Name of the Programme B.Sc. (H) Bioinformatics – 4 years {Session: 2024-2028}									
Semester-Wise Programme structure									
Sr. No.	**Year 1**		**Year 2**		**Year 3**		**Year 4**		
	Semester 1	**Semester 2**	**Semester 3**	**Semester 4**	**Semester 5**	**Semester 6**	**Semester 7**	**Semester 8 (Hons)**	**Semester 8 (Hons with research)**
1	Biomolecules [CU:4, L-3, P-1] {MCC1}	Biochemistry [CU:4, L-3, P-1] {MCC3}	Introduction to Bioinformatics and Biological Databases [CU:4, L-3, P-1] {MCC5}	Fundamentals of Unix Command Line [CU:6, L-4, P-2] {MCC7}	Molecular Biology [CU:6, L-4, P-2] {MCC9}	Regulation of gene expression [CU:6, L-4, P-2] {MCC12}	Advanced Cell Biology [CU:4, L-4, P-0] {CCH1}	Omics Studies and Data Analysis [CU:4, L-3, P-1]] {CCH4}	Omics Studies and Data Analysis [CU:4, L-3, P-1] {CCH4}
2	Basic Cell Biology [CU:4, L-3 P-1] {MCC2}	Fundamentals of Genetics [CU:4, L-3, P-1] {MCC4}	Biotechniques [CU:4, L-3, P-1] {MCC6}	Fundamentals of Programming [CU:6, L-4, P-2 {MCC8}	Introduction to Database Management System with MySQL [CU:6, L-4, P-2 {MCC10}	Molecular Modelling and Computer Aided Drug Design [CU:6, L-4, P-2 {MCC13}	Linux and Bash Scripting [CU:4, L-2, P-2 {CCH2}	Stem Cell and Regenative Medicine [CU:4, L-4, P-0] {CCH5}	Version Control with Git [CU:4, L-4, P-0] {MC10}
3	Introduction to Microbial World [CU:4, L-3, P-1] {MC1}	General Microbiology [CU:4, L-3, P-1] {MC2}	Enzymology [CU:4, L-3, P-1] {MC3}	Immunology [CU:4, L-4, P-0] {MC4}	Computational Methods in Biomolecular Sequences and Phylogenetic Analysis [CU:4, L-3, P-1 {MCC11}	Web Development [CU:4, L-3, P-1] {MCC14}	Tools for Genome Analysis [CU:4, L-3, P-1] {CCH3}	Topics in Life Science [CU:4, L-4, P-0] {DSE3}	Research Project/ Dissertation {CU: 12} (NTCC)
4	Fundamentals of Chemistry [CU:3, L-2, P-1] {MDC1}	Fundamentals of Physics [CU:3, L-2, P-1] {MDC2}	Protein Science [CU:3, L-3, P-0] {MDC3}	Professional Etiquette and Workplace Communication [CU:2, L-2, P-0] {AEC6}	Virology [CU:4, L-4, P-0] {MC5}	Pharmacogenetics [CU:4, L-4, P-0] {MC7}	Immunoinformatics [CU:4, L-3, P-1] {DSE1}	Clinical Trials [CU:4, L-3, P-1] {DSE4}	
5	Punjabi Language/Punjab History and culture [CU:1, L-1, P-0] {AEC1}	Punjabi Language/ History and Culture of Punjab [CU:1, L-1, P-0] {AEC3}	Fundamentals of Communication [CU:2, L-2, P-0] {AEC5}	Recombinant DNA Technology [CU:4, L-3, P-1] {SEC4}	Environmental biology [CU:2, L-2, P-0] {MC6}	Cancer Biology [CU:2, L-2, P-0] {MC8}	Population and Evolutionary Genetics [CU:4, L-4, P-0] {DSE2}	Version Control with Git [CU:4, L-4, P-0] {MC10}	

6	Foreign Business Language-I [CU:1, L-1, P-0] {AEC2}	Foreign Business Language – II [CU:1, L-1, P-0] {AEC4}	Programming with R [CU:3, L-2, P-1] {SEC3}				Intellectual Property rights, Biosafety and bioethics [CU:4, L-4, P-0] {MC9}		
7	Mathematics for Biosciences [CU:3, L-3, P-0] {SEC1}	Statistics for Biosciences [CU:3, L-3, P-0] {SEC2}	-	-		-			
8	Environment Studies - I [CU:2, L-2, P-0] {VAC1}	Environment Studies - II [CU:2, L-2, P-0] {VAC3}							
9	Understanding Self for Effectiveness [CU:1, L-1, P-0] {VAC2}	Individual, Society and Nation [CU:1, L-1, P-0] {VAC4}							
Credits	**23**	**23**	**20**	**22**	**22**	**22**	**24**	**20**	**20**
Total Credit: Credit Layout as per Curriculum and Credit Framework Guidelines - UGC 2022									**176**

MCC	**Major Core Course (Discipline Specific Course)**
MC	**Minor Course**
MDC	**Multidisciplinary Course**
AEC	**Ability Enhancement Course**
SEC	**Skill Enhancement Course**
VAC	**Value Added Course**
CCH	**Core Course - Hons.**
DSE	**Discipline Specific Elective**
MOOC	**Massive Open Online Course**

Programme structure for B.Sc. (H) Bioinformatics - 4 years (1st Semester)

Sr. No	Course Code	Course Title	Course Type	Credits					Credit Units
				L	T	P	FW	SW	
1		Biomolecules	Major Core Course	3	0	1	0	0	4
2	BCH101	Basic Cell Biology	Major Core Course	3	0	1	0	0	4
3	MBO104	Introduction to Microbial World	Minor Course	3	0	1	0	0	4
4		Fundamentals of Chemistry	Multidisciplinary Course	2	0	1	0	0	3
5	INL101/ INL103	Punjabi Language/Punjab History and Culture	Ability Enhancement Course	1	0	0	0	0	1
6	FOL101/102	Foreign Business Language-I	Ability Enhancement Course	1	0	0	0	0	1
7	MAT113	Mathematics for Biosciences	Skill Enhancement Course	3	0	0	0	0	3
8	ENV101	Environment Studies - I	Value Added Course	2	0	0	0	0	2
9	PSY101	Understanding Self for Effectiveness	Value Added Course	1	0	0	0	0	1
		Total Credits							**23**

Biomolecules

L	T	P	Total Credit Units
3	0	1	4

Course Objectives: To develop basic understanding of biomolecules.

Course Contents/syllabus:

	Teaching Hours
Unit I: Water and its Properties	**14**
Water and its Properties: Dissociation and association constants, pH and buffers. pI, pKa, Henderson Hasselbalch equation and its implications. **Basic Thermodynamics:** Laws of thermodynamics. Concepts of ΔG, ΔH and ΔS.	
Unit II: Carbohydrates	**13**
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	**13**
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	**14**
Proteins: Physico-chemical and structure of 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.	

Course Learning Outcomes:

- Understand the law of thermodynamics, water, and its properties.
- Understand and interpret 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.

List of Experiments -with basic instructions

1. Preparation of solutions and buffers.
2. Preparation of 0.1M phosphate buffer, pH 7.4, 250ml without using the pH meter. (By using Handerson –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.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Zubay, G.L., Parson, W.W. and Vance, D.E.	Principles of Biochemistry	Dubuque, Iowa: Wm. C. Brown,	1995	9780697264763, 0071148884,	129
Wilson K., Walker J.	Principle and Techniques of Biochemistry and Molecular Biology	Cambridge University Press	6th edition/2006	978-0521178747	744
Plummer, D.T.	An Introduction to Practical Biochemistry	New Delhi: Tata McGraw-Hill	2008	0070994870, 9780070994874	332

BCH101: Basic Cell Biology

L	T	P	Total Credit Units
3	0	1	4

Course Objectives: To develop basic understanding of cell biology.

Course Contents/syllabus:

	Hours
Unit I: Introduction to the Cell: theory and Broad Classification	
Cell: The cell theory, procaryotes and eucaryotes, Structure and function of major cell organelles, Cytoskeletal organization	13
Unit II: Role of Cellular Membranes	
Physical structure of model membranes in prokaryotes and eukaryotes, lipid bilayer, membrane proteins; Barrier function: diffusion, osmosis, active transport,.	13
Unit III: Cell division and cell cycle	
Mitosis and meiosis, cell cycle, modes of cell death . Cell transformation and cancer, the role of oncogenes ,proto-oncogenes, Tumor suppressor genes.,. Contribution of Nobel laureates in elucidation of the DNA structure,cell death and cell cycle.	14
Unit IV: Cell communication	
Modes of cell signalling, signal transduction, Receptor types, second messengers, overview of regulation of signalling pathways, bacterial chemotaxis and quorum sensing, Structure and function of cell adhesion molecules	14

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
1. 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:

Authors	Title	Publisher	Year	ISBN	Pages
De-Robertis, F.D.P. and De-Robertis Jr. E.M.F.	Cell and Molecular Biology	New York: Lippincott Williams & Wilkins	2011	9780781734936, 0781734932	734
Geoffrey, M.	The Cell: A molecular approach	New York; Oxford Sinauer Associates, Oxford University Press	2019	9781605358635, 1605358630	742
Harvey F Lodish	Molecular Cell Biology Ninth edition	New York: Macmillan International Higher Education	2021	9781319365486, 1319365485	1184

MBO104: Introduction to Microbial World

L	T	P	Total Credits
3	0	1	4

Course Objectives: Explore the microbial world to comprehend its diversity, and foster a foundational understanding of microbiology's relevance to scientific inquiry and practical applications.

Course content and syllabus

	Teaching Hours
Unit I: Introduction to Microbiology	**14 hrs**
Evolution, microbial life and biosphere, Brief history of Microbiology, naming and classification of microbes, Binomial Nomenclature, Whitaker's five kingdom system, CarlWoese three kingdom of classification, Difference between prokaryotic and eukaryotic microorganisms. Introduction to bacterial taxonomy– Bergey's manual of Systematic Bacteriology (Eubacteria and Archaebacterium).	
Unit II: The Prokaryotes: Domain Bacteria and Archaea	**13 hrs**
The prokaryotic groups, Domain Bacteria: Gram negative and Gram positive bacteria.Domain Archaea, diversity in archaea. **Microbial Growth and Nutrition:** The common nutritional requirements, Nutritional typesof Microbes, Microbes and Human welfare, Microbes and Human disease.	
Unit III: The Eukaryotes- Fungi, Algae, Protozoa and Helminths	**14 hrs**
Algae: General characteristics of algae, Different types of life cycles in algae, Selectedphyla of algae, roles of algae in nature. **Lichens** **Fungi**: General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultra-structure, Medically important fungi, Fungal diseases.**Protozoa** General characteristics with special reference to Amoeba, Paramecium, Plasmodium, Leishmania and Giardia, Medically important protozoa. General characteristics of slimemolds and helminths.	

Unit IV: Viruses, Viroids and Prions	13 hrs
General characteristics of Viruses, Viroids and Prions - Host range, virus size, viral structure-nucleic acid, capsid and envelope, general morphology, taxonomy of viruses, Latent and persistent viral infections, Diseases associated with viruses, viroid and prions.	

List of Experiments -with basic instructions (Total Teaching = 36 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.

Course Learning Outcomes:

- Understand diversity of Microbial world
- Evaluate bacterial classification and diversity
- Perceive knowledge of cellular organization of bacteria and archaea
- To understand the nutritional requirements of bacteria and different bacteriological techniques.

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, 9780070492258 5	957

Cappucino, J.G.	Microbiology - A laboratory manual, 4th ed., Harlow, Addition-Wesley.	Hoboken, N.J.: Pearson	2020	0135188997, 9780135203996, 0135203996	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
James T. Staley Robert P. Gunsalus, Stephen lory, Jerome J. Perry	MICROBIAL LIFE	Sinauer Associates; 2nd edition	2007	0878936858, 9780878936854	1066

Fundamentals of Chemistry

L	T	P	Total Credit Units
2	0	1	3

Course Objectives: To develop basic understanding of atomic structure and related physico-chemical properties of elements of the periodic table. In addition, this course focuses on fundamentals of organic molecules, structure, bonding, reactivity and reaction mechanisms as well as familiarization with the chemistry and biochemical role of biomolecules and related drug-like chemical molecules.

Course content and syllabus

	Teaching Hours
Unit 1: The Periodic Table : History and Periodic Trends	**9 hrs**
Introduction to atomic theories : Bohr's theory, de-Broglie theory, wave-particle duality, Schrodinger equation ; structure of atom and electron-filling rules in atomic orbitals; introduction to modern periodic table and key trends in physico-chemical elemental properties (size, shape, melting points, electron affinity, acid-base properties)	
Unit 2: Basic Organic Chemistry -I	**9 hrs**
Hybridization : Concept,valence bond theory, Shapes of molecule and reactive intermediates, effect on bond properties, , Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects of different functional groups, hyperconjugation and their applications; acids and bases: classification, factors affecting relative strength of inorganic and organic acids and bases, types of acid-base reactions, hard and soft acids and bases (HSAB) principle and applications	
Unit 3: Basic Organic Chemistry -II	**9 hrs**
Reaction mechanisms: Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles, organic reactions and their mechanism (Addition/Elimination and Substitution reactions), **Coordination compounds** : Introduction, nomenclature, nature and	

classification of ligands, hapticity, syntheses and applications of coordination compounds	
Unit4: Chemistry of biomolecules	**18 hrs**
Cell membrane and ion-transport : Structure, function and types of phospholipids, physiological significance of ions and intracellular ion-transport proteins (Na^+/K^+ pump) Enzymes and drugs: Definition, structural model, properties of enzymes, cofactors, apoenzyme, holoenzyme, factors affecting kinetics of enzymatic reactions, chemical mode of action of critical physiological enzymes, nomenclature, classification, properties and inhibitory mode of action of certain chemical drug-like chemical molecules like NSAIDs and antibiotics.	

Lab Practicals

List of Experiments:-

Inorganic Chemistry Practicals

- Titrimetric Analysis : Acid-Base Titrations
  (i) Apparatus calibration and preparation of solutions of different molarity/normality of titrants.
- (ii) Estimation of carbonate and hydroxide present together in mixture.
  (iii) Estimation of carbonate and bicarbonate present together in a mixture.
- Organic Chemistry Practicals
- Affinity-based separation of a mixture of commercial drug-like molecules and phytochemical mixtures by thin layer chromatography and column chromatography.
- Biophysical Chemistry Practicals
- Rate of enzymatic reactions:
  a. Determine the effect of physical factors on peroxide-decomposing rate of catalase enzyme in potatoes : (i) pH (ii) surface area (iii) temperature (iv) metal ions
  b. Determination of viscosity of aqueous and organic solutions of biomolecules using Ostwald's viscometer.

