random mutagenesis, Gene shuffling, production of chimeric proteins, Protein engineering concepts and examples (any two).

UNIT V **(10 Periods)**

Genetic engineering in plants: Use of *Agrobacterium tumefaciens* and A. rhizogenes, Ti plasmids, Strategies for gene transfer to plant cells, Direct DNA transfer to plants, Gene targeting in plants, Use of plant viruses as episomal expression vectors.

SUGGESTED READING

1. Brown TA. (2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing,Oxford, U.K.
2. Clark DP and Pazdernik NJ. (2009). Biotechnology-Applying the Genetic Revolution. Elsevier Academic Press, USA.

3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications ofrecombinant DNA. ASM Press, Washington
4. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7thedition. Blackwell Publishing, Oxford, U.K.
5. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rdedition. Cold Spring Harbor Laboratory Press.

RECOMBINANT DNA TECHNOLOGY-Lab

(BSCBT406P)

1. Isolation of chromosomal DNA from plant cells
2. Isolation of chromosomal DNA from *E.coli*
3. Qualitative and quantitative analysis of DNA using spectrophotometer
4. Plasmid DNA isolation
5. Restriction digestion of DNA
6. Making competent cells
7. Transformation of competent cells.
8. Demonstration of PCR

Comparative Anatomy and developmental biology of vertebrates
(BSCBT403)

Unit 1:
Integumentary System 4
Derivatives of integument w.r.t. glands and digital tips
Skeletal System 3
Evolution of visceral arches
Digestive System 4
Brief account of alimentary canal and digestive glands
Respiratory System 5
Brief account of Gills, lungs, air sacs and swim bladder

Unit-II:
Circulatory System 4
Evolution of heart and aortic arches
Urinogenital System 4
Succession of kidney, Evolution of urinogenital ducts
Nervous System 3
Comparative account of brain
Sense Organs 3
Types of receptors

Unit-III: Early Embryonic Development 12
Gametogenesis: Spermatogenesis and oogenesis w.r.t. mammals, vitellogenesis in birds; Fertilization: external (amphibians), internal (mammals), blocks to polyspermy; Early development of frog and humans (structure of mature egg and its membranes, patterns of cleavage, fate map, up to formation of gastrula);types of morphogenetic movements; Fate of germ layers; Neurulation in frog embryo.
Unit-IV: Late Embryonic Development
Implantation of embryo in humans, Formation of human placenta and functions, other types of placenta on the basis of histology; Metamorphic events in frog life cycle and its hormonal regulation.
Unit-V: Control of Development

Fundamental processes in development (brief idea) – Gene activation, determination, induction, Differentiation, morphogenesis, intercellular communication, cell movements and cell death

SUGGESTED READINGS

- Kardong, K.V. (2005)*Vertebrates' Comparative Anatomy, Function and Evolution*. IV Edition. McGraw-Hill Higher Education.
- Kent, G.C. and Carr R.K. (2000).*Comparative Anatomy of the Vertebrates*. IX Edition. The McGraw-Hill Companies.
- Hilderbrand, M and Gaslow G.E.*Analysis of Vertebrate Structure*, John Wiley and Sons.
- Walter, H.E. and Sayles, L.P;*Biology of Vertebrates*, Khosla Publishing House.
- Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
- Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.
- Carlson, Bruce M (1996). Patten's Foundations of Embryology, McGraw Hill, Inc.

Comparative Anatomy and developmental biology of vertebrates-Lab

(BSCBT407P)

1. Osteology:
a) Disarticulated skeleton of fowl and rabbit
b) Carapace and plastron of turtle /tortoise
c) Mammalian skulls: One herbivorous and one carnivorous animal.

2. Frog - Study of developmental stages - whole mounts and sections through permanent slides – cleavage stages, blastula, gastrula, neurula, tail bud stage, tadpole external and internal gill stages.

3. Study of the different types of placenta- histological sections through permanent slides or photomicrographs.

4. Study of placental development in humans by ultrasound scans.

5. Examination of gametes - frog/rat - sperm and ova through permanent slides or photomicrographs.

Molecules of Life

(BSCBT404)

Module-I

Carbohydrates

Classification of carbohydrates, reducing and non-reducing sugars, General properties of glucose and fructose, their open chain structure. Epimers, mutarotation and anomers. Determination of configuration of Glucose (Fischer proof). Cyclic structure of glucose. Haworth projections. Cyclicstructure of fructose. Linkage between monosachharides, structure of disacharrides (sucrose, maltose,lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation.**(10 Lectures)**

Module-II

Amino Acids, Peptides and Proteins

Classification *of Amino Acids,* Zwitterion 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 (t-butyloxycarbonyl and phthaloyl) & C-activating groups andMerrifield solid phase synthesis.**(12 Lectures)**

Module-III

Enzymes and correlation with drug action

Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, Specificity of enzyme action (including stereospecificity), Enzyme inhibitors and their importance, phenomenon of inhibition(Competitive and Non- competitive inhibition including allosteric inhibition). Drug action-receptor theory. Structure –activity relationships of drugmolecules, binding role of –OH group,-NH2 group, double bond and aromatic ring,**(12 Lectures)**

Module-IV

Nucleic Acids

Components of nucleic acids: Adenine, guanine, thymine and Cytosine (Structure only), other components of nucleic acids, Nucleosides and nucleotides **(nomenclature**), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (**types of RNA**), Genetic Code, Biological roles of DNA and RNA:Replication, Transcription and Translation. **(10 Lectures)**

Lipids

Introduction to lipids, classification.

Oils and fats: Common fatty acids present in oils and fats, Omega fatty acids, Trans fats,Hydrogenation, Saponification value, Iodine number. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol).

(8 Lectures)

Module-V

Concept of Energy in Biosystems

Calorific value of food. Standard caloric content of carbohydrates, proteins and fats. Oxidation of foodstuff (organic molecules) as a source of energy for cells. Introduction to Metabolism (catabolism, anabolism), ATP: the universal currency of cellular energy, ATP hydrolysis and free energy change.Conversion of food into energy. Outline of catabolic pathways of Carbohydrate-Glycolysis, Fermentation, Krebs Cycle. Overview of catabolic pathways of Fats and Proteins. Interrelationships in the metabolic pathways of Proteins, Fats and Carbohydrates.

(8 Lectures)

Recommended Texts:

- Morrison, R. T. & Boyd, R. N.*Organic Chemistry*, Dorling Kindersley (India)Pvt. Ltd. (Pearson Education).
- Finar, I. L.*Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt.Ltd. (Pearson Education).
- Finar, I. L.*Organic Chemistry* (*Volume 2)*, Dorling Kindersley (India) Pvt.Ltd. (Pearson Education).
- Nelson, D. L. & Cox, M. M*Lehninger's Principles of Biochemistry 7th Ed.,*W. H. Freeman.
- Berg, J.M., Tymoczko, J.L. & Stryer, L*Biochemistry*, W.H. Freeman, 2002.

Molecules of Life-Lab

(BSCBT408P)

1. Separation of amino acids by paper chromatography
2. To determine the concentration of glycine solution by formylation method.
3. Study of titration curve of glycine
4. Action of salivary amylase on starch
5. Effect of temperature on the action of salivary amylase on starch.
6. To determine the saponification value of an oil/fat.
7. To determine the iodine value of an oil/fat
8. Differentiate between a reducing/nonreducing sugar.
9. Extraction of DNA from onion/ cauliflower
10. To synthesize aspirin by acetylation of salicylic acid and compare it with the ingredient of an aspirin tablet by TLC.

Recommended Texts:

1. Furniss, B.S.; Hannaford, A.J.; Rogers, V.; Smith, P.W.G.; Tatchell, A.R. *Vogel's Textbook of Practical Organic Chemistry*, ELBS.
2. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry*,Universities Press.

