Progressive Education Society's

Modern College of Arts, Science and Commerce, Ganeshkhind, Pune-411016, India

(Autonomous)

(Affiliated to Savitribai Phule Pune University)

B. Sc. Blended

A

Degree Program

In collaboration with

University of Melbourne, Australia

and

Savitribai Phule Pune University, Pune-411007, India

F.Y.B.Sc.Blended (Semester I & II)

Syllabus and Course structure

Choice Based Credit System (CBCS) NEP-2024

from

Academic Year 2023-24

About B. Sc. Blended Degree Program

B. Sc. Blended is an innovative Bachelor Degree in collaboration with the University of Melbourne (UoM), Australia. The UoM is the topmost university in Australia and among the top 40 universities in the world.

The syllabus has been designed by the experts from University of Melbourne (UoM), Indian Institute of Science Education and Research (IISER), Savitribai Phule Pune University (SPPU) and Modern College of Arts, Science and Commerce, Pune (Shivajinagar and Ganeshkhind campus)

Highlights

- The DST-INSPIRE Fellows get scholarships for perusing B. Sc. Blended.
- The B.Sc. Blended program is internationally recognized and allows the Students for direct admission for post-graduation Program with appropriate majors in University of Melbourne, Australia (UOM) and other universities in Australia.
- The rank holders will get special fellowships for pursuing higher education in UOM.
- Guidance by experts from India and abroad.
- The students will be imparted solid training to enable them to prepare for the entrance examination and pursue Masters and Integrated Ph. D. degrees in reputed institutes such as IITs, IISERs and Central Universities
- In the first two years Biology, Physics, Chemistry and Mathematics are compulsory subjects and in the third year the students will take Chemistry as a special subject.
- The students get the essence of Chemistry with the multidisciplinary approach towards Biology, Physics, Mathematics, Computers and English.
- Free access to online learning resources of UOM.
- Guidance for the start ups.
- Guidance for the out of the box career opportunities for the creative students. E.g. Scientific writing, Scientific photography etc.

B. Sc. Blended Program Outcomes

After the completion of B.Sc. Blended, the student should be able to

1. apply their broad knowledge of science across a range of fields, with in-depth knowledge in at least one area of study, while demonstrating an understanding of the local and global contexts in which science is practiced;
2. articulate the methods of science and explain why current scientific knowledge is both contestable and testable by further inquiry;
3. apply appropriate methods of research, investigation and design, to solve problems in science, including the planning and/or conduct of a significant project, problem or investigation;
4. recognize the need for information; effectively search for, evaluate, manage and apply that information in support of scientific investigation or scholarly debate;
5. employ highly developed conceptual, analytical, quantitative and technical skills and are adept with a range of technologies;
6. evaluate the role of science in addressing current issues facing local and global communities, for example climate change, health and disease, food security, sustainable energy use;
7. work effectively in groups to meet a shared goal with people whose disciplinary and cultural backgrounds may differ from their own;
8. communicate clearly and convincingly about science ideas, practice and future contributions to expert and non-expert audiences, matching the mode of communication to their audience.

Eligibility

First Year B. Sc. Blended

Higher Secondary School Certificate (10+2) or its equivalent Examination in Science stream with Physics Chemistry, Mathematics and/or Biology.

Reservation and relaxation will be as per the Government of Maharashtra.

Second Year B. Sc. Blended

The students who has earned all the credits of F.Y.B.Sc. Blended

OR

The student who has earned the partial credits of F.Y.B.Sc. Blended and allowed to keep term (ATKT) as per the rules of SPPU.

Third and fourth Year B. Sc. Blended

The students who has earned all the credits of the previous years.

OR

The students who has earned all the credits of F.Y.B.Sc. Blended and allowed to keep term (ATKT) as per the rules of SPPU.

Duration: Multiple entry and multiple exit as per National Education Policy

Exit after first year: Certificate
Exit after second year: UG diploma
Exit after third year: Degree
Exit after forth year: Degree with honors

Medium of Instruction: English.

Examination

Examination of each credit course has two parts: continuous assessment (internal) and end semester examination (External) The internal assessment consists of Class Room Examinations (subjective/objective), Field Work, Viva-Voce, seminars, activities, tutorials, group discussions, assignments, Lab Work, , etc conducted throughout the semester. The end semester examination is based on the entire syllabus at the end of the semester.

Course Structure

22 credits per semester

1 Credit = 15 hours

B. Sc. Blended Credit Framework for the academic year 2024-25

(As per revised NEP guidelines)

	F. Y. B. Sc. Blended Semester 1				
Course Code	Course Name	Credits	T/P	Vertical	Heading
CHM101	Introductory and Organic Chemistry	2	T	v-1	DSC
CHM102	Chemistry Practical	2	P	v-1	DSC
BIO101	The Diversity of Life	2	T	v-1	DSC
BIO102	Biology Practical	2	P	v-1	DSC
PHY101	Introductory Classical Physics	2	T	v-1	DSC
PHY102	Physics Practical	2	P	v-1	DSC
MTH101	Calculus	4	T	v-3	OE/GE
IDC101	English: Critical Writing and Communication	2	T	v-5	AEC
	(from common basket- same as general B.Sc.)	2		v-5	VEC
	(from common basket- same as general B.Sc.)	2		v-5	IKS
	Total	22			
	F. Y. B. Sc. Blended Semester 2				
Course Code	Course Name	Credits	T/P	Vertical	Heading
CHM201	Inorganic and Physical Chemistry	2	T	v-1	DSC

CHM202	Chemistry Practical	2	P	v-1	DSC
BIO201	Biology of Cells	2	T	v-1	DSC
BIO202	Biology Practical	2	P	v-1	DSC
PHY201	Modern Physics	2	T	v-1	DSC
PHY202	Physics Practical	2	P	v-1	DSC
MTH201	Algebra	4	T	v-4	SEC
IDS201	Scientific Computation and Modelling	2	P	v-5	VEC
	(from common basket- same as general B.Sc.)	2		v-5	AEC
	(from common basket- same as general B.Sc.)	2		v-6	CC
	Total	22			

- **The student can select these courses from the common basket.**
- **The course codes and course names in the common basket will be as approved by the academic council for the common basket.**

Curriculum for F.Y. B.Sc. Blended Program (Semesters I -II)

Prerequisite: Concepts covered in the related topics up to H.S.C. level.
Laboratory skills learnt up to H.S.C. level

Course code: CHM101

Course Name: Introductory and Organic Chemistry

Number of credits: 2 Discipline Specific Course (DSC)
Number of lectures: 30

Course Outcomes (CO)

CO1: Introduction to the s,p,d,f blocks, trends of atomic size, valency, electronegativities, ionization potentials along the row and periods
CO2: Understanding of types of bonds and hybridisation.
CO3: Action of buffer and buffer capacity, choice of indicator
CO4: Understanding of different types of chemical reactions with mechanism
CO5: Application of first and second law of thermodynamics
CO6: Applications of ordinary differential equations in Chemistry
CO7: Numerical problem solving

