

# *Scheme of Examination and Syllabus*

(w.e.f 2018-19 onwards)

**Dual Degree B.Sc. (Hons) Biotechnology-M.Sc. Biotechnology**

**BASED ON CHOICE BASED CREDIT SYSTEM**



***Department of Bio and Nano Technology Guru  
Jambheshwar University of Science & Technology,  
Hisar-125 001, Haryana***

**Proposed Syllabus of the Programme for Dual Degree B.Sc. (Hons) Biotechnology-M.Sc.  
Biotechnology under Choice Based Credit System**

(w.e.f 2016-18 for 3<sup>rd</sup> to 6<sup>th</sup> semester)

(w.e.f 2017-19 for 1<sup>st</sup> to 6<sup>th</sup> semester)

<b>Scheme for Dual Degree B.Sc. (Hons.) ( Biotechnology)- M.Sc. ( Biotechnology)</b>							
<b>Paper code</b>	<b>Course opted</b>	<b>Nomenclature</b>	<b>Credits</b>	<b>Hr</b>	<b>Ext. Marks</b>	<b>Int. Marks</b>	<b>Total Marks</b>
<b>Semester-I</b>							
BXL-101	Ability Enhancement Compulsory Course-I	English	2	2	70	30	100
BXL-102	Ability Enhancement Compulsory Course-II	Environmental Science	2	2	70	30	100
BBL-102	Core Course-I	Biology-I (Cell & Cellular Processes)	4	4	70	30	100
BCL-101	Generic Elective-I	Chemistry I	4	4	70	30	100
BPL-101	Generic Elective-II	Physics-I Mechanics	4	4	70	30	100
BML-101/BBL-101	Generic Elective-III	Elementary Mathematics-I/Elementary Biology-I (Fundamentals of Biology)	4	4	70	30	100
BBP-101	Core Course Practical	Biology Lab-I	2	4	70	30	100
BCP-101	Generic Elective Practical-I	Chemistry Lab-I	2	4	70	30	100
BPP-101	Generic Elective Practical-II	Physics Lab-I	2	4	70	30	100
			26	32	630	270	900
<b>Semester-II</b>							
BXL-201	Ability Enhancement Compulsory Course-III	Hindi	2	2	70	30	100
BML-	Generic	Elementary	4	4	70	30	100

201/BBL-201	Elective-IV	Mathematics-II/Elementary Biology-II (Cell Biology)					
BBL-202	Core Course-II	Biology-II (General Biochemistry)	4	4	70	30	100
BPL-201	Generic Elective-V	Physics-II (Waves and Optics)	4	4	70	30	100
BCL-201	Generic Elective-VI	Chemistry-II	4	4	70	30	100
BXL-202	Generic Elective-VII	Computer Science	2	2	70	30	100
BCP-201	Generic Elective Practical-III	Chemistry Lab-II	2	4	70	30	100
BPP-201	Generic Elective Practical-IV	Physics Lab-II	2	4	70	30	100
BXP-201	Generic Elective Practical-V	Computer Science Lab	2	4	70	30	100
			26	32	630	270	900

<b>Scheme for Dual Degree B.Sc. (Hons.) ( Biotechnology)- M.Sc. ( Biotechnology)</b>							
<b>Paper code</b>	<b>Course opted</b>	<b>Nomenclature</b>	<b>Credits</b>	<b>Hr per week</b>	<b>Ext. Marks</b>	<b>Int. Marks</b>	<b>Total Marks</b>
<b>Semester-III</b>							
BBL-301	Core Course-III	Mammalian Physiology	4	4	70	30	100
BBL-302	Core Course-IV	Plant Anatomy & Physiology	4	4	70	30	100
BBL-303/BCL-301	Core Course-V	Inorganic Chemistry-I(Atomic Structure and Chemical Bonding)	4	4	70	30	100
BCL-302/BBL-304	Core Course-VI	Organic Chemistry (Hydrocarbons)	4	4	70	30	100
BBL-305-EC-I/ BBL-306-EC-I/ BBL-307-EC-I	Elective course-I	Any One course out of proposed 03(list attached below Including MOOC)	2	2	70	30	100
BBL-308-SEC-I/ BBL-309-SEC-I/ BBL-310-	SEC-I (list attached below)	Any One Skill Enhancement Course out of proposed 03 (list attached below)	2	2	70	30	100

SEC- I							
BBP-311	Core Course Practical – III	Animal & Plant Physiology (Lab I)	2	4	70	30	100
BBP- 312/BCP- 301	Generic Course Practical	Chemistry Lab (Inorganic Chemistry Lab -I)	2	4	70	30	100
			24	28	560	240	800
<b>Semester-IV</b>							
BBL-401	Core Course VII	Basic Microbiology	4	4	70	30	100
BBL-402	Core Course VIII	Microbial Physiology	4	4	70	30	100
BBL- 403/BCL- 401	Core Course IX	Inorganic Chemistry- II (Periodic Properties of Elements)	4	4	70	30	100
BBL- 404/BCL- 402	Core Course X	Organic Chemistry II (Functional group Chemistry)	4	4	70	30	100
<b>BBL-405- EC-II/ BBL-406- EC-II</b>	Elective Course- II (list attached below)	Any One Elective Course out of proposed 02 (list attached below)	2	2	70	30	100
BBL-407- SEC-II/ BBL-408- SEC-II/ BBL-409- SEC- II	SEC-II (list attached below)	Any One Skill Enhancement Course out of proposed 03 (list attached below)	2	2	70	30	100
BBP- 410/BCP- 402	Core Course Practical – IV	Organic Chemistry Lab-II	2	4	70	30	100
BBP-411	Core Course Practical-V	Basic Microbiology Lab	2	4	70	30	100
			24	28	560	240	800

<b>Scheme for Dual Degree B.Sc. (Hons.) ( Biotechnology)- M.Sc. ( Biotechnology)</b>							
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<b>Semester-V</b>							
BBL-501	Core Course XI	Genetics	4	4	70	30	100

BBL-502	Core Course XII	Developmental Biology	4	4	70	30	100
BBL-503/BCL-501	Core Course XIII	Inorganic Chemistry-III (Coordination Chemistry)	4	4	70	30	100
BBL-504/BCL 504	Core Course XIV	Pharmaceutical Chemistry	4	4	70	30	100
BBL-505-DSE-I/ BBL-506-DSE-I BBL-507-DSE-I	DSE-I (list attached below)	Any One Course out of proposed 03 (list attached below)	2	2	70	30	100
BBL-508-DSE-II/ BBL-509-DSE-II BBL-510-DSC-II	DSE-II (list attached below)	(Any One Course out of proposed 03 (list attached below)	2	2	70	30	100
BBP-511	Core Course Practical-VI	Biology Lab	2	4	70	30	100
BBP-512/BCP-501	Core Course Practical-VII	Inorganic Chemistry Lab	2	4	70	30	100
			24	28	560	240	800
<b>Semester-VI</b>							
BBL-601	Core Course XV	Bio- Analytical Tools	4	4	70	30	100
BBL-602	Core Course XVI	Recombinant DNA Technology	4	4	70	30	100
BBL-603	Core Course XVII	Molecular Biology	4	4	70	30	100
BBL-604/BCL-604	Core Course XVIII	Polymer Chemistry	4	4	70	30	100
BBL-605-DSE III/ BBL-606-DSE III/ BBL-607-DSE III	DSE-III (list attached below)	Any One Course out of proposed 03 (list attached below)	2	2	70	30	100
BBL-608-DSE-IV/ BBL-609-DSE-IV/ DSE-IV/	DSE-IV (list attached below)	Any One Course out of proposed 03 (list attached below)	2	2	70	30	100

BBL-610-DSE-IV							
BBP-611	Core Course Practical-VIII	Biology Lab	2	4	70	30	100
BBP-612/BCP-601	Core Course Practical-IX	Inorganic Chemistry Lab-IV	2	4	70	30	100
			24	28	560	240	800

C- Core Course, EC- Elective Course, AECC-Ability Enhancement Compulsory Course, SEC- Skill Enhancement Course, DSE- Discipline Specific Elective

### **Elective Course (EC) (any one per Semester in Semester 3<sup>rd</sup> to 4<sup>th</sup> )**

**3<sup>rd</sup> Semester: (Elective Course -I)- (Student should take any one out of below listed 03 Course)**

Sr. no.	Course Code	Nomenclature
1	BBL-305-EC-I	Any one MOOC through SWAYAM
2	BBL-306-EC-I	Biosafety
3	BBL-307-EC-I	Economic Botany

**4<sup>th</sup> Semester: (Elective Course -II) (Student should take Any One out of below listed 02 Course)**

Sr. no.	Course Code	Nomenclature
1	BBL-405-EC-II	Biotechnology & Human Welfare
2	BBL-406-EC-II	Evolutionary Biology

### **Skill Enhancement Course (Student should take any one per Semester in Semester three to four)**

**3<sup>rd</sup> semester**

Sr. no.	Course Code	Nomenclature
1	BBL-308-SEC-I	Molecular Diagnostic
2	BBL-309-SEC-I	Basics of Forensic

		Science
3	<b>BBL-310-SEC-I</b>	Ecology & Environment Management

**4<sup>th</sup> semester**

Sr. no.	Course Code	Nomenclature
1	<b>BBL-407-SEC-II</b>	Industrial & Environmental Biotechnology
2	<b>BBL-408-SEC-II</b>	Agro & Industrial Biotechnology
3	<b>BBL-409-SEC-II</b>	Food Biotechnology

**Discipline Centric Subjects (any two per semester one from each group in Semester V<sup>th</sup> & VI<sup>th</sup>)**

5 <sup>th</sup> Semester			6 <sup>th</sup> Semester		
DSE-I	BBL-505-DSE-I	Animal Diversity I	DSE-III	BBL-605-DSE- III	Animal Diversity II
	BBL-506-DSE- I	Medical Microbiology		BBL-606-DSE- III	Animal Biotechnology
	BBL-507-DSE- I	Bioinformatics		BBL-607-DSE-III	Immunology
DSE-II	BBL-508-DSE- II	Plant Diversity I	DSE-IV	BBL-608-DSE- IV	Plant Diversity II
	BBL-509-DSE II	Environment Biotechnology		BBL-609-DSE- IV	Plant Biotechnology
	BBL-510-DSE II	Biostatistics		IBBL-610-DSE-IV	Enzymology

**Notes: i)** Students who have studied mathematics at 10+1 and 10+2 level shall opt Elementary Biology-I (Paper code: BBL-101) & Mathematics-I (BML-102) and those who have studied Biology shall opt Elementary Mathematics -I (BML-101) & Biology -I (BBL-102) in 1st semester. ii) Semester-I & II will be common for all the four programmes.

**I<sup>st</sup> Semester**



**Paper Code: BXL 101    Ability Enhancement Compulsory Course-I  
ENGLISH**

**30 Hrs (2Hrs /week)**

**Credits: 2**

**Time: 3Hrs**

**Marks for Major Test (External): 70**

**Marks for Internal Exam: 30**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**UNIT-I**

**Syntax**

**7Hrs**

Sentence structures, Verb patterns and their usage.

**UNIT-II**

**Phonetics**

**8Hrs**

Basic Concepts – Vowels, Consonants, Phonemes, Syllables; Articulation of Speech Sounds – Place and Manner of Articulation; Transcription of words and simple sentences, using International Phonetic Alphabet.

**UNIT-III**

**Comprehension**

**7Hrs**

Listening and Reading comprehension – Note taking, Reviewing, Summarising, Interpreting, Paraphrasing and Précis Writing.

**UNIT-IV**

**Composition**

**8Hrs**

Descriptive, Explanatory, Analytical and Argumentative Writing - description of simple objects like instruments, appliances, places, persons, principles; description and explanation of processes and operations; analysis and arguments in the form of debate and group discussion.

**BOOKS SUGGESTED:**

- 1.Roy A. & Sharma P.L. English for Students of Science, Orient Longman.
- 2.Spoken English for India by R.K. Bansal and J.B. Harrison, Orient Longman.
3. Tickoo M.L. & Subramanian A.E. Intermediate Grammar, Usage and Composition, Orient Longman.
- 4.Pink M.A. & Thomas S.E. English Grammar, Composition and Correspondence, S. Chand and Sons Pvt. Ltd., Delhi.
- 5.Thomson & Martinet A Practical English Grammar, OUP, Delhi.
- 6.Hornby A.S Guide to Patterns and Usage in English, OUP, Delhi.
- 7.Balasubramanian T. A Textbook of English Phonetics for Indian Students, MacMillan, Chennai.
- 8.O'Connor J.D. Better English Pronunciation, Cambridge Univ. Press, London.
- 9.McCarthy English Vocabulary in Use, Foundation Books (Cambridge University Press), Delhi.
10. Buck, Assessing Listening, Foundation Books (Cambridge University Press), Delhi.

**Paper Code: BXL 102- Ability Enhancement Compulsory Course-II**

**ENVIRONMENTAL SCIENCE**

**30 Hrs (2Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 2**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**UNIT-I**

**The Multidisciplinary nature of environmental studies**

**8Hrs**

Definition, scope and importance, Need for public awareness.

Natural resources: Renewable and non-renewable resources

Natural resources and associated problems.

a) Forest resources: Use and over-exploitation, de-forestation

b) Water resources: Use and over-utilization of surface and ground water, floods and drought.

c) Mineral resources: Use and exploitation, environmental effects of extruding.

d) Food resources: World food problems, changes caused by agriculture, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.

e) Energy Resources: Growing energy needs, renewable and non-renewable energy sources use of alternative energy sources.

f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification

**UNIT-II**

**Ecosystems**

**7Hrs**

Concept of an ecosystem, Structure and function of an ecosystem, Procedures, consumers and decomposers, Energy flow in the ecosystem, Ecological succession & Food chains, food webs and ecological pyramids.

Biodiversity and its conservation: Introduction – Definition: genetic, species and ecosystem diversity, Biogeographical classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, National and local levels, India as a megadiversity nation.

**UNIT-III**

**Environmental Pollution**

**7Hrs**

Definition, Causes, effects and control measures of: - Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution & Nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes.

**UNIT-IV**

**Social Issues and the Environment**

**8Hrs**

From Unsustainable to sustainable development, urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Wasteland reclamation, Consumerism and waste products, environment Protection Act, Air (Prevention and Control of Pollution) Act, Water(Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environment legislation & Public awareness.

**BOOKS SUGGESTED:**

1. De A. K. Environmental Chemistry, Wiley Eastern Ltd, 1999.
2. Bharucha E. Text book of Environmental studies, University press, Hydrabad 2005.
3. Cunningham W P., Cooper T H. Gorhani E. Hepworth M T, Environmental Enclopedia, Jaico publication House, Mumbai, 2001.
4. Miller T G. Environmental Science Wadsworth publishing corp, 2000.