BASICS OF FORENSIC SCIENCE

(BSCBT501)

Course Outcome

The Students will learn the following the skills after completion of the course: The basic analysis of biological samples found at the crime scene. To handle the evidences left out at the crime scene. The basic methods for examine the different types of questioned documents. Identify the different petroleum products by TLC examination. Examination of counterfeit Indian currency notes, passports and other mechanical impressions. Identify the classification and mode of different types of poisons. Understanding the classification of firearms and their mechanisms.

Unit I **(15 Periods)**

Introduction and principles of forensic science, forensic science laboratory and its organization and service, tools and techniques in forensic science, branches of forensic science, causes of crime,

Unit II **(10 Periods)**

Role of modus operandi in criminal investigation. Classification of injuries and their medico-legal aspects, method of assessing various types of deaths.

Unit III **(15 Periods)**

Classification of fire arms and explosives, introduction to internal, external and terminal ballistics. Chemical evidence for explosives. General and individual characteristics of handwriting, examination and comparison of handwritings and analysis of ink various samples.

Unit IV **(10 Periods)**

Role of the toxicologist, significance of toxicological findings, Fundamental principles of fingerprinting, classification of fingerprints, development of finger print as science for personal identification,

Unit V **(10 Periods)**

Principle of DNA fingerprinting, application of DNA profiling in forensic medicine, Investigation Tools, eDiscovery, Evidence Preservation, Search and Seizure of Computers, Introduction to Cyber security.

SUGGESTED READING

1. Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press,Washington.
2. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty FirstCentury, Select Publishers, New Delhi (2001).
3. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, Universityof Delhi, Delhi (2002).
4. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).

5. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G.Eckert (ED.), CRC Press, Boca Raton (1997).
6. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).
7. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).

BASICS OF FORENSIC SCIENCE-Lab
(BSCBT505P)

1. Documentation of crime scene by photography, sketching and field notes.
2. Simulation of a crime scene for training.
3. To lift footprints from crime scene.
4. Case studies to depict different types of injuries and death.
5. Separation of nitro compounds (explosives)/ ink samples by thin layer chromatography.
6. Investigate method for developing fingerprints by Iodine crystals.
7. PCR amplification on target DNA and DNA profiling,
8. E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Recovering deleted evidences, Password Cracking

Elective-I Biochemistry

ANIMAL BIOTECHNOLOGY
(BSCBT502A)

Course Outcome

After successful completion of this course, student will be able to

1 Describe the limitations and challenges facing the animal industries and disciplines

2 Describe the various biotechnologies available to the animal related fields

3 Explain how developments in biotechnology may have applications in those fields

4 Evaluate and discuss public and ethical concerns over the use of animal biotechnology

5 Locate and critically evaluate scientific literature and experimental studies relating to animal biotechnology and be able to effectively communicate the findings in oral and written form.

UNIT - I **(15 Periods)**

Equipments and materials for animal cell culture technology, Primary and established cell line cultures, Introduction to the balanced salt solutions and simple growth medium. Culture medium, Serum and protein-free defined media and their applications

UNIT II **(10 Periods)**

Gene transfer methods in Animals – Microinjection, Embryonic Stem cell, gene transfer, Retrovirus & Gene transfer.

UNIT III **(10 Periods)**

Introduction to transgenesis. Transgenic Animals – Mice, Cow, Pig, Sheep, Goat, Bird, Insect. Animal diseases need help of Biotechnology – Foot-and mouth disease, Coccidiosis, Trypanosomiasis, Theileriosis.

UNIT IV **(10 Periods)**

Animal propagation – Artificial insemination, Animal Clones. Conservation Biology – Embryo transfer techniques. Introduction to Stem Cell Technology and its applications.

UNIT V **(15 Periods)**

Genetic modification in Medicine - gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, problems & ethics.

SUGGESTED READING

1. Brown, T.A. (1998). Molecular biology Labfax II: Gene analysis. II Edition. Academic Press,California,USA.
2. Butler, M. (2004). Animal cell culture and technology: The basics. II Edition. Bios scientificpublishers.
3. Glick, B.R. and Pasternak, J.J. (2009). Molecular biotechnology- Principles and applicationsof recombinant DNA. IV Edition. ASM press, Washington, USA.
4. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). Anintroduction to genetic analysis. IX Edition. Freeman & Co., N.Y., USA.
5. Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). Recombinant DNA-genes and genomes- A short course. III Edition. Freeman and Co., N.Y., USA.

Elective-I Biochemistry (Practical)

ANIMAL BIOTECHNOLOGY-Lab
(BSCBT506P (A))

1. Sterilization techniques: Theory and Practical: Glass ware sterilization, Mediasterilization, Laboratory sterilization
2. Sources of contamination and decontamination measures.
3. Preparation of Hanks Balanced salt solution
4. Preparation of Minimal Essential Growth medium
5. Isolation of lymphocytes for culturing
6. DNA isolation from animal tissue
7. Quantification of isolated DNA.
8. Resolving DNA on Agarose Gel.

Elective-I Biochemistry

PLANT BIOTECHNOLOGY
(BSCBT502B)

Course Outcome

The goal of this course is to introduce biotechnology methods in plants. The objective of the course is to give students new knowledge and widening of the knowledge acquired in other course by handling of classical and modern plant biotechnology processes, including breeding of healthy plants, plants with improved characteristics and plants for biomolecule production. Understanding of biotechnological processes has also applicative value in pharmaceutical and food industry, in agriculture and in ecology.

UNIT I (20 Periods)

Introduction, Cryo and organogenic differentiation, Types of culture: Seed , Embryo, Callus, Organs, Cell and Protoplast culture. Micropopagation Axillary bud proliferation, Meristem and shoot tip culture, cud culture, organogenesis, embryogenesis, advantages and disadvantages of micropropagation.

UNIT- II (10 Periods)

In vitro haploid production Androgenic methods: Anther culture, Microspore culture andogenesis Sgnificance and use of haploids, Ploidy level and chromosome doubling, diplodization,

UNIT - III (10 Periods)

Plant transformation technology: the basis of tumor formation, hairy root, Features of TI and RI plasmid, Gynogenic haploids, factors effecting gynogenesis, Somaclonal variation.

Nomenclautre, methods, applications basis and disadvantages.

UNIT - IV (10 Periods)

Protoplast Isolation and fusion Methods of protoplast isolation, Protoplast development, Somatic hybridization, identifiation and selection of hybrid cells, Cybrids, Potential of somatic hybridization limitations.

UNIT - V (10 Periods)

Plant Growth Promoting bacteria. Nitrogen fixation, Nitrogenase, Biocontrol of pathogens, Growth promotion by free-living bacteria.

SUGGESTED READING

1. Bhojwani, S.S. and Razdan 2004 Plant Tissue Culture and Practice.
2. Brown, T. A. Gene cloning and DNA analysis: An Introduction. Blackwell Publication. th
3. Gardner, E.J. Simmonns, M.J. Snustad, D.P. 2008 8 edition Principles of Genetics. Wiley India.
4. Raven, P.H., Johnson, GB., Losos, J.B. and Singer, S.R. 2005 Biology. Tata MC Graw Hill.
5. Reinert, J. and Bajaj, Y.P.S. 1997 Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture. Narosa Publishing House.
6. Russell, P.J. 2009 Genetics – A Molecular Approach. 3 edition. Benjamin Co. rd
7. Sambrook & Russel. Molecular Cloning: A laboratory manual. (3 edition)
8. Slater, A., Scott, N.W. & Fowler, M.R. 2008 Plant Biotechnology: The Genetic Manipulation ofPlants, Oxford University Press.

Elective-I Biochemistry (Practical)

PLANT BIOTECHNOLOGY -Lab
(BSCBT506P (B))

1. Sterilization techniques of plant materials.
2. Preparation of simple growth nutrient full strength, half strength, solidand liquid.
3. Preparation of complex nutrient medium (Murashige & Skoog's medium)
4. To selection, Prune, sterilize and prepare an explant for culture.
5. Significance of growth hormones in culture medium.
6. To demonstrate various steps of Micropropagation.
7. To perform callus culture.
8. To study the plant growth regulator.

