APPENDIX-I

Academic Year 2023-24
Detailed Programme Structure & Syllabus
M.Sc. Biochemistry Programme Structure

Semester I	Course Code	Title of papers	Credit	Max. Marks
1st SEM	PGBCH -101N	Cell Biology and Biomolecules	4	100
	PGBCH -102N	Analytical Biochemistry	4	100
	PGBCH -103N	Bioenergetics and Metabolism	4	100
	PGBCH -104N(P)	Practical's based on PGBCH 101,102 and 103	4	100
	PGBR-01N	Basics in Research	4	100
Credit I semester			**20**	**500**
2nd SEM	PGBCH -106N	Nutrition and Physiology	4	100
	PGBCH -107N	Bio Statistics	4	100
	PGBCH -108N	Clinical biochemistry	4	100
	PGBCH -109N(P)	Practical's based on PGBCH 105,106 and 107	4	100
	PGMP-02N	Mini Project	4	100
Credit II semester			**20**	**500**
3trd SEM	PGBCH -111N	Enzymology and enzyme technology	4	100
	PGBCH -112N	Immunology	4	100
	PGBCH -113N	Basic Biotechnology	4	100
	PGBCH -114N(P)	Practical's based on PGBCH 109,110 and 111	4	100
	PGRT -03N	Research Tools and Practices	4	100
Credit III semester			**20**	**500**
	Select any one group			
4rth SEM	**Group A** PGBCH – 116N	Bio-safety and IPR	4	100
	PGBCH -117N/ PGEVS-120N	Environmental Toxicology and Occupational Health Hazardous	4	100
	PGBCH-118N /PGZY-121N	Genetic Engineering	4	100
	PGBCH-119N(P)	Practical's based on PGBCH 114N and 115N	4	100
	OR			
	Group B PGBCH -120N	Microbiology and Toxicology	4	100
	PGBCH -121N	Industrial biotechnology	4	100
	PGBCH -122N	Bioinformatics	4	100
	PGBCH-123 N (P)	Practical's based on PGBCH 114N and 115N	4	100
	Compulsory paper			
	PGBCH-124 (D)N	Dissertation/Industrial training/Internship with Viva Voce	4	100
Credit IV semester			**20**	**500**
Total credit/Max. Marks			**80**	**2000**

Programme: **M.Sc**.	Year: 2023	Semester: **I**
Subject: **Biochemistry**		
Course Code: **PGBCH-101N**	Course Title: **Cell Biology and Biomolecules**	

Course Objectives:

- To discuss the basics of outline of biochemistry
- To discuss the structures of prokaryotic and eukaryotic cells
- To discuss the basic concept of cell organelles and its role in biochemical functions
- To discuss about cell and different organelles

Course Outcomes:

CO 1: Able to understanding the history and scope of Biochemistry in brief.
CO 2: Able to understanding of water properties and its role in living systems.
CO 3: Learn the conceptualize the cell structure and its functions
CO 4: Know the structure and functions of various cell organelles.
CO 5: Also know the structure and classification of amino acids

Credits: **4**	Type of Course: **Core**
Max. Marks: **100**	Min. Passing Marks: **36**

Block 1	**Cell and Cell Organelles**
Unit I	**Introduction to cell:** Cell biology and cell organelles: History of biochemistry, biochemical organization, architecture of cells, structure of prokaryotic and eukaryotic cell, structure of cell wall and cell membrane.
Unit II	**Cell organelles:** Structure and function of different cell organelles mitochondria, nucleus, endoplasmic reticulum, chloroplast, Golgi apparatus, ribosomes, lysosomes, centrioles cytoskeleton.
Block 2	**Block-II: Biomolecules Part I**
Unit V	Carbohydrates: Introduction to carbohydrates, monosaccharides-structure, properties and their derivatives, aldose and ketose, stereoisomerism of monosaccharides, acid and base reaction in monosaccharides, structure of disaccharides and oligosaccharides, types of polysaccharides, function of complex carbohydrate, glycosidic bonds, polysaccharides as energy storage.
Unit VI	**Proteins:** Introduction to protein, amino acids, primary, secondary, tertiary and quaternary structures of protein, structure of hemoglobin, proteinprotein interaction, protein interaction with nucleic acid, function of protein and malfunction of protein.
Block 3	**Block-III: Biomolecules Part II**
Unit V	**Lipids:** Introduction to lipids, types, structure and function of lipids, essential fatty and saturated fatty acid, wax, phospholipids, glycerophospholipidssphingophospholipids, glycolipids, glyceroglycolipids, sphingo-glycolipids, simple lipids, lipid bilayer structure, biological membrane: components and structure.
Unit VI	**Nucleic acids:** Introduction to nucleic acid, structure and components of nucleotides, nitrogen bases in nucleotide and nucleosides, nucleic acids, structures and types of RNA, double helix of DNA, Central Dogma, denauration of DNA, nucleic acid