**Paper Code: BBL-102- Core Course- I**  
**BIOLOGY-I (CELL & CELLULAR PROCESSES)**

**(4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**Unit I.**

**Techniques in Biology**

Principles of microscopy; Light Microscopy; Phase contrast microscopy; Fluorescence microscopy; Confocal microscopy; Sample Preparation for light microscopy; Electron microscopy (EM)- Scanning EM and Scanning Transmission EM (STEM); Sample Preparation for electron microscopy; X-ray diffraction analysis

**Unit II**

**Cell as a unit of Life**

The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components

**Unit III.**

**Cell Organelles**

1. Mitochondria: Structure, marker enzymes, composition; mitochondrial biogenesis; Semiautonomous nature; Symbiont hypothesis; Proteins synthesized within mitochondria; mitochondrial DNA
2. Chloroplast Structure, marker enzymes, composition; semiautonomous nature, chloroplast DNA
3. ER, Golgi body & Lysosomes Structures and roles. Signal peptide hypothesis, N-linked glycosylation, Role of golgi in O-linked glycosylation. Cell secretion, Lysosome formation.
4. Peroxisomes and Glyoxisomes: Structures, composition, functions in animals and plants and biogenesis
5. Nucleus: Nuclear Envelope- structure of nuclear pore complex; chromatin; molecular organization, DNA packaging in eukaryotes, euchromatin and heterochromatin, nucleolus and ribosome structure (brief).

**Unit IV.**

**Cell Wall & Membrane**

The functions of membranes; Models of membrane structure; The fluidity of membranes; Membrane proteins and their functions; Carbohydrates in the membrane; Faces of the membranes; Selective permeability of the membranes; Cell wall

Cell Division.

Role of Cell division; Overview of Cell cycle; Molecular controls; Meiosis

**SUGGESTED BOOKS**

1. Campbell, N.A. and Reece, J. B. (2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.
2. Raven, P.H et al (2006) Biology 7th edition Tata McGrawHill Publications, New Delhi
3. Sheeler, P and Bianchi, D.E. (2006) Cell and Molecular Biology, 3rd edition, John Wiley & sons NY

**Paper Code: BCL- 101**

**Generic Elective –I**

**CHEMISTRY-I**

**(4Hrs /week)**

**Credits: 4**

**Time: 3Hrs**

**Marks for Major Test (External): 70**

**Marks for Internal Exam: 30**

**Total Marks: 100**

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**UNIT-I**

**Chemical Thermodynamics**

**15 Hrs**

Objectives and limitations of Chemical Thermodynamics, state functions, thermodynamic equilibrium, work, heat, internal energy, enthalpy. First Law of Thermodynamics: First law of thermodynamics for open, closed and isolated systems. Reversible isothermal and adiabatic expansion/compression of an ideal gas. Irreversible isothermal and adiabatic expansion. Enthalpy change and its measurement, standard heats of formation and absolute enthalpies. Kirchoff's equation.

Second and Third Law: Various statements of the second law of thermodynamics. Efficiency of a cyclic process (Carnot's cycle). Entropy: Entropy changes of an ideal gas with changes in P, V, and T. Free energy and work functions. Gibbs-Helmholtz Equation, Criteria of spontaneity in terms of changes in free energy. Introduction to Third law of thermodynamics.

**UNIT-II**

**Conductance and Electrochemistry**

**15 Hrs**

Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions.

Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods. Applications of conductance to measure degree of dissociation of weak electrolytes.

Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half cell potentials, application of electrolysis in metallurgy and industry. Chemical cells with examples; Standard electrode (reduction) potential.

**UNIT-III**

**Fundamentals of Organic Chemistry**

**15 Hrs**

Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and

Hyperconjugation.

Cleavage of Bonds: Homolysis and Heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles.

Reactive Intermediates: Carbocations, Carbanions and free radicals.

Strength of organic acids and bases: Comparative study with emphasis on factors affecting  $pK$  values.

#### UNIT-IV

##### Stereochemistry

8Hrs

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

##### Chemistry of Biomolecules

7Hrs

Occurrence, classification of Carbohydrates. Amino acids, peptides and their classification.  $\alpha$ -Amino Acids. Zwitterions,  $pK_a$  values, isoelectric point, components of nucleic acids, nucleosides and nucleotides.

##### BOOKS SUGGESTED:

1. Atkins, P.W. & Paula, J. *Physical Chemistry*, 10<sup>th</sup> Ed., Oxford University Press, 2014.
2. Castellan, G.W., *Physical Chemistry*, Narosa Publishers
3. Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Finar, I. L. *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
5. Finar, I. L. *Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6. Eliel, E. L. & Wilen, S. H. *Stereochemistry of Organic Compounds*, Wiley: London, 1994.
7. Kalsi, P. S. *Stereochemistry Conformation and Mechanism*, New Age International, 2005.
- McMurry, J.E. *Fundamentals of Organic Chemistry*, 7<sup>th</sup> Ed. Cengage Learning India Edition, 2013.

**Paper Code: BPL-101      Generic Elective –II**

**PHYSICS-I MECHANICS**

**(4Hrs /week)**

**Credits: 4**

**Time: 3Hrs**

**Marks for Major Test (External): 70**

**Marks for Internal Exam: 30**

**Total Marks: 100**

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**UNIT – 1**

**15 Hrs**

**Fundamentals of Dynamics:** Reference frames. Inertial frames; Review of Newton's Laws of Motion. Galilean transformations; Galilean invariance. Momentum of variable mass system: motion of rocket. Motion of a projectile in Uniform gravitational field Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse.

**Work and Energy:** Work and Kinetic Energy Theorem. Conservative and non-conservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy.

**Collisions:** Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames.

**UNIT - 2**

**15 Hrs**

**Rotational Dynamics:** Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation.

**Elasticity:** Relation between Elastic constants. Twisting torque on a Cylinder or Wire. **Fluid Motion:** Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube.

**UNIT – 3**

**15 Hrs**

**Gravitation and Central Force Motion:** Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere.

Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS).

**Oscillations:** SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor.

**UNIT - 4**

**15 Hrs**

**Non-Inertial Systems:** Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems.

**Special Theory of Relativity:** Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass-energy Equivalence. Relativistic Doppler effect. Relativistic Kinematics. Transformation of Energy and Momentum.

**BOOKS SUGGESTED:**

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
3. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
4. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.
5. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
6. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
7. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

**Additional Books for Reference**

- 1) Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
- 2) University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
- 3) Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A. Serway, 2010, Cengage Learning
- 4) Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.



aper Code: BML-101                      Generic Elective –III

**ELEMENTARY MATHEMATICS-I**

**30 Hrs (2Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

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**UNIT – I**

**15 Hrs**

**Sets, Relations and Functions:** Sets and their Representations, The Empty Set, Finite and Infinite Sets, Equal Sets, Subsets, Universal Set, Venn Diagrams, Operations on Sets, Complement of a Set, Practical Problems on Union and Intersection of Two Sets, Cartesian Product of Sets, Relations, Functions.

**Sequences and Series:** Sequences, Series, Arithmetic Progression (A.P.), Geometric Progression (G.P.), Relationship Between A.M. and G.M.

**UNIT – II**

**15 Hrs**

**Straight Lines:** Introduction, Slope of a Line, Various Forms of the Equation of a Line, General Equation of a Line, Distance of a Point From a Line.

**Trigonometric Functions:** Angles, Trigonometric Functions, Trigonometric Functions of Sum and Difference of Two Angles, Trigonometric Equations.

**UNIT – III**

**15 Hrs**

**Permutations and Combinations:** Fundamental Principle of Counting, Permutations, Combinations.

**Binomial Theorem:** Introduction, Binomial Theorem for Positive Integral Indices, General and Middle Terms.

**UNIT – IV**

**15 Hrs**

**Linear Inequalities:** Inequalities, Algebraic Solutions of Linear Inequalities in One Variable and their Graphical Representation, Graphical Solution of Linear Inequalities in Two Variables, Solution of System of Linear Inequalities in Two Variables.

**Probability:** Introduction, Random Experiments, Event, Axiomatic Approach to Probability, Addition Theorems on Probability, Conditional Probability, Multiplicative Law of Probability.

**BOOKS SUGGESTED:**

1. Mathematics Text Book for Class XI, National Council of Educational Research and Training.
2. R.S. Verma and K.S. Sukla, Text Book on Trigonometry, Pothishala Pvt. Ltd, Allahabad.

3. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, S. Chand & Sons.
4. Ivo Duntsch and Gunther Gediga, Set, Relations, Functions, Methodos Publishers.

**Paper Code: BBL-101                      Generic Elective –III**

**ELEMENTARY BIOLOGY-I:    FUNDAMENTALS OF BIOLOGY**

**30 Hrs (2Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**UNIT – I**

**15 Hrs**

**Introduction to concepts of biology**

Themes in the study of biology; A closer look at ecosystem; A closer look at cell; The process of Science; Biology and everyday life.

**Evolutionary history of biological diversity**

Early earth and the origin of life; Major events in the history of life; Mechanism of Macroevolution; Phylogeny and the tree of life.

**UNIT – II**

**15 Hrs**

**Classifying the diversity of life**

Kingdoms of Life –Prokaryotes, Eukaryotes, Archaea

**Darwinian view of life and origin of species**

Darwin’s theory of evolution; The evolution of populations; Concepts of species; Mechanism of speciation

**Genetic approach to Biology**

Patterns of inheritance and question of biology; Variation on Mendel’s Law; The molecular basis of genetic information; The flow of genetic information from DNA to RNA to protein; Genetic Variation; Methodologies used to study genes and gene activities; Developmental noise; Detecting macromolecules of genetics; Model organisms for the genetic analysis; Distinction between Phenotype and Genotype

**UNIT – III**

**15  
Hrs**

**Chemistry of life**

The constituents of matter; Structure of an atom; The energy level of electron; The formation and function of molecules depend on chemical bonding between atoms; Chemical reaction make or break chemical bonds

**Water and life**

The water molecule is polar; Properties of water; Ionization of water

**Carbon and life**

Organic chemistry-the study of carbon compounds; what makes carbon special? Properties of organic compounds

#### UNIT - IV

15 Hrs

##### **Structure and function of biomolecules**

Most macromolecules are Polymers; Carbohydrates act as fuel and building materials; Lipids are group of hydrophobic molecules; Protein have diverse structures and functions; Nucleic acids store and transmit hereditary information

##### **BOOKS SUGGESTED**

1. Campbell, N.A. and Reece, J. B. (2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.
2. Raven, P.H et al (2006) Biology 7th edition Tata McGrawHill Publications, New Delhi
- 3.Griffiths, A.J.F et al (2008) Introduction to Genetic Analysis, 9th edition, W.H. Freeman & Co. NY

**Paper Code: BBP-101      Core Course Practical- I**

**BIOLOGY LAB-I**

**(4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 2**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**PRACTICALS**

1. To learn a) use of microscope b) principles of fixation and staining.
2. Preparation of Normal, molar and standard solutions, phosphate buffers, serial dilutions
3. Use of micropipettes
4. Measurement of cell size by cytometry
5. To perform gram staining of bacteria.
6. To study the cytochemical distribution of nucleic acids and mucopolysaccharides with in cells/tissues from permanent slides.
7. To perform quantitative estimation of protein using the Lowry's method. Determine the concentration of the unknown sample using the standard curve plotted.
8. To study of plasmolysis & deplasmolysis of *Rhoeo* leaf.
9. To study prokaryotic cells, Bacteria/fungi and eukaryotic cells.
10. To prepare squash from root tip of *Aliumcepa* & study various stages of mitosis.

**SUGGESTED BOOKS:**

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.
5. Campbell, N.A. and Reece, J. B. (2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.
6. Raven, P.H et al (2006) Biology 7th edition Tata McGrawHill Publications, New Delhi
7. Griffiths, A.J.F et al (2008) Introduction to Genetic Analysis, 9th edition, W.H. Freeman & Co. NY

**Paper Code: BCP-101**

**Generic Elective Practical-I**

**CHEMISTRY LAB-I**

**(4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 2**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

1. Preparation of reference solutions.
2. Redox titrations: Determination of  $\text{Fe}^{2+}$ ,  $\text{C}_2\text{O}_4^{2-}$  ( using  $\text{KMnO}_4$ ,  $\text{K}_2\text{Cr}_2\text{O}_7$ )
3. Iodometric titrations: Determination of  $\text{Cu}^{2+}$  (using standard hypo solution).
4. To determine the surface tension of at least two liquids using stalagmometer by drop no. and drop weight methods (Use of organic solvents excluded).
5. To study the effect of surfactant on surface tension of water.
6. To determine the viscosity of at least two liquids by using Ostwald's viscometer (use of organic solvents excluded).
7. To study the process of (i) sublimation (ii) Crystallization of camphor and phthalic acid
8. Preparation and purification through crystallization or distillation and ascertaining their purity through melting point or boiling point
  - (i) Iodoform from ethanol (or acetone)
  - (ii) p-Bromoacetanilide from acetanilide

**BOOKS SUGGESTED:**

1. Vogel A. I., Tatchell A.R., Furnis B.S., Hannaford A.J., Smith P.W.G., Vogel's Text Book of Practical Organic Chemistry, 5th Edn., Pubs: ELBS, 1989.
2. Pavia D.L., Lampanana G.M., Kriz G.S. Jr., Introduction to Organic Laboratory Techniques, 3rd Edn., Pubs: Thomson Brooks/Cole, 2005.
3. Mann F.G., Saunders P.C., Practical Organic Chemistry, Pubs: Green & Co. Ltd., London, 1978.
4. Svehla, G., Vogel's Qualitative Inorganic Analysis (revised); 7th edition, Pubs: Orient Longman, 1996.
5. Bassett, J., Denney, R.C., Jeffery, G.H., Mendham, J., Vogel's Textbook of Quantitative Inorganic Analysis (revised); 4th edition, Pubs: Orient Longman, 1978.
6. Yadav J. B., Advanced Practical physical Chemistry

**Paper Code: BPP-101**

**Generic Elective Practical-II**

**PHYSICS LAB – I**

**(4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 2**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To study the random error in observations.
3. To determine the height of a building using a Sextant.
4. To study the Motion of Spring and calculate (a) Spring constant, (b)  $g$  and (c) Modulus of rigidity.
5. To determine the Moment of Inertia of a Flywheel.
6. To determine  $g$  and velocity for a freely falling body using Digital Timing Technique
7. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
8. To determine the Young's Modulus of a Wire by Optical Lever Method.
9. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
10. To determine the elastic Constants of a wire by Searle's method.
11. To determine the value of  $g$  using Bar Pendulum.
12. To determine the value of  $g$  using Kater's Pendulum.

**BOOKS SUGGESTED:**

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal
4. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.