Course Learning Outcomes

1. 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.
2. Focus on fundamentals of organic molecules, structure, stereochemistry, bonding, reactivity.
3. Familiarization with types and mechanistic pathways of electron-transfer routes
4. Understanding of the cross-talk between the chemistry of biological molecules and drug-like chemical molecules

Text Books

A. Theory

Author	Title	Publisher	Ed/year	ISBN No	Pages
J.D. Lee	Concise Inorganic Chemistry	John Wiley and Sons Ltd	5th edition (2016)	978-8126515547	---
Greenwood, Earnshaw	Chemistry of the Elements	Butterworth - Heinemann	2nd edition (1997)	978-0750633659	
M. B. Smith, J. March, March's	Advanced Organic Chemistry: Reactions, Mechanisms, and Structure	Wiley-Interscience	8th Edition (2015)	978-8126556588	
Atkins P.W, Julio de Paula	Physical Chemistry	Oxford University Press, ELBS	11th edition (2018)	978-0198814740	

B. Practicals

Author	Title	Publisher	Ed/year	ISBN No	Pages
J. Mendham, R.C. Denney, J. D. Barnes, M.J.K. Thomas , Vogel's	Vogel's Quantitative Chemical Analysis	Longman	6th edition (1999)	978-0582226289	---

A.I. Vogel, A.R. Tatchell, B.S. Furnis	Vogel's Textbook of Practical Organic Chemistry	Prentice Hall	5th edition (2003)	978-0582462366	
Shoemaker, D.P Garland, C.W Nibler, J.W.	Experiments in Physical Chemistry	McGraw Hill Inc	8th edition (2008)	978-0070570078	

INL101: Punjabi Language

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: ਸ੍ਵਰ 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.

Text / Reference Books:

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 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 ਸ੍ਰੋਤ ਅਤੇ ਸਰੂਪ**	, ਵਾਰਿਸ ਸ਼ਾਹ ਫ਼ਾਊਂਡੇਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ	**2012**	-	-

ਦੁਨੀ ਚੰਦ੍ਰ	**ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਦਾ ਵਿਆਕਰਣ**	, ਪੰਜਾਬ ਯੂਨੀਵਰਸਿਟੀ ਪਬਲੀਕੇਸ਼ਨ ਬਿਊਰੋ, ਚੰਡੀਗੜ੍ਹ	**1995**	**-**	**-**
ਜੋਰਿੰਦਰ 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**		

INL103: History and Culture of Punjab

L	T	P	Total Credits
1	0	0	1

Course Contents/syllabus

	Teaching hours
Unit I:	**4.5 hrs**
Harappan Civilization: extent and town planning and socio-economic life. Life in Vedic Age: socio-economic and religious; Growth and impact of Jainism and Buddhism in Panjab.	
Unit II:	**4.5 hrs**
Society and Culture under Maurayas and Guptas. Bhakti movement: Main features; prominent saints and their contribution. Origin and development of Sufism	
Unit III:	**4.5 hrs**
Evolution of Sikhism: teaching of Guru Nanak; Institutional Development- Manji, Masand, Sangat and Pangat Transformation of Sikhism: Martyrdom of Guru Arjan; New policy of Guru Hargobind,martyrdom of Guru Tegh Bahadur. Institution of Khalsa: New baptism; significance	
Unit IV:	**4.5 hrs**

Changes in Society in 18th century: social unrest; emergence of misls and other institutions - rakhi, gurmata, dal khalsa. Society and Culture under Maharaja Ranjit Singh. 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	1989,3rd	-
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	-

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**
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**
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**
Description of objects, people and places Nationalities Speaking about one's professions	
Expressing Actions using regular –er ending verbs; avoir, être; reflexive verbs – usage, conjuagation Interview of celebrity	
Unit-IV- At the discotheque	**4.5 hrs**
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 endof 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 and Roopa Luktuke	Jumelage - 1 Methode De Fraincais - French	Langers International Private Limited	2020	978-938080 9854
Michael Magne, Marie-Laure Lions-Olivieri	Version Originale 1: Cahier d'exercices	Maison Des Langues	2010	978848 443561 7

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 Klelt Verlog	2011	978-8183072120
Heimy Taylor, Werner Haas	Station en Deutsch Self Study Course German Guide	Wiley	2007	978-0470165518

MAT113: Mathematics for Biosciences

	T	P	TOTAL CREDIT UNITS
	0	0	3

Course Objectives: This course introduces the fundamentals of basic mathematics required in the program on Biosciences. It includes the basic elements of Sets, Relations, Functions and their properties; Matrices Algebra; Differential Calculus and Integral Calculus. This course will develop analytical abilities to make exact calculations and will provide counting educational base to the students.

Course Contents/syllabus:

	Teaching Hours
Unit I: Sets, Relations and Function	**13 H**
Sets Types of Sets, Subsets, Complement of Sets, union and Intersection of Sets, Difference of Sets, Demorgan's Law, Cartesian product of Sets, relations, functions and their types and graphs	
Unit II: Matrix Algebra	**13 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 solving system of linear equations using Cramer's rule.	
Unit III: Differential Calculus	**14 H**
Algebra of limits, Continuity, Derivative of a function, Fundamental rules for differentiation, , , Derivatives of Implicit function, Inverse trigonometric function, Exponential and Logarithmic function, Parametric form, increasing decreasing function.	
Unit IV: Integral Calculus	**14 H**
Indefinite and definite integrals, methods of Integration, Properties of definite integrals, Areas of bounded regions.	

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., JoelHass, Christopher Heil &Maurice D. Weir	Thomas' Calculus (14th edition)	Pearson Education	2018	978-9353060411
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**
Multidisciplinary nature of environmental studies: Definition, scope and importance; components of environment –atmosphere, hydrosphere, lithosphere and biosphere. Concept of sustainability and sustainable development. *Natural resources*: 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**
Ecosystem: 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: Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).	

Unit-4- Biodiversity and its conservation	9 hrs
Biodiversity: Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India; biodiversity patterns and global biodiversity hot spots. India as a mega–biodiversity nation; endangered and endemic species of India. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; conservation of biodiversity: *in-situ* and *ex-situ* conservation of biodiversity. Ecosystem and biodiversity services: ecological, economic, social, ethical, aesthetic andinformation value.	

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 2nd edition	Blackwell Publishing	2004	978-1-405-11857-6	--

PSY101: Understanding Self for Effectiveness

L	T	P	Total Credits
1	0	0	1

Course Objectives: The objective of this course is to introduce the student to effective self management so that they can think and act in right manner. They should be able to manage themselves as well as other in more refined manner.

Course Contents/syllabus:

	Teaching time
Unit I: Self: Core Competency	**4.5 hrs**
Concept of Self and its characteristics, Components of Self – Self-identity, Self-concept, Self-confidence, Self-image.	
Unit II: Techniques of Self Awareness	**4.5 hrs**
Exploration through Johari Window, 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, Types of attitudes, Importance and relevance of attitude. Emotional Intelligence – Meaning, components, 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	9788126580 27
Towers, Marc	Self Esteem	merican 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 at Work	Publications	2006	9780761935322
Goleman, Daniel	Emotional Intelligence	BantamBooks	2007	9780553095036
Goleman, Daniel	ing with E.I	Bantam Books	1998	9780553104622

Programme structure for B.Sc. (H) Bioinformatics - 4 years (2nd Semester)

Sr. No	Course Code	Course Title	Course Type	Credits					Credit Units
				L	T	P	FW	SW	
1	BCH103	Biochemistry	Major Core Course	3	0	1	0	0	4
2	HGM101	Fundamentals of Genetics	Major Core Course	3	0	1	0	0	4
3	MBO102	General Microbiology	Minor Course	3	0	1	0	0	4
4	PHY213	Fundamentals of Physics	Multidisciplinary Course	2	0	1	0	0	3
5	INL104/106	Punjabi Language/ History and Culture of Punjab	Ability Enhancement Course	1	0	0	0	0	1
6	FOL103/104	Foreign Business Language – II	Ability Enhancement Course	1	0	0	0	0	1
7	MAT114	Statistics for Biosciences	Skill Enhancement Course	3	0	0	0	0	3
8	ENV106	Environment Studies - II	Value Added Course	2	0	0	0	0	2
9	PSY111	Individual, Society and Nation	Value Added Course	1	0	0	0	0	1
		Total Credits							**23**

BCH103: Biochemistry

L	T	P/S	Total Credits
3	0	1	4

Course objectives: To impart an understanding of the metabolic pathways linked with a series of chemical reactions occurring within a cell.

Course content and syllabus

	Teaching Hours
Unit I: Carbohydrate Metabolism	**14 hrs**
Glycolytic pathway, Gluconeogenesis, Citric acid cycle, Pentose phosphate pathway, Glyoxylate cycle, fate of absorbed carbohydrates, Regulation of carbohydrate metabolism	
Unit II: Lipid metabolism	**13 hrs**
Oxidation of fatty acids, Ketogenesis, Biosynthesis of saturated and unsaturated fatty acids, fate of absorbed dietary lipids. Regulation of lipid metabolism	
Unit III: Protein Metabolism	**14 hrs**
Fate of dietary proteins, Catabolism and Biosynthesis of amino acids, urea cycle and it's regulation. Regulation of protein metabolism	
Unit IV: Nucleic Acid Metabolism & Integration of metabolic pathways	**13 hrs**
Catabolism and biosynthesis of nucleotides, de-novo synthesis and salvage pathways. Interrelationship among carbohydrate, protein and fat metabolism	

List of Experiments:

1. Qualitative identification of Amino acids
2. Saponification test for lipid
3. Determination of Iodine number of fatty acids
4. Estimation of cholesterol

5. Estimation of DNA by Di-phenyl amine (DPA) method

6. Estimation of RNA by Orcinol method

Course Learning Outcomes:

1.Students will understand the metabolic pathways linked with a series of chemical reactions occurring within a cell.

2. Have knowledge of cellular metabolism, including central catabolic and anabolic pathways
.
3. 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	W.H. Freeman Company	2012	0070492581, 9780070492585	957
Jeremy M. Berg, Lubert Stryer, John LTymoczko, and Gregory J. Gatto,	Biochemistry	W.H. Freeman Company	2015	1319114652	1208

HGM101: Fundamentals of Genetics

L	T	P	Total Credits
3	0	1	4

Course Objectives: Explore the foundational principles of genetics, equipping students with essential knowledge of inheritance patterns, molecular mechanisms, and genetic diversity to understand biological processes and applications.

	Teaching Hours
Unit I Science of Genetics	**12 hrs**
DNA and RNA as genetic material, 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 and its numericals.	
Unit II Mendelian Genetics	**15 hrs**
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. **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.	

Unit III: Non- Mendelian Genetics	**13 hrs**
Introduction to Genomic imprinting, maternal effects, extra nuclear inheritance in mitochondria and chloroplast. Kappa articles in Paramoecium, Sigma factor in *Drosophila*, Cytoplamic Male Sterility (CMS) in maize maternal inheritance Sex determination, Dosage compensation with reference to X-inactivation in man, sex-linked, sex limited, sex influenced traits. Manifesting hetrozygotes, mosaics, chimeras, hermaphrodites.	
Unit IV: Gene Mapping	**14 hrs**
Use of sexual process in bacteria and bacteriophages in genetic mapping, 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

1.To test PTC tasting ability in a random sample and calculate gene frequencies for the taster and non–taster alleles,

2. To test for colour blindness using Ishihara charts

3. To study finger ball and palmar dermatoglyphics and calculate indices.

4. Human morphogenetic traits.

Course Learning Outcomes:

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

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Gardner EJ, Simmons MJ, Snustad DP	Principles of Genetics	Wiley-India	6th/2008	978-0471291312	480
Snustad DP, Simmons MJ	Principles of Genetics	John Wiley and Sons Inc.	6th/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 McGrawHill, New York	2012	0072325305	

MBO102: General Microbiology

L	T	P	Total Credits
3	0	1	4

Objectives: After studying this course, the students will be able to understand the basic concepts in microbiology and will gain knowledge about diversity of microorganisms and their structural organisation characteristics. It will also help students to understand the growth requirements of different microbes and methods of sterilization and imaging.

Course content and syllabus

	Teaching Hours
Unit I: History of Microbiology and Microbial Diversity	**13 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	**14 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, Archaebacterial cell wall, Gram and acid-fast staining mechanisms, lipopolysaccharide (LPS), spheroplasts, 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	**14 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	**13 hrs**
Sterilization 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

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:

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

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, 978007049258 5	957
Cappucino , J.G.	Microbiology-A laboratory manual, 4th ed., Harlow, Edition Wesley	Hoboken, N.J.: Pearson	2020	0135188997, 978013520399 6, 0135203996	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	978129201831 7	1030
Prescott, Harley and Klein's	Microbiology.9th Edition	McGraw Hill Higher education.	2013	978-0073402406	2272

PHY213: Fundamentals of Physics

L	T	P/S	Total Credits
2	0	1	3

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 and related applications

Course content and syllabus

	Teaching Hours
Unit I: Interference	**13 hrs**
Huygen's wave theory, Superposition principle, Conditions for sustained interference, Interference by division of Wavefront - Young's double slit experiment, Interference in thin parallel and wedge-shaped films, Newton's rings	
Unit II: Diffraction	**14 hrs**
Fresnel and Fraunhofer diffraction, Fraunhofer diffraction at a Single Slit, and N Slits, Plane Transmission grating, Rayleigh criterion and Resolving power and dispersive power of grating.	
Unit III: Polarization	**14 hrs**
Polarization of Light, Law of Malus, Brewster's Law, Birefringence, Nicol prism, Production and Analysis of Plane, Circularly and Elliptically Polarized Light, Half and Quarter Wave Plates, Optical and Specific Rotation, Laurent half shade and Bi-quartz polarimeter.	
Unit IV: Lasers	**13 hrs**
Introduction of Lasers, Induced Absorption, Spontaneous and Stimulated Emission, Einstein Coefficients, Population inversion, Fundamental of Lasers, Types of Pumping, Concept of Three and Four Level Lasers, Construction and Working Lasers	

List of Experiments

To determine the wavelength of sodium light by Newtons's rings method

To determine the angle of prism with the help of a spectrometer

To determine the dispersive power of the material of prism with the help of a spectrometer

To determine the specific rotation of sugar by Bi-quartz or Laurent half shade polarimeter

To determine the width of a narrow slit using diffraction phenomena

To determine the wavelength of a laser using diffraction grating

To determine the wavelength of sodium source using Michelson's interferometer

To determine the attenuation, numerical aperture and acceptance angle of the given optical fiber