	sequencing, biological function of nucleotides.

Suggested Text Book Readings:

1. David L. Nelson and Michael Cox, “Lehninger Principles of Biochemistry” International Edition-2021.
2. Dr J L Jain, “Fundamentals of Biochemistry” S. Chand and Company-2020.
3. P S Verma and V K Agarwal, “Cell Biology (Cytology, Biomolecule and Molecular Biology” S. Chand Publication-2016.
4. Talwar and Srivastava, “Textbook of Biochemistry and Human Biology” Eastern Economy Edition, Prentice Hall, India-2002.
5. Satyanarayana U., “Biochemistry” Elsevier India,2021

Suggested online links:

1. Cell Biology and Bio-molecule: Microprocessor and Its Applications (uprtou.ac.in)
2. Introduction to cell biology: me339_s02.pdf (stanford.edu)
3. Carbohydrates: Notes-C18-121.pdf (latech.edu)
4. Structure of Proteins: Structure and functions of Amino Acids and Proteins (aiimsrishikesh.edu.in)
5. Nucleic Acid: Biochemistry.pdf (sscasc.in)

This course can be opted as an elective by the students of following subjects: M.Sc. (Botany), M.Sc. (Zoology)

Suggested equivalent online courses (MOOCs) for credit transfer:

Biochemistry of Biomolecules: Biochemistry of Biomolecules - Course (swayam2.ac.in)

Programme: **M.Sc**.	Year: 2023	Semester: **I**
Subject: **Biochemistry**		
Course Code: **PGBCH-102N**	Course Title: ***Analytical Biochemistry***	

Course Objectives:

- To discuss the basics understanding of spectroscopy
- To discuss the role of electrophoreses in biochemical analysis
- To discuss the instrumentation and application of microscopy
- To discuss the basic principal of XRD

Course Outcomes:

CO 1: Abel to understand the instrumentation and principal of uv-visible spectroscopy
CO 2: know the instrumentation and application of chromatography
CO 3: Learn about electrophoreses principle and application in biochemistry
CO 4: Able to know microscopy and its functions
CO 5: Also able to know the instrumentation and application of NMR and XRD

Credits: **4**	Type of Course: **Core**
Max. Marks: **100**	Min. Passing Marks: **36**

Block 1	**Spectroscopy and Chromatography**
Unit-I	**Spectroscopy:** Origin of spectra and electronic transition, Visible and UV Spectroscopy-tools and techniques and applications, atomic adsorption, spectroscopy- tools and techniques and applications.
Unit-II	**Chromatography** Principle, thin layer, ion exchange, affinity, hydrophobic exchange and gel filtration chromatography, principle and instrumentation of high performance liquid chromatography (HPLC).
Block- II:	**Centrifugation and Electrophoresis**
Unit-III	**Centrifugation** Principles of centrifugation, types of centrifuges, differential centrifugation, density gradient, and ultracentrifugation.
Unit-IV	**Electrophoretic techniques:** General principles, electrophoresis of proteins, native-PAGE and SDS-PAGE, agarose gel electrophoresis for DNA, isoelectric- focusing, 2D gel electrophoresis.
Block- III:	**Microscopy, X-ray diffraction and NMR**
Unit-V	**Microscopy:** Basic principles and instrumentation of scanning election microscopy (SEM) and transmission electron microscopy (TEM), scanning tunneling microscopy, specific staining of biological materials
Unit-VI	**Instrumentation:** X-ray diffraction and NMR principle, instrumentation and applications.

