

M.Sc. (H) HGMM- 2 years (1st Semester)

Sr No	Course Code	Course Title	Course Type	Cred its					Credi t Units
				L	T	PS	FW	SW	
1	BCH601	Advanced Cell Biology	Core Course	4	0	0	0	0	4
2	BCH609	Metabolism of Biomolecules	Core Course	4	0	0	0	0	4
3	BCH602	Bioanalytical Techniques	Core Course	4	0	0	0	0	4
4		Practicals in HGMM-I	Core Course	0	0	8	0	0	4
	MBO601 BTY602	<u>Students will choose anytwo*</u> 1.General Microbiology and Microbial Genetics 2. IPR, Biosafety and Ethics 3. Concepts in Genetics 4. MOOC	Specialization Elective Course	4 4	0 0	0 0	0 0	0 0	4 4
6	PSY601	Behavioral 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 Courses 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

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

Course Contents/syllabus:

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

Course Learning Outcomes:

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

Pedagogy for Course Delivery:

Lectures: 62 sessions

Presentation / Seminar: 2

Class Test: 2 sessions

Quiz: 6 sessions
Total: 72 sessions

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

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 -, β - 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	4 th edition, 2013	9781118092446	1616 pages
D.L. Nelson and M.M. Cox	Lehninger Principles of Biochemistry	McMillan North Publication	4 th Edition 20	978-1319108243	1328 pages
L. Stryer	Biochemistry	Freeman & Co. New York.	5th Edition	978-0716746843	1050 pages

BCH602: Bioanalytical Techniques

Course content and syllabus

Unit I -Spectroscopy & Chromatography	
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	

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	
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	
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
Karp, Gerald	Cell and Molecular Biology: Concepts and Experiments	John Wiley and Sons, Inc	6th edition/2010	111830179X 978-1118301791	783
Wilson K., Walker J.	Principle and Techniques of Biochemistry and Molecular Biology	Cambridge University Press	6th edition/2006	0521178746 978-0521178747	744

Plummer, David	An Introduction to Practical Biochemistry	Tata Mc GrawHills	3rd edition/2017	0070994870 978- 0070994874	332
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Practicals in HGMM -I

L	T	P	Total Credits
0	0	8	4

Course Contents/syllabus:

Practicals in HGMM-I

List of Experiments (Total Teaching Hours = 60 hrs)

Unit-I : Biochemistry I

1. Preparation of molar solutions, normal solutions, and buffers (citrate buffer and phosphate buffer) and use of pH meter.
2. Estimation of carbohydrate in given solution by anthrone method.
3. Saponification test for lipid.
4. Estimation of cholesterol

Unit-II Biochemistry II

5. Estimation of DNA by Di-phenyl amine (DPA) method.
6. Estimation of RNA by Orcinol method
7. Quantitative Estimation of Proteins, Sugars, total lipids and amino acids.
8. Enzyme kinetics (Horse radish peroxidase)
9. Enzyme assay (catalase, amylase)

Unit-III: Genetics

10. Identification of inactivated X chromosome as Barr body.
11. Studies of a Model organism: Identification of normal and mutant flies (*Drosophila melanogaster*) & Preparation of *Drosophila* polytene chromosomes.
12. To test for color blindness using Ishihara charts.
13. To stain cellular organelles and visualize by microscopy.

Unit-IV:Chromatographic techniques

- 14.TLC
- 15.HPLC
- 16.GCMS

Course Learning Outcomes:

- Acquaintance with laboratory-based ethical code of conduct for well-being of oneself and peers.
- Identify the environmental and industrial relevance of experimental techniques in biochemistry.
- Quantitative estimation and separation of biologically relevant molecules.
- Learn basic techniques and concepts in genetics and cell biology.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
A.I. Vogel, A.R. Tatchell, B.S. Furnis	Vogel's Textbook of Practical Organic Chemistry	Prentice Hall	2003	978-0582462366	

Plummer ,D.T.	An Introduction to Practical Biochemistry	Tata McGra wHill	3 rd	0-07-099487-0	332
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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
<p>Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications.</p> <p>Protection of New GMOs: International framework for the protection of IP. IPs of relevance to Biotechnology and few Case Studies.</p> <p>Patent databases: Invention in context of “prior art”; Searching national/International Databases; Analysis and report formation</p>	
Unit II: Types of patent and patent application	18 hrs
<p>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</p>	
Unit III: Biosafety, GMOs and Biodiversity Act	18 hrs
<p>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</p> <p>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;</p> <p>Risk Assessment: Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartagena Protocol.</p> <p>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.</p> <p>Biodiversity Legislation in India; Indian Biodiversity Act and provisions on crop</p>	
Unit IV: Bioethics, Ethics and the law issues	18 hrs
<p>Bioethics: Concepts; Philosophical considerations; Epistemology of Science; Ethical Terms; Principles & Theories; Relevance to Biotechnology;</p> <p>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.</p>	

Course Learning Outcomes:

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

Text / Reference Books:

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

General Microbiology and 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
<p>Microscopy: Bright field, phase contrast, fluorescence, confocal, and electron microscopy.</p> <p>Principles of Microbiology: Principles and applications of bright field, dark field, phase contrast, fluorescence and scanning tunnelling microscopy.</p> <p>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.</p>	
Unit II: Bacterial Classification and Diversity	18 hrs
<p>Bacterial Classification and Diversity: Importance of taxonomy conventional and modern methods; polyphasic approach of bacterial classification, 16S rRNA</p> <p>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.</p> <p>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.</p> <p>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.</p>	
Unit III: Bacterial Genetics and Virology	18 hrs
<p>Bacterial Genetics and Virology: Transformation, transduction, conjugation, RecA, plasmids, their replication, copy number and compatibility, drug resistance; transposons,</p> <p>Viruses: General characteristics, classification, ultra-structure, purification & assay, viroids; virulent and temperate bacteriophages, γ-lytic cascades and lysogenic repression.</p>	
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 host cell behaviour by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells.	
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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/ye ar	ISBN No	Pages
Pelczar, M.J. Jr., Chan ECS and Krieg, N.R.	Microbiology: Concepts and Applications	New York; Madrid : McGraw-Hill,	1993	0070492581, 9780070492585	957
Cappucino, J.G.	Microbiology-A laboratory manual, 4th ed., Harlow, Addition-Wesley.	Hoboken, N.J.: Pearson	2020	0135188997, 9780135203996, 0135203996	541

Concepts in Genetics

L	T	P	Total Credits
4	0	0	4

Objectives: After studying this course, the students will be able to understand the basics of genetics.

