Semester-Wise Programme structure for M.Sc.(H) Biochemistry (2 Years)				
Sr. No.	**Year 1**		**Year 2**	
	Semester 1	**Semester 2**	**Semester 3**	**Semester 4**
1	Advanced Cell Biology [CU:4,L-4] {CC}	Immunology & Immunotechniques [CU:4,L-4] {CC}	Advanced Bioinformatics [CU:4,L-4] {CC}	Clinical Biochemistry [CU:4,L-4] {CC}
2	Bioanalytical Techniques [CU:4,L-4] {CC}	Molecular Biology & Gene Expression [CU:4,L-4] {CC}	Nutritional Biochemistry[CU:4,L-4] {CC}	Genetic Engineering and Recombinant DNA Technology [CU:4,L-4] {AC}
3	Metabolism of Biomolecules [CU:4,L-4] {CC}	Practicals in Biochemistry -II [CU:4,P-4] {CC}	Practicals in Biochemistry -III [CU:2,P-2] {CC}	SE6- [CU:4 , L-4] {SE}
4	Practicals in Biochemistry -I [CU:4,P-4] {CC}	SE3 [CU:4 ,L-4] {SE} {SE}	Fundamentals of BioEntrepreneurship [CU:2, L-2] {CC}	Dissertation Work [CU:12,P-12] {NTCC}
5	SE1- [CU:4 ,L-4] {SE}	SE4- [CU:4 ,L-4]	Research Paper Presentation [CU:2,P-2] {NTCC}	
6	SE2- [CU:4 ,L-4] {SE}	SE5- [CU:4 ,L-4] {SE}	Statistics for Life Sciences [CU:2,L-2] {CC}	
7	Behavioral Sciences [CU:1,L-1] {VAC}	Behavioral Sciences [CU:1,L-1] {VAC}	Dissertation Work [CU:8,P-8] {NTCC}	-
8	Foreign Business Language (French/German) [CU:1,L-1] {VAC}	Foreign Business Language (French/German) [CU:1,L-1] {VAC}	Professional Ethics -I [CU:1, L-1] {VAC}	-
Credits	**26**	**26**	**24**	**24**
Total Programme Credits				**102**

AC	**Allied Course**
AEC	**Ability Enhancement Course**
CC	**Core Course**
GE	**General Elective**
OE	**Open Elective**
SC	**Skill component**
SE	**Specialization Elective Course**

SEC	**Skill Enhancement Course**
VAC	**Value Added Course**
NTCC	**Non Teaching Credit Course**
CU	**Credit Unit**
L;T;P	**Lecture ; Tutorial ; Practical**
H	**Honours**

Programme structure for M.Sc. (H) Biochemistry- 2 years (1st Semester)

Sr. No	Course Code	Course Title	Course Type	Credits					Credit Units
				L	T	PS	FW	SW	
1	BCH601	Advanced Cell Biology	Core Courses	4	0	0	0	0	4
2	BCH602	Bioanalytical Techniques	Core Courses	4	0	0	0	0	4
3	BCH609	Metabolism of Biomolecules	Core Courses	4	0	0	0	0	4
4	BCH611	Practicals in Biochemistry-I	Core Course	0	0	4	0	0	4
5	1. MBO601 2.BTY602 3.CHE603	*Students will choose anytwo** 1.General Microbiology and Microbial Genetics 2. IPR, Biosafety and Ethics 3. Biochemistry of Transition Elements 4. MOOC	SpecializationElective Course	4 4	0 0	0 0	0 0	0 0	4 4
6	PSY601	Behavioural Science	Value Added Courses	1	0	0	0	0	1
7	FOL101/ FOL102	Foreign Business Language (French/German)	Value Added Courses	1	0	0	0	0	1
			Total Credits.						**26**

*The Specialization Elective Courses of 1st, 2nd and 4th Semesters will be pooled together.

The Specialization 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 Contents/syllabus:

	Teaching Hours
Unit I: Cell wall and Cell membrane	**18 hrs**
Cell wall and Cell Membrane: Physical structure of model membranes in prokaryotes and eukaryotes, and their constituents; structural organization and functions of cell organelles. **Transport of nutrients:** Ions and macromolecules across membranes. Different classes of pumps and their mechanism. Cellular energy transactions.	
Unit II: Organization of genomes	**18 hrs**
Organization of genomes: Genes and chromosomes, Operon, unique and repetitive DNA, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons. **Cell division and cell cycle:** Mitosis and meiosis, Cell cycle and its regulation, Apoptosis, Necrosis ,Autophagy and other forms of cell death. Contribution of Nobel laureates in elucidation of the DNA structure,cell death and cell cycle. **Cellular basis of differentiation and Development:** Meiosis, gametogenesis, fertilization and up to the formation of three germinal layers	
Unit III: Cell signaling	**18 hrs**
Cell signaling: Hormones and their receptors, cell surface receptor, and signalling mechanisms, bacterial chemotaxis and quorum sensing. **Cell transformation and cancer:** Oncogenes and proto-oncogenes, tumor suppressor genes, metastasis. Therapeutic interventions of uncontrolled cell growth.	
Unit IV: Cellular communication	**18 hrs**
Cellular communication: General principles of cell communication, cell adhesion and roles of different adhesion molecules, tight junctions, communicating junctions, neurotransmission and its regulation.	