## **SEMESTER-II**

Paper Code: BXL-201

Ability Enhancement Compulsory Course -III

HINDI

(2Hrs /week)

Marks for Major Test (External): 70

Credits: 2

Marks for Internal Exam: 30

Time: 3Hrs

Total Marks: 100

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

बी.एक्स.एल-201: हिन्दी

कुल अंक: 70

क्रेडिट -2

आंतरिक मूल्यांकन-30

समय-3 घण्टे

खण्ड (क)

निर्धारित कवि

- |           |          |
|-----------|----------|
| 1 कबीरदास | 2 सूरदास |
| 3 मीराबाई | 4 रसखान  |

खण्ड (ख)

हिन्दी साहित्य का इतिहास भक्तिकाल: पाठ्यक्रम में निर्धारित आलोचनात्मक प्रश्न-

- |                               |                              |
|-------------------------------|------------------------------|
| 1 सन्तकाव्य की प्रवृत्तियाँ   | 2 सूफी काव्य की प्रवृत्तियाँ |
| 3 कृष्ण काव्य की प्रवृत्तियाँ | 4 राम काव्य की प्रवृत्तियाँ  |
| 5 भक्तिकाल का: स्वर्णयुग      |                              |

खण्ड (ग)

अलंकार-अनुप्रास, श्लेष, यमक, उपमा, रूपक, अतिशयोक्ति, मानवीकरण, अन्योक्ति, समासोक्ति आदि।

खण्ड (घ)

मुहावरे एवं लोकोक्तियाँ।

खण्ड(क) के लिए निर्धारित पाठ्यपुस्तक-मध्यकालीन काव्य-कुंज : सं. डॉ. रामसजन पाण्डेय प्रकाशन:खाटूश्याम प्रकाशन, 1276/5 पीर जी मोहल्ला, प्रताप टाकीज, रोहतक।

निर्देश:- सभी प्रश्न अनिवार्य हैं।

1. खण्ड (क) में निर्धारित पाठ्यपुस्तक में से व्याख्या के लिए चार अवतरण पूछे जाएँगे, जिनमें से परीक्षार्थी को किन्हीं दो की सप्रसंग व्याख्या करनी होगी। प्रत्येक व्याख्या 6 अंक की होगी। पूरा प्रश्न 12 अंक का होगा।
2. खण्ड (क) में निर्धारित कवियों में से किन्हीं दो कवियों के साहित्यिक परिचय पूछे जाएँगे, जिनमें से किसी एक कवि का साहित्यिक परिचय लिखना होगा। यह प्रश्न 8 अंक का होगा।



3. खण्ड (क) में पाठ्यपुस्तक से निर्धारित आलोचनात्मक प्रश्नों में से दो प्रश्न पूछे जाएँगे, जिनमें से परीक्षार्थी को एक प्रश्न का उत्तर देना होगा। यह प्रश्न 10 अंक का होगा।
4. खण्ड(ख) में निर्धारित आलोचनात्मक प्रश्नों में से दो प्रश्न पूछे जाएँगे, जिनमें से किसी एक का उत्तर देना होगा। यह प्रश्न 10 अंक का होगा।
5. खण्ड(ख) से 12 अति लघूत्तरात्मक प्रश्न पूछे जाएँगे। प्रत्येक प्रश्न एक-एक अंक का होगा। पूरा प्रश्न 12 अंक का होगा।
6. खण्ड (ग) में निर्धारित अलंकारों में से दो अलंकार पूछे जाएँगे, जिनमें से एक अलंकार उदाहरणों सहित लिखना होगा। जो 8 अंक का होगा।
7. खण्ड (घ) से दस मुहावरों और लोकोक्तियों में से किन्हीं पांच मुहावरों का अर्थ एवं वाक्य प्रयोग लिखना होगा। जो 10 अंक का होगा।

**Paper Code: BML-201**

**Generic Elective -IV**

**ELEMENTARY MATHEMATICS-II**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**UNIT-I**

**15 Hrs**

**Matrix Algebra** : Introduction, types of matrices, addition and multiplication of matrix, transpose of matrix, concept of elementary row and column operations. Determinant and its properties, minors, cofactors. Application of determinants in finding area of triangle. Adjoint and inverse of square matrix. Solution of homogeneous and non-homogeneous linear equations and condition for solution.

**UNIT-II**

**15 Hrs**

**Differential Calculus** : Differentiation of standard functions including function of a function (Chain rule). Differentiation of implicit functions, logarithmic differentiation, parametric differentiation, elements of successive differentiation.

**Integral Calculus** : Integration as inverse of differentiation, indefinite integrals of standard forms, integration by parts, partial fractions and substitution. Formal evaluation of definite integrals.

**UNIT-III**

**15 Hrs**

**Ordinary Differential Equations** : Definition and formation of ordinary differential equations, equations of first order and first degree, variable separable, homogeneous equations, linear equations (Leibnitz form) and differential equations reducible to these types, Linear differential equation of order greater than one with constant coefficients, complementary function and particular integrals.

**UNIT-IV**

**15 Hrs**

**Partial Differential Equations:** Introduction and formation of P.D.E., solution of P.D.E., linear equation of first order (Lagrange's Equation), Non-Linear Equation of first order.

**Vector Calculus:** Differentiation of vectors, scalar and vector point functions, gradient of scalar field and directional derivative, divergence and curl of vector field and their physical interpretation.

**BOOKS SUGGESTED:**

1. Shanti Narayan : Differential and Integral Calculus, S. Chand.
2. S.L. Ross, : Differential Equations, John Wiley and sons inc., Ny, 1984.
3. Shanti Narayan : A Textbook of Matrices, S. Chand.
4. Ian N. Sneddon : Elements of Partial Differential Equations, McGraw Hill.
5. Murray R. Spiegel : Vector Analysis Schaum Publishing

**Paper Code: BBL-201                      Generic Elective -IV**

**ELEMENTARY BIOLOGY-II (CELL BIOLOGY)**

**(4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**UNIT I**

Cell: Introduction 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, cell recognition and membrane transport.

**UNIT II**

Membrane Vacuole system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments.

Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion.

**UNIT III**

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

**UNIT IV**

Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction.

Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics and molecular basis of cancer.

**SUGGESTED READING/BOOKS**

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. 8<sup>th</sup> 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. 7<sup>th</sup> edition. Pearson Benjamin Cummings Publishing, San Francisco.

**Paper Code: BBL-202**

**Core Course –II**

**BIOLOGY-II (GENERAL BIOCHEMISTRY)**

**(4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**UNIT I: Introduction to Biochemistry:**

A historical prospective. Amino acids & Proteins: Structure & Function. Structure and properties of Amino acids, Types of proteins and their classification, Forces stabilizing protein structure and shape. Different Level of structural organization of proteins, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins.

Carbohydrates: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoprotein's and their biological functions

**UNIT II**

Lipids: Structure and functions –Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol.

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, denaturation and re-naturation of DNA

**UNIT III**

Enzymes: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric & oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity, common features of active sites, enzyme specificity: types & theories, Biocatalysts from extreme thermophilic and hyperthermophilic archaea and bacteria. Role of: NAD<sup>+</sup>, NADP<sup>+</sup>, FMN/FAD, coenzymes A, Thiamine pyrophosphate, Pyridoxalphosphate, lipoic-acid, Biotin vitamin B12, Tetrahydrofolate and metallic ions

**UNIT IV**

Carbohydrates Metabolism: Reactions, energetics and regulation. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle, Electron Transport Chain, Oxidative phosphorylation.  $\beta$ -oxidation of fatty acids.

**SUGGESTED READING/BOOKS**

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

**Paper Code: BPL-201**

**Generic Elective V**

**PHYSICS-II (WAVES AND OPTICS)**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**UNIT-I**

**15 Hrs**

**Superposition of Collinear Harmonic oscillations:** Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences.

**Superposition of two perpendicular Harmonic Oscillations:** Graphical and Analytical Methods. Lissajous Figures with equal and unequal frequency and their uses.

**Wave Motion:** Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves.

**UNIT-II**

**15 Hrs**

**Velocity of Waves:** Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction.

**Superposition of Two Harmonic Waves:** Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Plucked and Struck Strings. Melde's Experiment. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves.

**Wave Optics:** Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence.

**UNIT- III**

**15 Hrs**

**Diffraction:** Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integral formula. (Qualitative discussion only) **Fraunhofer diffraction:** Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating.

**Fresnel Diffraction:** Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.

**UNIT-IV**

**15 Hrs**

**Interference:** Division of amplitude and wave front. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index.

**Interferometer:** Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer.

**Holography:** Principle of Holography. Recording and Reconstruction Method. Theory of Holography as Interference between two Plane Waves. Point source holograms.

**BOOKS SUGGESTED:**

1. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
2. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
3. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
4. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
5. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
6. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
7. Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications.

**Paper Code: BCL-201**

**Generic Elective- VI**

**CHEMISTRY-II**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**UNIT-I**

**Chemical Bonding and Molecular Structure**

**15 Hrs**

*Introduction to Ionic Bonding:* General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, polarizing power and polarizability

*Introduction to Covalent bonding:* Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

*Ionic Solids:* Factors affecting the formation of ionic solids, concept of close packing, radius ratio rule and coordination number. Calculation of limiting radius ratio for tetrahedral and octahedral sites. Structures of some common ionic solids NaCl, ZnS (zinc blende and wurtzite).

**UNIT-II**

**Acids and Bases**

**8 Hrs**

Brønsted–Lowry concept, conjugate acids and bases, relative strengths of acids and bases, effects of substituent and solvent, differentiating and levelling solvents. Lewis acid-base concept, classification of Lewis acids and bases, Lux-Flood concept and solvent system concept. Hard and soft acids and bases (HSAB concept), applications of HSAB process.

**Basic Coordination Chemistry**

**7Hrs**

Coordinate Bond. Werner's coordination theory, ligands, chelates. Nomenclature of coordination compounds. Stereochemistry of different coordination numbers, isomerism. Valence-bond and crystal field theories of bonding in complexes. Explanation of properties such as geometry colour and magnetism.

**UNIT-III**

**Chemical Kinetics And Catalysis**

**15 Hrs**

Rates of reactions, rate constant, order and molecularity of reactions. Differential rate law and integrated rate expressions for zero, first, second and third order reactions. Half-life time of a reaction. Methods for determining order of reaction. Effect of temperature on reaction rate and the concept of activation energy.

Catalysis: Homogeneous catalysis, Acid-base catalysis and enzyme catalysis. Heterogeneous catalysis.

**UNIT-IV**

**Basics of spectroscopy**

**15 Hrs**

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection

rules, validity of Beer-Lambert's law. Electromagnetic radiations, Introduction to ultraviolet, visible and infrared spectroscopy, electronic transitions,  $\lambda_{\max}$  &  $\epsilon_{\max}$ , chromophore, auxochrome, bathochromic, hypsochromic shifts. Infrared radiation and types of molecular vibrations, functional group and fingerprint region.

**BOOKS SUGGESTED:**

1. Cotton F.A. and Wilkinson G., Murillo C.A., Bochmann M., Advanced Inorg. Chemistry, 6th Edition, Pubs: John Wiley & Sons. Inc., 1999.
2. Lee J.D., Concise Inorganic Chemistry, 4th edition, Pubs: ELBS, 1991.
3. Huheey J.E., Keiter E.A., Keiter R.L., Inorganic Chemistry : Principles of Structures and Reactivity; 4th Edition, Pubs: Harper Collins, 1993.
4. Greenwood N.N. and Earnshaw A., Chemistry of the Elements, 2nd edition., Pubs: Butterworth/Heinemann, 1997.
5. Douglas B., Daniel D. Mc and Alexander J., Concepts of Models of Inorganic Chemistry, Pubs: John Wiley, 1987.
6. Puri B.R., Sharma L. R. and Pathania M. S., Principles of Physical Chemistry, Pubs: Vishal Publishing Company, 2003.
7. Laidler K. J Chemical Kinetics, McGraw Hill.
8. Castellan G.W. Physical Chemistry, Narosa Publishers
9. Kemp W. Organic Spectroscopy.



**Paper Code: BXL-202**

**Generic Elective- VII**

**COMPUTER SCIENCE**

**(2Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 2**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**UNIT-I**

**An Overview of Computer System**

**8Hrs**

Anatomy of a digital Computer, Memory UNITS, Main and Auxiliary Storage Devices, Input Devices, Output Devices, Classification of Computers. Radix number system: Decimal, Binary, Octal, Hexadecimal numbers and their inter-conversions; Representation of information inside the computers.

**UNIT-II**

**Operating System Basics**

**7Hrs**

The user Interface, Running Programmes, Managing files, Introduction to PC operating Systems: Unix/Linux, DOS, Windows 2000.

**UNIT-III**

**Internet basics**

**7Hrs**

Introduction to the basic concepts of Networks and Data Communications, How Internet works, Major features of internet, Emails, FTP, Using the internet.

**UNIT-IV**

**Programming Languages**

**8Hrs**

Machine-, Assembly-, High Level- Language, Assembler, Compiler, Interpreter, debuggers, Programming fundamentals: problem definition, algorithms, flow charts and their symbols, introduction to compiler, interpreter, assembler, linker and loader and their inter relationship.

**BOOKS SUGGESTED:**

1. Goel A., Computer Fundamentals, Pearson Education, 2010.
2. Aksoy P. &DeNardis L., Introduction to Information Technology, Cengage Learning, 2006
3. Sinha P. K. &Sinha P. Fundamentals of Computers, BPB Publishers, 2007

**Paper Code: BCP-201                      Generic Elective Practical -III**

**CHEMISTRY LAB-II**

**(4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 2**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1*

1. Complexometric titrations: Determination of  $Mg^{2+}$ ,  $Zn^{2+}$  by EDTA.
2. Paper Chromatography: Qualitative Analysis of any one of the following Inorganic cations and anions by paper chromatography ( $Pb^{2+}$ ,  $Cu^{2+}$ ,  $Ca^{2+}$ ,  $Ni^{2+}$ ,  $Cl^-$ ,  $Br^-$ ,  $I^-$  and  $PO_4^{3-}$  and  $NO_3^-$ ).
3. To determine the specific refractivity of at least two liquids.
4. Determine rate constant of acid catalysed hydrolysis of methyl acetate.
5. Determination of conductance of electrolytes
6. The preliminary examination of physical and chemical characteristics (physical state, colour, odour and ignition test), extra element detection (N,S,Cl, Br and I).

**BOOKS SUGGESTED:**

1. Vogel A. I., Tatchell A.R., Furnis B.S., Hannaford A.J., Smith P.W.G., Vogel's Text Book of Practical Organic Chemistry, 5th Edn., Pubs: ELBS, 1989.
2. Pavia D.L., Lampanana G.M., Kriz G.S. Jr., Introduction to Organic Laboratory Techniques, 3rd Edn., Pubs: Thomson Brooks/Cole, 2005.
3. Mann F.G., Saunders. P.C., Practical Organic Chemistry, Pubs: Green & Co. Ltd., London, 1978.
4. Svehla, G., Vogel's Qualitative Inorganic Analysis (revised); 7th edition, Pubs: Orient Longman, 1996.
5. Bassett, J., Denney, R.C., Jeffery, G.H., Mendham, J., Vogel's Textbook of Quantitative Inorganic Analysis (revised); 4th edition, Pubs: Orient Longman, 1978.
6. Das R.C. & Behra B. Experimental Physical Chemistry, McGraw Hill.
7. Shoemaker & Gailand Experiments in Physical Chemistry, McGraw Hill.
8. Yadav J. B. Advanced Practical physical Chemistry

**Paper Code: BPP-201    Generic Elective Practical-IV**

**PHYSICS LAB – II**

**(4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 2**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify  $\lambda^2/T$  law.
2. To investigate the motion of coupled oscillators.
3. To study Lissajous Figures.
4. Familiarization with: Schuster's focusing; determination of angle of prism.
5. To determine refractive index of the Material of a prism using sodium source.
6. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
7. To determine the wavelength of sodium source using Michelson's interferometer.
8. To determine wavelength of sodium light using Fresnel Biprism.
9. To determine wavelength of sodium light using Newton's Rings.
10. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
11. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
12. To determine dispersive power and resolving power of a plane diffraction grating.