(CHM 101) Introductory and Organic Chemistry	
Chapter 1: General Chemistry (6 lectures)	**No. of lectures**
The Periodic Table Review of development of periodic table, s,p, d,f blocks in modern periodic table, trends in the properties across the atomic size, valency, electronegativities, ionization potentials along the row and periods.	1
Molecular Structure and Bonding Types of bonds- ionic , covalent, coordinate covalent, metallic, hydrogen bonding, van der Waal. shapes of atomic orbitals, relation of bonding and molecular structure	2
Acids, Bases and buffers Types of acids and bases- Arrhenius, Lawry Bronstead, hard acids, Lewis, soft and hard. Strong and weak acid/base based on pK_a and pK_b. Henderson's equation. Functioning of buffer and buffer capacity , role of buffers in biological systems-Carbonate buffer, phosphate buffer.	2
Stoichiometry Mole concept, molecular weight and equivalent weight, valency, Rules for balancing the chemical reactions	1
Chapter 2: Organic Chemistry (12 lectures)	**No. of lectures**
Carbon – the basis of life Bonding in carbon and its significance in building the biomolecules	1
Structure and Bonding in Alkanes (sp^3 Hybridisation)	1
Structure and Bonding in Alkenes (sp^2 Hybridisation)	1
Benzene and its derivatives Geometry, inductive effect and resonance in mono, di and tri substituted benzenes. ortho, meta and para compounds	1
Structure and Bonding of Alkynes (sp Hybridisation)	1
Functional Groups General formula and reactivity of functional groups	1
Organic redox reactions Redox reactions of aldehydes, ketones and carboxylic acids	1
Addition reactions Hydrogenation, hydration	1
Nucleophilic addition reactions Concept of electrophile, steps involved in the reaction, structural changes and energy profile, preferred reactants	1
Nucleophilic substitution reactions Reaction mechanism, preferred reactants, energy profile and change in	1

optical properties in SN^1 and SN^2 reactions.	
Electrophilic aromatic substitution reactions Concept of electrophile, Mechanism, preferred reactants, structural changes and energy profile	1
Elimination reactions Mechanism, preferred reactants, energy profile, structural changes in E_1, E_2, E_{CB}	1
Chapter 3: Physical Chemistry (12 lectures)	
First Law of Thermodynamics Statement, Types of processes, -reversible, irreversible, cyclic, adiabatic, isochoric, isobaric, isothermal reversible and irreversible expansion of gases.	3
Second Law of Thermodynamics Statement, efficiency of engine, carnot cycle Concept of entropy and free energy	3
Real world examples of thermodynamics - eg solar energy, geothermal, wind power	1
Applications of first order Ordinary Differential Equations ecology models , rate of first order reaction, Newton's law of cooling	3
Applications of second order Ordinary Differential Equations Determination of coefficients, pH of dilute solutions	2

References:

1) Principles of Physical Chemistry, 4th edition (1965), S.H. Maron and C.F. Prutton, Collier Macmillan Ltd
2) The elements of Physical Chemistry, 5th edition (2009), Atkins P, de Paula J. , W. H. Freeman Publication, USA
3) University General Chemistry , 1st edition (2000), C.N. R. Rao, Macmillan Publishers, India
4) Stereochemistry: Conformation and mechanism by P.S.Kalsi
5) Organic chemistry by Jonathan clayden, nick greeves and stuart warren
6) An Introduction to Electrochemistry , edition reprint, 2011, Samuel Glasstone, BiblioBazaar, USA
7) Physical Chemistry for biological sciences, 1st edition, (2005), Chang R., University Science Books, USA
8) Physical Chemistry, 1st edition, (2003) David Ball, Thoson Learning, USA.
9) Essentials of Physical Chemistry, 24th edition, (2000), B S Bahl, G D Tuli, ArunBahl, S. Chand Limited, India.
10) Organic Chemistry, 6 th edition, (1992), Morrison Robert Thornton, Pearson Publication, Dorling Kindersley (India Pvt. Ltd.)

11) Guide book to Mechanism in Organic Chemistry by Peter Sykes, 6 th edition, (1996), Prentice Hall
12) Concise Inorganic Chemistry. 5th edition (2008), Author: J. D. Lee, John Wiley & Sons, USA.

Learning outcomes

1) Identification of trends in s,p,d,f block elements with respect to atomic size, valency, electronegativities, ionization potentials along the row and periods.
2) Identification of types of bonds-ionic, covalent coordinate covalent
3) Balancing of chemical equation
4) Derivation of Hinderson's equation to understand the concept of pKa. Selection of indicator.
5) Action of buffer and buffer capacity.
6) Understanding of hybridisation types and bonding.
7) Understanding of of reactions with mechanism
8) Applications of first and second law of thermodynamics
9) Derivations of first order kinetics, newton's law of cooling, and pH of dilute solutions
10) Numerical problem solving

Course code: CHM102

Course Name: Chemistry Practical

Number of credits: 2 Discipline Specific Course (DSC)
Number of sessions : 10 (each session of 3 hours)

Course Outcomes

CO1: To develop the laboratory safety and maintenance skill
CO2: To prepare the solution of desired concentration
CO2: To get the hands on experience of pH meter
CO3: To synthesis organic molecules

I] Chemical and laboratory safety (Compulsory)

- Safety symbols on labels of pack of chemicals and its meaning
- Understanding of Material Safety Data Sheets (MSDS)
  (Especially for the chemicals using for the experiments)
- Toxicity of the compounds
- Waste management
- Best laboratory practices

II] Physical Chemistry experiments

1. Determination of dissociation constant of a weak acid by pH metry.
2. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture by (i) two indicator method and (ii) pH metry.
3. Determination of heat of neutralization of HCl with NaOH.

III] Inorganic Chemistry experiments

1. Analysis of water hardness through EDTA complexometric titration.
2. Inorganic Qualitative Analysis (Any 2)

IV] Organic Chemistry experiments

1) Organic qualitative analysis (Any2)
(i) Acid, (ii)Phenol, (iii) Base, (iv) Neutral

2) Basic techniques: Determination of melting point and boiling point, Thin Layer Chromatography (TLC)

3) Separation of compounds using paper chromatography. Find R_f value of each component (Any1)

4) Separation of chlorophyll and xanthophyll from leaf extract

5) Separation of components of ink

V] Use any one Chemistry Software

Use any one software (Chem Draw-Sketch, ISI – Draw etc) to draw the structure of simple aliphatic, aromatic, heterocyclic organic compounds with substituents and get the correct IUPAC name.

Learning outcomes

1) Laboratory safety and maintenance skill
2) Preparation of solution
3) Hands on experience of pH meter
4) Synthesis of organic molecules
5) Use any one Chemistry software for drawing the structures

Course code: PHY101

Course Name: Introductory Classical Physics

Number of credits: 2 Discipline Specific Course (DSC)

Number of lectures: 30

Course Outcomes

CO1: Application of Newton's laws of motion to solve various problems related to day today life.

CO2: Concepts like zero work done, conservative forces, mass energy equivalence ($E= mc^2$).

CO3: Effect of force on various types of materials is described and physical properties like elasticity, different moduli etc. along with their relation.