Course content and syllabus

	Teaching Hours
Unit I: Mendelian Genetics	18 hrs
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 Punnett square. Phenomenon of Dominance and Dominance relationships (complete dominance, incomplete dominance, and co-dominance), Multiple allelism; Lethal alleles; Pleiotropy; Epistasis; Penetrance and expressivity; Phenocopy; Polygenic inheritance, Pleiotropism, Modifier/Modifying genes. Inheritance patterns in Human (Sex-linked, Autosomal, Unifactorial, Multifactorial).	
Unit II: Non- Mendelian Genetics	18 hrs
Introduction to Genomic imprinting, maternal effects, Maternal inheritance in mitochondria and chloroplast, Cytoplasmic Male Sterility (CMS) in maize, Sex determination, Dosage compensation with reference to X-inactivation in man, sex-linked, sex limited, sex influenced traits. Manifesting heterozygotes, mosaics, chimeras, hermaphrodites, Kappa Particles in Paramecium, Sigma factor in <i>Drosophila</i> Linkage & crossing over: Chromosome theory of Linkage, kinds of linkage, linkage groups, Sutton's view on linkage, Morgan's view on linkage, Chromosome Theory of Heredity (Sutton-Boveri), Inheritance patterns, 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: Chromatin structure and chromosomal anomalies	18 hrs
Chromosome structure, DNA packaging in eukaryotic cell: nucleosome, solenoid, chromatin loops, chromosomal territories, histone and non-histone proteins, DNA modifications and their role in gene regulation. Types of chromosomes, Variation in chromosome structure and number: Deficiency, duplication, translocation, inversions, monosomy, nullisomy, trisomy, tetrasomy, haploidy, polyploidy. Origin and transmission of chromosomal aberrations.	

Unit IV: Genetic Mapping	18 hrs
Use of sexual process in bacteria and bacteriophages in genetic mapping, Linkage mapping in Drosophila including determination of linkage groups, determination of map distance, determination of gene order, Tetrad analysis in Neurospora crassa; genetic mapping in haploid and diploid eukaryotes and multi-factorial inheritance and quantitative traits, cytological mapping. Hardy-Weinberg principle and effect of selection, mutation, migration and genetic drift on Hardy-Weinberg equilibrium.	

Course Learning Outcomes:

1. Understand basic genetics and Mendelian principles and various exceptions to it.
2. Understanding Non-mendelian genetics.
3. Understanding structural and numerical chromosomal anomalies.
4. Perceive knowledge of gene and chromosome mapping.

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	Ed/year	ISBN No	Pages
Gardner EJ, Simmons MJ, Snustad DP	Principles of Genetics	Wiley-India	6 th /2008	978-0471291312	480
Snustad DP, Simmons MJ	Principles of Genetics	John Wiley and Sons Inc.	6 th /2011	978-0470388259 0470388250	740
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	864
Tamarin R.H	Principles of Genetics	Tata McGrawHill, New York	2012	0072325305	697

PSY601: 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	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 hrs
Exploration through Johari Window, Mapping the key characteristics of self, Framing a charter for self Stages – self awareness, self acceptance and self-realization	
Unit III: Self Esteem & Effectiveness	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 hrs
Meaning and nature of attitude, Components and Types of attitude ,Importance and relevance of attitude Emotional Intelligence – Meaning, components, Importance and Relevance Positive and negative emotions, Healthy and Unhealthy expression of emotions	

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

1. The student will apply self-introspection as a tool for self-awareness.
2. The student will understand self-concept for self-recognition, self-improvement and perception of others.
3. The student will be able to analyze their physical self, social self, the competent self and psychological self.
4. The student will be able to analyze what motivates his/her actions and the actions of others

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Singh A.	Achieving Behavioural Excellence for Success	Wiley Publication	2012	978812658027
Towers, Marc	Self Esteem	American Media	1995	9781884926297
Pedler Mike, Burgoyne John, Boydell Tom	A Manager's Guide to Self-Development	McGraw-Hill	2006	978-0077114701

Covey, R. Stephen	Seven habits of Highly Effective People	Simon & Schuster Ltd	2013	978-1451639612
Khera Shiv	You Can Win	Macmillan	2005	978-0333937402
Gegax Tom	Winning in the Game of Life	Harmony Books	1999	978-0609603925
Singh, Dalip	Emotional Intelligence at Work	Publications	2006	9780761935322
Goleman, Daniel	Emotional Intelligence	Bantam Books	2007	9780553095036
Goleman, Daniel	ing with E.I	Bantam Books	1998	9780553104622

FOL102: Introduction to German Culture and 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 themselves in writing and orally in basic German. This course content focuses on the speech of the students in a lucid and a concurrent manner using appropriate vocabulary and pronunciation techniques. Extra stress will be given on their understanding of grammatical structures and the foreign accent of the language. At the end of the course, the student shall be able to:

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

Text / Reference Books:

Author	Title	Publisher	Year	ISBN
Rolf Bruseke	Starten Wir A 1	Langers InternationalPvt Ltd (Max Hueber Verlag)	2017	978-3190160006
Giorgio Motta	Wir Plus Grundkurs Deutschfur Junge Lerner Book	Ernst Kleit Verlag	2011	978-8183072120
Heimy Taylor, Werner Haas	Station en Deutsch Self StudyCourse 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
<ul style="list-style-type: none"> • Brief introduction of French and Francophone countries • Presenting oneself • Getting information about someone else • Greeting and taking leave • Asking/giving personal information 	
Unit-II- A rendez-vous ; Visiting a place	5 hrs
<ul style="list-style-type: none"> • Pronouncing and writing numbers in French • Spell and count numbers • Telling the time • Temporal expressions • Communicating in class • Fixing an hour, place for a meeting. • Describing a person. • Identifying a person, object and place • Describing relation in a family • A specific person, object and place 	
Unit-III- An interview	5 hrs
<ul style="list-style-type: none"> • Description of objects, people and places • Nationalities • Speaking about one's professions • Expressing Actions using regular –er ending verbs; avoir, être; reflexive verbs –usage, conjugation • Interview of celebrity 	
Unit-IV- At the discotheque	4 hrs
<ul style="list-style-type: none"> • Portrait by a journalist • Giving a positive or negative reply • Asking questions • Discussion with a person • Activities in a day 	

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

1. Understand information; Express in his own words; Paraphrase; Interpret and translate.
2. Apply information in a new way in a practical context
3. Analyse and break-down information to create new ideas
4. 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	978-9380809069
Manjiri Khandekar and Roopa Luktuke	Jumelage - 1 Methode De Fraincais - French	Langers Internation al Private Limited	2020	978- 938080 9854
<u>Michael Magne</u> , Marie-Laure Lions- Olivieri	Version Originale 1: Cahier d'exercices	Maison Des Langues	2010	978848 443561 7

M.Sc. (H) HGMM - 2 years (2nd Semester)