Course Learning Outcomes:

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

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
De-Robertis, F.D.P. and De-Robertis Jr. E.M.F.	Cell and Molecular Biology	Lippincott Williams & Wilkins	2012	978-1469810997	---
Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K. and Walter p.	Molecular Biology of The Cell	Garland Science Publishers	6th Edition	978-0815344643	1464

BCH602: Bioanalytical Techniques

L	T	P	Total Credits
4	0	0	4

Course content and syllabus

	Teaching Hours
Unit I -Spectroscopy & Chromatography	**18 hrs**
Spectroscopy- Concepts of spectroscopy, Laws of photometry. Beer-Lambert's law, Principles and applications of colorimetry. UV-Visible absorption spectroscopy, Fluorescence spectrophotometry, Mass spectroscopy, CD, X-ray diffraction, X-ray spectroscopy and NMR. **Chromatography –** Principles and applications of paper, thin layer, ion exchange, affinity, gel permeation, adsorption and partition chromatography. HPLC and FPLC.	
Unit II: Centrifugation & Electrophoresis	**18 hrs**
Principle of centrifugation, concepts of RCF, different types of instruments and rotors, preparative, differential and density gradient centrifugation, analytical ultra-centrifugation, determination of molecular weights and other applications, sub-cellular fractionation. Electrophoretic techniques – Principles of electrophoretic separation. Types of electrophoresis including paper, cellulose, acetate/nitrate and gel. Electroporation, Pulse field gel electrophoresis, 2D Gel Electrophoresis.	
Unit III: Microscopy	**18 hrs**
Microscopy – Bright field, Dark field, Phase contrast and Fluorescence microscopy, Transmission and scanning, freeze fracture techniques, specific staining of biological materials.	
Unit IV: Nano-biosensors	**18 hrs**
Introduction to Nano-biosensors and their biological applications.	

Course Learning Outcomes:

- Understand principles of various techniques to quantify and separate biomolecules.
- Describe the methodology of various bioanalytical techniques employed in laboratories.
- Discriminate between various techniques with respect to their applications.
- Evaluate the impact of Nano-biosensors in the advancement of bioanalytical techniques.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Plummer, David T.	An Introduction to Practical Biochemistry	Tata McGraw Hills	3rd	978-0070841659	352
Wilson Keith and Walker John.	Principles and techniques of Biochemistry and MolecularBiology	Cambridge University Press	7th	978-0521731676	759 pages

BCH609: Metabolism of Biomolecules

L	T	P	Total Credits
4	0	0	0

Objectives: After studying this course, the students will be able to refresh their knowledge of biomolecules and their metabolism.

Course content and syllabus

	Teaching Hours
Unit I: Carbohydrate metabolism	**18 hrs**
Structure, function, properties, reactions, and classification of carbohydrates; Glycosidic linkage – types, occurrence, and functions of glycoconjugates, Carbohydrate metabolism – degradation and synthesis of carbohydrates, glycolysis, gluconeogenesis, glycogenesis, TCA cycle, Electron transport chain, regulation of carbohydrate metabolism and central carbon metabolism.	
Unit II: Protein metabolism	**18 hrs**
Amino-acids, peptides, and proteins – Classification, biological role, Zwitterion structure, isoelectric point and correlation to acidity and basicity of amino acids. Overview of primary, secondary, tertiary, and quaternary structure of proteins, denaturation of proteins. Amino acid metabolism – biosynthesis and catabolism, amino acids as carbon pool, Autophagy, Protein maturation and secretion	
Unit III: Nucleic acid metabolism	**18 hrs**
Nucleic acids - Structure and function of nucleotides. Primary, secondary and tertiary structure of nucleic acids, DNA forms and conformations. Nucleotides – Biosynthesis and degradation of purine and pyrimidine nucleotides and its regulation.	
Unit IV: Fat metabolism	**18 hrs**
Classification, structure, properties and functions of fatty acids, essential fatty acids, fats, phospholipids, sphingolipids, cerebrosides, steroids, bile acids, prostaglandins and lipoproteins. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol). Biosynthesis and degradation of tri-acylglycerols, phospholipids and sphingolipids, α-, ß- and ω- oxidation of fatty acids,	

Course Learning Outcomes:

1. Understand carbohydrate metabolism.
2. Understand protein metabolism
3. Understand nucleic acid metabolism
4. Understand fat metabolism.