CO4: To understand various thermodynamic processes like Isothermal, isobaric, isochoric and laws of thermodynamics with their real world applications.
CO5: To understand the concept of entropy

PHY101 Introductory Classical Physics	
Chapter 1: Classical Mechanics (11 lectures)	**No. of lectures**
Straight line motion	1
Vectors	1
Two-and three-dimensional motion	1
Force and Motion: Newton's Laws	1
Force and Motion: Drag and Friction	1
Kinetic energy, work, power	1
Potential energy, conservation of energy	1
Collisions and momentum	1
Rotational motion	1
Angular momentum-I	1
Angular momentum-II	1
Chapter 2: Gravitation (6 lectures)	**No. of lectures**
Newton's law of gravity, superposition	1
Gravity at the earth's surface, far above the earth and within the earth	1
Work and gravitational potential energy	1
Kepler's laws: the planets and satellites	1
Orbital motion and energy	1
Einstein, the equivalence principle, gravity, gravitational lenses, gravitational waves	1
Chapter 3 : Thermal physics (3 lectures)	**No. of lectures**
Zeroth Law of Thermodynamics	1
Thermal expansion and absorption of heat First Law of Thermodynamics; adiabatic processes, constant volume processes, enthalpy, cyclical processes, free expansions	1
Heat transfer, conduction, emission, absorption. Second Law of Thermodynamics, Irreversible processes, entropy, free energy	1
Chapter 4: Elasticity, Fluids and Gases (8 lectures)	**No. of lectures**
Equilibrium and elasticity	1
Density and Pressure, Pascal's and Archimedes' Principles	1

Continuity and Bernoulli's Equation	1
Ideal gases (Kinetic theory of gases)	1
Mean free path, molecular speed distribution	1
Specific heat, adiabatic expansion	1
Real world examples - eg wind power, hydro, blood circulation, water in plants, materials, osmosis, wind and atmosphere	2
Chapter 5 : Applied Physics (2 lectures)	
Applications of second order ordinary differential equations: Springs , LRC series electrical circuits	1
Real world contextual examples in physics and application of ordinary differential equations	1

References:

1) Concept of Physics: H. C. Verma, Bharati Bhawan Publisher.
2) Heat and Thermodynamics: Brijlal, N. Subrahmanyam, S. Chand and Company Ltd.
3) Heat and Thermodynamics: Mark W. Zemansky, Richard H. Dittman, 7 th Edition, Mc-Graw Hill International Edition.
4) Fundamentals of Physics: Halliday Resnick and Walkar, 8th Edition.
5) Electromagnetics: B. B. Laud.

Learning Outcomes

1) Solving various problems of Application of Newton's laws of motion relatedmotion related to day today life.
2) Understanding of the concepts like zero work done, conservative forces, mass energy equivalence ($E= mc^2$).
3) Understanding the effect of force on various types of materials is described and physical properties like elasticity, different moduli etc. along with their relation.
4) Understanding various thermodynamic processes like Isothermal, isobaric, isochoric and laws of thermodynamics with their real world applications.
5) Application of ordinary differential equations in electricity.

Course code: PHY102

Course Name: Physics Practical

Number of credits: 2 Discipline Specific Course (DSC)
Number of lectures: 30

Course Outcomes

CO1: Laboratory maintenance
CO2: Use of pendulum

CO3: Use of instruments in physics

List of practicals

1. Simple Pendulum: To plot a L-T^2 graph using a simple pendulum and find the effective length of the simple pendulum for a given time period using the graph.
2. To calculate the acceleration due to gravity at a place.
3. Torsional Pendulum**:** To find the moment of inertia of the disc and the rigidity modulus of the material of the suspension wire subjected to torsional oscillations.
4. Young's Modulus: To determine the Young's modulus of elasticity of the material of a given wire using Searle's apparatus.
5. Spring: To determine the restoring force per unit extension of a spiral spring by statistical and dynamical methods and also to determine the mass of the spring.
6. Euler's Method: To determine the coefficient of friction by Euler's Method.
7. Viscosity: To determine Coefficient of Viscosity by Stoke's Method.
8. Any two experiments as per the requirement of the syllabus.

Learning outcomes

1) Maintenance of the Laboratory
2) Handling of the instruments
3) Working of pendulum

Course code: BIO201

Course Name: The Diversity of Life

Number of credits: 2 Discipline Specific Course (DSC) Number

Course Outcomes

CO1:To understand life's diversity.

CO2: To understand evolutionary relationship about origin of life,

CO3: To understand the concepts of cell theory and different types of cell.
CO4: To understand concepts of evolution and origin of multicellularity.
CO5: To understand major domains of kingdoms of biological diversity

Course Contents

BIO101. The Diversity of Life	
Chapter 1 : Unifying themes in Biology (12 lectures)	No of lectures
• Theory of evolution: understanding life's diversity	2
• Evolutionary relationships (phylogenies) are summarized in classifications	2
• Chemical evolution of life – Molecules to cells	2
• Cell theory and the origin of life, History	2
• Prokaryotic Cells: Bacteria and Archaea, structure and function	2
• Evolution of the eukaryotic cell, structure and function	2
• Endosymbiosis, examples – mitochondria ,chloroplast	1
Chapter 2: Diversity, structure and biology of major groups (18 lectures)	No of lectures
Protists 1 - Red and Green algae structure and function with suitable example Protists 2 - Chromists Protists 3 - Dinoflagellates and apicomplexans, flagellates, ciliates, amoebae	1
• Evolution of sex, life cycles with suitable example	1
• Origins of multiculticellularity	1
• Slime moulds and fungi structure and function with suitable example • Fungi 2	1
• Introduction to Land Plants • Bryophytes	1
• Evolution of vascular tissue, Lycophytes, fern allies, early fossil land plants • Ferns structure and function with suitable example	1
• Seed plants, the seed and secondary growth, Cycads and Ginkgo	1
• Conifer diversity and biology suitable example • Angiosperm structure, biology and diversity, the flower, double fertilization.	1
• Angiosperm phylogeny and evolution with suitable example	1
• Introduction to animals (Metazoa) • Simple animals with suitable example	1
• Protostomes-Flatworms and annelids	1
• Molluscs with suitable example	1
• Arthropods with suitable example	1
• Deuterostomes, Echinoderms-Chordates	1
• Fishes –sharks/rays, teleosts, coelacanth, lungfish with suitable example	1
• Amphibians • Reptiles	1
• Birds	1
• Mammals The primate story	1

Learning Outcomes:

- On completion of the course, students will be able to know about the origin of earth, origin of diversity of life, covering the domains and classification of plants, animals and micro-organisms.

- As it covers the details for and highlights the origin of life students will know the array of life on earth and how it is classified.
- Students get the insights for what distinguishes one organism from another and much more.