Suggested Text Book Readings:

1. Principal and Techniques Of Biochemistry and Molecular Biology, Wilson and Walker, Seven Editor, Cambridge Press.
2. Analytical Clinical Biochemistry, Kaushik Basu Et Al., Techno World Publisher,
3. Analytical Biochemistry, Mohammad Raies Et. Al., Book Enclave, Publisher

4. S.M. Khopkar, Basic Concepts of Analytical Chemistry, New Age International Pvt Ltd Publishers, 2018
5. Y R Sharma, Elementary organic spectroscopy; S Chand publication, Fifth edition 2013.
6. Pavia donald, Introduction to spectroscopy, 5th edition.

Suggested online links:

1. Introduction To Spectroscopy: Introduction To Spectroscopy.Pdf (Su.Se)
2. Principles Of Spectroscopy: Microsoft Powerpoint - Spectroscopy-Chem6230 (Ugpti.Org)
3. Introduction, Chromatography Theory, and Instrument Calibration: Microsoft Word - Ch 1 2017.Doc (Whitman.Edu)
4. Techniques in Techniques in Molecular Biology: Microsoft Word - Bbyet-141_ Vol. 1, Credit Page, Bi, Ci _28-7-2021_ (Egyankosh.Ac.In)

This course can be opted as an elective by the students of following subjects: M.Sc. (Botany), M.Sc. (Zoology)

Suggested equivalent online courses (MOOCs) for credit transfer:
Biochemistry of Biomolecules: Biochemistry of Biomolecules - Course (swayam2.ac.in)

Programme: **M.Sc**.	Year: 2023	Semester: **I**
Subject: **Biochemistry**		
Course Code: **PGBCH-103N**	Course Title: **Bioenergetics and Metabolism**	

Course Objectives:

- To discuss the process of metabolism
- To discuss the bioenergetics process
- To discuss the carbohydrate metabolism
- To discuss the metabolism of nitrogenous compounds

Course Outcomes:

CO 1: Able to know the energy production for metabolism.
CO 2: Learn about oxidation potential and energy production
CO 3: Learn about metabolism of carbohydrate metabolism
CO 4: Able to understand the metabolism of amino acid
CO 5: Also able to know the urea cycle and its regulation

Credits: **4**	Type of Course: **Core**
Max. Marks: **100**	Min. Passing Marks: **36**

Block 1	**Bioenergetics**
Unit I	**Bioenergetics-I:** Concept of free energy, standard free energy, determination of ΔG for a reaction, relationship between equilibrium constant and standard free energy change, biological standard state and standard free energy, change in coupled reactions.
Unit II	**Bioenergetics-II:** Redox potentials, high energy phosphate compounds-ATP, phosphate group transfer, photosynthetic light reactions.
Block 2	**Coenzyme sand Carbohydrate Metabolism**
Unit III	Coenzymes and cofactors: Prosthetic group, coenzymes involved in different metabolic pathways, classification of coenzymes, isozymes, abzymes, synzyme, pyridoxal phosphate and B12 coenzymes.
Unit IV	Carbohydrate Metabolism: Glycolysis, fermentation, TCA cycle, electron transport chain,oxidative phosphorylation, gluconeogenesis, glycogenesis, energetic can dregulation of metabolic cycles, metabolism of disaccharides, hormonal regulation of carbohydrate metabolism.
Block 3	**Metabolism of Amino acids and Nitrogen compounds**
Unit VI	**Amino acids:** General reactions of amino acid metabolism-transamination, decarboxylation , oxidative and non-oxidative deamination of aminoacids. Specialmetabolism of methionine, histidine, phenylalanine, tyrosine, tryptophan, lysine, valine, leucine, isoleucine and polyamines.
Unit V	**Metabolism of nitrogen compounds:** Metabolism and regulation, decarboxylation, transamination, deamination, metabolism and regulation of urea, Urea cycle and its regulation.