Sr. No	Course Code	Course Title	Course Type	Credits					Credit Units
				L	T	PS	FW	SW	
1	IMM601	Immunology and Immunotechniques	Core Course	4	0	0	0	0	4
2	HGM603	Molecular Biology and Gene Expression	Core Course	4	0	0	0	0	4
3		Practicals in HGMM -II	Core Course	0	0	8	0	0	4
4	BCH610	<u>Students will choose any three from the given choices*</u>	Specialization Elective Course						
		1. Concepts and prospects in molecular medicine		4	0	0	0	0	4
		2. Stem Cell and Regenerative Medicine		4	0	0	0	0	4
		3. Cancer therapeutics and personalized medicine		4	0	0	0	0	4
		4. Topics in Life Sciences							
		5. Human Physiology							
		6. MOOC							
5	PSY610	Behavioural Science	Value Added Course	1	0	0	0	0	1
6	FOL103/ FOL 104	Foreign Business Language	Value Added Course	1	0	0	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 students will 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-Antibody interactions, 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-cell activation 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 altered self.
- Students will develop ability to use this knowledge in the processes of immunization, antibody engineering, 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 (8 th Edition)	WH Freeman and Company, USA	2012	978- 1319114701	944
D. Male, J. Brostoff, D. Roth, I. Roitt	Immunology (8 th Edition)	Saunders, Elsevier, USA	2012	978- 0702045486	482
K. Murphy	Janeway's Immunobiology (8 th Edition)	Garland Science, USA	2011	978- 0815342908	887
A. Abbas, A. Lichtman, S. Pillai	Cellular and Molecular Immunology (8 th Edition)	Saunders, Elsevier, USA	2014	978- 8131264577	-

HGM603: Molecular Biology and Gene Expression

L	T	P	Total Credits
4	0	0	4

Learning Objective: The objective of this course is to teach students the molecular details of the process of DNA replication, transcription and translation in prokaryotes and eukaryotes and regulation of gene expression.

Course content and syllabus

	Teaching Hours
Unit I: DNA Replication	18 hrs
DNA replication in Prokaryotes: Initiation, Elongation and Termination. Regulation of replication. DNA replication in Eukaryotes: Initiation, Elongation and Termination. End-Replication problem.	
Unit II: RNA Transcription	18 hrs
RNA synthesis and processing in prokaryotes and eukaryotes: transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, 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 and elongation 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 and silencers. 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/yea r	ISBN No	Pag es
Watson, JD., Baker, TA., Stephen, PB., Alexander,	Molecular Biology of the Gene	Pearson Education	7 th Ed	978-9332585478	912

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

Practicals in HGMM -II

L	T	P	Total Credits
0	0	4	4

List of Experiments (Total Teaching Hours = 60 hrs)

Unit I: Human Physiology

1. Blood group typing using hemagglutination tests.
2. Glucose estimation in Blood and Urine by Glucose Oxidase/Peroxidase.
3. Quantification of Hemoglobin.
4. Immunodiffusion assay

Unit II: Immunology

5. ELISA
6. Analysis of cell types by cell counting and cell sorting.
7. Preparation of plasmid DNA by alkaline lysis. Calculating yield and purity of DNA by studying its absorbance and digestion with restriction enzyme.
8. Experiments with agarose gel electrophoresis to analyze relationship between mobility of DNA fragments of different sizes and the percentage of the gel.

Unit III: Molecular Biology

9. Digestion and ligation of plasmid DNA. Studying ligations following single and double digests and de-phosphorylation.
10. Elution of DNA from agarose gel.
11. Designing primers for a given DNA template and analyzing the role of different reaction components/conditions (MgCl₂ conc., temperature, conc. of template and number of cycles) on the efficiency of PCR.
12. Isolation and digestion of genomic DNA with different restriction enzymes.

Unit IV: Biotechniques

13. Preparation of proteins by acetone extraction method and also ammonium sulfate fractionation method and running the gel.
14. SDS PAGE analysis of given proteins.
15. Western blotting.
16. Immobilization of cells/enzymes.

Course Learning Outcomes:

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

- To perform various experiments in the areas of human physiology, immunology and molecular biology.
- 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
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Plummer, D.T.	An Introduction to Practical Biochemistry	Tata McGraw Hill	3 rd	0-07-099487-0	332
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Concepts and Prospects in Molecular Medicine

L	T	P	Total Credits
4	0	0	4

Course content and syllabus

	Teaching Hours
Unit I - Molecular Basis of Diseases	18 hrs
Human genetics relevant to molecular medicine, single nucleotide polymorphisms, multiple gene polymorphisms, single and multi-gene diseases, gene-environment interactions in disease manifestation, genetic and physical mapping of human genome and identification of disease-causing genes	
Unit II: Molecular Medicine Therapeutics	18 hrs
Gene therapy and recombinant molecules in medicine and therapeutic development, Antiviral therapies, vehicles for gene therapies, pharmacogenomics, its application, and role in developing novel therapies. RNAi and human diseases, alternate splicing, and human disease.	
Unit III: Signal Transduction and its role in Human Diseases	18 hrs
Cellular and tissue microenvironment in diseases, drug resistance with conventional chemotherapies, construction of knock-out and transgenic animals, protein as causes of human diseases.	
Unit IV: Applications of molecular medicine	18 hrs
Clinical trials, adjuvant therapies, monoclonal antibodies as drugs, nanobiotechnology and its applications in molecular medicine, next generation sequencing techniques. Stem cell research and its application in human health	

Course Learning Outcomes:

- Acquaintance with structure, functions and carbohydrates.
- Perceive knowledge of structure and function of proteins and enzymes.
- To gain knowledge about the nucleic acids their biosynthesis and regulation.
- Perceive knowledge about the structure, function and classification of Lipids.

Text/Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages

Littwack, G.	Human Biochemistry and Disease.	Academic Press.	2008	978-8177585421	966 .
Trent, R. J.	Molecular Medicine- Fourth Edition: Genomics to Personalized Healthcare.	Academic Press.	2012	9781118092446	1616

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	18 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	18 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	Principles of Regenerative Medicine	Academic Press	3 rd	978-0-12-369410-2	1454

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

Cancer Therapeutics and Personalised Medicine

L	T	P	Total Credits
4	0	0	4

Course content and syllabus

	Teaching Hours
Unit I: Cancer and its Causes	18 hrs
Types of cancer, Common symptoms, Schemes of classification, WHO classification, staging and grading, degree of malignancy, Pathology of cancer – hyperplasia, dysplasia, metaplasia, carcinoma <i>in situ</i> , biological heterogeneity, Mechanism of physical and chemical carcinogenesis, biological agents as carcinogens, Cancer predisposing genes, Oxidative stress in cancer, Role of DNA damage and repair in cancer	
Unit II: Hallmarks of Cancer and its targeting	18 hrs
Emerging Hallmarks of cancer – Deregulating cellular energetics and avoiding immune surveillance, Tumor Microenvironment – Role of cancer stem cells, targeting of the Hallmarks of Cancer	
Unit III: Dysregulation of Signaling Pathways in Cancer and their targeting	18 hrs
Role of PI3K/AKT/mTOR, EGFR/RAS/MAPK, Wnt/ β -catenin, JAK/STAT, TGF- β , and Notch pathways in the development of human cancers. Therapeutics targeting these pathways.	
Unit IV: Molecular Tools for Personalized Medicine	18 hrs
Molecular markers and disease diagnosis, progression and therapy targets, Next generation sequencing (NGS) technologies, digital droplet PCR, System biology approaches, Genome editing & gene transfer technology.	