References:

1. Reece, Taylor, Simon and Dickey - Campbell Biology: concepts and connections, 7th Edition, Pearson Education (Singapore) Pvt. Ltd.
2. General Zoology - By Goodnight and others, IBH Publishing Co.,
3. R.L. Kotpal, 10th Edition.,2009 - Modern text book of Zoology, Invertebrates, Rastogi publications, Meerut.
4. Parker J. and Haswell, W., - Text-Book of Zoology, ELBS Edition.
5. Cleveland Hickman Jr., Larry Roberts, Susan Keen, Allan Larson and David Eisenhour - Animal Diversity, 8th Edition, McGraw Hill Publication.
6. Das, Datta and Gangulee - College Botany (Vol I), Published by New Central Books Agency (P). Ltd.
7. V. Verma - Botany, 2010, Ane Books Pvt Ltd.
8. A.C. Dutta - Botany for Degree Students, 6th Edition, Oxford University Press, New York.
9. Richard S.K. Barnes - The Diversity of Living Organisms, John Wiley and Sons Ltd., Oxford, United Kingdom.
10. Lynn Margulis and Michael J. Chapman - Kingdoms and Domains:An Illustrated Guide to the Phyla of Life on Earth, 4th edition,Academic Press; (1st edition in January 26, 2009).
11. Brian K. Hall; BenediktHallgrímsson - Strickberger's Evolution, Fourth Edition, Jones and Bartlett Publishers, Inc.
12. Mark Ridley, 2004, 3rd Edition - Evolution, Blackwell Publishing.
13. Carl T. Bergstrom & Lee Alan Dugatkin - Evolution (second edition), W. W. Norton & Company; Second edition.
14. Douglas J. Futuyma - Evolution, 2nd/ 3rd Edition,Sinauer Associates.

Course code: BIO101

Course Name: The Diversity of Life

Number of credits: 2 Discipline Specific Course (DSC)

Course Outcome (CO)CO1: Understanding of concepts of biological evolution

CO2: Understanding of theoris of evolution of life

CO3: Understanding of basics of biological classification and introduction to major domains and kingdoms of biological diversity, and the structure and biology of these organisms.

Course Contents

Unit	Title	Lectures 30 Lectures
Unit 1	Chaoter 1: Unifying themes in Biology	12 Lectures
	• Theory of evolution: understanding life's diversity	2
	• Evolutionary relationships (phylogenies) are summarized in classifications	2
	• Chemical evolution of life – Molecules to cells	2
	• Cell theory and the origin of life, History	2
	• Prokaryotic Cells: Bacteria and Archaea, structure and function	2
	• Evolution of the eukaryotic cell, structure and function	2
	• Endosymbiosis, examples – • mitochondria ,chloroplast	1
Unit 2	Diversity, structure and biology of major groups	18 Lectures
	Protists 1 - Red and Green algae structure and function with suitable example	1
	Protists 2 - Chromists	
	Protists 3 - Dinoflagellates and apicomplexans, flagellates, ciliates, amoebae	
	Evolution of sex, life cycles with suitable example	1
	Origins of multiculticellularity	1
	Slime moulds and fungi structure and function with suitable example	1
	Fungi 2	
	Introduction to Land Plants	1
	Bryophytes	
	Evolution of vascular tissue, Lycophytes, fern allies, early fossil land plants	
	Ferns structure and function with suitable example	1
	Seed plants, the seed and secondary growth, Cycads and Ginkgo	1
	Conifer diversity and biology suitable example	1
	Angiosperm structure, biology and diversity, the flower, double fertilization.	
	Angiosperm phylogeny and evolution with suitable example	

	Introduction to animals (Metazoa)	1
	• Simple animals with suitable example	1
	• Protostomes-Flatworms and annelids	1
	• Molluscs with suitable example	1
	• Arthropods with suitable example	1
	• Deuterostomes, Echinoderms-Chordates	1
	• Fishes –sharks/rays, teleosts, coelacanth, lungfish with suitable example	1
	• Amphibians	1
	• Reptiles	1
	• Birds	
	• Mammals	1
	• The Primate story	

References:

1. Reece, Taylor, Simon and Dickey - Campbell Biology: concepts and connections, 7th Edition, Pearson Education (Singapore) Pvt. Ltd.
2. General Zoology - By Goodnight and others, IBH Publishing Co.,
3. R.L. Kotpal, 10th Edition.,2009 - Modern text book of Zoology, Invertebrates, Rastogi publications, Meerut.
4. Parker J. and Haswell, W., - Text-Book of Zoology, ELBS Edition.
5. Cleveland Hickman Jr., Larry Roberts, Susan Keen, Allan Larson and David Eisenhour - Animal Diversity, 8th Edition, McGraw Hill Publication.
6. Das, Datta and Gangulee - College Botany (Vol I), Published by New Central Books Agency (P). Ltd.
7. V. Verma - Botany, 2010, Ane Books Pvt Ltd.
8. A.C. Dutta - Botany for Degree Students, 6th Edition, Oxford University Press, New York.
9. Richard S.K. Barnes - The Diversity of Living Organisms, John Wiley and Sons Ltd., Oxford, United Kingdom.
10. Lynn Margulis and Michael J. Chapman - Kingdoms and Domains:An Illustrated Guide to the Phyla of Life on Earth, 4th edition,Academic Press; (1st edition in January 26, 2009).
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12. Mark Ridley, 2004, 3rd Edition - Evolution, Blackwell Publishing.
13. Carl T. Bergstrom & Lee Alan Dugatkin - Evolution (second edition), W. W. Norton & Company; Second edition.
14. Douglas J. Futuyma - Evolution, 2nd/ 3rd Edition,Sinauer Associates.

Learning Outcomes:

- On completion of the course, students will be able to know about the origin of earth, origin of diversity of life, covering the domains and classification of plants, animals and micro-organisms.
- As it covers the details for and highlights the origin of life students will know the array of life on earth and how it is classified.
- Students get the insights for what distinguishes one organism from another and much more.

Course code: BIO102

Course Name: Biology Practical

Number of credits: 2 Discipline Specific Course (DSC)

Number of lectures: 30

Course Outcome:

CO1:To get hands-on training on biochemical experiments.
CO2: To understand about zooplanktons from field visits.
CO3: To understand the world of the animal kingdom by visiting a zoology museum.

List of the practicals

1. Observation of zooplankton from pond samples under microscope
2. Determination of dissolved oxygen in water sample using Winkler titration
3. Collection and identification of invertebrate samples from pond by using different types of nets.
4. Visit to the museum at zoology department at Pune University and observe the collected specimens.
5. Using a taxonomic browser to identify the taxonomic lineage and explain key characteristics of the species.
6. Observe the characteristics of prokaryotic and eukaryotic cells.

Learning outcomes

1) Hands on training on biochemical experiments.
2) Understanding from field visits about zooplanktons.
3) Understanding the world of the animal kingdom by visiting a zoology museum.