Elective-II Biochemistry

BIO-ANALYTICAL TOOLS

(BSCBT503A)

Course Outcome

1. Bioanalytical tools are cell-based bioassays that give a measure of the effect and presence of known and unknown chemicals in complex environmental samples.
2. At the end of this course students would be able to understand the principle, working, maintain and calibrations of bioanalytical tools and techniques for industrial and research purpose.
3. Specifically students will be able to learn underlying principle of techniques such as electrophoresis, microscopy, spectroscopy, centrifugation and chromatography.

UNIT I *(10 Periods)*

Simple microscopy, phase contrast microscopy, Florescence and electron microscopy (TEM and SEM), Absorption and emission spectroscopy

UNIT II **(10 Periods)**

Principle and law of absorption fluorimetry, Colorimetric, Spectrophotometry (visible, UV, infrared), pH meter, Centrifugation,

UNIT III **(10 Periods)**

Cell fractionation techniques, Isolation of sub-cellular organelles and particles. Western blotting. Introduction to Biosensors and Nanotechnology and their applications**.**

UNIT IV **(15 Periods)**

Introduction to the principle of chromatography. Paper chromatography, thin layer chromatography, column chromatography: silica and gel filtration, affinity and ion exchange chromatography, gas chromatography, HPLC.

UNIT V **(15 Periods)**

Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse field gel electrophoresis, immuno- electrophoresis, isoelectric focusing,

SUGGESTED READING

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley& Sons. Inc.

2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.

3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 The World of the Cell.7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

Elective-II Biochemistry (Practical)

BIO-ANALYTICAL TOOLS -Lab

(BSCBT507P (A))

1. Native gel electrophoresis of proteins
2. SDS-polyacrylamide slab gel electrophoresis of proteins under reducing conditions.
3. Preparation of the sub-cellular fractions of rat liver cells.
4. Preparation of protoplasts from leaves.
5. Separation of amino acids by paper chromatography.
6. To identify lipids in a given sample by TLC.
7. To verify the validity of Beer's law and determine the molar extinction coefficient of NADH.
8. To study gas chromatography.

Elective-II Biochemistry

IMMUNOLOGY
(BSCBT503B)

Course Outcome

1. The course will provide technical knowledge as to how different diseases are caused and various responses mediated by living cells to combat pathogen attack.
2. At The course will provide sound knowledge of how immune system deals with various pathogens, different processes and cell types involved in prevention of disease.
3. Along with this the students will become aware about concept, synthesis and action mechanism of vaccines.

Unit-I (15 Periods)

a. Immunology: general concept, Immunology: history,
b. Organization of immune system, Antigen,
c. Antibody and its types, Structure & function.
d. Antigen- Antibody reaction.

(15 Periods)

Unit-II

a. Antigen-Antibody interaction
b. Immunohaematology general concept: (ELISA, RIA, Double Immuno Diffusion)
c. Blood group system and its application
d. Rh factor

Unit-III (10 Periods)

a. Hypersensitivity & its mechanism.
b. Effectors mechanisms,
c. Immunity of infectious diseases,
d. Monoclonal antibodies

Unit-IV (10 Periods)

a. Vaccines: Ideal vaccines, Recombinant vaccines.
b. Interferon

c. Cytokines

d. Autoimmunity: Introduction,

Unit-V *(10 Periods)*

a. Hemolytic anemia, Rheumatoid arthritis

b. Hepatitis-A, Hepatitis-B, AIDS,

c. Organ transplantation,

d. Immunodeficient diseases (SCID, Reticular Dysgenesis)

SUGGESTED READING

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6 th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11thedition Wiley-Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
4. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition GarlandScience Publishers, New York.
5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg.
6. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

Elective-II Biochemistry (Practical)

IMMUNOLOGY -Lab
(BSCBT507P (B))

1. Laboratory rule, equipment and tools for immunology laboratory.
2. To perform the Blood group detection.
3. To determine the Rh factor.
4. To perform the widal test.
5. To determine the VDRL TEST
6. To perform the double diffusion experiment.
7. To perform the ELISA test.

8. To study of vaccine mechanism.

Elective-I Chemistry-Polymer Chemistry

(BSCBT504A)

Module –I **12 Hrs.**

Introduction and history of polymeric materials:

Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of polymers.

Functionality and its importance:

Criteria for synthetic polymer formation, classification of polymerization processes,Relationships between functionality, extent of reaction and degree of polymerization.Bi-functional systems, Poly-functional systems.

Module –II **12 Hrs.**

Kinetics of Polymerization:

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerizationtechniques.

Crystallization and crystallinity:

Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

Nature and structure of polymers-Structure Property relationships.

Determination of molecular weight of polymers (Mn, Mw, etc) by end groupanalysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance.Polydispersity index.

Module –III **12 Hrs.**

Kinetics of Polymerization:

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.

Crystallization and crystallinity:

Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

Module- IV **12 Hrs.**

Nature and structure of polymers-Structure Property relationships.

Determination of molecular weight of polymers (Mn, Mw, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance.Polydispersity index.

Glass transition temperature (Tg) and determination of Tg, Free volume theory,WLF equation, Factors affecting glass transition temperature (Tg).

Module –V **12 Hrs.**

Polymer Solution – Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory-Huggins theory, Lower and Upper criticalsolution temperatures.

Properties of Polymers (Physical, thermal, flow & mechanical properties). Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyderesins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes, Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylene sulphidepolypyrrole,polythiophene)].

TEXT AND REFERENCE BOOKS

1. Seymour, R.B. &Carraher, C.E. Polymer Chemistry: An Introduction, Marcel Dekker, Inc. New York, 1981.
2. Odian, G. Principles of Polymerization, 4th Ed. Wiley, 2004.
3. Billmeyer, F.W. Textbook of Polymer Science, 2nd Ed. Wiley Interscience, 1971.
4. Ghosh, P. Polymer Science & Technology, Tata McGraw-Hill Education, 1991.
5. Lenz, R.W. Organic Chemistry of Synthetic High Polymers. InterscIencePublishers, New York, 1967.

Elective-I Chemistry

Analytical Methods in Chemistry

(BSCBT504B)

Qualitative and quantitative aspects of analysis:
Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals. **(5 Lectures)**

Optical methods of analysis:
Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law. *UV-Visible Spectrometry:* Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument; *Basic principles of quantitative analysis:* estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method. *Infrared Spectrometry:* Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques. Structural illustration through interpretation of data, Effect and importance of isotope
substitution.
Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples. **Thermal methods of analysis:**
Theory of thermogravimetry (TG), basic principle of instrumentation.
Techniques for quantitative estimation of Ca and Mg from their mixture.
(5 Lectures)

Electroanalytical methods:
Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points.
Techniques used for the determination of pKa values.
(10 Lectures)

Separation techniques:
Solvent extraction: Classification, principle and efficiency of the technique.
Mechanism of extraction: extraction by solvation and chelation.
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 nonaqueous media.
Chromatography: Classification, principle and efficiency of the technique.
Mechanism of separation: adsorption, partition & ion exchange.
Development of chromatograms: frontal, elution and displacement methods.
Qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC, TLC and HPLC.
Stereoisomeric separation and analysis: Measurement of optical rotation, calculation of Enantiomeric excess (ee)/ diastereomeric excess (de) ratios and determination of enantiomeric composition using NMR, Chiral solvents and chiral shift reagents. Chiral chromatographic techniques using chiral columns (GC and HPLC).
Role of computers in instrumental methods of analysis.
(15 Lectures)

Reference Books:
□ □ Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C*Vogel's Textbook of*

Quantitative Chemical Analysis, John Wiley & Sons, 1989.
 Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A*Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988. Christian, G.D; *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.
 Harris, D. C*Exploring Chemical Analysis*, Ed. New York, W.H. Freeman, 2001.
 Khopkar, S.M*Basic Concepts of Analytical Chemistry*. New Age, International Publisher, 2009.
 Skoog, D.A. Holler F.J. & Nieman, T.A*Principles of Instrumental Analysis*, Cengage Learning India Ed.
 Mikes, O*Laboratory Hand Book of Chromatographic & Allied Methods*, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.
 Ditts, R.V*Analytical Chemistry; Methods of Separation*, van Nostrand, 1974.