(Total Teaching = 72 hrs)

Course Learning Outcomes:

- Develop an advanced understanding of molecular mechanisms underlying cancer initiation and progression.
- Understand how genetic variants impact treatment outcomes.
- Discuss strategies to diagnose and treat various cancers

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Bruce, Alberts and Alexander Johnson and Julian Lewis, and Martin Raff	Molecular Biology of the Cell	Garland Science;	6th	978-0815344322	1342
Robert A. Weinberg	The Biology of Cancer	Garland Science	2nd	978-0-81-534220-5	960

Lauren Pecorino	Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics	Oxford University Press	3 rd	978-0-19- 957717-0	360
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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 versus 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.	
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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 and disease-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 of Genetics	Wiley-India	6 th /2008	978- 0471291312	480
Peter F Stanbury, Allan Whitaker, Stephen J Hall	Principles of Fermentatio n Technology	Butterworth - Heinemann Press. UK	2016	978- 0070492585	367
J. Owen, J. Punt, S. Stranford	Kuby Immunolog y(8 th Edition)	WH Freeman and Company, USA	2018	978- 1319114701	944
D. Male, J. Brostoff, D. Roth, I. Roitt	Immunolog y(8 th Edition)	Saunders, Elsevier, USA	2017	978- 1118415771	576
Wilson K., Walker J.	Principle and Techniques of Biochemistr y and Molecular Biology	Cambridg e University Press	2010	978- 0521178747	744

Human Physiology

L	T	P	Total Credits
4	0	0	4

Course Objective: In this course on Human anatomy and physiology the student will develop comprehension of the structure and function of the human body, of the inter-relation of the body systems within the human organism and develop an understanding of the principles of human anatomy and physiology.

	Teaching Hours
Unit I: Introduction to Human Body, its support and movement	18 hrs
Introduction to Human Body, Basic concepts of Organs, tissue and cell. Skeletal system — Classification of bones, Ossification and growth of bone, Histology of bone, Fracture and repair, Types of joints. Muscular system — Classification of muscles, Structure of smooth, cardiac, skeletal muscle, neuromuscular junction. Physiology of muscle contraction	
Unit II: Fluid and Gaseous transport	18 hrs
Cardiovascular System: Blood composition, Structure and function of heart and blood vessels, Types of blood vessels, Brief description of arterial, venous system and lymphatic system, Properties of Cardiac Muscle and Functional Tissues, Cardiac Cycle, Heart Rate, Cardiac Output, Blood Pressure (Systolic & Diastolic Blood pressure), ECG. Respiratory System: Physiological Anatomy of Respiratory Tract, Mechanism of Respiration, Transport of Respiratory Gases in Blood, Gaseous Exchange in Lungs and tissues	
Unit III: Structure and function of Digestive and excretory systems	18 hrs
Digestive System - Principal organs of the digestive system: Mouth, tongue, Teeth, Esophagus, Stomach, Small Intestine, Large Intestine, Rectum, Anus- structure & function. Principal accessory organs- salivary glands, liver, gall bladder, pancreas-structure & function, Role of gut hormones & enzymes in Digestion and mechanisms involved in absorption of food. Excretory System: Structure of Excretory System- Kidney, Nephron, Urinary Bladder; Urine Formation, Composition of Urine, micturition, Glomerular Filtration Rate (GFR)	
Unit IV: Regulation, Integration, Control and continuity of Human Life	18 hrs

<p>Endocrine Systems: Introduction to Endocrinology, Functions and Hormones secreted by Pituitary Gland, Thyroid Gland and Parathyroid Gland and Adrenal Gland, Sex glands, Functions of Pancreas.</p> <p>Nervous System: Structure and functions of Neuron, Brain and Central nervous system (Autonomic Nervous System, Parasympathetic Nervous System, Neurotransmitters, Action potential, Transmission at synapse, Sense Organs.</p> <p>Reproductive System: Structure, hormones secreted and functions of Male and Female Reproductive Organs</p>	
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Course Learning Outcomes:

- Understand the homoeostatic status of the human body
- Demonstrate the physiological processes and functions as applicable to human nutrition
- Compare the respiration and transportation of oxygen
- Perceive knowledge of human physiology

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Guyton AC, Hall JE	Textbook of Medical Physiology, 9th Ed.,	Elsevier	2015	9781455770052	1168
Wilson	Anatomy and Physiology in Health and Illness,	Edinburgh : Churchill Livingstone Elsevier, 2007.	2007	9780443101014	490

PSY610: Behavioural Science

L	T	P	Total Credits
1	0	0	1

Course Contents/syllabus:

	No. of Session
Unit-1- Individual differences & Personality	5 hrs
<ul style="list-style-type: none">• Personality: Definition & Relevance• Importance of nature & nurture in Personality Development• Importance and Recognition of Individual differences in Personality• Accepting and Managing Individual differences Intuition, Judgment, Perception & Sensation (MBTI) BIG5 Factors	
Unit-2- Managing Diversity	4 hrs
<ul style="list-style-type: none">• Defining Diversity• Affirmation Action and Managing Diversity• Increasing Diversity in Work Force• Barriers and Challenges in Managing Diversity	
Unit-3- Socialization, Patriotism and National Pride	5 hrs
<ul style="list-style-type: none">• Nature of Socialization• Social Interaction• Interaction of Socialization Process• Contributions to Society and Nation• Sense of pride and patriotism• Importance of discipline and hard work• Integrity and accountability	
Unit-4- Human Rights, Values, and Ethics	4 hrs
<ul style="list-style-type: none">• Meaning and Importance of human rights• Human rights awareness• Values and Ethics- Learning based on project work on Scriptures like- Ramayana, Mahabharata, Gita etc.	

List of Professional Skill Development Activities (PSDA):

1. Project on Understanding Diversity
2. Term Paper on Patriotism among Youth

Course Learning Outcomes: On completion of the course:

- To recognize individual differences
- To manage individual differences

- To develop patriotic feelings
- To recognized their self in relation to society & nation

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
Department of English, University of Delhi	The Individual & Society	Pearson Education	2010	978-8131704172	266
Umang Malhotra	Individual, Society, and the World	iUniverse	2004	978-0595662401	188
Tonja R. Conerly & Kathleen Holmes	Introduction to Sociology 3e	Openstax	2015	9781711493978	458
Daksh Tyagi	"A Nation of Idiots"	Every Protest	2019	978-8194275015	350

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
<ul style="list-style-type: none">• Descriptors/Topics• Talk about your family members• Usage of possessive adjectives• Describe your house/apartment• Prepositions of location• Negation	
Unit II: Lifestyle	4 hrs
<ul style="list-style-type: none">• 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
<ul style="list-style-type: none">• Descriptors/Topics• Filling up a simple form• Ask for personal information	
<ul style="list-style-type: none">• Usage of interrogative adjectives• Give directions about a place• Ordinal numbers• Usage of demonstrative adjectives	
Unit IV: Week-end	4 hrs
<ul style="list-style-type: none">• Descriptors/Topics• Talk about your week-end plans• Usage of disjunctive pronouns• Usage of Near Future tense• Talk about weather• Write a simple post card	

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

grammatical structures and the foreign accent of the language. At the end of the course, the student shall be able to:

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

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Christine Andant, Catherine Metton, Annabelle Nachon, Fabienne Nugue	A Propos - A1, Livre de l'élève et Cahier d'exercices.	Langers International Pvt. Ltd.	2010	978-9380809069	---
Collins Dictionaries	Easy Learning French Complete Grammar, Verbs and Vocabulary	Collins	2016	978-0008141721	---
Nikita Desai, Samapita DeySarkar	Apprenons 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
<ul style="list-style-type: none"> • Introduction of time • Read text related to time and teach the students the time expressions • Exercises related to Time • Adverbs of time and time related prepositions • Vocabulary: Countries, Nationalities, and their languages • Negation: "nicht/ kein" • Ja/Nein Fragen. • All the colors and color related vocabulary, adjectives, and opposites • Exercises and comprehension for the same 	
Unit II: Irregular verbs (unregelmässige Verben)	4 hrs
<ul style="list-style-type: none"> • Introduction to irregular verbs and their conjugation e.g. fahren, essen, lesen etc • Read a text related to the eating habits of Germans • Vocabulary: Obst, Gemüse, Kleiderstück with usage of irregular verbs • Free time and hobbies • Food and drinks 	
Unit III: Accusative case: articles and pronouns (Akkusativ Kasus: Artikel und Pronomen)	4 hrs
<ul style="list-style-type: none"> • Introduction to the concept of object (Akkusativ) • Formation of sentences along with the translation and difference between nominative and accusative articles • Usage of accusative Definite articles • Usage of accusative Indefinite articles 	
Unit IV: Accusative case: possessive pronouns (Akkusativ Kasus: Possessivpronomen) Family and Relationship	5 hrs
<ul style="list-style-type: none"> • Accusative Personal Pronouns: - Revision of the nominative personal pronouns and introduction of accusative. Applicability of pronouns for both persons and things. • Usage of accusative Personal Pronouns • Introduction of accusative possessive pronouns • Difference between nominative and accusative possessive pronouns • usage of accusative possessive pronouns 	

Course Learning Outcomes: After completing these modules, the students will be

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

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

1. Understand information; Express in his own words; Paraphrase; Interpret and translate.
2. Apply information in a new way in a practical context
3. Analyse and break-down information to create new ideas
4. 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 Für Ausländer	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 für Junge Lerner Book German Guide	Goyal Publishers	2011		248

M.Sc. (H) HGMM - 2 years (3rd Semester)

Sr No	Course Code	Course Title	Course Type	Credits					Credit Units
				L	T	PS	FW	SW	
1	BTY701	Advanced Bioinformatics	Core Course	4	0	0	0	0	4
2		Genetic engineering and recombinant DNA Technology	Core Course	4	0	0	0	0	4
3		Practicals in HGMM-III	Core Course	0	0	2	0	0	2
4		Fundamentals of BioEntrepreneurship	Core Course	2	0	0	0	0	2
5	STA701	Biostatistics	Core Course	2	0	0	0	0	2
6	NTCC	Seminar	NTCC	0	0	2	0	0	2
7	NTCC	Dissertation - I	NTCC	0	0	8	0	0	8
8	PSY706	Professional Ethics & Responsibilities - I	Value Added Course	1	0	0	0	0	1
Total Credits									25

BTY701: Advanced Bioinformatics

L	T	P	Total Credits
4	0	0	4

Course content and syllabus

Course objective: The student will be able to extract information from biological databases and using existing softwares will be able to analyse and use this information to better understand the biological system

	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. Molecular 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 alignment and Local alignment, general, gap and affine penalty. 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 Sequence Alignment: 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 method of sequence alignment. Significance of alignment score: E-value and bit-score, p-value. 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 Prokaryotes 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 protein structure, gene promoter and regulatory elements and compare genomes.

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 Spring Harbor Lab Press	2 nd Ed	978-9746520706	692
Lesk, A.M.	Introduction to Bioinformatics	Oxford University Press	2014	978-0198724674	376

Genetic Engineering and Recombinant DNA Technology

L	T	P	Total Credits
4	0	0	4

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 linked 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:

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

Author	Title	Publisher	Ed/year	ISBN No	Pages

J. Sambrook, E. F. Fritsch, and T. Maniatis, 2ndEdn.,	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, 5 th Edition	John Wiley	5 th edition, 2016	978-1-118-91840-1	1184
D.L. Nelson and M.M. Cox	Lehninger Principles of Biochemistry	Mcmillan	8 th Edition	13: 978-1-319-32234-2 (epub)	4381

Text/Reference Books

Practicals in HGMM -III

L	T	P	Total Credits
0	0	2	2

Unit I: Recombinant DNA Technology

1. Creating recombinant DNA: directional and non-directional cloning of a DNA fragment in a plasmid vector.
2. Demonstration of Chromatin immunoprecipitation and DNA sequencing methods.
3. Real time quantification of nucleic acids.
4. Using NCBI and UniProtKB web resources, Similarity searches using tools like BLAST, Multiple sequence alignment using ClustalW.

Unit II: Biological databases

5. Genetic databases (OMIM, London Dysmorphology, Possum)
6. Online Medical Genetic Support Groups for patients (Genetic Alliance, Family village).
7. Case studies and pedigree construction in clinical genetics.
8. Practical aspects in the case management of some genetic diseases.

Unit III: Bioinformatics I

9. Phylogenetic analysis of protein and nucleotide sequences.
10. Use of gene prediction methods (GRAIL, Genscan, Glimmer)
11. Use of different protein structure databases (PDB, SCOP, CATH)
12. Visualization/Studying protein structures using Deepview/PyMol

Unit IV: Bioinformatics II

13. Mutating and Energy minimization of protein structures
14. Ab-initio structure prediction of proteins
15. Homology modeling of proteins

Total Teaching Hours = 72 hrs

Course Learning Outcomes: This course will teach students to-

1. use basic bio-informatic procedures needed in a biotechnology lab
2. conduct sequence alignments and create phylogenetic tree based on it
3. perform PCR and learn variants to create different modifications in a DNA fragment
4. perform DNA cloning using vectors and learn the use of different enzymes used in the procedure

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
T A Brown	GENE CLONING AND DNA ANALYSIS: AN INTRODUCTION	Wiley Blackwell	8 th Edition	978-1119640783/ 1119640784	432

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

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

List of Professional Skill Development Activities (PSDA):

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

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

Lectures: 25 sessions

Presentation / Seminar: 5

Mid Term Test and End Term Test: 2 sessions

Assignment: 2 sessions

PSDA: 2 sessions

Quiz: -

Total: 36 sessions

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN	Pages
Evan J. Douglas	Entrepreneurial Intention: Past, Present,	Edward Elgar Publishing	2020	978-1-78897-522-3	216

	and Future Research				
Justin G. Longenecker, J. William Petty, Leslie E. Palich, and Frank Hoy	Small Business Management: Launching & Growing Entrepreneurial Ventures (20 th Edition)	Cengage	2023	978-0-3577-1880-3	712
Mike Kennard	Innovation and Entrepreneurship	Routledge	2021	978-0-367-51057-2	114
Debasish Biswas and Chanchal Dey	Entrepreneurship Development in India	Routledge	2021	978-0-367-76219-3	117
Robert D. Hisrich, Micheal P. Peters, Dean A. Shepherd, Sabyasachi Sinha	Entrepreneurship (11 th Edition)	McGraw Hill	2020	978-9390113309	696
Donald F. Kuratko and Jeffrey S. Hornsby	New Venture Management: The Entrepreneur's Roadmap for Development, Management, and Growth (3 rd Edition)	Routledge	2020	978-0367466725	356
Bruce R. Barringer and R. Duane Ireland	Entrepreneurship: Successfully Launching New Ventures (6 th Edition)	Pearson	2019	978-1-292-25533-0	617
Norman M. Scarborough and Jeffrey R. Cornwall	Essentials of Entrepreneurship and Small Business Management (9 th Edition)	Pearson	2019	978-1-292-26602-2	827
Mary Jane Byrd and Leon Megginson	Small Business Management: An Entrepreneur's	McGraw Hill	2017	978-1259538988	496