Course code: MTH101

Course Name: Calculus

Number of credits: 4 Open Elective(OE)/Generic Elective(GE)

Number of lectures: 60

MTH 101 Calculus	
Logic and Proof (20 lectures)	**No. of lectures**
Basic set theory (review)	2
Logical connectives (conjunction, disjunction, negation, conditional, bi-conditional) and truth tables	2
Propositional logic, logical equivalence, logical laws	2
Quantifiers, predicate calculus	1
Relations, equivalence relations, ordering	1
Functions including injective, surjective, bijective, inverse, composition	1
Number systems: Natural numbers, integers, rational numbers and their properties (eg closure under addition/multiplication/division; existence of additive/multiplicative identity/inverses)	4
Real numbers and their properties; completeness property	2
Proof methods: direct proof, contrapositive	1
Proof methods: contradiction, proof by cases	1
Proof methods: induction	1
Natural numbers, integers, rational numbers	1
Real numbers	1
Sequences and series (15 lectures)	**No. of lectures**
Sequences, limits, convergence and divergence	2
Proving limits using definition	1
Methods for evaluating limits: standard limits, limit theorems, continuity rule, sandwich theorem	2
Series, convergence and divergence of series, geometric series, harmonic p-series	2
Series convergence tests: divergence test, comparison test	2
Series convergence tests: ratio test, integral test, alternating series test	1
Power series, Taylor polynomials	2
Taylor series	1

Taylor's theorem, error in Taylor polynomial estimates	2
Differential calculus (5 lectures)	**No. of lectures**
Review of differential calculus: limits, derivative, differentiation rules incl. polynomials, trigonometric, exponential, log functions; product, quotient, chain rules	3
Review of inverse trigonometric functions and their derivatives, implicit differentiation	2
Integral calculus (20 lectures)	**No. of lectures**
Riemann integration	2
Fundamental Theorem of Calculus; review of standard anti-derivatives	2
Techniques of integration (review): derivative present substitution, linear substitution	2
Techniques of integration (review): integration of trigonometric functions using identities	2
Techniques of integration (review): integration of rational functions including partial fractions, integration yielding inverse trig functions	2
Techniques of integration (review): trigonometric substitutions; integration by parts	2
Improper integrals	1
Applications of integration: areas between curves	1
Applications of integration: volumes of surfaces of revolution	1
Ordinary differential equations: definition of ODE, order, general solution, initial conditions; separable ODEs	2
Solving linear ODE using integrating factor	1
Particular solutions of inhomogeneous constant coefficient linear ODEs using method of undetermined coefficients; principle of superposition	2

References:

1) Mathematical Analysis by S.C. Malik and Savita Arora, New Age International Private Limited (Fifth Edition), 2017
2) Ordinary and partial differential equations by Dr. M. D. Raisinghania, S. Chand

Learning outcomes MTH101

1) Understanding of the concepts and applications in calculus
2) Problem solving of Partial derivatives, Directional derivatives, Extrema of Functions
3) Solving Riemann integration, improper integration
4) Solving First and second order differential equations.

Course code: IDC101

Course Name: English: Critical Writing & Communication

Number of credits: 2 Ability Enhancement Course (AEC)

Number of lectures: 30

Course Outcomes:

CO1: Development of listening ability
CO2: Development of English reading ability
CO3: Development of Critical thinking in English
CO4: Speaking English with proper pronunciation
CO5: Development of proper conversation skill

IDC101 English: Critical Writing & Communication (Theory and Practical) – Syllabus		
Sr. no	**Theory**	**Practical**
1	**Listening -** Overview, Question Types, Listening Tips, Completing the blanks, Making Assumptions, Understanding numbers Understanding the alphabet, Distinguishing similar sounds	Listening for - Description, Time, Frequency, Similar meanings, Emotions, Explanation, Classification, Comparison and contrasts, Negative meaning, Chronology
2	**Reading-** Overview, Question Types, Reading Tips	Using first paragraph to make predictions, Using the topic sentence to make predictions, Looking for specific details Analyzing Questions and Answers, Identifying the tasks
3	**Writing-** Overview, Question types, Writing tips	Responding to task, Coherence and cohesion, Lexical resource, Generalizing and Qualifying, Grammatical range and accuracy
4	**Speaking-** Overview, Question type, Speaking tips	Introduction and Overview, Giving Information, Organizing and discussing a topic, Sequence, Comparing and contrasting Respond to follow up questions, Ask for clarification, Avoid short answers, Transition and intonation

Learning Ourcomes **1)** Development of proper conversation skill

F.Y.B.Sc.Blended Semester II

Course code: CHM 201

Course Name: Physical and Inorganic Chemistry

Credits: 2 Discipline Specific Course (DSC)

Number of lectures: 30

Course Outcomes (CO)

CO1: To understand the development of electrochemical cells
CO2: To understand the concepts and use of quantum chemistry
CO3: To understand the bonding in coordination compounds and their chemistry
CO4: Application of stereochemistry in biomolecules and understanding the mechanism
CO5: Application of thermodynamics in Bioenergetics

CHM 201 Physical and Inorganic Chemistry	
Chemistry of Life (12 lectures)	**No. of lectures**
The Biological Periodic Table ● elements essential for life. ● Role of Gp1 and 2 elements as electrolytes and role in structural materials (eg, Ca^{2+} in teeth and bones). ● Role of C, N, S and P as components of biomolecules. ● Role of transition metals in enzymes, transport molecules (eg haemoglobin ,myoglobin) and redox processes (due to range of available oxidation states). **Access to essential elements** ● humans via nutrition/ atmosphere ● plants uptake from solution/soils../atmosphere **Role of water** ● understood in terms of structure. H bonding in water, structure of ice, density vs liquid ● Properties of water, liquid temperature range, high specific heat and consequences for living systems. Solvent for a wide range of compounds (salts and covalent molecules) - relate to structure of water	3
Gases ● Solubility of gases, eg, O_2, CO_2, N_2, He, CH_4, Henry's Law. Methane clathrates. Lake Nyos tradegy, Divers and the 'bends" **Molecular species** ● **Oxygen** and its allotrope O_3, structures and properties. Role of O_2 in respiration. Respiration as a redox process. Thermodynamic data. Role of O_3 in the upper atmosphere in 'screening' UV radiation. Ozone degradation and CFCs.	1

● Oxygen transport in humans: Haemoglobin in red blood cells, Myoglobin in tissues. Equilibria. ● **Carbon** - Oxides of Carbon, CO and CO_2. Formation of CO and CO_2. Structures. CO properties, neutral oxide, toxicity - binding to Hb. CO_2 and photosynthesis. Thermodynamic data. Overview of photosynthesis and respiration. CO_2 as a green house gas. ● Acid- base properties of CO_2. CO_2 and H_2CO_3 equilibria. Acidity of oxides of nitrogen and sulfur - acid rain formation. ● Cycling of carbon (in various structures) through the bio- and geospheres. ● **Nitrogen** structure and properties. Hydrides, NH_3 and hydrazine N_2H_4 (optional), structures and properties - ammonia as a base. The oxides of nitrogen, NO, NO_2 and N_2O_4. Identification of NO and NO_2 as radicals. The biological roles of NO - neurotransmitter, blood vessel dilation... ● **Phosphorus -** Allotropes**.** formation of P_4O_{10} from P_4. Reaction of P_4O_{10} with water to form H_3PO_4. H_3PO_4 as a triprotic acid. Phosphate esters. Mention of phosphodiester link in DNA. ADP and ATP. Conversion of ATP to ADP and bioenergetics.	
Overview view of Isomerism **Constitutional isomers** - different atomic connectivity, examples **Stereoisomers** **Enantiomers -** Enantiomers and **t**etrahedral carbon. Optical activity. Sequence rules for specifying configuration (Cahn-Ingold-Prelog and R and S descriptors). Meso compounds. **Chirality in nature** - enantiomers and different biological properties. Limonene, drugs, e g, ibuprofen, **Cis-trans isomerism** - alkene stereochemistry. *E,Z* designation.	2
Carbohydrates ● synthesis of carbohydrates via photosynthesis ● simple sugars, eg, glucose and fructose ● formation of acetals (optional??) ● complex carbohydates - simple sugar linked by acetal bonds ● polysaccharides- cellulose, starch and glycogen ● cell surface carbohydrates - ABO blood system, influenza viruses **Amino acids, Peptides and Proteins** ● structure of the amino acids ● amino acids in solution - zwitterions ● formation of amide bonds by reaction of an amino group with a carboxyl group ● formation of peptides by peptide (amide bond formation) ● side- chain residues in proteins, neutral, basic, acidic ● protein structure: primary, secondary, tertary, quaternary with examples. Role of H-bonding, side chain residue interactions (e g salt links) and disulfide bridge formation in structure formation ● protein denaturation ● role of proteins - structural, transport, enzymes **Lipids**	2