**BOOKS SUGGESTED:**

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. A Laboratory Manual of Physics for undergraduate classes, D.P. Khandelwal, 1985, Vani Pub.

**Paper Code: BXP-201**

**Generic Elective Practical-V**

**COMPUTER SCIENCE LAB**

**(4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 2**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

C Programming language: C fundamentals, formatted input/ output, expressions, selection statements, loops and their applications; Basic types, arrays, functions, including recursive functions, program organization: local and external variables and scope; pointers & arrays

**Representative programming in C**

1. Write a program to find the largest of three numbers. (if-then-else)
2. Write a program to find the largest number out of ten numbers (for-statement)
3. Write a program to find the average male height & average female heights in the class (input is in form of sex code, height).
4. Write a program to find roots of quadratic equation using functions and switch statements.
5. Write a program to multiply two matrices

**BOOKS SUGGESTED:**

1. Kanetkar Y. Let Us C, BPB publication

## **SEMESTER-III**

**Paper Code: BBL-301**

**Core Course-III**

**MAMMALIAN PHYSIOLOGY**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**UNIT I: Digestion and Respiration (15 Periods)**

Digestion: Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids. Composition of bile, Saliva, Pancreatic, gastric and intestinal juice Respiration: Exchange of gases, Transport of O<sub>2</sub> and CO<sub>2</sub>, Oxygen dissociation curve, Chloride shift.

**UNIT II: Circulation (15 Periods)**

Composition of blood, Plasma proteins & their role, blood cells, Haemopoiesis, Mechanism of coagulation of blood. Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heartbeat.

**UNIT III: Muscle physiology and osmoregulation (15 Periods)**

Structure of cardiac, smooth & skeletal muscle, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction. Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation.

**UNIT IV: Nervous and endocrine coordination (15 Periods)**

Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, saltatory conduction, Neurotransmitters Mechanism of action of hormones (insulin and steroids) Different endocrine glands– Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions.

**SUGGESTED READING**

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Harcourt Asia PTE Ltd. /W.B. Saunders Company.
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition. John wiley & sons, Inc.

**Paper Code: BBL-302**

**Core Course-IV**

**PLANT ANATOMY AND PHYSIOLOGY**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**UNIT I: Anatomy**

**(10 Periods)**

The shoot and root apical meristem and its histological organization, simple & complex permanent tissues, primary structure of shoot & root, secondary growth, growth rings, leaf anatomy (dorsi-ventral and isobilateral leaf)

**UNIT II: Plant water relations and micro & macro nutrients**

**(12 Periods)**

Plant water relations: Importance of water to plant life, diffusion, osmosis, plasmolysis, imbibition, guttation, transpiration, stomata & their mechanism of opening & closing.

Micro & macro nutrients: criteria for identification of essentiality of nutrients, roles and deficiency systems of nutrients, mechanism of uptake of nutrients, mechanism of food transport

**UNIT III: Carbon and nitrogen metabolism**

**(20 Periods)**

Photosynthesis- Photosynthesis pigments, concept of two photo systems, photophosphorylation, Calvin cycle, CAM plants, photorespiration, compensation point

Nitrogen metabolism- inorganic & molecular nitrogen fixation, nitrate reduction and ammonium assimilation in plants.

**UNIT IV: Growth and development**

**(18 Periods)**

Growth and development: Definitions, phases of growth, growth curve, growth hormones (auxins, gibberellins, cytokines, abscisic acid, ethylene)

Physiological role and mode of action, seed dormancy and seed germination, concept of photo-periodic and vernalization.

**SUGGESTED READING**

1. Dickinson, W.C. 2000 Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. Esau, K. 1977 Anatomy of Seed Plants. Wiley Publishers.
3. Fahh, A. 1974 Plant Anatomy. Pergmon Press, USA and UK.
4. Hopkins, W.G. and Huner, P.A. 2008 Introduction to Plant Physiology. John Wiley and Sons.
5. Mauseth, J.D. 1988 Plant Anatomy. The Benjamin/Cummings Publisher, USA.
6. Nelson, D.L., Cox, M.M. 2004 Lehninger Principles of Biochemistry, 4<sup>th</sup> edition, W.H. Freeman and Company, New York, USA.
7. Salisbury, F.B. and Ross, C.W. 1991 Plant Physiology, Wadsworth Publishing Co. Ltd.
8. Taiz, L. and Zeiger, E. 2006 Plant Physiology, 4<sup>th</sup> edition, Sinauer Associates Inc .MA, USA

Paper Code: BCL-301/BBL-303      Core Course-V

**INORGANIC CHEMISTRY-I (ATOMIC STRUCTURE & CHEMICAL BONDING)**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**UNIT-I**

**Atomic Structure**

**15 Hrs**

Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrodinger's wave equation, significance of  $\psi$  and  $\psi^2$ . Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of *s*, *p*, *d* and *f* orbitals. Contour boundary and probability diagrams.

Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.

**UNIT-II**

**Periodicity of Elements**

**15 Hrs**

*s*, *p*, *d*, *f* block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to *s* and *p*-block.

(a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.

(b) Atomic radii (van der Waals)

(c) Ionic and crystal radii.

(d) Covalent radii (octahedral and tetrahedral)

(e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.

(f) Electron gain enthalpy, trends of electron gain enthalpy.

(g) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffe's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Sanderson's electron density ratio.

**UNIT-III**

**Chemical Bonding-I**

**15 Hrs**

*Ionic bond:* types of ions, size effects, radius ratio rule and its



limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its applications, Solvation energy.

*Covalent bond:* Lewis structure, Valence Bond theory (Heitler-London approach). Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules  $N_2$ ,  $O_2$ ,  $C_2$ ,  $B_2$ ,  $F_2$ , CO, NO, and their ions; HCl,  $BeF_2$ ,  $CO_2$ , (idea of s-p mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, multiple bonding (o and n bond approach) and bond lengths.

#### UNIT-IV

##### Chemical Bonding-II

15 Hrs

Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization.

Ionic character in covalent compounds: Bond moment and dipole moment, percentage ionic character from dipole moment and electronegativity difference.

*Metallic Bond:* Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids.

*Weak Chemical Forces:* van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions.

Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment) Effects of chemical force, melting and boiling points, solubility energetics of dissolution process.

##### BOOKS SUGGESTED:

1. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
2. Douglas, B.E. and McDaniel, D.H. *Concepts & Models of Inorganic Chemistry* Oxford, 1970.
3. Atkins, P.W. & Paula, J. *Physical Chemistry*, 10<sup>th</sup> Ed., Oxford University Press, 2014.
4. Day, M.C. and Selbin, J. *Theoretical Inorganic Chemistry*, ACS Publications, 1962.
5. Rodger, G.E. *Inorganic and Solid State Chemistry*, Cengage Learning India Edition, 2002.

**Paper Code: BCL-302/BBL-304**

**Core Course-VI**

**ORGANIC CHEMISTRY (HYDROCARBONS)**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**UNIT-I**

**Basics of Organic Chemistry**

**10Hrs**

Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties of Organic Compounds.

Dipole moment; Organic acids and bases; their relative strength, Curly arrow rules, formal charges; Nucleophilicity and basicity.

Aromaticity: Benzenoids and Hückel's rule.

Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

**Chemistry of Aliphatic Hydrocarbons-I 5Hrs Carbon-Carbon sigma bonds**

Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.

**UNIT-II**

**Chemistry of Aliphatic Hydrocarbons-II 15 Hrs Carbon-Carbon pi bonds:**

Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations.

*Reactions of alkenes:* Electrophilic additions their mechanisms (Markownikoff/ AntiMarkownikoff addition), mechanism of oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2-and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene.

*Reactions of alkynes:* Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.

**UNIT-III**

**Chemistry of Aliphatic Hydrocarbons-III**

**15 Hrs**

**Cycloalkanes and Conformational Analysis**

Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of cycloalkanes: Relative stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy diagrams.

**Aromatic Hydrocarbons**

*Aromaticity:* Huckel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of the groups.

## UNIT-IV

### Chemistry of Halogenated Hydrocarbons

15 Hrs

*Alkyl halides*: Methods of preparation, nucleophilic substitution reactions - S<sub>N</sub>1, S<sub>N</sub>2 and S<sub>N</sub>i mechanisms with stereochemical aspects and effect of solvent etc.; nucleophilic substitution vs. elimination.

*Aryl halides*: Preparation, including preparation from diazonium salts. nucleophilic aromatic substitution; S<sub>N</sub>Ar, Benzyne mechanism.

Relative reactivity of alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.

Organometallic compounds of Mg and Li - Use in synthesis of organic compounds.

### BOOKS SUGGESTED:

1. Morrison, R. N., Boyd, R. N. & Bhattacharjee S. K. *Organic Chemistry*, 7<sup>th</sup> ed. Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7<sup>th</sup> Ed. Cengage Learning India Edition, 2013.

**ELECTIVE COURSE –I**  
(Any one in Semester Three)

**Paper Code: BBL-305- EC-I      MOOC Course through SWAYAM**

**Paper Code: BBL-306- EC-I      Biosafety**

**Paper Code: BBL-307- EC-I      Economic Botany**

## **Paper Code: BBL-306 EC-1 – Elective Course-I**

### **Biosafety**

**30 Hrs (2Hrs /week)**

**Credits: 2**

**Time: 3Hrs**

**Marks for Major Test (External): 70**

**Marks for Internal Exam: 30**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

### **UNIT- I**

Introduction to Bioethics. Social and ethical issues in Biotechnology, causes of unethical acts, ignorance of laws, codes, policies and Procedures, Professional ethics – professional conduct, Ethical decision making, ethical dilemmas, good laboratory practices, good manufacturing practices, laboratory accreditation

### **UNIT –II**

Definition of Biosafety. Biosafety for human health and environment. Social and ethical issues of biosafety. Use of genetically modified organisms (BT cotton and BT brinjal) and their release in to the environment.

### **UNIT- III**

Intellectual property rights, patents and methods of application of patents, Trade Secrets, copyrights, Trade Marks, legal implications, farmers rights, plant breeder's rights. International and National conventions on biotechnology and related areas. WTO guidelines.

### **UNIT- IV**

Food Safety: Key terms, factors affecting food safety, recent concerns Food laws, standards and regulations, Food additives and contaminants, Hygiene and sanitation, HACCP.

### **BOOKS RECOMMENDED:**

1. Sasson A, Biotechnologies and Development, UNESCO Publications, 1988.
2. Sasson A. Biotechnologies in developing countries present and future, UNESCO publishers, 1993.
3. Singh K. Intellectual Property Rights on Biotechnology, BCII, New Delhi.

## **Paper Code: BBL-307 EC-1 – Elective Course-I**

### **Economic Botany**

**30 Hrs (2Hrs /week)**

**Credits: 2**

**Time: 3Hrs**

**Marks for Major Test (External): 70**

**Marks for Internal Exam: 30**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

#### **UNIT-I**

Origin, distribution, botanical description, brief idea of cultivation and uses of the following: Food plants-

**Cereals** (Rice, Wheat and Maize).

**Pulses-** (Gram, Arhar and Pea). **Vegetables-** (Potato, Tomato and Onion).

**Fibers-** Cotton, Jute and Flax.

**Oils-** Groundnut, Mustard and Coconut.

#### **UNIT-II**

Morphology of plant part used, brief idea of cultivation and uses of the following:

**Spices-** Coriander, Ferula, Ginger, Turmeric, Cloves.

#### **UNIT III**

**Medicinal Plants-** Cinchona, Rauwolfia, Atropa, Opium, Cannabis, Neem.

#### **UNIT IV**

Botanical description and processing of:

**Beverages-** Tea and Coffee.

**Rubber-** Hevea.

**Sugar-** Sugarcane.

General account and sources of timber; energy plantations and bio-fuels.

#### **Suggested Readings:**

1. Kocchar, S.L. 1998: Economic Botany in Tropics, 2nd edition, MacMillan India Ltd., New Delhi.
2. Sambammurthy, A.V.S.S. And Subramanyam, N.S. 1989: A Textbook of Economic Botany, Wiley Eastern Ltd., New Delhi.
3. Sharma, O.P. 1996: Hills Economic Botany (Late Dr. A.F. Hill adapted by O.P. Sharma), Tata McGraw Hill Co. Ltd., New Delhi.
4. Simpson, B.B. and Conner-Ogorzaly, M. 1986: Economic Botany- Plants in our World, McGraw Hill, New York.

**SKILL ENHANCEMENT COURSE-I ( SEC-I)**  
**(Any one per semester in semester Three to Four)**

**Paper Code: BBL-308- SEC (I) MOLECULAR DIAGNOSTICS**  
**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**UNIT I**

**(15 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**

**(15 Periods)**

Molecular methods in clinical microbiology:

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

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 III**

**(18 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. Immuno florescence. Radioimmunoassay.

**UNIT IV**

**(12 Periods)**

GLC, HPLC, Electron microscopy, flowcytometry and cell sorting.

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 by Paniker CKJ). University Press Publication.
5. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical 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-Century-Crofts publication.
8. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.
9. Microscopic Techniques in Biotechnology, Michael Hoppert.



**Paper code: BBL-309- SEC- (I)      BASICS OF FORENSIC SCIENCE**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

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

**Unit II**

**(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 III**

**(15 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 IV**

**(15 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 First Century, Select Publishers, New Delhi (2001).
3. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of 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).

**Paper code: BBL-310- SEC- (I)      ECOLOGY AND ENVIRONMENT MANAGEMENT**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**UNIT-I**

**(12 Periods)**

Our Environment: Geological consideration of Atmosphere, Hydrosphere, Lithosphere Scope of

Ecology. Development & Evolution of Ecosystem. Principles & Concepts of Ecosystem. Structure of ecosystem. Strata of an ecosystem. Types of ecosystem including habitats. Cybernetics & Homeostasis. Biological control of chemical environment.

**UNIT II**

**(20 Periods)**

Energy transfer in an Ecosystem. Food chain, food web, Energy budget, Production & decomposition in a system. Ecological efficiencies, Trophic structure & energy pyramids, Ecological energetic, principles pertaining to limiting factors, Bio-geochemical cycles (N,C,P cycles).

**UNIT-III**

**(18 Periods)**

Pollution & environmental Health related to Soil, Water, Air, Food, Pesticides, Metals, Solvents, Radiations, Carcinogen, Poisons. Detection of Environmental pollutant. Indicators & detection systems. Bio-transformation, Plastic, Aromatics, Hazardous wastes Environmental cleanup : Case studies

**UNIT-IV**

**(10 Periods)**

Environmental biotechnologies, Biotechnologies in protection and preservation of environment. Bioremediation, Waste disposal.