Course Learning Outcomes:

- Understand the fundamental principles underlying wave phenomena related to interference.
- Understanding the phenomenon of diffraction and its effects
- Understand importance and working of polarization technique, linear and circular polarization and applications
- Understanding on the properties of laser and construction with its applications in various fields

Text/Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Halliday, Resnick and Walker	Fundamentals of Physics	Wiley India Pvt Ltd	2006	978-8126514427	
Brijlal, Subramanyam & N Subrahmanyam	Principle of Optics	S. Chand publishing, 25th edition, 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	
Halliday, Resnick and Walker	Fundamentals of Physics	Wiley India Pvt Ltd	2006	978-8126514427	

INL104: Punjabi Language and Literature

L	T	P	Total Credits
1	0	0	1

Course content and syllabus

	Teaching Hours
Unit I:	**4 hours**
ਆਧੁਨਿਕ ਪੰਜਾਬੀ ਕਹਾਣੀ ਦਾ ਅਧਿਐਨ (ਕਥਾ ਕਹਾਣੀ) ਕਹਾਣੀ ਵਿਸ਼ਾ-ਵਸਤੂ/ਸਾਰ,ਪਾਤਰ-ਚਿਤਰਨ ਕਹਾਣੀਕਾਰ ਦੇ ਜੀਵਨ ਅਤੇ ਰਚਨਾ ਬਾਰੇ ਮੁੱਢਲੀ ਜਾਣਕਾਰੀ	
Unit II:	**4 hours**
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	
Unit III:	**5 hours**
ਵਿਆਕਰਨ ਸਿਧਾਂਤ ਅਤੇ ਵਿਹਾਰ 1. **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 2. **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:	**5 hours**

ਵਿਆਕਰਨ ਸਿਧਾਂਤ ਅਤੇ ਵਿਹਾਰ 1. ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਅਤੇ ਗੁਰਮੁਖੀ ਲਿੱਪੀ 2. ਭਾਸ਼ਾ, ਉਪਭਾਸ਼ਾ,ਟਕਸਾਲੀ ਭਾਸ਼ਾ ਅਤੇ ਪੰਜਾਬੀ ਦੀਆਂ ਉਪਭਾਸ਼ਾਵਾਂ	

Course Learning Outcomes:

1. Understand modern Punjabi Stories.
2. Interpret the importance of letter writing
3. Analyze the Punjabi language structure and grammar.
4. Examine the impact and importance of Punjabi dialects and Gurmukhi script on Punjabi language

Text / Reference Books:

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 ਸ੍ਰੋਤ ਅਤੇ ਸਰੂਪ**	, ਵਾਰਿਸ ਸ਼ਾਹ ਫ਼ਾਊਂਡੇਸ਼ਨ, ਅੰਮ੍ਰਿਤਸਰ	**2012**	**-**	**-**
ਦੁਨੀ ਚੰਦ੍ਰ	**ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਦਾ ਵਿਆਕਰਣ**	, ਪੰਜਾਬ ਯੂਨੀਵਰਸਿਟੀ ਪਬਲੀਕੇਸ਼ਨ ਬਿਊਰੋ,	**1995**	**-**	**-**

		ਚੰਡੀਗੜ੍ਹ			
ਜੋਰਿੰਦਰ 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:	**4.5 H**
1. Introduction of Colonial Rule in Punjab: Annexation of Punjab; Board of Administration. Western Education: Growth of Education and rise of middle classes. 3. Agrarian Development: Commercialization of agriculture; canalization and colonization.	
Unit II:	**4.5 H**
Early Socio Religious Reform: Christian Missionaries; Namdharis; Nirankaris. 5. Socio Religious Reform Movements: activities of Arya Samaj; Singh sabhas; Ahmadiyas; Ad Dharam Movement 6. Development of Press & literature: growth of print technology; development in literature	
Unit III:	**4.5 H**
7. Emergence of Political Consciousness: Gadar Movement; Jallianwala Bagh Massacre	
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:	4.5 H
Partition and its Aftermath: resettlement; rehabilitation 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 Gurdwara reform 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	---	---

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	**4.5 hrs**
Descriptors/Topics Talk about your family members Usage of possessive adjectives Describe your house/apartment Prepositions of location Negation	
Unit II: Lifestyle	**4.5 hrs**
Descriptors/Topics 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	**4.5 hrs**
Descriptors/Topics Filling up a simple form Ask for personal information Usage of interrogative adjectives Give directions about a place Ordinal numbers Usage of demonstrative adjectives	
Unit IV: Week-end	**4.5 hrs**

Descriptors/Topics 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 Dey Sarkar	Apprenons La Grammaire Ensemble - French	Langers International Pvt. 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	**4.5 hrs**
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)	**4.5 hrs**
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)	**4.5 hrs**
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	**4.5 hrs**

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:

Author	**Title**	**Publisher**	**Ed/year**	**ISBN No**	**Pages**
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

MAT114: Statistics for Biosciences

L	T	P	TOTAL CREDIT UNITS
3	0	0	3

Course Objectives: Develop proficiency in statistical analysis methods, including data collection, descriptive statistics, correlation, regression, probability distributions, and hypothesis testing, to interpret and analyze real-world data effectively.

	Teaching Hours
Unit I:	
Data collection and graphical presentation, Descriptive Statistics: Measures of central tendency-Arithmetic, geometric and harmonic mean, median, and mode.	**13 H**
Unit II:	
Measures of dispersion, Skewness and Kurtosis, Simple and multiple correlation coefficient, partial correlation, rank correlation, Simple and multiple linear regression model, Coefficient of determination.	**13 H**
Unit III:	
Random Variable: Expectation and Variance, Discrete distributions: Uniform, Bernoulli, Binomial, Poisson, Continuous distributions: Uniform and Normal distribution	**14 H**
Unit IV:	
Testing of Hypothesis: Tests of significance based on Normal, chi-square, t, and F distributions.	**14 H**

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

1. Students will understand the concept of data collection, representation, and measures of central tendency

2. Students will be able to apply the concept of dispersion, skewness, correlation, and regression of the given data

3. Students will be having knowledge of probability and random variables.

4. Students will be able to apply the significance based on testing of hypothesis.

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**
Environmental Pollution: 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**
Environmental Policies and practices: 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**

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 toimprove 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/year	ISBN No	Pages
William P. Cunningham, Mary Ann Cunningham	Principles of Environmental Science	McGraw-Hill	2019	9781260219715	664
William P. Cunningham, Mary Ann Cunningham, Barbara Woodworth Saigo	Environmental Science: A global concern	McGraw-Hill	2021	9781260363821	1280

PSY111: INDIVIDUAL, SOCIETY AND NATION

L	T	P/S	W/FW/ PSDA	TOTAL CREDIT UNITS
1	0	0	0	1

Course Contents/syllabus:

	No. of Session
Unit-1- Individual differences & Personality	**4.5 H**
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	**4.5 H**
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	**4.5 H**
Nature of Socialization and socialization process Social Interaction Meaning and Definition of Patriotism; Blind Patriotism and Constructive Patriotism The Meaning of Nationalism, Nation-building in India	
Unit-4- Human Rights, Values and Ethics	**4.5 H**

Meaning and Importance of human rights Human rights awareness Values and Ethics- Learning based on project work on Scriptures like- Ramayana, Mahabharata, Gita etc.	

Course Learning Outcomes: On completion of the course:

- To recognize individual differences
- To mange individual differences
- To develop patriotic feelings
- To recognized 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	2015	9781711493978	458
Daksh Tyagi	"A Nation of Idiots"	Every Protest	2019	978-8194275015	350

Programme structure for B.Sc. (H) Bioinformatics - 4 years (3nd Semester)

Sr. No	Course Code	Course Title	Course Type	Credits					Credit Units
				L	T	P	FW	SW	
1		Introduction to Bioinformatics and Biological Databases	Major Core Course	3	0	1	0	0	4
2	BTY201	Biotechniques	Major Core Course	3	0	1	0	0	4
3	BCH201	Enzymology	Minor Course	3	0	1	0	0	4
4	BTY202	Protein Science	Multidisciplinary Course	3	0	0	0	0	3
5	ENG104	Fundamentals of Communication	Ability Enhancement Course	2	0	0	0	0	2
6		Programming with R	Skill Enhancement Course	3	0	0	0	0	3
		Total Credits							**20**

Introduction to Bioinformatics and Biological Databases

L	T	P	Total Credits
3	0	1	4

Course Objectives: : The aim of this course is to teach students to apply the knowledge and basic concepts of biology and computer science

Course content and syllabus

	Teaching Hours
Unit I: Introduction to bioinformatics	**13 H**
Introduction to central dogma of Molecular biology, Basics of DNA, Genes , Genomes, RNA, Genetic code, Basics of Proteins, Origin and history of Bioinformatics, Goal and Scope of Bioinformatics, applications of bioinformatics. .	
Unit-II Biological Database	**14 H**
Biological Databases – Primary, Secondary and Composite databases: Genbank, EMBL, DDBJ, Uniprot, Swissprot, PIR, PDB, Genpepts, SCOP, Pfam. NCBI, EBI, DDBJ. nucleotide sequence flat files. Sequence formats: Genbank, FASTA, ASN. Information retrieval from biological databases- NCBI resource, Entrez, Pubmed, MEDLINE	
Unit III: Pairwise and Multiple sequence alignment	**14 H**
. Alignment of pairs of sequences; Introduction- Definition of sequence alignment, Methods - Dot matrix sequence comparison. Dynamic programming algorithm for sequence alignment – Global Alignment: Needleman- Wunsch, Local Alignment: Smith-Waterman, Gap penalty, Assessing the significance of an alignment Dynamic programming, progressive methods, Iterative methods, MSA using CLUSTAL, and PILEUP. Purpose and applications of multiple sequence alignment	
Unit IV: Scoring matrices and Database search	**13 H**
Similarity searches - PAM and BlOSUM matrix, Dayhoff substitution matrix, construction of PAM and BLOSUM matrix. Differences between PAM & BLOSUM Database searching for similar sequences. Sequence similarity search, FASTA sequence database similarity search, BLAST sequence database similarity search, variants of BLAST search, and other methods of comparing database of sequences and patterns	

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

1. Build an understanding about the significance and applications of Bio-Informatics.
2. Gain Knowledge about the different types of Biological Databases and their applications.
3. Apply algorithms for pairwise and multiple sequence alignment.
4. Analyze and examine the various searching techniques with matrices and databases.

List of Practicals

1. Extracting DNA and protein sequences from biological database in FASTA format
2. Searching Domain Databases: CDD, ProDOM3.
3. Performing Multiple sequence alignment with Clustal W
4. Database similarity search using BLAST to find sequences similar to query sequence.
5. Using different substitution matrices like PAM and BLOSUM to perform sequence similarity search

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Xiong, Jing	Essentials of Bioinformatics	Cambridge University	2007	978-8126541256
Mount, D.W.	Bioinformatics: Sequence and Genome Analysis	Cold Springer Harbor Lab Press	2004	978-9746520706
Lesk, A.M.	Introduction to Bioinformatics	Oxford University Press	2014	978-8170221548
Hooman H Rashidi, Lukas K Buehler	Bioinformatics Basics	CRC Press	1999	978-0849323751

BTY201-Biotechniques

L	T	P	Total Credits
3	0	1	4

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	**13 hrs**
Introduction to chromatographic separations, Principles and applications of paper, thin layer, column: adsorption ion-exchange, affinity, gel permeation, normal phase and reverse phase chromatography, gas chromatography, High performance liquid chromatography (HPLC).	
Unit II: Spectroscopic and centrifugation techniques	**14 hrs**
Principles and applications of UV-Visible, Infrared, Raman, Nuclear magnetic resonance, Fluorescence, Atomic absorption spectroscopy, X-ray diffraction, mass spectroscopy, Introduction to centrifugation, basic principles of sedimentation, types of centrifugation.	
Unit III: Electrophoretic techniques	**13 hrs**
Theoretical basis of electrophoretic separations, electrophoretic mobility, free and zone electrophoresis: moving boundary electrophoresis, paper, polyacrylamide gel (native and SDS-PAGE), pulse-field gel electrophoresis, isoelectric focusing.	
Unit IV: Microscopy	**14 hrs**
Principles and applications of Simple microscopy, phase contrast microscopy, fluorescence, and electron microscopy(Transmission and Scanning).	

List of Experiments:

1. To verify the validity of Beer's law and determine the molar extinction coefficient of $KMNO_4$
2. Separation of amino acids by paper chromatography
3. Plant pigment Separation by paper/thin layer chromatography

4. Demonstration of HPLC instrument
5. Demonstration of working of centrifuge for preparative and density gradient centrifugation.

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	6th edition/2010	1118886143	832
Wilson K., Walker J.	Principle and Techniques of Biochemistry and Molecular Biology	Cambridge University Press	6th edition/2006	0521178746	744
Rana, SVS	Biotechniques: Theory and Practice	Rastogi Publications	2018	8171338860	388
Plummer, David	An Introduction to Practical Biochemistry	Tata Mc Graw Hills	3rd edition/2017	0070941629	376

BCH201: Enzymology

L	T	P	Total Credits
3	0	1	4

Objectives- For a course in enzymology, the laboratory component focuses on hands-on experimentation with enzyme assays, purification techniques, and kinetic studies to reinforce theoretical concepts. Students gain practical skills in enzyme characterization, measurement of enzyme activity, and data analysis, enhancing their understanding of enzymatic processes. The theoretical aspect covers enzyme structure, function, kinetics, regulation, and applications in biotechnology, providing a foundational knowledge of enzymology's principles and significance in biochemical research and industry.

Course content and syllabus:

	Teaching Hours
Unit I: Enzymes and Coenzymes	**9 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 transcarbomoylase), reversible covalent modification (phosphorylation).	

Proteolytic cleavage- zymogen. Multienzyme complexes (pyruvate dehydrogenase, fatty acid synthase) and Enzyme regulation	
Unit IV: Application of Enzymes	**9 hrs**
Application of enzymes in diagnostics (SGPT, SGOT, creatine kinase, alkaline and acid phosphatases), enzyme immunoassay (HRPO), enzyme therapy (Streptokinase). Immobilized enzymes.	