Pedagogy for Course Delivery

Lectures: 60 sessions
Presentation / Seminar: 4 sessions
Class Test: 2 sessions
Surprise Test: 6 sessions
Total: 72 sessions

Text/Reference Books

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
Finar, I. L.	Organic Chemistry (Volume 1 & 2)	Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).	2002	1. 978-8177585421	966 pages
Voet, D. and Voet, J.	Biochemistry	Wiley	4th edition,2013	9781118092446	1616 pages
D.L. Nelson and M.M. Cox	Lehninger Principles of Biochemistry	McMillan North Publication	4th Edition 20	978-1319108243	1328 pages
L. Stryer	Biochemistry	Freeman &Co. New York.	5th Edition	978-0716746843	1050 pages

BCH611: Practicals in Biochemistry -I

L	T	P	Total Credits
0	0	4	4

Course Contents/syllabus:

List of Experiments (Total Teaching Hours = 60 hrs)

Good Laboratory Practices
Preparation of molar solutions, normal solutions and buffers (citrate buffer and phosphate buffer)
Determination of pH and use of pH meter
Qualtitative chemical analysis of carbohydrates by Fehling's Test, Tollen's Test, Molisch's Test ,Barfoed test and Benedict Test
Colorimetric estimation of glucose by DNS Method
Colorimetric Estimation of proteins by Biuret Method
Thin Layer and Paper Chromatography - a. Separation of plant pigments by paper chromatography b. Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layerchromatography (TLC).

Course Learning Outcomes:

- Acquaintance with laboratory-based ethical code of conduct for well-being of oneself andpeers
- Identify the environmental and industrial relevance of experimental techniques in biochemistry
- Qualitative chemical estimation and separation of biologically relevant molecules

Text / Reference Books:

AUTHOR	TITLE	Publisher	Ed/Year of publication	ISBN	Pages
A.I. Vogel, A.R. Tatchell, B.S. Furnis	Vogel's Textbook of Practical Organic Chemistry	Prentice Hall	5th	978-0582462366	1552
Plummer ,D.T.	An Introduction toPractical Biochemistry	Tata McGrawHill	3rd	0-07-099487-0	332

BTY602: IPR, Biosafety and Bioethics

L	T	P	Total Credits
4	0	0	4

Course content and syllabus

	Teaching Hours
Unit I: Introduction to IPR and Patent Database	**18 hrs**
Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications. **Protection of New GMOs:** International framework for the protection of IP. IPs of relevance to Biotechnology and few Case Studies. **Patent databases**: Invention in context of "prior art"; Searching national/International Databases; Analysis and report formation	
Unit II: Types of patent and patent application	**18 hrs**
Types of patents: Indian Patent Act 1970; Recent Amendments; Filing of a patent application; Precautions before patenting-disclosure/non-disclosure; WIPO Treaties; Budapest Treaty; PCT and Implications; Role of a Country Patent Office; Procedure for filing a PCT application	
Unit III: Biosafety, GMOs and Biodiversity Act	**18 hrs**
Biosafety: Introduction; Historical Background: Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines - Government of India; **Definition of GMOs & LMOs:** Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; **Risk Assessment:** Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartagena Protocol. **Biodiversity Act 2002:** Agricultural biodiversity; International Treaty on Plant Genetic Resources for Food and Agriculture (PGRFA); Conservation strategies for seed gene bank; Climate change and conservation of plant genetic resources; Global efforts for management of crop genetic resources; Strategies on PVFR and Biodiversity Acts. **Biodiversity Legislation in India;** Indian Biodiversity Act and provisions on crop	
Unit IV: Bioethics, Ethics and the law issues	**18 hrs**
Bioethics: Concepts; Philosophical considerations; Epistemology of Science; Ethical Terms; Principles & Theories; Relevance to Biotechnology; **Ethics and the Law Issues:** types and policies; Research concerns; Emerging issues: Biotechnology's Impact on Society; DNA on the Witness Stand - Use of genetic evidence in civil and criminal court cases; Challenges to Public Policy – To Regulate or Not to Regulate; Improving public understanding of biotechnology products to correct misconceptions.	

Course Learning Outcomes:

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

Text / Reference Books:

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

MBO601: General Microbiology & Microbial Genetics

L	T	P	Total Credits
4	0	0	4

Course content and syllabus

	Teaching Hours
Unit I: Types of Microscopy and Principles of Microbiology	**18 hrs**
Microscopy: Bright field, phase contrast, fluorescence, confocal, and electron microscopy. **Principles of Microbiology**: Principles and applications of bright field, dark field, phasecontrast, fluorescence and scanning tunnelling microscopy. **Methods in microbiology:** Pure culture techniques, theory & practice of sterilization, principles of microbial nutrition, microbial culture media, enrichment culture techniques, culture collection, isolation and & preservation.	
Unit II: Bacterial Classification and Diversity	**18 hrs**
Bacterial Classification and Diversity: Importance of taxonomy conventional and modern methods; polyphasic approach of bacterial classification, 16S rRNA **Genomic Similarity:** Content of guanine (G)+ cytosine (C) (%GC), DNA-DNA homology, Fatty acid analysis; archaea as the earliest life forms, archaea vs eubacteria, bacteria producing important secondary metabolites. **Prokaryotic Cells:** Structure-function; cell walls of eubacteria and related molecules, outer membrane of Gram-negative and Gram-positive bacteria, capsules, slime layers, Pili, fimbriae and flagella, sporulation and regeneration of bacteria. **Microbial Growth:** Definition of growth, mathematical expression of growth, growth curve, diauxic & synchronous growth, continuous culture, effect of environmental factors like temperature, pH, water availability, dissolved oxygen, agitation and aeration etc., on the growth of microbes.	
Unit III: Bacterial Genetics and Virology	**18 hrs**
Bacterial Genetics and Virology: Transformation, transduction, conjugation, RecA, plasmids, their replication, copy number and compatibility, drug resistance; transposons, **Viruses**: General characteristics, classification, ultra-structure, purification & assay, viroids; virulent and temperate bacteriophages, γ- lytic cascades and lysogenic repression.	
Unit IV: Host-pathogen interaction	**18 hrs**