Elective-I Chemistry-Inorganic Materials of Industrial Importance

(BSCBT504C)

Module-I **12 Hrs.**

Silicate Industries

Glass: Glassy state and its properties, classification (silicate and non-silicate glasses).Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.

Ceramics: Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications, superconducting and semiconducting oxides, fullerenes carbon nanotubes and carbon fibre. *Cements:* Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick setting cements.

Module-II **12 Hrs.**

Fertilizers:

Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate.

Surface Coatings:

Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, Vehicle, modified oils, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oilpaints, additives, Metallic coatings (electrolytic and electroless), metal spraying andanodizing.

Module-III **12 Hrs.**

Batteries:

Primary and secondary batteries, battery components and their role, Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery. Fuel cells, Solar cell and polymer cell.

Module-IV **12 Hrs.**

Alloys:

Classification of alloys, ferrous and non-ferrous alloys, Specific properties of elements in alloys. Manufacture of Steel (removal of silicon decarbonization, demanganization, desulphurization dephosphorisation) and surface treatment (argon treatment, heat treatment, nitriding, carburizing). Composition and properties of different types of steels.

Module-V **12 Hrs.**

Catalysis:

General principles and properties of catalysts, homogenous catalysis (catalytic steps and examples) and heterogenous catalysis (catalytic steps and examples) and their industrial applications,Deactivation or regeneration of catalysts. Phase transfer catalysts, application of zeolites as catalysts.

Chemical explosives:

Origin of explosive properties in organic compounds, preparation and explosive properties of lead azide, PETN, cyclonite (RDX). Introduction to rocket propellants.

Reference Books:

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
2. R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
3. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics*,Wiley Publishers, New Delhi.
4. J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, NewDelhi.
5. P. C. Jain & M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
6. R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, New Delhi.
7. B. K. Sharma: *Engineering Chemistry*, Goel Publishing House, Meerut

Elective-I Chemistry
Polymer Chemistry Lab
(BSCBT508P(A))

1. **Polymer synthesis**

1. Free radical solution polymerization of styrene (St) / Methyl Methacrylate(MMA) / Methyl Acrylate (MA) / Acrylic acid (AA).
a. Purification of monomer
b. Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bisisobutylonitrile(AIBN)
2. Preparation of nylon 66/6
1. Interfacial polymerization, preparation of polyester from isophthaloyl chloride (IPC) and phenolphthalein
a. Preparation of IPC
b. Purification of IPC
c. Interfacial polymerization
3. Redox polymerization of acrylamide
4. Precipitation polymerization of acrylonitrile
5. Preparation of urea-formaldehyde resin
6. Preparations of novalac resin/resold resin.
7. Microscale Emulsion Polymerization of Poly(methylacrylate).

Polymer characterization

1. Determination of molecular weight by viscometry:
(a) Polyacrylamide-aq.$NaNO_2$ solution
(b) (Poly vinyl proplylidine (PVP) in water
2. Determination of the viscosity-average molecular weight of poly(vinyl alcohol) (PVOH) and the fraction of "head-to-head" monomer linkages in the polymer.
3. Determination of molecular weight by end group analysis: Polyethylene glycol (PEG) (OH group).
4. Testing of mechanical properties of polymers.
5. Determination of hydroxyl number of a polymer using colorimetric method.

Polymer analysis

1. Estimation of the amount of HCHO in the given solution by sodium sulphite method
2. Instrumental Techniques
3. IR studies of polymers
4. DSC analysis of polymers
5. Preparation of polyacrylamide and its electrophoresis

*at least 7 experiments to be carried out.

Reference Books:

- M.P. Stevens,*Polymer Chemistry: An Introduction*, 3rd Ed., Oxford University Press, 1999.
- H.R. Allcock, F.W. Lampe & J.E. Mark,*Contemporary Polymer Chemistry*,3rd ed. Prentice-Hall (2003)
- F.W. Billmeyer,*Textbook of Polymer Science*, 3rd ed. Wiley-Interscience (1984)
- J.R. Fried,*Polymer Science and Technology*, 2nd ed. Prentice-Hall (2003)
- P. Munk & T.M. Aminabhavi,*Introduction to Macromolecular Science*, 2nd ed. John Wiley & Sons (2002)
- L. H. Sperling,*Introduction to Physical Polymer Science*, 4th ed. John Wiley & Sons (2005)
- M.P. Stevens,*Polymer Chemistry: An Introduction* 3rd ed. Oxford University Press (2005).
- Seymour/ Carraher's Polymer Chemistry, 9th ed. by Charles E. Carraher,
- Svehla, G.*Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
- Mendham, J.*Vogel's Quantitative Chemical Analysis*, Pearson, 2009.

Elective-I Chemistry

ANALYTICAL METHODS IN CHEMISTRY-Lab

(BSCBT508P(B))

I. Separation Techniques

1. Chromatography:

(a) Separation of mixtures

(i) Paper chromatographic separation of Fe3+, Al3+, and Cr3+.

(ii) Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the Rf values.

(b) Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their Rf values.

(c) Chromatographic separation of the active ingredients of plants, flowers and juices by TLC

II. Solvent Extractions:

(i) To separate a mixture of Ni2+

& Fe2+

by complexation with DMG and extracting the Ni2+-

DMG complex in chloroform, and determine its concentration by spectrophotometry.

(ii) Solvent extraction of zisconium with amberliti LA-1, separation from a mixture of irons and gallium.

3. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.

4. Determination of Na, Ca, Li in cola drinks and fruit juices using flame photometric techniques.

5. Analysis of soil:

(i) Determination of pH of soil.

(ii) Total soluble salt (iii) Estimation of calcium, magnesium, phosphate, nitrate

6. Ion exchange:

(i) Determination of exchange capacity of cation exchange resins and anion exchange resins.

(ii) Separation of metal ions from their binary mixture.

(iii) Separation of amino acids from organic acids by ion exchange chromatography.

III Spectrophotometry

1. Determination of pKa values of indicator using spectrophotometry.

2 Structural characterization of compounds by infrared spectroscopy.

3 Determination of dissolved oxygen in water.

4 Determination of chemical oxygen demand (COD).

5 Determination of Biological oxygen demand (BOD).

6 Determine the composition of the Ferric-salicylate/ ferric-thiocyanate complex by Job's method.

Reference Books:

 Jeffery, G.H., Bassett, J., Mendham, J. &Denney, R.C. *Vogel's Textbook of Quantitative Chemical Analysis*, John Wiley & Sons, 1989.

 Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A*Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.

 Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.

 Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.

 Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009.

□ □ Skoog, D.A. Holler F.J. & Nieman, T.A *Principles of Instrumental Analysis*, Cengage Learning India Ed.
□ □ Mikes, O *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.
□□ Ditts, R.V. *Analytical Chemistry; Methods of Separation*, van Nostrand, 1974.

Elective-I Chemistry

Inorganic Materials of Industrial Importance Lab

(BSCBT508P(C))

1. Determination of free acidity in ammonium sulphate fertilizer.
2. Estimation of calcium in calcium ammonium nitrate fertilizer.
3. Estimation of phosphoric acid in superphosphate fertilizer.
4. Electroless metallic coatings on ceramic and plastic material.
5. Determination of composition of dolomite (by complexometric titration).
6. Analysis of (Cu, Ni); (Cu, Zn) in alloy or synthetic samples.
7. Analysis of Cement.
8. Preparation of pigment (zinc oxide).

Reference Books:

□ □ E. Stocchi *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
□ □ R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
□ □ W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics*, Wiley Publishers, New Delhi.
□ □ J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
□ □ P. C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
□ □ R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, New Delhi.
□ □ Sharma, B.K. & Gaur, H *Industrial Chemistry*, Goel Publishing House, Meerut(1996).