● Ester formation. Fats and oils - glycerol, saturated and unsaturated fatty acids, triglyceride formation **DNA** ● Purine and pyrimidine bases ● Nucleosides, nucleotides, phosphodiester link -polynucleotides. ● Base pairing in DNA - Watson and Crick double helix. Factors stabilising helix, H-bonding, base stacking interactions. Physical properties - light absorption in UV - mutagenic effects. Molecular basis for heredity. ● Differences between DNA and RNA ● The Central Dogma	
Concept of Reaction Rate ● Factors affecting rate: concentration, temperature, physical state of reactants, presence/absence of catalyst. Examples ● Thermodynamic versus kinetic control **Enzymes as catalysts** ● Classification of enzymes ● Enzyme specificity ● Mechanism of action - energy diagram for catalysed and uncatalysed reactions. ● Examples of enzyme catalysed reactions, e g, carbonic anhydrase and role in CO_2 transportation	1
Energy and Food ● Measuring the energy content of foods via calorimetry. Calculations ● Comparison of the energy content of carbohydrates, proteins and fats	1
Overview of Catabolic Pathways ● hydrolysis of foods (fats, carbohydrates, proteins) to small molecules ● cellular degradation to acetyl CoA ● Acetyl CoA oxidized in the citric acid cycle to CO_2 ● Energy released in citric acid cycle. ● Electron transport chain converts ADP to ATP utilising energy released by citric acid cycle **Chemistry/structures of key components in catabolism** ● ADP and ATP revisited ● Utilization of ATP and chemistry and energetics of coupled reactions, e g, phosphorylation of glucose to glucose 6 - phosphate ● Other examples **Overview of Anabolism** ● Carbohydrate biosynthesis as an example. Simplified form	2
Inorganic Chemistry (12 lectures)	**lectures**
Ionic Compounds and their Solutions	1
Structures of Solids Crystalline and amorphous compounds, unit cell , Bravais lattices	1
Main Group Chemistry- elements and trends in properties	1
Electrochemistry	4

Types of electrochemical cells, Daniel cell, Nernst equation, derivation and applications, calculation of pH, solubility product, electric work, free energy Electrochemical series, salt bridge, representation of electrochemical cell, Applications of electrochemical cells - fuel cells, batteries	
The transition metals : a survey, transition metals in biological systems,	1
Coordination Chemistry Bonding and structure of coordination compounds, IUPAC names of the metal complexes, types of ligands, inner sphere and outer sphere complexes Application of cis platin, application of complexes as molecular switches	4
Quantum Chemistry (6 lectures)	lectures
Derivation of time independent Schrödinger equation, various forms of Schrödinger equation. Heisenberg's Uncertainty Principle- experimental evidence	2
Bohr and Schrödinger models of the hydrogen atom	1
Complex atoms Pauli Exclusion Principle, Periodic Table of Elements, selection rules and spectra. Spectra of Hydrogen atom.	2
Nuclear fission and fusion	1

References:

1) Principles of Physical Chemistry, 4th edition (1965), S.H. Maron and C.F. Prutton, Collier Macmillan Ltd
2) The elements of Physical Chemistry, 5th edition (2009), Atkins P, de Paula J. , W. H. Freeman Publication, USA
3) University General Chemistry , 1st edition (2000), C.N. R. Rao, Macmillan Publishers, India
4) Stereochemistry: Conformation and mechanism by P.S.Kalsi
5) Organic chemistry by Jonathan clayden, nick greeves and stuart warren
6) An Introduction to Electrochemistry , edition reprint, 2011, Samuel Glasstone, BiblioBazaar, USA
7) Physical Chemistry for biological sciences, 1st edition, (2005), Chang R., University Science Books, USA
8) Physical Chemistry, 1st edition, (2003) David Ball, Thoson Learning, USA.
9) Essentials of Physical Chemistry, 24th edition, (2000), B S Bahl, G D Tuli, ArunBahl, S. Chand Limited, India.
10) Organic Chemistry, 6 th edition, (1992), Morrison Robert Thornton, Pearson Publication, Dorling Kindersley (India Pvt. Ltd.)
11) Guide book to Mechanism in Organic Chemistry by Peter Sykes, 6 th edition, (1996), Prentice Hall,
12) Concise Inorganic Chemistry. 5th edition (2008), Author: J. D. Lee, John Wiley & Sons, USA.

Learning Outcomes

1) Understanding of the structure of biomolecules and their properties
2) Application of thermodynamics in Bioenergetics
3) Construction of electrochemical cell and finding its potential, electrical work and Gibbs free energy.
4) Significance of Shrodinger equation and Heisenberg uncertainty principle.
5) Understanding the bonding in coordination compounds, their IUPAC nomenclature and reactivity.

Course code: CHM202

Course Name: Chemistry Practical

Number of credits: 2 Discipline Specific Course (DSC)

Number of sessions: 10 (3 hour each)

Course Outcomes (CO)

CO1: Determination of heat of solution
CO2: Use of pH meter for determination of the chemical changes
CO3: Skill in the synthesis of inorganic complexes
CO4: Techniques for the separation of natural products
CO5: Skill in the single stage preparation of the compound

List of experiments

I] Physical Chemistry practical

1. Estimation of acid neutralizing capacity of commercially available antacids.
2. Heat of solution of KNO_3/ NH_4Cl.
3. Draw polar plots of the atomic orbitals:1s, 2s, p_x,dz^2, dxy, dx^2-y^2 , fz^3

II] Inorganic Chemistry practical

1. Synthesis of commercially important Mohr's salt.
2. Determination of water of crystallization of the synthesized Mohr's salt.
3. To synthesize a typical coordination complex (Any1),
   (i) Hexaamminecobalt (III) chloride $[Co(NH_3)_6]Cl_3$
   (ii)Hexaammino copper (II) sulphate $[Cu(NH_3)_6]SO_4$
4. Idometric titration (Any1)
   (i) Estimation of available chlorine in bleaching powder
   (ii) Analysis of vitamin C

III] Organic Chemistry practicals

1. Synthesis, purification by crystallization and determination of melting points of the organic compounds. Show the comparative TLC and determine the R_f value of reactant and product. (Any2)
   (i) The Preparation of Paracetamol
   (ii) The Reduction of Benzoin
   (iii) The Oxidation of Menthol
2. Isolation of a Natural Product (Any2)
   (i) Caffeine from tea leaves
   (ii) Eugenol from clove
   OR isolation of any two natural products