Host-pathogen interaction: Recognition and entry processes of different pathogens like bacteria, viruses and protozoans into animal and plant host cells, alteration of hostcell behaviour by pathogens, virus-induced cell transformation, pathogen-induceddiseases in animals and plants, cell-cell fusion in both normal and abnormal cells.	

Course Learning Outcomes:

- Understand advanced Microbiology.
- Evaluate bacterial classification and diversity
- Compare effect of different environment factor on bacterial growth
- Perceive knowledge of host-pathogen interaction

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Pelczar, M.J. Jr., ChanECS and Krieg, N.R.	Microbiology : Concepts and Applications	New York; Madrid : McGraw-Hill,	1993	0070492581, 9780070492585	957
Cappucino, J.G.	Microbiology-A laboratory manual,4th ed., Harlow, Addition-Wesley.	Hoboken, N.J.:Pearson	2020	0135188997, 9780135203996, 0135203996	541

CHE603: Biochemistry of Transition Elements

L	T	P	Total Credits
4	0	0	4

Course Contents/syllabus:

	Teaching Hours
Unit I: Organotransition metal chemistry-I	18 hrs
General introduction, 18-valence electron rule, general applications of organometallic complexes in health and industry. Futuristic aspects of organotransition metal chemistry	
Unit II: Organotransition metal chemistry-II	18 hrs
Structure and bonding, of π-bonded organometallic compounds including carbonyls, nitrosyls and their M.O. diagrams. Metal-carbon multiple bonds. Fluxional organometallic compounds including π-allyl complexes.	
Unit III: Bioinorganic Chemistry -I	18 hrs
Biologically important metals and metal complexes *(i) Vitamin B12:* Bio-inorganic chemistry of cobalt, vitamin B12, combalamins, cobamide and their model compounds. *(ii) Metals in Medicine:* Metal deficiency and disease, toxic effects of metals, metals used for diagnosis and chemotherapy with particular reference to anticancer drugs, selenium and tellurium drugs, cis-platin and analogues, alternatives to cis-platin, adverse effects of anticancer drugs, toxicity due to non-essential metals *(i) Introduction to biomolecules:* proteins, enzymes, nucleic acids, porphyrin and corri *(ii) Role of metals in bio-systems:* a general survey of the role of main group elements and transition elements in biological systems ionophores, cation transport: Na/K ion pump. *(iii) Heme and non-heme proteins:* Haemoglobin and myoglobin as oxygen carriers, Bo effect. Coordination chemistry of Fe(II) in haemoglobin and oxyhaemoglobin. Relaxed and tense (R & T) configurations of haemoglobin, electronic formulations and mode o bonding of dioxygen in haemoglobin	

(modeling), Cytochromes and other natural oxygen carriers such as hemerythrins and hemocyanins.	
Unit IV: Bioinorganic Chemistry - II	18 hrs
(i)Metalloenzymes: Carbonic anhydrase and carboxy peptidase, amino peptidase, Alkaline phosphate. Superoxide dismutase; inhibition of metalloenzymes ii) Nitrogen fixation: Classification of nitrogen fixing bacteria (iii) Nitrogenase enzymes: Structural identification of nitrogenase enzymes and itssynthetic analogues-double cubane cluster. Mechanism of nitrogen fixation by nitrogenases and role of ATP in nitrogen fixation.	

Course Learning Outcome:

- Understanding the role of metals in the functioning of critical enzymes and in nitrogenfixation
- Comprehension of unique physico-chemical characteristics of naturally occurring transition metal compounds

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
Zubay, G., Parson, W.W. and Vance D.E	Principles of Biochemistry	Brown (William C.) Co ,U.S.	1995	978-0697142757	---
Voet, D.nd VoJ.	Biochemistry	Wiley	5th edition (2018)	978-1119451662	1200
I. Levine	Physical Chemistry	Tata McGrawHill Education	6th edition(2011)	978-0071321211	1012

PSY601: Behavioural Science: Understanding Self for Effectiveness

L	T	P	Total Credits
1	0	0	1

Course Objectives: The objective of this course is to introduce the student to effective self management so that they can think and act in right manner. They should act as a dynamic leader and motivator by understanding themselves as well as other in more refined manner.