ENZYMOLOGY
(BSCBT601)

Course Outcome

1. Upon successful completion of this course, the student will learn, the major classes of enzyme and their functions in the cell.
2. The course also provides information pertaining to role of co-enzyme cofactor in enzyme catalyzed reaction, properties of enzymes and regulation of biochemical pathways.
3. Differentiate between equilibrium and steady state kinetics and analyzed simple kinetic data and estimate important parameter (Km. Vmax, Kcat etc).

UNIT - I **(10 Periods)**

Isolation, crystallization and purification of enzymes, test of homogeneity of enzyme preparation, methods of enzyme analysis. Enzyme classification (rationale, overview and specific examples) Zymogens and their activation(Proteases and Prothrombin).

UNIT – II **(15 Periods)**

Enzyme substrate complex: concept of E-S complex, binding sites, active site, specificity, Kinetics of enzyme activity, Michaelis-Menten equation and its derivation, Different plots for the determination of Km and Vmax and their physiological significance, factors affecting initial rate, E, S, temp. & pH.

UNIT – III **(10 Periods)**

Two substrate reactions (Random, ordered and ping-pong mechanism) Enzyme inhibition types of inhibition, determination of Ki, suicide inhibitor. Mechanism of enzyme action: General mechanistic principle, factors associated with catalytic efficiency. Enzyme regulation: Product inhibition, feed backcontrol, covalent modification.

UNIT – IV **(15 Periods)**

Allosteric enzymes with special reference to aspartate transcarbomylase and phosphofructokinase. Qualitative description of concerted and sequential models. Negative co- operativity and half site reactivity. Enzyme - Enzyme interaction, Protein ligand binding, measurements analysis of binding isotherm, cooperativity, Ribozymes. Multifunctional enzyme-eg Fatty Acid synthase.

UNIT – V **(10 Periods)**

Enzyme Technology: Methods for large scale production of enzymes.
Immobilized enzyme and their comparison with soluble enzymes, Methods for immobilization of enzymes. Immobilized enzyme reactors. Application of Immobilized and soluble enzyme in health and industry. Application to fundamental studies of biochemistry.

SUGGESTED READING

1. Biochemistry, Lubert Stryer, 6th Edition, WH Freeman, 2006.
2. Harper's illustrated Biochemistry by Robert K. Murray, David A Bender, KathleenM.Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil.

28th Edition, McGrawHill, 2009.
3. Biochemistry, Donald Voet and Judith Voet, 2nd Edition, Publisher: John Wiley andSons,1995.
4. Biochemistry by Mary K.Campbell & Shawn O.Farrell, 5th Edition, Cenage Learning,2005.
5. Fundamentals of Enzymology Nicholas Price and Lewis Stevens Oxford University Press1999
6. Fundamentals of Enzyme Kinetics Athel Cornish-Bowden Portland Press 2004
7. Practical Enzymology Hans Bisswanger Wiley–VCH 2004
8. The Organic Chemistry of Enzyme-catalyzed Reactions Richard B. Silverman Academic Press2002

ENZYMOLOGY-Lab
(BSCBT605P)

1. Quantitative estimation of proteins by Bradford/Lowry's method.
2. Isolation and assay of alpha-amylase activity from saliva
3. Purification of an enzyme from any natural resource
4. Isolation and assay of acid phosphatase from sweet potato
5. Determination of Km and V max
6. Effect of pH and temperature on enzyme activity
7. Determination of specific activity of an enzyme
8. Molecular weight determination of a protein by gel electrophoresis

Elective-III Biochemistry

GENOMICS & PROTEOMICS
(BSCBT602A)

Course Outcome

The course aims to appraise the students to the vital concepts of technologies pertinent to Genomics and Proteomics, their applications and demonstrate skills to apply the knowledge in scientific queries. On the completion of the course

1. The student will be able discern the crucial concepts and techniques applied in genomics, transcriptomics and proteomics.
2. Be able to classify the complexity of genome/ proteome structural and functional organization.
3. Formulate and assess experimental design for solving theoretical and experimental problems in Genomics and Proteomics fields.

UNIT I **(15 Periods)**

Introduction to Genomics, DNA sequencing methods – manual & automated: Maxam & Gilbert and Sangers method. Pyrosequencing, Genome Sequencing: Shotgun & Hierarchical (clonecontig) methods, Genome sequence project.

UNIT II **(10 Periods)**

Computer tools for sequencing projects: Genome sequence assembly software.Managing and Distributing Genome Data: Web based servers and softwares for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser,

UNIT III **(10 Periods)**

NCBI genome. Selected Model Organisms' Genomes and Databases. Introduction to protein structure, Chemical properties of proteins. Physical interactions thatdetermine the property of proteins.

UNIT IV **(15 Periods)**

Short-range interactions, electrostatic forces, van der waal interactions, hydrogen bonds, Hydrophobic interactions. Determination of sizes (Sedimentation analysis, gel filteration, SDS-PAGE); Native PAGE, Determination of covalent structures – Edman degradation.

UNIT V **(10Periods)**

Introduction to Proteomics, Analysis of proteomes. 2D-PAGE. Sample preparation, solubilization, reduction, resolution. Reproducibility of 2D-PAGE. Mass spectrometry based methods for protein identification.

SUGGESTED READING

1. Genes IX by Benjamin Lewin, Johns and Bartlett Publisher, 2006.
2. Modern Biotechnology, 2nd Edition, S.B. Primrose, Blackwell Publishing, 1987.
3. Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition, B.R. Glick, J.J. Pasternak and C.L. Patten, 2010.
5. Molecular Cloning: A Laboratory Manual (3rd Edition) Sambrook and Russell Vol. I to III,1989.
6. Principles of Gene Manipulation 6th Edition, S.B.Primrose, R.M.Twyman and R.W. Old.Blackwell Science, 2001.
7. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and SonsInc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition.Benjamin Cummings.
4. Russell, P. J. (2009). *i*Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
5. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications ofrecombinant DNA. ASM Press, Washington.
6. Pevsner, J. (2009). Bioinformatics and Functional Genomics. II Edition. John Wiley & Sons.

Elective-III Practical Biochemistry

GENOMICS & PROTEOMICS-Lab
(BSCBT606P(A))

1. Use of SNP databases at NCBI and other sites
2. Use of OMIM database
3. Detection of Open Reading Frames using ORF Finder
4. Proteomics 2D PAGE database
5. Softwares for Protein localization.
6. Hydropathy plots
7. Native PAGE
8. SDS-PAGE

Elective-III Biochemistry

BIOINFORMATICS

(BSCBT602B)

Course outcome
A student completing a major in Bioinformatics shall be able to apply:

1. Knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics
2. Existing software effectively to extract information from large databases and to use this information in computer modeling
3. Problem-solving skills, including the ability to develop new algorithms and analysis methods
4. An understanding of the intersection of life and information sciences, the core of shared concepts, language and skills the ability to speak the language of structure-function relationships, information theory, gene expression, and database queries

UNIT I **(15 Periods)**

Introduction to Bioinformatics Biological Database- Primary, secondary and composite

Databases - Definition, data mining methods and analysis tools. Various types of databases, Evolutionary studies

UNIT II **(15 Periods)**

History of Bioinformatics. The notion of Homology. Sequence Information Sources, EMBL, GENBANK, Entrez, Unigene, Understanding the structure of each source and using it on the web. Protein Information Sources, PDB, SWISSPROT, TREMBL,

UNIT III **(10 Periods)**

Understanding the structure ofeach source and using it on the web.

Introduction of Data Generating Techniques and Bioinformatics problem posed by them- Restriction Digestion, Chromatograms, Blots, PCR, Microarrays, Mass Spectrometry.

UNIT IV **(10 Periods)**

Sequence and Phylogeny analysis, Detecting Open Reading Frames, Outline of sequence Assembly, Mutation/Substitution Matrices, Pairwise Alignments, Introduction to BLAST, using it on the web, Interpreting results, Multiple Sequence Alignment, Phylogenetic Analysis.