	Guidebook (8 th Edition)				
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 (10 th 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	

Biostatistics

L	T	P	Total Credits
2	0	0	2

Course Contents/syllabus:

	Teaching Hours
Unit I	9 hrs
Introduction to probability, measures of central tendency and measures of dispersion. 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 to understand 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	TITL E	Publisher	Year of publication	ISBN
Rohatgi V. K. and Saleh, A.K. Md. E.	An Introduction to Probability and Statistics	2 nd Edition, John Wiley and Sons	2009	9788126519262, 9788126519262
Casella G. and Berger R. L.	Statistical Inference	2 nd Edition, Cengage Learning India	2002	9788131503942, 9788131503942

Hogg R. V., Mckean J. and Craig A. T	Introduction to Mathematical Statistics	7 th Edition, Pearson Education India	2013	9789332519114, 9789332519114
Mukhopadhyay P	Mathematical Statistics	Books and Allied	2016	978818713493 0

Seminar

L	T	P	Total Credits
0	0	2	2

Course content and syllabus

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

Dissertation -I

L	T	P	Total Credits
0	0	8	8

Course content and syllabus

The student will undertake a research project under the supervision of a faculty member.

PSY706: Professional Ethics and Responsibilities -I

L	T	P	Total Credits
1	0	0	1

Course content and syllabus

	Teaching Hours
Unit I: [Origins of Morality and Ethics]	5 hrs
Moral Diversity, Moral Universals, Evolution of Morality, Reciprocal Altruism, Culture influence on our thought and action, Moral Differences, Kinds of Societies, Conservatives and Liberals, Disgust and Honor, Religion and Morality. Morality as Part of Our Nature, Skepticism About the Self, Free Will and the Situation. Utilitarian Ethics (outcome based), Deontological Ethics (duty based), Virtue Ethics (virtue based), and Communitarian Ethics (community based).	
Unit II: [Research Design: Inquiry and Discovery]	4 hrs
The Process of Inquiry, What is Curiosity, The components of enquiry design, What is atheory, Using inquiry as individuals, Elements of Critical Thinking, Inquiry Approaches: Quantitative, Qualitative, and Mixed Methods, Relationships Between Variables, Questions and Hypotheses, Conceptualization and Operationalization, What is Literature Review?	
Unit III: [Gender justice and workplace safety]	4 hrs
Introduction to Gender Justice- Notion and Significance, International and Constitutional Perspectives on Gender Equality, Protection of Women at Workplace, Gender Violence- Within and Beyond	
Unit IV: [Gene technology and Ethics]	5 hrs
History of genetics and genomics, Recent Developments in Cloning, Cloning and Conservation, DNA Fingerprinting, Individual Identification and Ancestry Next Generation Science Standards. Genomics in Medicine, Genetically Modified Organisms and food, Mapping Morality: The Rights and Wrongs of Genomics, Societal implications of genetically modified organisms and food	

Course Learning Outcomes:

1. Learn the concept of ethics and morality.
2. How to design experimental research – inquiry and discovery
3. Learn the problems of gender bias
4. Ethical issue related with gene technology

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Daniel McGuire	Synthetic Biology:	Syrawood Publishing House	2016	978- 16828633 74	278
R. Subramanian	Professional Ethics	Oxford University press	2017	978- 01994750 70	472

M.Sc. (H) HGMM - 2 years (4th Semester)

Sr. No	Course Code	Course Title	Course Type	Credits					Credit Units
				L	T	PS	FW	SW	
1		Molecular Basis of Human Diseases	Core Course	4	0	0	0	0	4
2		Advanced Genetics	Allied Course	4	0	0	0	0	4
3		<u><i>Students will choose anyone from the given choices*</i></u> 1. Model genetic systems 2. Biochemical Toxicology 3. Omics Technology and Applications 4. Advanced Enzymology 5. MOOC	Specialization Elective Course	4	0	0	0	0	4
4		Professional Ethics and Responsibilities -II	Value Added Course	1	0	0	0	0	1
5		Dissertation - II	Mandatory Course	0	0	12	0	0	12

Total Credits

25

Molecular Basis of Human Diseases

L	T	P	Total Credits
4	0	0	4

Course content and syllabus

	Teaching Hours
Unit I	16 hrs
Host-pathogen Interactions: Infectious diseases, host-pathogen interactions, genetic susceptibility to infection. Entry of pathogens into the host; colonization and factors predisposing to infections; types of toxins and their structure; Mode of actions, host signalling in response to infections, bacterial two component signaling systems, bacterial adhesins, virulence factors, bacterial biofilms and applications	
Unit II	18 hrs
Genetic disorders: Common genetic disorders due to altered chromosome numbers, aberrations; Diabetes as a genetic disease, recessive genetic disorders, Intersex Disorders: Male Pseudo-hermaphrodite (MPH) including testicular feminization syndrome, Female Pseudo-hermaphrodite (FPH) including congenital adrenal hyperplasia, True Hermaphrodites (TH), Mixed gonadal dysgenesis (MGD) & Dysgenetic male pseudohermaphrodite (DMP) and Persistent Mullerian duct syndrome (PMDS), diabetes and other complex human diseases..	
Unit III	18 hrs
Disorders of Haematopoietic and Muscular System and Multifactorial diseases: Haematopoietic systems - Sickle cell anemia, Thalassemias and Haemophilias and Haematopoietic Malignancies. Muscular Dystrophy. Molecular and genetic basis of Diabetes, Dementia, Schizophrenia, Cancer, Coronary Artery diseases, Hypertension and neuronal disorders such as Autism, Alzheimer's and Parkinson. Mental Retardation.	
Unit IV	20 hrs
Mechanisms of Infection and Therapeutic Interventions: Protein and DNA secreting systems and pathogenicity island. Molecular basis of antimicrobial resistance and its detection. Molecular approaches in clinical microbiology, antimicrobial agents; Sulfa drugs; Antibiotics: Penicillins and Cephalosporins; Broad-spectrum antibiotics; Antibiotics from prokaryotes; Antifungal antibiotics; Mode of action; Resistance to antibiotics. Chemo, Radio, Gene and Stem Cell Therapies: Anticancer drugs targeting genomic DNA, radiations to kill abnormal cells, gene therapies in various diseases, problems in gene therapy, ethical and biosafety issues in gene therapies, current stem cell therapies, stem cells in heart, brain and spinal cord regeneration	