Course Contents/syllabus:

	Time
Unit I: Understanding Self and Worth	**4 hrs**
Formation of self concept Dimension of Self Components of self; Self Competency; Meaning and Nature of Self Esteem; Importance & need of Self Esteem; Steps to enhance Self Esteem; Self Esteem at work	
Unit II: Emotional Intelligence: Brain Power	**5 hrs**
Introduction to EI; Difference between IQ, EQ and SQ Relevance of EI at workplace; Self assessment, analysis and action plan	
Unit III: Managing Emotions and Building Interpersonal Competence	**5 hrs**
Need and relevance of Emotions; Healthy and Unhealthy expression of emotions Anger: Conceptualization and Cycle Developing emotional and interpersonal competence; Self assessment, analysis and action plan	
Unit IV: Leading Through Positive Attitude	**4 hrs**
Understanding Attitudes; Formation of Attitudes; Types of Attitudes; Effects of Attitude on: Behavior, Perception, Motivation, Stress, Adjustment, Time Management, Effective Performance Building Positive Attitude	

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

- To apply cutting edge scientific insights about human behaviour, and learn how to change human behavior by altering the "context" in which people act rather than how they think
- Understand state-of-the-art methodological and statistical approaches that are necessary to evaluate the effectiveness of behavioral change.
- Apply behavioral science knowledge and skills to develop insights on individuals and society
- Analyze the nature of human behavior and the impact of factors that influence how humans feel, think and act at an individual, group and societal level
- Evaluate the influence of values and attitudes on human behavior.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Singh A.	Achieving Behavioural Excellence for Success	Wiley Publication	2012	9788126 5 8027
Towers, Marc	Self Esteem	American Media	1995	9781884 9

				26297
Pedler Mike, BurgoyneJohn, Boydell Tom	A Manager's Guide to Self-Development	McGraw-Hill	2006	978-0077114701
Covey, R. Stephen	Seven habits of HighlyEffective People	Simon & Schuster Ltd	2013	978-1451639612
Khera Shiv	You Can Win	Macmillan	2005	978-0333937402
Gegax Tom	Winning in the Game ofLife	Harmon yBooks	1999	978-0609603925
Singh, Dalip	Emotional Intelligence atWork	Publications	2006	9780761935322
Goleman, Daniel	Emotional Intelligence	Banta m Books	2007	9780553095036
Goleman, Daniel	ing with E.I	Banta m Books	1998	9780553104622

FOL102:Introduction to German Culture & Language

L	T	P	Total Credits
1	0	0	1

Course Contents/syllabus:

	Teaching hours
Unit-I Introduction to German Language (Einführung)	**5 hrs**
Introduction to German as a global language, Self-introduction and Greetings, DieAlphabeten, Phonetics: the sound of consonants and vowels, Wie buchstabieren Sie Ihren Name?	
Unit-II- Numbers and everyday conversation (die Zahl und Gespräche)	**4 hrs**
Counting in German from 1-100, Simple Calculation and verb 'kosten' - Wie vielkostet 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)	**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 hrs**
The Family, Work-life and Professions (Familienmitglieder und Berufe) Vocabulary: Professions and conjugation of the verb 'sein' Introduction to simplepossessive pronouns with the help of the verb 'haben' Usage of possessive pronouns. Interrogative sentences (W-Fragen) W-Fragen: who, what, where, when, which, how, how many, how much, etc. Exercises on the question pronouns	

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

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

Text / Reference Books:

Author	Title	Publisher	Year	ISBN

Rolf Bruseke	Starten Wir A 1	Langers International Pvt Ltd (Max Hueber Verlag)	2017	978-3190160006
Giorgio Motta	Wir Plus Grundkurs Deutsch fur Junge Lerner Book	Ernst Klelt Verlog	2011	978-8183072120
Heimy Taylor, Werner Haas	Station en Deutsch Self Study Course German Guide	Wiley	2007	978-0470165515

FOL101: Introduction to French Culture & Language

L	T	P	Total Credits
1	0	0	1

Course Contents/syllabus:

	Teaching hours
Unit-I Introduction to French language	**4 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	**5 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	**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 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 themselvesin writing and orally in basic French. This course content focuses on the speech of the students in a lucid and a concurrent manner using appropriate vocabulary and pronunciation techniques. Extra stress will be given on their understanding of grammatical structures and the foreign accent of the language. At the end of the course, the student shall be able to :

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

Text / Reference Books:

Author	Title	Publisher	Year	ISBN No
Christine Andant, Chaterine Metton, Annabelle Nachon, Fabienne Nugue	A Propos - A1 Livre De L'Eleve, Cahier D' Exercices	Langers International Private Limited	2010	978-938080 9069
Manjiri Khandekar and Roopa Luktuke	Jumelage - 1 Methode De Fraincais - French	Langers Internationa l 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

Programme structure for M.Sc. (H) Biochemistry- 2 years (2nd Semester)