UNIT V **(10 Periods)**

Searching Databases: SRS, Entrez, Sequence Similarity Searches-BLAST, FASTA, Data Submission. Tools for sequence alignment, Genome Annotation: Pattern and repeat finding, Gene identification tools.

SUGGESTED READING

1. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. OxfordUniversity 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. IIEdition. Benjamin Cummings.

Elective-III Practical Biochemistry

BIOINFORMATICS -Lab

(BSCBT606P(B))

1. Sequence information resource
2. Understanding and use of various web resources: EMBL, Genbank, Entrez, Unigene,Protein information resource (PIR)
3. Understanding and using: PDB, Swissprot, TREMBL
4. Retrieval of information from nucleotide databases.
5. Multiple sequence alignment using Clustal W.
6. Sequence analysis of protein (BLAST)
7. Sequence analysis of Nucleotide (BLAST)

Elective-III Biochemistry

ENVIRONMENTAL BIOTECHNOLOGY
(BSCBT602C)

Course Outcome

- The student will be able to evaluate the potential of biodegradation of organic pollutants, taking microbial and physical/chemical environments, as well as the chemical structure of the compound itself, into consideration.
- Students will understand the phenomenon of phytoremediation for the decontamination of soil and water, wetlands as treatment processes, biofilms/biofilters for vapor-phase wastes, and composting.
- Students will learn about the environmental quality evaluation, monitoring, and remediation of contaminated environments.
- Students will learn about the use of biosensors in environmental analysis, environmental engineering.

UNIT I **(15 Periods)**

Conventional fuels and their environmental impact – Firewood, Plant, Animal, Water, Coal and Gas. Modern fuels and their environmental impact – Methanogenic bacteria, Biogas, Microbial hydrogen Production,

UNIT II **(15 Periods)**

Conversion of sugar to alcohol Gasohol, Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents.Degradation of lignin and cellulose using microbes, Phytoremediation.

UNIT III **(10 Periods)**

Degradation of pesticides and other toxic chemicals by micro-organisms- degradation aromatic and chlorinates hydrocarbons and petroleum products. Treatment of municipal waste and Industrial effluents. Bio-fertilizers

UNIT IV **(10 Periods)**

Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil. Algal and fungal biofertilizers (VAM)

UNIT V **(10 Periods)**

Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium). Environmental significance of genetically modified microbes, plants and animals.

SUGGESTED READING

1. Environmental Science, S.C. Santra
2. Environmental Biotechnology, Pradipta Kumar Mohapatra
3. Environmental Biotechnology – Concepts and Applications, Hans-Joachim Jordening andJesef Winter
4. Waste Water Engineering, Metcalf and Eddy, Tata McGraw hill
5. Agricultural Biotechnology, S.S. Purohit
6. Environmental Microbiology : Methods and Protocols, Alicia L. Ragout De Spencer, John F.T. Spencer
7. Introduction to Environmental Biotechnology, Milton Wainwright
8. Principles of Environmental Engineering, Gilbert Masters
9. Wastewater Engineering – Metcalf & Eddy

Elective-III Practical Biochemistry

ENVIRONMENTAL BIOTECHNOLOGY -Lab

(BSCBT606P(C))

1. Calculation of Total Dissolved Solids (TDS) of water sample.
2. Calculation of BOD of water sample.
3. Calculation of COD of water sample.
4. Bacterial Examination of Water by MPN Method.
5. Role of bacterial systems in decolourization of effluents.
6. Role of fungal systems in decolourization of effluents.
7. Biomethanation from wastes
8. Hydrogen production from microalgae

Elective-IV Biochemistry

BIOPROCESS TECHNOLOGY

(BSCBT603A)

Course Outcome

To acquaint students with technical and biological aspect of microbial utilisation for production of metabolites. After completion of this course, student will be able to ¬ Designing of bioreactors and control necessary for maximising production. ¬ Select and optimise media for maximum production of microbial metabolites. ¬ Designing of protocols for strain improvement and separation of molecules after fermentation process.

UNIT I **(15 Periods)**

Introduction to bioprocess technology. Range of bioprocess technology and its chronological development. Basic principle components of fermentation technology. Types of microbial culture and its growth kinetics– Batch, Fedbatch and Continuous culture.

UNIT II **(10 Periods)**

Design of bioprocess vessels- Significance of Impeller, Baffles, Sparger; Types of culture/production vessels- Airlift; Cyclone Column; Packed Tower and their application inproduction processes.

UNIT III **(15 Periods)**

Media and Fermentation: Typical media composition.Medium formulation.Carbon, Nitrogen, Minerals and Energy sources.The addition of precursors and metabolic regulators to media Medium optimization.Oxygen requirements.Antifoams.Air and media sterilization- Media and Air sterilization.

UNIT IV **(12 Periods)**

Introduction to oxygen requirement in bioprocess; mass transfer coefficient; factors affecting KLa. Bioprocess measurement and control system with special reference to computer aided process control.

UNIT V **(8 Periods)**

Introduction to downstream processing, product recovery and purification. Effluent treatment. Microbial production of ethanol, amylase, lactic acid and Single Cell Proteins.

SUGGESTED READING

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology.2nd edition. Panima Publishing Co. New Delhi.

3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2ndedition, Elsevier Science Ltd.

Elective-IV Practical Biochemistry

BIOPROCESS TECHNOLOGY-Lab
(BSCBT607P(A))

1. Media formulation - Sterilization of bioreactors.
2. Study of fermentors-Demonstration only.
3. Calculation of thermal death point (TDP) of a microbial sample.
4. Production and analysis of ethanol.
5. Production and analysis of amylase.
6. Production and analysis of lactic acid.
7. Isolation of industrially important microorganism from natural resource.
8. Cell and enzyme immobilization.

Elective-IV Biochemistry

BIOSTATISTICS

(BSCBT603B)

Course outcome

In this course we'll learn how to effectively collect data, describe data, and use data to make inferences and conclusions about real world phenomena. After finishing this course, you should be able to:

- Recognize the importance of data collection and its role in determining scope of inference.
- Demonstrate a solid understanding of interval estimation and hypothesis testing.
- Choose and apply appropriate statistical methods for analyzing one or two variables.
- Use technology to perform descriptive and inferential data analysis for one or two variables.
- Interpret statistical results correctly, effectively, and in context.
- Understand and critique data-based claims.
- Appreciate the power of data.

UNIT I **(12 Periods)**

Types of Data, Collection of data; Primary & Secondary data, Classification and Graphical representation of Statistical data. Measures of central tendency and Dispersion. Measures of Skewness and Kurtosis.

UNIT II **(12 Periods)**

Probability classical & axiomatic definition of probability, Theorems on total and compound probability)

UNIT III **(12 Periods)**

Elementary ideas of Binomial, Poisson and Normal distributions. Methods of sampling, confidence level, critical region, testing of hypothesis and standard error

UNIT IV **(12 Periods)**

large sample test and small sample test. Problems on test of significance, t-test, chi-square testfor goodness of fit and analysis of variance (ANOVA)

UNIT V **(12 Periods)**

Correlation and Regression. Emphasis on examples from Biological Sciences.

SUGGESTED READING

1. Le CT (2003) Introductory biostatistics. 1st edition, John Wiley, USA
2. Glaser AN (2001) High Yield^{TM} Biostatistics. Lippincott Williams and Wilkins, USA
3. Edmondson A and Druce D (1996) Advanced Biology Statistics, Oxford University Press.
4. Danial W (2004) Biostatistics : A foundation for Analysis in Health Sciences, John Wiley andSons Inc.

