

Semester-Wise Programme structure for B.Sc. HGMM (3 Years)

| Sr. No. | Year 1 | | Year 2 | | Year 3 | |
|----------------|---|---|---|--|--|--|
| | Semester 1 | Semester 2 | Semester 3 | Semester 4 | Semester 5 | Semester 6 |
| 1 | Biochemistry-I [CU:6,L-4, P-2] {CC} | Biochemistry-II [CU:6,L-4, P-2] {CC} | Biotechniques [CU:6,L-4, P-2] {CC} | Immunology[CU:6 ,L-4, P-2] {CC} | Molecular Biology [CU:6,L-4, P- 2] {CC} | Gene Regulation [CU:6,L-4, P-2] {CC} |
| 2 | Basic Cell Biology [CU:6,L-4, P-2] {CC} | Fundamentals of Genetics [CU:6,L-4, P-2] {CC} | Enzymology [CU:6,L-4, P-2] {CC} | Human Anatomy and Physiology [CU:6,L-4, P-2] {CC} | Developmental Biology [CU:6,L-4, P- 2] {CC} | Molecular Biology of Human Diseases[CU:6, L-4, P-2] {CC} |
| 3 | General Chemistry [CU:4,L-3, P-1] {AC} | General Microbiology [CU:4,L-3, P-1] {AC} | Genetics & Inheritance Biology [CU:6,L-4, P-2] {CC} | Microbial Physiology and Metabolism [CU:6,L-4, P-2] {CC} | SE -I [CU:4 ,L-4] {SE} | SE -3 [CU:4 ,L- 4] {SE} |
| 4 | SEC1- Mathematics for Life Sciences [CU:2,L-2] {SEC} | SEC2- Statistics for Life Sciences [CU:2,L-2] {SEC} | Protein Science [CU:4,L-4] {AC} | Recombinant DNA Technology [CU:4,L-3, P-1] {AC} | SE -2 [CU:4 ,L-4] {SE} | SE -4 [CU:4 ,L- 4] {SE} |
| 5 | EVS-I [CU:2,L- 2] {AEC} | EVS-II [CU:2,L-2] {AEC} | SEC3- Prgramng with C [CU:2,L-1,P- 1] {SEC} | SEC4- Fundamentals of Physics [CU:2,L- 2] {SEC} | SEC -5 [CU:2 ,L-2] {SEC} | SEC -7 [CU:2 ,L-2] {SEC} |
| 6 | Communicatio n skills [CU:1,L-1] {VAC} | Communication skills [CU:1,L-1] {VAC} | - | - | SEC -6 [CU:2 ,L-2] {SEC} | SEC -8 [CU:2 ,L-2] {SEC} |
| 7 | Behavioural Sciences[CU:1 ,L-1] {VAC} | Behavioural Sciences[CU:1, L-1] {VAC} | - | - | - | - |
| 8 | FBL [CU:1,L-1] {VAC} | FBL [CU:1,L-1] {VAC} | - | - | - | - |
| 9 | PL/HCP [CU:1,L-1] {AEC} | PL/HCP [CU:1,L-1] {AEC} | - | - | - | - |
| Credits | 24 | 24 | 24 | 24 | 24 | 24 |

Total Programme Credits **144**

| | |
|------------|-----------------------------------|
| AC | Allied Course |
| AEC | Ability Enhancement Course |
| CC | Core Course |

| | |
|--------------|---------------------------------------|
| GE | General Elective |
| OE | Open Elective |
| SC | Skill component |
| SE | Specialization Elective Course |
| SEC | Skill Enhancement Course |
| VAC | Value Added Course |
| NTCC | Non Teaching Credit Course |
| CU | Credit Unit |
| L;T;P | Lecture ; Tutorial ; Practical |
| H | Honours |

B.Sc. (H) Human Genetics and Molecular Medicine- 3 years (1st Semester)

| Sr. No | Course Code | Course Title | Course Type | Credits | | | | | Credit Units |
|--------|---------------|---|----------------------------|---------|---|----|----|----|--------------|
| | | | | L | T | PS | FW | SW | |
| 1 | BCH101 | Basic Cell Biology | Core Courses | 4 | 0 | 2 | 0 | 0 | 6 |
| 2 | BCH102 | Biochemistry-I | Core Courses | 4 | 0 | 2 | 0 | 0 | 6 |
| 3 | | General Chemistry | Allied Courses | 3 | 0 | 1 | 0 | 0 | 4 |
| 4 | | Mathematics for Life Biosciences | Skill component | 2 | 0 | 0 | 0 | 0 | 2 |
| 5 | ENV101 | Environment Studies -I | Ability Enhancement Course | 2 | 0 | 0 | 0 | 0 | 2 |
| 6 | ENG101 | Communication Skills -I | Value Added Course | 1 | 0 | 0 | 0 | 0 | 1 |
| 7 | FOL101/FOL102 | Foreign Business Language | Value Added Course | 1 | 0 | 0 | 0 | 0 | 1 |
| 8 | PSY101 | Behavioural Science -I | Value Added Course | 1 | 0 | 0 | 0 | 0 | 1 |
| 9 | INL101/INL103 | Punjabi Language/Punjab History & Culture | Ability Enhancement course | 1 | 0 | 0 | 0 | 0 | 1 |

Total Credits

24

BCH101: Basic Cell Biology

Course content and syllabus

| L | T | P | Total Credits |
|---|---|---|---------------|
| 4 | 0 | 2 | 6 |

Course Objectives: To develop basic understanding of cell biology

| | Teaching Hrs |
|--|---------------|
| Unit I: Introduction to the Cell: theory and Broad Classification | 18 hrs |
| Cell: The cell theory, Broad Classification of cells, Structure and function of cell organelles, Cytoskeletal structures (actin, microtubules etc.). | |
| Unit II: Cell wall and Cell Membrane | 18 hrs |
| Cell wall and Cell Membrane: physical structure of model membranes in prokaryotes and eukaryotes, lipid bilayer, membrane proteins, other constituents; diffusion, osmosis, active transport, and regulation. | |
| Unit III: Cell division and cell cycle | 18 hrs |
| Cell division and cell cycle: Mitosis and meiosis, Cell cycle, Apoptosis, Necrosis and Autophagy. Cell transformation and cancer: oncogenes and proto-oncogenes, Tumor suppressor genes, metastasis. Contribution of Nobel laureates in elucidation of the DNA structure, cell death and cell cycle. | |
| Unit IV: Cell Signalling | 18 hrs |
| Cell signalling: General principles, signal transduction, Hormones and their receptors, second messengers, regulation of signalling pathways, bacterial chemotaxis and quorum sensing., Cell adhesion molecules, contribution in cell communication | |

List of Experiments -with basic instructions

1. To study different parts of microscope
2. Cytochemical staining of proteins by Methylene blue
3. Cytochemical staining of polysaccharides by PAS
4. Study of stages of Mitosis using onion root tip
5. Study of stages of Meiosis in onion flower buds
6. Preparation of Buccal Smear for microscopic examination
7. To study the effect of isotonic, hypotonic and hypertonic solutions on cells
8. To demonstrate cell viability and cell death

Course Learning Outcomes:

- Understand types of cells and cellular organelles.
- Identify differences in the structure of different types of cell walls and membranes.
- Compare the cell division and cell cycle.
- Perceive knowledge of signalling cascades and communication networks in the cell.

Text/Reference Books

| AUTHOR | TITLE | Publisher | Year of publication | ISBN | Pages |
|---|--------------------------------|--|----------------------------|----------------|--------------|
| De-Robertis, F.D.P., and De-Robertis Jr. E.M.F. | Cell and Molecular Biology | Lippincott Williams & Wilkins | 2011 | 9781260219718 | 233 |
| Geoffrey, M | The Cell: A molecular approach | Oxford Sinauer Associates, Oxford University Press | 2014 | 978-0070083660 | 322 |
| Lodish, H.F | Molecular Cell Biology. | Macmillan International) | 2021 | 9781260363821 | 456 |

BCH102: Biochemistry-I

Course content and syllabus

| L | T | P | Total Credits |
|----------|----------|----------|----------------------|
| 4 | 0 | 2 | 6 |

| | Teaching Hours |
|---|-----------------------|
| Unit I: Water and its Properties | 18 hrs |

| | |
|--|---------------|
| Water and its Properties: Dissociation and association constants, pH and buffers. pI, pK_a , Henderson Hasselbalch equation and its implications. Basic Thermodynamics: Laws of thermodynamics. Concepts of ΔG , ΔH and ΔS . | |
| Unit II: Carbohydrates | 18 hrs |
| Carbohydrates: Structure, properties and functions of: Monosaccharides (glucose, fructose, ribose and others, D-and L- sugars, reducing and non-reducing sugars), Disaccharides (maltose, sucrose and lactose) and polysaccharides (Starch and glycogen) | |
| Unit III: Lipids and Nucleic Acids | 18 hrs |
| Lipids: Classification, Structure and function. Conformation of Nucleic acids: Structural characteristics of A, B and Z-DNA. Significance of DNA and RNA. | |
| Unit IV: Proteins | 18 hrs |
| Proteins: Physico-chemical and structural properties of amino acids, non-protein and rare amino acids. Protein Structure: Primary, Secondary, Tertiary, Quaternary, structure of proteins, Forces stabilizing Primary, Secondary and Tertiary protein structures. Enzymes: structure & function. Forces that stabilize biomolecules: electrostatic and van der Waal's interaction, hydrogen bonding. Interactions with solvents, Hydrophobic effect. | |

List of Practicals with basic instructions (Total = 60 hrs)

1. Preparation of solutions and buffers.
2. Preparation of 0.1M phosphate buffer, pH 7.4, 250ml without using the pH meter. (By using Henderson –Hasselbalch equation)
3. Verification of Beer Lamberts Law.
4. Estimation of carbohydrate in given solution by anthrone method.
5. Study the presence of reducing/non-reducing sugar in biological samples.
6. Protein estimation by Lowry's method and other methods.
7. Determination of acid value and saponification value of a fat.

Course Learning Outcomes:

- Understand the law of thermodynamics, water, and its properties.
- Determine the structure and properties of carbohydrates.
- Comparing the structure of various types of lipids, and their role on biological systems.
- Evaluate the structure and functional properties of proteins.

Text/Reference Books

| Author | Title | Publisher | Ed/year | ISBN No | Pages |
|----------------------|--|----------------------------|------------------|----------------|-------|
| Wilson K., Walker J. | Principle and Techniques of Biochemistry and Molecular Biology | Cambridge University Press | 6th edition/2006 | 978-0521178747 | 744 |
| Plummer, David | An Introduction to Practical Biochemistry | Tata Mc GrawHills | 3rd edition/2017 | 978-0070994874 | 250 |

General Chemistry

Course content and syllabus

| L | T | P | Total Credits |
|---|---|---|---------------|
| 3 | 0 | 1 | 4 |

| | Teaching Hours |
|---|----------------|
| Unit I: Atomic Theory | 14 hrs |
| Bohr's theory, Wave mechanics: de' Broglie equation, Heisenberg's Uncertainty, Principle and its significance, Schrödinger's wave equation, Quantum numbers and their significance. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of s, p, d and f orbitals. 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: The Periodic Table: History and Periodic Trends | 14 hrs |
| Unit II: The Periodic Table: History and Periodic Trends 14 h Detailed discussion of the following properties of s, p, d, f block elements in long form of periodic table. with reference to s and p-block; Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table, Atomic radii (van'der Waals), Ionic and crystal radii (octahedral and tetrahedral), Covalent radius, Ionization enthalpy and factors affecting successive ionization energies. Applications of ionization enthalpy, trends in electron gain enthalpy, electronegativity- Pauling, Mullikan, Allred Rochow scales, electro-negativity and bond order, partial charge, hybridization, group electronegativity. | |
| Unit III: Fundamentals of Organic Chemistry | 13 hrs |

| | |
|---|---------------|
| Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties. Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength. Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophilicity and basicity; Types, shape and relative stabilities of reaction intermediates (Carbocations, Carbanions, Free radicals and Carbenes). Organic reactions and their mechanism: Addition, Elimination and Substitution reactions | |
| Unit IV: States of matter : Gases and Liquids | 13 hrs |
| Deviations from ideal gas behavior, compressibility factor, and its variation with pressure for different gases. Causes of deviation from ideal behavior. van de Waals equation of state, its derivation and application in explaining real gas behaviour; van der Waals equation expressed in virial form, Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, critical and van der Waals constants, law of corresponding states. Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η ; variation of viscosity with temperature and pressure. Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities. | |

List of Practicals with basic instructions (Total = 30 hrs)

Inorganic Chemistry Practicals

1. Titrimetric Analysis
 - (i) Calibration and use of apparatus.
 - (ii) Preparation of solutions of different Molarity/Normality of titrants.
 - (iii) Use of primary and secondary standard solutions.
2. Acid-Base Titrations
 - (i) Estimation of carbonate and hydroxide present together in mixture.
 - (ii) Estimation of carbonate and bicarbonate present together in a mixture.

Organic Chemistry Practicals

3. Chromatography
 - a. Separation of a mixture of two amino acids by ascending and horizontal paper chromatography
 - b. Separation of a mixture of two sugars by ascending paper chromatography

c. Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC).

Physical Chemistry Practicals

4. Surface tension measurements
 - a. Determine the surface tension by (i) drop number (ii) drop weight method.
 - b. Study the variation of surface tension of detergent solutions with concentration.
5. Viscosity measurements using Ostwald's viscometer
Determine of viscosity of aqueous solutions of (i) ethanol (ii) sugar at room temperature.

Course Learning Outcomes:

- Knowledge of evolution of scientific theories to explain the atomic structure, molecular geometry and physico-chemical behaviour of atomic matter made from elements in periodic table.
- Focus on fundamentals of organic molecules, structure, stereochemistry, bonding, reactivity and reaction mechanisms.
- Familiarization with solid and liquid states of matter and its physical laws related to describe the

Text/Reference Book

| Author | Title | Publisher | Ed/year | ISBN No | Pages |
|---|---------------------------------------|-------------------------------|-------------------------|---------------------|-------|
| J.D. Lee, | Concise Inorganic Chemistry | John Wiley and Sons Ltd | 5th edition/2016 | ISBN 978-8126518 | 547 |
| Atkins P.W, Julio dePaula, | Physical Chemistry | Oxford University Press, ELBS | 11 TH , 2018 | ISBN 978-0198814740 | 250 |
| Shoemaker, D.P Garland, C.W Nibler, J.W | ., Experiments in Physical Chemistry, | McGraw Hill Inc, | 8th edition (2008), | ISBN 978-0070570078 | 345 |

Mathematics for Biosciences

| L | T | P | TOTAL CREDIT UNITS |
|---|---|---|--------------------|
| 2 | 0 | 0 | 2 |

Course Contents/syllabus:

| | Teaching Hours |
|---|----------------|
| Unit I: Sets, Relations and Function | 9 H |
| Sets and their properties, Cartesian product of Sets, relations, functions and their types and graphs | |
| Unit II: Matrix Algebra | 9 H |
| Matrices, Types of Matrices, Addition of matrices, Subtraction of matrices and Product of matrices. Properties of Matrix Multiplication. Transpose of Matrix, Symmetric and Skew-symmetric Matrices, Inverse of Matrix and system of linear equations | |
| Unit III: Differential Calculus | 9 H |
| Algebra of limits, Continuity, Derivative of a function, Fundamental rules for differentiation, increasing and decreasing functions, Introduction to Partial derivatives | |
| Unit IV: Integral Calculus | 9 H |
| Indefinite and definite integrals, methods of Integration, Properties of definite integrals | |

Course Learning Outcomes: On the successful completion of this course,

- Students will demonstrate the ability to distinguish corresponding sets as representations of relations or functions by the analysis of graphical, numeric, or symbolic data
- Students will demonstrate the ability to apply the concept of matrices in real-life situations
- Students will understand the concepts of Limits, Continuity and Differentiability and their applications
- Students will understand and analyze the concept of Integration with the help of Differentiation and study its various applications

Text / Reference Books:

| AUTHOR | TITLE | Publisher | Year of publication | ISBN |
|---|---------------------------------|-------------------|---------------------|----------------|
| George B. Thomas Jr., Joel Hass, Christopher Heil & Maurice D. | Thomas' Calculus (14th edition) | Pearson Education | 2018 | 978-9353060411 |

| | | | | |
|-----------|--------------------------------|----------|------|----------------|
| Weir | | | | |
| H.K. Dass | Higher Engineering Mathematics | S. Chand | 2014 | 978-8121938907 |

ENV101: Environmental Studies -I

Course content and syllabus

| L | T | P | Total Credits |
|---|---|---|---------------|
| 2 | 0 | 0 | 2 |

| | Teaching Hours |
|---|----------------|
| Unit-1- Multidisciplinary nature of environmental studies and Natural Resources-1 | 9 hrs |
| <i>Multidisciplinary nature of environmental studies:</i> Definition, scope and importance; components of environment –atmosphere, hydrosphere, lithosphere and biosphere. Concept of sustainability and sustainable development. | |
| <i>Natural resources:</i> Land resources and land use change, land degradation, soil erosion and desertification. | |
| Unit-2- Natural Resources-2 | 9 hrs |
| Deforestation: causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal population. | |
| Water Resources-Use and over-exploitation of surface and groundwater, floods, drought, conflicts over water (international and inter-state). | |
| Heating of earth and circulation of air; air mass formation and precipitation. Energy resources- renewable and non-renewable energy sources, use of alternate energy sources, Growing energy needs, Case studies. | |
| Unit-3-Ecosystems | 9 hrs |

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| <p><i>Ecosystem</i>: What is an ecosystem; Structure and function of an ecosystem; Energy flow in the ecosystem; Food chains, food webs and ecological succession. Case studies of the following ecosystems:</p> <p>Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).</p> | |
| Unit-4- Biodiversity and its conservation | 9 hrs |
| <p><i>Biodiversity</i>: Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India; biodiversity patterns and global biodiversity hot spots.</p> <p>India as a mega-biodiversity nation; endangered and endemic species of India.</p> <p>Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; conservation of biodiversity: <i>in-situ</i> and <i>ex-situ</i> conservation of biodiversity.</p> <p>Ecosystem and biodiversity services: ecological, economic, social, ethical, aesthetic and information value.</p> | |

Course Learning Outcomes:

- Understand natural resources and evaluate limitations surrounding renewable and non-renewable resources
- Understand the nuances of ecosystem and learn about behaviour of various ecosystem
- Learn about the types, services and threats to our biodiversity and importance of conserving it.

Text/Reference Books

| AUTHOR | TITLE | Publisher | Year of publication | ISBN | Pages |
|--|-------------------------------------|----------------------------|----------------------------|----------------|--------------|
| William P. Cunningham, Mary Ann Cunningham | Principles of Environmental Science | McGraw-Hill | 2019 | 9781260219718 | -- |
| Dash and Dash | Fundamentals of ecology | Tata McGraw-Hill Education | 2009 | 978-0070083660 | -- |

| | | | | | |
|---|---|----------------------|------|-------------------|----|
| William P. Cunningham, Mary Ann Cunningham, Barbara Woodworth Saigo | Environmental Science: A global concern, | McGraw-Hill | 2021 | 9781260363821 | -- |
| Gaston K.J. and Spicer, J. I. | Biodiversity –An Introduction 2 nd edition | Blackwell Publishing | 2004 | 978-1-405-11857-6 | -- |

ENG101: Communication Skills-I

| L | T | P | Total Credits |
|---|---|---|---------------|
| 1 | 0 | 0 | 1 |

Course Contents/syllabus:

| | Teaching hours |
|---|----------------|
| Unit I: Basic Concepts in Communication | 3.5 hrs |
| Definition of communication, Nature and process of communication, role and purpose of communication, types and channels of communication, communication networks/flow of communication: vertical, diagonal, horizontal, barriers to communication: physical, language, and semantic, socio-psychological, organizational, gateway to effective communication, towards communicative competence, choosing the appropriate channel and medium of communication, social communication: small talk and building rapport, barriers in communication. | |
| Unit II: Communication Types | 5.5 hrs |
| Verbal communication: Oral Communication: Forms, Advantages & Disadvantages, Written Communication: Forms, Advantages & Disadvantages, Introduction of Communication Skills (Listening, Speaking, Reading, Writing), Nonverbal communication: functions and effective use, KOPPACT(Kinesics, Oculesics, Proxemics, Para-language, Artifacts, Chronemics, Tactilics). The implication of appropriate communication; effective ways of using social media, importance of digital literacy. | |
| Unit III: Reading and Writing Skills | 3 hrs |
| Significance of reading; Reading Comprehension, gathering ideas from a given text, identify the main purpose and context of the text, evaluating the ideas, interpretation of the text, Paragraph development; essay writing. | |

| | |
|--|-------|
| Unit IV: Speaking and Presentation Skills | 6 hrs |
| Speaking skills: fluency, vocabulary, grammar, and pronunciation; effective speaking: selection of words, your voice, and non-verbal communication, functions of speaking: interaction, transaction, and performance; structuring the message; effective speaking strategies. Planning, preparation, practice, and performance; audience analysis, audio-visual aids, analyzing the non-verbal communication, methods of delivery: impromptu, extemporaneous, memorization, manuscript, and outlining. | |

Course Learning Outcomes:

- Students will be able to understand the basic processes of communication, both verbal as well as non-verbal—nature, scope, and power of communication processes.
- Students will be able to demonstrate cultural sensitivity in communication and appreciation of cultural variations of diverse socio-cultural contexts.
- Students will be able to develop an awareness of the role of mass media in shaping public psyche, beliefs, and perceptions about social realities and build an informed and critical perspective.
- Students will be able to analyze situations and audiences to make right choices about the most effective and efficient ways to communicate and deliver messages.
- Students will be able to assess various barriers in communication and develop communicative competence thereby for effective communication.