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
Jocelyn, E. K., Elliot, S. G., Stephen, T. K. (2009), Lewin's Gene X. Jones & Barlett. 4. Milunsky, A., Milunsky, J. (2009). Genetic Disorders and the Fetus: Diagnosis, Prevention and Treatment, 6th Edition. Wiley-Blackwell publishers. 5. Trent, R. J. (2010). Molecular Medicine, Fourth Edition: Genomics to Personalized Healthcare. Academic Press. 6. Trent, R. J. (2005).	Clinical Chemistry	International Edition MOSBY, Elsevier	9 th Ed	978-0702079368	432

Molecular Medicine: An Introductory Text. Academic Press.					
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Advanced Genetics

L	T	P	Total Credits
4	0	0	4

Course content and syllabus

	Teaching Hours
Unit I Clinical Genetics	18 hrs
Historical development of Medical and Clinical Genetics. Impact of genetics in medicine. Indications for and types of invasive and non-invasive prenatal diagnostic techniques. Amniocentesis, Chorionic villus sampling, Ultrasonography, Fetoscopy, Maternal serum screening. Pre-conceptual and Preimplantation genetic diagnosis.	
Unit II Genetic Screening and Genetic counselling	18 hrs
Genetic screening and genetic testing, Newborn screening, population carrier screening, Pre-symptomatic and predisposition testing. Historical overview of genetic counselling: Models of Eugenic, Medical/Preventive, Decision making, Psychotherapeutic counselling; current definition and goals, Philosophy and ethos of genetic services and counselling Components of genetic counselling: Indications and purpose, Information gathering and construction of pedigrees, Medical Genetic evaluation, Basic components of Medical History, Past medical history: social & family history. Physical examination: General and dysmorphology examination, Documentation Patterns of inheritance, risk assessment and counselling in common Mendelian and multifactorial disorders. Biochemical and Molecular genetic tests: In Children, Presymptomatic testing for late onset diseases (predictive medicine).	
Unit III: Human population genetics	18 hrs
Introduction, Applications and subdivisions of human population genetics Allele frequencies- deriving genotypic & allelic frequencies, introduction to quantitative genetics, deriving allelic frequencies from molecular data, changes in allele frequencies. Genetics & Polymorphism- phenotypic & genotypic polymorphisms, transient polymorphism, balanced polymorphisms. Random & Non-random mating- positive & negative assortative mating, role in population size & change in gene frequency. Hardy-Weinberg method & its applications- calculating allelic frequencies, assumptions of Hardy-Weinberg equilibrium, proof of Hardy-Weinberg equilibrium, Generation time, testing for fit to Hardy-Weinberg equilibrium. Random Genetic drift- definition, its effects in small & large populations, bottlenecking & founder effect, genetic drift simulation, genetic drift vs selection. Genetic equilibrium- definition, conditions for its stability, deviation of it (evolution).	

Selection – overview, types & subtypes, negative & positive selections, patterns, and mechanism of selection (stabilizing, disruptive, directional, balancing, disassortative sexual selection, frequency dependent selection), overdominance, natural selection, artificial selection, ecological selection.	
Unit IV: Human evolutionary genetics	18 hrs
<p>Evolution of Genetic Diversity- natural variation, sources of genetic variation.</p> <p>Molecular Evolution– general approaches, principles, rates of molecular evolution. Evolution of eukaryotic genome structure, Gene family, evolution and phylogenetics, gene genealogies, causes of change in allele frequency, molecular study of phylogeny, neutral theory of molecular evolution.</p> <p>Consanguinity and inbreeding, Inbreeding coefficient of a population and individuals through path analysis, Computation of Wright's 'F', Computation of 'F' for autosomal gene, biological consequences of inbreeding, Concept of genetic load and its measurements,</p> <p>Genetics of Speciation- Patterns and processes of speciation: Reproductive isolating barriers, Species concepts, Genetics of reproductive isolation and species, Natural hybridization. Classification of races through UNESCO guidelines, Admixture of races, Ethnic elements in Indian population (Classification by A.C. Haddon, S.S. Sarkar and Guha), objectives of racial classification.</p>	

Course Learning Outcomes:

- Understand how genetics is taken to bedside.
- Gain knowledge about prenatal and preimplantation disorders and genetics.
- Understand the legal restrictions about genetic screening.
- Acquire knowledge about Genetic Counselling.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Gardner, A. and Davies, T	Human Genetics	Viva Books, New Delhi	2 nd /2017	9789386105356.	328
Gibson, G	A Primer of Human Genetics. Sinauer.	Sinauer Associates is an imprint of Oxford University Press	2015	978-1605353135 1605353132	442
Korf, B.R. and Irons	Human Genetics and Genomics.	John Wiley and Sons, Hoboken	4 th / 2013	0470654473 978-0470654477	288
Read, A. and Donnai, D.	New Clinical Genetics.	Scion, UK	2015	9781911510703	468

Skirton, H. and Patch, C.	Genetics for the Health Sciences.	Viva Books, New Delhi, published by arrangements with Scion Publishing Limited.	2017	9781904842705	236
Strachan, T. Goodship, J. and Chinnery P.	Genetics and Genomics in Medicine.	Garland Publishers, New York.	2015	978-0815344803 0815344805	832
Turnpenny, P.D. and Ellard, S	Emery's Elements of Medical Genetics.	Elsevier	2015	9780702066856	416
Roderick R. McInnes and Huntington F. Willard	Thompson & Thompson Genetics in Medicine	Elsevier	8 th /2015	978-1437706963 1437706967	560

Model Genetic Systems

L	T	P	Total Credits

Course content and syllabus

	Teaching Hours
Unit I Introduction to various Model Genetic Systems	18 hrs
<p><i>Dictyostelium discoideum</i>: An overview: life cycle, Use of <i>Dictyostelium</i> as a model system.</p> <p>Yeast: Tetrad analysis, yeast mating type switch, Use as a model system to study cell cycle, genetic recombination</p> <p><i>Caenorhabditis elegans</i>: Isolation & identification of mutants, Study of cell lineage, apoptosis, RNA interference.</p> <p><i>Drosophila</i>: Advantages in genetic analysis, Nomenclature of gene mutation, Balancer chromosomes, Mutagenesis and isolation of new variants, Generation of somatic and germline mosaics, Targeted overexpression of genes, <i>Drosophila</i> genome, online databases and other resources.</p> <p>Zebrafish: Isolation and identification of mutants, use of Morpholinos, Zebrafish as a model system for the study of human diseases, Zebrafish genome and online resources.</p> <p>Mouse: Relationship between human and mouse chromosomes, Advantages to use as a model organism, Understanding gene function by transgenic and knockout studies, Mouse genome database, Humanized mice.</p>	
Unit II Exploiting <i>Drosophila</i> Genetics	18 hrs
<p>Stem cells in <i>Drosophila</i>, Oogenesis in <i>Drosophila</i>, Ectopic expression, Generation of Transgenic <i>Drosophila</i>: (a) Germ-line transformation, (b) Application of P-element based vectors in transgenic generation; Advancement in <i>Drosophila</i> genetics: (a) Mitotic recombination, (b) Somatic clones, (c) Germ-line clones, (d) Conditional and /or targeted expression/ablation of genes/transcripts (e.g. UAS/GAL4 system), (e) RNAi based screening of gene functions in <i>Drosophila</i>.</p>	

Unit III: <i>Drosophila</i> as a model for human diseases	18 hrs
<i>Drosophila</i> model for human genetic disorders like Parkinson's, Huntington's, Alzheimer's diseases etc.; Use of <i>Drosophila</i> as a model organism for drug screening. Online databases and other resources for <i>Drosophila</i> genetics.	
Unit IV: Model Organisms in Human Genome Project	18 hrs
Genome – about genomes of model organisms (E. coli, Yeast, C. elegans, <i>Drosophila melanogaster</i> , laboratory mouse, Zebra fish, Human), types of genomes, genomes & genetic variation, comparison of different genomes, genome evolution, Overview of their genome projects.	