Elective-IV Practical Biochemistry

BIOSTATISTICS -Lab
(BSCBT607P(B))

1. Based on graphical Representation
2. Based on measures of Central Tendency
3. Based on Dispersion
4. Based on Distributions Binomial Poisson Normal
5. Based on t- test
6. Based on f- test
7. Based on z- test
8. Based on Chi-square test

Elective-IV Biochemistry

NANOTECHNOLOGY

(BSCBT603C)

Course Outcome

- The student will develop a fundamental knowledge of nanomaterials.
- The student will demonstrate a basic understanding of the length scale that defines nano for metal and semiconductor materials.
- The student will demonstrate an understanding of the properties of materials with strong dependence on size.
- The student will demonstrate an understanding of approaches to nanomaterials characterization.
- The student will demonstrate an understanding of approaches to engineering nanomaterials and nanostructures.
- The student will demonstrate an understanding of the challenges on safe nanotechnology.

UNIT I **(12 Periods)**

Introduction to Nanobiotechnology , Fundamental sciences and broad areas of Nanobiotechnology.

Biological nanoparticles production - plants and microbial.

Concepts in nanobio-machines for information processing and communications

UNIT II **(12 Periods)**

Nanomaterial in biotechnology - nanoparticles, quantum dots, nanotubes and nanowires

Nanotechnology in biosensors, biochips

UNIT III **(12 Periods)**

Applications of Nanobiotechnology, Biomedical Nanotechnology, Using Antibodies in Biosensors: Immunoassays, Antibodies in Molecular Recognition Sensors,

UNIT IV **(12 Periods)**

Production of Antibodies, Monoclonal Antibodies, Reverse Transcriptase, Recombinant DNA, Antibodies as Selection Tools for Nanoscale.

UNIT V **(12 Periods)**

Micro- and Nanosensors and Applications in Biotechnology, Electrochemical Nanosensors.

Nanotechnology for Manipulation of Biomolecules: Optical Tweezers, Dielectrophoresis, Some Dielectrophoresis Applications, Micro- and Nanofluidics

References:

1. Introduction to nanoscience and nanotechnology, CRC Press, Tylor and Francis Group, Boca Raton, G. L. Hornyak, H. F. Tibbals, J. Dutta and J J. Moore.

2. Introductory Nanoscience: Physical and Chemical Concepts, CRC Press, Tylor and Francis Group, Boca Raton, M. Kuno.

Elective-IV Practical Biochemistry

NANOTECHNOLOGY-Lab
(BSCBT607P(C))

1. Demonstration of nanoparticle synthesis.
2. Demonstration of green silver nano particles.
3. Study of Scanning electron microscope(SEM)
4. Photoluminescence study of nanomaterials
5. Mechanical properties of nanomaterials
6. Analysis of Graphene using Raman spectroscopy.
7. Synthesis of TiO2- PVA nanocomposite.
8. Grain size estimation by using XRD.

Elective-II Chemistry

INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS

(BSCBT604A)

Unit-I

Introduction to spectroscopic methods of analysis:

Recap of the spectroscopic methods covered in detail in the core chemistry syllabus: Treatment of analytical data, including error analysis. Classification of analytical methods and the types of instrumental methods. Consideration of electromagnetic radiation.

Unit-II

Molecular spectroscopy:

Infrared spectroscopy:
Interactions with molecules: absorption and scattering. Means of excitation (light sources), separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat, differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR). Samples and results expected. Applications: Issues of quality assurance and quality control, Special problems for portable instrumentation and rapid detection.
UV-Visible/ Near IR – emission, absorption, fluorescence and photoaccoustic. Excitation sources (lasers, time resolution), wavelength dispersion (gratings, prisms, interference filters, laser, placement of sample relative to dispersion, resolution), Detection of signal (photocells, photomultipliers, diode arrays, sensitivity and S/N), Single and Double Beam instruments, Interpretation (quantification, mixtures, absorption vs. fluorescence and the use of time, photoaccoustic, fluorescent tags).

Unit-III

Separation techniques
Chromatography: Gas chromatography, liquid chromatography, supercritical fluids, Importance of column technology (packing, capillaries), Separation based on increasing number of factors (volatility, solubility, interactions with stationary phase, size, electrical field), Detection: simple vs. specific (gas and liquid), Detection as a means of further analysis (use of tags and coupling to IR and MS), Electrophoresis (plates and capillary) and use with DNA analysis. *mmunoassays and DNA techniques*
Mass spectroscopy: Making the gaseous molecule into an ion (electron impact, chemical ionization), Making liquids and solids into ions (electrospray, electrical discharge, laser desorption, fast atom bombardment), Separation of ions on basis of mass to charge ratio, Magnetic, Time of flight, Electric quadrupole. Resolution, time and multiple separations, Detection and interpretation (how this is linked to excitation).

Unit-IV

Elemental analysis:
Mass spectrometry (electrical discharges).
Atomic spectroscopy: Atomic absorption, Atomic emission, and Atomic fluorescence. Excitation and getting sample into gas phase (flames, electrical discharges, plasmas), Wavelength separation and

resolution (dependence on technique), Detection of radiation (simultaneous/scanning, signal noise), Interpretation (errors due to molecular and ionic species, matrix effects, other interferences).

Unit-V

NMR spectroscopy: **P**rinciple, Instrumentation, Factors affecting chemical shift, Spincoupling, Applications.

Electroanalytical Methods: Potentiometry & Voltammetry

Radiochemical Methods

X-ray analysis and electron spectroscopy (surface analysis)

Reference books:

- Skoog, D.A. Holler F.J. & Nieman, T.A.*Principles of Instrumental Analysis*, Cengage Learning India Ed.
- Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A.*Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
- P.W. Atkins: Physical Chemistry.
- G.W. Castellan: Physical Chemistry.
- C.N. Banwell: Fundamentals of Molecular Spectroscopy.
- Brian Smith: Infrared Spectra Interpretations: A Systematic Approach.
- W.J. Moore: Physical Chemistry.

Elective-II Chemistry

INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS-Lab

(BSCBT608P(A))

1. Safety Practices in the Chemistry Laboratory
2. Determination of the isoelectric pH of a protein.
3. Titration curve of an amino acid.
4. Determination of the void volume of a gel filtration column.
5. Determination of a Mixture of Cobalt and Nickel (UV/Vis spec.)
6. Study of Electronic Transitions in Organic Molecules (i.e., acetone in water)
7. IR Absorption Spectra (Study of Aldehydes and Ketones)
8. Determination of Calcium, Iron, and Copper in Food by Atomic Absorption
9. Quantitative Analysis of Mixtures by Gas Chromatography (i.e., chloroform and carbon tetrachloride)
10. Separation of Carbohydrates by HPLC
11. Determination of Caffeine in Beverages by HPLC
12. Potentiometric Titration of a Chloride-Iodide Mixture
13. Cyclic Voltammetry of the Ferrocyanide/Ferricyanide Couple
14. Nuclear Magnetic Resonance
15. Use of fluorescence to do "presumptive tests" to identify blood or other body fluids.
16. Use of "presumptive tests" for anthrax or cocaine
17. Collection, preservation, and control of blood evidence being used for DNA testing
18. Use of capillary electrophoresis with laser fluorescence detection for nuclear DNA (Y chromosome only or multiple chromosome)
19. Use of sequencing for the analysis of mitochondrial DNA
20. Laboratory analysis to confirm anthrax or cocaine
21. Detection in the field and confirmation in the laboratory of flammable accelerants or explosives
22. Detection of illegal drugs or steroids in athletes
23. Detection of pollutants or illegal dumping
24. Fibre analysis

At least 10 experiments to be performed.

Reference Books:

- Skoog, D.A. Holler F.J. & Nieman, T.A*Principles of Instrumental Analysis*, Cengage Learning India Ed.
- Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A*Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.

Elective-II Chemistry

Noval Inorganic Solids

(BSCBT604B)

Unit-I

Synthesis and modification of inorganic solids: Conventional heat and beat methods, Co-precipitation method, Sol-gel methods, Hydrothermal method, Ion-exchange and Intercalation methods.