Sr. No	Course Code	Course Title	Course Type	Credits			
				L	T	PS	CU
1	IMM601	Immunology and Immunotechniques	Core Course	4	0	0	4
2	HGM603	Molecular Biology and Gene Expression	Core Course	4	0	0	4
3	BCH606	Practicals in Biochemistry -II	Core Course	0	0	4	4
4	BCH605 HGM601 BCH608	*Students will choose any **three** from the given choices** 1. Advanced Enzymology 2. Stem Cell and Regenerative Medicine 3. Essentials in Biotechnology 4. Synthetic and systems Biology 5. Topics in Life Sciences 6. MOOC	Specialization Elective Course	4 3 4	0 0 0	0 1 0	4 4 4
5	PSY611	Behavioural Science	Value Added Course	1	0	0	1
6	FOL103/ FOL104	Foreign Business Language	Value Added Course	1	0	0	1
		Total Credits					**26**

*The Specialization Elective Course of 1st, 2nd and 4th semesters will be pooled together.

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

IMM601: Immunology and Immunotechniques

L	T	P	Total Credits
4	0	0	4

Learning Objective: The objective of this course is to provide basics of immune system where studentswill learn the components and molecules of immunity and various immune responses at the cellular level that work together to protect the host, autoimmune disorders and Immunotechniques.

Course content and syllabus

	Teaching Hours
Unit I: Introduction and Overview of Immune System	**18 hrs**
Historical development of the branch "Immunology", Overview of the immune system,Molecules, cells and organs involved in immunity. Hematopoiesis, Innate immunity, adaptive immunity, Antigens, Immunogens, Haptens, Epitopes. Antigen-Antibodyinteractions, Discovery of immunoglobulins.	
Unit II: Adaptive Immune response	**18 hrs**
Humoral Immunity, Structure and function of various classes of immunoglobulins, Generation of antibody diversity, class switching among constant-region genes, B-cellactivation and differentiation, B-cell receptor and the immunoglobulin superfamily, Generation of B cells, Responses, Immunological memory, Cell mediated immunity, MHC restriction and mechanism of antigen presentation, T-cell receptors, maturation,activation and differentiation, Generation of different types of T cells, Responses, Immunological memory.	
Unit III: Immune Effector Mechanisms and Immune system in Health/Disease	**18 hrs**
Properties of cytokines, receptors, The complement systems, mechanism of complement activation, pathology related to complement proteins, Allergy, hypersensitivity (I,II,III,IV), Tolerance, Mechanisms of induction of autoimmunity, treatment of autoimmune diseases. Immunodeficiencies, AIDS, Transplantation immunology, Tumor antigens and cancer immunotherapy, Concepts of vaccines, whole-organism vaccines, recombinant vaccines, DNA vaccine, synthetic peptide and multivalent sub-unit vaccines.	
Unit IV: Immunotechniques	**18 hrs**
Applications of antibodies in diagnostics and routine laboratory assay systems.Agglutination reaction, principles of western blots, radioimmunoassay, ELISA, immunohistochemistry, Development of monoclonal antibodies, Flow cytometry,immunocytes identification and purification.	

Course Learning Outcomes:

- Understanding of mechanisms used by the human body to fight foreign agents and disease-causing pathogens.
- Students will be able to devise strategies to combat infection or diseases produced by alteredself.
- Students will develop ability to use this knowledge in the processes of immunization, antibodyengineering, vaccine development, transplantation, and cancer therapy.
- Students will develop ability to use various techniques of immunology in research work.

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	978-1319114701	944
D. Male, J. Brostoff, D. Roth, I. Roitt	Immunology (8th Edition)	Saunders, Elsevier, USA	2012	978-0702045486	482
K. Murphy	Janeway's Immunobiology (8th Edition)	Garland Science, USA	2011	978-0815342908	887
A. Abbas, A. Lichtman, S. Pillai	Cellular and Molecular Immunology (8th Edition)	Saunders, Elsevier, USA	2014	978-8131264577	-

HGM603: Molecular Biology and Gene Expression

L	T	P	Total Credits
4	0	0	4

Course content and syllabus

	Teaching Hours
Unit I: DNA Replication	**18 hrs**
DNA replication in Prokaryotes: Initiation, Elongation and Termination. Regulation ofreplication. DNA replication in Eukaryotes: Initiation, Elongation and Termination. End-Replicationproblem.	
Unit II: RNA Transcription	**18 hrs**
RNA synthesis and processing in prokaryotes and eukaryotes: transcription factors andmachinery, formation of initiation complex, transcription activator and repressor, RNApolymerases, capping, elongation, and termination, RNA processing, RNA editing, spilicing, and polyadenylarion, structure and function of different types of RNA, non coding RNA, RNA transport.	
Unit III: Translation of Proteins	**18 hrs**
Protein synthesis and processing in prokaryotes and eukaryotes: Ribosome structure,genetic code, aminoacylation of tRNA, tRNA-identity aminoacyl tRNA synthetases, formation of initiation complex, initiation factors and their regulation, elongation andelongation factors, termination, translation proof-reading, translational inhibitors, Post-translational modification of proteins.	
Unit IV: Regulation of Gene Expression	**18 hrs**
Regulation of Gene Expression in Bacteria: Concept of operon, lac operon, catabolite repression, trp operon Phages: control of lytic and lysogenic cycles Regulation of Gene Expression in Eukaryotes: Regulatory promoters, enhancers andsilencers. Transcription activator protein. Role of mediator protein in transcription. Gal4 operon. Chromatin remodeling and Epigenetic modifications.	

Course Learning Outcomes:

(i) Molecular mechanisms of DNA replication in prokaryotes and Eukaryotes
(ii) DNA transcription in prokaryotes and eukaryotes
(iii) Protein synthesis in prokaryotes and eukaryotes
(iv) regulation of gene expression

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Watson, JD., Baker, TA., Stephen, PB., Alexander,	Molecular Biology of theGene	Pearson Education	7th Ed	978-9332585478	912

G., Levine, M., Losick R.					
Tropp, B.E.	Molecular Biology Genes to proteins	Jones and Bartlet	4th Ed.	978-93-80853-49-9	1096

BCH606: Practicals in Biochemistry -II

L	T	P	Total Credits
0	0	4	4

List of Experiments -with basic instructions (Total time = 120 hrs)

1. Laboratory Safety including Chemical, Biological and Radiations.
2. DNA isolation from bacteria/yeast/animals/plants
3. Preparation of proteins by acetone extraction method and also ammonium sulfate fractionationmethod and running the gel.
4. Extraction & Fractionation of Nucleic acids
5. Visualizing and Quantification of nucleic acids
6. Blotting techniques (Slot/ Dot/ Western)
7. Assay of isoenzmes. (LDH/CPK)
8. Isolation of Enzymes from different sources
11. Enzyme kinetics
12. Assay of glutathione transferase
13. Assay for Cytochrome P450
14. Enzyme assays pertaining to liver (Liver Function Test)
15. Affinity Chromatography for isolating types of Immunoglobulins.
16. Amylase assay
17. Immobilization of cells/enzymes
18. ELISA
19. Analysis of cell types by cell counting and cell sorting
20. Dose response curve
21. Enzymes associated with toxicity: SOD, Catalase, Glutathione peroxidase, Lipid peroxidase
22. Enzyme assays: Acetylcholinesterase, β-Glucuronidase, Glucose-6-phosphate dehydrogenase,ATPase.

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

- Perform various experiments in the areas of enzymology, immunology, molecular biology, andtoxicology
- 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

BCH605: Advanced Enzymology

L	T	P	Total Credits
4	0	0	0

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

	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 usinginitial velocity, inhibition and isotope exchange studies; Practical aspects of kinetic studies: Enzyme assays, coupled assays, Reaction conditions optimization (pH, temperature, substrate concentration).	18
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
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 affectingamino 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
Unit IV: Enzyme turnover	
Enzyme turnover: Kinetics of turnover, methods for measuring rates of enzymesturnover, Correlation between rates of turnover and the structure and functions of enzymes, Mechanism of enzyme degradation, significance of enzyme turnover.	18

(Total Teaching = 72 hrs)

Course Learning Outcomes:

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

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Ram Sarup Singh, ReetaRani Singhania, Ashok Pandey, Christian Larroche	Advances in Enzyme Technology - A volumein 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

HGM601: Stem Cell Biology and Regenerative Medicine

L	T	P	Total Credits
4	0	0	4

Course content and syllabus

	Teaching Hours
Unit I: Introduction to Stem Cells	**18 hrs**
Definition; Historical Perspectives, Stem cell types, embryonic, extra-embryonic fetal, adult and induced pluripotent stem cells Origin and sources, Cancer stem cells, General characteristics of stem cells and major pathways controlling self renewal and pluripotency	
Unit II: Introduction to Cell-based Therapies	**16 hrs**
Fundamentals of Cell-Based Therapies, Stem Cell Research, Biology of Human Mesenchymal Stem Cells, endothelial progenitor cells and hematopoietic stem cells .	
Unit III: Regenerative Medicine for Diseases	**20 hrs**
Biology of regeneration, Strategies of Regenerative Medicine: Cell transplantation, Bio- artificial Tissue and Induction of Regeneration In Situ, Regenerative Medicine for Diseases of the Retina and limbal stem cell, Islet Cell Therapy and Pancreatic Stem Cells, Cell Therapies for Bone and Cartilage Regeneration, Regenerative Medicine Approaches to Skin Cell-Based Therapy , Use of stem cells for therapy of malignant diseases and non-malignant diseases like neurological, cardiac, autoimmune, and metabolic disorders	
Unit IV: Regulatory and Ethical Issues and future prospects	**18 hrs**
Overview of DCGI/FDA regulation in stem cell research and development Ethical and regulatory issues related to stem cell research and therapy, National and International Guidelines, Quality control issues in using stem cells for clinical applications, Clinical trials and future prospective	

(Total Teaching = 72 hrs)

Course Learning Outcomes:

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

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Anthony Atala, Robert Lanza, James A. Thomson and Robert M. Nerem	Principles of Regenerative Medicine	Academic Press	3rd	978-0-12-369410-2	1454