Course Learning Outcomes:

At the end of the course, the students will -

- Recall the types of enzymes, their classification and their importance
- Explain enzyme kinetics and enzyme inhibitors
- Identify the mechanisms of enzyme action
- Classify the enzymes according to their application in diagnostics and drug discovery

List of Experiments -with basic instructions

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
5. Determination of Km and Vmax using Lineweaver-Burk plot

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
David Nelson	Lehninger: Principles of Biochemistry	WH Freeman	2017	9781319108243	1328
Nicholas C.P. and Lewis S.	Fundamentals of Enzymology	Oxford University Press	3rd Ed	978-0198064398	322
Voet, D., Voet, J.G.	Biochemistry	Wiley	4th Ed	978-0071737074	245

BTY202: Protein Science

L	T	P	Total Credits
4	0	0	4

Objectives: After studying this course, the students will be able to understand the relationship between protein sequence, structure, and function. It will give them a broad overview of diseases caused by protein misfolding and methods to study and compare proteins.

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	**18 hrs**
Protein primary sequence analysis, DNA sequence analysis, pair wise sequence alignment, FASTA algorithm, BLAST, multiple sequence alignment, DATA basesearching using BLAST and FASTA. Phylogenetic tree analysis	
Unit IV: Analysis of protein-protein interactions	**18 hrs**
Pull-down assay, Yeast two hybrid assay, Coimmunoprecipitation assay, Fluorescence resonance energy transfer (FRET). DNA- protein interactions, footprinting assay, EMSA.	

Course Learning Outcomes:

1. Understand basic concepts of protein structure.
2. Learn protein functions by ligand binding -enzymes and antibodies.
3. Compare protein sequences.
4. Protein-Protein/Protein-Nucleic Acid interaction.

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, 8th Edition	Macmillan	2021	ISBN:9781319322328	1120
Thomas E. Creighton	Proteins: Structures and Molecular Properties	W. H. Freeman	1993	9780716770305	507

ENG (104): Fundamentals of Communication

L	T	P	Total credits
2	0	0	2

Objectives: To help students develop skills in the areas of vocabulary, grammar, presentation, and interactive communication so that any deficiencies in either skills or their application do not interfere with communication. Prerequisites: Good Listening, Speaking, Reading, and Writing Skills.

Course Contents/syllabus:

	Teaching Hours
Unit I: Basic Concepts of Communication	9
• Definition, Nature and Role of Communication • Communication Networks: Flow, Medium and Channel • Barriers to Communication • SWOT (Strengths, Weaknesses, Opportunities, Threats) Analysis	
Unit II: Communication Types	9
• Introduction of Communication Skills (Listening, Speaking, Reading and Writing) • Nonverbal Communication: Functions and Effective use • KOPPACT (Kinesics, Oculesics, Proxemics, Paralanguage, Artifacts, Chronemics, Tactilics).	
Unit III: Digital Literacy and Social Media	8
• Importance of Digital Literacy • Netiquette • E-mail Etiquette • Advantages/Disadvantages of social media • Effective ways of using social media • Blogs/Content writing • Professional Profile on Web	
Unit IV: Gateway to Industry	10
• Resume Writing • Cover Letter • Interview Skills • LinkedIn Profile • Writing LinkedIn Recommendations	

Course Learning Outcomes:

- Students will be able to understand the basic processes of communication, both verbal as well as nonverbal—nature, scope, and power of communication processes.

- Students will be able to understand the different types and forms of communication and their functions, use, and significance.
- Students will be able to develop an understanding of the importance of digital literacy. They will also be able to develop an awareness of the role of social media in shaping public psyche, beliefs, and perceptions about social realities and build an informed and critical perspective.
- Students will be able to read and interpret complex messages and take decisions accordingly. They will also be able to improve their speaking skills and develop effective speaking strategies.

Texts/Reference books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
P. D. Chaturvedi and Mukesh Chaturvedi	*Business Communication: Concepts, Cases and Applications*	Pearson Education	2006	9788131701720	516
Herta A. Murphy, Herbert Hildebrandt, Jane Thomas	*Effective Business Communication*	Tata McGraw Hill Education	2008	9780070187757	
Jeff Butterfield	*Soft Skills for Everyone*	Cengage Learning	2017	9789353501051	628

Programming with R

L	T	P	Total Credits
3	0	0	3

Course Objectives: The aim of this course is to teach students the fundamentals of R programming for its application in statistically oriented data analysis.

Course Contents/syllabus:

	Teaching Hours
Unit I: Introduction to R	**13 H**
The R environment, softwares, R statistics, R window system, R help, R commands	
Unit II: Objects, Arrays and matrices	**13 H**
Intrinsic attributes: mode and length, Factors: tapply() and ragged arrays, ordered factors, Arrays, Array indexing, Index matrices, The array () function, The outer product of two arrays, Generalized transpose of an array, The concatenation function, c(), with arrays	
Unit III: Lists, Data frames and Reading data from files	**14 H**
Lists, Constructing and modifying lists, Data frames, Making data frames, Working with data frames, Accessing built in datasets, Loading data from other R packages, Editing data	
Unit IV: Loops, Conditional operators and Functions	**14 H**
Control statements, Conditional execution: if statements, Repetitive execution: for loops, repeat and while, Functions, Defining new binary operators, Named arguments and defaults, The '…' argument, Assignments within functions, Classes, generic functions and object orientation	

Course Learning Outcomes: At the end of the course, the students will:

1. Learn R basics, including environment, software, statistics, and commands.

2. Master data attributes, factors, arrays, and related functions.

3. Acquire skills in working with lists, data frames, and data import.

4. Understand loops, conditionals, and function creation.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
W. N. Venables, D. M. Smith and the R Core Team	An Introduction to R	R Core Team	2023	

Programme structure for B.Sc. (H) Bioinformatics - 4 years (4th Semester)

Sr. No	Course Code	Course Title	Course Type	Credits					Credit Units
				L	T	P	FW	SW	
1		Fundamentals of Unix Command Line	Major Core Course	4	0	2	0	0	6
2		Fundamentals of Programming	Major Core Course	4	0	2	0	0	6
3	IMM202	Immunology	Minor Course	4	0	0	0	0	4
4		Professional Etiquette and Workplace Communication	Ability Enhancement Course	2	0	0	0	0	2
5	BTY207	Recombinant DNA Technology	Skill Enhancement Course	3	0	1	0	0	4
		Total Credits							**22**

Fundamentals of Unix Command line

L	T	P	Total Credits
4	0	2	6

Course Objectives: The aim of this course is to teach students to apply the knowledge and the fundamentals of Linux and Bash scripting.

Course Contents/syllabus:

	Teaching Hours
Unit I: Introduction to Computers and Operating Systems	**18 hrs**
Introduction to Computers, Overview of computer hardware and software, Block structure of a computer, Understanding computer components: CPU, memory, storage, input/output devices, Introduction to operating systems: Windows, macOS, Linux, Linux kernel, Linux distributions, Shell, Directory and File commands: Directory structure, Directory Commands, Disk usage of a Specific Directory, File commands, Moving and renaming Files, Important Files and Directories, File and Directory Security	
Unit II: Linux Search Tools	**18 hrs**
Finding Files using attributes: ls, find command, Files Age, files by size, strings within a Text File, Strings within Binary files, Regular Expressions, Find Processes,Text file processing with Grep, Basics of awk programming	
Unit III: Shell Scripting	**18 hrs**
Programming with Linux, Shell, Command Aliases, User Defined Variables, Evaluating Expressions, Using Quotes in Shell Scripts, Exit Status, Command Line Arguments, Redirection of Standard Input and Output, Pipes, Conditional Statements, Test command, Loops, The case statement	
Unit IV: Linux administration	**18 hrs**
Shutting down and Changing Runlevels, Adding and Removing Users, Get Process Status, Find processes by Pattern or User, Display Active Processes, Kill a Process, Switch User	

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

1. Learn basics of computers and Linux

2. Learn searching and working with text patterns in Linux
3. Learn Shell scripting
4. Learn Linux Administration

List of Practicals

1. Install and setup a Linux Distribution
2. Make new files and folders
3. Copy and Move files and folders
4. Use R-sync to backup files and folders
5. Find files with specific attributes
6. Find and Kill specific processes
7. Add and Remove users
8. Use Bash scripting to automate common tasks

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Donald K. Burleson	Easy Linux Commands	SPD	2010	8184043295	196
Eric Metthes	Classic Shell Scripting	O'Reilly	2015	978-0-596-00595-5	568

Fundamentals of Programming

L	T	P	Total Credits
4	0	2	6

Course Objectives: The aim of this course is to teach students the fundamentals of R programming for its application in statistically oriented data analysis.

Course Contents/syllabus:

	Teaching Hours
Unit I: Introduction to Python	**18 H**
Introduction to Programming with Python, Computer Hardware architecture, Interpreter anc compiler, Building blocks of programs, Debugging, Variables, Expressions, and Statements, Values and types, Variable names and keywords, Statements, Operators and operands	
Unit II: Conditional execution, Functions and Classes	**18 H**
Boolean expression, Logical operators, Conditional execution, Alternative executions, Chained conditionals, Catching exceptions with try and except, Function calls, Built-in functions, Type conversion functions, Math functions, Random numbers, Adding new functions, Definitions and uses, Flow of execution, Parameters and arguments, fruitful and void functions, classes	
Unit III: Iterations, strings, Files, Lists	**18 H**
Updating Variables, While statement, Infinite Loops, Finishing iterations with continue, Definite loops using for, Strings, string slices, immutable strings, Looping and counting strings, The in operator with strings, String comparison, String methods, Parsing string, Opening files, Text files and Lines, getting user input for file names, searching through a file, writing files, Lists	
Unit IV: Dictionaries, Tuples, Regular Expression	**18 H**
Dictionaries and files, Looping over dictionaries, text parsing, Immutability of tuples, comparing tuples, Dictionary and Tuples, Multiple assignment with dictionaries, tuples as keys in Dictionaries, Sequences, Character matching in regular expressions, extracting data with regular expressions	

Course Learning Outcomes: At the end of the course, the students will:

1. Basics of Computer programming with Python

2.Master conditional execution and functions

3. Acquire skills in working with Iterations, strings, Files, Lists.

4. Understand Dictionaries, Tuples, Regular Expression

List of Practicals

1. Introduction to Python and Basic Syntax:
    1.Setting up Python environment
    2.Introduction to Python interpreter
    3.Writing and executing basic Python programs
    4.Understanding variables, expressions, and statements
    5.Debugging Python programs
2. Conditional Execution and Functions:
    1.Writing Python programs using conditional statements (if, elif, else)
    2.Implementing logical operators in Python
    3.Introduction to functions in Python
    4.Writing and calling functions with and without parameters
    5.Handling exceptions using try and except blocks
3. Loops and Strings:
    1.Implementing while loops in Python
    2.Writing programs using for loops
    3.Working with strings in Python
    4.String manipulation (slicing, concatenation, methods)
4. Lists and File Operations:
    1.Understanding lists and list operations
    2.Writing Python programs using lists
    3.Performing list manipulation (appending, slicing, sorting, etc.)
    4.Reading and writing text files using Python
5. Dictionaries and Tuples:
    1.Introduction to dictionaries in Python
    2.Writing Python programs using dictionaries
    3.Understanding tuple data structure
    4.Implementing tuple operations
    5.Using tuples as keys in dictionaries
6. Regular Expressions:
    1.Introduction to regular expressions
    2.Writing Python programs using regular expressions
    3.Character matching with regular expressions
    4.Extracting data from strings using regular expressions
    5.Parsing text files using regular expressions
7. Classes and Object-Oriented Programming (OOP):
    1.Introduction to classes and objects
    2.Writing Python programs using classes
    3. Defining attributes and methods in classes
    4.Creating objects and calling methods
    5. Understanding inheritance and polymorphism in Python

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Charles Severance	Python for Everybody	SPD	2017	248

IMM202: Immunology

L	T	P	Total Credits
4	0	0	4

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	**18 hrs**
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	**18 hrs**
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	**18 hrs**
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 (Live but attenuated, Killed, Subunit, Recombinant, DNA and Peptide)	
Unit IV: Immunological Techniques	**18 hrs**

Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, Immunoassays, ELISA, ELISPOT, Western blotting, Immunofluoresence, Flow cytometry, fluorescence activated cell sorting analysis, microarrays to assess gene expression	

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 (8th Edition)	WH Freeman and Company, USA	2012	1319114709	944
D. Male, J. Brostoff, D. Roth, I. Roitt	Immunology (8th Edition)	Saunders, Elsevier, USA	2012	9780702045486	482

Professional Etiquette and Workplace Communication

L	T	P	Total Credits
2	0	0	2

Course Objectives: This course is aimed to equip students with effective written and employment communication. In this course, students will learn some theoretical inputs into the difference between written and oral communication, the process of writing, its different types and strategies the correct format of business documents, and cross-cultural communication, persuasion and employment communication.

Course content and syllabus

	Teaching Hours
Unit I—Writing Process & Workplace Communication	**9 hrs**
• Writing process: Pre-writing, writing & post writing • 7Cs of Writing • Business Letters • Notice • Agenda • Minutes of meeting • Virtual Meeting and Video Conferencing • Nuances of conducting effective meetings	
Unit II—Presentation Skills	**10 hrs**
• Planning, preparation, Practice, Performance • Audience analysis • Analyzing the nonverbal communication • Story-Telling • Methods of Delivery: Impromptu, Extemporaneous, Memorisation, Manuscript, Outlining	
Unit III— Professional Etiquette	**8 hrs**
• Power Dressing • Telephonic Manners/ Voice mail etiquette • Business Salutation Etiquette • Different Cultural Etiquette & Protocol • Teamwork • Time-Management	
Unit IV- Cross Cultural Communication	**9 hrs**

• Cross Cultural Communication: meaning and significance • Definition of Culture • Elements of Culture • Characteristics of Culture • Culture and Context • Cultural Shock: Meaning and Stages • Ethnocentrism, Stereotyping, Xenophobia and Cultural Relativism • Strategies for Effective Communication in multicultural context • Acculturation	

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

- Understand the nature, importance, and process of written communication.
- Deliver effective presentations in contexts that may require power point, extemporaneous or impromptu oral presentations
- Acquire and exhibit professional etiquette.
- Respect other cultures and develop rapport in a multi-cultural society, thereby developing a broadened unbiased perspective.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
Herta Murphy, Herbert Hildebrandt, Jane Thomas	*Effective Business Communication*	McGraw Hill Education	2017	978-0070187757	640
Karen Schneiter Williams, Joyce P Logan, A.C. Buddy Krizan, Patricia Merrier	*Communicating in Business*	Cengage Learning India Private Limited	2012	978-8182093195	712
Ryan Sharma	*The Unwritten Rules of Professional Etiquette*	Habile Press	2020	978-1734980509	122

BTY207:Recombinant DNA Technology

L	T	P	Total Credits
3	0	1	4

Course content and syllabus

	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 8 bacteriophage, 8 and other high-capacity vectors enable genomic libraries to be constructed, Vectors for other bacteria, Bacterial Artificial chromosomes (BACs); Phage display libraries, 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**
The problem of selection, Direct selection, Identification of a clone from a gene library, Methods for clone identification. 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	3rd Ed	978-0879695767	2344

T.A. Brown	Gene Cloning and DNA Analysis - An introduction	Wiley - Blackwell	2010	9781405181730	338

Programme structure for B.Sc. (H) Bioinformatics - 4 years (5th Semester)

Sr. No	Course Code	Course Title	Course Type	Credits					Credit Units
				L	T	P	FW	SW	
1		Introduction to Database Management System with MySQL	Major Core Course	4	0	2	0	0	6
2	HGM301	Molecular Biology	Major Core Course	4	0	2	0	0	6
3		Computational Methods in Biomolecular Sequences and Phylogenetic Analysis	Major Core Course	3	0	1	0	0	4
4	MBO303	Virology	Minor Course	4	0	0	0	0	4
5		Environmental biology	Minor Course	2	0	0	0	0	2
6		*Summer Internship (4 Cr)							
		Total Credits							**22**

**(4 Cr of Summer Internship earned by students during summer Internship after Second Semester or Fourth Semester, will be taken into account in Fifth Semester of a student who pursue three year UG Programme without taking exit option).*

Introduction to Database Management System with MySQL

L	T	P	Total Credits
4	0	2	6

Course Objectives: The aim of this course is to acquire proficiency in database management, enabling efficient data storage, retrieval, and manipulation for effective information management.