Books/literature

| AUTHOR | TITLE | Publisher | Year of publication | ISBN |
|--|--|-------------------------|----------------------------|---------------|
| P. D. Chaturvedi and Mukesh Chaturvedi | Business Communication: Concepts, Cases and Applications | Pearson Education | 2006 | 9788131701720 |
| Meenakshi Raman and Prakash Singh | Business Communication | Oxford University Press | 2012 | 9780198077053 |
| Jeff Butterfield | Soft Skills for Everyone | Cengage Learning | 2017 | 9789353501051 |

COURSE CODE: FOL101 (Introduction to French Culture & Language)

| L | T | P | Total Credits |
|----------|----------|----------|----------------------|
| 1 | 0 | 0 | 1 |

Course Contents/syllabus:

| | Teaching hours |
|--|----------------|
| Unit-I Introduction to French language | 3 hrs |
| <ul style="list-style-type: none"> • Brief introduction of French and Francophone countries • Presenting oneself • Getting information about someone else • Greeting and taking leave • Asking/giving personal information | |
| Unit-II- A rendez-vous ; Visiting a place | 6 hrs |
| <ul style="list-style-type: none"> • Pronouncing and writing numbers in French • Spell and count numbers • Telling the time • Temporal expressions • Communicating in class • Fixing an hour, place for a meeting. • Describing a person. • Identifying a person, object and place • Describing relation in a family • A specific person, object and place | |
| Unit-III- An interview | 4.5 hrs |
| <ul style="list-style-type: none"> • Description of objects, people and places • Nationalities • Speaking about one's professions • Expressing Actions using regular –er ending verbs; avoir, être; reflexive verbs –usage, conjugation • Interview of celebrity | |
| Unit-IV- At the discotheque | 4.5 hrs |
| <ul style="list-style-type: none"> • Portrait by a journalist • Giving a positive or negative reply • Asking questions • Discussion with a person • Activities in a day | |

Course Learning Outcomes: At the end of this course, the students will be able to express themselves in writing and orally in basic French. This course content focuses on the speech of the students in a lucid and a concurrent manner using appropriate vocabulary and pronunciation techniques. Extra stress will be given on their understanding of grammatical structures and the foreign accent of the language. At the end of the course, the student shall be able to :

- Understand information; Express in his own words; Paraphrase; Interpret and translate.
- Apply information in a new way in a practical context
- Analyse and break-down information to create new ideas
- Evaluate and express opinion in a given context

Text / Reference Books:

| Author | Title | Publisher | Year | ISBN No |
|--------|-------|-----------|------|---------|
| | | | | |

| | | | | |
|---|---|--|------|------------------------|
| Christine Andant, Chaterine Metton, Annabelle Nachon, Fabienne Nugue | A Propos - A1 Livre De L'Eleve, Cahier D' Exercices | Langers International Private Limited | 2010 | 978- 938080 9069 |
| Manjiri Khandekar andRoopa Luktuke | Jumelage - 1 Methode De Fraincais - French | Langers International Private Limited | 2020 | 978- 938080 9854 |
| Michael Magne, Marie- LaureLions-Olivieri | Version Originale 1: Cahier d'exercices | Maison Des Langues | 2010 | 978848 443561 7 |

COURSE CODE: FOL102 (Introduction to German Culture & Language)

| L | T | P | Total Credits |
|---|---|---|------------------|
| 1 | 0 | 0 | 1 |

Course Contents/syllabus:

| | Teaching hours |
|--|-------------------|
| Unit-I Introduction to German Language (Einführung) | 3 hrs |
| Introduction to German as a global language, Self-introduction and Greetings, Die Alphabeten, Phonetics: the sound of consonants and vowels, Wie buchstabieren Sie Ihren Name? | |
| Unit-II- Numbers and everyday conversation (die Zahl und Gespräche) | 6 hrs |
| Counting in German from 1-100, Simple Calculation and verb 'kosten' - Wie viel kostet das? Plural Forms, Vocabulary: Wochentage, Monate, Jahreszeiten, Ordinal numbers and the question - Wann haben Sie Geburtstag? | |
| Unit-III- Regular verbs and nominative case: articles and pronouns (Regelmässige Verben und Nominativ Kasus: Artikel und Pronomen) | 4.5 hrs |
| Introduction to all personal pronouns and conjugation of Regular verbs Detailed exercise on regular verbs. Reading a text on regular verbs. Introduction to definite. Vocabulary: Schulsachen und Getränke, Nominative case/ Articles (der, die, das) Nominative Pronouns: - Applicability of pronouns for both persons and things. Usage of nominative Personal Pronouns Introduction of nominative possessive pronouns usage of nominative possessive pronouns | |
| Unit-IV- The Family, Work-life and Professions (Familienmitglieder und Berufe) & Interrogative sentences (W-Fragen) | 4.5 hrs |
| The Family, Work-life and Professions (Familienmitglieder und Berufe) Vocabulary: Professions and conjugation of the verb 'sein' Introduction to simple possessive pronouns with the help of the verb 'haben' Usage of possessive | |

| | |
|--|--|
| pronouns. | |
| Interrogative sentences (W-Fragen) W-Fragen: who, what, where, when, which, how, how many, how much, etc. Exercises on the question pronouns | |

Course Learning Outcomes: At the end of this course, the students will be able to express themselves in writing and orally in basic German. This course content focuses on the speech of the students in a lucid and a concurrent manner using appropriate vocabulary and pronunciation techniques. Extra stress will be given on their understanding of grammatical structures and the foreign accent of the language. At the end of the course, the student shall be able to:

- Understand information; Express in his own words; Paraphrase; Interpret and translate.
- Apply information in a new way in a practical context
- Analyse and break-down information to create new ideas
- Evaluate and express opinion in a given context

Text / Reference Books:

| Author | Title | Publisher | Year | ISBN |
|---------------------------|---|---|------|----------------|
| Rolf Bruseke | Starten Wir A 1 | Langers International Pvt Ltd (Max Hueber Verlag) | 2017 | 978-3190160006 |
| Giorgio Motta | Wir Plus Grundkurs Deutsch fur Junge Lerner Book | Ernst Kleit Verlag | 2011 | 978-8183072120 |
| Heimy Taylor, Werner Haas | Station en Deutsch Self Study Course German Guide | Wiley | 2007 | 978-0470165518 |

COURSE CODE: PSY101 (Behavioural Science: Understanding Self for Effectiveness)

| L | T | P | Total Credits |
|---|---|---|---------------|
| 1 | 0 | 0 | 1 |

Course Contents/syllabus:

| | Teaching time |
|---|----------------|
| Unit I: Self: Core Competency | 4.5 hrs |
| Understanding of Self, Components of Self – Self identity , Self concept, Self confidence , Self image , BIG5 Factors | |
| Unit II: Techniques of Self Awareness | 4.5 hrs |

| | |
|--|----------------|
| Exploration through Johari Window, Mapping the key characteristics of self, Framing a charter for self Stages – self awareness, self acceptance and self realization | |
| Unit III: Self Esteem & Effectiveness | 4.5 hrs |
| Meaning, Importance, Components of self esteem, High and low self esteem, Measuring your self esteem | |
| Unit IV: Building Positive Attitude and Emotional Competence | 4.5 hrs |
| Meaning and nature of attitude, Components and Types of attitude ,Importance and relevance of attitude Emotional Intelligence – Meaning, components, Importance and Relevance Positive and negative emotions, Healthy and Unhealthy expression of emotions | |

Course Learning Outcomes: At the end of this course, the students will be able to:

- The student will apply self-introspection as a tool for self-awareness.
- The student will understand self-concept for self-recognition, self-improvement and perception of others.
- The student will be able to analyze their physical self, social self, the competent self and psychological self.

The student will be able to analyze what motivates his/her actions and the actions of others

Text / Reference Books:

| AUTHOR | TITLE | Publisher | Year of publication | ISBN |
|---|--|----------------------|----------------------------|----------------|
| Singh A. | Achieving Behavioural Excellence for Success | Wiley Publication | 2012 | 978812658027 |
| Towers, Marc | Self Esteem | American Media | 1995 | 9781884926297 |
| Pedler Mike, Burgoyne John, Boydell Tom | A Manager's Guide to Self-Development | McGraw-Hill | 2006 | 978-0077114701 |
| Covey, R. Stephen | Seven habits of Highly Effective People | Simon & Schuster Ltd | 2013 | 978-1451639612 |
| Khera Shiv | You Can Win | Macmillan | 2005 | 978-0333937402 |
| Gegax Tom | Winning in the Game of Life | Harmony Books | 1999 | 978-0609603925 |

| | | | | |
|-----------------|-------------------------------|---------------|------|---------------|
| Singh, Dalip | Emotional Intelligence atWork | Publications | 2006 | 9780761935322 |
| Goleman, Daniel | Emotional Intelligence | Banta m Books | 2007 | 9780553095036 |
| Goleman, Daniel | ing with E.I | Banta m Books | 1998 | 9780553104622 |

COURSE CODE: INL101 (Punjabi)

| L | T | P | Total Credits |
|---|---|---|---------------|
| 1 | 0 | 0 | 1 |

Course content and syllabus

| | Weightage (%) | Teaching Hours |
|--|---------------|----------------|
| Unit I: | 25% | 4 hours |
| ਆਧੁਨਿਕ ਪੰਜਾਬੀ ਕਵਿਤਾ ਦਾ ਅਧਿਐਨ (ਕਾਵਿ-ਸੁਮੇਲ ਪਾਠ-ਪੁਸਤਕ) ਕਵਿਤਾ ਦਾ ਸਾਰ/ਕੇਂਦਰੀ ਭਾਵ ਅਤੇ ਪ੍ਰਸੰਗ ਸਾਹਿਤ ਵਿਆਖਿਆ ਕਵੀ ਦੇ ਜੀਵਨ ਅਤੇ ਸਾਹਿਤਕ ਯੋਗਦਾਨ ਬਾਰੇ ਮੁੱਢਲੀ ਜਾਣਕਾਰੀ | | |
| Unit II: | 25% | 4 hours |
| 1.ਲੇਖ-ਰਚਨਾ ਲੇਖ-ਰਚਨਾ: ਮਹੱਤਵ, ਕਿਸਮਾਂ ਅਤੇ ਵੱਖ-ਵੱਖ ਵਿਸ਼ਿਆਂ ਅਨੁਸਾਰ ਵਿਹਾਰਕ ਅਭਿਆਸ 2.ਸੰਖੇਪ-ਰਚਨਾ ਸੰਖੇਪ-ਰਚਨਾ: ਮਹੱਤਵ ਅਤੇ ਤਕਨੀਕ | | |
| Unit III: | 25% | 5 hours |
| ਵਿਆਕਰਨ ਸਿਧਾਂਤ ਅਤੇ ਵਿਹਾਰ: 1.ਵਿਆਕਰਨ: ਪਰਿਭਾਸ਼ਾ;ਮਹੱਤਤਾ;ਉਦੇਸ਼;ਵਿਆਕਰਨ ਦੇ ਅੰਗ 2. ਪੰਜਾਬੀ ਧੁਨੀਵਿਓਂਤ: ਸ਼੍ਰੀ ਅਤੇ ਵਿਅੰਜਨ ਧੁਨੀਆਂ ਦਾ ਵਰਗੀਕਰਨ, ਉਚਾਰਨ ਅੰਗ | | |
| Unit IV: | 25% | 5 hours |
| ਵਿਆਕਰਨ ਸਿਧਾਂਤ ਅਤੇ ਵਿਹਾਰ: ਸ਼ਬਦ ਸ਼੍ਰੇਣੀਆਂ: ਪਰਿਭਾਸ਼ਾ ਅਤੇ ਪ੍ਰਕਾਰ | | |

| | | |
|--|--|--|
| ਨਾਂਵ, ਪੜਨਾਂਵ, ਵਿਸ਼ੇਸ਼ਣ, ਕਿਰਿਆ, ਕਿਰਿਆ ਵਿਸ਼ੇਸ਼ਣ, ਸਬੰਧਕ, ਯੋਜਕ ਅਤੇ ਪ੍ਰਸ਼ਨ-ਸੂਚਕ ਸ਼ਬਦ | | |
|--|--|--|

Course Learning Outcomes:

1. Understand modern Punjabi Poetry.
2. Interpret the importance of essay and precise writing
3. Analyze the Punjabi language structure and grammar.
4. Examine the impact and importance of grammar and language structure.

Pedagogy for Course Delivery

Lectures: 14 sessions

Presentation / Seminar/ Assignment: 2 sessions

Mid Term Test & End Term Exam: 2 sessions

Quiz: 3

Total: 18 sessions

Assessment/ Examination Scheme:

| | Theory L/T (%) | Lab/Practical/Studio (%) | End Term Examination | Reference |
|---------------|----------------|--------------------------|----------------------|-----------|
| Text / Books: | 100 | 0 | 100 | |

| AUTHOR | TITLE | Publisher | Year of publication | ISBN | Pages |
|--------------------------------|---|---|---------------------|------|-------|
| ਡਾ. ਕਰਮਜੀਤ ਸਿੰਘ (ਸੰਪਾ.), | ਕਾਵਿ ਸੁਮੇਲ | ਪਬਲੀਕੇਸ਼ਨ ਬਿਊਰੋ, ਪੰਜਾਬ ਯੂਨੀਵਰਸਿਟੀ ਚੰਡੀਗੜ੍ਹ | 2020 | - | - |
| ਸੁਰਿੰਦਰ ਸਿੰਘ ਖਹਿਰਾ (ਸੰਪਾ.), | ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਵਿਆਕਰਨ ਅਤੇ ਬਣਤਰ | ਪਬਲੀਕੇਸ਼ਨ ਬਿਊਰੋ, ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ ਪਟਿਆਲਾ | 2015 | - | - |
| ਡਾ. ਹਰਕੀਰਤ ਸਿੰਘ, | ਕਾਲਜ ਪੰਜਾਬੀ ਵਿਆਕਰਨ ਅਤੇ ਲੇਖ ਰਚਨਾ | ਪੰਜਾਬ ਸਟੇਟ ਯੂਨੀਵਰਸਿਟੀ ਟੈਕਸਟ ਬੁੱਕ ਬੋਰਡ, ਚੰਡੀਗੜ੍ਹ | 1999 | - | - |
| ਡਾ. ਪ੍ਰੇਮ ਪ੍ਰਕਾਸ਼ ਸਿੰਘ | ਕਾਲਜ ਪੰਜਾਬੀ ਵਿਆਕਰਨ | ਮਦਾਨ ਪਬਲੀਕੇਸ਼ਨਜ਼, ਪਟਿਆਲਾ | 2002 | - | - |

| | | | | | |
|------------------------------|---|--|------|----|---|
| | ਅਤੇ ਲੇਖ ਰਚਨਾ | | | | |
| ਡਾ. ਬੂਟਾ ਸਿੰਘ ਬਰਾੜ | ਪੰਜਾਬੀ ਵਿਆਕਰਨ ਸਿਧਾਂਤ ਅਤੇ ਵਿਹਾਰ | ਚੇਤਨਾ ਪ੍ਰਕਾਸ਼ਨ, ਪੰਜਾਬੀ ਭਵਨ, ਲੁਧਿਆਣਾ | 2012 | - | - |
| ਡਾ. ਬੂਟਾ ਸਿੰਘ ਬਰਾੜ | ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਸ਼੍ਰੋਤ ਅਤੇ ਸਰੂਪ | , ਵਾਰਿਸ ਸ਼ਾਹ ਫ਼ਾਊਂਡੇਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ | 2012 | - | - |
| ਦੁਨੀ ਚੰਦ | ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਦਾ ਵਿਆਕਰਣ | , ਪੰਜਾਬ ਯੂਨੀਵਰਸਿਟੀ ਪਬਲੀਕੇਸ਼ਨ ਬਿਊਰੋ, ਚੰਡੀਗੜ੍ਹ | 1995 | - | - |
| ਜੋਗਿੰਦਰ ਸਿੰਘ ਪੁਆਰ ਅਤੇ ਹੋਰ | ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਦਾ ਵਿਆਕਰਨ (ਭਾਗ 1,2,3), | ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਅਕਾਦਮੀ ਜਲੰਧਰ | 2003 | - | - |
| ਸੁਖਵਿੰਦਰ ਸਿੰਘ ਸੰਘਾ | ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਵਿਗਿਆਨ | ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਅਕਾਦਮੀ ਜਲੰਧਰ | 2010 | -- | - |
| ਅਗਨੀਹੋਤਰੀ, ਵੇਦ | ਪਰਿਚਾਇਕ ਭਾਸ਼ਾ ਵਿਗਿਆਨ | ਦੀਪਕ ਪਬਲਿਸ਼ਰਜ਼ ਜਲੰਧਰ | 1981 | | |

COURSE CODE: INL102 (History and Culture of Punjab)

| L | T | P | Total Credits |
|---|---|---|------------------|
| 1 | 0 | 0 | 1 |

Course Contents/syllabus

| | Teachin ghours |
|----------------|-------------------|
| Unit I: | 4.5 hrs |

| | |
|--|----------------|
| 1. Harappan Civilization: extent and town planning and socio-economic life. 2. Life in Vedic Age: socio-economic and religious; 3. Growth and impact of Jainism and Buddhism in Panjab. | |
| Unit II: | 4.5 hrs |
| 4. Society and Culture under Maurayas and Guptas. 5. Bhakti movement: Main features; prominent saints and their contribution. 6. Origin and development of Sufism | |
| Unit III: | 4.5 hrs |
| 7. Evolution of Sikhism: teaching of Guru Nanak; Institutional Development- Manji, Masand, Sangat and Pangat 8. Transformation of Sikhism: Martyrdom of Guru Arjan; New policy of Guru Hargobind, martyrdom of Guru Tegh Bahadur. 9. Institution of Khalsa: New baptism; significance | |
| Unit IV: | 4.5 hrs |
| 10. Changes in Society in 18th century: social unrest; emergence of misls and other institutions - rakhi, gurmata, dal khalsa. 11. Society and Culture under Maharaja Ranjit Singh. 12. MAP (of undivided physical geographical map of Punjab): Major Historical Places: Harappa, Mohenjodaro, Sanghol, Ropar, Lahore, Amritsar, Kiratpur, Anandpur Sahib, Tarn Taran, Machhiwara, Goindwal, Khadur Sahib. | |

Course Learning Outcomes:

Understand the history of various cultures in Punjab.

Interpret the importance of Maurayan, Gupta and Bhakti influences on Punjab
Apply the teaching of Sikhism on the emergence of the Khalsa .

Examine the impact societal changes on socio-cultural and physical landscape of Punjab

Text / Reference Books:

| Author | Title | Publisher | Ed/year | ISBN No |
|-----------------|---|--------------------------------|-----------------------|---------|
| L.M Joshi, | History and Culture of the Punjab, Part-I | Punjabi University, Patiala | 1989, 3 rd | - |
| Buddha Prakash | Glimpses of Ancient Punjab | Punjabi University, Patiala, | 1983 | - |
| Khushwant Singh | A History of the Sikhs, vol I: 1469-1839, . | oxford University Press, Delhi | 1991 | - |

B.Sc. (H) Human Genetics and Molecular Medicine- 3 years (2nd Semester)

| Sr No | Course Code | Course Title | Course Type | Credits | | | | | Credi t Units |
|----------|-------------------|--|--------------------------------------|---------|---|----|----|----|---------------------|
| | | | | L | T | PS | FW | SW | |
| 1 | BCH104 | Biochemistry – II | Core Course | 4 | 0 | 2 | 0 | 0 | 6 |
| 2 | HGM101 | Fundamentals of Genetics | Core Course | 4 | 0 | 2 | 0 | 0 | 6 |
| 3 | MBO102 | General Microbiology | Allied Course | 3 | 0 | 1 | 0 | 0 | 4 |
| 4 | | Statistics for Biosciences | Skill Enhanceme ntcourse | 2 | 0 | 0 | 0 | 0 | 2 |
| 5 | ENV106 | Environmental Studies-II | Ability Enhanceme ntCourse | 2 | 0 | 0 | 0 | 0 | 2 |
| 6 | ENG103 | Communication Skills -II | Value Adde d Course | 1 | 0 | 0 | 0 | 0 | 1 |
| 7 | PSY106 | Behavioural Science - II | Value Adde d Course | 1 | 0 | 0 | 0 | 0 | 1 |
| 8 | FOL103/ FOL104 | Foreign Business Language –II | Value Adde d Course | 1 | 0 | 0 | 0 | 0 | 1 |
| 9 | INL104/ INL106 | Punjabi Language/ History and Culture of Punjab | Ability Enhanc ement Course | 1 | 0 | 0 | 0 | 0 | 1 |

Total Credits

24

BCH104: Biochemistry-II

| L | T | P | Total Credits |
|---|---|---|---------------|
| 4 | 0 | 2 | 6 |

Course content and syllabus

| | Teaching Hours |
|---|----------------|
| Unit I: Carbohydrate Metabolism | 18 hrs |
| Glycolytic pathway - aerobic and anaerobic glycolysis, Gluconeogenesis, Regulation of glycogen metabolism, Citric acid cycle and its regulation, Pentose phosphate pathway, Glyoxylate cycle, fate of absorbed carbohydrates, fructose, galactose, and mannose. | |
| Unit II: Lipid metabolism | 18 hrs |
| Oxidation of fatty acids - Beta oxidation, alpha-oxidation, and omega oxidation, Ketogenesis, Biosynthesis of saturated and unsaturated fatty acids, Biosynthesis and degradation of tri-acyl glycerol and cholesterol, fate of absorbed dietary lipids | |
| Module III Protein Metabolism | 18 hrs |
| Catabolism of amino acids, trans-amination, Oxidative and non-oxidative deamination, Decarboxylation- urea cycle and its regulation, Biosynthesis of creatinine, fate of dietary proteins | |
| Module IV Nucleic Acid Metabolism & Integration of metabolic pathways | 18 hrs |
| Catabolism and biosynthesis of nucleotides, de-novo synthesis and salvage pathways, Regulation of purine and pyrimidine biosynthesis, Interrelationship among carbohydrate, protein and fat metabolism | |

List of Experiments -with basic instructions (Total Teaching = 60 hrs)