**SUGGESTED READING**

1. Chapman, J.L., Reiss, M.J. 1999. Ecology: Principles and applications (2<sup>nd</sup> edition) Cambridge University Press.
2. Divan Rosencraz, Environmental laws and policies in India, Oxford Publication.
3. Ghosh, S.K., Singh, R. 2003. Social forestry and forest management. Global Vision Publishing House
4. Joseph, B., Environmental studies, Tata Mc Graw Hill.
5. Michael Allabay, Basics of environmental science, Routledge Press.
6. Miller, G.T. 2002. Sustaining the earth, an integrated approach. (5<sup>th</sup> edition) Books/Cole, Thompson Learning, Inc.
7. Mohapatra Textbook of environmental biotechnology IK publication.
8. Rana SVS, Environmental pollution – health and toxicology, Narosa Publication
9. Sinha, S. 2010. Handbook on Wildlife Law Enforcement in India. TRAFFIC, India.
10. Thakur, I S, Environmental Biotechnology, I K Publication.

**Paper code: BBP-311      Core Course Practical-III**

**ANIMAL & PLANT PHYSIOLOGY (LAB I)**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 2**

**Marks for Internal Exam: 30**

**Time: 4Hrs**

**Total Marks: 100**

## **PRACTICALS**

### **A. Plant physiology**

1. Study of enzyme ATPase
2. Demonstration of ascent of sap
3. Sugar and amino acids analysis of phloem sap, with paper chromatography.
4. Determination of Chlorophyll a / b ratio of C3 and C4 plants.
5. Determination of rate of respiration in germinating seeds under aerobic and anaerobic conditions.
6. To demonstrate that oxygen is evolved during photosynthesis
7. To demonstrate that CO<sub>2</sub> and light are necessary for photosynthesis
8. Effect of red and far red light on seed germination and study of photomorphogenesis.
9. Study of enzyme glutamate oxaloacetate transaminase.
10. Study of nitrate reductase in plants.
11. Study of effect of PEG induced water stress on seed germination.
12. Effect of phytohormones on plant growth
13. Separation of chloroplast pigments by chromatography

### **B. Animal physiology**

1. Estimation of Hemoglobin content in the given blood sample.
2. Qualitative identification and quantitative estimation of proteins in the given sample.
3. Qualitative identification and quantitative estimation of. Carbohydrates in the given samples.
4. Qualitative identification of nitrogenous wastes. Viz Ammonia, Urea and Uric acid,
5. Quantitative estimation of ammonia and urea in the given sample.
6. Measurement of Quantitative estimation of unit oxygen consumption in aquatic animals (fish/crab).
7. Effect of temperature on the heartbeat of fresh water mussel.

### **Reference Books:**

1. General and Comparative physiology - Hoar, W.S. Prentice Hall of India, New Delhi.
2. Comparative animal physiology - Professor C.L. and Brown, F.A W.B. Saunders ,Philadelphia.
3. Animal physiology Cambridge university press. Cambridge - Schmidt – Nielsen K.
4. A handbook of Animal physiology - Pantelouris. EMA; W.B. Saunders Co. Philadelphia. Principles
5. of physiology - Hantenstein A, Van NestransRoinheld company, New York.
6. An introduction to general and comparative animal physiology - Flory, E. W.B.Saunders Co.,
7. Philadelphia.

**Paper Code: BCP 301/BBP 312      Generic Course Practical-III**

**CHEMISTRY LAB (INORGANIC CHEMISTRY LAB-I)**

**(4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 2**

**Marks for Internal Exam: 30**

**Time: 4Hrs**

**Total Marks: 100**

**(A) Titrimetric Analysis**

- (i) Calibration and use of apparatus
- (ii) Preparation of solutions of different Molarity/Normality of titrants

**(B) Acid-Base Titrations**

- (i) Estimation of carbonate and hydroxide present together in mixture. (ii) Estimation of carbonate and bicarbonate present together in a mixture. (iii) Estimation of free alkali present in different soaps/detergents

**(C) Oxidation-Reduction Titrimetry**

- (i) Estimation of Fe(II) and oxalic acid using standardized  $\text{KMnO}_4$  solution.
- (ii) Estimation of oxalic acid and sodium oxalate in a given mixture.
- (iii) Estimation of Fe(II) with  $\text{K}_2\text{Cr}_2\text{O}_7$  using internal (diphenylamine, anthranilic acid) and external indicator.

**BOOKS SUGGESTED:**

1. Mendham, J., A. I. Vogel's *Quantitative Chemical Analysis 6th Ed.*, Pearson, 2009.

## SEMESTER-IV

**Paper Code: BBL-401**

**Core Course-VII**

**BASIC MICROBIOLOGY**

**(4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**Unit-I**

History, scope and significance of Microbiology, Cell structure of prokaryotic and eukaryotic cell. Comparison of the structure and function of each component of eubacterial cell and archeobacteria. Biosynthesis of bacterial cell wall. General characters of Fungi (Yeast, Dermatophytes, and opportunistic pathogens), Algae (Cynobacteria, Chlorella), Protozoa (Entamoeba, Plasmodium). Principles of bacterial taxonomy, classification of bacteria and general characteristics of each group including Rickettsia, Pplo and Chlamydiae.

**Unit-II**

Nature and general properties of viruses – Classification, nomenclature of RNA and DNA viruses, Principles of virus structure, chemical composition and general steps in replication of viruses. General methods of cultivation, purification, detection and quantification of bacterial, animal and plant viruses. Prions and Virusoids, viroids, satellite and defective virus practices.

**Unit-III**

**Microbiological techniques:** Sterilization and disinfection – Physical and chemical methods. Isolation of pure cultures. Cultivation of aerobic and anaerobic microbes. Media for growth of microorganisms (bacteria, fungi, algae). Preservation and maintenance of cultures. Methods of identification of bacteria. Nutrition and growth: nutritional groups of bacteria (autotrophy and heterotrophy). Nutritional mutants and their use in metabolic studies. Growth cycle of bacteria, estimation of bacterial growth, factors influencing growth (physical and chemical), synchronous culture and continuous culture and continuous growth of microbes.

**Unit-IV**

**Modes of gene transfer in bacteria-** Conjugation, transformation and transduction, **Recombination in bacteria-** Homologous recombination, transpositional recombination and site-specific recombination.

**Environmental Microbiology-** Nitrogen cycle, Regulation of nif and nod genes, Carbon Cycle, Sulphur cycle and Phosphorous cycle.

**Industrial Microbiology-** Brief outline and type of reactions in fermentation, production of alcohol, citric acid and vinegar, production of amino acids(Glu, Asp, Lys, Phe and His), Production of vitamins( Riboflavin, Vitamin B12 and carotenoids), Production of penicillin and streptomycin .

**Books/Authors**

1. Microbiology. Prescott L, . M., Harley, J. and Klein, D .A
2. Stainer R.Y. Adelberg, E.A., Ingrham J.L. General Microbiology. 4<sup>th</sup> ed. Macmillan, 1976.
3. Davis, B.D. Dulbecco, R.Eisen, H.N., Ginsberg H.S Microbiology Harper & Row publishers 1980.
4. Pelczar, M.L.Chan, E.C.S. Krieg, N.R. Microbiology, Mc Graw-Hill Book Company, 1986.
5. Freeman B.A. Burrows Text book of Microbiology Saunders HB Company, 1985.
6. Joklik, W.K., Willet H.P., Amos, D.B. and Wilfert C.M. Zinssers Microbiology, 19<sup>th</sup> ed. Prentice- Hall International Inc. 1988.
7. Paul J. Vandemark, Barry L. Bartzing th microbes. The Benjamin/ cummings publishing company, Inc.1987.
8. Lansing M. Prescott, John P.Harley, Donald. A.Klein, Microbiology, 3<sup>rd</sup> edition brown publishers, 1996.

**MICROBIAL PHYSIOLOGY****60 Hrs (4Hrs /week)****Marks for Major Test (External): 70****Credits: 4****Marks for Internal Exam: 30****Time: 3Hrs****Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**UNIT I****(12 Periods)**

Nutritional classification of microorganisms based on carbon, energy and electron sources, Metabolite Transport, Diffusion: Passive and facilitated, Primary active and secondary active transport, Group translocation (phosphotransferase system), symport, antiport and uniport, electrogenic and electro neutral transport, transport of Iron.

**UNIT II****(13 Periods)**

Microbial Growth. Definition of growth, balanced and unbalanced growth, growth curve, the mathematics of growth-generation time, specific growth rate, batch and continuous culture, synchronous growth, diauxic growth curve. Measurement of microbial growth. Measurement of cell numbers, cell mass and metabolic activity.

**UNIT III****(15 Periods)**

Effect of the environment on microbial growth Temperature- temperature ranges for microbial growth, classification based on temperature ranges and adaptations, pH-classification based on pH ranges and adaptations, solutes and water activity, oxygen concentration, radiation and pressure. Chemolithotrophic metabolism, Physiological groups of aerobic and anaerobic chemolithotrophs. Hydrogen oxidizing bacteria and methanogens.

**UNIT IV****(20 Periods)**

Phototrophic metabolism. Historical account of photosynthesis, diversity of phototrophic bacteria, anoxygenic and oxygenic photosynthesis, photosynthetic pigments: action and absorption spectrum, type, structure and location, physiology of bacterial photosynthesis: light reactions, cyclic and non-cyclic photophosphorylation. Carbon dioxide fixation, Calvin cycle and reductive TCA cycle.

**SUGGESTED READING**

1. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag
2. Madigan MT, Martinko JM and Parker J. (2003). Brock Biology of Microorganisms. 10th edition. Pearson/ Benjamin Cummings.
3. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons.
4. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India.
5. Stanier RY, Ingraham JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5<sup>th</sup> edition, McMillan Press.
6. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

Paper Code: BCL-401/BBL-403      Core Course-IX

## INORGANIC CHEMISTRY-II (PERIODIC PROPERTIES OF ELEMENTS)

60 Hrs (4Hrs /week)

Marks for Major Test (External): 70

Credits: 4

Marks for Internal Exam: 30

Time: 3Hrs

Total Marks: 100

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

### UNIT-I

#### Chemistry of *s* and *p* Block Elements

15 Hrs

Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Complex formation tendency of *s* and *p* block elements.

Hydrides and their classification ionic, covalent and interstitial. Basic beryllium acetate and nitrate.

### UNIT-II

#### Chemistry of *p* Block Elements

15 Hrs

Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses.

Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes and graphitic compounds, silanes, Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acids of sulphur, interhalogen compounds, polyhalide ions, pseudohalogens and basic properties of halogens.

### UNIT-III

#### Transition Elements

15Hrs

General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, and ability to form complexes.

Stability of various oxidation states and e.m.f. (Latimer & Bsworth diagrams). Difference between the first, second and third transition series.

Chemistry of Ti, V, Cr Mn, Fe and Co in various oxidation states (excluding their metallurgy)

### UNIT-IV

#### Lanthanides and Actinides

7 Hrs

Electronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanide contraction, separation of lanthanides (ion-exchange method only).

#### Noble Gases

8Hrs

Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of XeF<sub>2</sub>, XeF<sub>4</sub> and XeF<sub>6</sub>; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF<sub>2</sub>). Molecular shapes of noble gas compounds (VSEPR theory).



### BOOKS SUGGESTED:

1. Lee, J.D. *Concise Inorganic Chemistry*, ELBS, 1991.
2. Douglas, B.E; Mc Daniel, D.H. & Alexander, J.J. *Concepts & Models of Inorganic Chemistry 3<sup>rd</sup>Ed.*, John Wiley Sons, N.Y. 1994.
3. Greenwood, N.N. & Earnshaw. *Chemistry of the Elements*, Butterworth-Heinemann. 1997.
4. Cotton, F.A. & Wilkinson, G. *Advanced Inorganic Chemistry*, Wiley, VCH, 1999.
5. Rodger, G.E. *Inorganic and Solid State Chemistry*, Cengage Learning India, Edition, 2002.
6. Miessler, G. L. & Donald, A. Tarr. *Inorganic Chemistry 4<sup>th</sup> Ed.*, Pearson, 2010.
7. Atkin, P. *Shriver & Atkins' Inorganic Chemistry 5<sup>th</sup> Ed.* Oxford University Press (2010).

Paper code: BCL-402/BBL-404 Core Course –X

**ORGANIC CHEMISTRY-II (Functional Group Chemistry)**

**60 Hrs (4Hrs /week)**

**Credits: 4**

**Time: 3Hrs**

**Marks for Major Test (External): 70**

**Marks for Internal Exam: 30**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**UNIT-I**

**Alcohols, Phenols, Ethers and Epoxides**

**15 Hrs**

*Alcohols:* preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouvaelt-Blanc Reduction; Preparation and properties of glycols: Oxidation by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement;

*Phenols:* Preparation and properties; Acidity and factors effecting it, Ring substitution reactions, Reimer-Tiemann and Kolbe's-Schmidt Reactions, Fries and Claisen rearrangements with mechanism.

*Ethers and Epoxides:* Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and LiAlH<sub>4</sub>

**UNIT-II**

**Carbonyl Compounds**

**15 Hrs**

Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer Villiger oxidation, oxidations and reductions (Clemmensen, Wolff-Kishner, LiAlH<sub>4</sub>, NaBH<sub>4</sub>, MPV, PDC and PGC); Addition reactions of unsaturated carbonyl compounds: Michael addition.

Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.

**UNIT-III**

**Carboxylic Acids and their Derivatives**

**15 Hrs**

Preparation, physical properties and reactions of monocarboxylic acids: Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids: succinic/phthalic, lactic, malic, tartaric, citric, maleic and fumaric acids. Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic substitution at acyl group- Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann-bromamide degradation and Curtius rearrangement.

**Sulphur containing compounds:**

Preparation and reactions of thiols, thioethers and sulphonic acids.

## UNIT-IV

### Nitrogen Containing Functional Groups

15 Hrs

Preparation and important reactions of nitro and compounds, nitriles and isonitriles Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid.

Diazonium Salts: Preparation and their synthetic applications.

### BOOKS SUGGESTED:

1. Morrison, R. T., Boyd, R. N. & Bhattacharjee S. K. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Graham Solomons, T.W. *Organic Chemistry*, John Wiley & Sons, Inc.
4. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7<sup>th</sup> Ed. Cengage Learning India Edition, 2013.
5. Carey, F. A. & Sundberg R. J. *Advanced Organic Chemistry, Part A: Structure and Mechanism*, Springer.
6. Carey, F. A. & Sundberg R. J. *Advanced Organic Chemistry, Part B: Reactions and Synthesis*, Springer.

## LECTIVE COURSES-II

(Any one out of 02 Course Code BBL405-EC-(II), BBL406-EC-II)

Paper Code: BBL-405- EC-II

### BIOTECHNOLOGY AND HUMAN WELFARE

30 Hrs (2Hrs /week)

Marks for Major Test (External): 70

Credits: 2

Marks for Internal Exam: 30

Time: 3Hrs

Total Marks: 100

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and on compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type question each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

#### UNIT I

Industry: protein engineering; enzyme and polysaccharide synthesis, activity and secretion, alcohol and antibiotic formation.

#### UNIT II

Agriculture: N<sub>2</sub> fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; qualitative improvement of livestock.