Course Contents/syllabus:

	Teaching Hours
Unit I: Introduction to Databases	**18 H**
Relational and Non-relational databases. Introduction to SQL. Introduction to MySQL. Creating and Populating a Database. Query Primer: Its mechanics and clauses. Filtering: Condition evaluation, building condition, condition types	
Unit II: Working with Multiple tables and sets	**18 H**
Querying multiple tables: Join, Cartesian product, inner joins, self-joins. Working with sets: set theory primer, set operators, set operation rules. Data generation, manipulation and conversion	
Unit III: Grouping and Aggregates	**18 H**
Grouping concepts, aggregate functions, implicit v/s explicit groups, counting distinct values, generating groups, group filter conditions. Subqueries: Introduction, types, non-correlated subqueries, correlated subqueries. Joins: Outer joins, cross joins, natural joins. Conditional logic: case expression, examples of case expression. Transactions.	
Unit IV: Indexes and Constraints	**18 H**
Indexes: Types, uses. Constraints: Constraint creation. Views: their uses, data security, data aggregation, hiding complexity, updating views	

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

1. Demonstrate proficiency in designing and implementing SQL databases.
2. Efficiently retrieve and manipulate data using SQL queries.
3. Ensure data integrity and security in SQL database management.
4. Optimize database performance for improved system efficiency.

List of Practicals

1. Give an example of a) Self join b) Equi join c) Non-equi Join d) Outer join. Create a query to display the employee number and name of the employees who earn more than the average salary. Sort the result in ascending order of salary.

2. Explain the concept of view by taking an example or writing a Query in SQL. Write a Query to
a) Create a user with password
b) Grant system privileges to the user
c) Create a manager role and then allows the manager to create tables and views
d) Grant query and privileges to the user on employee table
e) Grant privileges to update specific column to user and roles
f) Revoke the privileges given to user on employee table

3. Write a program in pl/sql to explain following:
a) Cursor b) Exception handling c) Procedure and functions d) Triggers

4. Design employee information system demonstrating the use of database connectivity with oracle or access

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Alan Beaulieu	Learning SQL Generate, Manipulate, and Retrieve Data	O'Reilly	2005	978-93-5213-978-1
Conrad Bessant, Ian Shadforth and Darren Oakley	Building Bioinformatics Solutions With Perl, R, and MySQL	Oxford University Press	2009	978-0-19-958690-5

HGM301: Molecular Biology

L	T	P	Total Credits
4	0	2	6

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

Course content and syllabus

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

DNA damage and repair mechanisms	
Unit III: Transcription	**18 hrs**
RNA Transcription in bacteria and eukaryotes 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.	
Unit IV: Protein Translation	**18 hrs**
Genetic code: Its deciphering, degeneracy and general features. 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 Translation in Prokaryotes: formation of initiation complex, initiation factors, elongation, elongation factors, and termination. Translation in Eukaryotes: formation of initiation complex, initiation factors, elongation, elongation factors and termination. Translation proof-reading, translation inhibitors. Post-translation modifications of proteins and their effect on their structure and function. Protein targeting: Signal sequence and targeting proteins to specific cellular locations.	

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	7th Ed	978-9332585478	912
Tropp, B.E.	Molecular Biology Genes to Proteins	Jones and Bartlett	4th Ed	978-93-80853-49-9	1096

Computational Methods in Biomolecular Sequences and Phylogenetic Analysis

L	T	P	Total Credits
3	0	1	4

Course Objectives: The aim of this course is to teach students to apply the knowledge of sequence database, sequence alignment and phylogenetic tree in bioinformatics.

Course Contents/syllabus:

	Teaching Hours
Unit I: Basic concepts	**13 H**
Motif and Domains: Basic concept, types of motifs and domains, Sequence patterns and profiles: Basic concept and definition of sequence patterns and profiles, various types of pattern representations viz. consensus, regular expression (Prosite-type) and sequence profiles; PSSM, profile-based database searches using PSI-BLAST. Domain databases: CDD, SMART, ProDom Tools for searching pattern and profile: InterPro, Pfam, Prosite, and PRATT.	
Unit-II Pairwise and Multiple sequence alignment	**13 H**
Alignment of pairs of sequences; Introduction- Definition of sequence alignment, Methods - Dot matrix sequence comparison. Dynamic programming algorithm for sequence alignment – Global Alignment: Needleman- Wunsch, Local Alignment: Smith-Waterman, Gap penalty, Assessing the significance of an alignment Dynamic programming, progressive methods, Iterative methods, MSA using CLUSTAL, and PILEUP. Purpose and applications of multiple sequence alignment Similarity searches - PAM and BlOSUM matrix, Dayhoff substitution matrix, construction of PAM and BLOSUM matrix. Differences between PAM & BLOSUM	
Unit III: Phylogeny	**14 H**
Phylogenetic analysis: Basic terminology in Phylogenetics Introduction to phylogenetic analysis and its application, Phylogenetic tree terminology and topologies Methods of Phylogenetic Tree Construction: Distance Based Methods: NJ, FM & UPGMA Character Based Methods: Maximum Parsimony & Maximum Likelihood Brief introduction to Bootstrapping & Jackknifing. Introduction to Phylip and MEGA packages.	
Unit IV: Neural Networks and Hidden Markov Models	**14 H**

Neural Networks -Introduction – Priors & likelihoods - Learning algorithms: backpropagation - Neural Networks: Applications - Sequence encoding & output interpretation- Sequence correlations & neural networks Hidden Markov Models: Introduction -Prior information & initialization -Likelihood & basic algorithms -Learning algorithms -Applications of HMMs: general aspects -Protein applications Contemporary issues in Analytical Bio-Informatics Use of HMM and Neural Networks to predict secondary and tertiary structure of proteins	

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

1. Build an understanding about the basic concepts of motifs and domains in protein sequence analysis.
2. Apply algorithms for pairwise and multiple sequence alignment.
3. Analyze and examine the various methods of Phylogenetic tree construction.
4. Explain the various concepts involved in Neural Networks and Hidden Markov Models.

List of Practicals

1. Searching Domain Databases: CDD, ProDOM
2. Searching Motif Databases: Prosite and InterPro
3. Searching Motif and domain using: ScanProsite, InterProScan and PRATT
4. Building Phylogenetic tree using distance based method & character based methods by PHYLIP or MEGA
5. Tree evaluation

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Xiong, Jing	Essentials of Bioinformatics	Cambridge University	2007	978-8126541256
Mount, D.W.	Bioinformatics: Sequence and Genome Analysis	Cold Springer Harbor Lab Press	2004	978-9746520706
Lesk, A.M.	Introduction to Bioinformatics	Oxford University Press	2014	978-8170221548
Hooman H Rashidi, Lukas K Buehler	Bioinformatics Basics	CRC Press	1999	978-0849323751

MBO303: 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 (ϕX174, 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	6th Ed	978-1405171120	536
Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR, Skalka, AM	Principles of Virology, Molecular biology, Pathogenesis and Control	ASM Press	2nd Ed (2000)	978-1555811273	820
Carter J and Saunders V	Virology: Principles and Applications	Wiley	2nd (2013)	978-1119991427	394

Environmental Biology

L	T	P	Total Credits
2	0	0	2

Course Objectives: This course aims to provide students with a basic understanding of the physical environment encompassing atmosphere, hydrosphere, lithosphere, and biosphere. Further, it also helps them to learn about different biological resources, techniques and their importance in environmental biodiversity conservation and management.

Course content and syllabus

	Teaching Hours
Unit-1 Concepts of Environment	**9 hrs.**
Environment: Definition and importance; Principles and Scope, Atmosphere: Composition of air- Layers of Atmosphere, Ozone layer, Hydrosphere, hydrologic cycle, Lithosphere, Biosphere: Concept and definition; Types of Biomes and their distribution. Biogeographic zones: Phytogeographic zones, Zoogeographic zones	
Unit-2 Biodiversity and Conservation	**9 hrs.**
Introduction to Biodiversity: Definition, concept and Types of biodiversity, Status of Biodiversity – Global, National and Local Status, Types and Significance of Biodiversity, Threats to Biodiversity, Biodiversity Conservation: Current Practices in Conservation - In Situ Conservation and Ex Situ Conservation of Threatened Species - Cryopreservation, Gene Banks, Gene Pool and Species Conservation	
Unit-3 Biological Resources	**9 hrs.**
Forest Types and their resources, Carbon Sequestration, Use and Over-Exploitation – Timber and their Resources, Effects on Forest and Tribal People – Social and Cultural Forest, Agricultural resources and practices, green revolution, White revolution and blue revolution, livestock resource.	
Unit-4 Environmental Microbiology and Biotechnology	**9 hrs.**
Ecological Restoration: Wastewater treatment: Anaerobic and aerobic process, Methanogenesis, Bioreactors. immobilization techniques - Bioremediation: Biostimulation and Bioaugmentation, Phytoremediation. Biofertilizers – Biopesticides – Biofuels – Biomining. Genetically Modified organisms - merits and demerits	

Course Learning Outcomes:

1. The learner will understand the structure and function of our life supporting environment along with fundamentals of Environmental sciences.
2. The student could understand the threats to biodiversity and can identify the suitable technique for conservation of biodiversity.
3. The student would understand the importance of energy resources in a systematic way.
4. They will know suitable methods for characterizing the activity, function, diversity and composition of microbial communities.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Botkin, D.B. and Keller, E.A.	Environmental Science: Earth as a Living Planet	John Wiley and Sons	2011	9781118048948	656
Krishnamurthy, K.V	An Advanced Textbook on Biodiversity – Principles and Practice	Oxford and IBH Publishing	2003	9788120416062	651
R. A. Eggleton, G. J. Churchman	Clays, Controlling the Environment	CSIRO PUBLISHING	1995	9780643105669	544
Scrogg, A	Environmental Biotechnology	Oxford University Press,	2005	9780013032984	447

Programme structure for B.Sc. (H) Bioinformatics - 4 years (6th Semester)

Sr. No	Course Code	Course Title	Course Type	Credits					Credit Units
				L	T	P	FW	SW	
1	BCH302	Regulation of gene expression	Major Core Course	4	0	2	0	0	6
2		Molecular Modelling and Computer Aided Drug Design	Major Core Course	4	0	2	0	0	6
3		Web Development	Major Core Course	3	0	1	0	0	4
4	HGM307	Pharmacogenetics	Minor Course	4	0	0	0	0	4
5		Cancer Biology	Minor Course	2	0	0	0	0	2
		Total Credits							**22**

BCH302: Regulation of Gene Expression

L	T	P	Total Credits
4	0	2	6

Objectives: An understanding of different ways prokaryotes and eukaryotes regulate the expression of various gene and methods to study DNA-Protein interaction

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, Genomic imprinting of Igf2 and H19 genes 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: Genome Cluster and Genomic Imprinting	**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 *hsp70* genes of *Drosophila melanogaster*	

Cellular and molecular mechanisms of development: *Drosophila melanogaster*; Gradients decide compartments, maternal gene products establish gradients in early embryogenesis, anterior-posterior development by gene regulators, dorsal ventral development axes, receptor-ligand interactions, compartments determine cell fate at blastula stage, complex loci involved in regulation, homeobox and homeotic genes, Nematode (*C elegans*) development.	

List of Experiments -with basic instructions

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: at the end of the students will learn about

1. Concept and knowledge of different strategies in the regulation of gene expression in prokaryotes
2. Concept and knowledge of different strategies in the regulation of gene expression in eukaryotes
3. Understand structure of DNA-binding domains and techniques to study DNA-Protein Interaction
4. Role of Genome Cluster and Genome imprinting in gene expression

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Krebs, J.E., Goldstein, E.S., and Kilpatric, S.T.	Lewin's Genes XII	Jones and Bartlett Learning	12th Ed	978-1284104493	838
Watson JD, Baker TA, Bell SP, Gann A, Levine M, Losick R.	Molecular Biology ofthe Gene	Pearsons Publishers	7th Ed.	978-9332585478	912
Tropp, B.E.	Molecular Biology Genes to proteins	Jones and Bartlet	4th 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	6th Ed	978-0-818 3-4464-3	1342

Molecular Modelling and Computer Aided Drug Design

L	T	P	Total Credits
4	0	2	6

Course Objectives: The aim of this course is to impart an understanding of the process of Drug designing using three dimensional structure of the biomolecular target.