Suggested Text Book Readings:

1. Bioenergetics, David Nicholls, Academic Press ISBN: 9780123884251 4th Edition
2. Bioenergetics, Alexander Lowen Penguin Books, ISBN13: 9780140194715

3. Principles of Biochemistry: Lehninger, Nelson and Cox. Student Edition, CBS 1439 Publishers and Distributors, Delhi.
4. Fundamentals of Biochemistry: Dr J L Jain, S. Chand and Company

Suggested online links:

1. Bioenergetics: (Pdf) Bioenergetics (Researchgate.Net)
2. Metabolism of Amino Acids —General Aspects: Bch103-7.Pdf (Davuniversity.Org)
3. Carbohydrates Metabolism: Slide 1 (Mgcub.Ac.In)
4. Glycolysis- glycolysis (ttuhsc.edu)
5. Introduction to Nitrogen Metabolism: Nitrogen Metabolism.pdf (slideshare.net)

This course can be opted as an elective by the students of following subjects: NA

Suggested equivalent online courses (MOOCs) for credit transfer: NA

Programme: M.**Sc.**	Year: **2023-24**	Semester: **I**
Subject: **Biochemistry**		
Course Code: **PGBR-01N**	Course Title: **Basics in Research**	

Course Objectives:

- To discuss the Sources of information
- To discuss about journal abbreviations
- To discuss the monographs, dictionaries, text books etc.

Course Outcomes:

CO 1: Able to learn about how to get information of research.
CO 2: Learn about journal and article and research manuals
CO 3: Able to know the role of primary, secondary and tertiary sources of information.
CO 4: Gain knowledge about abstract and citation index.
CO 5: Also know about digital web resources

Credits: 4	**Type of Course:** Core
Max. Marks: 100	Min. Passing Marks: 36

Topic 1	**Literature Survey** Introductions: Sources of information, need for reviewing literature, primary-secondary and tertiary sources, journals, journal abbreviations, abstracts, current titles, reviews, monographs, dictionaries, text books, current contents, patents. Introduction to chemical abstracts and beilstein, subject index, substance index, author index, formula index and other indices with examples. Digital: Web resources, E-journals, journal access, TOC alerts. Hot articles: Citation index, UGC infonet, E-books, Impact Factors, Search engines- Google scholar, chemical industry, Wiki-databases, chemSpider, Science Direct, SciFinder, Scopus
Topic 2	**Ethics and IPR** Regulatory bodies, practices and compliances, Good Laboratory Practices (GLP), Research Ethics & Misconduct, Patents, Copyrights, GI and Trademarks, Product and process patent, Patent Treaties and Convention, process of filing patent, database of patent, search and retrieval.

Suggested Text Book Readings:

1. Use different searching engine to get relevant information (Google scholar, chemical industry, Wiki-databases, chem Spider, Science Direct, SciFinder, Scopus.
2. Access to different online research library and research portal (Web resources, E-journals, journal access, TOC alerts)

Suggested online link:

1. You tube
2. Web resources
3. Hot articles
4. Science Direct
5. SciFinder, Scopus

Google scholar

Suggested equivalent online courses (MOOCs) for credit transfer:

1. **Research Ethics, Shri. Manoj Kumar K, INFLIBNET, https://onlinecourses.swayam2.ac.in/cec22_ge28/preview**

Note:- In this paper, learner itself study the UNITS and prepare a report.

Instructions for submitting the reports

1. 02 copies of Report will be submitted by learner to the study center.
2. The evaluation will be in 100 marks.
3. Internal assessment will be done by the counsellor of the study center under 30 percent marks and upload the marks to the university portal which is provided by examination department.
4. The coordinator of study center will send a one copy of report along with the print copy of uploaded internal marks (30 marks) to the concerned school for external evaluation. The external evaluation will be in 70 marks within the stipulated date.
5. The concerned school will send the external marks of evaluated reports to the examination department and also upload it on university portal.