#### UNIT III

Environments: e.g. chlorinated and non-chlorinated organ pollutant degradation; degradation of hydrocarbons and agricultural wastes, stress management, development of biodegradable polymers such as PHB..

#### UNIT IV

Forensic science: e.g. solving violent crimes such as murder and rape; solving claims of paternity and theft etc. using various methods of DNA finger printing.

Health: e.g. development of non- toxic therapeutic agents, recombinant live vaccines, gene therapy, diagnostics, monoclonal in *E.coli*, human genome project.

#### SUGGESTED READING

1. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.
2. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international publishers

**Paper code: BBL-406-EC- II**

## **EVOLUTIONARY BIOLOGY**

**30 Hrs**

**(2Hrs**

**/week)**

**Credits:2**

**Time: 3Hrs**

**Marks for Major Test (External): 70**

**Marks for Internal Exam: 30**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type question each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**Unit 1. Introduction :** Lamarckism, Darwinism, Neo-Darwinism

**Life's beginning:** An overview (chemogeny, biogeny, the RNA World)

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**Unit 2. Evidences of evolution:** Paleontological evidences. Molecular evidences, Phylogeny of hor  
**Process of evolutionary change:** Organic variations, Population genetics, Natural selection

**Unit 3.**

**Products of evolutionary change:** Species concept,  
Isolating mechanisms and modes of speciation

**Extinction and mass extinction**

**Unit 4. Origin and evolution of man**

**Phylogenetic trees:** Multiple sequence alignment,  
Construction of Phylogenetic tree, Interpretation of trees.

### **SUGGESTED BOOKS**

1. Ridley, M. (2004) Evolution. III Edition. Blackwell Publishing
  2. Barton, N. H., Briggs, D.E.G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring Harbour Laboratory Press.
  3. Hall, B.K. and Hallgrimsson, B. (2008) Evolution. IV Edition. Jones and Bartlett Publishers
- Pevsner, J. (2009) Bioinformatics and functional genomics. II Edition. Wiley-Blackwell

**SKILL ENHANCEMENT COURSES-II**  
(Any one per semester)

**Paper Code: BBL-407-SEC-II INDUSTRIAL & ENVIRONMENTAL BIOTECHNOLOGY**

**30 Hrs (2Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 2**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and on compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type question each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**Unit - 1**

Principles of Microbial growth – introduction, the ways of growing microorganisms, ways to increase yield of microbes, Batch, fed-batch and continuous cultures (definition and kinetics).

Bioreactor / Fermenter – types, working & operation of Bioreactors, Fermenters (Stirred tank, bubble columns, airlift. Bioreactors, Static, Submerged and agitated fermentation), advantages & disadvantages of solid substrate & liquid fermentations. Upstream processing (Strain selection, Sterilization), Downstream processing – extraction, separation, concentration, recovery & purification, operations (Insulin, Vitamins, Metabolites).

**Unit - 2**

Biotechnology in specific medical & industrial applications - Retting of jute, microbial process for immunization (Production of monoclonal antibodies), Deterioration of paper, textiles, painted surfaces and their prevention, Biofilms, microbial biopolymers, biosurfactants, Microbial culture selection with high yield potential.

**Unit - 3**

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, Conversion of sugar to alcohol Gasohol.

**Unit - 4**

Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents. Degradation of lignin and cellulose using microbes. Phyto-remediation. Degradation of pesticides and other toxic chemicals by microorganisms- degradation aromatic and chlorinated hydrocarbons and petroleum products.

Treatment of municipal waste and Industrial effluents. Bio-fertilizers. Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil. Algal and fungal biofertilizers (VAM), Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium). Environmental significance of genetically modified microbes, plants and animals.

**Suggested Readings**

1. Sullia S. B& Shantharam S: (1998) General Microbiology, Oxford & IBH Publishing Co. Pvt. Ltd.
2. Glaser A.N & Nilaido.H (1995) Microbial Biotechnology, W.H Freeman & Co.
3. Prescott & Dunn (1987) Industrial Microbiology 4th Edition, CBS Publishers & Distributors.
4. Prescott & Dunn (2002) Industrial Microbiology, Agrobios (India) Publishers.
5. Crueger W. & Crueger A. (2000) A text of Industrial Microbiology, 2nd Edition, Panima Publishing Corp.
6. Stanbury P.F, Ehitaker H, Hall S.J (1997) Principles of Fermentation Technology., Aditya Books (P) Ltd.
7. Waste Water Engineering, Metcalf and Eddy, Tata McGraw hill
8. Environmental Microbiology : Methods and Protocols, Alicia L. Ragout De Spencer, John F.T. Spencer
9. Introduction to Environmental Biotechnology, Milton Wainwright
10. Principles of Environmental Engineering, Gilbert Masters
11. Waste water Engineering – Metcalf & Eddy

**Paper Code: BBL-408-SEC-II AGRO & INDUSTRIAL BIOTECHNOLOGY**

**30 Hrs (2Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 2**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and on compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type question each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**A. PLANT BIOTECHNOLOGY**

**UNIT I Plant Tissue Culture.**

Methods of plant micro propagation. Plant tissue culture techniques. Ovary and ovule culture. In vitro pollination and fertilization. Embryo culture. Embryogenesis and organogenesis and their practical applications Micropropagation of elite species. Axillary bud, shoot tip and meristem culture.

Haploids and their application Somaclonal. Application and variation. Single cell cultures and their application in selection of variant/mutant with or without mutagen treatment.

**UNIT II**

Introduction to protoplast isolation and regeneration and its application. Various methods of fusing protoplasts-chemical, electrical. Somatic hybridization. Introduction. Practical applications. Use of markers for selection of hybrid cells.

**UNIT III**

Use of plant cell, protoplasts and tissue culture for genetic manipulation of plants. methods of gene transfer into plant cells. Vectors. Transformation techniques. Crop improvement and development of transgenic plants. Gene-gun.

Single cell protein. SCP from waste, agricultural crops and algae. Economic implication of SCP. Biofertilizers Mycorrhizae.

**B. ANIMAL BIOTECHNOLOGY**

**Unit IV**

Gene constructs Promoters, reporter and marker genes. Vector for gene transfer into animal cells. Transfection methods. Embryonic stem cell transfer. Targeted gene transfer. Detection of transgenics and transgene function. Transgenic animals.

**C. MARINE BIOTECHNOLOGY**

**Books/Authors:**

1. Biotechnology and genomics Gupta, .P.K.
2. Plant Biotechnology. Doods
3. A text Book of Biotechnology Kumar, .H.D.
4. Molecular Biology and Genetic engineering. Gupta, P.K.
5. Biotechnology. Singh, B.D.
6. Gene Biotechnology Jogdand, .S.N.
7. Fundamentals of Genetics. Singh. B. D. 2004. Kayani Publishers. New Delhi

**Paper Code: BBL-409-SEC-II FOOD BIOTECHNOLOGY**

**30 Hrs (2Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 2**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**UNIT- I**

Introduction to food processing biotechnology in relation to the food industry, nutritive value of food. Microorganisms associated with food, its sources, types and behavior in foods. Contamination of foods by pesticides, fertilizers, industrial waste and chemical contaminants. Principles underlying food spoilage: chemical, physical and physiological changes caused by microorganisms. Control measures for food poisoning.

**UNIT- II**

Food Preservation: Bioprocessing of meat, fisheries, vegetables, dairy products, enzymes and chemicals used in food processing, biochemical engineering for flavour and food production, cryopreservation, irradiated foods. Fermented Food Products. Dairy products. non-beverage plant products, beverages and related products of baking. Quality Control, case studies on Biotechnology in the evolution of food quality. Food Spoilage & Food Borne Diseases

**UNIT- III**

Utilization of microorganisms in food Industry, Single cell protein, Nutraceuticals, Natural and artificial sweeteners and their role in controlling diseases and deficiencies.

**UNIT –IV**

Industrial cultures– Bacteria, Algae, Fungi, Actinomycetes; Primary and secondary screening of microorganisms for industrial products. Isolation and preservation of microorganisms for industrial products. Production of microbial products-organic acids (citric acid), amino acids (aspartic acid), alcohols and beverages (ethanol), enzymes (proteases) antibiotics (penicillin), vaccines (BCG), vitamins (B12) and dairy products (cheese).

Nitrogen fixation and mass production of biofertilizers - diazotrophic microorganisms, Biochemical aspects of diazotrophy. Genetics of free living and symbiotic diazotrophs. Blue Green Algae and Azolla, Mycorrhizae. Vermiculture, Mass cultivation of commercially valuable macro and micro algae for agar agar, alginates, single cell protein and other products.

**BOOKS RECOMMENDED**

1. Roger A., Gordan B., and John T., Food Biotechnology, 1989.
2. Frazier, Food Microbiology,



**Paper Code: BCP-402/ BBP 410                      Core course Practical IV**

**ORGANIC CHEMISTRY LAB-II**

**60 Hrs (4Hrs /week)**

**Credits: 2**

**Time: 4 Hrs**

**Marks for Major Test (External): 70**

**Marks for Internal Exam: 30**

**Total Marks: 100**

1. Detection of extra elements (N, S, Halogens).
2. Functional group test for nitro, amine and amide groups.
3. Qualitative analysis of unknown organic compounds containing following functional groups: alcohol, carboxylic acid, phenol and carbonyl groups.

**BOOKS SUGGESTED:**

1. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education(2009)
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.*, Pearson (2012)
3. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis*, University Press (2000).
4. Ahluwalia, V.K. & Dhingra, S. *Comprehensive Practical Organic Chemistry: Qualitative Analysis*, University Press (2000).

**Paper code: BBP- 411 Core Course Practical V**

**BASIC MICROBIOLOGY LAB**

**60 Hrs (4Hrs /week)**

**Credits: 2**

**Time: 4 Hrs**

**Marks for Major Test (External): 70**

**Marks for Internal Exam: 30**

**Total Marks: 100**

**PRACTICALS**

1. Isolation of bacteria & their biochemical characterization.
2. Staining methods: simple staining, Gram staining, spore staining, negative staining, hanging drop.
3. Preparation of media & sterilization methods, Methods of Isolation of bacteria from different sources.
4. Determination of bacterial cell size by micrometry.
5. Enumeration of microorganism - total & viable count.

**SUGGESTED READING**

1. Alexopoulos CJ, Mims CW, and Blackwell M. (1996). *Introductory Mycology*. 4 th edition. John and Sons, Inc.
2. Jay JM, Loessner MJ and Golden DA. (2005). *Modern Food Microbiology*. 7th edition, CBS Publishers and Distributors, Delhi, India.
3. Kumar HD. (1990). *Introductory Phycology*. 2nd edition. Affiliated East Western Press.
4. Madigan MT, Martinko JM and Parker J. (2009). *Brock Biology of Microorganisms*. 12th edition. Pearson/Benjamin Cummings.
5. Pelczar MJ, Chan ECS and Krieg NR. (1993). *Microbiology*. 5th edition. McGraw Hill Book Company.
6. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). *General Microbiology*. 5th edition. McMillan.
7. Tortora GJ, Funke BR, and Case CL. (2008). *Microbiology: An Introduction*. 9 th edition. Pearson Education.
8. Willey JM, Sherwood LM, and Woolverton CJ. (2008). *Prescott, Harley and Klein's Microbiology*. 7th edition. McGraw Hill Higher Education.

## **SEMESTER-V**

**Paper Code: BBL-501**

**Core course -XI**

## **GENETICS**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

### **Unit - I**

Mendelism & Chromosome Theory – Mendel's principles, applications of Mendel's principles, chromosome Theory of Heredity (Sutton-Boveri), Inheritance patterns, phenomenon of Dominance, Inheritance patterns in Human (Sex-linked & Autosomal).

### **Unit - II**

Linkage & Crossing over - Chromosome theory of Linkage, kinds of linkage, linkage groups, Genetic mapping, Relationship between Linkage & Crossing over, mechanism of Meiotic Crossing over, Types and mechanism of Crossing over, significance of Crossing over.

### **Unit - III**

Non-Mendelian inheritance – Evidences for Cytoplasmic factors, cytoplasmic inheritance, extranuclear inheritance (mitochondrial, chloroplast), maternal inheritance.

### **Unit - IV**

Chromosomal variation in Number & Structure – Euploidy, Non-disjunction & Aneuploidy, Aneuploidy in Human, Induced Polyploidy, applications of Polyploidy.

Human Genetics: Karyotype, banding, nomenclature of chromosome subdivisions. Genetic disorders. Down, Turner and Klinefelter syndromes, chronic myeloid leukemia, cry of cat syndrome, cystic fibrosis.

### **Suggested Readings**

1. Genetics: Strickberger MW
2. Genetics Analysis by Griffiths and Suzuki
3. Genetics: Instant notes series
4. Genetics: Hartl and Jones
5. Genetics: Gupta PK
6. Genetics: Gardner
7. Microbial Genetics: David Friefelder
8. Gene IX: Lewin Benjamin

**Paper Code: BBL-502**

**Core course -XII**

## **DEVELOPMENTAL BIOLOGY**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

### **UNIT I: Gametogenesis and Fertilization**

**(10 Periods)**

Definition, scope & historical perspective of development Biology, Gametogenesis – Spermatogenesis, Oogenesis Fertilization - Definition, mechanism, types of fertilization. Different types of eggs on the basis of yolk.

### **UNIT II: Early embryonic development**

**(20 Periods)**

Cleavage: Definition, types, patterns & mechanism Blastulation: Process, types & mechanism Gastrulation: Morphogenetic movements– epiboly, emboly, extension, invagination, convergence, de-lamination. Formation & differentiation of primary germ layers, Fate Maps in early embryos.

### **UNIT III: Embryonic Differentiation**

**(20 Periods)**

Differentiation: Cell commitment and determination- the epigenetic landscape: a model of determination and differentiation, control of differentiation at the level of genome, transcription and post-translation level Concept of embryonic induction: Primary, secondary & tertiary embryonic induction, Neural induction and induction of vertebrate lens.

### **UNIT IV: Organogenesis**

**(10 Periods)**

Neurulation, notogenesis, development of vertebrate eye. Fate of different primary germ layers Development of behaviour: constancy & plasticity, Extra embryonic membranes, placenta in Mammals.

## **SUGGESTED READING**

1. Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
2. Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.
3. Kalthoff, (2000). Analysis of Biological Development, II Edition, McGraw-Hill Professional.

**INORGANIC CHEMISTRY-III (COORDINATION CHEMISTRY)**

60 Hrs (4Hrs /week)

Marks for Major Test (External): 70

Credits: 4

Marks for Internal Exam: 30

Time: 3Hrs

Total Marks: 100

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**UNIT-I****Coordination Chemistry-I****15 Hrs**

Werner's theory, valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding. Crystal field theory, measurement of  $10 Dq$  ( $\Delta_o$ ), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of  $10 Dq$  ( $\Delta_o$ ,  $\Delta_t$ ). Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar geometry. Qualitative aspect of Ligand field and MO Theory.

**UNIT-II****Coordination Chemistry-II****15Hrs**

IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect, polynuclear complexes, Labile and inert complexes- Thermodynamic & Kinetic stability.