Course Contents/syllabus:

	Teaching Hours
Unit I: Introduction to Molecular Modelling and Drug Design	**18 hrs**
Introduction to applications of Bioinformatics in drug discovery, Basics of molecular modeling and its significance, Introduction to drug design and its importance, Overview of computational methods in drug discovery, Software tools used in molecular modeling and drug design	
Unit II: Protein Structure Prediction and Molecular Docking	**18 hrs**
Introduction to protein structure prediction methods, Homology modeling and its applications, Introduction to molecular docking, Principles and algorithms of molecular docking, Hands-on practice on molecular docking	
Unit III: Molecular Dynamics Simulations and Ligand-Protein Interactions	**18 hrs**
Introduction to molecular dynamics simulations, Principles and algorithms of molecular dynamics simulations, Force-fields, Components of a force field equation, Non-bonded interactions – deriving partial charges, Lennard-Jones potential and parameterization, Non-bonded interactions – deriving partial charges, Lennard-Jones potential and parameterization. Introduction to water models (SPC, TIP3P, TIP4P, BF and ST2) and united atom force fields. Hands-on practice on molecular dynamics simulation software, Analysis of ligand-protein interactions, Binding affinity prediction and scoring functions	
Unit IV: Quantitative Structure-Activity Relationship (QSAR) Studies and Drug Design Strategies	**18 hrs**
Introduction to QSAR studies, Principles and applications of QSAR in drug discovery, Hands-on practice on QSAR software, Introduction to drug design strategies, Case studies and applications of computer-aided drug design	

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

1. To understand the principles of molecular modeling and computer-aided drug design.
2. To learn various computational methods used in drug discovery.
3. To gain practical experience in molecular docking, molecular dynamics simulations, and QSAR studies.
4. To understand the basics of protein structure prediction and ligand-protein interactions.
5. To explore different strategies in drug design.

List of Practicals

1. Molecular Modeling Software set: PyMol, AutoDock, GROMACS, etc
2. Homology Modeling
3. Molecular Docking
4. Molecular Dynamics Simulations

5. Analysis of Molecular Dynamics Trajectory: Visualizing molecular dynamics trajectory, Analyzing protein dynamics, root mean square deviation (RMSD), and root mean square fluctuation (RMSF)

6. Quantitative Structure-Activity Relationship (QSAR)

7. Predicting biological activity using QSAR models, Virtual screening of compound libraries, Identifying potential drug candidates

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Jenny Gu, Philip Bourne	Structural Bioinformatics, 2nd Edition	Wiley Blackwell	2018	8126574712	1034
Sonsoles Martín-Santamaría	Computational Tools for Chemical Biology	Royal Society of Chemistry	2017	978-1-78262-700-5	378

Web Development

L	T	P	Total Credits
3	0	1	4

Course Objectives: The aim of this course is to learn about various web development languages such as HTML, Javascript, etc.

Course Contents/syllabus

	Teaching Hours
Unit I: Internet, WWW, and HTML	**13 hrs**
Internet and WWW: Introduction to internet and its applications, Internet service providers, domain name server, internet address. World Wide Web and its evolution, uniform resource locator (URL). Introduction to Web servers & Proxy server, HTTP protocol. HTML and Common tags: Document Structure Tags, Formatting Tags, Text Level formatting, Block Level formatting; Lists: ordered list Unordered List, definition List; Anchor tag, Hyperlink tags, Absolute and relative path, Tables and its attributes, Image and Image maps; Frames: Frame Tag, Nesting Frame Tag, Targeting named frames, creating floating frames, Using Hidden frames; Forms: Form Elements, Form Attributes – Action Attribute, Method Attribute, Name Attribute; Form Input Types and Input Restrictions; Form Input Attributes.	
Unit II: dHTML and style sheets	**13 hrs**
DHTML: Moving elements and Images, changing colors and hiding elements, moving between layers, mouse rollovers, Difference between HTML and DHTML. STYLE SHEETS: Cascading style sheet, Different approaches to style sheets, Using Multiple approaches, Linking to style information in separate file using the <LINK> tag, embedded style information, Using <STYLE> tag, Cascading Order.	
Unit III: JAVA scripts	**14 hrs**
Java Scripts: Introduction Benefits of java script, Client-Side JavaScript, Server-Side JavaScript, JavaScript Objects, JavaScript Security, Editing java scripts Displaying information, Alerls(), Promots(), confirm box, Operators; Statements: Conditional Statements, Conditional loops;	

Functions, Arrays, Objects-math, string, date, Boolean, number, document, windows, regExp. Document and its Associated Objects: Document, Link, Area, Anchor, Image, Applet, Layer Events	
Unit IV: dHTML with JAVA script	**14 hrs**
DHTML with java script, Object model collection, events in java script, filters and transitions-Flip filter, Image mask, shadow filter, alpha filter, Blur filter. Event Handlers: General Information about Events, Defining Event Handlers, event, onAbort, onBlur, onChange, onClick, onDblClick, onDragDrop, onError, onFocus, onKeyDown, onKeyPress, onKeyUp, onLoad, onMouseDown, onMouseMove, onMouseOut, onMouseOver, onMouseUp, onMove, onReset, onResize, onSelect, onSubmit, onUnload	

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

1. The concepts and models of internet programming
2. Foundations of HTML and WWW
3. The concepts and programs of JAVA
4. Use the dHTML with JAVA script

List of Practicals

1. Design a web page using different text formatting tags.

2. Design a web page with links to different pages and allow navigation between pages.

3. Design a web page with Imagemaps.

4. Design a web page with different tables.

5. Design a webpage using frames.

6. Design a website using style sheets so that the pages have uniform style.

7. Using Java Script design a web page that prints factorial / Fibonacci series / any given series.

8. Design a form with a test box and a command button. Using Java Script write a program whether the number entered in the text box is a prime number or not.

9. Design a form and validate all the controls placed on the form using Java Script.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN

Thomas Powell	Web Design The complete Reference,	McGraw-Hill Education	2002	978-0072283631
Thomas Powell	HTML and XHTML The complete Reference	McGraw-Hill Education	2003	978-9746520706

BCH302: Pharmacogenetics

L	T	P	Total Credits
4	0	0	4

Course Objectives: The course's main objectives are to give students an understanding of the pharmacogenetic variation in drug response in different individuals, methods to study, and the importance of human genetics and genomics studies in drug therapy optimization and precision medicine.

Course Contents/syllabus

	Teaching Hours
Unit I: Introduction to Pharmacogenetics	**18 hrs**
Definition and goals of Pharmacogenetics. Historical background and development of pharmacogenetics. Key principles and concepts in pharmacogenetics. **Genetic Variations:** Introduction to genetic variation and relevance to pharmacogenetics. Types of genetic variation: single nucleotide polymorphism (SNP), insertion/deletion, copy number variation. Genetic polymorphism and their impact on drug response. Importance of genetic diversity in different ethnic groups.	
Unit II: Genetic variants determining drug response	**18 hrs**
Overview of ADMET studies. Overview of Drug Metabolism Pathway: Phase I, II and III pathways. Role of cytochrome P450 enzymes in drug metabolism. Reaction catalyzed by cytochrome P450 enzymes. Genetic variation in drug metabolizing enzymes and effect on drug response Transporters of drugs and importance genetic variation in drug response Determinants of drug receptor and target proteins. Genetic variations affecting drug-receptor interaction and effect on drug response. Precision Medicine	
Unit III: Genotype and Phenotype Association	**18 hrs**
Principles of Genetic Medicine Introduction to Biological Databases like HapMap, 100000 Genomes and ENCODE. Databases to search for SNPs. dbGaP and other bioinformatics tools to analyse relationship between genotype and phenotype. Genome Wide Association Studies (GWAS) and meta-analysis. Integrated analysis of multiple types of genomic data. Application of various omic data in pharmacogenomics.	
Unit IV: Clinical Application Pharmacogenetics and ELSI	**18 hrs**

Disease specific pharmacogenetics: cardiovascular diseases, oncology, psychiatry, etc. Personalized medicine and drug prescription. Pharmacogenetic testing and its role in guiding drug selection, dose optimization and minimizing adverse drug reaction. Challenges and limitations of pharmacogenetic testing. Ethical, Legal and Social Implications in pharmacogenetic testing and research. Confidentiality, informed consent, and privacy issues related to genetic information. Public perception, policy, and regulatory aspect of pharmacogenetics	

Course Learning Outcomes: at the end of the course the students will be able to:

- Understand importance of genetic variation in pharmacogenetic studies
- Understand the role of genetic variation in drug transporters and metabolizing enzymes in interindividual drug response
- Bioinformatics methods to study relationship between genotype and phenotype
- Precision medicine and ELSI concerns with pharmacogenetics

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Gary Walsh	Pharmaceutical Biotechnology: Concepts and Applications.	John Wiley & Sons: West Sussex.	2007	978-0470012451	807
Daan J. A. Crommelin, Robert D. Sindelar, Bernd Meibohm	Pharmaceutical Biotechnology: Fundamentals and Applications.	Informa Healthcare: New York.	2008	9781420044386	1359
J. Licinio and M.-L. Wong	Pharmacogenomics: The Search for Individualized Therapies.	Wiley-Blackwell	2009	978-3-527-61630-5	599
Rothstein, M.A.	Pharmacogenomics: Social, Ethical, and Clinical Dimensions	Wiley-Liss	2003	978-0471227694	368
Lin, M. and Wu, R.	Statstical & Computational Pharmacogenomics	CRC	2008	978-1584888284	368

Cancer Biology

L	T	P	Total Credits
2	0	0	2

Course content and syllabus

	Teaching Hours
Unit I: Introduction to Cancer	**9 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	**9 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.	
Unit III: Role of cell cycle and apoptosis and autophagy	**9 hrs**
Cell cycle regulation and cell death, Cellular senescence, telomeres and immortalization, Autophagy in Cancer.	
Unit IV: Cancer Epigenetics & Metabolism	**9 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 ofcancer
- Understand the application of cancer diagnosis and therapy

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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	978-0815344322	1342
Rakesh Srivastava	Apoptosis,cell signalling and human diseases	Humana Press	1st	9781588298829	395
Berg J.M., Tymoczko J.L., Stryer L.	Biochemistry	WH Freeman & Company	5th	13: 978-1-4641-2610-9	1023

Programme structure for B.Sc. (H) Bioinformatics - 4 years (7th Semester)

Sr. No	Course Code	Course Title	Course Type	Credits					Credit Units
				L	T	P	FW	SW	
1	BCH601	Advanced Cell Biology	Core Course - Hons.	4	0	0	0	0	4
2	BIF606	Linux and Bash Scripting	Core Course - Hons.	2	0	2	0	0	4
3		Tools for Genome Analysis	Core Course - Hons.	3	0	1	0	0	4
4		Immunoinformatics	Discipline Specific Elective	3	0	1	0	0	4
5		Population and Evolutionary Genetics	Discipline Specific Elective	4	0	0	0	0	4
	BTY602	Intellectual Property rights, Biosafety and bioethics	Minor Course	4	0	0	0	0	4
		Total Credits							**24**

BCH601: Advanced Cell Biology

L	T	P/S	Total Credit Units
4	0	0	4

Course Objectives: To develop an advanced understanding of the cell, cellular signaling and communications and its genome organization.

Course Contents/syllabus:

	Hours
Unit I: Cell wall and Cell membrane	**18 hrs**
Cell wall and Cell Membrane: Physical structure of model membranes in prokaryotes and eukaryotes, and their constituents; structural organization and functions of cell organelles. **Transport of nutrients:** Ions and macromolecules across membranes. Different classes of pumps and their mechanism. Cellular energy transactions.	
Unit II: Organization of genomes	**18 hrs**
Organization of genomes: Genes and chromosomes, Operon, unique and repetitive DNA, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons. **Cell division and cell cycle:** Mitosis and meiosis, Cell cycle and its regulation, Apoptosis, Necrosis ,Autophagy and other forms of cell death. Contribution of Nobel laureates in elucidation of the DNA structure,cell death and cell cycle. **Cellular basis of differentiation and Development:** Meiosis, gametogenesis, fertilization and up to the formation of three germinal layers	
Unit III: Cell signaling	**18 hrs**
Cell signaling: Hormones and their receptors, cell surface receptor, and signalling mechanisms, bacterial chemotaxis and quorum sensing.	

Cell transformation and cancer: Oncogenes and proto-oncogenes, tumor suppressor genes, metastasis. Therapeutic interventions of uncontrolled cell growth.	
Unit IV: Cellular communication	**18 hrs**
Cellular communication: General principles of cell communication, cell adhesion and roles of different adhesion molecules, tight junctions, communicating junctions, neurotransmission and its regulation.	

Course Learning Outcomes:

- Understand about different component of cell, and cellular signalling and communication mechanisms in the cell.
- Discuss the basic differences in genome of prokaryotic and eukaryotic cells.
- Evaluate various modes of cell signaling and cell transformation mechanisms.
- Analyze the knowledge of nutrient transport mechanisms and cellular basis of differentiation and cellular development.

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, Saunders, Philadelphia.	New York: Lippincott Williams & Wilkins,	2011	9780781734936, 0781734932	734

BIF606: Linux and Bash Scripting

L	T	P	Total Credits
2	0	2	4

Course Objectives: The aim of this course is to teach students to apply the knowledge and the fundamentals of Linux and Bash scripting.

Course Contents/syllabus:

	Teaching Hours
Unit I: Introduction to Linux	**09 hrs**
Introduction to Linux and Linux kernel, Linux distributions, Shell, Directory and File commands: Directory structure, Directory Commands, Disk usage of a Specific Directory, File commands, Moving and renaming Files, Important Files and Directories, File and Directory Security	
Unit II: Linux Search Tools	**09 hrs**
Finding Files using attributes: ls, find command, Files Age, files by size, strings within a Text File, Strings within Binary files, Find Processes,Text file processing with Grep, awk	
Unit III: Shell Scripting	**09 hrs**
Programming with Linux, Shell, Command Aliases, User Defined Variables, Evaluating Expressions, Using Quotes in Shell Scripts, Exit Status, Command Line Arguments, Redirection of Standard Input and Output, Pipes, Conditional Statements, Test command, Loops, The case statement	
Unit IV: Linux administration	**09 hrs**
Shutting down and Changing Runlevels, Adding and Removing Users, Get Process Status, Find processes by Pattern or User, Display Active Processes, Kill a Process, Switch User	

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

1. Learn basics of Linux
2. Learn searching and working with text patterns in Linux
3. Learn Shell scripting
4. Learn Linux Administration

List of Practicals

1. Install and setup a Linux Distribution
2. Make new files and folders

3. Copy and Move files and folders
4. Use R-sync to backup files and folders
5. Find files with specific attributes
6. Find and Kill specific processes
7. Add and Remove users
8. Use Bash scripting to automate common tasks

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Donald K. Burleson	Easy Linux Commands	SPD	2010	8184043295	196
Eric Metthes	Classic Shell Scripting	O'Reilly	2015	978-0-596-00595-5	568

Tools for Genome Analysis

L	T	P	Total Credits
3	0	1	4

Course Objectives: The aim of this course is to teach students to apply the knowledge and basic concepts of biology and computer science..