Inorganic solids of technological importance: Solid electrolytes – Cationic, anionic, mixed Inorganic pigments – coloured solids, white and black pigments. Molecular material and fullerides, molecular materials & chemistry – one-dimensional metals, molecular magnets, inorganic liquid crystals.

Unit-II

Nanomaterials:

Overview of nanostructures and nanomaterials: classification. Preparation of gold and silver metallic nanoparticles, self-assembled nanostructures-control of nanoarchitecture-one dimensional control. Carbon nanotubes and inorganic nanowires. Bio-inorganic nanomaterials, DNA and nanomaterials, natural and antisical nanomaterials, bionano composites.

Unit-III

Introduction to engineering materials for mechanical construction: Composition, mechanical and fabricating characteristics and applications of various types of cast irons, plain carbon and alloy steels, copper, aluminium and their alloys like duralumin, brasses and bronzes cutting tool materials, super alloys thermoplastics, thermosets and composite materials.

Composite materials: Introduction, limitations of conventional engineering materials, role of matrix in composites, classification, matrix materials, reinforcements, metal-matrix composites, polymer-matrix composites, fibre-reinforced composites, environmental effects on composites, applications of composites.

Unit-IV

Speciality polymers: Conducting polymers - Introduction, conduction mechanism, polyacetylene, polyparaphenylene and polypyrrole, applications of conducting polymers, Ion-exchange resins and their applications. Ceramic & Refractory: Introduction, classification, properties, raw materials, manufacturing and applications.

Unit-V

Industrial Gases and Inorganic Chemicals

Industrial Gases: Large scale production, uses, storage and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene.

Inorganic Chemicals: Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chrome alum, potassium dichromate and potassium permanganate.

Reference Books:

- Shriver & Atkins. Inorganic Chemistry, Peter Alkins, Tina Overton, Jonathan Rourke, 32 Mark Weller and Fraser Armstrong, 5th Edition, Oxford University Press (2011-2012)
- Adam, D.M. Inorganic Solids: An introduction to concepts in solid-state structural chemistry. John Wiley & Sons, 1974.
- Poole, C.P. & Owens, F.J. Introduction to Nanotechnology John Wiley & Sons, 2003.
- Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002.
- E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
- R.M. Felder, R.W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.
- J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
- S. S. Dara: A Textbook of Engineering Chemistry, S. Chand & Company Ltd. New Delhi.
- K. De, Environmental Chemistry: New Age International Pvt., Ltd, New Delhi.
- S. M. Khopkar, Environmental Pollution Analysis: Wiley Eastern Ltd, New Delhi.

42

- S.E. Manahan, Environmental Chemistry, CRC Press (2005).
- G.T. Miller, Environmental Science 11th edition. Brooks/ Cole (2006).
- A. Mishra, Environmental Studies. Selective and Scientific Books, New Delhi (2005).

Elective-II **Chemistry**

Noval Inorganic Solids-Lab

(BSCBT608P(B))

1. Determination of cation exchange method
2. Determination of total difference of solids.
3. Synthesis of hydrogel by co-precipitation method.
4. Synthesis of silver and gold metal nanoparticles.
5. Determination of dissolved oxygen in water.
6. Determination of Chemical Oxygen Demand (COD).
7. Determination of Biological Oxygen Demand (BOD)
8. Percentage of available chlorine in bleaching powder.
9. Measurement of chloride, sulphate and salinity of water samples by simple titration method (AgNO3 and potassium chromate).
10. Estimation of total alkalinity of water samples (CO32-, HCO3-) using double titration method.
11. Measurement of dissolved CO2.

Preparation of borax/ boric acid.

Reference Books:

- E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
- R.M. Felder, R.W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.
- J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
- S. S. Dara: A Textbook of Engineering Chemistry, S. Chand & Company Ltd. New

Elective-II Chemistry

Organometallics, Bioinorganic chemistry, Polynuclear hydrocarbons and UV, IR Spectroscopy (BSCBT604C)

Module-I

Chemistry of 3d metals

Oxidation states displayed by Cr, Fe, Co, Ni and Co. A study of the following compounds (including preparation and important properties); Peroxo compounds of Cr, $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, sodium nitroprusside, $[Co(NH_3)_6]Cl_3$, $Na_3[Co(NO_2)_6]$.

(6 Lectures)

Module-II

Organometallic Compounds

Definition and Classification with appropriate examples based on nature of metalcarbon bond (ionic, s, p and multicentre bonds). Structures of methyl lithium, Zeiss salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals. p-acceptor behaviour of carbon monoxide. Synergic effects (VB approach)-(MO diagram of CO can be referred to for synergic effect to IR frequencies).

(12 Lectures)

Module-III

Bio-Inorganic Chemistry

A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na^+, K^+ and Mg^{2+} ions: Na/K pump; Role of Mg^{2+} ions in energy production and chlorophyll. Role of Ca^{2+} in blood clotting, stabilization of protein structures and structural role (bones).

(12 Lectures)

Section B: Organic Chemistry-4 **(30 Lectures)**

Module-IV

Polynuclear and heteronuclear aromatic compounds:

Properties of the following compounds with reference to electrophilic and nucleophilic substitution: Naphthalene, Anthracene , Furan, Pyrrole, Thiophene, and Pyridine.

(6 Lectures)

Active methylene compounds:

Preparation: Claisen ester condensation. Keto-enol tautomerism. *Reactions:* Synthetic uses of ethylacetoacetate (preparation of non-heteromoleculeshaving upto 6 carbon).

(6 Lectures)

Module-V

Application of Spectroscopy to Simple Organic Molecules

Application of visible, ultraviolet and Infrared spectroscopy in organic molecules.Electromagnetic radiations, electronic transitions, λmax & εmax, chromophore, auxochrome, bathochromic andhypsochromic shifts. Application of electronic spectroscopy and Woodward rules for calculating l max of conjugated dienes and α,β– unsaturated compounds.

Infrared radiation and types of molecular vibrations, functional group and fingerprint region. IR spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on >C=O stretching absorptions).

(18 Lectures)

Reference Books:

- James E. Huheey, Ellen Keiter & Richard Keiter: *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Publication.
- G.L. Miessler & Donald A. Tarr: *Inorganic Chemistry*, Pearson Publication.
- J.D. Lee: *A New Concise Inorganic Chemistry*, E.L.B.S.
- F.A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley & Sons.
- I.L. Finar: *Organic Chemistry* (Vol. I & II), E.L.B.S.
- John R. Dyer: *Applications of Absorption Spectroscopy of Organic Compounds*, Prentice Hall.
- R.M. Silverstein, G.C. Bassler & T.C. Morrill: *Spectroscopic Identification of OrganicCompounds*, John Wiley & Sons.
- R.T. Morrison & R.N. Boyd: *Organic Chemistry*, Prentice Hall.
- Peter Sykes: *A Guide Book to Mechanism* in *Organic Chemistry*, Orient Longman.
- Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry*, S. Chand.

Elective-II Chemistry

Organometallics, Bioinorganic chemistry, Polynuclear hydrocarbons and UV, IR Spectroscopy-Lab

(BSCBT608P(C))

Section A: Inorganic Chemistry

1. Separation of mixtures by chromatography: Measure the *Rf* value in each case.(Combination of two ions to be given) Paper chromatographic separation of Fe3+, A13+ and Cr3+ or Paper chromatographic separation of Ni2+, Co2+, Mn2+ and Zn2+

2. Preparation of any two of the following complexes and measurement of their conductivity:

(i) tetraamminecarbonatocobalt (III) nitrate

(ii) tetra ammine copper (II) sulphate

(iii) potassium tri oxalatoferrate (III) trihydrate

Compare the conductance of the complexes with that of M/1000 solution of NaCl, MgCl2 and LiCl3.

Section B: Organic Chemistry

Systematic Qualitative Organic Analysis of Organic Compounds possessing

Mono functional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

Reference Books:

- A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
- A.I. Vogel: Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G.*Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C*Practical Organic Chemistry* Orient-Longman,1960.

Project/Dissertation

(BSCBT609P)