**UNIT-III****Reaction Kinetics and Mechanism****15 Hrs**

Introduction to inorganic reaction mechanisms. Substitution reactions in square planar complexes, Trans-effect, theories of trans effect, Mechanism of nucleophilic substitution in square planar complexes, Thermodynamic and Kinetic stability, Kinetics of octahedral substitution, Ligand field effects and reaction rates, Mechanism of substitution in octahedral complexes.

**UNIT-IV****Bioinorganic Chemistry****15 Hrs**

Metal ions present in biological systems, classification of elements according to their action in biological system. Geochemical effect on the distribution of metals. Sodium / K-pump, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine.

Iron and its application in bio-systems, Haemoglobin; Storage and transfer of iron.

**BOOKS SUGGESTED:**

1. Purcell, K.F & Kotz, J.C. *Inorganic Chemistry* W.B. Saunders Co, 1977.
2. Huheey, J.E., *Inorganic Chemistry*, Prentice Hall, 1993.
3. Lippard, S.J. & Berg, J.M. *Principles of Bioinorganic Chemistry* Panima Publishing Company 1994.
4. Cotton, F.A. & Wilkinson, G, *Advanced Inorganic Chemistry* Wiley-VCH, 1999.
5. Basolo, F, and Pearson, R.C. *Mechanisms of Inorganic Chemistry*, John Wiley & Sons, NY, 1967.
6. Greenwood, N.N. & Earnshaw A. *Chemistry of the Elements*, Butterworth-Heinemann, 1997.

**Paper Code: BCL-504/BBL-504**

**Course Course-XIV**

**PHARMACEUTICAL CHEMISTRY**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**UNIT-I**

**15 Hrs**

Physiochemical aspects of Drug action- Stereochemical aspects of drug action (Optical, geometric and bioisomerism of drug molecules with biological action), conformational isomerism, solubility and partition coefficient, chemical bonding. Drug receptor, Drug receptor interactions, receptor- effector theories, types of receptor and their action including transduction mechanism and G proteins. Principles of drug design (Theoretical aspects).

**UNIT-II**

**15 Hrs**

Classification, structure and therapeutic uses of antipyretics: Paracetamol (with synthesis),

Analgesics: Ibuprofen (with synthesis), Antimalarials: Chloroquine (with synthesis). An elementary treatment of Antibiotics and detailed study of chloramphenicol, and antacid (ranitidine). Antibacterial and antifungal agents (Sulphonamides, Sulphanethoxazol, Sulphacetamide, Trimethoprim).

Medicinal values of curcumin (haldi), azadirachtin (neem).

**UNIT-III**

**15 Hrs**

Synthesis of the representative drugs of the following classes: Central Nervous System agents (Phenobarbital, Diazepam), Cardiovascular (Glyceroltrinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine), antiviral agents (Acyclovir).

**UNIT-IV**

**15 Hrs**

Fermentation: Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin (iii) Lysine, Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C.

**BOOKS SUGGESTED:**

1. Patrick, G. L. Introduction to Medicinal Chemistry, Oxford University Press, UK, 2013.
2. Singh, H. & Kapoor, V.K. Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, Pitampura, New Delhi, 2012.
3. Foye, W.O., Lemke, T.L. & William, D.A.: Principles of Medicinal Chemistry, 4th ed., B.I. Waverly Pvt. Ltd. New Delhi

## DISCIPLINE SPECIFIC ELECTIVE-I

**Paper Code: BBL-505-DSE-I ANIMAL DIVERSITY I**  
**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

### UNIT I

**(15 Periods)**

- a. Outline of classification of Non- Chordates upto subclasses. Coelomata, Acoelomata, Symmetries, Deutrostomes, Protostomes.
- b. Protozoa: Locomotion, Reproduction, evolution of Sex, General features of *Paramecium* and *Plasmodium*. Pathogenic protozoans Porifera: General characters, outline of Classification; skeleton, Canal System

### UNIT II

**(15 Periods)**

- a. Coelenterata: General Characters, Outline of classifications Polymorphism, Various types of stinging cells; Metagenesis, coral reefs and their formation.
- b. Platyhelminthes- General Characters; Outline of classification; Pathogenic flatworms: Parasitic adaptations.
- c. Aschelminthes: General features, Outline of classification, Pathogenic roundworms and their vectors in relation to man: Parasite adaptation.

### UNIT III

**(15 Periods)**

- a. Annelida: - General features, Outline of classification, Coelom: Metameric segmentation, General features of Earthworm, Vermicomposting.
- b. Arthropoda: General Features, Outline of Classification; Larval forms of crustacean, Respiration in Arthropoda; Metamorphosis in insects; Social insects; Insect vectors of diseases; Apiculture, Sericulture.

### UNIT IV

**(15 Periods)**

- a. Mollusca : general features, Outline of classification, Shell Diversity; Torsion in gastropoda,
- b. Echinodermata: General features, Outline of Classification Larval forms
- c. Hemichordata: Phylogeny: Affinities of *Balanoglossus*

### SUGGESTED READING

1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. & J.I., Spicer (2002) The Invertebrates: A New Synthesis. III Edition. Blackwell Science.
2. Barrington, E.J.W. (1979) Invertebrate Structure and Functions. II Edition. E.L.B.S. and Nelson.
3. Boradale, L.A. and Potts, E.A. (1961) Invertebrates: A Manual for the use of Students. Asia Publishing Home.
4. Bushbaum, R. (1964) Animals without Backbones. University of Chicago Press.
5. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-HillCompanies.



**Paper Code: BBL-506-DSE-I MEDICAL MICROBIOLOGY**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**UNIT I**

**(15Periods)**

Introduction: Normal microflora of human body, nosocomial infections, carriers, septic shock, septicemia, pathogenicity, virulence factors, toxins, biosafety levels.

Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy of gram positive bacteria: *S.aureus*, *S.pyogenes*, *B.anthraxis*, *C.perferinges*, *C.tetani*, *C.botulinum*, *C.diphtheriae* *M.tuberculosis*, *M. leprae*.

**UNIT II**

**(15 Periods)**

Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy caused by gram negative bacteria: *E.coli*, *N. gonorrhoea*, *N. meningitidis*, *P. aeruginosa*, *S. typhi*, *S. dysenteriae*, *Y. pestis*, *B. abortus*, *H. influenzae*, *V. cholerae*, *M. pneumoniae*, *T. pallidum* *M. pneumoniae*, *Rickettsiaceae*, *Chlamydiae*.

**UNIT III**

**(12 Periods)**

Diseases caused by viruses- Picornavirus, Orthomyxoviruses, Paramyxoviruses, Rhabdoviruses, Reoviruses, Pox virus, Herpes virus, Papova virus, Retro viruses (including HIV/AIDS) and Hepatitis viruses.

**UNIT IV**

**(15 Periods)**

Fungal and Protozoan infections. Dermatophytoses (*Trichophyton*, *Microsporun* and *Epidermophyton*) Subcutaneous infection (*Sporothrix*, *Cryptococcus*), systemic infection (*Histoplasma*, *Coccidoides*) and opportunistic fungal infections (*Candidiasis*, *Aspergillosis*), Gastrointestinal infections (Amoebiasis, Giardiasis), Blood-borne infections (Leishmaniasis, Malaria)

**SUGGESTED READINGS**

1. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.
2. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier. .
3. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

**Paper Code: BBL-507-DSE-I BIOINFORMATICS**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

#### **UNIT I**

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. **(10 Periods)**

#### **UNIT II**

Protein Information Sources, PDB, SWISSPROT, TREMBL, Understanding the structure of each 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. **(20 Periods)**

#### **UNIT III**

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. **(20 Periods)**

#### **UNIT IV**

Searching Databases: SRS, Entrez, Sequence Similarity Searches-BLAST, FASTA, Data Submission.

Genome Annotation: Pattern and repeat finding, Gene identification tools. **(10 Periods)**

#### **SUGGESTED READING**

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

## DISCIPLINE SPECIFIC ELECTIVE-II

**Paper Code: BBL-508-DSC- (II) PLANT DIVERSITY I**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

### UNIT I

**Algae: (20 Periods)**

General character, classification and economic importance. Life histories of algae belonging to various classes: Chlorophyceae – *Volvox*, *Oedogonium* Xantho phyceae – *Vaucheria* Phaeophyceae – *Ectocarpus* Rhodophyceae-*Polysiphonia*

### UNIT II

**Fungi: (20 Periods)**

General characters, classification & economic importance. Life histories of Fungi: Mastigomycotina- *Phytophthora* Zygomycotina- *Mucor* Ascomycotina- *Saccharomyces* Basidomycotina-*Agaricus* Deutromycotina-*Colletotrichum*

### UNIT III

**Lichens : (10 Periods)**

Classification, general structure, reproduction and economic importance. Plant diseases: 4 of 36. Casual organism, symptoms and control of following plant diseases. Rust & Smut of Wheat. White rust of Crucifers. Late blight of Potato. Red rot of Sugarcane. Citrus Canker.

### UNIT IV

**Bryophytes: (10 Periods)**

General characters, classification & economic importance. Life histories of following: *Marchantia*. *Funaria*.

### SUGGESTED READING

1. Agrios, G.N. 1997 Plant Pathology, 4<sup>th</sup> edition, Academic Press, U.K.
2. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. 1996 Introductory Mycology, 4<sup>th</sup> edition, John Wiley and Sons (Asia) Singapore.
3. Bold, H.C. & Wayne, M.J. 1996 (2<sup>nd</sup>Ed.) Introduction to Algae.
4. Kumar, H.D. 1999. Introductory Phycology. Aff. East-West Press Pvt Ltd., Delhi.
5. Lee, R.E. 2008. Phycology, Fourth Edition, Cambridge University Press, USA.
6. Sambamurty 2008 A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany. IK International Publishers.
7. Shaw, A.J. and Goffinet, B. 2000 Bryophyte Biology. Cambridge University Press.
8. Van den Hoek, C.; Mann, D.J. & Jahns, H.M. 1995. Algae: An introduction to Phycology. Cambridge Univ. Press.
9. Vander-Poorter 2009 Introduction to Bryophytes. COP.
- (iv) Webster, J. and Weber, R. 2007 Introduction to Fungi. 3<sup>rd</sup> edition, Cambridge University Press, Cambridge.
- (v) Wickens, G.E. 2004 Economic Botany: Principles and Practices, Springer. Kuwer Publishers, Dordrecht, The Netherlands

**Paper Code: BBL-509-DSC- (II) ENVIRONMENTAL BIOTECHNOLOGY**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**UNIT I**

**(18 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, Conversion of sugar to alcohol Gasohol.

**UNIT II**

**(20 Periods)**

Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents. Degradation of lignin and cellulose using microbes. Phyto-remediation. Degradation of pesticides and other toxic chemicals by micro-organisms- degradation aromatic and chlorinated hydrocarbons and petroleum products.

**UNIT III**

**(15 Periods)**

Treatment of municipal waste and Industrial effluents. Bio-fertilizers

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

**UNIT IV**

**(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 and Jesef 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

**Paper Code: BBL-510-DSC- (II) BIOSTATISTICS**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**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**

**(18 Periods)**

Probability classical & axiomatic definition of probability, Theorems on total and compound probability), Elementary ideas of Binomial, Poisson and Normal distributions.

**UNIT III**

**(18 Periods)**

Methods of sampling, confidence level, critical region, testing of hypothesis and standard error, large sample test and small sample test. Problems on test of significance, t-test, chi-square test for goodness of fit and analysis of variance (ANOVA)

**UNIT IV**

**(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™ 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 and Sons Inc.

**Paper Code: BBP-511 Core Course Practical-VI**

**BIOLOGY LAB**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

1. Demonstration of chromosomal (structural and numerical) aberrations
2. Study of polytene chromosomes (lamp brush chromosomes and giant chromosomes).
3. Karyotypic study.
4. Effect of colchicine on chromosomes
5. Demonstration of Mendelian laws using color marbles or beads
6. Evaluation of segregation and random assortment using Chi square test or test of fitness.
7. Construction of genetic maps based on Problems in two and three factor crosses
8. Estimation of acid phosphatase levels in Tad pole tails
9. Types of anthers
10. Types of stigmas
11. Anther development in plants
12. Stages of megasporogenesis
13. Endosperm types
14. One and two dimensional separation of protein.
15. Scanning and image analysis of 2-D gels.
16. Spectral analysis of proteins.
17. Computer assisted demonstration of microarray technology: DNA and protein
18. Liposome preparation.

**SUGGESTED BOOKS:**

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). VIII ed. Principles of Genetics. Wiley India.
2. Karp, G. 2010 Cell and Molecular Biology: Concepts and Experiments. 6<sup>th</sup> edition. John Wiley & Sons. Inc.
3. De Robertis, E.D.P. and De Robertis, E.M.F. 2006 Cell and Molecular Biology. 8<sup>th</sup> edition. Lippincott Williams and Wilkins, Philadelphia.
4. Cooper, G.M. and Hausman, R.E. 2009 The Cell: A Molecular Approach. 5<sup>th</sup> edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
5. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
6. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. XI Edition. Benjamin Cummings.
7. Russell, P. J. (2009). *i*Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
8. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis. W. H. Freeman and Co.

**Paper code: BCP-501/BBP-512      Core Course Practical-VII**

**INORGANIC CHEMISTRY LAB**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

**Gravimetric Analysis:**

1. Estimation of nickel (II) using Dimethylglyoxime (DMG).
2. Estimation of copper as CuSCN
3. Estimation of iron as Fe<sub>2</sub>O<sub>3</sub> by precipitating iron as Fe(OH)<sub>3</sub>.
4. Estimation of Al (III) by precipitating with oxine and weighing as Al(oxine)<sub>3</sub> (aluminium oxinate).

**Inorganic Preparations:**

1. Tetraamminecopper (II) sulphate, [Cu(NH<sub>3</sub>)<sub>4</sub>]SO<sub>4</sub>.H<sub>2</sub>O
2. *Cis and trans* K[Cr(C<sub>2</sub>O<sub>4</sub>)<sub>2</sub>. (H<sub>2</sub>O)<sub>2</sub>] Potassium dioxalato diaquachromate (III)
3. Tetraamminecarbonatocobalt (III) ion
4. Potassium tris(oxalato)ferrate(III)

**BOOKS SUGGESTED:**

1. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.*, Pearson, 2009.
3. Vogel's *Qualitative Inorganic Analysis*, Revised by G. Svehla. Pearson Education, 2002.
4. Marr & Rockett *Practical Inorganic Chemistry*. John Wiley & Sons 1972.
5. Synthesis and characterization of inorganic compounds by W. L. Jolly, Prentice Hall.

## **SEMESTER-VI**



**Paper Code: BBL-601     Core Course XV**

**BIO-ANALYTICAL TOOLS**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**UNIT I**

**(10 Periods)**

Simple microscopy, phase contrast microscopy, fluorescence and electron microscopy (TEM and SEM), pH meter, absorption and emission spectroscopy

**UNIT II**

**(15 Periods)**

Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infrared), centrifugation, cell fractionation techniques, isolation of sub-cellular organelles and particles.