Course Contents/syllabus:

	Teaching Hours
Unit I: Introduction to databases	**13 H**
Scope and applications of bioinformatics, Biological Databases – Primary, Secondary and Composite databases: Genbank, EMBL, DDBJ, Uniprot, Swissprot, PIR, PDB, Genpepts, SCOP, Pfam. NCBI, EBI, DDBJ. nucleotide sequence flat files. Sequence formats: Genbank, FASTA, ASN. Information retrieval from biological databases- NCBI resource, Entrez, Pubmed, MEDLINE. .	
Unit-II Pairwise and Multiple sequence alignment	**13 H**
Alignment of pairs of sequences; Introduction- Definition of sequence alignment, Methods - Dot matrix sequence comparison. Dynamic programming algorithm for sequence alignment – Global Alignment: Needleman- Wunsch, Local Alignment: Smith-Waterman, Gap penalty, Assessing the significance of an alignmentDynamic programming, progressive methods, Iterative methods, MSA using CLUSTAL, and PILEUP. Purpose and applications of multiple sequence alignment	
Unit III: Scoring matrices and Database search	**14 H**
Similarity searches - PAM and BlOSUM matrix, Dayhoff substitution matrix, construction of PAM and BLOSUM matrix. Differences between PAM & BLOSUM Database searching for similar sequences. Sequence similarity search, FASTA sequence database similarity search, BLAST sequence database similarity search, variants of BLAST search, and other methods of comparing database of sequences and patterns.	
Unit IV: Phylogeny	**14 H**

Phylogenetic analysis: Basic terminology in Phylogenetics Introduction to phylogenetic analysis and its application, Phylogenetic tree terminology and topologies Methods of Phylogenetic Tree Construction: Distance Based Methods: NJ, FM & UPGMA Character Based Methods: Maximum Parsimony & Maximum Likelihood Brief introduction to Bootstrapping & Jackknifing. Introduction to Phylip and MEGA packages.	

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

1. Build an understanding about the significance and applications of bioinformatic tools.
2. Apply algorithms for pairwise and multiple sequence alignment.
3. Analyze and examine the various searching techniques with matrices and databases.
4. Analyze and examine the various methods of Phylogenetic tree construction

List of Practicals

1. Extracting DNA and protein sequences from biological database in FASTA format
2. Searching Domain Databases: CDD, ProDOM3.
3. Performing Multiple sequence alignment with Clustal W
4. Database similarity search using BLAST to find sequences similar to query sequence.
5. Using different substitution matrices like PAM and BLOSUM to perform sequence similarity search
6. Building Phylogenetic tree using distance based method & character based methods by PHYLIP or MEGA
7. Tree evaluation

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Xiong, Jing	Essentials of Bioinformatics	Cambridge University	2007	978-8126541256
Mount, D.W.	Bioinformatics: Sequence and Genome Analysis	Cold Springer Harbor Lab Press	2004	978-9746520706
Lesk, A.M.	Introduction to Bioinformatics	Oxford University Press	2014	978-8170221548
Hooman H Rashidi, Lukas K Buehler	Bioinformatics Basics	CRC Press	1999	978-0849323751

Immunoinformatics

L	T	P	Total Credits
3	0	1	4

Course Objectives: The aim of this course is to provide students with a comprehensive understanding of immunology, major histocompatibility complex (MHC) and human leukocyte antigen (HLA) systems, vaccine design principles, and the utilization of immunoinformatics tools and databases for advancing research and development in immunology and vaccine design.

Course content and syllabus

	Teaching Hours
Unit I: Introduction to Immunology	**13 hrs**
Introduction to immune System, Immune cell types, Hematopoiesis, B and T lymphocytes, Lymphoid organs (primary and secondary), Inflammation, Innate and Adaptive immune system. Antibody structure, Generation of antibody diversity, Major histocompatibility complex, Antigen presentation, APCs, T-cell development, negative/positive selection. Humoral immunity/Cell-mediated immunity, T cell subtypes. B-cell maturation/activation BCR signaling, memory B and T cell. Autoimmunity, Vaccine production, Immunization, polyclonal and monoclonal antibodies.	
Unit II: Immunoinformatics tools and databases	**13 hrs**
Databases & tools: MHCDB(NCBI), IEDB, The IMGT/HLA Database, IPD (The Immuno Polymorphism Database), BciPep, Epitome, CED, Ag-Ab database, Allergen Databases.	
Unit III: MHC and HLA: Structure, Polymorphism, and Epitope Prediction	**14 hrs**
Major Histocompatibility Complex: Structure and functions of MHC class I and II, MHC polymorphism, MHC supertypes, MHC peptides- Specificity, characterization, MHCpeptide designing tool. HLA: HLA-peptide interactions, Antigen Processing in the MHC Class I Pathway, Processing of MHC Class II Epitopes, Sequential and Conformational Epitopes, Epitope Prediction algorithms - T cell and B cell epitope prediction tool.	
Unit IV: Vaccine Design and Development	**14 hrs**
Rational vaccine design: Reverse vaccinology, Toxoid as vaccine, Conjugate vaccine, DNA vaccine, Recombinant vector vaccines. Structure-based Vaccine design: tools and techniques, Antigenicity modification, Epitope replacement, germline targeting, Epitope focusing.	

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

1. Understand the principles of immunological processes, including immune cell types, antigen recognition, and immune regulation.
2. Effectively utilize immunoinformatics tools and databases for accessing, analyzing, and interpreting immunological data.
3. Analyze antigen presentation, epitope prediction, and immune recognition using MHC and HLA systems.
4. Evaluate diverse vaccine design strategies, including rational, structural-based, and personalized approaches.

List of Practicals

1. Introduction to different Immunoinformatics databases
2. B-Cell Epitope prediction
3. T-Cell processing and immunogenicity prediction
4. MHC-I binding sites predictions for domain sequence
5. MHC-II binding sites predictions
6. Computational Vaccine designing

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Flower, Darren R	Immunoinformatics: predicting immunogenicity in silico	Humana Press, New Jersey	2007	9781588296993	438
Namrata Tomar	Immunoinformatics	Humana Press, New Jersey	2014	9781493911158	586

Population and Evolutionary Genetics

L	T	P	Total Credits
4	0	0	4

Course Objectives: The students will study and develop an understanding of population and evolutionary genetics, and the consequences of inbreeding and apply genetic principles to real-world clinical situations.

Course content and syllabus

	Teaching Hours
Unit I Human Evolution	**18 hrs**
Theories of evolution: Lamarckian evolution theory, Darwin's theory of evolution, Neo- Darwinism, modern synthesis theory of evolution, Macroevolution & Microevolution. Overview of human evolution, Primitive hominids and australopithecine stages, Evolutionary trends and relationship with family trees, Distributions, Physical characteristics, Brain size and cultural behaviour of pithecanthropine stage, neanderthal transition stage, neanderthal stage and modern human.	
Unit II Human Population Genetics	**18 hrs**
Introduction, Applications and subdivisions of human population genetics **Allele frequencies**- deriving genotypic & allelic frequencies, introduction to quantitativegenetics, deriving allelic frequencies from molecular data, changes in allele frequencies. **Genetics & Polymorphism**- phenotypic & genotypic polymorphisms, transientpolymorphism, balanced polymorphisms. **Random & Non-random mating**– positive & negative assortative mating, role inpopulation size & change in gene frequency. **Hardy-Weinberg method & its applications**– calculating allelic frequencies, assumptions of Hardy-Weinberg equilibrium, proof of Hardy-Weinberg equilibrium, Generation time, testing for fit to Hardy-Weinberg equilibrium	
Unit III: Human Evolutionary Genetics	**18 hrs**

Random Genetic drift– definition, its effects in small & large populations, bottlenecking& founder effect, genetic drift simulation, genetic drift vs selection. **Genetic equilibrium**– definition, conditions for its stability, deviation of it (evolution). **Selection**– overview, types & subtypes, negative & positive selections, patterns andmechanism of selection (stabilizing, disruptive, directional, balancing, disassortative sexual selection, frequency dependent selection), overdominance, natural selection, artificial selection, ecological selection. **Evolution of Genetic Diversity**- natural variation, sources of genetic variation. **Molecular Evolution**– general approaches, principles, rates of molecular evolution.Evolution of eukaryotic genome structure, Gene family, evolution and phylogenetics, Gene genealogies, causes of change in allele frequency, molecular study of phylogeny,neutral theory of molecular evolution.	
Unit IV: Inbreeding and its effects	**18 hrs**
Consanguinity and inbreeding, Inbreeding coefficient of a population and individuals through path analysis, Computation of Wright's 'F', Computation of 'F' for autosomal gene, Biological consequences of inbreeding, Concept of genetic load and its measurements, **Genetics of Speciation**- Patterns and processes of speciation: Reproductive isolating barriers, Species concepts, Genetics of reproductive isolation and species, Natural hybridization. Classification of races through UNESCO guidelines, Admixture of races, Ethnic elements in Indian population (Classification by A.C. Haddon, S.S. Sarkar and Guha), Objectives of racial classification.	

Course Learning Outcomes:

- Understand Human Evolution and genetics associated.
- Gain knowledge about genetics at population level.
- Understand about polymorphisms.
- Acquire knowledge about various human races.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Balding, D.J., Bishop, M. and Cannings, C.C	Handbook of Statistical Genetics.	John Wiley and Sons, England	2007	978-047005830-5	1616

Brandon, R.N	Concepts and Methods in Evolutionary Biology	Cambridge University Press, USA.	1996	978-0521498883 0521498880	240
Cavalli-Sforza, L.L. and Bodmer, W.F.	The Genetics of Human Population	W.H. Freeman and Co., San Francisco, CA.	2013	978-0486406930	992
Falconer, F.S. and MacKay, T.F.C.	Introduction to Quantitative Genetics.	Benjamin-Cummings Pub Co; Subsequent edition	1996	0582243025 978-0582243026	464
Hamilton, M.B.	Population Genetics	Wiley-Blackwell, USA	2009	1405132779 978-1405132770	424
Hartl, D.L. and Clark, A.G.	Principles of Population Genetics.	Sinaur Associates, Inc., Massachusetts	4th/2007	0878933085 978-0878933082	672
Hedrick, P.W.	Genetics of Population	Jones and Bartlett Publishers, Massachusetts	4th/2011	0763757373 978-0763757373	675
Neale, B., Ferreira, M.A.R., Medland, S.E. and Posthuma, D.	Statistical Genetics: Gene Mapping through Linkage and Association.	Taylor and Francis Group, USA	2008	9780415410403	608

BTY602: IPR, Biosafety and Bioethics

L	T	P	Total Credits
4	0	0	4

	Teaching Hours
Unit I: Introduction to IPR and Patent Database	**18 hrs**
Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications. **Protection of New GMOs:** International framework for the protection of IP. IPs of relevance to Biotechnology and few Case Studies. **Patent databases**: Invention in context of "prior art"; Searching national/International Databases; Analysis and report formation	
Unit II: Types of patent and patent application	**18 hrs**
Types of patents: Indian Patent Act 1970; Recent Amendments; Filing of a patent application; Precautions before patenting-disclosure/non-disclosure; WIPO Treaties; Budapest Treaty; PCT and Implications; Role of a Country Patent Office; Procedure for filing a PCT application	
Unit III: Biosafety, GMOs and Biodiversity Act	**18 hrs**
Biosafety: Introduction; Historical Background: Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines - Government of India; **Definition of GMOs & LMOs:** Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; **Risk Assessment:** Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartagena Protocol. **Biodiversity Act 2002:** Agricultural biodiversity; International Treaty on Plant Genetic Resources for Food and Agriculture (PGRFA); Conservation strategies for seed gene bank; Climate change and conservation of plant genetic resources; Global efforts for management of crop genetic resources; Strategies on PVFR and Biodiversity Acts. **Biodiversity Legislation in India;** Indian Biodiversity Act and provisions on crop	

Unit IV: Bioethics, Ethics and the law issues	18 hrs
Bioethics: Concepts; Philosophical considerations; Epistemology of Science; Ethical Terms; Principles & Theories; Relevance to Biotechnology; **Ethics and the Law Issues:** types and policies; Research concerns; Emerging issues: Biotechnology's Impact on Society; DNA on the Witness Stand - Use of genetic evidence in civil and criminal court cases; Challenges to Public Policy – To Regulate or Not to Regulate; Improving public understanding of biotechnology products to correct misconceptions.	

Course Learning Outcomes:

- Understand IPR and its database.
- Evaluate different types of patents and policies
- Compare the biosafety methods and differences between GMOs and LMOs.
- Perceive knowledge of Bioethics and laws.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
D N Choudhary	Evolution of patent laws: "developing countries' perspective	Delhi Capital Law House	2006	OCLC Number: 255182178	476

Programme structure for B.Sc. (H) Bioinformatics - 4 years (8th Semester) without Research

Sr. No	Course Code	Course Title	Course Type	Credits					Credit Units
				L	T	P	FW	SW	
1		Omics Studies and Data Analysis	Core Course - Hons.	3	0	1	0	0	4
2	BCH610	Topics in Life Science	Core Course - Hons.	4	0	0	0	0	4
3	HGM602	Stem cell Biology and Regenerative Medicine	Discipline Specific Elective	4	0	0	0	0	4
4		Clinical trials	Discipline Specific Elective	3	0	1	0	0	4
5	BIF607	Version Control with Git	Minor Course	4	0	0	0	0	4
		Total Credits							**20**

Omics Studies and Data Analysis

L	T	P	Total Credits
3	0	1	4

Course Objectives: The aim of this course is to teach students the scope of omics research and methods in genomics and transcriptomics.

Course Contents/syllabus:

	Teaching Hours
Unit I: Omics Data and Data format	**13 hrs**
Overview of multi-omics studies: concepts and applications, Introduction to genomics, transcriptomics, proteomics, and metabolomics, Integration of multi-omics data sets, Challenges and opportunities in multi-omics data analysis, Biological Data Sources: NCBI, ENSEMBL, TCGA, GenBank, Short Read Archive, UniProt. UCSC Genome Browser, FlyBase, RNA-central, Common data formats and conversion	
Unit II: Omics technology	**13 hrs**
Technologies for Genomics, proteomics, transcriptomics. Normalization techniques for transcriptomics, proteomics, and metabolomics data, integration of multi-omics data sets, , Sequence Ontology, Gene Ontology, Visualizing data, Sequencing instruments, Types of Sequencing instruments, Paired-end sequencings, Sequencing Data preparation, Sequencing coverage, Short Read Archive (SRA), Quality Control, adapter trimming	
Unit III: Sequence alignment and Data analysis	**14 hrs**
Proteomics data analysis, Sequence alignment, Generation of sequening alignment, alignment scores, percent identity, CIGAR string, Global and local alignments, BLAST, Short Read Alignment, bwa aligner, bowtie aligner, Multiple Sequence aligner, SAM/BAM format	
Unit IV: Genomic Variation and Data Visualization	**14 hrs**
Visualizing large scale genomic variations, Variation calling, Multi-sample variant calling, Variant Call Format (VCF), Variant annotation and effect prediction. RNA-Seq Analysis, Chip-seq Analysis, Sequence assembly, Whole genome assembly, Metagenomics: taxonomies, classifying 16s sequences, neonatal microbiome, Heatmaps, scatter plots, and volcano plots	

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

1. Comprehensive understanding of Omics data.
2. Learning Experimental and bio-informatic workflows in Omics data generation and analysis.
3. Learn the concepts of data analysis in proteomics.
4. Understand the concepts of RNA seq data analysis.