Course Learning Outcomes:

- Understand basics of model systems.
- Gain knowledge about *Drosophila* and its genetics in greater detail.
- Acquaintance with various cloning techniques used in *Drosophila*.
- Understand use of model organisms in Human Genome Project.

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Bate, Michael, and Martinez Arias, Alfonso	The Development of <i>Drosophila Melanogaster</i>	Cold Spring Harbor Press	1993	978-0879694234 0879694238	
Snustad DP, Simmons MJ	Principles of Genetics	John Wiley and Sons Inc.	6 th /2011	978-0470388259 0470388250	
L. Wolpert, J. Smith, T. Jessell, P. Lawrence, E. Robertson and E. Meyerowitz	Principles of Development	Oxford Univ Press.	3 rd /2006	0199275378 978-0199275373	576
Wood	The Nematode: <i>C.elegans</i>	CSHL Press	1988	978-0879694333 0879694335	667

Biochemical Toxicology

L	T	P	Total Credits
4	0	0	4

Course content and syllabus

	Teaching Hours
Unit I: Fundamentals of Toxicology	18 hrs
Definition, scope and relationship of Toxicology to other sciences. Nature of toxic effects. Acute and chronic exposure. Dose: response relationship, Determination of LD-50, no observed effect level (NOEL), acceptable daily intake, bioavailability, volume of distribution, plasma half life, total body burden, total body clearance. Synergism and Antagonism	
Unit II: Metabolism of xenobiotics/toxicants	18 hrs
Metabolism of Toxicant- Introduction, absorption and distribution. Cytochrome P- 450, MFO system and their role in xenobiotic metabolism. Non-microsomal oxidation. Phase-I and Phase-II reactions, conjugations, Glucoronide conjugates, Conjugations catalysed by sulfotransferases, methyl transferases and acetyl transferases. Glutathione conjugation and Amino acid conjugations. Genetic polymorphisms in Phase-1 and Phase-2 enzymes and their effect on the xenobiotic metabolism.	
Unit III: Toxicity Testing	18 hrs
Toxicity Testing and Target organ toxicity, Ames test, Host mediated assay and dominant lethal test, Drosophilla sex linked recessive lethal test, micronucleus test, Transgenic rodents somatic and germ cell gene mutation assays, <i>in vivo</i> mammalian alkaline comet assay, and <i>in vitro</i> gene mutation assays using the <i>TK</i> locus. Toxicology of Medical devices, Haemotoxicology, Hepatotoxicity.	
Unit IV: Toxicity of common xenobiotics	18 hrs
Toxicity of Pesticides-Classes of pesticides: Organochlorine, Organophosphates and carbamates. DDT: Metabolism, toxicity, persistence and bioaccumulation. Organophosphate-Metabolism and mechanism of insecticidal action. Metal Toxicity-Toxicity of Lead and its effect on heme synthesis. Toxicology of various forms of mercury, Arsenic Toxicity. Drug Toxicity-Paracetamol, Metabolism and its Toxic effects	

Course Learning Outcomes:

- Tech about the harmful effects upon short-term and long-term exposure to various chemical compounds.
- Enzymes involved in the metabolism of xenobiotics.
- Effect of genetic polymorphism on the clearance of xenobiotics.
- Experimental approaches to assess the toxicity of a compound.
- Molecular mechanisms of action of toxicants

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
Lee, B-M., and Kacew, S.	Lu's Basic Toxicology: Fundamentals, Target Organs, and Risk Assessment	CRC Press	7 th Ed	978-1138089273	663
Hayes, A.W., and Kruger, C.L.	Principle & Methods of Toxicology	CRC Press	5 th Ed	978-1842145364	2184
Klaassen, C.D.	Casarett & Doull's Toxicology: The Basic Science of Poisons	McGraw Hill	9 th Ed	978-1259863745	1648

Omics Technology and Applications

L	T	P	Total Credits
4	0	0	4

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:

- To expose students in the multiple areas of omic technologies
- Students will learn about different approaches used in the areas of Genomics, transcriptomics, proteomics, metabolomics, and interactomics
- Learn how different omic approaches is used to generate testable hypothesis
- 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- 813171559 8	464
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Advanced Enzymology

L	T	P	Total Credits
4	0	0	4

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.

	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
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 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
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

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
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Professional Ethics and Responsibilities - II

L	T	P	Total Credits
1	0	0	1

Course content and syllabus

	Teaching Hours
Unit I: [Ethics and Empathy]	4 hrs
Religion and Morality. Morality as Part of Our Nature, Skepticism About the Self, Free Will and the Situation, Culture mixing and its consequences, Factors affecting Evaluative Responses to Culture Mixing, Culture as a Knowledge Structure, Multi-Culture Mindsets, Biculturalism & Frame Switching, Assimilation to a Cultural Frame, Globalization and the Forces Shaping the Behaviour.	
Unit II: [Importance of Sampling and Ethical Issues in Research]	5 hrs
Sampling and its Importance, Basic Statistics Concepts, Reliability and Validity, Creating a Representative Sample, Ethical Issues Overview, Voluntary Participation, No Harm to Participants, other Ethical Issues	
Unit III: [A bias neutral workplace]	4 hrs
Creating a Bias Neutral Work Environment, management strategies for workplace bias and personal bias, effective communication methods and how to measure outcomes, strengthening the position of women in society	
Unit IV: [Sustainability, Responsibility and Ethics]	5 hrs
Concepts of sustainability, such as social, environmental and economic dimensions, and the importance of time, Ecological Sustainability. responsible business and research practices, Different approaches to responsibility in research and corporate organizations, such social responsibility, social entrepreneurship, or corporate citizenship. Environmental Ethics, Land ethics, Deep ecology, Ecofeminism.	

Course Learning Outcomes:

- Understand basic concepts of morality in mixed cultures.
- Learn to resolve the issues in research.
- Learn to create a bias free work culture.
- To learn the concept of Sustainability and Responsibility

Text / Reference Books:

Author	Title	Publisher	Ed/year	ISBN No	Pages
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Rita Gupta	Sexual Harassment at Workplace, 2013	Lexis Nexis	2013	978- 93514305 37	320
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Dissertation -II

L	T	P	Total Credits
0	0	12	12

Course content and syllabus

The student will undertake a research project under the supervision of a faculty member.