Learning Outcomes

1) Determination of heat of solution
2) Use of pH meter for determination of the chemical changes
3) Skill in the synthesis of inorganic complexes
4) Separation of natural products by paper chromatography
5) Skill in the single stage preparation of the compound

Course code: PHY201

Course Name: Modern Physics

Number of credits: 2 Discipline Specific Course (DSC)

Number of lectures: 30

Course Outcomes

CO1: To understand matter waves in quantum mechanics.
CO2: To understand expectation values, observables and operators.
CO3: To understand tunnelling phenomenon and hydrogen atom, helium atom in quantum mechanics.
CO4: To learn about the zeroth law of thermodynamics and thermodynamic equilibrium.
CO5: To understand Carnot's cycle, Heat engines and Stirling cycle.
CO6: Apply the basic knowledge of classical mechanics

PHY201 Modern Physics	
Electricity and Magnetism	**No. of lectures**
Electric charge, conductors and insulators	1
Coulomb's Law, superposition principle	1
Electric field, superposition principle	1
Electric flux	1
Gauss's law, applications	1
Energy and electric field; electric potential	1
Calculating potential from the field, electric potential, potential energy surfaces.	1
Electric dipoles	1
Capacitance; parallel plate capacitors	1
Energy storage in capacitors, dielectrics, series and parallel circuits	1
Conductors, electric current, electric power, Ohm's law	1
Kirchoff's rules, resistors in series and parallel circuits	1
Magnetic field, magnetic force, Lorentz force, cyclotrons	1
Lorentz force, ion velocity filter, Hall effect, Biot-Savart Law	1
Bio-Savart Law, Ampere's Law, solenoids, earth's magnetic field	1
Magnetic field due to a current, forces on current-carrying wires, Electromagnetic induction, magnetic flux	1
Lenz' Law, Faraday's law, Maxwell's equations, applications	1
Magnetic materials	1

Oscillations and Waves	**lectures**
Simple harmonic motion, pendulum, diatomic molecules,Damped harmonic motion, resonance - electronic circuits, evolution of populations	2
One dimensional waves, Interference and standing waves, Sound waves and the speed of sound, Intensity, sound level and the physics of music	2
Doppler effect and supersonic motion, shock waves	1
Optics	**lectures**
Images and mirrors	1
Thin lenses and optical instruments	1
Young's experiment, interference	1
Thin films and the Michaelson interferometer	1
Diffraction by slits and apertures	1
Diffraction by gratings and X-ray diffraction	1
Optical Microscopy	1
Spectroscopy	1
Modern Physics	**lectures**
Challenges to classical physics; special relativity	1
Lorentz transformation, transformation of velocities, Doppler effect	1
Relativistic momentum and energy	1
Photons and the photoelectric effect	1
Quantum physics, blackbody radiator, matter waves	1
Trapped particles and the tunneling particles	1
Nuclear physics, nuclear properties, nuclear decay	1
Quarks, Leptons, The Big Bang	1

References

1) Concept of Physics: H. C. Verma, BharatiBhavan Publisher.
2) Fundamentals of Physics: HallidayResnik and Walkar, 8th Edition.
3) 'The Feynman lectres' by Feynman
4) Principles of physics by Halliday, Resnick and Walker
5) Concepts of modern physics by Arthur Beiser

Learning Outcomes

1) Understanding matter waves in quantum mechanics.
2) Understanding expectation values, observables and operators.
3) Understanding tunnelling phenomenon and hydrogen atom, helium atom in quantum mechanics.
4) Learning about the zeroth law of thermodynamics and thermodynamic equilibrium.
5) Understanding Carnot's cycle, Heat engines and Stirling cycle.
6) Applying the basic knowledge of classical mechanics

Course code: PHY102

Course Name: Physics Practical

Number of credits: 2 Skill Enhancement Course (SEC)

Number of sessions : 10 (3 hours each)

Course Outcomes

CO1: To determine the Refracting Angle, Refractive Index and Dispersive power of prism using spectrometer.

CO2: To determine the coefficient of thermal Conductivity of bad conductor

CO3: Study of charging and Discharging of Capacitor.

CO4: Verification of Kirchhoff's law

CO5: Wavelength determination of main spectral line of mercury light using plane transmission grating.

CO6: Apply the basic knowledge of classical mechanics in day to day life

List of Practicals (Any6)

1. To find the specific charge density of an electron particle in a CRT by Thomson method.
2. Determination of the radius of a current carrying coil 2-Determination of magnetic field with the variation of distance along the axis of current carrying coil.
3. To determine the Wavelength of main spectral line of mercury light using plane transmission grating.
4. To determine the Refracting Angle, Refractive Index and Dispersive power of prism using spectrometer.
5. To determine the coefficient of thermal Conductivity of bad conductor by Lee's Disc.
6. Charging and Discharging of Capacitor.
7. Verification of Kirchhoff's law.

Learning Outcomes

1) To determine the Refracting Angle, Refractive Index and Dispersive power of prism using spectrometer.
2) To determine the coefficient of thermal Conductivity of bad conductor
3) Study of charging and Discharging of Capacitor.
4) Verification of Kirchhoff's law
5) Wavelength determination of main spectral line of mercury light using plane transmission grating.
6) Apply the basic knowledge of classical mechanics in day to day life

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Course code: BIO201

Course Name: Biology of Cells

Number of credits: 2 Discipline Specific Course (DSC)

Number of lectures: 30

Course Objective (CO):

CO1: Introduction to basic unit of life, the cell, and its structural and functional elements.

CO2: Learning the components of a cells and their functioning, cell division, contribution of a cell to form multicellular units, and flow of genetic information within a biological system through the central dogma of life.

CO3: This subject covers details and highlights of the cell ant its components which is very helpful to get knowledge how components of life works at micro level.

Course Contents

Topic	
Chapter 1: Chemistry of Life (8 lectures)	No of lectures
● The chemical basis of life, Biogeny, Chemogeny,Cognogemy	1
● Bioenergetics : Laws of thermodynamics applied to humans	1
● Enzymes and catalysed reactions : Introduction, Hypothesis, Classification, Nomenclature and examples	1
● Metabolism: Catabolism and anabolism and regulation	1
● Concatenation and Biopolymers	1
● Stereochemistry and Biomolecular chirality	1
● Biochemistry and Biomolecular structure	1
● Small inorganic molecules of biological importance	1
Chapter 2: The Biology of Cells (1 lecture)	
● Introduction to Cell Biology , cell theory, history of cell biology, significance of cell biology	1
Chapter 3: The cell contained (6 lectures)	
● The plasma membrane, structure and function	1
● Cell walls, extracellular matrix, cellulose synthesis, other cell wall components, structure and function, components of ECM	2
● Cytoplasm: content, chemistry and properties , functions	1
● Cytoskeleton, actin filaments, microtubules , structure and function	2
Chapter 4: Information flow in the cell (3 lectures)	
● Nucleus, chromosomes, DNA , structure, function and applications	1
● Genes and the genetic code, properties and applications	1

• Control of gene expression, introduction to central dogma	1
Chapter 5: Harvesting energy (3 lectures)	
• Mitochondria, ATP, energetic reactions, electron transport pathways, cellular respiration , morphology, structure and function	1
• Chloroplasts, photosynthesis, historical experiments, pigments, photosystems , morphology, structure and function	2
Chapter 6: Multicellularity and the Dividing Cell (7 lectures)	
• Cell division, cell cycle, mitosis, cytokinesis, division and distribution of organelles, Significance of cell division, types and phases of cell cycle	2
• Meiosis, formation of haploid cells , types of meiosis and genetic recombination in meiosis	1
• Communication and signaling, recognizing and responding, types and examples	2
• Cell differentiation and multicellularity, dedifferentiation and redifferentiation , example and significance	2

Learning Outcomes:

- On completion of the course, student will be able to understand the structure and function of each of the organelles and cell division and central dogma of life.
- Students will gain elementary knowledge about how things work at micro level deep inside all organisms', cell to cell signaling and communication.