Robert Lanza, John Gearhart, Brigid Hogan, Douglas Melton, Roger Pedersen, E. Donnall Thomas, James Thomson and Sir Ian Wilmut	Essentials of StemCell Biology	Elsevier	2nd	978-0-12-374729-7	712

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	

Topics in Life Sciences

L	T	P	Total Credits
4	0	0	4

Objective: The objective of this course is to provide students with in-depth knowledge of concepts significant 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:

- Gain knowledge about Mendelian principles and various exceptions to it.
- Understanding the concepts of enzymes and biochemical processes.
- Perceive knowledge of mechanisms used by the human body to fight foreign agents anddisease-causing pathogens.
- 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 ofGenetics	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

PSY611: Conflict Resolution & Management

L	T	P	Total Credits
1	0	0	1

Course content and syllabus

	Teaching Hours
Unit I: Conflict Management, Resolution and Management	**5 hrs**
• Meaning and Nature of Conflict • Types of Conflicts • Styles and Techniques of conflict management • Conflict Resolution Strategies • Management, Transformation, Settlement and Resolution of Conflicts	
Unit II: Behavioural & Interpersonal Communication	**5hrs**
• Meaning and characteristics of interpersonal communication • Process and Elements of Interpersonal Communication • Culture, Identity, language and Interpersonal communication • Meaning and Nature of Behavioural Communication • Relevance of Behavioural Communication	
Unit III: Relationship Management for Personal and professional Development	**4hrs**
• Importance of Relationships • Maintaining Healthy Relationship • Communication Style • Types of Interpersonal Relationships	
Unit IV: Stress Management	**4hrs**
• Understanding of Stress & GAS Model Symptoms of Stress. • Individual and Organizational consequences with special focus on health Healthy and Unhealthy strategies for stress management • Social support for stress management and well being • Stress free, Successful and Happy Life	

Course Learning Outcomes:

1. To recognize Conflict and How to Manage them.
2. To learn Communication and interpersonal behavior
3. To understand the significance & Importance of Relationship
4. To learn to live stress free and happy life.

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	**5 hrs**
Descriptors/Topics • Talk about your family members • Usage of possessive adjectives • Describe your house/apartment • Prepositions of location • Negation	
Unit II: Lifestyle	**4 hrs**
Descriptors/Topics • Talk about your hobbies and pastimes • Usage of appropriate articles : definite and contracted • Talk about your daily routine • Usage of pronominal verbs	
Unit III: In the city	**5 hrs**
Descriptors/Topics • Filling up a simple form • Ask for personal information	
• Usage of interrogative adjectives • Give directions about a place • Ordinal numbers • Usage of demonstrative adjectives	
Unit IV: Week-end	**4 hrs**
Descriptors/Topics • Talk about your week-end plans • Usage of disjunctive pronouns • Usage of Near Future tense • Talk about weather • Write a simple post card	

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

foreign accent of the language. At theend of the course, the student shall be able to:

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

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Christine Andant, Catherine Metton, Annabelle Nachon, Fabienne Nugue	A Propos - A1, Livre de l'élève et Cahier d'exercices.	Langers International Pvt. Ltd.	2010	978-9380809069	---
Collins Dictionaries	Easy Learning French Complete Grammar, Verbs and Vocabulary	Collins	2016	978-0008141721	---
Nikita Desai, Samapita Dey Sarkar	Apprenons La Grammaire Ensemble - French	Langers International Pvt. Ltd.	2017	978-8193002681	---

FOL104: German Grammar

L	T	P	Total Credits
1	0	0	1

Course content and syllabus

	Teaching Hours
Unit I: Time (Uhrzeit); People and the World: Land, Nationalität und Sprache	**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 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 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	**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 willbe proficient in formulating meaningful sentences as they will be capable of applying their knowledgeof all the irregular verbs they have learnt during the session. They will also have an idea of German culture by studying about various German festivals.

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

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

Text / Reference Books:

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

Programme structure for M.Sc. (H) Biochemistry- 2 years (3rd Semester)

Sr. No	Course Code	Course Title	Course Type	Credits			Credit Units
				L	T	PS	
1	BTY701	Advanced Bioinformatics	Core Course	4	0	0	4
2	BCH701	Nutritional Biochemistry	Core Course	4	0	0	4
3	BCH702	Practicals in Biochemistry-III	Core Course	0	0	2	2
4	CBA705	Fundamentals of BioEntrepreneurship	Core Course	2	0	0	2
5	STA701	Biostatistics	Core Course	2	0	0	2
6	NTCC	Research Paper Presentation	NTCC	0	0	2	2
7	NTCC	Dissertation Work	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 Wilkins, London	2013	978-1605474618	1648
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	Routledge	2021	978-0-367-76219-3	117

	Development in India				
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 Century (10th Edition)	McGraw-Hill Education	2016	978-0-07-786248-8	484
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 M.Sc. (H) Biochemistry- 2 years (4th Semester)

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

*The Specialization Elective Course of 1st, 2nd, and 4th semesters will be pooled together.

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