1. Ninhydrin Test for Qualitative identification of Amino acids
2. Xanthoproteic Test for Qualitative identification of Aromatic Amino acids
3. Saponification test for lipid

4. Determination of Iodine number of fatty acids
5. Estimation of cholesterol
6. Estimation of protein by Bradford/Lowry's method
7. Estimation of DNA by Di-phenyl amine (DPA) method
8. Estimation of RNA by Orcinol method

Course Learning Outcomes:

- Students will understand the metabolic pathways linked with a series of chemical reactions occurring within a cell.
- This course will describe the chemical changes catalyzed by cellular components and various intracellular controls.
- Have knowledge of cellular metabolism, including central catabolic and anabolic pathways
- Understand how different control mechanisms may be integrated to coordinate cell metabolism and function.
- Understand how metabolism is coordinated in body systems and have knowledge of how disturbances in metabolism contribute to diseases

Text / Reference Books:

| Author | Title | Publisher | Ed/year | ISBN No | Pages |
|---|--|----------------------|---------|---------------------------|-------|
| David L Nelson; and Michael M. Cox, W.H. Freeman | Lehninger's Principles of Biochemistry | WH Freeman | 2012 | 0070492581, 9780070492585 | 957 |
| Jeremy M. Berg, Lubert Stryer, John L Tymoczko, and Gregory J. Gatto, | Biochemistry | W.H. Freeman Company | 2018 | 1319114652 | 1208 |

HGM101: Fundamentals of Genetics

| L | T | P | Total Credits |
|---|---|---|---------------|
| 4 | 0 | 2 | 6 |

Course content and syllabus

| | Teaching Hours |
|---|----------------|
| Unit I Science of Genetics | 18 hrs |
| <p>Description of cell cycle, cell division: mitosis, meiosis, DNA and RNA as genetic material, Chromosome structure: nucleosome, solenoid, chromatin loops, chromosomal territories, Types of chromosomes, Variation in chromosome structure and number: Deficiency, duplication, translocation, inversions, monosomy, nullisomy, trisomy, tetrasomy, haploidy, polyploidy. Origin and transmission of chromosomal aberrations.</p> <p>Brief history of genetics, Mendel and his experiments; Principles of segregation and independent assortment and their chromosomal basis; Test cross; Application of laws of probability to Mendelian inheritance. Understanding Punnet square.</p> | |
| Unit II Mendelian Genetics | 18 hrs |
| <p>Chromosome Theory of Heredity (Sutton-Boveri), Inheritance patterns, phenomenon of Dominance and Dominance relationships (complete dominance, incomplete dominance and co-dominance), Multiple allelism; Lethal alleles; Pleiotropy; Epistasis; Penetrance and expressivity; Phenocopy; Polygenic inheritance, Pleiotropism, Modifier/Modifying genes. Inheritance patterns in Human (Sex-linked, Autosomal, Unifactorial, Multifactorial).</p> <p>Linkage & Crossing over: Chromosome theory of Linkage, kinds of linkage, linkage groups, Sutton's view on linkage, Morgan's view on linkage, types of Crossing over, mechanism of Meiotic Crossing over, theories about the mechanism of Crossing over, cytological detection of Crossing over, significance of Crossing over.</p> | |
| Unit III: Non- Mendelian Genetics | 18 hrs |
| <p>Introduction to Genomic imprinting, maternal effects, extra nuclear inheritance in mitochondria and chloroplast. Sex determination, Dosage compensation with reference to X-inactivation in man, sex-linked, sex limited, sex influenced traits. Manifesting heterozygotes, mosaics, chimeras, hermaphrodites, Kappa articles in Paramecium, Sigma factor in <i>Drosophila</i>, Cytoplasmic Male Sterility (CMS) in maize maternal inheritance</p> | |

| | |
|--|---------------|
| Unit IV: Gene Mapping | 18 hrs |
| Use of sexual process in bacteria and bacteriophages in genetic mapping, genetic mapping in haploid and diploid eukaryotes. Multifactorial inheritance and quantitative traits, determination of linkage groups, determination of map distance, determination of gene order, cytological mapping. Hardy-Weinberg principle and effect of selection, mutation, migration and genetic drift on Hardy-Weinberg equilibrium. | |

List of Experiments -with basic instructions (Total Teaching = 60 hrs)

1. Preparation of Mitotic Chromosome from human Leucocytes.
2. Study of salivary gland chromosomes in *Drosophila*.
3. Using Punnet Square in predicting genotypes of offsprings.
4. To test PTC tasting ability in a random sample and calculate gene frequencies for the taster and non- taster alleles,
5. Barr body analysis in buccal smear
6. To test for colour blindness using Ishihara charts
7. To study finger ball and palmar dermatoglyphics and calculate indices.
8. Human morphogenetic traits.

Course Learning Outcomes:

- Understand basic genetics.
- Gain knowledge about Mendelian principles and various exceptions to it.
- Understanding how sex of an organism has an impact on various diseases.
- Perceive knowledge of gene and chromosome mapping.

Text / Reference Books:

| Author | Title | Publisher | Ed/year | ISBN No | Pages |
|--|------------------------------|-----------------------------|-----------------------|------------------------------|-------|
| Gardner J, Simmons MJ , Snustad DP | Principles of E Genetics | Wiley-India | 6 th /2008 | 978-0471291312 | 480 |
| Snustad , Simmons MJ | Principles of DP Genetics | John Wiley and Sons Inc. | 6 th /2011 | 978-0470388259 0470388250 | 740 |

| | | | | | |
|---|----------------------|-------------------------------------|---|--|-----|
| Griffith F, Wessler R, Lewontin C,Carroll SB | AJ S R | Introduction to Genetic Analysis | W. H.2007 Freeman and Co., New York | 978-0716768876 0716768879 | 800 |
| Strickberger, M.W | | Genetics | Prentice-Hall India Pvt. Ltd., New Delhi | 1999 8120309499 978-8120309494 | 600 |
| Tamarin R.H | | Principles of Genetics | Tata McGrawH ill, New York | 2012 0072325305 | 697 |

MBO102: General Microbiology

| L | T | P | Total Credits |
|----------|----------|----------|----------------------|
| 3 | 0 | 1 | 4 |

Course content and syllabus

| | Teaching Hours |
|--|-----------------------|
| Unit I: History of Microbiology and Microbial Diversity | 14 hrs |
| Discovery of microorganisms, contributions of prominent scientists in microbiology, spontaneous generation v/s Biogenesis, discovery of antibiotics. Physiological diversity, microbial classification (prokaryotes: Bacteria and Archaea, eukaryotes: Fungi, Algae, Protozoa, Helminthes) Binomial nomenclature, Whittaker's and Carl Woese's classification. | |
| Unit II: Cell organization | 13 hrs |

| | |
|--|---------------|
| Cell size, shape and arrangement, glycocalyx, capsule, flagella, endoflagella, fimbriae and pili. Cell-wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls, Archaeobacterial cell wall, Gram and acid fast staining mechanisms, lipopolysaccharide (LPS), sphaeroplasts, protoplasts, and L-forms. Effect of antibiotics and enzymes on the cell wall. Cell Membrane: Structure, function and chemical composition of bacterial, archaeal and eubacterial cell membranes. Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids Endospore: Structure, formation, stages of sporulation. | |
| Unit III: Microbial Nutrition, Growth and control | 13 hrs |
| Nutritional requirements (macro and micronutrients), Temperature, pH, osmotic pressure, Types of culture media, uptake of nutrients, Maintenance of pure cultures. Microbial growth: Growth curve, Generation time, measurement of growth and factors affecting growth of bacteria. Methods in Microbiology: Microbial culture media, enrichment culture techniques, Pure culture techniques: Streaking, serial dilution and plating methods; cultivation, maintenance and preservation/stocking of pure cultures. | |
| Unit IV: Sterilization, disinfection and microscopy | 14 hrs |
| Sterilisation and disinfection- Definitions, Principles. Methods of sterilization- Physical methods (Heat, Filtration), Radiation and Chemical methods. Control of sterilization and Testing of sterility. Microscopy – Principles, Light microscope, Phase Contrast, Dark field, Bright field, Fluorescent, Interference microscope (Stereo microscope), Confocal, Inverted microscope, and Electron microscope (TEM and SEM). Measurement of Microorganisms- Micrometry. Staining- Simple, Gram staining, Negative staining, Capsule staining, Spore staining, Flagellar staining, Nuclear staining and Acid fast staining. | |

List of Experiments -with basic instructions (Total Teaching = 30 hrs)

1. Microbiology-Good Laboratory Practices and Bio-safety.
2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, hot air oven, light microscope, pH meter) used in the microbiology laboratory.
3. Preparation of culture media for bacterial cultivation.
4. Sterilization of medium and glassware using Autoclave and Hot air oven, respectively and assessment for sterility.
5. Demonstration of the presence of microflora in the environment (soil/water/air)

Course Learning Outcomes:

- Understand the cellular organization of microbes and different methods of staining.
- Compare different nutritional requirements of microbes and methods of culturing.
- Identify different method of sterilization and imaging.
- Understand the microbial diversity and contributions made by prominent scientists in microbiology.

Text / Reference Books:

| Author | Title | Publisher | Ed/year | ISBN No | Pages |
|--|--|--------------------------------|---------|---------------------------|-------|
| Pelczar, M.J. Jr., Chan ECS and Krieg, N.R. | Microbiology: Concepts and Applications | New York ;Madrid: McGraw-Hill, | 1993 | 0070492581, 9780070492585 | 957 |
| Cappucino, J.G. | Microbiology- A laboratory manual, 4th ed., Harlow, Addition-Wesley. | Hoboken, N.J.: Pearson | 2020 | 0135188997, 9780135203996 | 541 |
| Tortora GJ, Funke BR and Case CL | Microbiology :An Introduction. 9th edition | Pearson Education | 2008 | 0805347917 | 912 |
| Madigan MT, Martinko JM, Dunlap PV and Clark DP. | Brock Biology of Microorganisms | Pearson International Edition | 2014 | 9781292018317 | 1030 |

Statistics for Biosciences

| L | T | P | TOTAL CREDIT UNITS |
|---|---|---|--------------------|
| 2 | 0 | 0 | 2 |

Course Contents/syllabus:

| | |
|--|-----------------------|
| | Teaching Hours |
|--|-----------------------|

| | |
|---|------------|
| Unit I: | 9 H |
| Data collection and graphical presentation, Descriptive Statistics: Measures of central tendency-Arithmetic, geometric and harmonic mean, median, and mode. | |
| Unit II: | 9 H |
| Measures of dispersion, Skewness and Kurtosis, Correlation, and regression | |
| Unit III: | 9 H |
| Definitions of Probability, Conditional Probability, Bayes' theorem, random variables: discrete and continuous, density and mass functions. | |
| Unit IV: | 9 H |
| Expected values and moment generating functions, Discrete distributions: Uniform, Bernoulli, Binomial, Poisson, Continuous distributions: Uniform and Normal distribution | |

Course Learning Outcomes: On the successful completion of this course,

- Students will understand the concept of data collection, representation, and measures of central tendency
- Students will be able to apply the concept of dispersion, skewness, correlation, and regression of the given data
- Students will be having knowledge of probability and random variables.
- Students will be able to apply the concepts of probability and random variables to different distributions

Text / Reference Books:

| AUTHOR | TITLE | Publisher | Year of publication | ISBN |
|--|---|----------------------|----------------------------|----------------|
| Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying E. Ye | Probability and Statistics for Engineers and Scientists | Pearson; 9th edition | 2010 | 978-0321629111 |
| G Shanker Rao | Probability and Statistics for Science and Engineering | Universities Press | 2011 | 9788173717444 |

| | | | | |
|---------------------|---|-------------------------------------|------|---------------|
| SC Gupta, VK Kapoor | Fundamentals of Mathematical Statistics | Sultan Chand & Sons Private Limited | 2000 | 9788180545283 |
|---------------------|---|-------------------------------------|------|---------------|

ENV106: Environmental Studies-II

| L | T | P | Total Credits |
|---|---|---|---------------|
| 2 | 0 | 0 | 2 |

Course content and syllabus

| | Teaching Hours |
|---|----------------|
| Unit I: Environmental Pollution | 9 hrs |
| <i>Environmental Pollution:</i> types, Cause, effects and controls –Air, water, soil, chemical and noise pollution. Nuclear hazard and human health risk Solid waste Management-control measures of urban and industrial waste. Pollution case studies. | |
| Unit II: Environmental Policies and Practices | 9 hrs |
| <i>Environmental Policies and practices:</i> Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture. Environment laws: Environment Protection Act; Air (Prevention and Control of Pollution) Act; Water (Prevention and Control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act, international agreements: Montreal and Kyoto protocols and convention on biological diversity(CBD), The Chemical Weapons Convention (CWC). Natural reserves, tribal population and rights and Human-wildlife conflict in Indian context. | |
| Unit III: Human communities and the environment | 9 hrs |

| | |
|---|--------------|
| Impacts on environment, human health and welfare. | |
| Carbon foot-print. Resettlements and rehabilitation of project affected persons, case studies. Disaster management: floods, earthquake, cyclone and landslides. Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan. Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi). | |
| Unit IV: Field Work | 9 hrs |
| <ul style="list-style-type: none"> • Visit to an area to document environmental assets: river/forest/flora/fauna, etc. • Visit to local polluted Site-Urban/Rural/Industrial/Agricultural • Study of common plants, insects, birds and basic principles of identification. • Study of simple ecosystems-pond, river, Delhi Ridge, etc | |

Course Learning Outcomes:

- Understanding the types of pollution and their impact on environment and human health.
- Understand the environmental concerns and their impact on humans and agriculture.
- Able to analyse the impacts of natural and manmade disaster on human population and settlements.
- Sensitization about the environmental issues and concerns leading to proactive actions to improve the environmental conditions in our daily life.
- Able to imbibe practical approach and solution to solve environmental concerns.

Text / Reference Books:

| Author | Title | Publisher | Ed/y ear | ISBN No | Pa g es |
|--|---|------------------|-----------------|-------------------|----------------|
| William P. Cunningham, Mary Ann Cunningham | Principles of Environmental Science | McGraw-Hill | 2019 | 9781260219 718 | -- |
| William P. Cunningham, Mary Ann Cunningham, Barbara Woodworth Saigo | Environmental Science: A global concern | McGraw-Hill | 2021 | 9781260363 821 | -- |

Communication Skills—II (ENG-103)

| L | T | P/S | SW/ FW | TOTAL CRED ITUNITS |
|---|---|-----|-----------|--------------------------|
| 1 | 0 | 0 | 0 | 1 |

Course Contents/syllabus:

| | Teachin gHrs (H) |
|--|---------------------------------|
| Unit I: Basic Concepts in Communication | 3 H |
| Towards communicative competence; choosing the appropriate channel and medium of communication; ways to develop communication skills in the areas of Listening, Speaking, Reading, and Writing. | |
| Unit II: Communication Types | 4 H |
| Nonverbal communication: detailed analysis, KOPPACT (Kinesics, Oculistics, Proxemics, Paralanguage, Artefacts, Chronemics, Tactilics). | |
| Unit III: Communication and Technology | 3 H |
| Importance of digital literacy and communication on digital platforms. | |
| Unit IV: Presentation Skills | 5 H |
| Planning, preparation, practice, and performance; audience analysis, audio-visual aids, analyzing the non-verbal communication, methods of delivery: impromptu, extemporaneous, memorization, manuscript, and outlining. | |

Course Learning Outcomes:

- Students will be able to understand the need and the methods required to develop communication skills in the areas of listening, speaking, reading, and writing.
- Students will be able to understand the significance of non-verbal communication in various contexts.
- Students will be able to develop an awareness of the role of digital platforms in shaping public psyche, beliefs, and perceptions about social realities and build an informed and critical perspective.
- Students will be able to develop and upgrade their presentation skills.

Text / Reference Books:

| AUTHOR | TITLE | Publisher | Year of publication | ISBN |
|--|--|-------------------------|---------------------|---------------|
| P. D. Chaturvedi and Mukes hChaturvedi | Business Communication: Concepts, Cases and Applications | Pearson Education | 2006 | 9788131701720 |
| Meenakshi Raman and dPrakash Singh | Business Communication | Oxford University Press | 2012 | 9780198077053 |
| Jeff Butterfield | Soft Skills for Everyone | Cengage Learning | 2017 | 9789353501051 |

PSY106: INDIVIDUAL, SOCIETY AND NATION

Course Contents/syllabus:

| L | T | P/S | SW/FW /PSDA | TOTAL CREDIT UNITS |
|---|---|-----|-------------|--------------------|
| 1 | 0 | 0 | 0 | 1 |

| | No. of Session |
|--|----------------|
| Unit-1- Individual differences & Personality | 4 H |
| <ul style="list-style-type: none"> • Personality: Definition & Relevance • Importance of nature & nurture in Personality Development • Importance and Recognition of Individual differences in Personality • Accepting and Managing Individual differences Intuition, Judgment, Perception & Sensation (MBTI) BIG5 Factors | |
| Unit-2- Managing Diversity | 4 H |

| | |
|---|------------|
| <ul style="list-style-type: none"> • Defining Diversity • Affirmation Action and Managing Diversity • Increasing Diversity in Work Force • Barriers and Challenges in Managing Diversity | |
| Unit-3- Socialization, Patriotism and National Pride | 4 H |
| <ul style="list-style-type: none"> • Nature of Socialization • Social Interaction • Interaction of Socialization Process • Contributions to Society and Nation • Sense of pride and patriotism • Importance of discipline and hard work • Integrity and accountability | |
| Unit-4- Human Rights, Values and Ethics | 3 H |
| <ul style="list-style-type: none"> • Meaning and Importance of human rights • Human rights awareness • Values and Ethics- Learning based on project work on Scriptures like- Ramayana, Mahabharata, Gita etc. | |

List of Professional Skill Development Activities (PSDA):

- Project on Understanding Diversity
- Term Paper on Patriotism among Youth

Course Learning Outcomes: On completion of the course:

- To recognize individual differences
- To manage individual differences
- To develop patriotic feelings
- To recognize their self in relation to society & nation

Text / Reference Books:

| AUTHOR | TITLE | Publisher | Year of publication | ISBN | Pages |
|--|--------------------------|-------------------|----------------------------|----------------|--------------|
| Department of English, University of Delhi | The Individual & Society | Pearson Education | 2010 | 978-8131704172 | 266 |

| | | | | | |
|------------------------------------|------------------------------------|---------------|------|----------------|-----|
| Umang Malhotra | Individual, Society, and the World | iUniverse | 2004 | 978-0595662401 | 188 |
| Tonja R. Conerly & Kathleen Holmes | Introduction to Sociology 3e | Openstax | 2018 | 9781711493978 | 458 |
| Daksh Tyagi | "A Nation of Idiots" | Every Protest | 2019 | 978-8194275018 | 350 |

FOL103: French Grammar

| L | T | P | Total Credits |
|---|---|---|---------------|
| 1 | 0 | 0 | 1 |

Course content and syllabus

| | Teaching Hours |
|--|-----------------------|
| Unit I: My family and my house | 4 hrs |
| Descriptors/Topics <ul style="list-style-type: none"> • Talk about your family members • Usage of possessive adjectives • Describe your house/apartment • Prepositions of location • Negation | |
| Unit II: Lifestyle | 3 hrs |
| Descriptors/Topics <ul style="list-style-type: none"> • Talk about your hobbies and pastimes • Usage of appropriate articles : definite and contracted • Talk about your daily routine • Usage of pronominal verbs | |
| Unit III: In the city | 3 hrs |

| | |
|--|--------------|
| Descriptors/Topics <ul style="list-style-type: none"> • Filling up a simple form • Ask for personal information • Usage of interrogative adjectives • Give directions about a place • Ordinal numbers | |
| <ul style="list-style-type: none"> • Usage of demonstrative adjectives | |
| Unit IV: Week-end | 3 hrs |
| Descriptors/Topics <ul style="list-style-type: none"> • Talk about your week-end plans • Usage of disjunctive pronouns • Usage of Near Future tense • Talk about weather • Write a simple post card | |

Course Learning Outcomes: At the end of this course, the students will be able to interact in a simple way on everyday topics. This course content focuses on the speech of the students in a lucid and a concurrent manner using appropriate vocabulary and pronunciation techniques. Extra stress will be given on their understanding of grammatical structures and the foreign accent of the language. At the end of the course, the student shall be able to:

- Understand information; Express in his own words; Paraphrase; Interpret and translate.
- Apply information in a new way in a practical context
- Analyze and break-down information to create new ideas
- Evaluate and express opinion in a given context

Text / Reference Books:

| Author | Title | Publisher | Ed/ year | ISBN No | Pages |
|--|---|---------------------------------|----------|----------------|-------|
| Christine Andant, Catherine Metton, Annabelle Nachon, Fabienne Nugue | A Propos - A1, Livre de l'élève et Cahier d'exercices. | Langers International Pvt. Ltd. | 2010 | 978-9380809069 | --- |
| Collins Dictionaries | Easy Learning French Complete Grammar, Verbs and Vocabulary | Collins | 2016 | 978-0008141721 | --- |

| | | | | | |
|----------------------------------|--|---------------------------------------|------|--------------------|-----|
| Nikita Desai, Samapita DeySarkar | Apprenons L a Grammaire Ensemble - French | Langers Internationa IPvt. Ltd. | 2017 | 978- 8193002681 | --- |
|----------------------------------|--|---------------------------------------|------|--------------------|-----|

FOL104: German Grammar

| L | T | P | Total Credits |
|---|---|---|---------------|
| 1 | 0 | 0 | 1 |

Course content and syllabus

| | Teaching Hours |
|--|----------------|
| Unit I: Time (Uhrzeit); People and the World: Land, Nationalität und Sprache | 4 hrs |
| <ul style="list-style-type: none"> • Introduction of time • Read text related to time and teach the students the time expressions • Exercises related to Time • Adverbs of time and time related prepositions • Vocabulary: Countries, Nationalities, and their languages • Negation: "nicht/ kein" • Ja/Nein Fragen. • All the colors and color related vocabulary, adjectives, and opposites • Exercises and comprehension for the same | |
| Unit II: Irregular verbs (unregelmässige Verben) | 3 hrs |
| <ul style="list-style-type: none"> • Introduction to irregular verbs and their conjugation e.g. fahren, essen, lesen etc • Read a text related to the eating habits of Germans • Vocabulary: Obst, Gemüse, Kleiderstück with usage of irregular verbs • Free time and hobbies • Food and drinks | |
| Unit III: Accusative case: articles and pronouns (Akkusativ Kasus: Artikel und Pronomen) | 3 hrs |
| <ul style="list-style-type: none"> • Introduction to the concept of object (Akkusativ) • Formation of sentences along with the translation and difference between nominative and accusative articles • Usage of accusative Definite articles • Usage of accusative Indefinite articles | |

| | |
|---|--------------|
| Unit IV: Accusative case: possessive pronouns (Akkusativ Kasus: Possessivpronomen) Family and Relationship | 3 hrs |
| <ul style="list-style-type: none"> • Accusative Personal Pronouns: - Revision of the nominative personal pronouns and introduction of accusative. Applicability of pronouns for both persons and things. • Usage of accusative Personal Pronouns • Introduction of accusative possessive pronouns • Difference between nominative and accusative possessive pronouns • usage of accusative possessive pronouns | |

Course Learning Outcomes: After completing these modules, the students will be capable of constructing sentences with possessive and demonstrative adjectives in German. In addition, they will be proficient in formulating meaningful sentences as they will be capable of applying their knowledge of all the irregular verbs they have learnt during the session. They will also have an idea of German culture by studying about various German festivals.

At the end of the course, the student shall be able to:

- Understand information; Express in his own words; Paraphrase; Interpret and translate.
- Apply information in a new way in a practical context
- Analyse and break-down information to create new ideas
- Evaluate and express opinion in a given context

Text / Reference Books: [mention the name of the books. Can add more rows]

| Author | Title | Publisher | Ed/ye ar | ISBN No | Pa g es |
|--|---|-------------------|----------|----------------|---------|
| Dora Schulz, Heinz Griesbach | Deutsche Sprachlehre Fur Auslander | Max Hueber Verlag | 1984 | 978-3190010066 | --- |
| Hartmut Aufderstrasse, Jutta Muller, Helmut Muller | Themen Aktuell: Glossar Deutsch | Max Hueber Verlag | 2003 | 978-3190816903 | --- |
| Giorgio Motta | Wir Plus Grundkurs Deutsch fur Junge Lerner Book German Guide | Goyal Publishers | 2011 | | 248 |

INL104: Punjabi Language and Literature

| L | T | P | Total Credits |
|---|---|---|---------------|
| 1 | 0 | 0 | 1 |

Course content and syllabus

| | Weightage (%) | Teaching Hours |
|--|---------------|----------------|
| Unit I: | 25% | 4 hours |
| <p>ਆਧੁਨਿਕ ਪੰਜਾਬੀ ਕਹਾਣੀ ਦਾ ਅਧਿਐਨ (ਕਥਾ ਕਹਾਣੀ) ਕਹਾਣੀ ਵਿਸ਼ਾ-ਵਸਤੂ/ਸਾਰ,ਪਾਤਰ-ਚਿਤਰਨ ਕਹਾਣੀਕਾਰ ਦੇ ਜੀਵਨ ਅਤੇ ਰਚਨਾ ਬਾਰੇ ਮੁੱਢਲੀ ਜਾਣਕਾਰੀ</p> | | |
| Unit II: | 25% | 4 hours |
| <p>ਦਫ਼ਤਰੀ ਚਿੱਠੀ-ਪੱਤਰ ਰਚਨਾ ਚਿੱਠੀ-ਪੱਤਰ ਲੇਖਣ ਕਲਾ,ਮਹੱਤਤਾ ਅਤੇ ਕਿਸਮਾਂ ਦਫ਼ਤਰੀ ਚਿੱਠੀ-ਪੱਤਰ ਰਚਨਾ ਦੇ ਜ਼ਰੂਰੀ ਅੰਗ ਅਤੇ ਵੱਖ-ਵੱਖ ਵਿਸ਼ਿਆਂ ਅਨੁਸਾਰ ਵਿਹਾਰਕ ਅਭਿਆਸ</p> | | |
| Unit III: | 25% | 5 hours |
| <p>ਵਿਆਕਰਨ ਸਿਧਾਂਤ ਅਤੇ ਵਿਹਾਰ</p> <ol style="list-style-type: none"> ਪੰਜਾਬੀ ਅਰਥ ਬੋਧ ਅਰਥਾਂ ਦੇ ਆਧਾਰ ਦੇ ਸ਼ਬਦਾਂ ਦੀਆਂ ਕਿਸਮਾਂ ਅਤੇ ਉਦਾਹਰਨਾਂ, ਸਮਾਨਰਥਕ ਸ਼ਬਦ, ਬਹੁਅਰਥਕ ਸ਼ਬਦ, ਵਿਰੋਧਾਰਥਕ ਸ਼ਬਦ, ਬਹੁਤੇ ਸ਼ਬਦਾਂ ਦੇ ਸਥਾਨ ਤੇ ਇੱਕ ਸ਼ਬਦ ਮੁਹਾਵਰੇ, ਅਖਾਣ : ਪਰਿਭਾਸ਼ਾ ਅਤੇ ਉਦਾਹਰਨਾਂ ਪੰਜਾਬੀ ਵਾਕ ਬੋਧ ਵਾਕ ਪ੍ਰੀਭਾਸ਼ਾ,ਵਾਕ ਦੇ ਤੱਤ, ਪੰਜਾਬੀ ਵਾਕ ਤਰਤੀਬ ਵਾਕ ਵਰਗੀਕਰਨ:ਕਾਰਜ ਦੇ ਅਧਾਰ ਤੇ ਵਾਕਾਂ ਦੀਆਂ ਕਿਸਮਾਂ, ਬਣਤਰ ਦੇ ਅਧਾਰ ਤੇ ਵਾਕਾਂ ਦੀਆਂ ਕਿਸਮਾਂ | | |
| Unit IV: | 25% | 5 hours |
| <p>ਵਿਆਕਰਨ ਸਿਧਾਂਤ ਅਤੇ ਵਿਹਾਰ</p> <ol style="list-style-type: none"> ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਅਤੇ ਗੁਰਮੁਖੀ ਲਿੱਪੀ ਭਾਸ਼ਾ, ਉਪਭਾਸ਼ਾ,ਟਕਸਾਲੀ ਭਾਸ਼ਾ ਅਤੇ ਪੰਜਾਬੀ ਦੀਆਂ ਉਪਭਾਸ਼ਾਵਾਂ | | |

Course Learning Outcomes:

5. Understand modern Punjabi Stories.
6. Interpret the importance of letter writing
7. Analyze the Punjabi language structure and grammar.
8. Examine the impact and importance of Punjabi dialects and Gurmukhi script on Punjabi language.

Pedagogy for Course Delivery

Lectures: 14 sessions
 Presentation / Seminar/ Assignment: 2 sessions
 Mid Term Test & End Term Exam: 2 sessions
 Quiz: 3
 Total:18 sessions

Assessment/ Examination Scheme:

| Theory L/T (%) | Lab/Practical/Studio (%) | End Term Examination |
|----------------|--------------------------|----------------------|
| 100 | 0 | 100 |

Text /
 Books:

Reference

| AUTHOR | TITLE | Publisher | Year of publication | ISBN | Pages |
|--------------------------------|---|--|---------------------|------|-------|
| ਡਾ. ਧਨਵੰਤ ਕੌਰ (ਸੰਪਾ.), | ਕਥਾ ਕਹਾਣੀ | ਪਬਲੀਕੇਸ਼ਨ ਬਿਊਰੋ, ਪੰਜਾਬ ਯੂਨੀਵਰਸਿਟੀ ਚੰਡੀਗੜ੍ਹ | 2009 | - | - |
| ਸੁਰਿੰਦਰ ਸਿੰਘ ਖਹਿਰਾ (ਸੰਪਾ.), | ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਵਿਆਕਰਨ ਅਤੇ ਬਣਤਰ | ਪਬਲੀਕੇਸ਼ਨ ਬਿਊਰੋ,ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ ਪਟਿਆਲਾ | 2015 | - | - |
| ਡਾ.ਹਰਕੀਰਤ ਸਿੰਘ, | ਕਾਲਜ ਪੰਜਾਬੀ ਵਿਆਕਰਨ ਅਤੇ ਲੇਖ ਰਚਨਾ | ਪੰਜਾਬ ਸਟੇਟ ਯੂਨੀਵਰਸਿਟੀ ਟੈਕਸਟ ਬੁੱਕ ਬੋਰਡ,ਚੰਡੀਗੜ੍ਹ | 1999 | - | - |
| ਡਾ. ਪ੍ਰੇਮ ਪ੍ਰਕਾਸ਼ ਸਿੰਘ | ਕਾਲਜ ਪੰਜਾਬੀ ਵਿਆਕਰਨ ਅਤੇ ਲੇਖ ਰਚਨਾ | ਮਦਾਨ ਪਬਲੀਕੇਸ਼ਨਜ਼, ਪਟਿਆਲਾ | 2002 | - | - |
| ਡਾ. ਬੂਟਾ ਸਿੰਘ ਬਰਾੜ | ਪੰਜਾਬੀ ਵਿਆਕਰਨ ਸਿਧਾਂਤ ਅਤੇ ਵਿਹਾਰ | ਚੇਤਨਾ ਪ੍ਰਕਾਸ਼ਨ, ਪੰਜਾਬੀ ਭਵਨ,ਲੁਧਿਆਣਾ | 2012 | - | - |
| ਡਾ. ਬੂਟਾ ਸਿੰਘ ਬਰਾੜ | ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਸ਼੍ਰੋਤ ਅਤੇ ਸਰੂਪ | , ਵਾਰਿਸ ਸ਼ਾਹ ਫਾਊਂਡੇਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ | 2012 | - | - |

| | | | | | |
|---------------------------|-------------------------------------|--|------|----|---|
| ਦੁਨੀ ਚੰਦ੍ਰ | ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਦਾ ਵਿਆਕਰਣ | , ਪੰਜਾਬ ਯੂਨੀਵਰਸਿਟੀ ਪਬਲੀਕੇਸ਼ਨ ਬਿਊਰੋ, ਚੰਡੀਗੜ੍ਹ | 1995 | - | - |
| ਜੋਗਿੰਦਰ ਸਿੰਘ ਪੁਆਰ ਅਤੇ ਹੋਰ | ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਦਾ ਵਿਆਕਰਨ (ਭਾਗ 1,2,3), | ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਅਕਾਦਮੀ ਜਲੰਧਰ | 2003 | - | - |
| ਸੁਖਵਿੰਦਰ ਸਿੰਘ ਸੰਘਾ | ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਵਿਗਿਆਨ | ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਅਕਾਦਮੀ ਜਲੰਧਰ | 2010 | -- | - |
| ਅਗਨੀਹੋਤਰੀ, ਵੇਦ | ਪਰਿਚਾਇਕ ਭਾਸ਼ਾ ਵਿਗਿਆਨ | ਦੀਪਕ ਪਬਲਿਸ਼ਰਜ਼ ਜਲੰਧਰ | 1981 | - | - |

INL106: History and Culture of Punjab

| L | T | P/S | SW/FW | Total Credit Units |
|---|---|-----|-------|--------------------|
| 1 | 0 | 0 | 0 | 1 |

Course Contents/syllabus:

| | Weightage (%) |
|--|---------------|
| Unit I: | 4H |
| 1. Introduction of Colonial Rule in Punjab: Annexation of Punjab; Board of Administration. 2. Western Education: Growth of Education and rise of middle classes. 3. Agrarian Development: Commercialization of agriculture; canalization and colonization. | |
| Unit II: | 4H |
| 4. Early Socio Religious Reform: Christian Missionaries; Namdharis; Nirankaris. 5. Socio Religious Reform Movements: activities of Arya Samaj; Singh sabhas; Ahmadiyahs; Ad Dharam Movement 6. Development of Press & literature: growth of print technology; development in literature | |
| Unit III: | 4H |
| 7. Emergence of Political Consciousness: Gadar Movement; Jallianwala Bagh Massacre 8. Gurudwara Reform Movement; major Morchas; Activities of Babbar Akalis. 9. Struggle for Freedom: Non-Cooperation Movement; HSRA and Bhagat Singh; Civil Disobedience Movement; Quit India Movement. | |
| Unit IV: | 3H |
| 10. Partition and its Aftermath: resettlement; rehabilitation 11. Post-Independence Punjab: Linguistic Reorganization; Green Revolution. | |

Course Learning Outcomes:

- Understand the history of Punjab region in modern times.
- Interpret the importance early socio religious reform, movements, developments.
- Examine the contribution of major reform movements: Gadar, Babbar Akalis and Gurdwarareform morchas.
- Examine the impact of Partition of Punjab and major changes in Punjab after independence.

Text / Reference Books:

| Author | Title | Publisher | Ed/year | ISBN No | Pages |
|--------------------------|---|---|----------------|----------------|--------------|
| Singh, Kirpal | History and Culture of the Punjab, Part II (Medieval Period) | Publication Bureau, Punjabi University, Patiala | 1990(3rd ed.). | --- | --- |
| Singh, Fauja(ed.) | History of the Punjab, Vol.III | Punjabi University, Patiala | 1972 | --- | --- |
| Grewal, J.S. | The Sikhs of the Punjab , the New Cambridge History of India | Orient Longman | 1990 | --- | --- |
| Singh, Khushwant | A History of the Sikhs, vol I: 1469-1839 | oxford University Press, Delhi | 1991 | --- | --- |
| Chopra, P.N., Puri, B.N. | A Social, Cultural and Economic History of India , Vol.II, And Das | M.N. Macmillan, Delhi | 1974 | --- | --- |

B.Sc. (H) Human Genetics and Molecular Medicine- 3 years (3rd Semester)

| Sr No | Course Code | Course Title | Course Type | Credits | | | | | Credit Units |
|----------|----------------|--|--------------------------------|---------|---|----|----|----|-----------------|
| | | | | L | T | PS | FW | SW | |
| 1 | | Biotechniques | Core Course | 4 | 0 | 2 | 0 | 0 | 6 |
| 2 | | Enzymology | Core Course | 4 | 0 | 2 | 0 | 0 | 6 |
| 3 | | Genetics and Inheritance Biology | Core Course | 4 | 0 | 2 | 0 | 0 | 6 |
| 4 | | Protein Science | Allied Course | 4 | 0 | 0 | 0 | 0 | 4 |
| 5 | | Prgrammng with C | Skill Enhanceme ntCourse | 1 | 0 | 1 | 0 | 0 | 2 |

Total Credits**24**

Biotechniques

| L | T | P | Total Credits |
|---|---|---|---------------|
| 4 | 0 | 2 | 6 |

Objective: This course will provide students with the understanding of various analytical techniques used in biology/biotechnology-based research and industry. The course will acquaint the students with the various instruments, their configuration and principle of working, operating procedures, data generation and its analysis.

Course content and syllabus

| | Teaching Hours |
|---|----------------|
| Unit I: Introduction to chromatographic techniques | 18 hrs |
| Theoretical basis of chromatographic separations, Principles and applications of paper, thin layer, column, ion-exchange, affinity, gel permeation, normal phase and reverse phase chromatography, gas chromatography, High performance liquid chromatography (HPLC) | |
| Unit II: Spectroscopic and centrifugation techniques | 18 hrs |
| Theory and application of UV-Visible, Infrared, Raman, Nuclear magnetic resonance, Fluorescence, Atomic absorption spectroscopy, X-ray diffraction, Introduction to mass spectroscopy, Introduction to centrifugation, basic principles of sedimentation, types of centrifuges and their uses, density gradient and analytical centrifugation, sub-cellular fractionation | |
| Unit III: Electrophoretic techniques | 18 hrs |
| Theoretical basis of electrophoretic separations, electrophoretic mobility, moving boundary electrophoresis, paper, starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse-field gel electrophoresis, immune-electrophoresis, isoelectric focusing, western blotting | |
| Unit IV: Microscopy | 18 hrs |
| Simple microscopy, phase contrast microscopy, fluorescence, and electron microscopy (Transmission and Scanning) | |

List of Experiments with basic instructions (Total teaching hours =60 hrs):

1. To verify the validity of Beer's law and determine the molar extinction coefficient of KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$
2. Separation of amino acids by paper chromatography
3. To identify biomolecules in a given sample by paper/thin layer chromatography
4. Demonstration of HPLC instrument
5. Determination of concentration of metal ion using atomic absorption spectroscopy
6. Demonstration of working of centrifuge
7. Preparation of sub-cellular fractions of cells
8. Native and SDS-polyacrylamide gel electrophoresis of proteins.

Course Learning Outcomes:

Students will be able to

1. apply basic principles of different analytical techniques in analytical work.
2. use spectroscopy and chromatography in biotechnological applications.
3. use microscopy, centrifugation, and electrophoretic techniques.
4. demonstrate principle and working of various instruments.
5. use various techniques for solving industrial and research problems.

Text / Reference Books:

| Author | Title | Publisher | Ed/year | ISBN No | Pages |
|----------------------|--|----------------------------|------------------------------|----------------|-------|
| Karp, Gerald | Cell and Molecular Biology: Concepts and Experiments | John Wiley and Sons, Inc | 6 th edition/2018 | 978-1118886144 | 832 |
| Wilson K., Walker J. | Principle and Techniques of Biochemistry and Molecular Biology | Cambridge University Press | 6 th edition/2006 | 978-0521178747 | 744 |
| Rana, SVS | Biotechniques: Theory and Practice | Rastogi Publications | 2018 | - | 376 |
| Plummer, David | An Introduction to Practical Biochemistry | Tata Mc GrawHills | 3 rd edition/2017 | 978-0070994874 | 250 |

Enzymology

| L | T | P | Total Credits |
|---|---|---|---------------|
| 4 | 0 | 2 | 6 |

Course content and syllabus

| | Teaching Hours |
|--|----------------|
| Unit I: Enzymes and Coenzymes | 18 hrs |
| Nature of enzymes - protein and non-protein (ribozyme). Cofactor and prosthetic group, apoenzyme, holoenzyme. IUBMB classification of enzymes. Features of enzyme catalysis Factors affecting the rate of chemical reactions, collision theory, activation energy and transition state theory, catalysis, reaction rates and thermodynamics of reaction. Catalytic power and specificity of enzymes (concept of active site), Koshland's induced fit hypothesis. Involvement of coenzymes in enzyme catalysed reactions: Mechanism of action of TPP, FAD, NAD, pyridoxal phosphate, biotin, coenzyme A, tetrahydrofolate, lipoic acid. | |
| Unit II: Enzyme Kinetics and Inhibition | 18 hrs |

| | |
|---|---------------|
| Relationship between initial velocity and substrate concentration, steady state kinetics, equilibrium constant – mono-substrate reactions. Michaelis-Menten equation, Lineweaver-Burk plot, Eadie-Hofstee and Hanes plot. Km and Vmax, Kcat and turnover number. Effect of pH, temperature and metal ions on the activity of enzyme. Bi-substrate reactions: Types of bi bi reactions (sequential – ordered and random, ping pong reactions). | |
| Enzyme inhibition: Reversible inhibition and irreversible (competitive, uncompetitive, noncompetitive, mixed type). Mechanism based inhibitors - antibiotics as inhibitors. | |
| Unit III: Mechanisms of Enzyme catalysed reactions | 18 hrs |
| General features - proximity and orientation, strain and distortion, acid base and covalent catalysis (chymotrypsin, lysozyme). Metal activated enzymes and metalloenzymes, transition state analogues. Regulation of enzyme activity : Control of activities of enzymes (end product inhibition) and metabolic pathways, feedback inhibition (aspartate transcarbamoylase), reversible covalent modification (phosphorylation). Proteolytic cleavage- zymogen. Multienzyme complexes (pyruvate dehydrogenase, fatty acid synthase) and Enzyme regulation | |
| Unit IV: Application of Enzymes | 18 hrs |
| Application of enzymes in diagnostics (SGPT, SGOT, creatine kinase, alkaline and acid phosphatases), enzyme immunoassay (HRPO), enzyme therapy (Streptokinase). Immobilized enzymes. Isoenzymes Enzyme Inhibitors as drugs. Drug Design | |

List of Experiments -with basic instructions (Total Teaching = 60 hrs)

1. Partial purification of acid phosphatase from germinating mung bean.
2. Assay of enzyme activity and specific activity, e.g. acid/alkaline phosphatase.
3. Effect of pH on enzyme activity
4. Effect of temperature on enzyme activity
4. Determination of Km and Vmax using Lineweaver-Burk plot
5. Enzyme inhibition - calculation of Ki for competitive inhibition.
6. Continuous assay of lactate dehydrogenase.
7. Coupled assay of glucose-6-phosphate dehydrogenase.

Course Learning Outcomes: at the end of the course, the students will learn

- Types of enzymes, classification and their importance
- Enzyme kinetics and enzyme inhibitors
- Mechanisms of enzyme action
- Application of enzymes in diagnostics and drug discovery

Text / Reference Books:

| Author | Title | Publisher | Ed/yea r | ISBN No | Pag es |
|--------------|--------------------------|------------|-------------|---------------|-----------|
| David Nelson | Lehninger: Principles of | WH Freeman | 2017 | 9781319108243 | 1328 |

| | | | | | |
|----------------------------|----------------------------|-------------------------|--------------------|----------------|---|
| | Biochemistry | | | | |
| Nicholas C.P. and Lewis S. | Fundamentals of Enzymology | Oxford University Press | 3 rd Ed | 978-0198064398 | - |
| Voet, D., Voet, J.G. | Biochemistry | Wiley | 4 th Ed | 978-0071737074 | - |

Genetics and Inheritance Biology

| L | T | P | Total Credits |
|---|---|---|---------------|
| 4 | 0 | 2 | 6 |

| | Teaching Hours |
|---|----------------|
| Unit I Human Genetics | 18 hrs |
| History of Human Genetics and Human Genome, Pedigrees- gathering family history, pedigree symbols, construction of pedigrees, presentation of molecular genetic data in pedigrees. Monogenic traits Autosomal inheritance-dominant, recessive, Sex-linked inheritance, Sex-limited and sex-influenced traits, Mitochondrial inheritance, MIM number, Complications to the basic pedigree patterns- nonpenetrance, variable expressivity, pleiotropy, late onset, dominance problems, anticipation, genetic heterogeneity, genomic imprinting and uniparental disomy, spontaneous mutations, mosaicism and chimerism, male lethality, X- inactivation, Risk assessment; application of Bayes' theorem, Allele frequency in population, Consanguinity and its effects | |
| Unit II Complex Traits | 18 hrs |
| Approaches to analysis of complex traits- 'Nature -nurture' concept, role of Family and shared environment, monozygotic and dizygotic twins and adoption studies, Polygenic inheritance of continuous (quantitative) traits, normal growth charts, Dysmorphology, Polygenic inheritance of discontinuous (dichotomous) traits- threshold model, liability and recurrence risk, Genetic susceptibility in multifactorial disorders (alcoholism, diabetes mellitus, obesity), Estimation of genetic components of multifactorial traits: empiric risk, heritability, coefficient of relationship. | |
| Unit III: Human Cytogenetics | 18 hrs |

| | |
|--|---------------|
| Molecular organization of the human genome, Transposable elements, Human chromosome organization and structure, Centromeres, Neocentromeres, Kinetochores, Telomeres, chromosome nomenclature; sister chromatid exchanges (SCE); mosaicism; structure of human X and Y chromosome; ring chromosomes; human artificial chromosome. Heterochromatin and Euchromatin and its significance. Various types of mutations, Role of radiations and chemicals in inducing mutations, Effects of mutations, Mutation rates in humans, Pleiotropy. | |
| Unit IV: Techniques for inheritance Biology | 18 hrs |
| Chromosome banding techniques — G,C,R,Q,T,NOR, High-resolution banding, Molecular correlates of chromosome bands, Fragile sites, Chromosome nomenclature and cytogenetic notation for G-banded chromosomes, VNTRs, Applications of amniocentesis, chorionic villus sampling (CVS) and fluorescence in situ hybridization (FISH). classification, use of Human Cyto-genetics in Medical science | |

List of Experiments -with basic instructions (Total Teaching = 60 hrs)

- 1 Demonstration of short-term blood lymphocyte culture — Washing and sterilization of glassware and plasticware.
2. Preparation of chemical solutions and culture medium.
3. Setting up the culture; Harvesting the culture, Staining and Banding.
4. Scoring of prepared slides, Demonstration of photomicrography, Developing and printing of photographs,
5. Karyotyping of solid-stained and G-banded chromosome preparations.
6. Identification of structural and numerical chromosomal aberrations from photographs, Sister chromatid exchange analysis from peripheral blood lymphocyte culture.
7. Numericals on chromosome nomenclature.
8. Numericals on Pedigree Analysis.

Course Learning Outcomes:

- Understand Human Genome and various types of mutations.
- Gain knowledge about various complex traits of Humans.
- Acquaintance with various banding techniques
- Overall understanding about cytogenetics.

Text / Reference Books:

| Author | Title | Publisher | Ed/year | ISBN No | Pages |
|--|---------------------------|--------------------------------|-----------------------|------------------------------|-------|
| Gardner EJ, Simmons MJ, Snustad DP | Principles of Genetics | Wiley-India | 6 th /2008 | 978-0471291312 | 480 |
| Snustad DP, Simmons MJ | Principles of Genetics | John Wiley and Sons Inc. | 6 th /2011 | 978-0470388259 0470388250 | |

| | | | | | |
|--|---|---|-----------------------|------------------------------|-----|
| Griffith AJF, Wessler SR, Lewontin RC, Carroll SB | Introduction to Genetic Analysis | W. H. Freeman and Co., New York | 2007 | 978-0716768876 0716768879 | 800 |
| Strickberger, M.W | Genetics | Prentice-Hall India Pvt. Ltd., New Delhi | 1999 | 8120309499 978-8120309494 | - |
| Tamarin R.H | Principles of Genetics | Tata McGrawH ill, New York | 1998 | 978-0697354624 | 680 |
| Freshney, R.I. | Animal Cell Culture: A | IRL Press, Oxford, 2 nd ed. | 2 nd /1992 | 9781119513018 | 832 |
| | Practical Approach | | | | |
| Rooney, D.E. and Czepulkowski, B.H. | Human Cytogenetics: A Practical Approach | IRL Press Ltd., Oxford. | 1986 | 0947946713 978-0947946718 | 260 |
| Sumner, A.T | Chromosomes: Organization and Function | Blackwell Publishing Co., Oxford. | 2003 | 0632054077 | 287 |

Protein Science

| L | T | P | Total Credits |
|---|---|---|------------------|
| 4 | 0 | 0 | 4 |

Course content and syllabus

| | Teaching Hours |
|--|-------------------|
| Unit I: Protein Structure | 18 hrs |
| Peptide bond, protein secondary structure – fibrous and globular proteins, proteins stability, tertiary and quaternary structure, Protein Folding: Theory and Experiment, Folding Accessory Proteins, Protein Structure Prediction and Design, Protein Dynamics. | |
| Unit II: Protein misfolding, aggregation and denaturation | 18 hrs |

| | |
|---|---------------|
| Protein misfolding and aggregation, amyloid formation. Conformational Diseases: Alzheimer's, Prion diseases, Huntington's disease, sickle cell anemia, Parkinsons. Structural Evolution Protein denaturation and folding, Chemical evolution, Chemical Synthesis of Polypeptides. IDP (Intrinsically disordered proteins). | |
| Unit III: Protein alignment and database research | 12 hrs |
| Protein primary sequence analysis, DNA sequence analysis, pair wise sequence alignment, FASTA algorithm, BLAST, multiple sequence alignment, DATA basearching using BLAST and FASTA. Phylogenetic tree analysis | |
| Unit IV: Analysis of protein-protein interactions | 12 hrs |
| Pull-down assay, Yeast two hybrid assay, Coimmunoprecipitation assay, Fluorescence resonance energy transfer (FRET). DNA- protein interactions, footprinting assay, EMSA. | |

Course Learning Outcomes:

- Understand basic concepts of protein structure.
- Learn protein functions by ligand binding -enzymes and antibodies.
- To understand the role of proteins in cellular transport.
- To understand the role of proteins as signaling molecules.

Text / Reference Books:

| Author | Title | Publisher | Ed/year | ISBN No | Pages |
|------------------------------------|---|-------------------|---------|-------------------------|-------|
| Donald Voet, Judith G. Voet | Biochemistry, 4th Edition | John Wiley & Sons | 2018 | ISBN: 978-0-470-57095-1 | 18 20 |
| David L. Nelson and Michael M. Cox | Lehninger Principles of biochemistry, 8 th Edition | Macmillan | 2021 | ISBN:9781319322328 | 1120 |

Programming with C

| L | T | P | Total Credits |
|---|---|---|---------------|
| 1 | 0 | 1 | 2 |

Course Objectives: The course is designed to provide basic knowledge of procedural programming and learn constructs of C language. Students will be able to develop logics which will help them to create programs in C.

Course Contents/syllabus:

| | |
|--|-----------------------|
| | Teaching Hours |
|--|-----------------------|

| | |
|--|--------------|
| Unit I: Unit I: Introduction of Programming Languages. | 5 hrs |
| Introduction: Types of Languages, Evolution of 'C' Language, Structure of a 'C' Program, C' Program development life cycle, Executing and Debugging a 'C' Program. 'C' Tokens: Keywords and Identifiers, Operators, Constants, Variables, Data Types, Precedence of Operators, Scope and Lifetime of Variables | |
| Unit II: Control Statement and Looping | 4 hrs |
| Control Statements: Decision Making using if statement, Types of if ...else block, Switch case Block, Arithmetic Expressions, Evaluation of Expressions, GOTO statement Looping: Concept of Loop, For loop, While loop, Do while loop, Jumping in Loop, break and continue statement. | |
| Unit III: Arrays and Strings | 4 hrs |
| Arrays and Strings: Introduction to array, Processing Array Contents, 2D arrays, Array with three or more dimensions. String, string concatenation, Comparing strings, String handling Functions | |
| Unit IV: Functions, Structure and Unions | 5 hrs |
| Function: Concept of Function, User defined Function, System Defined Function, Function Calling, Types of parameters passing in function, return type in Function. Structure & Union: Need of Structure, Implementing Structure Variable, Arrays of Structure, Structure within Structure, Introduction of Unions, Difference between Structure and Unions | |

Course Learning Outcomes: After studying this course students will be able:

1. To understand the fundamentals and tokens of C programming.
2. To develop skills to implement decision making through control structures in C.
3. To Analyze the working and implementation of array in memory.
4. To Optimize the code with the help of functions and structures.

Lab/ Practical with basic instructions (Total teaching 15 hrs):

Objective: The aim of this section of Lab is to teach experiments of C programming pertaining to the units being taught in the theory paper specifically related to procedural programming, strings, structures and unions.

1. Write a Program to read radius value from the keyboard and calculate the area of circle and print the result in both floating and exponential notation.
2. Write a Program to convert temperature. (Fahrenheit –Centigrade and vice-versa)
3. Write a program for computing the volume of sphere, cone and cylinder assume that dimensions are integer's use type casting where ever necessary.
4. Write a Program to read marks of a student in six subjects and print whether pass or fail(using if-else).
5. Write a Program to calculate roots of quadratic equation (using if-else).
6. Write a Program to calculate electricity bill. Read starting and ending meter reading. The charges are as follows.

No. of Units Consumed Rate
in(Rs) 1-100 1.50 per unit

101-300 2.00 per unit for excess of 100 units
 301-500 2.50 per unit for excess of 300
 units 501-above 3.25 per unit for excess of
 500 units

Do the Following Programs Using for, while, do-while loops.

7. Write a program to calculate sum of individual digits of a given number.
8. Write a program to check whether given number is palindrome or not.
9. Write a program to check whether a given number is a Fibonacci number or not.
10. Write a program to read 2 numbers x and n then compute the sum of the Geometric Progression. $1+x+x^2+x^3+\dots+x^n$
11. Write a program to print the following formats.
 - 1 * * *
 - 1 2 * * * *
 - 1 2 3 * * * * *
 - 1 2 3 4 * * * * * *
12. Write a program to perform matrix addition, matrix subtraction and transpose of a matrix.
13. Write a program to verify the given string is palindrome or not (without built-in functions, with using built-in functions).
14. Write a program to swap two numbers using a) Call By Value B) Call By Reference.
18. Write a program to create structure for an account holder in a bank with following Fields: name, account number, address, balance and display the details of five account holders.

Text / Reference Books:

| Author | Title | Publisher | Ed/year | ISBN No | Pages |
|--|---|-------------------------|---------|----------------|-------|
| Jeri R. Hanly, Elliot B. Koffman | Problem Solving and Program Design in C | Pearson | 2018 | 978-0134014890 | 345 |
| Pradip Dey, Manas Ghosh | Programming In C | Oxford University Press | 2018 | 978-0199491476 | 720 |
| Yashwant Kanetkar | Let Us C | BPB Publications | 2020 | 978-9389845686 | 556 |

B.Sc. (H) Human Genetics and Molecular Medicine- 3 years (4thSemester)

| Sr . No | Course Code | Course Title | Course Type | Credits | | | | | Credit Units |
|---------------|----------------|--|--------------------------------|---------|---|----|----|----|-----------------|
| | | | | L | T | PS | FW | SW | |
| 1 | | Immunology | Core Course | 4 | 0 | 2 | 0 | 0 | 6 |
| 2 | | Human Anatomy and Physiology | Core Course | 4 | 0 | 2 | 0 | 0 | 6 |
| 3 | | Microbial Physiology and metabolism | Core Course | 4 | 0 | 2 | 0 | 0 | 6 |
| 4 | | Recombinant DNA Technology | Allied Course | 3 | 0 | 1 | 0 | 0 | 4 |
| 5 | | Fundamentals of Physics | Skill enhancement course | 2 | 0 | 0 | 0 | 0 | 2 |

Total Credits

24

Immunology

| L | T | P | Total Credits |
|---|---|---|---------------|
| 4 | 0 | 2 | 6 |

Objective: The objective of this course is to provide students with detail understanding of different cells of the immune system and their role in immune protection as well as application of immunological techniques

Course content and syllabus

| | Teaching Hours |
|---|----------------|
| Unit I: Introduction and Immune Cell Types | 1 hrs 8 |
| Immune system, Concept of Innate and Adaptive immunity, Hematopoietic stem cells, Lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells), Granulocytes and Monocytes, Cell participation in innate and adaptive Immunity | |
| Unit II: Antigens, Antibodies and Major Histocompatibility Complex | 1 hrs 8 |
| Characteristics of an antigen (Foreignness, Molecular size, and Heterogeneity), Haptens, Epitopes (T & B cell epitopes), T-dependent and T-independent antigens, Factors responsible for immunogenicity, Adjuvants, Super-antigens, Structure and function of antibody, Antibody classes, VDJ rearrangements, Monoclonal and chimeric antibodies, Major Histocompatibility: Structure and Functions of MHC I & II molecules, Antigen processing and presentation, Inflammatory response, Complement System | |
| Unit III: Generation of Immune Response and Vaccines | 1 hrs 8 |
| Primary and Secondary Immune Response, Generation of Humoral Immune Response (Plasma and Memory cells), Generation of Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co- stimulatory signals), Killing Mechanisms by CTL and NK cells, Types of autoimmunity and hypersensitivity with examples, Immunodeficiencies - Animal models (Nude and SCID mice), SCID, DiGeorge syndrome, Chediak- Higashi syndrome, tumor antigens, Vaccines: Active and passive immunization, Vaccine types (Livebut attenuated, Killed, Subunit, Recombinant, DNA and Peptide) | |
| Unit IV: Immunological Techniques | 1 hrs 8 |
| Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, Immunoassays, ELISA, ELISPOT, Western blotting, Immunofluorescence, Flow cytometry, fluorescence activated cell sorting analysis, microarrays to assess gene expression | |

List of Experiments: (Total Teaching Hours = 60 hrs)

1. Identification of human blood groups.
2. Total Leukocyte Count of the given blood sample.
3. Differential Leukocyte Count of the given blood sample.
4. Separation of serum from the given blood sample.
5. Immunodiffusion by Ouchterlony method.
6. DOT ELISA.
7. Immuno-electrophoresis.

Course Learning Outcomes:

- Students will be able to explain the role of immune cells and their role in body defense mechanism
- Students will be able to devise strategies to combat infection or diseases produced by altered self.
- Students will develop ability to use this knowledge in the processes of immunization, antibody engineering, vaccine development, transplantation, and diseases.
- Students will be able to demonstrate immunological techniques

Text / Reference Books:

| Author | Title | Publisher | Ed/year | ISBN No | Pages |
|---|--|-----------------------------|---------|----------------|-------|
| J. Owen, J. Punt, S. Stranford | Kuby Immunology (8 th Edition) | WH Freeman and Company, USA | 2012 | 978-1319114701 | 944 |
| D. Male, J. Brostoff, D. Roth, I. Roitt | Immunology (8 th Edition) | Saunders, Elsevier, USA | 2012 | 978-0702045486 | 482 |
| K. Murphy | Janeway's Immunobiology (8 th Edition) | Garland Science, USA | 2011 | 978-0818342908 | 887 |
| A. Abbas, A. Lichtman, S. Pillai | Cellular and Molecular Immunology (10 th Edition) | Saunders, Elsevier, USA | 2014 | 978-8131264577 | - |

Human Anatomy and Physiology

| L | T | P | Total Credits |
|---|---|---|---------------|
| 4 | 0 | 2 | 6 |

Course content and syllabus

| | Teaching Hours |
|---|----------------|
| Unit I Introduction to Developmental Biology | 18 hrs |
| <p>Introduction: What is developmental biology? History and Basic Concepts</p> <p>From Sperm and Egg to Embryo: 1. Beginning the Developmental Program: Gametogenesis, Structure of eggs and sperm, Comparing oogenesis and spermatogenesis</p> <p>2. Fertilization: Beginning a New Organism- Gamete recognition, Gamete fusion and prevention of polyspermy, Activation of egg metabolism, Fusion of the genetic material.</p> | |
| Unit II Early Development | 18 hrs |
| <p>Early Embryogenesis: Cleavage: Generating a Multicellular Embryo (a) Overview of Cleavage in Amphibians/Birds/Mammals, Gastrulation and cell movement and types of movement, Germ layers.</p> <p>Body Patterning: Animal-Vegetal Axis, Rotation of Fertilization and the Dorso-Ventral Axis Organizer in Amphibia, Development of Body plan in <i>Drosophila</i>, Maternal genes, Zygotic genes, Segment Identity genes. Segment identity and Hox genes.</p> | |
| Unit III: Development of Various Organs | 18 hrs |
| <p>Building with Ectoderm: The Vertebrate Nervous System and Epidermis: Neural Tube Formation and Patterning; Brain Growth; Neural Crest Cells and Axonal Specificity; Ectodermal Placodes and the Epidermis.</p> <p>Building with Mesoderm and Endoderm: Organogenesis; Paraxial Mesoderm: The Somites and Their Derivatives; Intermediate and Lateral Plate Mesoderm: Heart, Blood, and Kidneys; Development of the Tetrapod Limb; The Endoderm: Tubes and Organs for Digestion and Respiration.</p> <p>Postembryonic Development: Metamorphosis: The Hormonal Reactivation of Development; Regeneration; Aging and Senescence</p> | |
| Unit IV: Developmental Genetics | 18 hrs |
| Principles of Developmental Biology - Genetic approaches, Genetic marking, Genetic malformations. Developmental Patterns – Developmental dynamics of cell specification (Autonomous, Syncytial & conditional), Morphogenetic fields. The Genetic Core of Development - The Embryological origins of Gene Theory, Early attempts at Developmental Genetics, Genomic equivalence, determining the function of genes during development, Gene targeting (Knockout) experiments, determining function of a message Antisense RNA. | |

List of Experiments -with basic instructions (Total Teaching = 72 hrs)

1. Slide analysis and identification (Different developmental Stages).
2. Study of vertebrate development through models
3. Study of organogenesis in humans using educational videos.
4. *Drosophila* development: Setting up cross. Observing *Drosophila* embryo under microscope.
5. Studying *Drosophila* life cycle: Larvae, pupae and adult.
6. Studying Chick embryo in detail.
7. Cleavage patterns.

Course Learning Outcomes:

- Understand how a single cell develops to an organism.
- Perceive knowledge about early stages of development.
- Understand how three germ layers give rise to all the organs and organ systems.
- Acquire knowledge about genetics behind development.

Text / Reference Books:

| Author | Title | Publisher | Ed/year | ISBN No | Pages |
|---|---------------------------|------------------------|-----------------------|------------------------------|-------|
| S. F. Gilbert | Developmental Biology | Sinauer Associates Inc | 8 th /2006 | 9781605356044 | 500 |
| L. Wolpert, J. Smith, T. Jessell, P. Lawrence, E. Robertson and E. Meyerowitz | Principles of Development | Oxford Univ Press. | 3 rd /2006 | 0199275378 978-0199275373 | 576 |

Microbial Physiology and Metabolism

| L | T | P | Total Credits |
|---|---|---|---------------|
| 4 | 0 | 2 | 6 |

Course content and syllabus

| | Teaching Hours |
|---|----------------|
| Unit I: Microbial growth and effect of environmental factors on growth | 18 hrs |

| | |
|---|---------------|
| <p>Definitions of growth, measurement of microbial growth, Batch culture, Continuous culture, generation time and specific growth rate, synchronous growth, diauxic growth curve</p> <p>Microbial growth in response to environment -Temperature (psychrophiles, mesophiles, thermophiles, extremophiles, thermodurics, psychrotrophs), pH (acidophiles, alkaliphiles), solute and water activity (halophiles, xerophiles, osmophilic), Oxygen (aerobic, anaerobic, microaerophilic, facultative aerobe, facultative anaerobe), barophilic. Microbial growth in response to nutrition and energy – Autotroph/Phototroph, heterotrophy, Chemolithoautotroph, Chemolithoheterotroph, Chemoheterotroph, Chemolithotroph, photolithoautotroph, Photoorganoheterotroph.</p> <p>Passive and facilitated diffusion Primary and secondary active transport, concept of uniport, symport and antiport</p> | |
| Unit II: Chemoheterotrophic Metabolism | 18 hrs |
| <p>Aerobic Respiration: Concept of aerobic respiration, anaerobic respiration and fermentation. Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway TCA cycle, Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial ETC, electron transport phosphorylation, uncouplers and inhibitors.</p> <p>Anaerobic respiration and fermentation: Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate/nitrite and nitrate/ammonia respiration; fermentative nitrate reduction)</p> <p>Fermentation - Alcohol fermentation and Pasteur effect; Lactate fermentation (homofermentative and heterofermentative pathways), concept of linear and branched fermentation pathways.</p> | |
| Unit III: Chemolithotrophic and Phototrophic Metabolism | 18 hrs |
| <p>Introduction to aerobic and anaerobic chemolithotrophy with an example each. Hydrogen oxidation (definition and reaction) and methanogenesis (definition and reaction) Introduction to phototrophic metabolism - groups of phototrophic microorganisms, anoxygenic vs. oxygenic photosynthesis with reference to photosynthesis in green bacteria, purple bacteria and cyanobacteria</p> | |
| Unit IV: Nitrogen Metabolism | 18 hrs |
| <p>Introduction to biological nitrogen fixation Ammonia assimilation</p> <p>Assimilatory nitrate reduction, dissimilatory nitrate reduction, denitrification</p> | |

List of Experiments -with basic instructions (Total Teaching = 60 hrs)

1. Study and plot the growth curve of *E. coli* by turbidometric and standard plate count methods.
2. Calculations of generation time and specific growth rate of bacteria from the graph plotted with the given data
3. Effect of temperature on growth of *E. coli*
4. Effect of pH on growth of *E. coli*
5. Effect of carbon and nitrogen sources on growth of *E. coli*
6. Effect of salt on growth of *E. coli*
7. Demonstration of alcoholic fermentation
8. Demonstration of the thermal death time and decimal reduction time of *E. coli*.

Course Learning Outcomes:

- Study the types of microbial growth and effect of environmental factors.
- Understand the mechanism of nutrients uptake and transport in micro-organisms.
- Study different types of growth in micro-organisms in response to nutrition and energy.
- Classify the microbes on the basis of metabolic processes and their energy requirements.
- Perceive knowledge of microbial nitrogen metabolism.

Text / Reference Books:

| Author | Title | Publisher | Ed/year | ISBN No | Pages |
|---|---|----------------------------------|----------------------------|------------------------------|-------|
| Madigan MT, and Martinko JM | Brock Biology of Microorganisms. | Prentice Hall International Inc. | 14 th Ed./ 2014 | 9781292018317 | 1030 |
| Moat AG and Foster JW | Microbial Physiology 4 th Edition | John Wiley & Sons | 2002 | 0471394831 978-0471394839 | 736 |
| Willey JM, Sherwood LM, and Woolverton CJ | Prescott's Microbiology. 9 th edition. | McGraw Hill Higher Education | 2013 | 9780073402406 0073402400 | 2272 |
| Pelczar Jr MJ, Chan ECS, and Krieg NR. | Microbiology. 5 th edition | Tata McGraw Hill. | 1993 | 0070492581, 9780070492585 | 957 |

Recombinant DNA Technology

| | | | |
|----------|----------|----------|----------------------|
| L | T | P | Total Credits |
| 3 | 0 | 1 | 4 |

Course content and syllabus

Course Objective: To teach methods of DNA manipulations, cloning and gene editing

| | Teaching Hours |
|---|-----------------------|
| Unit I: Gene Cloning and DNA Analysis | 18 hrs |
| Polymerase chain reaction, DNA modifying enzymes: polymerases, kinases, ligases, phosphatases; Primers designing, Purification of DNA fragments, Restriction enzymes, DNA ligation, Vectors, DNA Transformation, GENOMIC DNA and Plasmid Isolation, Restriction digestion and DNA Analysis by gel electrophoresis. | |
| Unit II: Vectors for Gene Cloning and DNA Manipulation | 9 hrs |
| Cloning vectors based on E. coli plasmids, Plasmid copy number control, Cloning vectors based on M13 bacteriophage, Cloning vectors based on λ bacteriophage, λ and other high-capacity vectors enable genomic libraries to be constructed, Vectors for other bacteria, Bacterial Artificial chromosomes (BACs); Vectors for yeast and other fungi, Yeast artificial chromosomes (YACs), Cloning vectors for higher plants, Tobacco Mosaic Virus (TMV); Cloning vectors for animals. Problem of Plasmid incompatibility, The problem of selection, Direct selection, Identification of a clone from a gene library, Methods for clone identification. | |
| Unit III: Cloning a Specific Gene | 18 hrs |
| Transduction, conjugation and transfection, Types of plasmids, Recombinant Bacterial strains for bioremediation; online servers/software for DNA and protein analysis: Acquiring DNA sequence encoding the protein of interest (for example GFP) from online database like PUBMED and PDB. Analysis of DNA sequence for presence of internal restriction digestion sites etc. | |
| Unit IV: Advanced Cloning Techniques | 9 hrs |
| Homologous recombination, Molecular mechanism of RecBCD, RecA, RuvA-B, Holliday Model; Non-homologous End Joining (NHEJ) versus Homologous DNA recombination; Positive and negative selection, Zinc finger nucleases (ZFN), Transcription activator-like effector nucleases (TALENs), Discovery of adaptive immunity, The CRISPR-Cas9 (clustered regularly interspaced short palindromic repeats) system, Methods to create gene-knock out animal model systems. Cre-LoxP recombination system | |

List of Experiments

1. Acquiring DNA sequence encoding the protein of interest (for example GFP) from online database like Genbank and Uniprot. Analysis of DNA sequence for presence of internal restriction digestion sites etc using softwares like gene runner.
2. Primer designing: Designing of 5' forward and 3' reverse complementary primers containing appropriate restriction digestion sites, affinity tags (penta-His etc.).
3. PCR amplification of the DNA segment of interest from a suitable source, purification of the PCR product.
4. Restriction digestion, and subsequent ligation into the suitable bacterial expression vector (also containing an antibiotic resistant marker) of interest.
5. Preparation of competent cells and transformation into suitable competent cells (BL21 etc.).
6. Selection of the antibiotic resistant single colony.
7. Plasmid isolation from the transformed cells and sequencing it to confirm the sequence of cloned DNA segment of interest.

Course Learning Outcomes:

Students will be able to:

1. Understand basic concepts of DNA manipulation.
2. Understand the procedure of gene cloning
3. Have a thorough understanding of vectors
4. Perceive knowledge of advanced gene editing methods

Text / Reference Books:

| Author | Title | Publisher | Ed/year | ISBN No | Pages |
|--|---|-------------------------------------|--------------------|----------------|--------------|
| J. Sambrook, E. F. Fritsch, and T. Maniatis, 2nd Edn., | Molecular cloning: a laboratory manual, | Cold Spring Harbor Laboratory Press | 3 rd Ed | 978-0879695767 | 2344 |
| T.A. Brown | Gene Cloning and DNA Analysis - An introduction | Wiley - Blackwell | 2010 | 9781405181730 | 338 |

Fundamentals of Physics

| L | T | P | Total Credits |
|----------|----------|----------|----------------------|
| 2 | 0 | 0 | 2 |

Course Objectives:

Aim of this course is to introduce the students about fundamentals of graduate level Physics, which forms the basis of all Applied Science specifically physical optics, mechanics, dynamics, and acoustics relating human body

| Unit I: Interference, diffraction, and polarization (10) | HRS |
|--|------------|
| Young's double slit experiment, Huygen's principle, Superposition principle, Analysis of interference (constructive and destructive) and conditions for sustained interference, Interference in thin parallel and wedge-shaped films, Newton's rings, introduction to diffraction: Fresnel and Fraunhofer diffraction, Rayleigh criterion and Resolving power and dispersive power of grating, Polarization of Light, Law of Malus, Brewster's Law, Circularly and Elliptically Polarized Light, Half and Quarter Wave Plates | 9 hrs |
| Unit II: Lasers (8) | |
| Introduction of Lasers, Induced Absorption, Spontaneous and Stimulated Emission, Einstein Coefficients, Population inversion, Fundamental of Lasers, | 9 hrs |
| Types of Pumping, Concept of Three and Four Level Lasers, Construction and Working Lasers, Properties of Laser and its applications | |
| Unit III: Mechanics and dynamics of a human body (12) | |
| Mechanics: Muscular Action, Friction, Energetics, Model of Walking, Material Components of the Body, Bone, Ligaments and Tendons, Cartilage, Elastic Properties, Basic Stress-Strain Relationships, Fluid mechanics: Characteristic Pressures in The Body, Physics of Pressure and Flow of Fluids, Law of Laplace, Fluids in Motion, Equation of Continuity, Bernoulli's Equation, Viscous Flow and Poiseuille's Law, Thermodynamics: First and second laws of thermodynamics, Concept of free energy, entropy, heat content of food, bomb calorimetry | 9 hrs |
| Unit IV: Waves and human body (6) | |
| Speed and Properties of Sound Waves, Intensity of Sound Waves, Sound propagation from one Medium to Another, Speech Production, Types of Sounds Hearing, Other Vibrations of the Body, Cardiac and Other Sources of Sounds | 9 hrs |

Course Learning Outcomes:

1. Understand the fundamental principles underlying phenomena of interference, diffraction, and polarization
2. Understanding on the properties, construction, and applications of laser
3. Understand and analyse the mechanical and dynamical aspects of the different components of a human body
4. Understand and analyzing basics of sound with its impact on the body

| AUTHOR | TITLE | Publisher | Year of publication | ISBN |
|---------------------------------------|---|--|----------------------------|----------------|
| Irving P. Herman | Physics of the HumanBody | Springer , ISSN1618-721 | 2006 | 978-3540817062 |
| W. HughesB | Aspects of Biophysics | John willey andsons | 1979 | 978-0471019909 |
| R.K. Hobbie | Intermediate Physics inBiology and Medicine | Springer | 2001 | 978-3319126814 |
| Halliday, Resnickand Walker | Fundamentals of Physics | Wiley India Pvt Ltd | 2006 | 978-8126514427 |
| Brijlal, Subramanyam & N Subrahmanyam | Principle of Optics | S. Chand publishing, 25thedition, 2012 | 2006 | 978-8121926119 |
| Ghatak, Ajay | Optics | Tata McGraw-Hill | 4th Edition | 9789339220907 |
| Jenkins F A, White H E | Fundamentals of optics | Mcgraw hill | 4th Edition | 9780072561913 |

B.Sc. (H) Human Genetics and Molecular Medicine- 3 years (5th Semester)

| Sr. No | Course Code | Course Title | Course Type | Credits | | | | | Credit Units |
|--------|-------------|--|--------------------------------|---------|---|----|----|----|--------------|
| | | | | L | T | PS | FW | SW | |
| 1 | | Molecular Biology | Core Course | 4 | 0 | 2 | 0 | 0 | 6 |
| 2 | | Developmental Biology | Core Course | 4 | 0 | 2 | 0 | 0 | 6 |
| 3. | | <u>Students will choose any two of the given choices*</u> | Specialization Elective Course | | | | | | |
| 4. | | 1. Microbial Genetics | | 4 | 0 | 0 | 0 | 0 | 4 |
| | | 2. Nanomedicine | | 4 | 0 | 0 | 0 | 0 | 4 |
| | | 3. Virology | | | | | | | |
| | | 4. Endocrinology | | | | | | | |
| | | 5. MOOC | | | | | | | |
| 5. | | <u>Students will choose any two of the given choices**</u> | Skill Enhancement Course | | | | | | |
| | | 1. Cell Signalling | | 2 | 0 | 0 | 0 | 0 | 2 |
| | | 2. Research Methodology | | 2 | 0 | 0 | 0 | 0 | 2 |
| | | 3. Biowarfare and Bioterrorism | | | | | | | |
| | | 4. Programming in Python | | | | | | | |
| | | 4. MOOC | | | | | | | |

Total Credits

24

*The specialization Elective courses in semesters 5 and 6th will be pooled together.

** The Skill Enhancement courses in semesters 5th and 6th will be pooled together.

The Specialization Elective Course and Skill Enhancement Course can also be taken through MOOC. A maximum of 4 credits per semester can be taken through MOOC.

Molecular Biology

| | | | |
|----------|----------|----------|----------------------|
| L | T | P | Total Credits |
| 4 | 0 | 2 | 6 |

Course content and syllabus

Course Objectives: To teach the fundamentals of DNA replication, transcription and translation

| | Teaching Hours |
|--|-----------------------|
| Unit I: Genes and Genomes | 15 hrs |
| <p>The History and Birth of Molecular Biology. Relationships between genotype and phenotype. Contributions of Nobel Laureates in the area of Molecular Biology</p> <p>Genes and Genomes: Molecular definition of gene. Organization of genes on chromosomes. Repetitive DNA. Simple sequence DNA. Interspersed-Repeat DNA and mobile DNA elements.</p> <p>Chromosome structure: Bacterial chromatin and specific proteins to condense bacterial DNA.</p> <p>Nucleosomes. Chromatin organization in eukaryotes. Functional Rearrangements in chromosomal DNA. Extra-nuclear genomes, Specific notations, conventions and terminologies used in genetics</p> | |
| Unit II: DNA Replication, Damage and Repair | 21 hrs |
| <p>DNA replication is semi-conservative and bi-directional.</p> <p>DNA replication in bacteria: Initiation, elongation and termination of bacterial DNA replication. Enzymes involved in DNA replication.</p> <p>Eukaryotic DNA replication machinery. Initiation, elongation and termination of replication. Telomeres and Telomerase. Leading strand problem in replication.</p> <p>DNA replication in Archaea</p> <p>DNA damage and repair mechanisms</p> | |

| | |
|---|---------------|
| Unit III: Transcription | 18 hrs |
| <p>RNA Transcription in bacteria and eukaryotes</p> <p>RNA and Transcription: Types of RNA. Types of RNA polymerase and structure; Molecular apparatus and events during prokaryotic and eukaryotic RNA synthesis. Post—transcriptional modifications of transcripts. Processing of different types of RNA. RNA editing. Formation of spliceosome complex. Inhibitors of RNA metabolism and their mechanism of action; RNA degradation.</p> | |
| Unit IV: Protein Translation | 18 hrs |
| <p>Genetic code: Its deciphering, degeneracy and general features.</p> <p>tRNA, aminoacylation of tRNA, tRNA identity and aminoacyl tRNA synthetases. Structure of ribosomes, and its assembly and disassembly. Codon: anti-codon base pairing, Wobble hypothesis</p> <p>Translation in Prokaryotes: formation of initiation complex, initiation factors, elongation, elongation factors, and termination.</p> <p>Translation in Eukaryotes: formation of initiation complex, initiation factors, elongation, elongation factors and termination.</p> <p>Translation proof-reading, translation inhibitors.</p> <p>Post-translation modifications of proteins and their effect on their structure and function.</p> <p>Protein targeting: Signal sequence and targeting of proteins to specific cellular locations.</p> | |

List of Experiments -with basic instructions (Total Teaching = 72 hrs)

1. Verification of Chargaff's rule by paper chromatography.
2. Ultraviolet absorption spectrum of DNA and RNA.
3. Determination of DNA and RNA concentration by A₂₆₀nm.
4. Determination of the melting temperature and GC content of DNA.
5. To study the viscosity of DNA solutions.

6. Isolation of chromosomal DNA from E. coli/plant/yeast/animal cells.

7. Recombinant Protein Expression and Purification

Course Learning Outcomes: at the end of this course, students will learn about:

- History and development of molecular biology, structure of genome and terminologies used in molecular genetics
- DNA replication in bacteria, archaea and eukaryotes
- Mechanism of transcription in bacteria and eukaryotes.
- Mechanisms of translation and bacteria and eukaryotes.

Text / Reference Books:

| Author | Title | Publisher | Ed/year | ISBN No | Pages |
|---|-------------------------------------|--------------------|--------------------|-------------------|-------|
| Watson, JD., Baker, TA., Stephen, PB., Alexander, G., Levine, M., Losick R. | Molecular Biology of the Gene | Pearson Education | 7 th Ed | 978-9332585478 | 912 |
| Tropp, B.E. | Molecular Biology Genes to Proteins | Jones and Bartlett | 4 th Ed | 978-93-80853-49-9 | 1096 |
| Lewin, B. | Genes XI | Jones and Bartlett | 2013 | 978-9380853710 | - |

Developmental Biology

| L | T | P | Total Credits |
|---|---|---|---------------|
| 4 | 0 | 2 | 6 |

Course content and syllabus

| | Teaching Hours |
|--|----------------|
| Unit I Introduction to Developmental Biology | 18 hrs |

| | |
|---|----------------------|
| <p>Introduction: What is developmental biology? History and Basic Concepts</p> <p>From Sperm and Egg to Embryo: 1. Beginning the Developmental Program: Gametogenesis, Structure of eggs and sperm, Comparing oogenesis and spermatogenesis 2. Fertilization: Beginning a New Organism- Gamete recognition, Gamete fusion and prevention of polyspermy, Activation of egg metabolism, Fusion of the genetic material.</p> | |
| <p>Unit II Early Development</p> | <p>18 hrs</p> |
| <p>Early Embryogenesis: Cleavage: Generating a Multicellular Embryo (a) Overview of Cleavage in Amphibians/Birds/Mammals, Gastrulation and cell movement and types of movement, Germ layers.</p> <p>Body Patterning: Animal-Vegetal Axis, Rotation of Fertilization and the Dorso-Ventral Axis Organizer in Amphibia, Development of Body plan in <i>Drosophila</i>, Maternal genes, Zygotic genes, Segment Identity genes. Segment identity and Hox genes.</p> | |
| <p>Unit III: Development of Various Organs</p> | <p>18 hrs</p> |
| <p>Building with Ectoderm: The Vertebrate Nervous System and Epidermis: Neural Tube Formation and Patterning; Brain Growth; Neural Crest Cells and Axonal Specificity; Ectodermal Placodes and the Epidermis.</p> <p>Building with Mesoderm and Endoderm: Organogenesis; Paraxial Mesoderm: The Somites and Their Derivatives; Intermediate and Lateral Plate Mesoderm: Heart, Blood, and Kidneys; Development of the Tetrapod Limb; The Endoderm: Tubes and Organs for Digestion and Respiration.</p> <p>Postembryonic Development: Metamorphosis: The Hormonal Reactivation of Development; Regeneration; Aging and Senescence</p> | |
| <p>Unit IV: Developmental Genetics</p> | <p>18 hrs</p> |
| <p>Principles of Developmental Biology - Genetic approaches, Genetic marking, Genetic malformations. Developmental Patterns – Developmental dynamics of cell specification (Autonomous, Syncytial & conditional), Morphogenetic fields. The Genetic Core of Development - The Embryological origins of Gene Theory, Early attempts at Developmental Genetics, Genomic equivalence, determining the function of genes during development, Gene targeting (Knockout) experiments, determining function of a message Antisense RNA.</p> | |

List of Experiments -with basic instructions (Total Teaching = 60 hrs)

1. Slide analysis and identification (Different developmental Stages).
2. Study of vertebrate development through models
3. Study of organogenesis in humans using educational videos.
4. *Drosophila* development: Setting up cross. Observing *Drosophila* embryo under microscope.
5. Studying *Drosophila* life cycle: Larvae, pupae and adult.
6. Studying Chick embryo in detail.
7. Cleavage patterns.

Course Learning Outcomes:

- Understand how a single cell develops to an organism.
- Perceive knowledge about early stages of development.
- Understand how three germ layers give rise to all the organs and organ systems.
- Acquire knowledge about genetics behind development.

Text / Reference Books:

| Author | Title | Publisher | Ed/year | ISBN No | Pages |
|---|---------------------------|------------------------|-----------------------|------------------------------|-------|
| S. F. Gilbert | Developmental Biology | Sinauer Associates Inc | 8 th /2006 | 9781605356044 | 500 |
| L. Wolpert, J. Smith, T. Jessell, P. Lawrence, E. Robertson and E. Meyerowitz | Principles of Development | Oxford Univ Press. | 3 rd /2006 | 0199275378 978-0199275373 | 576 |

Microbial Genetics

| L | T | P | Total Credits |
|---|---|---|---------------|
| 4 | 0 | 0 | 4 |

Course content and syllabus

| | Teaching Hours |
|--|----------------|
| Unit I: Genome Organization and Mutations | 18 hrs |

| | |
|--|---------------|
| Genome organization: <i>E. coli</i> , <i>Saccharomyces</i> , <i>Tetrahymena</i> . Organelle genome: Chloroplast and Mitochondria. | |
| Mutations and mutagenesis: Definition and types of Mutations; Physical and chemical mutagens; Molecular basis of mutations; Functional mutants (loss and gain of function mutants); Uses of mutations. Reversion and suppression: True revertants; Intra- and inter-genic suppression; Ames test; Mutator genes. | |
| Unit II: Plasmids | 18 hrs |
| Types of plasmids – F plasmid, R Plasmids, colicinogenic plasmids, Ti plasmids, linear plasmids, yeast- 2 μ plasmid, Plasmid replication and partitioning, Host range, plasmid- incompatibility, plasmid amplification, Regulation of copy number, curing of plasmids Phage Genetics: Features of T4 genetics , Genetic basis of lytic versus lysogenic switch of phage lambda | |
| Unit III: Mechanisms of Genetics Exchange | 18 hrs |
| Transformation - Discovery, mechanism of natural competence Conjugation - Discovery, mechanism, Hfr and F' strains, Interrupted mating technique and time of entry mapping Transduction - Generalized transduction, specialized transduction, LFT & HFT lysates, Mapping by recombination and co-transduction of markers | |
| Unit IV: Transposable Elements | 18 hrs |
| Prokaryotic transposable elements – Insertion Sequences, composite and non-composite transposons, Replicative and Non replicative transposition, Mu transposon Eukaryotic transposable elements - Yeast (Ty retrotransposon), Drosophila (P elements), Maize (Ac/Ds) Uses of transposons and transposition | |

Course Learning Outcomes: at the end of the students will learn about

- Basics of microbial genetics including organization of genome of various microorganisms
- Mutations and their importance
- Roles and significance of transposable elements
- Mechanisms of genetic exchange

Text / Reference Books:

| Author | Title | Publisher | Ed/yea r | ISBN No | Pag es |
|---|--------------------------------|-----------|----------------------|-------------------|-----------|
| Snyder, L., Peters, J.E., Henkin, T.M., and Champness, W. | Molecular Genetics of Bacteria | ASM Press | 4 th Ed | 978-1-55581-892-0 | 707 |
| Klug WS, Cummings MR, Spencer, C, Palladino, M. | Concepts of Genetics | Pearsons | 11 th Ed. | 978-9353940409 | - |

| | | | | | |
|-----------|---------------------------------------|------------|---------|--------------------|-----|
| Pierce BA | Genetics: A Conceptual Approach | WH Freeman | 7th Ed. | 978- 1319308318 | 976 |
|-----------|---------------------------------------|------------|---------|--------------------|-----|

Nanomedicine

| L | T | P | Total Credits |
|---|---|---|---------------|
| 4 | 0 | 0 | 4 |

Objective: To make students acquainted with the fundamental concepts of nanotechnology and develop an understanding to employ its principles in biomedical applications.

Course content and syllabus

| | Teaching Hours |
|--|-------------------|
| Unit I: Introduction to nanomaterials | 18 hrs |
| Importance of "Nano" dimension, size matters: bulk vs nanomaterials, nanotechnology exists in nature, brief history of nanotechnology, concept of dimensionality of nanomaterials, effect of 'nano' scale on material properties (electrical, thermal, mechanical, optical, chemical), quantum structures, quantum confinement, classification of nanostructured materials, surface effects of nanomaterials, nanocomposites | |
| Unit II: Synthesis and Characterization of Nanomaterials | 18 hrs |
| Bottom-up and top-down approaches, physical and chemical methods: mechanical milling, laser ablation, arc discharge, chemical vapor deposition, physical vapor deposition, wet chemical synthesis of nanoparticles, self-assembly, biological synthesis of nanomaterials | |
| Unit III: Bionanotechnology | 18 hrs |
| Surface functionalization of nanomaterials for biological applications, nano-antimicrobials, viral nanotechnology, Biological nanomachines: protein and DNA, peptide nanotechnology, DNA nanotechnology, cellular uptake mechanisms of nanomaterials | |
| Unit IV: Nanomaterials Applications in Biology and Nanotoxicity | 18 hrs |
| Polymeric biomaterials, lipid nanoparticles for drug delivery applications, nanoparticles for bioimaging, cancer therapeutics, and tissue engineering applications, stimuli-responsive nanoparticles, nano-artificial cells, nanomaterials for organ printing, nanotoxicology | |

Course Learning Outcomes:

Students will be able to

1. Comprehend the concept of "nanotechnology" and its interdisciplinary aspects.
2. Learn various approaches of synthesizing nanomaterials, their advantages, and limitations.

3. Gain knowledge about various techniques used for characterizing nanomaterials.
4. Comprehend the importance of engineered nanomaterials for biomedical, and therapeutic applications.

Text / Reference Books:

| Author | Title | Publisher | Ed/year | ISBN No | Pages |
|--|--|--|---------|----------------|-------|
| G. Cao | Nanostructures and Nanomaterials: Synthesis, Properties and Applications | Imperial College Press | 2004 | 978-9814324557 | 596 |
| C. M. Niemeyer, C. A. Mirkin | Nanobiotechnology; Concepts, Applications and Perspectives | Wiley-VCH | 2004 | 978-8126538409 | - |
| G. J. Leggett, R. A. L. Jones | Bionanotechnology: In Nanoscale Science and Technology | John Wiley & Sons | 2005 | -- | - |
| B. S. Murthy, P. Shankar, B. Raj, B. B. Rath and J. Murday | Textbook of Nanoscience and Nanotechnology | Universities Press-IIM | 2012 | 978-3642280290 | 244 |
| T. Pradeep | Nano: The Essentials | Tata McGraw-Hill Publishing Company Ltd. | 2007 | 978-0070617889 | 461 |

Virology

| L | T | P | Total Credits |
|---|---|---|---------------|
| 4 | 0 | 0 | 4 |

Course content and syllabus

| | Teaching Hours |
|--|----------------|
| Unit I: Nature and Properties of Viruses | 18 hrs |
| Introduction: Discovery of viruses, nature and definition of viruses, general properties, concept of viroids, virusoids, satellite viruses and Prions. Theories of viral origin. Structure of Viruses: Capsid symmetry, enveloped and non-enveloped viruses. Isolation, purification and cultivation of viruses. Viral taxonomy: Classification and nomenclature of different groups of viruses. | |
| Unit II: Bacteriophages | 18 hrs |

| | |
|---|---------------|
| Diversity, classification, one step multiplication curve, lytic and lysogenic phages (lambda phage) concept of early and late proteins, regulation of transcription in lambda phage. | |
| Unit III: Viral Replication and Transmission | 18 hrs |
| Modes of viral transmission: Persistent, non-persistent, vertical and horizontal. Salient features of viral Nucleic acid : Unusual bases (TMV, T4 phage), overlapping genes (ϕ X174, Hepatitis B virus), alternate splicing (HIV), terminal redundancy (T4 phage), terminal cohesive ends (lambda phage), partial double stranded genomes (Hepatitis B), long terminal repeats (retrovirus), segmented (Influenza virus), and non-segmented genomes (picornavirus), capping and tailing (TMV). Viral multiplication and replication strategies: Interaction of viruses with cellular receptors and entry of viruses. Replication strategies of viruses as per Baltimore classification (phi X 174, Retroviridae, Vaccinia, Picorna), Assembly with example of Polio virus and T4 phage, maturation and release of virions. | |
| Unit IV: Viral Diseases, prevention and application of viruses | 18 hrs |
| Introduction to oncogenic viruses: Types of oncogenic DNA and RNA viruses: Concepts of oncogenes and proto-oncogenes. Antiviral compounds and their mode of action. Interferon and their mode of action. General principles of viral vaccination. | |
| Application of virology: Use of viral vectors in cloning and expression, Gene therapy, Phage display and phage therapy. | |

Course Learning Outcomes: at the end of the course the students will:

- Get an exhaustive account of viruses, their structure and classification
- Learn about replication of viruses
- Viral diseases and methods to control them
- Various applications of virology

Text / Reference Books:

| Author | Title | Publisher | Ed/year | ISBN No | Pages |
|---|---|--------------------------|---------------------------|----------------|-------|
| Dimmock, NJ, Easton, AL, Leppard, KN | Introduction to Modern Virology | Blackwell Publishing Ltd | 6 th Ed | 978-1405171120 | 536 |
| Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR, Skalka, AM | Principles of Virology, Molecular biology, Pathogenesis and Control | ASM Press | 2 nd Ed (2000) | 978-1855811273 | 820 |
| Carter J and Saunders V | Virology: Principles and Applications | Wiley | 2 nd (2013) | 978-1119991427 | 394 |

Endocrinology

| L | T | P | Total Credits |
|---|---|---|---------------|
| 4 | 0 | 0 | 4 |

Course content and syllabus

| | Teaching Hours |
|--|----------------|
| Unit I Basics of Endocrine System | 18 hrs |
| Functional organization and general characteristics of endocrine system, target gland concept, Negative and positive feed-back control, Classification of hormones, Methods to assay quantity and quality of hormones. | |
| Unit II Hormone Action | 18 hrs |
| Mechanism of hormone action: Signal transduction pathways for steroidal and non-steroidal hormones, role of receptors, receptor desensitization, steroid hormones, signalling involving cyclic AMP, cyclic GMP, phosphoinositides, calcium, diacylglycerol and nitric oxide, kinase-phosphatase system and its examples. | |
| Unit III: Physiology of hormonal system | 20 hrs |
| Structure, biosynthesis and release of hormones, biochemical and physiological role, and pathophysiology of Hypothalamus; Pituitary, Thyroid; Parathyroid, Calcitonin acid Vitamin D3; Adrenals; Pancreas; Gonads; G.I.T. tract; Heart (Endothelins and ANF). Various diseases associated with these glands. How lifestyle plays an important role to maintain hormonal balance. | |
| Unit IV: Growth Factors | 16 hrs |

| | |
|--|--|
| Growth factors: Chemistry, Biological functions and mechanism of action of Epidermal growth factor; Hematopoietic cell growth factor; Fibroblast growth factor and Interleukins; Insulin like-growth factors, Nerve growth factors. Placental hormones | |
|--|--|

Course Learning Outcomes:

- Understand in detail about human Endocrine System.
- Perceive knowledge about various glands and diseases associated.
- Understand in detail about how hormones act on human body.
- Acquire knowledge about various growth factors.

Text / Reference Books:

| Author | Title | Publisher | Ed/year | ISBN No | Pages |
|--|--|--------------------|------------------------|------------------------------|-------|
| Murray, R.K., Granner, D.K. and Rodwell, V.W, | Harper's Illustrated Biochemistry | McGraw Hill | 30 th /2018 | 978-0071825344 0071825347 | 817 |
| B. Alberts, D. Bray, J. Lewis, Martin Raff, Keith Roberts, and J. D Watson | Molecular and Cellular Biology | Garland Science | 6 th /2012 | 978-0818344322 0818344325 | 1464 |
| David G. Gardner, Dolores M. Shoback | Greenspan's Basic and Clinical Endocrinology | McGraw Hill | 10 th /2017 | 978-1259589287 1259589285 | 944 |
| Shlomo Melmed, Kenneth Polonsky, P. Reed Larsen, Henry M. Kronenberg | Williams Textbook of Endocrinology | Elsevier | 30 th /2016 | 978-0323555968 0323555969 | 1792 |
| Kumar V, Abbas, A.K., and Aster, J.C. | Robbins Basic Pathology | Saunders Elsevier. | 8 th /2007 | 978-1416029731 | 952 |

Cell Signalling

| | | | |
|----------|----------|----------|--------------|
| L | T | P | Total |
|----------|----------|----------|--------------|

| | | | |
|----------|----------|----------|----------------|
| | | | Credits |
| 2 | 0 | 0 | 2 |

Course content and syllabus

| | Teaching Hours |
|--|-----------------------|
| Unit I: Introduction to Cell Signaling | 4 hrs |
| Modes of signaling, signaling molecules, Intracellular and cell surface receptors, Hormone signaling | |
| Unit II: GPCR & RTK | 12 hrs |
| G-protein mediated signaling, second messengers, receptors tyrosine kinases, Ras-MAPK pathway, JAK-STAT pathway, PI3K-AKT pathway, | |
| Unit III: Signaling through other pathways | 10 hrs |
| Integrins, cadherins, Hedgehog, Notch, Heat shock and ER stress response, Serine/Threonine pathways | |
| Unit IV: Aberrant signaling | 4 hrs |
| Cancer, Notch signaling dependent Diseases, Hedgehog signaling dependent Diseases, Diabetes | |

(Total Teaching = 30 hrs)

Course Learning Outcomes:

- Differentiate structure, receptors, and mechanism of actions of hormones.
- Describe pathways of cellular signaling, cross-talk and regulation.
- Discuss how disruptions in cellular signaling may lead to disease, and illustrate with selected examples.

Text / Reference Books:

| Author | Title | Publisher | Ed/year | ISBN No | Pages |
|--|---|----------------------|----------------|-----------------------|--------------|
| Bruce, Alberts and Alexander Johnson and Julian Lewis, and Martin Raff | Molecular biology of the cell | Garland Science; | 6th | 978-0818344322 | 1342 |
| Rakesh Srivastava | Apoptosis, cell signalling and human diseases | Humana Press | 1st | 9781888298829 | 395 |
| Berg J.M., Tymoczko J.L., Stryer L. | Biochemistry | WH Freeman & Company | 5th | 13: 978-1-4641-2610-9 | 1023 |

Research Methodology

| L | T | P | Total Credits |
|---|---|---|---------------|
| 2 | 0 | 0 | 2 |

Course content and syllabus

| | Teaching Hours |
|--|----------------|
| Unit I: Basic Concepts | 9 hrs |
| Research process, problem identification, research designs, informal experimental designs. Completing randomized design, randomized block design, latin square design, factorial designs | |
| Unit II: Sample collection | 9 hrs |
| Random sampling, complex random sampling, non-probability sampling, measurement and scaling techniques. Data collection. | |
| Unit III: Research Presentation | 9 hrs |
| The students will be taught to present their work in written form and also how to make effective power point presentation | |
| Unit IV: Literature Survey | 9 hrs |
| The students will be required to review literature in their respective disciplines and submit an assignment for evaluation. | |

Course Learning Outcomes:

- Teach students importance of research conceptualization and planning
- Teach student how to make effective written and spoken presentations
- Teach students how to read a research paper

Text / Reference Books:

| Author | Title | Publisher | Ed/ye ar | ISBN No | Pa g es |
|------------------------|--|----------------------------------|---------------------|----------------|---------|
| Kothari, C.R | Research Methodology :Methods and Techniques | New Age Internationa lPublishers | 4 th Ed. | 978-9386649225 | 480 |
| Arya., P.P. and Pal, Y | Research Methodologyin Management: Theory and Case Studies | Deep and Deep Publishers | 2011 | 978-8184503718 | --- |

Biowarfare and Bioterrorism

| L | T | P | Total Credits |
|---|---|---|---------------|
| 2 | 0 | 0 | 2 |

Course content and syllabus

| | Teachin gHours |
|--|----------------|
| Unit I: Introduction | 9 hrs |
| History of Biowarfare. Difference between biowarfare and bioterrorism. Laws preventingthe use of Bioweapons | |
| Unit II: Agents of Biowarfare and Bioterrorism | 9 hrs |
| Various biological agents (bacteria and viruses) that can be used as bioweapons, their properties, mode of spread, infection, incubation period, symptoms, and current treatment strategies. | |
| Unit III: Dissemination and Detection of Biological Agents | 9 hrs |
| Modes of dissemination or delivery of biological Agents: by air through aerosol spray; throughexplosives (missile, bombs, artillery, etc), contamination of food and water; injected or absorbed through the skin Methods to detect and identify biological agents. | |
| Unit IV: Mitigation Strategies | 9 hrs |

| | |
|--|--|
| Public Health and emergency response preparedness. Role of antimicrobials, vaccines, antibodies, immune modulators, and other medications in mitigation. Uses of different biomaterials as a protective cover. | |
|--|--|

Course Learning Outcomes:

- Will learn about the history of biological warfare
- Understand the agents used as biological weapons
- Delivery of Biological Agents
- Methods to detect and identify biological agents.
- Public Health strategies to mitigate effects of biological weapons

Text / Reference Books:

| Author | Title | Publisher | Ed/Year | ISBN No | Pages |
|-------------|---|-----------------------|---------|----------------|-------|
| Dando, M.R. | Bioterror and Biowarfare - A Beginner's Guide | OneWorld Publications | 2006 | 978-1851684472 | 256 |
| Boyle, F. | Biowarfare and Terrorism | Clarity Press | 2005 | 978-0932863461 | 139 |

Programming in Python Lab

| L | T | P/S | SW/FW | TOTAL CREDIT UNITS |
|---|---|-----|-------|--------------------|
| 0 | 0 | 4 | 0 | 2 |

Course Contents/syllabus:

List of Experiments (Total: 72 Hours)

1. Compute sum, subtraction, multiplication, division and exponent of given variables

input by the user.

2. Compute area of following shapes: circle, rectangle, triangle, square, trapezoid and parallelogram.
3. Compute volume of following 3D shapes: cube, cylinder, cone and sphere.
4. Compute and print roots of quadratic equation $ax^2+bx+c=0$, where the values of a, b, and c are input by the user.
5. Print numbers up to N which are not divisible by 3, 6, 9,, e.g., 1, 2, 4, 5, 7,....
6. Write a program to determine whether a triangle is isosceles or not?
7. Print multiplication table of a number input by the user.
8. Compute sum of natural numbers from one to n number.
9. Print Fibonacci series up to n numbers e.g. 0 1 1 2 3 5 8 13.....n
10. Compute factorial of a given number.
11. Count occurrence of a digit 5 in a given integer number input by the user.
12. Print Geometric and Harmonic means of a series input by the user.
13. Evaluate the Arithmetic expressions.
14. Print all possible combinations of 4, 5, and 6.
15. Determine prime numbers within a specific range.
16. Count number of persons of age above 60 and below 90.
17. Compute transpose of a matrix.
18. Perform following operations on two matrices.
 - 1) Addition 2) Subtraction 3) Multiplication
19. Count occurrence of vowels.
20. Count total number of vowels in a word.
21. Determine whether a string is palindrome or not.
22. Perform following operations on a list of numbers:
 - 1) Insert an element 2) delete an element 3) sort the list 4) delete entire list
23. Display word after Sorting in alphabetical order.
24. Perform sequential search on a list of given numbers.
25. Perform sequential search on ordered list of given numbers.
26. Maintain practical note book as per their serial numbers in library using Python dictionary.
27. Perform following operations on dictionary
 - 1) Insert 2) delete 3) change
28. Check whether a number is in a given range using functions.
29. Write a Python function that accepts a string and calculates number of upper case letters and lower case letters available in that string.
30. To find the Max of three numbers using functions.
31. Multiply all the numbers in a list using functions.
32. Solve the Fibonacci sequence using recursion.
33. Get the factorial of a non-negative integer using recursion.
34. Write a program to create a module of factorial in Python.

Course Learning Outcomes: After studying this course students will be able to:

1. Explain environment, data types, operators used in Python.
2. Compare Python with other programming languages.
3. Outline the use of control structures and numerous native data types with their methods.
4. Design user defined functions, modules, files, and packages and exception handling methods.

5. Learn to handle exceptions in Python.

Text / Reference Books:

| AUTHOR | TITLE | Publisher | Year of publication | ISBN |
|--|--------------------------------|--------------------|----------------------------|----------------|
| Programming in Python | Programming in Python | BPB | 2017 | 978-9386551276 |
| R. Nageswara Rao | Core Python Programming | Dreamtech Press | 2021 | 978-9390457151 |
| Martin C. Brown | Python, The complete Reference | Tata Mc. Graw Hill | 2018 | 978-9387572942 |
| A. Martelli, A. Ravenscroft, S. Holden | Python in a Nutshell | Shroff/O'Reilly | 2017 | 978-9352135400 |

B.Sc. (H) Human Genetics and Molecular Medicine- 3 years (6th Semester)

| Sr. No | Course Code | Course Title | Course Type | Credits | | | | | Credit Units |
|----------------------|-------------|---|--------------------------------|---------|---|----|----|----|--------------|
| | | | | L | T | PS | FW | SW | |
| 1 | | Regulation of Gene Expression | Core Course | 4 | 0 | 2 | 0 | 0 | 6 |
| 2 | | Molecular Biology of Human Diseases | Core Course | 4 | 0 | 2 | 0 | 0 | 6 |
| 3. | | <u>Students will choose any two of the given choices*</u> | Specialization Elective Course | | | | | | |
| 4. | | 1. Computational Skills 2. Introductory Bioinformatics 3. Biopolymers and its Medical Applications 4. MOOC | | 4 | 0 | 0 | 0 | 0 | 4 |
| | | | | 4 | 0 | 0 | 0 | 0 | 4 |
| 5. | | <u>Students will choose any two of the given choices**</u> | Skill Enhancement Course | 2 | 0 | 0 | 0 | 0 | 2 |
| | | 1. Biomaterials 2. Cancer Biology 3. BioEntrepreneurship 4. MOOC | | 2 | 0 | 0 | 0 | 0 | 2 |
| Total Credits | | | | | | | | | 24 |

*The Specialization Elective course from 5th and 6th semesters will be pooled together.

** The Skill Enhancement Courses from 5th and 6th semesters will be pooled together.

The Specialization Elective Course and the Skill Enhancement Course can also be taken through MOOC. A maximum of 4 credits per semester can be taken through MOOC.

Regulation of Gene Expression

| L | T | P | Total Credits |
|---|---|---|---------------|
| 4 | 0 | 2 | 6 |

Course content and syllabus

| | Teaching Hours |
|--|----------------|
| Unit I: Regulation of Gene Expression in Prokaryotes | 18 hrs |
| Regulation of Gene Expression in Prokaryotes: concept of operon, ORF. Control at initiation of transcription. Promoter strength and role of sigma factors. Lac Operon (Genetic and Biochemical aspects), araBAD operon. Catabolite repression. trp and his Operons. Regulation of genes for ribosomal RNA and proteins. Bacterial viruses (Lytic and Lysogenic modes). Role of small molecules and RNA in gene control. Riboswitches and bacterial two component system. | |
| Unit II: Regulation of Gene Expression in Eukaryotes | 18 hrs |
| Regulation of Gene Expression in Eukaryotes: Gene regulation in Yeast (Galactose metabolism, Gal 4 protein, Mating Type), role of mediators, enhancer elements. Chromatin remodelling: histone modification, epigenetic changes Post-transcriptional regulation. RNA silencing: siRNA, miRNA, transitive RNAi, ncRNA. Regulation at translational level | |
| Unit III: DNA-Protein Interaction | 18 hrs |
| Structures of DNA binding domain: HTH, wHTH, zinc fingers, leucine zippers, HLH, Loop-sheet-helix. Specificity in DNA-protein interactions. Techniques to study DNA-protein interaction- DNA footprinting, DNA pull down, EMSA, Super-shift, CHIP, reporter assays, Co-crystal studies, yeast two hybrid system, FISH. | |
| Unit IV: | 18 hrs |
| Genomic regulatory domains: Introduction to regulation of expression of gene clusters; locus control region (LCR): structure and function LCR of mouse globin gene cluster; Insulators, structure and functions, the insulators of <i>hsp70</i> genes of <i>Drosophila melanogaster</i> ; Genomic imprinting of <i>Igf-2</i> and <i>H-19</i> genes | |

List of Experiments -with basic instructions (Total Teaching = 60 hrs)

1. Extraction of total nucleic acids from plant tissue.
2. Diauxic growth curve effect.
3. Isolation of mRNA from yeast by affinity chromatography.
4. Effect of inhibitors on protein synthesis.
5. Accumulation of protein due to proteasome inhibitors.

Course Learning Outcomes:

- Will have the knowledge of structure and function of genes

- Concept and knowledge of different strategies in regulation of gene expression in prokaryotes and eukaryotes
- Understand structure of DNA-binding domains
- Learn various techniques to study DNA-protein interaction

Text / Reference Books:

| Author | Title | Publisher | Ed/year | ISBN No | Pages |
|--|-------------------------------------|-----------------------------|---------------------|--------------------|-------|
| Krebs, J.E., Goldstein, E.S., and Kilpatrick, S.T. | Lewin's Genes XII | Jones and Bartlett Learning | 12 th Ed | 978-1284104493 | 838 |
| Watson JD, Baker TA, Bell SP, Gann A, Levine M, Losick R. | Molecular Biology of the Gene | Pearsons Publishers | 7 th Ed. | 978-9332585478 | 912 |
| Tropp, B.E. | Molecular Biology Genes to proteins | Jones and Bartlett | 4 th Ed. | 978-93-80853-49-9 | 1096 |
| Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., and Walter, P. | Molecular Biology of The Cell | Garland Science | 6 th Ed | 978-0-818 3-4464-3 | 1342 |

Molecular Biology of Human Diseases

| L | T | P | Total Credits |
|---|---|---|---------------|
| 4 | 0 | 2 | 6 |

Course content and syllabus

| | Teaching Hours |
|--|----------------|
| Unit I Essential Concepts of Human Disease | 18 hrs |
| Introduction to Mechanisms of Human Disease, Cell Death, Cell Death; Inflammation and Tissue Remodeling, Inflammation and Tissue Remodeling, Mutations, Human Genetics and Epigenetics Respiratory Diseases: Introduction to the Respiratory System, Cystic Fibrosis; Asthma and COPD. | |

| | |
|---|---------------|
| Unit II Neoplasia and Reproductive Diseases | 18 hrs |
| <p>Neoplasia: Introduction to Neoplasia, Pulmonary Neoplasia, Breast Neoplasia, Prostate Hyperplasia and Cancer, Lymphoid and Myeloid Malignancy, Colorectal Neoplasia.</p> <p>Reproductive Disorders: Introduction to the Reproductive System, Male Infertility, Female Infertility I (Uterine Disorders), Female Infertility II (Turner Syndrome and PCOS).</p> | |
| Unit III: Metabolic Disorders | 20 hrs |
| <p>Disorders of carbohydrate metabolism: An overview of carbohydrate metabolism; diabetes mellitus, hyperinsulism; glycogen storage diseases including von Gierke disease, Pompe disease.</p> <p>Disorders of amino acid metabolism: An overview of amino acid metabolism; including albinism, Homocystinuria, Maple syrup urine disease, Phenylketonuria, Tyrosinemia.</p> <p>Disorders of fatty acid oxidation: An overview of fatty acid metabolism and transportation; including Gaucher's disease, Tay-sachs disease, Niemann-pick disease, Fabry's disease</p> | |
| Unit IV: Circulatory Diseases | 10 hrs |
| Introduction to the Circulatory System, Hemostasis, Hemostatic Diseases, Atherosclerosis and Coronary Artery Disease; Stroke; Cardiomyopathy; Marfan Syndrome. | |

List of Experiments -with basic instructions (Total Teaching = 60 hrs)

1. Preparation of buffers and solutions for molecular biology experiments
2. DNA isolation from Human blood and Microbes.
3. Plasmid DNA isolation.
4. Agarose gel Electrophoresis of genomic DNA and plasmid DNA.
5. Preparation of restriction digestion of DNA samples.
6. Gel Documentation and photography.

Course Learning Outcomes:

- Understand about a wide variety of human diseases.
- Perceive knowledge about cancers and its pathology.
- Understand in detail about metabolic disorders.
- Acquire knowledge about reproductive disorders.

Text / Reference Books:

| Author | Title | Publisher | Ed/year | ISBN No | Page |
|--------|-------|-----------|---------|---------|------|
|--------|-------|-----------|---------|---------|------|

| | | | | | |
|---|---|---------------------|-----------------------|------------------------------|----------|
| | | | | | s |
| Coleman W. B. and Tsongalis G.J | Molecular Pathology: The Molecular Basis of Human Disease | Academic Press | 2 nd /2017 | 978-0128027618 | 802 |
| Cox, M. M, Doudna, J and Donnell, M. | Molecular Biology, Principles and Practice | W. H. Freeman | 1 st /2012 | 978-0716779988 | 944 |
| Lodish, H, Berk, A, Kaiser, C A, Krieger, M. Scott, | Molecular Cell Biology | W. H. Freeman | 6 th /2008 | 978-0716768876 0716768879 | 973 |
| P.M., Bretscher, A, Ploegh, H and Matsudaira, P. | | | | | |
| Strachan, T. and Read, A. P | Human Molecular Genetics | John Wiley and Sons | 3 rd /2004 | 978-0818 341826 | 596 |
| Kumar V, Abbas, A.K., and Aster, J.C. | Robbins Basic Pathology | Saunders Elsevier. | 8 th /2007 | 978- 1416029731 | 952 |

Computational Skills

| L | T | P | Total Credits |
|---|---|---|---------------|
| 4 | 0 | 0 | 4 |

Course content and syllabus

| | Teaching Hours |
|--|----------------|
| Unit I: Computer Fundamentals | 18 hrs |
| Introduction to Computers: Characteristics of Computers, Uses of computers, Types and generations of Computers | |
| Unit II: Computer Organization | 18 hrs |
| Basic Computer Organization Units of a computer, CPU, ALU, memory hierarchy, registers, | |

| | |
|--|---------------|
| I/O devices User Interface with the Operating System, System Tools, Data Representation | |
| Unit III: Networks | 18 hrs |
| Binary representation of integers and real numbers, 1's Complement, 2's Complement, Addition and subtraction of binary numbers, BCD, ASCII, Unicode Networks terminology, Types of networks, router, switch, server client architecture | |
| Unit IV: Multimedia | 18 hrs |
| Introduction, Characteristics, Elements, Application, Problem Solving, Notion of algorithms, stepwise methodology of developing an algorithm, developing macros in spreadsheet, General Awareness IT Act, System Security (virus/firewall etc.) | |

Course Learning Outcomes:

Students will be able to:

1. Understanding computer and computer related skills as the interface between biology and computer is intertwined.
2. Gain knowledge of characteristics and organization of computer units.
3. Apply different aspects of computer knowledge for tackling biology related aspect.

Text / Reference Books:

| Author | Title | Publisher | Ed/year | ISBN No | Pages |
|-------------|---------------------------|--|---------|---------------|-------|
| V Rajaraman | Fundamentals of Computers | Prentice Hall India Learning Private Limited | 2014 | 9788120350670 | 448 |
| Anita Goel | Computer Fundamentals | Pearson Education | 2010 | 9788131733097 | 500 |

Introductory Bioinformatics

| L | T | P | Total Credits |
|---|---|---|---------------|
| 4 | 0 | 0 | 4 |

Course content and syllabus

| | Teaching Hours |
|---|----------------|
| Unit I: Introduction to Bioinformatics and Biological Databases | 18 hrs |
| Introduction to Bioinformatics. Historical background. Scope of bioinformatics in modern research Introduction to biological databases - primary, secondary and composite databases, NCBI, PubMed, nucleic acid databases (GenBank, EMBL, DDBJ, NDB), protein databases (UniProt-Swiss-Prot, PDB), Structure visualization softwares (RasMol, PDBviewer), file formats (FASTA, ASN Genbank). | |
| Unit II: Sequence alignment | 18 hrs |
| Concepts of sequence similarity, identity and homology. Alignment – local and global alignment, pairwise and multiple sequence alignments, amino acid substitution matrices (PAM and BLOSUM). Programs for pairwise and multiple sequence alignment (CLUSTALW), Introduction to database search using BLAST. | |
| Unit III: Protein Structure Prediction | 18 hrs |
| Hierarchy of protein structure - primary, secondary and tertiary structures Structural Classes, Motifs, Folds and Domains. Protein secondary structure prediction Protein tertiary structure prediction in presence and absence of structure template. Energy minimizations and evaluation by Ramachandran plot. Protein structure and rational drug design. | |
| Unit IV: Genome Organization and analysis | 18 hrs |
| Diversity of Genomes: Viral, prokaryotic & eukaryotic genomes. Genome, transcriptome, proteome, 2-D gel electrophoresis, MALDI- TOF spectrometry. Major features of completed genomes: <i>E.coli</i> , <i>S.cerevisiae</i> , <i>Arabidopsis</i> , Human. | |

Course Learning Outcomes:

- Introduces students to bioinformatics which is an integral part of biomedical research
- Understand role of biological databases and download appropriate literature, sequences and other relevant information from biological databases
- Understand importance of sequence alignment
- Predict structures of proteins
- Understand organization of genomes and techniques used to study.

Text / Reference Books:

| Author | Title | Publisher | Ed/yea | ISBN No | Pag |
|--------|-------|-----------|--------|---------|-----|
|--------|-------|-----------|--------|---------|-----|

| | | | | | |
|---------------------------|--|----------------------------|------|---------------|-----|
| | | | r | | es |
| Xiong, J. | Essential Bioinformatics | Cambridge University Press | 2006 | 0521706106 | 352 |
| Ghosh, Z. and Mallick, B. | Bioinformatics – Principles and Applications | Oxford University Press | 2008 | 9780195692303 | 560 |

Biopolymers and its Medical Applications

| L | T | P | Total Credits |
|---|---|---|---------------|
| 4 | 0 | 0 | 4 |

Course content and syllabus

| | Teaching Hours |
|--|----------------|
| Unit I: | 18 hrs |
| Introduction and Basic Concepts: Definition of Terminology and Basic Concepts, Nomenclature of Polymers, Polymer Architectures | |
| Unit II: | 18 hrs |
| Polymers in Solution, Molecular Weight, Physical State Nano Polymers and related Materials: Fracture Behavior, Tailor-Made Plastics, Cross-Linked Materials, Polymer Additives, Nanopolymers and their applications. Hydrogels and applications | |
| Unit III: | 18 hrs |
| Polymeric nanoparticles: the future of nanomedicine, Biopolymers Introduction and classification, Biopolymers: Bioplastics, biofibers, biopolymeric composites, Bio-inorganic polymeric composites, Biopolymers for Specific Applications, Biomedical, Drug delivery, Environmental, Pharmaceutical Technology. | |
| Unit IV: | 18 hrs |
| Bio-polymeric nanomaterials and its applications: Polysaccharides, Polysaccharide Graft Copolymers – Synthesis, Properties and Applications, Chitosan bio-polymers- Basic sources, characteristics, polymer isolation process, derivatives and their various bio medical applications. Future research trends of biopolymers. Biopolymer Blends and Biocomposites, Biopolymers as wound healing materials, Biopolymers as biofilters and biobarriers. Stimuli responsive polymers: Classifications, preparation and their various applications | |

Course Learning Outcomes:

Students will be able to:

1. Understand the recent developments and trends of biopolymers

2. Gain knowledge of various characterization techniques used for characterizing biopolymers
3. Analyze and apply knowledge for applications of biopolymers in various fields, especially in the field related to nanoscience and nanotechnology for medical application.

Text / Reference Books:

| Author | Title | Publisher | Ed/year | ISBN No | Pages |
|------------------------------|--|----------------------|-----------------|---------------|-------|
| Fred W. Billmeyer | Textbook of Polymer Science | Wiley India Pvt. Ltd | 3 rd | 9788126511105 | 600 |
| Susheel Kalia and LucAvérous | Biopolymers: Biomedical and Environmental Applications | Wiley India Pvt. Ltd | 2011 | 9780470639238 | 642 |

Biomaterials

| L | T | P | Total Credits |
|---|---|---|---------------|
| 2 | 0 | 0 | 2 |

Objective: To impart knowledge on structure-property relationship in biomaterials and their applications as implants.

Course content and syllabus

| | Teaching Hours |
|---|----------------|
| Unit I: Introduction | 9 hrs |
| Materials-Bulk properties and surface properties | |
| Unit II: Material Classes | 9 hrs |
| Class of materials used in biomedical applications | |
| Unit III: Cell-Material Interactions | 9 hrs |
| Biological interactions with materials-Proteins, cells, and tissues, biological responses: Inflammation, immunity, toxicity, coagulation, tumorigenesis. Biofilms, Pathological calcification, Biocompatibility | |
| Unit IV: Applications | 9 hrs |
| Applications of biomaterials: drug delivery, tissue engineering, cardiovascular, orthopedic, dental, functional tissues, etc. | |

Total teaching hours: 30 hrs

Course Learning Outcomes:

- Students will be able to understand the fundamentals and classes of materials.
- Describe interactions between biomaterials, proteins and cells.

- Explain methods to modify surfaces of biomaterials and choose material for desired biological response.
- Analyse the interactions between biomaterial and tissue for short term and long-term implantations, distinguish between reactions in blood and in tissue.

Text / Reference Books:

| Author | Title | Publisher | Ed/year | ISBN No | Pages |
|--|--|---------------------|---------|----------------|-------|
| Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons | Biomaterials Science: An Introduction to Materials in Medicine | Academic Press, USA | 2004 | 978-0123746269 | 18 73 |
| J.B. Park and J.D. Bronzino | Biomaterials : Principles and Applications | CRC Press | 2002 | 0849314917 | 264 |
| K.C. Dee, D.A. Puleo and R. Bizios | An Introduction to Tissue-Biomaterial Interactions | Wiley | 2002 | 0471253944 | 248 |
| Park J.B. and Lakes R.S | Biomaterials: An Introduction, 3 rd edition | Springer press | 2010 | 978-1441922816 | 562 |

Cancer Biology

| L | T | P | Total Credits |
|---|---|---|---------------|
| 2 | 0 | 0 | 2 |

Course content and syllabus

| | Teaching Hours |
|---|----------------|
| Unit I: Introduction to Cancer | 8 hrs |
| Basics of cancer, Theories of cancer development, classification, types of cancer Differences between benign tumor and malignant forms of cancer, Multi-step and multi-stage processes – initiation, promotion and progression, Overview of the hallmarks of cancer, cancer stem cells | |
| Unit II: Molecular basis of Carcinogenesis | 12 hrs |
| Mutagens, carcinogens, Tumor viruses, Proto-oncogenes, cellular and viral Oncogenes and tumor suppressor genes and their mechanism of action, Genetic abnormalities in cancer, Angiogenesis, invasion and metastasis. | 96 |
| Unit III: Role of cell cycle and apoptosis and autophagy | 8 hrs |

| | |
|--|--------------|
| Cell cycle regulation and cell death, Cellular senescence, telomeres and immortalization, Autophagy in Cancer. | |
| Unit IV: Cancer Epigenetics & Metabolism | 8 hrs |
| Role of DNA methylation, histone modifications and non-coding RNAs in cancer development, Cancer metabolism. | |

(Total Teaching = 36 hrs)

Course Learning Outcomes:

- Demonstrate basic understanding of cancer biology
- Acquire knowledge on molecular mechanisms involved in initiation as well as progression of cancer
- Understand the application of cancer diagnosis and therapy

Text / Reference Books:

| Author | Title | Publisher | Ed/year | ISBN No | Pages |
|--|---|----------------------|-----------------|-----------------------|-------|
| Bruce, Alberts and Alexander Johnson and Julian Lewis, and Martin Raff | Molecular biology of the cell | Garland Science; | 6 th | 978-0818344322 | 1342 |
| Rakesh Srivastava | Apoptosis, cell signalling and human diseases | Humana Press | 1 st | 9781888298829 | 395 |
| Berg J.M., Tymoczko J.L., Stryer L. | Biochemistry | WH Freeman & Company | 5 th | 13: 978-1-4641-2610-9 | 1023 |

BioEntrepreneurship

| L | T | P | Total Credits |
|---|---|---|---------------|
| 2 | 0 | 0 | 2 |

Course Objectives: To help students gain understanding of the basic concepts of entrepreneurship, diagnose new business opportunities, formulate business plans, and identify different institutional support available to the entrepreneurs.

Course Content/ Syllabus

| | Teaching Hours |
|---|-----------------------|
| Unit I: Basic Concepts of Entrepreneurship | 9 |
| Introduction to Entrepreneurship: Meaning, Background, Importance, The Benefits of Entrepreneurship, The Potential Drawbacks of Entrepreneurship, Factors that Influence Entrepreneurship, How to Avoid the Pitfalls, Factors Responsible for Entrepreneurship Growth; Entrepreneur Background and Characteristics; Entrepreneurial Potential in a Prospective Entrepreneur; Entrepreneurial Skills and Competencies; Types of entrepreneurs and entrepreneurship, Myths and Realities about Entrepreneurs; New Trends in Entrepreneurship Development; Economic Development through Entrepreneurship; Role of Entrepreneurship in the Economic Development of India | |
| Unit II: Environmental Monitoring and Importance of Business Idea | 9 |
| Creativity and innovation, Role of Creativity & Innovation in Entrepreneurship, Sources of New Ideas – Consumers, Existing Products and Services, Distribution Channels, Federal Government, Research and Development; Methods of Generating Ideas – Focus Groups, Brainstorming, Brainwriting, Problem Inventory Analysis; Creative Problem Solving – Brainstorming, Reverse Brainstorming, Brainwriting, Gordon Method, Checklist Method, Free Association, Forced Relationships, Collective Notebook Method, Attribute Listing Method, Big-dream Approach, Parameter Analysis, Mind Mapping, Force-Field Analysis, TRIZ, Rapid Prototyping; Innovation, Types of Innovation – Breakthrough, Technological, and Ordinary Innovation; Opportunity Recognition; Product Planning and Development Process – Idea Stage, Concept Stage, Product Development Stage, Test Marketing Stage, and Commercialization Stage; Technology Readiness Levels; Intellectual Property Rights | |
| Unit III: Scanning the Environment & Business Plan Development | 9 |
| Identifying the business opportunity: SWOT and PESTEL analysis, Viability Screening/Feasibility Analysis: Market Feasibility, Production Feasibility, Organisational Feasibility, Financial Feasibility; Business Plan Development: Introduction, Business Plan, Various Business Models – The Business Model Canvas, The Lean Canvas, Types of Business Plans, Structure of a Basic Business Plan, Creating a Business Plan – Executive Summary, General Company Description, The Opportunity or Competitive Analyses, Market Research and Industry Analysis, Strategy, The Team, Marketing Plan, Operational Plan, Financial Plan, and An Appendix | |
| Unit IV: Sources of Capital and Institutional Support for Entrepreneurs | 9 |

| | |
|---|--|
| Sources of Funding for Entrepreneurs: Bootstrapping, Friends and Family Members, Crowdfunding, Angel Investment, Venture Capital, Financial Institutions, Bank Loans, Trade Credit, Initial Public Offerings/Issue of Shares, Debentures; Role of Government in Promoting Entrepreneurship: Atal Innovation Mission, Biotechnology Industry Research Assistance Council, Department of Science and Technology, Digital India, Jan Dhan-Aadhaar-Mobile, Make in India, National Skill Development Mission, Pradhan Mantri Kaushal Vikas Yojana, Science for Equity Empowerment and Development, Stand-Up India, Start-Up India, Support to Training and Employment Programme for women, Trade-Related Entrepreneurship Assistance and Development, USAID | |
|---|--|

Course Learning Outcomes: On completion of the course, the student shall be able to:

- Understand the concept of entrepreneurship, its emergence and its need for society.
- Formulate a business idea and diagnose for a new business opportunity.
- Identify various business gaps and develop a business plan
- Evaluate and identify different institutional support available to the entrepreneur.

List of Professional Skill Development Activities (PSDA):

- Research on growth profile of an entrepreneur
- Identify opportunity, generate idea and conduct feasibility Analysis
- Design a Business Plan
- Develop an Entrepreneur Journal where reflection and personal experiences will be recorded
- Write personal insights, lessons learned, other readings, and the video clips you watch in this semester
- Interview one entrepreneur mentor and come up with five good business questions you would like to ask him or her
- Comparative study of startups in the field of Biopharmaceuticals, Bioagriculture, Bioindustry, and Bioservices.

Pedagogy for Course Delivery: The course will be taught using theory and case-based method. Blended mode of teaching-learning will be adopted. The students would be provided with content in form of study material, articles and videos. Instructor would lay emphasis on explaining basic concepts included in the course. PSDAs shall form part of internal assessment.

Lectures: 25 sessions

Presentation / Seminar: 2

Mid Term Test and End Term Test: 2 sessions

PSDA: 1 sessions
 Quiz: - 6 sessions
Total: 36 sessions

Text / Reference Books:

| Author | Title | Publisher | Year of publication | ISBN | Pages |
|--|--|-------------------------|----------------------------|-------------------|--------------|
| Evan J. Douglas | Entrepreneurial Intention: Past, Present, and Future Research | Edward Elgar Publishing | 2020 | 978-1-78897-522-3 | 216 |
| Justin G. Longenecker, J. William Petty, Leslie E. Palich, and Frank Hoy | Small Business Management: Launching & Growing Entrepreneurial Ventures (20 th Edition) | Cengage | 2023 | 978-0-3577-1880-3 | 712 |
| Mike Kennard | Innovation and Entrepreneurship | Routledge | 2021 | 978-0-367-51057-2 | 114 |
| Debasish Biswas and Chanchal Dey | Entrepreneurship Development in India | Routledge | 2021 | 978-0-367-76219-3 | 117 |
| Robert D. Hisrich, Micheal P. Peters, Dean A. Shepherd, Sabyasachi Sinha | Entrepreneurship (11 th Edition) | McGraw Hill | 2020 | 978-9390113309 | 696 |
| Donald F. Kuratko and Jeffrey S. Hornsby | New Venture Management: The Entrepreneur's Roadmap | Routledge | 2020 | 978-0367466725 | 356 |

| | | | | | |
|--|---|-----------------------|------|-------------------|-----|
| | for Development, Management, and Growth (3 rd Edition) | | | | |
| Bruce R. Barringer and R. Duane Ireland | Entrepreneurship: Successfully Launching New Ventures (6 th Edition) | Pearson | 2019 | 978-1-292-25533-0 | 617 |
| Norman M. Scarborough and Jeffrey R. Cornwall | Essentials of Entrepreneurship and Small Business Management (9 th Edition) | Pearson | 2019 | 978-1-292-26602-2 | 827 |
| Mary Jane Byrd and Leon Megginson | Small Business Management: An Entrepreneur's Guidebook (8 th Edition) | McGraw Hill | 2017 | 978-1259538988 | 496 |
| Robert D. Hisrich and Veland Ramadani | Effective Entrepreneurial Management: Strategy, Planning, Risk Management, and Organization | Springer | 2017 | 978-3-319-50465-0 | 230 |
| Stephen Spinelli, Jr. and Robert J. Adams, Jr. | New Venture Creation: Entrepreneurship for | McGraw-Hill Education | 2016 | 978-0-07-786248-8 | 484 |

| | | | | | |
|------------------|--|--------------------|------|----------------|-----|
| | the 21st Century (10 th Edition) | | | | |
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