References :

1. Molecular Cell Biology. 7th Edition, (2012) Lodish H., Berk A, Kaiser C., KReigerM.,Bretscher A., Ploegh H., Angelika Amon A., Matthew P. Scott M.P., W.H. Freeman and Co., USA.
2. Molecular Biology of the Cell, 5th Edition (2007) Bruce Alberts, Alexander Johnson,JulianLewis, Martin Raff, Keith Roberts, Peter Walter. Garland Science, USA
3. Cell Biology, 6th edition, (2010) Gerald Karp. John Wiley & Sons., USA.
4. The Cell: A Molecular Approach, 6th edition (2013), Geoffrey M. Cooper, Robert E. Hausman, Sinauer Associates, Inc. USA.

Course code: BIO202

Course Name: Biology Practical

Number of credits: 2 Discipline Specific Course (DSC)

Number of sessions : 10 (3 hours each)

Course outcomes

CO1: To understand handling of microscope for observations of slide.
CO2: To understand and hands on training to handle Gel apparatus.
CO3: Understand the working of electron and fluorescent microscopy.
CO4: Learning and handling hematocytometer for counting of cells.
CO5: Observing and learning to prepare slides to study cell division from onion root tip.

List of practicals

1. Microscopy and observation recording of representative organelle readymade specimens
2. Staining of cell for observations of- Flagella, cell wall, endospores, etc.
   a. Plant call, bacterial, fungi samples
   b. malachite green, safranin, Leifson flagella stain/RYU flagella stain, nitric acid, crystals of potassium chlorate
3. Introduction and visualization DNA-Proteins in silico
4. A one day visit to IISER Pune for electron/ fluorescence microscopy observations
5. Observation of budding in yeast & different kinds of cells
6. Observation of live/dead cells using Trypan blue staining
7. Isolation of DNA
8. Mitosis in onion root tips
9. Any two related experiments

Learning outcomes

1) Handling of microscope for observations of slide.
2) Hands on training to handle Gel apparatus.
3) Understanding the working of electron and fluorescent microscopy.
4) Learning and handling hematocytometer for counting of cells.
5) Observing and learning to prepare slides to study cell division from onion root tip.

References:

Course code: MTH201

Course Name: Algebra

Number of credits: 4 Skill Enhancement Course (SEC)

Number of lectures : 60

Course Outcomes

CO1: Find roots of the polynomials in Complex Numbers

CO2: Solve System of linear equations using matrices

CO3: Know about Mean Value theorems and its applications

CO4: Know about Scalar and Vector projections

MTH 201 Algebra	
Analysis (15 lectures)	**No. of lectures**
Limits of real-valued functions	2
Proving limits using the definition	2
Continuity & differentiability	1
Examples of differentiable and non-differentiable functions; continuity and differentiability of standard functions including polynomials, trigonometric, exponential, log functions and their inverses	4
Techniques for evaluating limits including L'Hopital's rule, sandwich theorem	2
Mean Value Theorem and applications	2
Applications of differential calculus eg related rates	2
Complex numbers (7 lectures)	**No. of lectures**
Review of complex numbers including algebra, Argand plane, cartesian and polar form	1
Complex exponential	2
Fundamental Theorem of Algebra	2
de Moivre's theorem; roots of complex numbers	2
Vectors (8 lectures)	**No. of lectures**
Vector arithmetic, dot product, vector projections (review)	2
Vector cross product; scalar triple product; parametric curves specified by vector equations	2
Lines and planes in R^3	2

Lines and planes in R^3	2
Linear Algebra (30 lectures)	**No. of lectures**
Solving systems of linear equations with Gaussian elimination	2
Solutions of systems of linear equations - consistency, uniqueness	2
Geometric interpretation of solutions	2
Matrices, matrix addition, multiplication, transpose and properties (review)	3
Matrix inverse	2
Determinant	2
R^n as a vector space, linear independence of vectors in R^n	2
Span of a set of vectors, subspaces of R^n	2
Basis and dimension in R^n	2
Abstract vector space axioms; examples and non-examples of vector spaces	2
Bases, dimension and co-ordinates in (finite dimensonal) abstract vector spaces	2
Definition of linear transformation and examples/non-examples	2
Linear transformations of the plane	2
Matrix representation of a linear transformation	1
Image and kernel of a linear transformation	1
Rank and nullity	1

Learning Outcomes

1) Finding roots of the polynomials in Complex Numbers
2) Solving System of linear equations using matrices
3) Knowing about Mean Value theorems and its applications
4) Knowing about Scalar and Vector projections

References:

1) Ordinary and partial differential equations by Dr. M. D. Raisinghania, S. Chand (18th Edition), 1976
2) Mathematical Analysis by S.C. Malik and Savita Arora, New Age International Private Limited (Fifth Edition), 2017

Course code: IDC201

Course Name: Scientific Computation and Modelling
(Practical Course)

Number of credits: 2 Value Enhancement Course (VEC)

Number of lectures : 30 or 10 sessions of 3 hours

Course Objectives (CO):

CO1: Basic concepts in computing
CO2: use of free resource softwares
CO3: understanding of concepts in computer progamming

IDC201 Scientific Computation and Modelling (Practical Course)	
Topics	**No. of Lectures**
Introduction to computing What is computing; Introduction to Electronic data processing; Electronic devices; Information storage; access and management; Key terms used in IT; Introduction to computer networks; Brief introduction to compilers, interpreters and associated languages Introduction to Scientific Computing (Definition,Need and design of Scientific Computing processes, Use of different software systems for Scientific Computing, Examples)	2
Introduction to Open Source Software History and use of Open Source Software Examples of popular Open Source Software in different domains with special focus on Environmental Science, Examples	1
Algorithms and System Analysis Design and components of algorithms, flowcharts, steps to design the optimum algorithm, analysis of algorithms, examples; System thinking, steps of system analysis, defining the problem and designing the optimum solution, examples	2
Python Syntax: Variables and Assignments; variable types; input-output; arithmatic; functions and built-in function; If & While; Lists & Tables for loops, Simple Visualisations	15
Numerical Analysis: 1D integrals using Trapezoidal and Simpson's Rule; Euler's Method ; Generating Random numbers OR **Mathematical Modelling:** Agent Based Modelling; using NET Logo or similar tool, simple Harmonic Oscillator, Random Walks	10

Learning Outcomes:

1) Making algorithms
2) Knowledge of the open resource software
3) Understanding the basic concepts in computing and developing a small program.

References: