Semester-Wise Programme structure for B.Sc. + M.Sc. Biochemistry (Integrated) (5 Years)										
Sr. No.	**Year 1**		**Year 2**		**Year 3**		**Year 4**		**Year 5**	
	Semester 1	**Semester 2**	**Semester 3**	**Semester 4**	**Semester 5**	**Semester 6**	**Semester 7**	**Semester 8**	**Semester 9**	**Semester 10**
1	Biomolecules [CU:4, L-3 P-1] {MCC}	Carbohydrate Biochemistry [CU:4,L-3 P-1] {MCC}	Biotechniques [CU:4,L-3 P-1] {MCC}	Membrane Biology & Bioenergetics [CU:6,L-4, P-2] {MCC}	Molecular Biology [CU:6,L-4, P-2] {MCC}	Gene Regulation [CU:6, L-4, P-2] {MCC}	Advanced Cell Biology [CU:4, L-4] {CCH}	Advanced Enzymology [CU:4,L-2] {CCH}	Advanced Bioinformatics [CU:4, L-4] {CCH}	Genome Engineering and Recombinant DNA Technology [CU:4,L-4] {CCH}
2	Basic Cell Biology [CU:4, L-3 P-1] {MCC}	Fundamentals of Genetics CU:4,L-3 P-1] {MCC}	Protein Biochemistry [CU:4,L-3 P-1] {MCC}	Amino Acid & Nucleic Acid Metabolism [CU:6,L-4, P-2] {MCC}	Lipid Biochemistry [CU:6,L-4, P-2] {MCC}	Physiological Biochemistry [CU:6, L-4, P-2] {MCC}	Cell Culture Technology [CU:4, L-3, P-1] {CCH}	Practicals in Biochemistry-II [CU:4, P-4] {CCH}	Nutritional Biochemistry [CU:4, L-4] {CCH}	Clinical Biochemistry [CU:4,L-4] {CCH}
3	Introduction To Microbial World CU:4,L-3 P-1] {MC}	General Microbiology [CU:4,L-3, P-1] {MC}	Enzymology CU:4,L-3 P-1] {MC}	Immunology [CU:4,L-4] {MC}‘	Endocrinology [CU:4 ,L-4] {MC}	Nutritional and Clinical Biochemistry [CU:4 ,L-4] {MC}	Practicals in Biochemistry-I [CU:4, P-4] {CCH}	Topics in Life Sciences [CU:4 ,L-4] {DSE}	Practicals in Biochemistry-III [CU:2, P-2] {CCH}	DSE [CU:4 ,L-4]
4	Fundamentals of Chemistry [CU:3, L-2, P-1] {MDC}	Fundamentals of physics [CU:3,L-2, P-1] {MDC}	Programming with R [CU:3,L-2,P-1] {MDC}	Recombinant DNA Technology [CU:4,L-3, P-1] {SEC}	Introductory Bioinformatics [CU:4 ,L-4] {MC}	Pharmacogenetics [CU:4 ,L-4] {MC}	Neurobiochemistry [CU:4, L-4] {DSE}	Clinical Trials [CU:4, L-2] {DSE}	Fundamentals of BioEntrepreneurship [CU:2, L-2] {CCH}	Dissertation -II [CU:12, P-12] {NTCC}
5	PL/HCP [CU:1, L-1] {AEC}	PL/HCP [CU:1,L-1] {AEC}	Communication skills I [CU:2,L	Communication skills II [CU:2,L	Environmental Biology [CU:2	Plant Biochemistry [CU:2	Applications of Biochemistry	Synthetic and Systems Biology	Biostatistics [CU:2, L-2] {CCH}	

			-2] {AEC}	-2] {AEC}	,L-2] {MC}	,L-2] {MC}	to Biotechnology [CU:4, L-4] {DSE}	[CU:4, L-2] {DSE}		
6	FBL [CU:1, L-1] {AEC}	FBL [CU:1,L-1] AEC}	Protein Science [CU:3,L-3] {SEC}	-	-	-	Intellectual Property Rights, Biosafety and Bioethics [CU:4, L-4] {MC}		Seminar [CU:2, P-2] {NTCC}	
7	Mathematics for Biosciences [CU:3, L-3] {SEC}	SEC2 - Statistics for Biosciences [CU:2,L-2] {SEC}	-	-	-	-			Dissertation -I [CU:8, P-8] {NTCC}	
8	EVS-I [CU:2, L-2] {VAC}	EVS-2 [CU:2,L-2] {VAC}	-	-	-	-				
9	Behavioural Sciences 1 [CU:1, L-1] {VAC}	Behavioural Sciences 2 [CU:1,L-1] {VAC}	-	-	-	-				
Credits	**23**	**23**	**20**	**22**	**22**	**22**	**24**	**20**	**24**	**24**
Total Credit: Credit Layout as per Curriculum and Credit Framework Guidelines - UGC 2022										**224**

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**

Note:	*(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).*

Programme structure for Integrated B.Sc. + M.Sc. (H) Biochemistry- 5 years (1st Semester)

Sr. No	Course Code	Course Title	Course Type	Credit Units			
				L	T	PS	Total Credits
1	BCH101	Basic Cell Biology	Major Core Courses	3	0	1	4
2	BCH102	Biomolecules	Major Core Courses	3	0	1	4
3	MBO104	Introduction to Microbial World	Minor Courses	3	0	1	4
4		Fundamentals of Chemistry	Multi-disciplinary coiurse	2	0	1	3
5	MAT113	Mathematics for Biosciences	Skill Enhancement Course	3	0	0	3
6	ENV101	Environment Studies -I	Value Added Course	2	0	0	2
7	PSY101	Behavoiral Studies-I	Value Added Course	1	0	0	1
8	FOL101/FOL 102	Foreign Language	Ability Enhancement course	1	0	0	1
9	INL101/INL1 02	Punjabi Language/Punjab History & Culture	Ability Enhancement course	1	0	0	1
		Total Credits					**23**

BCH101: Basic Cell Biology

L	T	P	Total Credits
3	0	1	4

Course Objectives: To develop basic understanding of cell biology

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

List of Experiments -with basic instructions

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

Course Learning Outcomes:

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

Text/Reference Books

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

BCH102: Biomolecules

L	T	P	Total Credits
3	0	1	4

Course content and syllabus

	Teaching Hours
Unit I: Water and its Properties	**14 hrs**
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 hrs**
Carbohydrates: Structure, properties and functions of: Monosaccharides (glucose,fructose, ribose and others, D-and L- sugars, reducing and non-reducing sugars), Disaccharides (maltose, sucrose and lactose) and polysaccharides (Starch and glycogen)	
Unit III: Lipids and Nucleic Acids	**13 hrs**
Lipids: Classification, Structure and function. **Conformation of Nucleic acids:** Structural characteristics of A, B and Z-DNA. Significance of DNA and RNA.	
Unit IV: Proteins	**14 hrs**
Proteins: Physico-chemical and structural properties of amino acids, non-protein andrare amino acids. **Protein Structure:** Primary, Secondary, Tertiary, Quaternary, structure of proteins,Forces stabilizing Primary, Secondary and Tertiary protein structures**.** **Enzymes:** structure & function. **Forces that stabilize biomolecules:** electrostatic and van der Waal's interaction, hydrogen bonding. Interactions with solvents, Hydrophobic effect.	

List of Practicals with basic instructions

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

Course Learning Outcomes:

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

Text/Reference Books

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

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 types of 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, Selected phyla 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 andassessment for sterility.
5.

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, 9780070492581 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 andCase CL	Microbiology:An Introduction. 9th edition	Pearson Education	2008	0805347917	912
Madigan MT, Martinko JM, Dunlap PV andClark DP.	Brock Biologyof Microorganisms	Pearson InternationalEdition	2014	9781292018317	1030
James T. Staley Robert P. Gunsalus, Stephen lory,Jerome J. Perry	MICROBIAL LIFE	Sinauer Associates;2nd edition	2007	0878936858, 9780878936854	1066

MAT113: Mathematics for Biosciences

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L	T	P	TOTAL CREDIT UNITS
3	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

L	T	P	TOTAL CREDIT UNITS
2	0	0	2

Course Contents/syllabus:

	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	--

FOL101 (Introduction to French Culture & Language)

L	T	P	Total Credits
1	0	0	1

Course Objectives- The course aims to provide students with a foundational understanding of French culture and language, including key aspects of French society, history, and customs. Through linguistic and cultural immersion, students will develop basic communication skills in French and gain insights into the cultural nuances of the Francophone world.

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 objectives- 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.

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 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

PSY101 (Behavioural Science: Understanding Self for Effectiveness)

L	T	P	Total Credits
1	0	0	1

Course Contents/syllabus:

	Teaching time
Unit I: Self: Core Competency	**4.5 hrs**
Understanding of Self, Components of Self – Self identity , Self concept, Self confidence , Self image , BIG5 Factors	
Unit II: Techniques of Self Awareness	**4.5 hrs**
Exploration through Johari Window, Mapping the key characteristics of self, Framing acharter for self Stages – self awareness, self acceptance and self realization	
Unit III: Self Esteem & Effectiveness	**4.5 hrs**
Meaning, Importance, Components of self esteem, High and low self esteem, Measuring your self esteem	
Unit IV: Building Positive Attitude and Emotional Competence	**4.5 hrs**
Meaning and nature of attitude, Components and Types of attitude ,Importance and relevance of attitude Emotional Intelligence – Meaning, components, Importance andRelevance 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 perceptionof 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	9788126580027
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	Bantam Books	2007	9780553095036
Goleman, Daniel	ing with E.I	Bantam Books	1998	9780553104622

INL101 (Punjabi)

L	T	P	Total Credits
1	0	0	1

Course content and syllabus

	Teaching Hours
Unit I:	**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:	**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:	**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:	**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**	-	-
ਜੋਗਿੰਦਰ ਸਿੰਘ ਪੁਆਰ ਅਤੇ ਹੋਰ	**ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਦਾ ਵਿਆਕਰਨ**	ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਅਕਾਦਮੀ ਜਲੰਧਰ	**2003**	-	-

	(ਭਾਗ 1,2,3),				
ਸੁਖਵਿੰਦਰ ਸਿੰਘ ਸੰਘਾ	**ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਵਿਗਿਆਨ**	ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਅਕਾਦਮੀ ਜਲੰਧਰ	**2010**	**--**	**-**
ਅਗਨੀਹੋਤਰੀ,ਵੇਦ	ਪਰਿਚਾਇਕ ਭਾਸ਼ਾ ਵਿਗਿਆਨ	ਦੀਪਕ ਪਬਲਿਸ਼ਰਜ਼ ਜਲੰਧਰ	**1981**		

INL102 (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**
7. Evolution of Sikhism: teaching of Guru Nanak; Institutional Development-Manji,Masand, Sangat and Pangat 8. Transformation of Sikhism: Martyrdom of Guru Arjan; New policy of Guru Hargobind,martyrdom of Guru Tegh Bahadur. Institution of Khalsa: New baptism; significance	
Unit IV:	**4.5 hrs**
10. Changes in Society in 18th century: social unrest; emergence of misls and other institutions - rakhi, gurmata, dal khalsa. Society and Culture under Maharaja Ranjit Singh. 12. MAP (of undivided physical geographical map of Punjab): Major Historical Places: Harappa, Mohenjodaro, Sanghol, Ropar, Lahore, Amritsar, Kiratpur, Anandpur Sahib, Tarn Taran, Machhiwara, Goindwal, Khadur Sahib.	

Course Learning Outcomes:

- Understand the history of various cultures in Punjab.
- Interpret the importance of Maurayan,Gupta and Bhakti influences on PunjabApply 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	-

Fundamentals of Chemistry

L	T	P	TOTAL CREDITS
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

	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	9 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	----

Programme structure for Integrated B.Sc. + M.Sc. (H) Biochemistry- 5 years (2nd Semester)

Sr. No	Course Code	Course Title	Course Type	Credit Units			
				L	T	PS	Total credits
1	BCH105	Carbohydrate Biochemistry	Major Core Course	3	0	1	4
2	HGM101	Fundamentals of genetics	Major Core Course	3	0	1	4
3	MBO102	General Microbiology	Minor Course	3	0	1	4
4	PHY213	Fundamentals of Physics	Mult-disciplinary course	2	0	1	3
5	ENV106	Environmental Studies-II	Value Added Course	2	0	0	2
6	PSY106	Behavioural Science - II	Value Added Course	1	0	0	1
7	MAT114	Statistics for Biosciences	Skill Enhancement Course	3	0	0	3
8	FOL103/ FOL104	Foreign Business Language –II	Value Added Course	1	0	0	1
9	INL104/ INL106	Punjabi Language/ History and Culture of Punjab	Ability Enhancement Course	1	0	0	1
		Total Credits					**23**

BCH105-Carbohydrate Biochemistry

L	T	P	TOTAL CREDITS
3	0	1	4

Course Objectives: To understand the structure, catabolism & anabolism of carbohydrates; regulation & malfunction of the pathways associated with carbohydrate metabolism

Course contents-

	Teaching Hrs
Unit I:Carbohydrates structure and functions	**9 hrs**
Various classes of carbohydrates; Glycosaminoglycans; Bacterial polysaccharides, Glycoproteins (O- and N-glycoproteins). Role of carbohydrates in molecular targeting & cell recognition. Physical and chemical methods for determining the structure of polysaccharides	
Unit II: Carbohydrate Metabolism	**18 hrs**
Introduction to metabolism. Important metabolic principles. Methods used for studying metabolism. Sources of carbohydrates in food, digestion and absorption of carbohydrates in human body. Metabolic pathways for the degradation of carbohydrates: Catabolism of glucose, fructose and galactose. Fermentation, Pasteur effect, Tricarboxylic acid cycle (anaplerotic and cataplerotic reactions), Glyoxylate cycle and its significance	
Unit III: Biosynthetic pathways	**9 hrs**
HMP pathway: Importance of generation of NADPH, Glutathione and red cell membrane integrity, glycogenolysis. Major pathways for biosynthesis of carbohydrates: gluconeogenesis and glycogenesis, glycogen storage diseases. Biosynthesis of disaccharides (sucrose. lactose), amino sugars, cell wall polymers and mucopolysaccharides.	
Unit IV: Regulation of metabolic pathways	**18 hrs**
Regulation of glycolysis, gluconeogenesis, TCA, HMP pathway and glycogen metabolism. Shuttle systems for moving reducing equivalents. Various mechanisms of metabolic regulations. Kinetic factors. Feed back inhibition and feed forward stimulation. Reversible and irreversible covalent modification of regulatory enzymes. Monocyclic cascade systems. Cyclic AMP (cAMP) and Ca^{2+} ions as bioregulators. Levels of glucose in blood and its regulation. Glucose tolerance test: oral and intravenous. Procedure and interpretation. Glycosuria, glycosylated hemoglobin Defects of regulation of carbohydrate metabolism metabolic characteristics and symptoms.	

List of Experiments -with basic instructions

1. Estimation of blood glucose.
2. Hydrolysis of starch/glycogen by α-amylase.
3. Extraction and assay of glycogen from liver/muscle tissue.
4. Estimation of Lactose in milk by DNS method.
5. Qualitative and quantitative tests of sugar in urine.
6. To assay α-amylase activity in serum
7. Estimation of pyruvate/ LDH activity.
8. Determination of the activities of the Kreb's cycle dehydrogenases in the liver.

Course Learning Outcomes:

- Understand carbohydrates' structure and functions in biological systems
- Understanding anabolic and catabolic pathways of carbohydrate metabolism
- Delineation of central metabolic pathways
- Understanding the key components and mechanisms for the regulation of central metabolic pathways

Text/Reference Books

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
David L. Nelson; Michael M. Cox	Lehninger: Principles of Biochemistry	8th ed. W.H. Freeman;	2021	978-1319228002	1248
Donald, V. and Judith G.V.	Biochemistry	4th ed. Wiley	2010	978-0470570951	1428
Lubert Stryer	Biochemistry	9th ed. W.F. Freeman and Co	2019	978-1319114671	1296
Hiram Gilbert	Basic Concepts in Biochemistry: A Student's Survival Guide	McGraw-Hill Medical	1999	978-0071356572	311

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.

Course contents-

	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**
I ntroduction 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	800
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	694
Tamarin R.H	Principles of Genetics	Tata McGrawHill, New York	2012	0072325305	862

PHY213: Fundamentals of Physics

L	T	P	TOTAL CREDIT UNITS
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 Contents/Syllabus:

	Total Hrs
Unit I: Interference	9 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	9 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	9 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	9 hrs
Introduction of Lasers, Induced Absorption, Spontaneous and Stimulated Emission, Einstein Coefficients, Population inversion, Fundamental of Lasers, Types of Pumpin Concept of Three and Four Level Lasers, Construction and Working Lasers	

List of Experiments

1. To determine the wavelength of sodium light by Newtons's rings method
2. To determine the angle of prism with the help of a spectrometer
3. To determine the dispersive power of the material of prism with the help of a spectrometer
4. To determine the specific rotation of sugar by Bi-quartz or Laurent half shade polarimeter
5. To determine the width of a narrow slit using diffraction phenomena
6. To determine the wavelength of a laser using diffraction grating
7. To determine the wavelength of sodium source using Michelson's interferometer
8. To determine the attenuation, numerical aperture and acceptance angle of the given optical fiber

Course Learning Outcomes:

1. Understand the fundamental principles underlying wave phenomena related to interference.

2. Understanding the phenomenon of diffraction and its effects
3. Understand importance and working of polarization technique, linear and circular polarization and applications
4. Understanding on the properties of laser and construction with its applications in various fields

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	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	

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

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 to improve the environmental conditions in our daily life.
- Able to imbibe practical approach and solution to solve environmental concerns.

Text / Reference Books:

Author	Title	Publisher	Ed/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

PSY106: 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 Social Interaction Interaction of Socialization Process Contributions to Society and Nation Sense of pride and patriotism Importance of discipline and hard work Integrity and accountability	
Unit-4- Human Rights, Values and Ethics	**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.	

List of Professional Skill Development Activities (PSDA):

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

Course Learning Outcomes: On completion of the course:

- To recognize individual differences
- To 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 &	Introduction to Sociology 3e	Openstax	2015	9781711493978	458
Kathleen Holmes					
Daksh Tyagi	"A Nation of Idiots"	Every Protest	2019	978-8194275015	350

FOL103: French Grammar

L	T	P	Total Credits
1	0	0	1

Course content and syllabus

	Teaching Hours
Unit I: My family and my house	**4.5 hrs**
Talk about your family members Usage of possessive adjectives Describe your house/apartment Prepositions of location Negation	
Unit II: Lifestyle	**4.5 hrs**
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**
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**
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 wayon 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:

Course learning outcomes-

- 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 informulating 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.

Course learning outcomes-

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

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

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

Author	**Title**	**Publisher**	**Ed/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

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:

- Understand modern Punjabi Stories.
- Interpret the importance of letter writing
- Analyze the Punjabi language structure and grammar.

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, ਚੰਡੀਗੜ੍ਹ	**1995**	**-**	**-**
ਜੋਗਿੰਦਰ ਸਿੰਘ ਪੁਆਰ ਅਤੇ ਹੋਰ	**ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਦਾ ਵਿਆਕਰਨ (ਭਾਗ 1,2,3),**	ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਅਕਾਦਮੀ ਜਲੰਧਰ	**2003**	**-**	**-**
ਸੁਖਵਿੰਦਰ ਸਿੰਘ ਸੰਘਾ	**ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਵਿਗਿਆਨ**	ਪੰਜਾਬੀ ਭਾਸ਼ਾ ਅਕਾਦਮੀ ਜਲੰਧਰ	**2010**	**--**	**-**

ਅਗਨੀਹੋਤਰੀ,ਵੇਦ	ਪਰਿਚਾਇਕ ਭਾਸ਼ਾ ਵਿਗਿਆਨ	ਦੀਪਕ ਪਬਲਿਸ਼ਰਜ਼ ਜਲੰਧਰ	**1981**	**-**	**-**

INL106: History and Culture of Punjab

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

Course Contents/syllabus:

	Weightage
Unit I:	**4.5 H**
Introduction of Colonial Rule in Punjab: Annexation of Punjab; Board of Administration. Western Education: Growth of Education and rise of middle classes. Agrarian Development: Commercialization of agriculture; canalization and colonization.	
Unit II:	**4.5 H**
Early Socio Religious Reform: Christian Missionaries; Namdharis; Nirankaris. Socio Religious Reform Movements: activities of Arya Samaj; Singh sabhas; Ahmadiyas; Ad Dharam Movement. Development of Press & literature: growth of print technology; development in literature	
Unit III:	**4.5 H**
Emergence of Political Consciousness: Gadar Movement; Jallianwala Bagh Massacre. Gurudwara Reform Movement; major Morchas; Activities of Babbar Akalis. 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	---	---

Programme structure for Integrated B.Sc. + M.Sc. (H) Biochemistry- 5 years (3rd Semester)

Sr. No	Course Code	Course Title	Course Type	Credit Units			
				L	T	PS	Total credits
1	BTY201	Biotechniques	Major Core Course	3	0	1	4
2	BCH201	Enzymology	Minor Course	3	0	1	4
3		Protein Biochemistry	Major Core Course	3	0	1	4
4	BTY202	Protein Science	Skill Enhancement Course	3	0	0	3
5		Programming with R	Skill Enhancement Course	2	0	1	3
6	ENG104	Communication Skills -I	Ability Enhancement Coiurse	2	0	0	2
		Total Credits					**20**

BTY201-Biotechniques

L	T	P	Total Credits
3	0	1	4

Objective: This course will provide students with the understanding of various analytical techniques usedin 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

Protein Biochemistry

L	T	P	TOTAL CREDIT UNITS
3	0	1	4

	Teaching Hours
Unit I: Proteins	**14 hrs**
Proteins: Non-covalent interactions stabilizing protein structure. Levinthal paradox, Protein folding: free energy tunnel theory, Molecular chaperon in protein folding. Native proteins and their conformation. Protein misfolding: Prions disease and other misfolding disease, Behaviour of proteins in solutions. Salting in & salting out of proteins. Denaturation of proteins. Purification of proteins and criteria of protein purity. Protein cleavage using chemicals and enzymes.	
Unit II: Specialized proteins	**13 hrs**
Structure and biological functions of globular proteins (hemoglobin, types of Hb, myoglobin) and fibrous proteins (collagen, keratin and silk fibroin), sickle cell hemoglobin. Conjugated proteins. Lectins and their biological functions. Metalloproteins, immunoglobullins, glycoproteins.	
Unit III: Overview of Amino Acid Metabolism	**14 hrs**
Nitrogen cycle, incorporation of ammonia into biomolecules. Digestion and absorption of dietary proteins. Protein calorie malnutrition - Kwashiorkar and Marasmus. Nitrogen balance, glucose-alanine cycle, Comparative Biochemistry of Nitrogen excretion. Urea cycle and inherited defects of the urea cycle. General reactions of amino acids: transamination, the role of pyridoxal phosphate, SGOT, and SGPT and their clinical significance. Deamination and decarboxylation reactions.	
Unit IV: Proteins	**13 hrs**
Glucogenic and ketogenic amino acids. Catabolism of Essential amino acids. Metabolism of one carbon unit (tetrahydrofolate cofactors), Catabolism of Essential amino acids. Disorders of amino acids metabolism, phenylketonuria, alkaptonuria, maple syrup urine disease, methylmalonic academia (MMA), homocystinuria and Hartnup's disease	

List of Practicals with basic instructions

2. Absorption spectra of protein-BSA, nucleic acids- Calf thymus DNA and RNA.
3. Paper chromatography of amino acids.
4. Assay of serum transaminases- SGOT and SGPT.
5. Estimation of proteins by biuret method.
6. Estimation of proteins by Lowry's method.
7. Estimation of Serum total proteins and albumin-globulin Ratio.
8. Estimation of serum urea.
9. Protein estimation by Bradford method.

Course Learning Outcomes:

- Understand the structure of proteins their physical and chemical properties, estimation separation, and estimations in biological samples

- Learning about advanced protein structures, functions, and their roles in various biological processes and diseases.
- Enhanced learning on nitrogen metabolism, protein digestion, related clinical implications, and biochemical pathways involving amino acid
- To understand amino acid metabolism pathways and revelation of the genetic and biochemical basis of related disorders.

Text/Reference Books

Author	Title	Publisher	Ed/year	ISBN No	Pages
Wilson K., Walker J.	Principle and Techniques of Biochemistry and Molecular Biology	Cambridge University Press	6th edition /2006	978-0521178747	744
Plummer, David	An Introduction to Practical Biochemistry	Tata Mc GrawHills	3rd edition /2017	978-0070994874	250
Boyer, Rodney F	Concepts in biochemistry	John Wiley & Sons	2002	9780470003794	626
Donald, V. and Judith G.V.,	Biochemistry	4th ed. Wiley	2010	978-0470570951	1428
Lubert Stryer	Biochemistry.	9th ed. W.F. Freeman and Co	2019	978-1319114671	1296

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 catalysisFactors affecting the rate of chemical reactions, collision theory, activation energy and transition state theory, catalysis, reaction rates and thermodynamics of reaction. Catalyticpower 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

BIF: Programming with R

L	T	P	Total Credits
3	0	0	3

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

Course content and 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	**14 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	**13 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	

ENG (104): Introduction to Communication Skills

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	444
Jeff Butterfield	*Soft Skills for Everyone*	Cengage Learning	2017	9789353501051	628

Programme structure for Integrated B.Sc. + M.Sc. (H) Biochemistry- 5 years (4th Semester)

Sr. No	Course Code	Course Title	Course Type	Credit Units			
				L	T	PS	Total credits
1	IMM202	Immunology	Minor Course	4	0	0	4
2		Membrane Biology and Bioenergetics	Major Core Course	4	0	2	6
3		Amino Acid & Nucleic Acid Metabolism	Major Core Course	4	0	2	6
4	BTY207	Recombinant DNA Technology	Skill Enhancement Course	3	0	1	4
5		Communication Skills -II	Ability Enhancement Course	2	0	0	2
		Total Credits					**22**

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

Amino Acid & Nucleic Acid Metabolism

L	T	P	TOTAL CREDIT UNITS
4	0	2	6

Course objectives: The course aims to provide a comprehensive understanding of amino acid and nucleic acid metabolism, elucidating the biosynthetic pathways and regulatory mechanisms involved. Students will explore the diverse roles of these molecules in cellular processes and organismal physiology, including their significance in energy metabolism, genetic information transfer, and cellular signaling.

Course content:

	Teaching Hours
Unit I: Biosynthesis of amino acids	**18 hrs**
Biosynthesis of non-essential and essential amino acids (Except aromatic amino acids). Regulation of amino acid biosynthesis	
Unit II: Biosynthesis of aromatic amino acids	**18 hrs**
Biosynthesis of aromatic amino acids. Biosynthesis and physiological roles of creatine and creatinine, Polyamines (putresine, spermine, spermidine), catecholamines (dopamine, epinephrine, norepinephrine) and neurotransmitters (serotonin, GABA), melanin, NAD+ and Auxin	
Unit III: Amino acid derivatives: biosynthesis and functions	**18 hrs**
Porphyrins: classification of porphyrins. Important porphyrins occurring in nature. Bile pigments-chemical nature and their physiological significance. Biosynthesis of heme. Metabolic defects associated with heme biosynthesis. Heme catabolism and various types of jaundices Nucleic acids: structure, supercoiled DNA, Viral DNA, plasmids, mi RNA and Sn RNA, Nucleoproteins	
Unit IV: Protein degradative pathways	**18 hrs**
Digestion of nucleic acids, degradation of purine and pyrimidine nucleotides. Inhibitors of nucleotide metabolism. Disorders of purine and pyrimidine metabolism – Lesch-Nyhan syndrome, Gout, SCID, De novo and salvage biosynthesis of purine & pyrimidine nucleotides & regulation, biosynthesis of deoxy ribonucleotides, Mechanism of action of anti-cancerous drugs affecting nucleic acid metabolism, Integration and regulation of mammalian metabolism.	

List of Practicals with basic instructions (Total = 72 hrs)

1. Estimation of serum creatinine.

2. Isolation of egg albumin from egg white.
3. Estimation of serum uric acid.
4. Estimation of DNA by diphenylamine method.
5. Estimation of RNA by orcinol method
6. Estimation of bilirubin in serum
7. Isolation of RNA and DNA from tissue/culture.

Course Learning Outcomes: On the successful completion of this course

- Students will acquire analytical skills related to nitrogenous compound analysis
- Clinical significance of abnormalities in protein-related pathways,
- Students will develop analytical skills in studying protein-derived compounds, enhancing their ability to diagnose and research related disorders.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
G. C. Barrett, D. T. Elmore,	Amino Acids and Peptides	Oxford Brookes University	1998	9781139163828	224
Michael Murphy, Rajeev Srivastava, Kevin Deans	Clinical Biochemistry : An Illustrated Color Text	Academic Press	7th Edition, 2023	9780323881661	200
Donald, V. and Judith G.V.	Biochemistry	4th ed. Wiley	2010	978-0470570951	1428
Lubert Stryer	Biochemistry	9th ed. W.F. Freeman and Co.	2019	978-1319114671	1296

Membrane Biology and Bioenergetics

L	T	P	TOTAL CREDIT UNITS
4	0	2	6

Objective: To make students aware of the structural and functional aspects of membranes. Highlighting the significance of their compositional heterogeneity & to various cell functions

	Teaching Hours
Unit I: Biological membrane	**18 hrs**
An integrated discipline in life Sciences historical developments. Membrane structure and organization: Genesis of different biological models of membranes structure and raft concept. Organization of proteins and lipids in the membranes. Protein- lipid interactions Fluid mosaic model of membrane structure, its merits and demerits. Constituents of biological membranes in prokaryotes and eukaryotes. Asymmetric nature of biomembranes and its significance. Structure of RBC membrane.	
Unit II: Membrane dynamics and transport system	**18 hrs**
Physical properties of membrane lipids, membrane fluidity, phase transitions, cytological biochemical probes and methods to study membrane fluidity. Membrane transport: Types of membrane transport, passive diffusion, facilitative diffusion, carrier mediated active transport group transfer of sugars in bacteria. Role of Na, K- ATPase. Ca- ATPase & H^+-ATPase. Ionophores and siderophores, structure	
Unit III: characterization, biosynthesis and significance	**18 hrs**
Membrane analysis: Isolation and characterization of cell membranes, criteria of membrane purity. Extraction of membrane lipids and proteins. Solubilization of membranes and their reconstitution. Insertion of components, labeling of membrane probes and determination of transbilayer distribution of membrane components. Liposomes: Unilamelar and multilamelar vesicles. Methods of their preparation, characterization and their applications in targeting drugs and gene therapy. Biogenesis and turnover of membranes: Synthesis of membrane components and their trafficking, signal hypothesis, coated vesicles. Regulation and coordination of membrane component synthesis. Membrane disorders: Erythrocyte deformities, transport disorders. Disorders of membrane lipids	
Unit IV: Fundamentals of **bioenergetics**	**18 hrs**
Concepts of bioenergetics, principles of thermodynamics & their application in Biochemistry, concept of free energy, relation between equilibrium constant & standard free energy change, biological standard state and standard free energy change in coupled reactions, biological redox reactions, redox potential, its relation with the free energy change (including derivation & numericals). High energy phosphate compounds, phosphate group transfer potential.	

List of Practicals with basic instructions (Total = 72 hrs)

1. Cell fractionation
2. Isolation of mitochondria
3. Isolation of chloroplasts from spinach leaves
4. Identifying fractions with marker enzymes
5. Extraction and estimation of lipids from membrane
6. Effect of inhibitors and uncouplers on ATP Synthesis
7. RBC ghost cell preparation and separation of proteins by SDS-PAGE
8. Estimation of phospholipids
9. Preparation of liposomes
10. Estimation of cholesterol
11. Effect of detergents and other membrane-active substances on erythrocytes.

Course Learning Outcomes:

- Understanding of membrane structure, composition, and functions, and membrane-associated processes.
- Understanding cellular processes such as signaling, trafficking, and homeostasis.
- Enhancing the understanding of membrane-related diseases and therapies.
- Understanding the concept of membrane biophysics.

Text/Reference Book

Author	Title	Publisher	Ed/year	ISBN No	Pages
Jain MK.	Introduction to Biological membranes	John Wiley and Sons Ltd	1988	9780471844716	423
Vance DE & Vance JE,	Biochemistry of Lipids, Lipoproteins and Membranes	Benzamin Cummings	2002	9780444511386	648
RB Gennis Biomembranes	Biomembranes: Molecular Structure and Function	Springer Verlag	2013	978-1-4757-2065-5	533
Gerald Karp, Janet Iwasa, Wallace Marshall	Karp's Cell and Molecular Biology	9th ed. Wiley-Lis New York,	2020	978-1119598244	944
Harvey Lodish; Arnold Berk; Chris A. Kaiser; Monty Krieger; Anthony Bretscher; Hidde Ploegh; Kelsey C. Martin; Michael Yaffe; Angelika Amon	Molecular Cell biology of cell	9th ed. WH Freeman	2021	9781319208523	1264

BTY207:Recombinant DNA Technology

L	T	P	Total Credits
3	0	1	4

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

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); Vectors for yeast and other fungi, Yeast artificial chromosomes (YACs), Cloning vectors for higher plants, Tobacco Mosaic Virus (TMV); Cloning vectors for animals. Problem of Plasmid incompatibility, The problem of selection, Direct selection, Identification of a clone from a gene library, Methods for clone identification.	
Unit III: Cloning a Specific Gene	**18 hrs**
Transduction, conjugation and transfection, Types of plasmids, Recombinant Bacterial strains for bioremediation; online servers/software for DNA and protein analysis: Acquiring DNA sequence encoding the protein of interest (for example GFP) from online database like PUBMED and PDB. Analysis of DNA sequence for presence of internal restriction digestion sites etc.	
Unit IV: Advanced Cloning Techniques	**9 hrs**
Homologous recombination, Molecular mechanism of RecBCD, RecA, RuvA-B, Holliday Model; Non-homologous End Joining (NHEJ) versus Homologous DNA recombination; Positive and negative selection, Zinc finger nucleases (ZFN), Transcription activator-like effector nucleases (TALENs), Discovery of adaptive immunity, The CRISPR-Cas9 (clustered regularly interspaced short palindromic repeats) system, Methods to create gene-knock out animal model systems. Cre-LoxP recombination system	

List of Experiments

1. Acquiring DNA sequence encoding the protein of interest (for example GFP) from online database likeGenbank 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 containingappropriate restriction digestion sites, affinity tags (penta-His etc.).
3. PCR amplification of the DNA segment of interest from a suitable source, purification of the PCRproduct.
4. Restriction digestion, and subsequent ligation into the suitable bacterial expression vector (alsocontaining 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 method.

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

Professional Etiquette and Presentation Skills

L	T	P	TOTAL CREDIT UNITS
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

Programme structure for Integrated B.Sc. + M.Sc. (H) Biochemistry- 5 years (5th Semester)

Sr. No	Course Code	Course Title	Course Type	Credit Units			
				L	T	PS	Total credits
1	HGM301	Molecular Biology	Major Core Course	4	0	2	6
2		Lipid Biochemistry	Major Core Course	4	0	2	6
3.		Endocrinology	Major Core Course	4	0	0	4
4.	BIF301	Intoductory Bioinformatics	Minor Course	4	0	0	4
5.		Environmental Biology	Minor Course	2	0	0	2
		Total Credits					**22**

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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, Wobblehypothesis 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 andfunction. Protein targeting: Signal sequence and targeting of 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 inmolecular 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 ofthe Gene	Pearson Education	7th Ed	978-9332585478	912
Tropp, B.E.	Molecular Biology Genes to Proteins	Jones an d Bartlett	4th Ed	978-93-80853-49-9	1096

Lipid Biochemistry

L	T	P	TOTAL CREDIT UNITS
4	0	2	6

Course Objective: To learn pathways of lipid metabolism & their derivatives

Course curriculum:

	Teaching Hours
Unit I: Lipid catabolism	**18 hrs**
Digestion and absorption of lipids. Catabolism of saturated and unsaturated fatty acids (β-oxidation) and branched chain fatty acids (α-oxidation). ω-oxidation, peroxisomal degradation of fatty acids, Ketone body formation and their utilization. Degradation of triacylglycerols and phospholipids. Regulation of fatty acid oxidation and triacylglycerol hydrolysis.	
Unit II: Lipid biosynthesis	**18 hrs**
Biosynthesis of saturated and unsaturated fatty acids, their elongation and regulation. Biosynthesis & functions of triglycerides, phospholipids, ether lipids, spingolipids, glycolipids, gangliosides. Respiratory distress syndrome Metabolism of eicosanoids (synthesis, inactivation and biological importance). Biosynthesis of cholesterol. Regulation of cholesterol synthesis	
Unit III: Terpenes and steroids and fat-soluble vitamins	**18 hrs**
Terpenes and steroids: Structure, classes and functions of terpenes and terpenoids. Basic structure of steroids; animal sterols, Phytosterols, sterols of yeast & fungi (Mycosterols). Color reactions of sterols. Biosynthesis of Dolichol, Steroidal hormones, Bile acids. Fat soluble vitamins-structures and biological functions of Vitamin A, D, E and K.	
Unit IV: Lipoproteins, liposomes, structure, functions, metabolic pathways Integration.	**18 hrs**
Structure metabolism and functions of lipoproteins. Relationship between cholesterol and atherosclerosis. Structure and applications of liposomes, Biomedical consequences of lipid metabolism. Disorders of metabolism of complex lipids. Integration of metabolic pathways.	

List of Practicals with basic instructions (Total = 72 hrs)

1. Estimation of total lipids in serum by Vanilin method.
2. Estimation of inorganic phosphate and phospholipids.
3. Estimation of cholesterol in serum.
4. Estimation of free fatty acids.

5. Estimation of Vitamin D.
6. Separation of lipids by thin layer chromatography on silica gel plates.
7. Qualitative and quantitative analysis of ketone bodies.
8. Estimation of Vitamin A.

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

- Understanding of the biochemical processes involving lipids, including their synthesis, breakdown, and the roles of various lipid derivatives.
- Students will be able to comprehend the molecular basis of lipid-related diseases, lipid signaling pathways, and the development of therapeutic interventions.
- Students will acquire skills in lipid analysis techniques and their applications in research and clinical settings,

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
Donna Thompson	Handbook of Lipid Metabolism	8th ed. W.H. Freeman;	2015	978-1632394019	292
Neale D. Ridgway and Roger S. McLeod	Download Biochemistry of Lipids, Lipoproteins and Membranes	Academic Press	2010	978-0-444-63438-2	599
Antonio Blanco Gustavo Blanco	Medical Biochemistry	Academic Press	2017	978-0-12-803550-4	805

BIF301: Introductory Bioinformatics

L	T	P	Total Credits
4	0	0	0

Course Ojbectives: Equipping students with foundational knowledge in bioinformatics, enabling them to analyze biological data, navigate bioinformatics tools and databases, and understand the interdisciplinary aspects of this field, thereby preparing them for further studies or careers in bioinformatics and related areas.

Course content and syllabus

	Teaching Hours
Unit I: Introduction to Bioinformatics and Biological Databases	**18 hrs**
Introduction to Bioinformatics. Historical background. Scope of bioinformatics in modern research Introduction to biological databases - primary, secondary and composite databases, NCBI, PubMed, nucleic acid databases (GenBank, EMBL, DDBJ, NDB), protein databases (UniProt-Swiss-Prot, PDB), Structure visualization softwares (RasMol, PDBviewer), file formats (FASTA, ASN Genbank).	
Unit II: Sequence alignment	**18 hrs**
Concepts of sequence similarity, identity and homology. Alignment – local and global alignment, pairwise and multiple sequence alignments, amino acid substitution matrices (PAM and BLOSUM). Programs for pairwise and multiple sequence alignment (CLUSTALW), Introduction to database search using BLAST.	
Unit III: Protein Structure Prediction	**18 hrs**
Hierarchy of protein structure - primary, secondary and tertiary structures Structural Classes, Motifs, Folds and Domains. Protein secondary structure prediction Protein tertiary structure prediction in presence and absence of structure template. Energy minimizations and evaluation by Ramachandran plot. Protein structure and rational drug design.	
Unit IV: Genome Organization and analysis	**18 hrs**

Diversity of Genomes: Viral, prokaryotic & eukaryotic genomes. Genome, transcriptome, proteome, 2-D gel electrophoresis, MALDI- TOF spectrometery. Major features of completed genomes: *E.coli, S.cerevisiae, Arabidopsis,* Human.	

Course Learning Outcomes:

1. Understand role of biological databases and download appropriate literature, sequences and otherrelevant information from biological databases
2. Understand importance of sequence alignment
3. Predict structures of proteins
4. Understand organization of genomes and techniques used to study.

Text / Reference Books:

Author	**Title**	**Publisher**	**Ed/year**	**ISBN No**	**Pages**
Xiong, J.	Essential Bioinformatics	Cambridge University Press	2006	0521706106, 978- 0521600828	352
Ghosh, Z. and Mallick, B.	Bioinformatics –Principles and Applications	Oxford University Press	2008	0195692306, 9780195692303	560

Endocrinology

L	T	P	Total Credits
4	0	0	4

Course objectives: The course aims to provide a comprehensive understanding of the endocrine system, focusing on its functional organization, hormone actions, physiological roles, and associated pathologies. Through detailed exploration of signal transduction pathways, receptor mechanisms, and the biochemical basis of hormone release, students will develop insights into the regulation of various endocrine glands and their impact on overall health, including the influence of lifestyle factors.

Course content and syllabus

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

Course Learning Outcomes:

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

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Murray, R.K., Granner, D.K. and Rodwell, V.W,	Harper's Illustrated Biochemistry	McGraw Hill	30th/2018	978-0071825344 0071825347	817
B. Alberts, D. Bray, J. Lewis, Martin Raff, Keith Roberts, and J. D Watson	Molecular and Cellular Biology	Garland Science	6th/2012	978-0818 344322 0818 344325	1464
David G. Gardner, Dolores M. Shoback	Greenspan's Basic and Clinical Endocrinology	McGraw Hill	10th/2017	978-1259589287 1259589285	944
ShlomoMelmed, Kenneth Polonsky, P. Reed Larsen, Henry M. Kronenberg	Williams Textbook of Endocrinology	Elsevier	30th/2016	978-0323555968 0323555969	1792
Kumar V, Abbas, A.K., and Aster, J.C.	Robbins Basic Pathology	Saunders Elsevier.	8th/2007	978-1416029731	952

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.

Programme structure for Integrated B.Sc. + M.Sc. (H) Biochemistry 5 years (6th Semester)

Sr. No	Course Code	Course Title	Course Type	Credit Units			
				L	T	P	Total Credits
1	BCH302	Regulation of Gene Expression	Major Core Course	4	0	2	6
2		Physiological Biochemistry	Major Core Course	4	0	2	6
3		Nutritional And Clinical Biochemistry	Major Core Course	4	0	0	4
4		Pharmacogenetics	Minor Course	4	0	0	4
5		Plant Biochemistry	Minor Course	2	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 of the 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

Plant Biochemistry

L	T	P	Total Credits
2	0	0	2

Course Objectives: This course aims to provide students with a basic understanding of the structure and function of plant organelles. Additionally, students will gain valuable insight into different types of enzymes involved in the regulation of important processes, such as photosynthesis, respiration, and metabolism.

Course content and syllabus

	Teaching Hours
Unit-1 Plant Organelles and their enzymes	**9 hrs.**
Structure, Function and biogenesis of chloroplasts, Mitochondria and microbodies (peroxisomes and glyoxysomes), Enzymes and its functions, Principles, nomenclature and kinetics, Enzymes, how enzymes work and isozymes, Enzyme kinetics, Enzyme regulation	
Unit-2 Photosynthesis	**9 hrs.**
Evolution of photosynthesis, Photosynthetic electron transport, Components of photosynthetic apparatus and their role, phosphorylation, C3, C4 and CAM pathways, Photorespiration and Starch and sucrose formation, Carbon partitioning.	
Unit-3 Respiration	**9 hrs.**
Glycolysis, Pentose Phosphate Pathway, TCA cycle, Oxidative electron transport and phosphorylation, Interactions among primary metabolic pathways.	
Unit-4 Nitrogen/Sulphur and fat metabolism	**9 hrs.**
Symbiotic and asymbiotic nitrogen fixation, Biosynthesis of amino acids, Glyoxylate cycle, Fatty acid Formation/Oxidation, Sulfate assimilation pathway, Glutathione synthesis and function	

C**ourse Learning Outcomes:**

1. Gain an understanding of the structure and function of plant organelles.
2. Learn about enzyme classification, activation, and inhibition.
3. Investigate the metabolism of vital elements such as sulfur, nitrogen, and fat.
4. Understand how enzymes facilitate nutrient utilization and storage.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Buchannan B, Gruiseem W, Jones R	Biochemistry and Molecular Biology of Plants	ASPP, Maryland	2000	044898255	564
Hans-Walter Heldt	Plant Biochemistry	Academic Pres	2006	978-0120883912	656
Taiz L and Zeiger E	Plant Physiology	Sinauer Associates	2006	9780878935659	782

Pharmacogenetics

L	T	P	Total Credits
4	0	0	4

Course Objectives: After studying this course, the students will be able to understand several genetic diseases. They will be able to understand how a single gene and a group of genes working in coordination affect a major system. They will be able to acquire knowledge about various genetic disorders and their recent therapies.

Course curriculum:

	Teaching Hours
Unit I Introduction to Genetic Disorders	**18 hrs**
An overview of the genetic basis of syndromes and disorders. Spectrum of genetic diseases (single gene, chromosomal, multifactorial, mitochondrial, somatic cell genetic diseases) and patterns of their inheritance.	
Unit II Monogenic and multifactorial Diseases	**18 hrs**
Monogenic diseases with well-known molecular pathology 1. Cystic fibrosis 2. Tay-Sachs syndrome 3. Marfan syndrome. **Multifactorial Diseases**: 1. Diabetes type 2; Cancers; 3. Hypertension; 4. Obesity; 5. Atherosclerosis	
Unit III: Various genetic disorders	**18 hrs**
Disorders of muscle 1. Dystrophies (Duchenne Muscular dystrophy and Becker Muscular Dystrophy) 2. Myotonias 3. Myopathies **Disorders of Haemopoietin systems** 1. Overview of Blood cell types and haemoglobin 2. Sickle cell anaemia 3. Thalassemias 4. Hemophilias. **Chromosomal instability syndromes –** Ataxia telangectasia, Fanconi anemia, Bloom's Syndrome, Nijmegen breakage syndrome.	
Unit IV: Therapies for Genetic Disorders	**18 hrs**

Therapies for genetic disorders and multifactorial diseases: Stem cell therapies: stem cell types, cord blood cells, bone marrow transplantation; current stem cell therapies; gene therapies: methods; diseases suitable for gene therapies: hemoglobinopathies, cystic fibrosis, muscular dystrophies, cancer; challenges in gene therapy; regulatory requirements. Management of genetic disorders.	

- **Course Learning Outcomes:**
- Understand several genetic diseases.
- Perceive knowledge about how a single gene and genes working in coordination affect a major system.
- Acquire knowledge about various genetic disorders.
- Acquire knowledge about recent therapies for genetic disorders.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Roderick R. McInnes and Huntington F. Willard	Thompson & Thompson Genetics in Medicine	Elsevier	8th/2018	978-1437706963 1437706967	560
Cox and Sinclair	Molecular Biology in Medicine	Blackwell	1997	0-632-02784-1	340
DE Grouchy and Turleau	Clinical Atlas on Human Chromosomes.	John Wiley & Sons	2nd/1984	047189205X 978-0471892052	487
Strachan, T. and Read, A. P	Human Molecular Genetics	Garland Edition	4th/2011	978-0818 341499 0818 341490	781
Jankowski and Polak	Clinical Gene Analysis and Manipulation	Cambridge	1996	9780521478960	475

Physiological Biochemistry

L	T	P	Total Credits
4	0	2	6

Course objective: The course aims to provide students with a comprehensive understanding of physiological biochemistry, encompassing the intricate mechanisms underlying cellular and systemic functions in the human body. Through detailed study of blood clotting, respiratory processes, gastrointestinal and hepatic physiology, as well as reproductive and neurophysiology, students will gain insights into the biochemical basis of health and disease.

Course content and syllabus

	Teaching Hours
Unit I: Blood Cells and Blood Clotting:	**18 hrs**
Blood components and their function, plasma proteins, molecular mechanism of blood coagulation, role of vitamin K in coagulation, anticoagulant and fibrinolytic systems. Anemias, polycythemia, haemophilia and thrombosis. Homeostasis: Intracellular, extracellular and interstitial fluid. Acid Base Balance: Acid base balance; Role of blood buffers; respiratory and renal mechanism in the maintenance of blood pH; Excretory System: Anatomy of the kidney and the nephron; formation of urine; tubular re-absorption of glucose, water and electrolytes; tubular secretion; regulation of water and electrolyte balance; role of kidneys and hormones in their maintenance, Assessment of kidney function. Physiology of glomerular filtration and GFR. Acidosis and alkalosis. Glomerular nephritis, renal failure, dialysis and diuretics.	
Unit II: Respiration	**9 hrs**
Components of respiratory system and their functions; Mechanism of respiration, transfer of blood gases- O2 and CO2; Bohr effect; role of chloride ions in oxygen transport; effect of 2,3-BPG on O2 affinity of hemoglobin; Clinical importance of 2,3-BPG, Regulation of respiration. Hypoxia, hypercapnea. Muscle: Types of muscles, muscle proteins, organization of contractile protein and mechanism of muscle contraction, sources of energy for muscle contraction. Physiology of the cardiac muscle, control of cardiac function and output. Arterial & venous system, capillary fluid exchange. Arterial pressure and its regulation. Hypertension, atherosclerosis and myocardial infarction.	
Unit III: Gastrointestinal Physiology	**18 hrs**
General principles of alimentary tract secretion; Composition, function, stimulation and regulation of saliva, gastric, pancreatic, intestinal and bile secretions. Importance of mucous(Lubricating & protective properties); Digestion and absorption of carbohydrates, lipids and proteins. Peptic ulcer, diarrhoea and constipation. Hepatic Physiology: Anatomy of the hepatic lobule and blood flow into the liver. Formation and secretion of bile; enterohepatic cycle, reticuloendothelial	

system, metabolic importance of liver. Liver function tests. Jaundice, liver cirrhosis and fatty liver.	
Unit IV: Reproductive Physiology	**9 hrs**
Hormonal regulation of testicular and ovarian function, spermatogenesis and oogenesis, Puberty, pregnancy and lactation, Biochemistry of milk and colostrum. Neurophysiology: Neuron, types of synapses, transmission of nerve impulse, role of Ca+2 in release of neurotransmitter from pre-synaptic membrane, function of receptor proteins and secondary messengers on the postsynaptic neuron; Characteristics of some important neurotransmitters (Dopamine, GABA, Glutamate, Acetylcholine, Serotonin, NO).	

List of Experiments

1. Hematology
    1. RBC and WBC counting
    2. Differential leucocyte count.
    3. Clotting time
2. Estimation of haemoglobin.
3. Separation of plasma proteins.
4. Determination of total iron binding capacity.
5. Measurement of blood pressure.
6. Separation of isoenzymes of LDH by electrophoresis.
7. Histology of connective tissue, liver and/ brain permanent slides.
8. Estimation of osmolarity in blood.
9. Estimation of ammonia in blood.

Course Learning Outcomes:

Students will be able to:

5. Understand the intricate biochemical mechanisms underlying physiological functions.
6. analyze and interpret biochemical data to understand normal and pathological processes.
7. diagnose and propose interventions for physiological disorders.
8. Perceive the holistic nature of human physiology.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Rodney Boyer	Concepts in Biochemistry	Wiley	2nd/2018	978-1119293300	848
Jeremy M. Berg et al.	Biochemistry	W. H. Freeman	9th/2019	978-1319114657	1256
David L. Nelson	Lehninger Principles of Biochemistry	W. H. Freeman	7th/2017	978-1464126116	1276

Lubert Stryer	Biochemistry	W. H. Freeman	8th/2015	978-1464126116	1872

Nutritional And Clinical Biochemistry

L	T	P	Total Credits
4	0	0	4

Course objective: To provide information on concept of nutrition & health and understand the physiological and biochemical significance of micronutrients and macronutrients. To provide understanding and applied knowledge to the theory and practice of clinical biochemistry.

Course content and syllabus

	Teaching Hours
Unit I: Fundamentals of Human Nutrition and Metabolism	**9 hrs**
Defining Nutrition, role of nutrients. Unit of energy, Biological oxidation of foodstuff ,Physiological forms of energy, Caloric value & energy content of various foods. Measurement of energy expenditure: Direct and indirect Calorimetery. Respiratory quotient (RQ), Protein and non-protein RQ and its calculations. Basal metabolic rate (BMR: Factors affecting BMR, calculation of BMR. Specific dynamic of food, Energy requirement in various physiological and pathological conditions. Thermogenesis and the effect in various physiological process.Theory of satiety and hunger. Calorie malnutrition and over nutrition. Starvation-history, morbid Anatomy, changes in its body composition, metabolic , stores of energy and survival. Obesity-aeriology, assessment of clinical features, treatment, diet, effect of exercise.	
Unit II: Nutritional Biochemistry: Macronutrients and Their Metabolic Roles	**18 hrs**
Proteins: - Sources and chemical nature, Review of functions of proteins in the body. Essential and Nonessential amino acids , protein as a source of energy, protein reserves, Digestion and absorption. Nitrogen balance and various factors affecting Nitrogen balance. Endogenous and exogenous fecal and urinary nitrogen and their importance. Methods of estimating endogenous nitrogen. Dynamic state of Nitrogen metabolism. Methods for assessment of quality of proteins, Protein requirements for various age groups. Individual amino acid deficiency. Amino acid imbalance, antagonism and toxicity. Role of dipeptides in clinical nutrition. Carbohydrates: Review functions of carbohydrates. Digestion, absorption ,utilization and storage, hormonal regulation of blood glucose. Dietary requirements and source of carbohydrates, Dietary fibres, various types of dietary fibres, chemistry of fibres, physical properties, dietary source, role of fibre in lipid metabolism, colon function, blood glucose level and GI tract functions. Dietary Fats:- Review of classification, sources, functions, digestion, absorption, utilization and storage. Essential Fatty Acids; Functions of EFA, RDA, – excess and deficiency of EFA. Lipotropic factors, Fibres in preventing cancer, diabetes, coronary heart disease. Possible adverse effects. Role of n-3 PUFAs in pathogenesis of various diseases, Effects of n-3 PUFA on liproproteins, thrmoboxane, prostaglandins and leukotrienes, Importance of n- 3/ n-6 PUFA ratio.	

Unit III: Daignostic Enzymes and Organ function Tests	**9 hrs**
Enzyme assay in serum/plasma, urine, and cells. - Clinically important enzymes. - Use of isoenzymes in diagnosis. Assessment and clinical manifestation of hepatic, renal, gastrointestinal, and pancreatic functions.	
Unit IV: Disorders of Metabolism	**18 hrs**
Carbohydrates- Diabetes mellitus, Glycogen Storage diseases, galactosemia, pentosuria. Amino Acids- Disorders of glycine, sulfur containing amino acids, aromatic amino acids, histidine, branched chain amino acids and proline, disorders of propionate and methylmalonate metabolism. Disorders in urea biosynthesis.	

Leaning outcomes: Students by the end of the course will-

1. Students will understand the roles of proteins, carbohydrates, and fats in human metabolism.
2. They will analyze how macronutrients influence energy balance and metabolic health.
3. Through assessments, students will apply nutritional principles to promote health and prevent disease.
4. They will integrate this knowledge into clinical practice for personalized dietary interventions.

Programme structure for Integrated B.Sc. + M.Sc. (H) Biochemistry- 5 years (7th Semester)

Sr. No	Course Code	Course Title	Course Type	Credit Units			
				L	T	P	Total Credits
1	BCH601	Advanced Cell Biology	Major Core Course	4	0	0	4
2		Cell Culture Technology	Major Core Course	3	0	1	4
3	BCH611	Practicals in Biochemistry I	Major Core Course	0	0	4	4
4		Neurobiochemistry	Discipline Specific Elective*	4	0	0	4
5		Applications of Biochemistry to Biotechnology	Discipline Specific Elective*	4	0	0	4
6	BTY602	Intellectual Property Rights, Biosafety and Bioethics	Minor Course	4	0	0	4
		Total Credits					24

***The Discipline Specific Elective Courses of 7th and 8th semesters will be pooled together. The Discipline Specific Elective Course can also be taken through MOOC. A maximum of 4 credits per semester can be taken through MOOC.**

BCH601: Advanced Cell Biology

L	T	P	Total Credits
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:

1. Understand about different component of cell, and cellular signalling and communication mechanisms in the cell.
2. Discuss the basic differences in genome of prokaryotic and eukaryotic cells.
3. Evaluate various modes of cell signaling and cell transformation mechanisms.
4. 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

Cell Culture Technology

L	T	P	Total Credits
3	0	1	4

Course Objectives: To develop an understanding of basic principles underlying in vitro techniques for culture ofanimal and human cells and their genetic manipulation for better understanding of human diseases.

Course content and syllabus

	Teaching Hours
Unit I: Principles of Cell Culture	**9 hrs**
Establishment, Maintenance and Cryopreservation of primary cell culturesand cell lines, Sub-culture; Growth phases of cells in a culture, Cell synchronization, Cell transformation and immortalization, Serum containing and serum-free media; Contamination, and sterilization in cell culture; Mechanisms of cell proliferation and cell death in animal cell culture *in vitro*	
Unit II: Characterization & Scale up techniques	**18 hrs**
Characterization of cultured cells : cell morphology, chromosome content, enzyme activity, immunostaining; Cell separation based on cell type and cell density, antibody-based techniques (immune-panning, magnetic sorting); Scaling up-techniques for cells in suspension and in monolayer	
Unit III: Animal Transgenesis	**18 hrs**
Transgenic animals – benefits, risks and challenges, Methods of creating transgenic animals; Production of Transgenic Mouse Model to Study Human Diseases. Strategies to create Knock-out, Knock-in and Conditional Knock-out Mice, Inducible knockouts.	
Unit IV: Applications of Cell Culture technology	**9 hrs**
Molecular pharming, Diagnostics, Drug screening, Gene therapy, Animal cloning, stem cell isolation and banking, Xeno-transplantatio ,GMP; Regulatory and ethical issues in Animal biotechnology	

List of Experiments -with basic instructions

1. Laboratory design and GMP practices in animal cell culture laboratory
2. Preparation and sterilization of cell culture media
3. Cryopreservation of cell lines
4. Thawing of frozen cells to initiate a new cell culture and sub-culture (passaging)
5. Cell counting and estimation of cell viability by trypan blue
6. Cell seeding
7. Subculture
8. Cytotoxicity assay by MTT
9. Scratch assay

Course Learning Outcomes: By the end of the course, students would be able to:

1. Comprehend the fundamental concepts of animal cell culture, and its importance.
2. Identify the various types of cell culture protocols and their importance
3. Compare and Discuss the significance of transgenesis methods with reference to animal models.
4. Correlate the principles with applications of animal cloning and gene therapy along with ethical concerns.

Text / Reference Books:

Author	**Title**	**Publisher**	**Ed/year**	**ISBN No**	**Pages**
R. Ian Freshney.	Culture of Animal Cells: A Manual of Basic Technique & Specialized Applications	John Willey & Sons Inc, USA,	2016, 7th ED	9781118873656	736
Jeremy M. Berg, Lubert Stryer, John L Tymoczko, and Gregory J. Gatto,	Biochemistry	W.H. Freeman Company	2015	1319114652	1208
M Butler	Animal Cell Culture and Technology (THE Basics)	Taylor & Francis	2003	9781859960493	256

BCH611: Practicals in Biochemistry – I

L	T	P	Total Credits
0	0	4	4

Objective- This course will teach students about practical aspects of Microbiology, biochemistry and bioanalytical techniques.

Course content and syllabus

	Teaching Hours
Unit I: Basic Culture Techniques	**36 hrs**
1. Preparation of solid/liquid culture media. 2. Isolation and purification of micro-organisms from soil/water/air. 3. Estimation of CFU count by spread/pour plate method. 4. Gram staining of bacterial culture 5. Preservation of microbial pure culture	
Unit II: Techniques in Biochemistry	**36 hrs**
1. Preparation of buffers and solutions 2. Estimation of carbohydrates 3. Estimation of proteins by Bradford method 4. Estimation of proteins using uv-spectroscopy from its molar extinction coefficient. 5. Saponification value of fats/oils	
Unit III: Microbial Growth	**36 hrs**
1. Bacterial Growth curve 2. Effect of pH/temperature on bacterial growth. 3. Effect of different carbon source on bacterial growth. 4. Effect of different nitrogen source on bacterial growth.	
Unit IV: Bioanalytical Techniques	**36 hrs**
1. Verification of Lambert-Beers law. 2. Preparation of standard curve. 3. Separation of amino acids by paper/thin-layer chromatography. 4. Plant pigment separation by paper/thin-layer chromatography.	

Course Learning Outcomes: this course will teach students to-

1. Preparation of culture media and isolation of microbes
2. Quantitative estimation of various biomolecules
3. Microbial growth and effect of different parameters on microbial growth
4. Use of spectroscopy and chromatography in biology

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Plummer, D.T.,	An Introduction to Practical Biochemistry	Tata McGraw-Hill	3rd	0-07-099487-0	332
Ponmurugan, P. and Prabhu, B. G.	Biotechniques	MJP Publishers	2021	978-8180941191	696

Neurobiochemistry

L	T	P	Total Credits
4	0	0	4

Course Objective: An interdisciplinary course investigating the chemical processes involved in central nervous system functioning and communication. Emphasis will be placed on the chemical aspects of synthesis, metabolism, and release of neurotransmitters. The role of neurochemistry in behavioral and neurological disease states will be evaluated. Current research topics in this area will also be presented.

Course content and syllabus

	Teaching Hours
Unit I: Muscle Biochemistry	**13 hrs**
Skeletal muscle structure, plasmolemma, transverse tubules, sacroplasmic reticulum and myofibrils. Actin, myosin, tropomyosin, troponin, Z disc and H line components. Molecular mechanism of contraction, subcellular ion movements during the contraction cycle in skeletal muscle.	
Unit II: Neuromorphology	**14 hrs**
Metabolic and functional classification of skeletal muscle fibers. Twitch, myosin ATPase activities. The motor unit. Role of calmodulin.Organisation of neuron, dendrites and axons. Glial cells – astrocytes, oligodendrocytes, ependymal cells, Schwan cells. Nerve fiber types and functions.	
Unit III: Neurophysiology	**13 hrs**
Excitation and conduction, generation and conduction of action potential, saltatory conduction, ion channels and transport of ions. synaptic transmission, Neurotransmitters and Neurohormones – chemistry, synthesis, storage and release. Blood Brain CSF barrier– Characteristics, transport systems. Biochemistry of vision.	
Unit IV: Transport across membrane	**14 hrs**
Types of transport (simple diffusion, passive facilitated diffusion), active transport primary and secondary group translocation, transport ATPases, transport by vesicle formation. Neurological disorders – Headache, facial pain, migraine, epilepsy, stroke, selected neurocutaneous diseases, movement disorder, Benign essential (familiar) tremor, Parkinsonism, Huntington's disease, multiple sclerosis, motor neuron disease, Myasthenia Gravis.	

Course Learning Outcomes:

- Students will acquire knowledge of skeletal muscle and their coordinaton.
- Students will acquire knowledge of glial cells and Metabolic and functional classification of skeletal muscle fibers.
- Students will acquire knowledge of Neurotransmitters and neurohormones
- Students will acquire knowledge of transport system and various neurological disorders.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Brady et al.	Basic Neurochemistry	Academic Press	2012	978-0-12-374947-5	567

Application Of Biochemistry To Biotechnology

L	T	P	Total Credits
4	0	0	4

Objectives- The course will focus on providing knowledge and understanding of the current technologies and process.

	Teaching Hours
Unit I: Advanced Techniques in Protein and Nucleic Acid Analysis and Manipulation	**13 hrs**
Micromethods in Protein Chemistry: Isolation of peptides for Sequence analysis. Peptide mapping, chemical and enzymatic hydrolysis of proteins. Extraction and fractionation of RNA and DNA, Isolation of plasmids, plasmid derived vectors, phages and yeast vectors, Enzymes involved in recombinant DNA technology, Genomic and cDNA library. Ti plasmid as tool for genetic engineering in plants, Bacterial transformation screening of transformants, use of Minicells and Maxicells to detect the expression of DNA, Hybrid released translation (HRT), Hybrid arrested translation (HART) for screening of protein	
Unit II: Advanced Molecular Techniques in Nucleic Acid Analysis and Manipulation	**14 hrs**
N-labelling Random labeling of nucleic acid probes, Nick translation, Hybridization and blotting techniques. dot blot. Northern and Southern blot, South-Western blot analysis, In vitro translation, biotin- avidin system applications in detection of bio-molecules. Chromosomal walking & Chromosome jumping, DNA microarray chip technology, Auto-radiography and fluorography, Techniques to study DNA protein interactions, Generation of transgenic animals and plants, knockout animals	
Unit III: Advanced Techniques in Molecular Biology and Genetic Analysis	**13 hrs**
Chemical Synthesis of oligonucleotides, Polymerase Chain Reaction (PCR), Basic principle, method, Variations of PCR, Amplification of specific DNA fragments: Applications in medicine and forensic sciences. Gene mapping, Polymorphism and Techniques to detect polymorphism: RAPD, RFLP, AFLP etc. DNA based diagnosis of genetic disorders, Recombinant DNA technology in medicine and industry. In situ Hybridization, gene therapy.	
Unit IV: Monoclonal Antibodies and Vaccine Development: Production, Applications, and Types	**14 hrs**
Monoclonal Antibodies and Vaccines: Definition and nature of monoclonal antibodies (MCA); Antigen preparation for MCA production; Methodology producing MCA; Immunization and generation of immune response, Myleoma cells for hybridization; cell fusion and selection of hybrids using HAT medium. Cloning and isolation of hybrid cell lines. In vitro and in vivo culture of hybrid cell lines, Screening of specific MCA; Purificatin and labeling of MCA, uses and applications of MCA. T-cell hybridomas and their applications. Vaccines (subunit, live recombinant, attenuated and DNA Vaccines).	

Course Learning Outcomes:

At the end of the course, the students will learn-

1. Learn and apply various biotechnological methods including protein chemistry, nucleic acid analysis, PCR, monoclonal antibody production, and vaccine development.
2. Utilize techniques in biomedical research and forensic analysis, such as DNA amplification for diagnostics, genetic mapping, gene therapy, and protein purification.
3. Combine molecular biology principles with biochemical knowledge to understand processes like DNA-protein interactions, recombinant DNA technology, and gene expression analysis.
4. Evaluate biochemistry and biotechnology journals to assess methodologies, interpret results, and apply findings effectively

Text books

Author	Title	Publisher	Ed/year	ISBN No	Pages
Robert F. Barnard, Sudhir P. Glick, Jack J. Pasternak	Molecular Biotechnology	ASM Press	4th	978-1-55581-498-4	1328
Michael R. Green, Joseph Sambrook	Molecular Cloning: A Laboratory Manual	Cold Spring Harbor Laboratory Press	4th	978-1936113422	1123
Voet, D., Voet, J.G.	Biochemistry	Wiley	4th Ed	978-0071737074	245

BTY602: IPR, Biosafety and Bioethics

L	T	P	Total Credits
4	0	0	4

Course Objectives: Examine Intellectual Property Rights (IPR), Biosafety, and Bioethics to understand their implications in biotechnology and life sciences, fostering insights into ethical, legal, and safety considerations**.**

Course contents

	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:

1. Understand IPR and its database.
2. Evaluate different types of patents and policies
3. Compare the biosafety methods and differences between GMOs and LMOs.
4. 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 Integrated B.Sc. + M.Sc. (H) Biochemistry- 5 years (8th Semester)

Sr. No	Course Code	Course Title	Course Type	Credit Units			
				L	T	P	Total Credits
1	BCH605	Advanced Enzymology	Major Core Course	4	0	0	4
2.	BCH606	Practicals in Biochemistry-II	Major Core Course	0	0	4	4
3	BCH610	Topics in Life Sciences	Discipline Specific Elective*	4	0	0	4
4		Clinical Trials	Discipline Specific Elective*	4	0	0	4
5		Synthetic and Systems Biology	Minor Course	3	0	1	4
		Total Credits					**20**

*The Discipline Specific Elective Courses of 7th and 8th Semesters will be pooled together.

The Discipline Specific Elective Course can also be taken through MOOC. A maximum of 4 credits per semester can be taken through MOOC.

BCH605: Advanced Enzymology

L	T	P	Total Credits
4	0	0	4

Course Objectives: The objective of the course is to provide a deeper insight into the fundamentals of enzyme structure and function and kinetics of soluble and immobilized enzymes. Also it deals with current applications and future potential of enzymes.

Course content and syllabus

	Teaching Hours
Unit I: Enzyme Kinetics	
Concept of convergent and divergent evolution of enzymes; Purification of enzymes: strategy & criteria of enzyme purity, judging the success of purification procedure; Kinetics of multi substrate enzyme catalyzed reactions: classification, kinetics of multisubstrate reactions, Investigation of reaction mechanism by using initial velocity, inhibition and isotope exchange studies; Practical aspects of kinetic studies: Enzyme assays, coupled assays, Reaction conditions optimization (pH, temperature, substrate concentration).	18 hrs
Unit II: Chemical mechanisms of enzyme catalysed reactions	
Methods of pre-steady state analysis: Rapid mixing and sampling techniques, Relaxation methods, Absolute concentration of enzymes, Sigmoidal Kinetics: Cooperativity phenomenon for protein ligand binding, symmetric & sequential models for action of allosteric enzymes and their significance, Hill and Scatchard plots.	18 hrs
Unit III: Investigating the active site structure	
Identification of active site of enzymes: By trapping of enzyme-substrate complex, use of substrate analogues, enzyme modification by chemical procedures affecting amino acid side chains, treatment with class-specific inhibitors and site-directed mutagenesis, by studying the effect of changing pH. A brief account of investigation of three dimensional structure of active site, Structures & mechanisms of selected enzymes: Dehydrogenases, proteases, ribonuclease and lysozyme.	18 hrs
Unit IV: Enzyme turnover	
Enzyme turnover: Kinetics of turnover, methods for measuring rates of enzymes turnover, Correlation between rates of turnover and the structure and functions of enzymes, Mechanism of enzyme degradation, significance of enzyme turnover.	18 hrs

Course Learning Outcomes:

1. Comprehensive understanding of enzyme kinetics and thermodynamics with intention of concept application in enzyme research.
2. To enhance the knowledge in the application of enzymes in food, pharmaceutical, and green chemistry industry.
3. A thorough understanding of the techniques of enzyme engineering.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Ram Sarup Singh, Reeta Rani Singhania, Ashok Pandey, Christian Larroche	Advances in Enzyme Technology - A volume in Biomass, Biofuels, Biochemicals	Elsevier	2019	978-0-444-64114-4	-
N. S. Punekar	Enzymes: Catalysis, Kinetics and Mechanisms	Springer	2018	978-981-13-0784-3	562

BCH606: Practicals in Biochemistry -II

L	T	P	Total Credits
0	0	4	4

Course Objectives- This course will teach students about practical aspects of Molecular biology, protein purification, enzyme assays, microbiology and immunological techniques.

Course content and syllabus

	Teaching Hours
Unit I	**36 hrs**
Laboratory Safety including Chemical, Biological and Radiations. · Analysis of cell types by cell counting and cell sorting · Dose response curve · Enzymes associated with toxicity: SOD, Catalase, Glutathione peroxidase, Lipid peroxidase · Enzyme assays: Acetylcholinesterase, ß-Glucuronidase, Glucose-6-phosphate dehydrogenase, ATPase.	
Unit II	**36 hrs**
Amylase assay · Immobilization of cells/enzymes · Assay of isoenzmes. (LDH/CPK) · Isolation of Enzymes from different sources · Enzyme kinetics · Assay of glutathione transferase · Assay for Cytochrome P450 · Enzyme assays pertaining to liver (Liver Function Test.	
Unit III	**36 hrs**
DNA isolation from bacteria/yeast/animals/plants · Preparation of proteins by acetone extraction method and also ammonium sulfate fractionation method and running the gel. · Extraction & Fractionation of Nucleic acids · Visualizing and Quantification of nucleic acids · Blotting techniques (Slot/ Dot/ Western)	
Unit IV	**36 hrs**
Affinity Chromatography for isolating types of Immunoglobulins. · ELISA · Chromatographic techniques a. TLC (Separation of sugars/amino acids) b. HPLC c. GCMS	

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

- Perform various experiments in the areas of enzymology, immunology, molecular biology, and toxicology
- Understand how to analyze and interpret experimental data

- Learn how to scientifically report data

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Plummer, D.T.	An Introduction to Practical Biochemistry	Tata McGraw Hill	3rd	0-07-099487-0	332

BCH610: Topics in Life Sciences

L	T	P	Total Credits
4	0	0	4

Course Objectives: 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 and disease-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. Stranford	Kuby Immunology (8th Edition)	WH Freeman and Company, USA	2018	978-1319114701	944
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

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	Textbook of	Wiley India	3rd	9788126524945	784

Day Sylvan Green	Clinical Trials	Pvt Ltd			
P. Brouwers	Handbook of Clinical Trials	Garland Science	2nd	1901346293	388

Synthetic and Systems Biology

L	T	P	Total Credits
3	0	1	4

Course Objectives: This course offers a concise exploration of Synthetic and Systems Biology, covering DNA assembly techniques, synthetic networks, cell-free protein synthesis, and biofuel production. Students will gain the skills and knowledge needed to engage in advanced research and innovation in biotechnology.

Course content and syllabus

	Teaching Hours
Unit I: Fundamentals of Synthetic Biology	**14**
Modern techniques of DNA assembly – NEBuilder HiFi DNA Assembly, Gibson Assembly, BioBrick Assembly, Golden Gate Assembly. Synthetic bacterial chromosome, synthetic yeast chromosomes for modular metabolic engineering, Genomic engineering using transposable elements in vertebrates	
Unit II: Synthetic Networks	**13**
Biological parts – Sensor Proteins (switches), Regulatable promoters, Models of gene expression, artificial networks, production of simple networks capable of producing genetic oscillators and toggle switches, consequences of gene expression variability, examples of synthetic networks – Biofuels and green chemicals.	
Unit III: Fundamentals of System Biology	**13**
Expanding the chemistry of life by cell free protein synthesis and incorporation of nonnatural amino acids, Engineering of membrane proteins that responds to physical stimuli and their applications: Light-gated channels and pumps for optogenetics, Mechanoreceptors, Temperature- and magnetic field-gated channels. Genetically encoded nanosensors, Ratiometric and intensimetric nanosensors. *In vivo* use of nanosensors	
Unit IV: Biofuels	**14**
First, Second, third and fourth generation biofuels and technologies; types, microbial production of biofuels, lignocellulose - structure, degradation and role of enzymes, co-utilization of mixed sugars, cost analysis, genome editing of microbes to produce ethanol, butanol, jet-fuels, biodiesel, and bio-hydrogen	

List of Experiments - with basic instructions

1. Cloning of a complete gene expression system by HIFI DNA assembly.
2. Online data mining to identify genes which responds to physical and chemical stimuli.
3. Online data mining to identify promoters which responds to physical and chemical stimuli.
4. in-silico design of a protein with new features.

Course Learning Outcomes:

1. Understand basic concepts of synthetic biology.
2. Learn to construct artificial gene networks and proteins.
3. Learn the techniques to re-wire genetic networks.
4. To know the areas of applications of synthetic biology.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Bas JHM Rosier, Tom FA de Greef	Synthetic Biology: How to make an oscillator	eLife Sciences Publications, Ltd	2015		
Edited By: Paul S Freemont (Imperial College, UK) and Richard I Kitney (Imperial College, UK)	Synthetic Biology — A Primer	World scientific	2012	ISBN: 978-1-84816-863-3	196
Uri Alon,	An Introduction to Systems Biology: Design Principles of Biological Circuits	Chapman & Hall/CRC	2006	ISBN-13978-1584886426	

Programme structure for Integrated B.Sc. + M.Sc. (H) Biochemistry- 5 years (9th Semester)

Sr. No	Course Code	Course Title	Course Type	Credit Units			
				L	T	P	Total Credits
1	BTY701	Advanced Bioinformatics	Major Core Course	4	0	0	4
2	BCH701	Nutritional Biochemistry	Major Core Course	4	0	0	4
3	BCH702	Practicals in Biochemistry-III	Major Core Course	0	0	2	2
4	CBA705	Fundamentals of BioEntrepreneurship	Major Core Course	2	0	0	2
5	STA701	Biostatistics	Major Core Course	2	0	0	2
	NTCC	Seminar	NTCC	0	0	2	2
	NTCC	Dissertation -I	NTCC	0	0	8	8
		Total credits					24

BTY701: Advanced Bioinformatics

L	T	P	Total Credits
4	0	0	4

Course Objectives: By the end of this course, the students will have acquired a solid foundation in bioinformatics, encompassing essential concepts, tools, and techniques for the analysis of biological data.

Course content and syllabus

	Teaching Hours
Unit I: Biological Databases	**18 hrs**
Nucleotide and Protein databases: Primary, secondary and composite database: genbank, EMBL, DDBJ, Uniprot, Swissprot, PIR, PDB, Genpepts, SCOP, CATH, Pfam. NCBI,EBI, DDBJ. nucleotide sequence flat files. Sequence formats: Genbank, FASTA, ASN. Introduction to metabolic pathway databases on the web-KEGG, EcoCyc, Metacyc.Enzyme databases- BRENDA, LIGAND database. Molecule visualization softwares: RasMol, Pymol, Cn3D, VMD etc. Information retrieval from biological databases- NCBI resource, Entrez, Pubmed, MEDLINE.	
Unit II: Sequence Alignment	**18 hrs**
Introduction to sequence alignment: Pairwise Sequence Alignment, Global alignmentand Local alignment, general, gap and affine penality. DotPlot, Scoring functions, Substitution Matrices- PAM and BLOSUM matrices. Dynamic Programming- implementation of the Needleman and Wunsch algorithm and Smith Waterman Algorithm for pairwise alignment and testing alignment score Multiple Sequence Alignment- consensus sequence, motifs and profiles. SP (Sum of Pairs) measure.Progressive method of of Sequence Alignemnt: Clustal W, Clustal X, T- COFFEE	
Unit III: Sequence Database search and Protein Structure Prediction	**18 hrs**
Sequence database search using BLAST and FASTA. Word method and k-tuple methodof sequence alignment. Significance of alignment score: E-value and bit-score, p-vaue.Variants of BLAST-blastN, blastP, blastX, TblastN, TblastX. Hidden Markov Model, Position Specific Scoring Matrix Methods to predict secondary structure of proteins Methods to predict tertiary structure of proteins: Homology modelling, threading, ab-initio modelling	

Unit IV: Gene Prediction and Phylogenetics	18 hrs
Prediction of Genes in Prokayrotes and Eukaryotes Prediction of Promoter and regulatory Elements Introduction to Phylogenetics: Gene Phylogeny v/s Species Phylogeny. Phylogenetic tree construction: forms of tree representation, methods, and programs	

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

1. Search various biological database and extract biologically relevant information
2. Perform pair-wise and multiple sequence alignment
3. Search sequence database to identify homologous sequences in other organisms
4. Predict secondary and tertiary structure of proteins
5. Predict gene, promoter and regulatory elements
6. Compare genomes and build phylogenetic tree

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Xiong, Jing	Essentials of Bioinformatics	Cambridge University	2007	978-0521706100	352
Mount, D.W.	Bioinformatics : Sequence and Genome Analysis	Cold Springer Harbor Lab Press	2nd Ed	978-9746520706	692
Lesk, A.M.	Introduction to Bioinformatics	Oxford University Press	2014	978-0198724674	376

BCH701: Nutritional Biochemistry

L	T	P	Total Credits
4	0	0	0

Course Objective- The course aims to delve into the biochemical foundations of human nutrition, exploring how various nutrients impact health and well-being. Students will learn to assess dietary needs, formulate nutritional strategies, and address nutritional issues throughout life.

Course content and syllabus

	Teaching Hours
Unit I Basics of Nutrition	**15 hrs**
Defining Nutrition, role of nutrients. Unit of energy, Biological oxidation of foodstuff, Physiological forms of energy, Caloric value & energy content of various foods. Measurement of energy expenditure: Direct and indirect Calorimetery. Respiratory quotient (RQ), Calculating Protein and non-protein RQ. Basal metabolic rate (BMR): Factors affecting BMR, calculation of BMR. Specific dynamic of food, Energy requirement in various physiological and pathological conditions. Thermogenesis and the effect in various physiological process. Theory of satiety and hunger. Calorie malnutrition and over nutrition. Starvation-history, morbid Anatomy, changes in its body composition, metabolic, stores of energy and survival. Obesity-aeriology, assessment of clinical features, treatment, diet, effect of exercise.	
Unit II Macronutrients	**15 hrs**
Proteins: - Sources and chemical nature, Review of functions of proteins in the body. Essential and Nonessential amino acids, protein as a source of energy, protein reserves, Digestion and absorption. Nitrogen balance and various factors affecting Nitrogen balance. Endogenous and exogenous fecal and urinary nitrogen and their importance. Methods of estimating endogenous nitrogen. Dynamic state of Nitrogen metabolism. Methods for assessment of quality of proteins, Protein requirements for various age groups. Individual amino acid deficiency. Amino acid imbalance, antagonism and toxicity. Role of dipeptides in clinical nutrition. **Carbohydrates**: Review functions of carbohydrates. Digestion, absorption, utilization and storage, hormonal regulation of blood glucose. Dietary requirements and source of carbohydrates, Dietary fibres, various types of dietary fibres, chemistry of fibres, physical properties, dietary source, role of fibre in lipid metabolism, colon function, blood glucose level and GI tract functions. **Dietary Fats**: - Review of classification, sources, functions, digestion, absorption, utilization and storage. Essential Fatty Acids; Functions of EFA, RDA, – excess and deficiency of EFA. Lipotropic factors,	

Fibres in preventing cancer, diabetes, coronary heart disease. Possible adverse effects. Role of n-3 PUFAs in pathogenesis of various diseases, Effects of n-3 PUFA on liproproteins, thrmoboxane, prostaglandins and leukotrienes, Importance of n- 3/ n-6 PUFA ratio.	
Unit III: Vitamins	**15 hrs**
Vitamins: Sources, structure, biochemical functions, and deficiency diseases of Vitamins A, D,E,K and vitamin B complex. Role of Vitamin A as an antioxidant, in Visual cycle, dermatology and immunity. Role of Vitamin K in Gamma carboxylation and blood clotting, Vitamin K cycle. Role of Vitamin E as an antioxidant. Extra-skeletal role of Vitamin D and its effect on bone physiology. Hypervitaminosis. Vitamin C role as cofactor in amino acid modifications. Functions of choline, carnitine, inositol and taurine, carotenoids, glutamine and arginine.	
Unit IV: Trace Elements and Related Diseases	**15 hrs**
Iron: Various forms of iron present in food. Iron Exchange in body, intake, absorption, metabolism and regulation, transport, stores, iron overload and deficiency and its treatment. **Calcium**: Various forms of calcium present in food. physiological role of calcium in skeleton and non skeleton tissues. Calcium intake, absorption, role of calcium in lactation and pregnancy and in various other diseases. Hypocalcemia and hypercalcemia. **Zinc**: Distribution in body and Food. Zn deficiency, toxicity and treatment. **Copper**: Distribution in body. Cu deficiency, toxicity and treatment. Phosphorus, Iodine, Chlorine, Cobalt, Fluoride, Mg, Se, Manganese, Chromium, Molybdenum Distribution in the human body, Physiology, Function, deficiency, Toxicity and Sources, Food and drug interactions and Nutraceuticals; Nutrient interactions affecting ADME of drugs, Alcohol and nutrient deficiency, Antidepressants, psychoactive drugs and nutrient interactions, Appetite changes with drug intakes and malnutrition. Food as medicine.	

Course Learning Outcomes:

- Understand basics to nutrition and diet.
- Gain knowledge about various macronutrients, their sources and importance
- Acquaintance with various trace elements important for body and associated diseases.
- Overall understanding of food.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
M.E. Shils, J.A. Olson, M. Shike and A. C. Ross	Modern Nutrition in Health and Disease	Lippincott Williams and	2013	978-1605474618	1648

		Wilkins, London			
Davidson and Passmore	Human Nutrition and Dietetics	Longman Group Ltd., Hong Kong.	8th/1986	978-0443017650	660
S.S. Gropper, J.L. Smith and J.L. Groff	Advanced Nutrition and Human Metabolism	Wadsworth, USA	5th/2009	978-1133104056	608
Jim Mann & A. Stewart Truswell	Essentials of human nutrition	Oxford University Press, UK.	3rd/2007	978-0198752981	720

BCH702 : Practicals in Biochemistry -III

L	T	P	Total Credits
0	0	2	2

Course Objectives: The course aims to provide students with practical expertise in biochemical analysis techniques and bioinformatics tools for gene and protein sequence analysis, including database searches, sequence alignment, BLAST analysis, homology modeling, primer design, and statistical analysis.

Course content and syllabus

	Teaching Hours
Unit I	**18 hrs**
Glucose estimation in Blood and Urine by Glucose Oxidase/Peroxidase. Quantification of Haemoglobin Determination of free radical scavenging by FRAP Assay Estimation of Electrolytes Determination of Leucocyte Ascorbate. Estimation of topopherol by bipyridyl.	
Unit II	**18 hrs**
To know the methylation pattern at DNA (By Bisulfite conversion) To estimate the proteases activity by Dye binding method. Estimation of Calcium by OCPC method. Immunodiffusion Estimation of Sodium Benzoate from Jam/ Jelly Methods of preparation of nano-bioparticles	
Unit III	**18 hrs**
PubMed search Search and download gene sequences from GenBank Search and download protein sequences from Uniprot/Swissprot Pair-wise sequence alignment for protein and nucleic acids Multiple sequence alignment for proteins and nucleic acids	
Unit IV	**18 hrs**
BLAST search (blastp, blastn, psi-BLAST) Building homology model of proteins using Swiss-Model (or any other homology model building server) Primer designing using Gene Runner (or any other primer designing software) Calculating Mean, SD, SEM using MS-Excel Making bar diagram, histogram, scatter plot, etc using MS-Excel	

Course Learning Outcomes: this course will teach students to-

1. Use biological database
2. Compare protein and DNA sequences
3. Use of microbiology in industries
4. Methods in gene cloning

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Plummer, D.T.,	An Introduction to Practical Biochemistry	Tata McGraw-Hill	2017	978-0070994874	332
Ponmurugan, P. and Prabhu, B. G.	Biotechniques	MJP Publishers	2021	978-8180941191	696
Maheshwari, D.K.,	Practical Microbiology	S Chand & Company	2010	978-8121921534	413

CBA705: Fundamentals of BioEntrepreneurship

L	T	P	Total Credits
2	0	0	2

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

Course Content/ Syllabus

	Teaching Hours
Unit I: Basic Concepts of Entrepreneurship	**9**
Introduction to Entrepreneurship: Meaning, Background, Importance, The Benefits of Entrepreneurship, The Potential Drawbacks of Entrepreneurship, Factors that Influence Entrepreneurship, How to Avoid the Pitfalls, Factors Responsible for Entrepreneurship Growth; Entrepreneur Background and Characteristics; Entrepreneurial Potential in a Prospective Entrepreneur; Entrepreneurial Skills and Competencies; Types of entrepreneurs and entrepreneurship, Myths and Realities about Entrepreneurs; New Trends in Entrepreneurship Development; Economic Development through Entrepreneurship; Role of Entrepreneurship in the Economic Development of India	
Unit II: Understanding Creativity and Innovation	**9**
Creativity and innovation, Role of Creativity & Innovation in Entrepreneurship, Sources of New Ideas – Consumers, Existing Products and Services, Distribution Channels, Federal Government, Research and Development; Methods of Generating Ideas – Focus Groups, Brainstorming, Brainwriting, Problem Inventory Analysis; Creative Problem Solving – Brainstorming, Reverse Brainstorming, Brainwriting, Gordon Method, Checklist Method, Free Association, Forced Relationships, Collective Notebook Method, Attribute Listing Method, Big-dream Approach, Parameter Analysis, Mind Mapping, Force-Field Analysis, TRIZ, Rapid Prototyping; Innovation, Types of Innovation – Breakthrough, Technological, and Ordinary Innovation; Opportunity Recognition	
Unit III: Product Planning and Development Process & Business Plan Development	**9**
Product Planning and Development Process – Idea Stage, Concept Stage, Product Development Stage, Test Marketing Stage, and Commercialization Stage; Technology Readiness Levels; Intellectual Property Rights; Business Plan Development: Introduction, Business Plan, Various Business Models – The Business Model Canvas, The Lean Canvas, Types of Business Plans, Structure of a Basic Business Plan, Creating a Business Plan	

Unit IV: Sources of Capital and Institutional Support for Entrepreneurs	9
Sources of Funding for Entrepreneurs: Bootstrapping, Friends and Family Members, Crowdfunding, Angel Investment, Venture Capital, Financial Institutions, Bank Loans, Trade Credit, Initial Public Offerings/Issue of Shares, Debentures; Role of Government in Promoting Entrepreneurship: Atal Innovation Mission, Biotechnology Industry Research Assistance Council, Department of Science and Technology, Digital India, Jan Dhan-Aadhaar-Mobile, Make in India, National Skill Development Mission, Pradhan Mantri Kaushal Vikas Yojana, Science for Equity Empowerment and Development, Stand-Up India, Start-Up India, Support to Training and Employment Programme for women, Trade-Related Entrepreneurship Assistance and Development, USAID	

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

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

List of Professional Skill Development Activities (PSDA):

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

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Evan J. Douglas	Entrepreneurial Intention: Past, Present, and Future Research	Edward Elgar Publishing	2020	978-1-78897-522-3	216
Justin G. Longenecker, J. William Petty, Leslie E. Palich, and Frank Hoy	Small Business Management: Launching & Growing Entrepreneurial Ventures (20th Edition)	Cengage	2023	978-0-3577-1880-3	712

Mike Kennard	Innovation and Entrepreneurship	Routledge	2021	978-0-367-51057-2	114
Debasish Biswas and Chanchal Dey	Entrepreneurship Development in India	Routledge	2021	978-0-367-76219-3	117
Robert D. Hisrich, Micheal P. Peters, Dean A. Shepherd, Sabyasachi Sinha	Entrepreneurship (11th Edition)	McGraw Hill	2020	978-9390113309	696
Donald F. Kuratko and Jeffrey S. Hornsby	New Venture Management: The Entrepreneur's Roadmap for Development, Management, and Growth (3rd Edition)	Routledge	2020	978-0367466725	356
Bruce R. Barringer and R. Duane Ireland	Entrepreneurship: Successfully Launching New Ventures (6th Edition)	Pearson	2019	978-1-292-25533-0	617
Norman M. Scarborough and Jeffrey R. Cornwall	Essentials of Entrepreneurship and Small Business Management (9th Edition)	Pearson	2019	978-1-292-26602-2	827
Mary Jane Byrd and Leon Megginson	Small Business Management: An Entrepreneur's Guidebook (8th Edition)	McGraw Hill	2017	978-1259538988	496
Robert D. Hisrich and Veland Ramadani	Effective Entrepreneurial Management: Strategy, Planning, Risk Management, and Organization	Springer	2017	978-3-319-50465-0	230
Stephen Spinelli, Jr. and Robert J. Adams, Jr.	New Venture Creation: Entrepreneurship for the 21st	McGraw-Hill Education	2016	978-0-07-786248-8	484

	Century (10th Edition)				
David H. Holt	Entrepreneurship: New Venture Creation	Pearson	2016	978-9332568730	584
Peter F. Drucker	Innovation and Entrepreneurship	Harper Business	2006	978-0060851132	288
Robert J. Calvin	Entrepreneurial Management	McGraw-Hill	2005	9780071450928	295
Steve Mariotti	Entrepreneurship and Small Business Management	Pearson publishers	2014	978-0133767186	

STA701: Biostatistics

L	T	P	Total Credits
2	0	0	2

Course Objectives: Master statistical methods applied to biological data analysis. Develop skills to interpret and critically assess research findings in biological sciences.

Course Contents/syllabus:

	Teaching Hours
Unit I	**9 hrs**
Introduction to probability, measures of central tendency and measures ofdispersion. Fundamentals Random variables: discrete and continuous and their properties	
Unit II	**9 hrs**
Transformation of random variable and Probability integral transformation, Discrete distributions and continuous distributions	
Unit III	**9 hrs**
Multiple random variable, Joint and Marginal distributions, Bivariate transformation, Covariance and correlation	
Unit IV	**9 hrs**
Random sample, and properties of random sample, Fundamental of Sampling distribution and hypothesis testing	

Course Learning Outcomes: On the successful completion of this course the student will be able tounderstand the

1. basics of the probability
2. concept of random variable and transformation of random variable
3. statistical distributions and their applications in the real-world problems
4. random sample and their properties

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
Rohatgi V. K. and Saleh, A.K. Md. E.	An Introduction to Probability and Statistics	2nd Edition, John Wiley and Sons	2009	9788126519262, 9788126519262	---
Casella G. and Berger R. L.	Statistical Inference	2nd Edition, Cengage Learning India	2002	9788131503942, 9788131503942	---
Hogg R. V., Mckean J. and Craig A. T	Introduction to Mathematical Statistics	7th Edition, Pearson Education India	2013	9789332519114, 9789332519114	----
Mukhopadhyay P	Mathematical Statistics	Books and Allied	2016	9788187134930	----

NTCC: Seminar Presentation

L	T	P	Total Credits
0	0	2	2

Course Objectives: Learn effective techniques for presenting research papers to enhance communication skills and acquire strategies to deliver clear and engaging presentations of research findings for academic and professional audiences.

Course content and syllabus

Students will present the latest research/review article published in a reputed international peer-reviewed journal.

NTCC: Dissertation -I

L	T	P	Total Credits
0	0	8	8

Course objectives: Undertake research work with an aim of conducting original research and gain proficiency in research methodologies and scholarly inquiries.

Course content and syllabus

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

Programme structure for Integrated B.Sc. + M.Sc. (H) Biochemistry 5 years (10th Semester)

Sr.No	Course Code	Course Title	Course Type	Credit Units			
				L	T	P	Total Credits
1	BTY702	Genetic Engineering and Recombinant DNA Technology	Major Core Course	4	0	0	4
2	BCH703	Clinical Biochemistry	Major Core Course	4	0	0	4
3	HGM602	*Students will choose any one from the given choices* 1. Omics Technology and its Applications 2. Protein Engineering 3. MOOC	Minor Course	4	0	0	4
5		Dissertation -II	NTCC	0	0	12	12
		Total Credits					**24**

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

BTY702: Genetic Engineering and Recombinant DNA Technology

L	T	P	Total Credits
4	0	0	4

Course Objectives: Explore the fundamental principles of genetic engineering and recombinant DNA technology. Develop a deep understanding of techniques for gene manipulation and their applications in biotechnology and medicine.

Course content and syllabus

	Teaching Hours
Unit I: Genetic Recombination	**18 hrs**
Basic laws of Mendelian Genetics, Yeast Genetics as a tool to understand unlinked and liked genes, Tetrad analysis, linkage analysis, Measurement of genetic distance, Single nucleotide polymorphisms, Haplotype analysis, Haplotype as a tool for measuring genetic variation and relatedness,	
Unit II: Genetic manipulation mechanisms	**18 hrs**
Restriction-Modification systems in bacteria, cloning by complementation and selection, screening versus selection, Molecular mechanism of genetic recombination- homologous recombination, non homologous end-joining, RecBCD, Rec A and RuvABC systems, Eukaryotic recombinases like Rad51, Cre-Lox system of recombination, Gene knockout and knock-in strategies, CRISPR, TALENs, ZFN nucleases, Gene therapy	
Unit III: Gene knock-down strategies	**18 hrs**
Heterochromatin and euchromatin, Anti-sense methods of gene silencing, RNA interference, discovery and mechanisms in plants, animals and yeast, role of Dicer, Rdp and Ago1, Role in RNA degradation and link with heterochromatin silencing, miRNA and translational suppression and applications, gene silencing and DNA methylation, X-inactivation, role of RNA in X-inactivation	
Unit IV: Other genetic manipulation approaches	**18 hrs**
Other recombination systems, like RNA splicing, protein splicing, RNA editing, DNA cloning vectors in bacteria, yeast, plants and animals, bacteriophage vectors and systems of transformation, Design of expression vectors in different species, library construction vectors, DNA elimination in Trypanosomes	

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

1. Understand basic concepts of DNA integrity and genetic alterations.
2. Understand the concept of DNA cloning and vector
3. Understanding objectives and methods of knock-in and knockout techniques
4. Understand various genetic tools available for genetic manipulation in different organism

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
D. Voet, J. G Voet and C. W. Pratt	Fundamentals of Biochemistry, 5th Edition	John Wiley	5th edition, 2016	978-1-118-91840-1	1184
D.L. Nelson and M.M. Cox	Lehninger Principles of Biochemistry	Mcmillan	8th Edition	13: 978-1-319-32234-2 (epub)	4381

BCH703:Clinical Biochemistry

L	T	P	Total Credits
4	0	0	4

Course objective- The course objective for clinical biochemistry is to provide students with a comprehensive understanding of biochemical principles and laboratory techniques essential for diagnosing and monitoring diseases, emphasizing the interpretation of biochemical data in clinical contexts.

Course content and syllabus

	Teaching Hours
Unit I: Disorders of carbohydrates	**15 hrs**
Carbohydrates- Diabetes mellitus, Glycogen Storage diseases, galactosemia, pentosuria. Amino Acids- Disorders of glycine, sulfur containing amino acids, aromatic amino acids, histidine, branched chain amino acids and proline, disorders of propionate and methylmalonate metabolism. Disorders in urea biosynthesis.	
Unit II: Disorders of lipid	**15 hrs**
Hyperlipoproteinemia, Abetalipoproteinemia, Hyperlipidemia, Tay-Sachs Disease (Gangliosidosis), Neimann Pick Disease, Gaucher's Disease, Krabb's Disease, Metachromatic leukodystrophy and Fabry's Disease, Wolman's Disease, Disorders of porphyrin and heme metabolism, Disorders in purine and pyrimidine metabolism.	
Unit III: Abnormalities in metabolism	**15 hrs**
Inborn Errors of Metabolism – Phenylketonuria, alkaptonuria, albinism, tyrosinosis, maple syrup urine disease, Lesch-Nyhan syndrome, sickle cell anemia, Histidinemia. Digestive diseases – Maldigestion, malabsorption, creatorrhoea, diarrhoea and steatorrhoea. Disorders of liver and kidney – Jaundice, fatty liver, normal and abnormal functions of liver and kidney. Inulin and urea clearance. Electrolytes and acid-base balance – Regulation of electrolyte content of body fluids and maintenance of pH, reabsorption of electrolytes. Abnormalities in Nitrogen Metabolism – Uremia, hyperuricemia, porphyria and factors affecting nitrogen balance.	
Unit IV: Biochemical and diagnostic tests in clinical practice.	**15 hrs**
Diagnostic Enzymes – Enzymes in health and diseases. Biochemical diagnosis of diseases by enzyme assays – SGOT, SGPT, CPK, cholinesterase, LDH Biochemical tests in clinical practice: uses of a chemical/biochemical analysis; Criteria for selecting a method for biochemical analysis; Enzymes as diagnostic tool; Advantages and disadvantages of enzyme assays; Isoenzymes and their diagnostic importance; Methods for the detection of isoenzymes; Organ function tests: clinical	

presentation and diagnosis of the diseases of the liver and kidney; Bilirubin metabolism and hyperbilirubinaemia; Acid base disorders.	

Course Learning Outcomes:

- Understand the disorders of lipid and carbohydrate metabolism.
- Perceive the knowledge of genetic and chromosomal abnormalities.
- Understand the abnormalities due to defect in metabolic process.
- Understand biochemical test in the clinical practices and the mechanism.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No.	Pages
Marshell W.J. and Bangert, S.K.	Clinical Chemistry	International edition MOSBY, Elsevier	9th Ed	978-0702079368	432
Burtis, C.A., Awood, E.R. and Bruns, D.E. TIETZ,	Text book of Clinical Chemistry and Molecular Diagnosis	Elsevier	4th Ed.	---	---
Lieberman, M and Peet, A.	Medical Biochemistry, A Clinical Approach. 3rd Ed	Lippin Williman wilkins	2017	978-1496387721	1008

HGM602: Omics Technology and its Applications

L	T	P	Total Credits
4	0	0	4

Course Objectives: Explore the principles and methodologies of genomics, transcriptomics, proteomics, metabolomics, and microbiomics. Learn to apply cutting-edge bioinformatics tools for data analysis in various fields.

Course content and syllabus

	Teaching Hours
Unit I: Genomics	**18 hrs**
DNA sequencing methods- Sanger and Maxam-Gillbert method. Next-generation sequencing platforms. Techniques for genome research (chromosome walking, RFLP, chromosome capture techniques). Application of microbial genome variability for human welfare. Human genome sequencing project. Genome sequencing strategies: Hierarchical and whole genome shotgun sequencing. 100000 genome project.	
Unit II: Genome Evolution and Annotation	**18 hrs**
Evolution by Genome Expansion and Reduction Metagenomics Methods to Compare Genomes Archaeal Genomics Microbial Genome Annotation Genomics for pathogenic microbes – Search for better vaccines	
Unit III: Transcriptomics and Proteomics	**18 hrs**
Introduction to Transcriptomics: Methods to estimate RNA – RT-PCR, SAGE, RNA sequencing, direct RNA sequencing. Introduction to Proteomics: Methods to estimate proteins: 2D-PAGE, 2D-DIGE, ICAT, ITRAQ, SILAC. Importance of transcriptomics and proteomics in infectious and non-infectious diseases	
Unit IV: Metabolomics, Interactomics	**18 hrs**
Introduction to metabolomics and Interactomics. Experimental approaches to estimate metabolite levels. Fluxomics. High-throughput approaches towards Protein-protein and DNA-protein interactions Integrated (multi-omic) approaches in infectious and non-infectious diseases	

Course Learning Outcomes:

1. To expose students in the multiple areas of omic technologies
2. Students will learn about different approaches used in the areas of Genomics, transcriptomics, proteomics, metabolomics, and inteactomics.

3. Learn how different omic approaches is used to generate testable hypothesis.
4. Role of multi-omic approaches towards better understanding of infectious and non-infectious diseases.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Thomas J. Dougherty and Steven J. Projan	Microbial Genomics and Drug Discovery	CRC	2003	978-0824740412	264
A. Malcolm Campbell, Laurie J. Heyer	Discovering Genomics, Proteomics and Bioinformatics	Pearson Education	2007	978-8131715598	464

Protein Engineering

L	T	P	Total Credits
4	0	0	4

Course Objectives: Develop a deep understanding of protein structure, function, and engineering principles. Gain proficiency in designing novel proteins with tailored properties for applications in biotechnology and medicine.

Course content and syllabus

	Teaching Hours
Unit I: Protein Structure and Function Review	**18 hrs**
Amino acids in proteins; Protein structure: Chemistry, features and elucidation.	
Unit II Protein Architecture Analysis	**18 hrs**
Protein Structure assessment; Primary structure - Peptide mapping, peptide sequencingmethods; Secondary structure - Motifs and functions; Tertiary structure - Domains, folding, kinetics; Protein structure modeling; Experimental and computational protein design	
Unit III: Structure Function relationships- Prediction, engineering and design	**18 hrs**
Protein motifs and role in engineering (DNA binding, Helix turn helix, Zn - finger, Leucine zippers); Mutagenesis and Protein engineering - Site directed and saturation mutagenesis, DNA shuffling; error prone PCR; Protein Evolution - Cell surface and cell free display, Library construction and screening; Protein engineering strategies - Directed evolution and Rational Design Combinatorial enzyme engineering; Therapeuticproteins in Antibody engineering; Multifunctional proteins	
Unit IV: High throughput Protein Engineering	**18 hrs**
Rational protein design - Computational design interventions; Engineered Biomimetic proteins; Protein Modular Design - re-engineering using non canonical amino acids, protein structural and mechanical property modification; Sequence and knowledge based design; De novo protein design; Forward and reverse protein engineering, Case examples.	

Course Learning Outcomes:

1. Recognize the fundamental concepts of protein structure and can apply this knowledge in designing proteins for bioengineering purposes.
2. Explain the theory and practice of a variety of protein engineering methods.
3. Infer and model specific examples of engineered proteins and their applications.
4. Map the requisite strategies for devising bioreactors used in engineering tissues.
5. Synthesize and design a basic protein engineering experiment.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Voet D. and Voet G.,	Biochemistry	John Wiley and Sons,	3rd /2001	9780321733603	1178
Branden C. and Tooze J.	Introduction to Protein Structure	Garland Publishing, NY, USA	1999	456879994	345

NTCC: Dissertation -II

L	T	P	Total Credits
0	0	12	12

Course objective: Undertake research work with an aim of conducting original research and gain proficiency in research methodologies and scholarly inquiries.

Course content and syllabus

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