List of Practicals

1. To annotate genome of a prokaryotic organism.
2. To annotate genome of a eukaryotic organism.
3. To understand data type of transcriptomics, proteomics and metabolomics
4. Data cleaning and developing volcano plots
5. Data analysis of RNA-seq, ChIP-seq, and Proteome-MS

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Preeti Arivaradarajan and Gauri Misra	Omics Approaches, Technologies And Applications	Springer	2018	ISBN: 978-981-13-2925-8	

BCH610: Topics in Life Sciences

L	T	P	Total Credits
4	0	0	4

Objective: The objective of this course is to provide students with in-depth knowledge of conceptssignificant to crack CSIR-NET, ICAR-JRF, ICMR-JRF, GATE-Biotechnology.

Course content and syllabus:

	Teaching Hours
Unit I: Inheritance Biology	**18 hrs**
Mendelian principles: Dominance, segregation, independent assortment. Concept of gene: Allele, multiple alleles, pseudo allele, complementation Tests. Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited, and sex influenced characters. Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants. Extra chromosomal inheritance: Inheritance of Mitochondrial and chloroplast genes, maternal inheritance. Recombination: Homologous and non-homologous recombination including transposition.	
Unit II: Genetic Variations	**18 hrs**
Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. **Quantitative genetics:** Polygenic inheritance, heritability and its measurements, QTL mapping. **Mutation:** Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis.	
Unit III: Cell Communication and Cell signaling	**18 hrs**
G-Protein Molecular Organization, Structural Features of G Protein Activation, Structural Determinants of Receptor–G-Protein Specificity; Cytokine Signalling Proteins: JAK Structure and Localization, JAK-STAT pathway, RTK, Nuclear receptors	

, STAT Structure and Function, Inhibition of Cytokine Signalling Integrins, cadherins, Ras-MAPK pathway, Hedgehog, PI3K, Notch, Serine/Threonine pathways, lipid signalling	
Unit IV: Developmental Biology	**18 hrs**
Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development. Use of Drosophila as model organism for studying developmental biology. Production of gametes, cell surface molecules in sperm-egg recognition in animals; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis.	

Course Learning Outcomes:

1. Gain knowledge about Mendelian principles and various exceptions to it.
2. Understanding the concepts of enzymes and biochemical processes.
3. Perceive knowledge of mechanisms used by the human body to fight foreign agents anddisease- causing pathogens.
4. Discriminate between various techniques with respect to their applications.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Gardner EJ, Simmons MJ, Snustad DP	Principles of Genetics	Wiley-India	6th/2008	978-0471291312	480
Peter F Stanbury, Allan Whitaker, Stephen J Hall	Principles of Fermentation Technology	Butterworth-Heinemann Press. UK	2016	978-0070492585	367
J. Owen, J. Punt, S. Stranfo	Kuby Immunology (8th Edition)	WH Freeman and Company, USA	2018	978-1319114701	944

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D. Male, J. Brostoff, D. Roth, I. Roitt	Immunology(8th Edition)	Saunders, Elsevier, USA	2017	978-1118415771	576
Wilson K., Walker J.	Principle and Techniques of Biochemistry and Molecular Biology	Cambridge University Press	2010	978-0521178747	744

HGM602: Stem Cell Biology and Regenerative Medicine

L	T	P	Total Credits
4	0	0	4

Course objectives: The overall aim is to promote an understanding of the potential of stem cells in cell based and regenerative medicine by exposing the students to the biology of stem cells and their translational opportunities in regenerative medicine

Course content and syllabus

	Teaching Hours
Unit I: Introduction to Stem Cells	**18 hrs**
Definition; Historical Perspectives, Stem cell types, embryonic, extra-embryonic fetal, adult and induced pluripotent stem cells Origin and sources, Cancer stem cells, General characteristics of stem cells and major pathways controlling self renewal and pluripotency	
Unit II: Introduction to Cell-based Therapies	**14 hrs**
Fundamentals of Cell-Based Therapies, Stem Cell Research, Biology of Human Mesenchymal Stem Cells, endothelial progenitor cells and hematopoietic stem cells .	
Unit III: Regenerative Medicine for Diseases	**22 hrs**
Biology of regeneration, Strategies of Regenerative Medicine: Cell transplantation, Bio-artificial Tissue and Induction of Regeneration In Situ, Regenerative Medicine for Diseases of the Retina and limbal stem cell,Islet Cell Therapy and Pancreatic Stem Cells, Cell Therapies for Bone and Cartilage Regeneration, Regenerative Medicine Approaches to Skin Cell-Based Therapy , Use of stem cells for therapy of malignant diseases and non-malignant diseases like neurological, cardiac, autoimmune, and metabolic disorders	
Unit IV: Regulatory and Ethical Issues and future prospects	**18 hrs**
Overview of DCGI/FDA regulation in stem cell research and development, Ethical and regulatory issues related to stem cell research and therapy, National and International Guidelines, Quality control issues in using stem cells for clinical applications, Clinical trials and future prospective	

Course Learning Outcomes:

1. Develop basic understanding of stem cells
2. Evaluate the clinical significance of stem cell research in regenerative medicine
3. Assess strategies to overcome hurdles in stem cell biology

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Anthony Atala, Robert Lanza, James A. Thomson and Robert M. Nerem	Principles of Regenerative Medicine	Academic Press	3rd	978-0-12-369410-2	1454
Robert Lanza, John Gearhart, Brigid Hogan, Douglas Melton, Roger Pedersen, E. Donnall Thomas, James Thomson and Sir Ian Wilmut	Essentials of Stem Cell Biology	Elsevier	2nd	978-0-12-374729-7	712

Clinical Trials

L	T	P	Total Credits
4	0	0	4

Course Objectives: This course aims to equip students with comprehensive knowledge and practical skills in Clinical Trials, covering essential topics such as study design, trial processes, quality control, and ethical considerations. Students will gain proficiency in understanding, implementing, and critically evaluating clinical trials, preparing them for roles in research, pharmaceutical industries, and regulatory bodies.

Course content and syllabus

	Teaching Hours
Unit I: Introduction to Biomedical Study design	**18 hrs**
Definition, scope & types of clinical trials, Study population, randomization process, blinding, sample size, recruitment, Epidemiology and observational data	
Unit II: Clinical trial process	**18 hrs**
Key components of clinical trials including sample size, Phase 0,1,2,3,4, multi-centric trials, Documentation, Audit, Inspection, Pharmacovigilance and drug safety, Clinical trial Registries, IRB, Informed consent, reporting and evaluation of data.	
Unit III: QC in Biomedical research	**18 hrs**
Introduction to Quality Assurance & QC, GLP & Accreditation, adverse effect reporting(SAE), withdrawal of clinical trial, Data Safety Monitoring Boards, Harmonization and Good Clinical Practices, Ethics in biomedical research	
Unit IV: Current scenario of Clinical trials and its management	**18 hrs**
Globalization of clinical trials, scenario in India, limitation of clinical trials, IT in clinical trials, Examples of successful clinical trials	

Course Learning Outcomes:

1. Examine the rationale for carrying out clinical trials
2. Analyze major ethical issues one must consider when planning a human-subjects study
3. Evaluate the process of Good Clinical Practice while conducting a clinical trial

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
David Machin Simon Day Sylvan Green	Textbook of Clinical Trials	Wiley India Pvt Ltd	3rd	9788126524945	784

P. Brouwers	Handbook of Clinical Trials	Garland Science	2nd	1901346293	388

BIF607: Version Control with Git

L	T	P	Total Credits
3	0	1	4

Course Objectives: The aim of this course is to teach students to apply the knowledge and the fundamentals of Version Control with Git.

Course Contents/syllabus:

	Teaching Hours
Unit I: Thinking in Versions and Git Basics	**13 hrs**
Introduction, The Git Workflow, Creating new repository, Adding and removing Files, Commit, Git Checkout, Git Revert and Reset	
Unit II: Git Branches	**14 hrs**
Git Branches Introduction, Usage scenarios, Starting a new Branch, Naming Branches, Editing Branches, Merging Branches, Merge Commits, Handling Merge Commits	
Unit III: Using Git Remotes	**14 hrs**
Git Hub, Remote, remote URLs, SSH (Secure Shell), HTTPS, Git Protocol, Remote Branches, Pushing Changes, Pulling Changes, Resolving merge conflicts, Push rejection, Tracking Branches, Git fetch, Existing Branch	
Unit IV: Version History	**13 hrs**
Git Log, Starting Point, Viewing a range of commits, Filtering the log, Commit IDs, Commit messages, Making commits, Comparing Commits, Tagging commits, git checkout	

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

1. Learn basic theory of Version control with Git
2. Learn about Git branches
3. Learn about Git Remote repositories
4. Learn to evaluate version histories with Git

List of Practicals

1. Record changes with Git
2. Compare changes and show commits with Git
3. Practical Branching and merging with Git
4. Create and then Resolve a conflict with Git
5. Find out when something broke/changed with git bisect

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
David Demaree	Git for Humans	A Book Apart	2016	978-1-9375573-9-3	141

Programme structure for B.Sc. (H) Bioinformatics - 4 years (8th Semester) with Research

Sr. No	Course Code	Course Title	Course Type	Credits					Credit Units
				L	T	P	FW	SW	
1		Omics Studies and Data Analysis	Core Course - Hons.	3	0	1	0	0	4
2	BIF607	Version Control with Git	Minor Course	4	0	0	0	0	4
3		Research Project/ Dissertation	Research Project/ Dissertation	0	0	12	0	0	12
		Total Credits							**20**

Omics Studies and Data Analysis

L	T	P	Total Credits
3	0	1	4

Course Objectives: The aim of this course is to teach students the scope of omics research and methods in genomics and transcriptomics.

Course Contents/syllabus:

	Teaching Hours
Unit I: Omics Data and Data format	**13 hrs**
Overview of multi-omics studies: concepts and applications, Introduction to genomics, transcriptomics, proteomics, and metabolomics, Integration of multi-omics data sets, Challenges and opportunities in multi-omics data analysis, Biological Data Sources: NCBI, ENSEMBL, TCGA, GenBank, Short Read Archive, UniProt. UCSC Genome Browser, FlyBase, RNA-central, Common data formats and conversion	
Unit II: Omics technology	**13 hrs**
Technologies for Genomics, proteomics, transcriptomics. Normalization techniques for transcriptomics, proteomics, and metabolomics data, integration of multi-omics data sets, , Sequence Ontology, Gene Ontology, Visualizing data, Sequencing instruments, Types of Sequencing instruments, Paired-end sequencings, Sequencing Data preparation, Sequencing coverage, Short Read Archive (SRA), Quality Control, adapter trimming	
Unit III: Sequence alignment and Data analysis	**14 hrs**
Proteomics data analysis, Sequence alignment, Generation of sequening alignment, alignment scores, percent identity, CIGAR string, Global and local alignments, BLAST, Short Read Alignment, bwa aligner, bowtie aligner, Multiple Sequence aligner, SAM/BAM format	
Unit IV: Genomic Variation and Data Visualization	**14 hrs**
Visualizing large scale genomic variations, Variation calling, Multi-sample variant calling, Variant Call Format (VCF), Variant annotation and effect prediction. RNA-Seq Analysis, Chip-seq Analysis, Sequence assembly, Whole genome assembly, Metagenomics: taxonomies, classifying 16s sequences, neonatal microbiome, Heatmaps, scatter plots, and volcano plots	

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

1. Comprehensive understanding of Omics data.
2. Learning Experimental and bio-informatic workflows in Omics data generation and analysis.
3. Learn the concepts of data analysis in proteomics.
4. Understand the concepts of RNA seq data analysis.

List of Practicals

1. To annotate genome of a prokaryotic organism.
2. To annotate genome of a eukaryotic organism.
3. To understand data type of transcriptomics, proteomics and metabolomics
4. Data cleaning and developing volcano plots
5. Data analysis of RNA-seq, ChIP-seq, and Proteome-MS

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Preeti Arivaradarajan and Gauri Misra	Omics Approaches, Technologies And Applications	Springer	2018	ISBN: 978-981-13-2925-8	

BIF607: Version Control with Git

L	T	P	Total Credits
3	0	1	4

Course Objectives: The aim of this course is to teach students to apply the knowledge and the fundamentals of Version Control with Git

Course Contents/syllabus:

	Teaching Hours
Unit I: Thinking in Versions and Git Basics	**13 hrs**
Introduction, The Git Workflow, Creating new repository, Adding and removing Files, Commit, Git Checkout, Git Revert and Reset	
Unit II: Git Branches	**14 hrs**
Git Branches Introduction, Usage scenarios, Starting a new Branch, Naming Branches, Editing Branches, Merging Branches, Merge Commits, Handling Merge Commits	
Unit III: Using Git Remotes	**14 hrs**
Git Hub, Remote, remote URLs, SSH (Secure Shell), HTTPS, Git Protocol, Remote Branches, Pushing Changes, Pulling Changes, Resolving merge conflicts, Push rejection, Tracking Branches, Git fetch, Existing Branch	
Unit IV: Version History	**13 hrs**
Git Log, Starting Point, Viewing a range of commits, Filtering the log, Commit IDs, Commit messages, Making commits, Comparing Commits, Tagging commits, git checkout	

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

1. Learn basic theory of Version control with Git
2. Learn about Git branches
3. Learn about Git Remote repositories
4. Learn to evaluate version histories with Git

List of Practicals

1. Record changes with Git
2. Compare changes and show commits with Git
3. Practical Branching and merging with Git
4. Create and then Resolve a conflict with Git
5. Find out when something broke/changed with git bisect

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
David Demaree	Git for Humans	A Book Apart	2016	978-1-9375573-9-3	141

Dissertation Work

L	T	P	Total Credits
0	**0**	**12**	**12**

Course content and syllabus

The students will undertake research work under the supervision of a faculty member.