**UNIT III**

**(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 IV**

**(20 Periods)**

Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse field gel electrophoresis, immuno- electrophoresis, isoelectric focusing, Western blotting. Introduction to Biosensors and Nanotechnology and their applications.

**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. 7<sup>th</sup> edition. Pearson Benjamin Cummings Publishing, San Francisco.

**Paper code: BBL-602      Core Course XVI**

## **RECOMBINANT DNA TECHNOLOGY**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

### **UNIT I**

**(15 Periods)**

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

### **UNIT II**

**(20 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, 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 III**

**(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 IV**

**(15 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-Appling the Genetic Revolution. Elsevier Academic Press, USA.
3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington
4. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7<sup>th</sup> edition. Blackwell Publishing, Oxford, U.K.
5. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3<sup>rd</sup> edition. Cold Spring Harbor Laboratory Press.

**Paper Code: BBL-603 Core Course XVII**

**MOLECULAR BIOLOGY**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**UNIT I: DNA structure and replication**

**(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-priming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication.

**UNIT II: DNA Damage, repair and homologous recombination**

**(10 Periods)**

DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, translation synthesis, recombinational repair, non-homologous end joining. Homologous recombination: models and mechanism.

**UNIT III: Transcription and RNA processing**

**(17 Periods)**

RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing.

**UNIT IV: Regulation of gene expression and translation**

**(18 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, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation., Posttranslational modifications of proteins.

**SUGGESTED READING**

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. 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.

**Paper Code: BBL-604/BCL-604      Core Course      XVIII**

**POLYMER CHEMISTRY**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**UNIT-I**

**Functionality and its importance**

**15 Hrs**

Criteria for synthetic polymer formation, Polymerisation reactions -Addition and condensation - Mechanism of cationic, anionic and free radical addition polymerization; Metallocene-based Ziegler-Natta polymerisation of alkenes; Relationships between functionality, extent of reaction and degree of polymerization. Bi-functional systems, Poly-functional systems.

**UNIT-III**

**Kinetics of Polymerization**

**15 Hrs**

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.

**Nature and structure of polymers**-Structure Property relationships.

**UNIT-III**

**15 Hrs**

**Determination of molecular weight of polymers** ( $M_n$ ,  $M_w$ , etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance.

Polydispersity index.

**Glass transition temperature (T<sub>g</sub>) and determination of T<sub>g</sub>**, Free volume theory, WLF equation, Factors affecting glass transition temperature (T<sub>g</sub>).

**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 critical solution temperatures.

**UNIT-IV**

**Properties of Polymers**

**15 Hrs**

Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly (vinyl chloride) and related polymers, poly(vinyl

acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes,

Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylenesulphidepolypyrrole, polythiophene)].

**BOOKS SUGGESTED:**

1. Seymour R.B. & Carraher C.E.: *Polymer Chemistry: An Introduction*, Marcel Dekker, Inc. New York, 1981.
2. Odian G.: *Principles of Polymerization*, 4<sup>th</sup> Ed. Wiley, 2004.
3. Billmeyer F.W: *Textbook of Polymer Science*, 2<sup>nd</sup> 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*. Interscience Publishers, New York, 1967.

### DISCIPLINE CENTRIC SUBJECTS-III

**Paper Code: BBL-605-DSE- III ANIMAL DIVERSITY II**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

#### **UNIT I: Proto-chordates, Pisces and Ambhibia (15 Periods)**

Proto-chordates: Outline of classification, General features and important characters of *Herdmania*, *Branchiostoma*

Origin of Chordates

Pisces: Migration in Pisces, Outline of classification Amphibia: Classification, Origin, Parental care, Paedogenesis

#### **UNIT II: Reptilia, Aves and Mammalia (15 Periods)**

Reptelia: Classification, Origin

Aves: Classification, Origin, flight- adaptations, migration

Mammalia: Classification, Origin, dentition

#### **UNIT III: Comparative anatomy of vertebrates I (15 Periods)**

Comparative anatomy of various systems of vertebrates: Integumentary, digestive respiratory systems.

#### **UNIT IV: Comparative anatomy of vertebrates II (15 Periods)**

Comparative Anatomy of vertebrates – Heart, Aortic arches, Kidney & urinogenital system, Brain, Eye, Ear.

Autonomic Nervous system in Mammals

#### **SUGGESTED READING**

1. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.
2. Kardong, K.V. (2005) Vertebrates Comparative Anatomy, Function and evolution. IV Edition. McGraw-Hill Higher Education.
3. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.
4. Weichert, C.K. (1970). Anatomy of Chordate. McGraw Hill.
5. Young, J.Z. (2004). The life of vertebrates. III Edition. Oxford university press.

**Paper code: BBL-606-DSE- III      ANIMAL BIOTECHNOLOGY**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

**UNIT I      (10 Periods)**

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

**UNIT II      (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 III      (20 Periods)**

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

**UNIT IV      (20 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 scientific publishers.
3. Glick, B.R. and Pasternak, J.J. (2009). Molecular biotechnology- Principles and applications of 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). An introduction 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.

**Paper Code: BBL-607-DSE- III      IMMUNOLOGY**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

#### **UNIT I**

**(20 Periods)**

Immune Response - An overview, components of mammalian immune system, molecular structure of Immuno-globulins or Antibodies, Humoral & Cellular immune responses, T-lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells), T-cell receptors, genome rearrangements during B-lymphocyte differentiation, Antibody affinity maturation class switching, assembly of T-cell receptor genes by somatic recombination.

#### **UNIT II**

**(15 Periods)**

Regulation of immunoglobulin gene expression – clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity, hypotheses (germ line & somatic mutation), antibody diversity.

#### **UNIT III**

**(13 Periods)**

Major Histocompatibility complexes – class I & class II MHC antigens, antigen processing. Immunity to infection – immunity to different organisms, pathogen defense strategies, avoidance of recognition. Autoimmune diseases, Immunodeficiency-AIDS.

#### **UNIT IV**

**(12 Periods)**

Vaccines & Vaccination – adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, passive & active immunization. Introduction to immunodiagnostics – RIA, ELISA.

#### **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. 11th edition 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 Garland Science 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.



## DISCIPLINE SPECIFIC ELECTIVE-IV

**Paper code: BBL-608-DSE- IV  
60 Hrs (4Hrs /week)**

**PLANT DIVERSITY II**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

### **UNIT I: Pteridophytes**

**(10 Periods)**

General characters of pteridophytes, affinities with bryophytes & gymnosperms, classification, economic importance, study of life histories of fossil Pteridophytes – *Rhynia*.

### **UNIT II: Pteridophytes: Type studies**

**(20Periods)**

Life histories of *Selaginella*- (Heterospory and seed habit), *Equisetum*, *Pteris*, *Lycopodium*.

### **UNIT III: Gymnosperms**

**(20 Periods)**

General characters, classification, geological time scale, theories of fossil formation, types of fossils, fossil gymnosperms- *Williamsonia* & *Glossopteris*, telome and stele concept.

### **UNIT IV: Gymnosperms: Type studies .**

**(10 Periods)**

Life histories of *Cycas* & *Pinus*, economic importance of gymnosperms

## **SUGGESTED READING**

1. Bhatnager, S.P. and Moitra, A. 1996 Gymnosperms. New Age International (P) Ltd. Publishers, New Delhi.
2. Parihar, N.S. 1996. The Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.
3. Sambamurty 2008 A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany. IK International Publishers.
4. Wickens, G.E. 2004 Economic Botany: Principles and Practices, Springer. Kuwer Publishers, Dordrecht, The Netherlands

**Paper code: BBL-609-DSE- IV PLANT BIOTECHNOLOGY**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

#### **UNIT I**

**(15 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**

**(20 Periods)**

In vitro haploid production Androgenic methods: Anther culture, Microspore culture andogenesis Sgnificance and use of haploids, Ploidy level and chromosome doubling, diplodization, Gynogenic haploids, factors effecting gynogenesis, chromosome elimination techniques for production of haploids in cereals.

#### **UNIT – III**

**(20 Periods)**

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

Somaclonal variation

Nomenclature, methods, applications basis and disadvantages.

#### **UNIT – IV**

**(10 Periods)**

Plant Growth Promoting bacteria.

Nitrogen fixation, Nitrogenase, Hydrogenase, Nodulation,

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.
3. Gardner, E.J. Simmonns, M.J. Snustad, D.P. 2008 8<sup>th</sup> 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<sup>rd</sup>edition. Benjamin Co.
7. Sambrook & Russel. Molecular Cloning: A laboratory manual. (3<sup>rd</sup> edition)
8. Slater, A., Scott, N.W. & Fowler, M.R. 2008 Plant Biotechnology: The Genetic Manipulation of Plants, Oxford University Press.

**Paper code: BBL-610-DSE- IV      ENZYMOLOGY**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 4**

**Marks for Internal Exam: 30**

**Time: 3Hrs**

**Total Marks: 100**

*Note: The examiner is requested to set nine questions in all, selecting two questions from each UNIT and one compulsory question (Question No.1 based on entire syllabus will consist of seven short answer type questions each of two marks). The candidate is required to attempt five questions in all selecting one from each UNIT and the compulsory Question No.1.*

#### **UNIT – I**

**(20 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).

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  $K_m$  and  $V_{max}$  and their physiological significance, factors affecting initial rate, E, S, temp. & pH. Collision and transition state theories, Significance of activation energy and free energy.

#### **UNIT – II**

**(15 Periods)**

Two substrate reactions (Random, ordered and ping-pong mechanism) Enzyme inhibition types of inhibition, determination of  $K_i$ , suicide inhibitor.

Mechanism of enzyme action: General mechanistic principle, factors associated with catalytic efficiency: proximity, orientation, distortion of strain, acid-base, nucleophilic and covalent catalysis. Techniques for studying mechanisms of action, chemical modification of active site groups, specific examples: chymotrypsin, Isozyme, GPDH, aldolase, RNase, Carboxypeptidase and alcohol dehydrogenase.

Enzyme regulation: Product inhibition, feed backcontrol, covalent modification.

#### **UNIT – III**

**(13 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, Hill and scatchard plots, kinetics of allosteric enzymes. Isoenzymes– multiple forms of enzymes with special reference to lactate dehydrogenase. Multienzyme complexes. Ribozymes. Multifunctional enzyme-eg Fatty Acid synthase.

#### **UNIT – IV**

**(13 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. Enzyme electrodes.

Thermal stability and catalytic efficiency of enzyme, site directed mutagenesis and enzyme engineering– selected examples, Delivery system for protein pharmaceuticals, structure function relationship in enzymes, structural motifs and enzyme evolution.

Methods for protein sequencing. Methods for analysis of secondary and tertiary structures of enzymes. Protein folding *invitro* & *invivo*.

### **SUGGESTED READING**

1. Biochemistry, Lubert Stryer, 6th Edition, WH Freeman, 2006.
2. Harper's illustrated Biochemistry by Robert K. Murray, David A Bender, Kathleen M.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 Press 1999
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 Press 2002.

**Paper code: BBP-611 Core Course Practical VIII**

**BIOLOGY LAB**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 2**

**Marks for Internal Exam: 30**

**Time: 4 Hrs**

**Total Marks: 100**

**PRACTICALS:**

1. Separation of nucleic acid bases by paper chromatography.
2. Microscopy- Theoretical knowledge of Light and Electron microscope.
3. Study of the following techniques through electron / photo micrographs: Fluorescence microscopy, autoradiography, positive staining, negative staining, freeze fracture, freeze etching, shadow casting.
4. Study of structure of cell organelles through electron micrographs.

**Permanent slide preparation:**

- a. Cytochemical staining of DNA-Feulgen.
- b. Cytochemical staining of DNA and RNA- Methyl Green Pyronin (MGP).
- c. Cytochemical staining of Polysaccharides-Periodic Acid Schiff's (PAS).
- d. Cytochemical staining of Total proteins- Bromophenol blue.
- e. Cytochemical staining of Histones -Fast Green.

**SUGGESTED BOOKS**

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6<sup>th</sup> Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8<sup>th</sup> edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5<sup>th</sup> 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. 7<sup>th</sup> edition. Pearson Benjamin Cummings Publishing, San Francisco.

**Paper Code: BCP-601/BBP-612 Core Course Practical IX  
INORGANIC CHEMISTRY LAB-IV**

**60 Hrs (4Hrs /week)**

**Marks for Major Test (External): 70**

**Credits: 2**

**Marks for Internal Exam: 30**

**Time: 4 Hrs**

**Total Marks: 100**

**PRACTICALS:**

1. Qualitative semi-micro analysis of mixtures containing 2 anions and 2 cations. Emphasis should be given to the understanding of the chemistry of different reactions.

The following radicals are suggested:  $\text{CO}_3^{2-}$ ,  $\text{NO}_2^-$ ,  $\text{S}^{2-}$ ,  $\text{SO}_3^{2-}$ ,  $\text{S}_2\text{O}_3^{2-}$ ,  $\text{CH}_3\text{COO}^-$ ,  $\text{F}^-$ ,  $\text{Cl}^-$ ,  $\text{Br}^-$ ,  $\text{I}^-$ ,  $\text{NO}_3^-$ ,  $\text{BO}_3^{3-}$ ,  $\text{C}_2\text{O}_4^{2-}$ ,  $\text{PO}_4^{3-}$ ,  $\text{NH}_4^+$ ,  $\text{K}^+$ ,  $\text{Pb}^{2+}$ ,  $\text{Cu}^{2+}$ ,  $\text{Cd}^{2+}$ ,  $\text{Bi}^{3+}$ ,  $\text{Sn}^{2+}$ ,  $\text{Sb}^{3+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Al}^{3+}$ ,  $\text{Cr}^{3+}$ ,  $\text{Zn}^{2+}$ ,  $\text{Mn}^{2+}$ ,  $\text{Co}^{2+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Ba}^{2+}$ ,  $\text{Sr}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ . Mixtures should preferably contain one interfering anion, **or** combination of anions e.g.  $\text{CO}_3^{2-}$  and  $\text{SO}_3^{2-}$ ,  $\text{NO}_2^-$  and  $\text{NO}_3^-$ ,  $\text{Cl}^-$  and  $\text{Br}^-$ ,  $\text{Cl}^-$  and  $\text{I}^-$ ,  $\text{Br}^-$  and  $\text{I}^-$ ,  $\text{NO}_3^-$  and  $\text{Br}^-$ ,  $\text{NO}_3^-$  and  $\text{I}^-$ . Spot tests should be done whenever possible.

**Chromatography of metal ions**

2. Principles involved in chromatographic separations. Paper chromatographic separation of following metal ions:

- i. Ni (II) and Co (II)
- ii. Fe (III) and Al (III)

(e.g. bidentate ligands like acetylacetone, DMG, glycine) by substitution method.

**BOOKS SUGGESTED:**

1. Vogel's *Qualitative Inorganic Analysis*, Revised by G. Svehla. Pearson Education, 2002.
2. Marr & Rockett *Practical Inorganic Chemistry*. John Wiley & Sons 1972.
3. Synthesis and characterization of inorganic compounds by W. L. Jolly, Prentice Hall