Programme: **M.Sc**.	Year: 2023	Semester: **II**
Subject: **Biochemistry**		
Course Code: **PGBCH-106N**	Course Title: **Nutrition and Physiology**	

Course Objectives:

- To discuss the nutrition and physiology of human
- To discuss the element of human nutrition
- To discuss the protein that is the building block of living being
- To discuss the digestive system and respiration

Course Outcomes:

CO 1: Able to understand the role of nutrition in physiology

CO 2: Learn the Basal metabolic rates (BMR)

CO 3: Able to describe the dietary resource and metabolic functions of nutrients

CO 4: Able to know the blood composition

CO 5: Also able to know the respiratory system and ATP

Credits: **4**	Type of Course: **Core**
Max. Marks: **100**	Min. Passing Marks: **36**

Block 1	**Nutrition and Nutritional Elements**
Unit I	**Basic Concepts of nutrition:** Function of nutrients, measurement of caloric value of food, basal metabolic rate (BMR); factors affecting BMR, recommended dietary allowances, dietary recommendations human nutritional needs, malnutrition.
Unit II	**Elements of nutrition:** Dietary requirement of carbohydrates, lipids and proteins; concepts of protein quality, micronutrients and macronutrients, essential amino acids, essential fatty acids and their physiological function, deficiency and toxicity of nutrients.
Block 2	**Vitamins, Minerals and Physiology**
Unit III	**Vitamins and minerals:** Dietary sources, biochemical functions, water soluble and fat soluble vitamins, requirements and deficiency diseases associated with vitamins, role of minerals in metabolism
Unit IV	**Introduction to physiology:** Blood-composition and functions of plasma, erythrocytes, leucocytes and thrombocytes, blood coagulation, types of blood groups, antigen and antibodies, blood transfusion.
Block 3	**Digestive system and Respiration**
Unit V	**Digestive system:** Compositions, parts of alimentary canal, functions and regulation of saliva, gastric, pancreatic, intestinal and bile secretions, role of enzymes in digestive system.
Unit VI	**Respiration:** Inspiration and expiration, types of respiration, lungs structure, mechanism of breathing and Its regulation,

Suggested Text Book Readings:

1. David L. Nelson and Michael Cox, “Lehninger Principles of Biochemistry” International Edition-2021.

2. Dr J L Jain, “Fundamentals of Biochemistry” S. Chand and Company-2020.
3. Nutritional Biochemistry, DC Sharma, CBS Nursing publication
4. Nutritional Biochemistry, Tom Brody, Academic Press publication
5. Satyanarayana U., “Biochemistry” Elsevier India,2021

Suggested online links:

1. Food, Nutrition, Health and Fitnes: kehe103.pdf (ncert.nic.in)
2. Human Vitamin and Mineral Requirements: Foreword (fao.org)
3. Vitamins: Vitamins & Minerals (austincc.edu)
4. The Digestive System: https://www.uc.edu/content/dam/uc/ce/docs/OLLI/Page Content/OLLI - The Digestive System.pdf

This course can be opted as an elective by the students of following subjects: M.Sc. (Zoology) M.Sc. (Nutrition and Home Science)

Suggested equivalent online courses (MOOCs) for credit transfer: NA

Programme: **M.Sc**.	Year: 2023	Semester: **II**
Subject: **Biochemistry**		
Course Code: **PGBCH-107N**	Course Title: **Bio-Statistics**	

Course Objectives:

- To discuss the history and scope of bio-statistics
- To discuss the different statistical techniques used in biochemistry
- To discuss the bio chemical data analysis using statistical methods
- To discuss the research methodology and hypothesis

Course Outcomes:

CO 1: Able to understanding of history and scope of bio-statistics
CO 2: Able to know the role of mode, median and mode in data analysis.
CO 3: To learn about sampling and sampling analysis
CO 4: Able to know the process of analysis of variance
CO 5: also able to hypothesis analysis and implementation

Credits: **4**	Type of Course: **Core**
Max. Marks: **100**	Min. Passing Marks: **36**

Block 1	
Unit I	Meaning and Types of Research, Significance of Research, About Research Problem and its Selection, Measures of Central Tendency, Measures of Dispersion, Measures of Asymmetry.
Unit II	Measures of Relationship, Regression Analysis Association of Attributes, 3-Sigma Limits.About Sampling, Different Types of Sampling Designs, Simple Random Sampling, Stratified Sampling, Cluster Sampling.
Block 2	**Vitamins, Minerals and Physiology**
Unit III	Basic Concepts of Probability, Definitions of Probability, Additive and Multiplicative law of Probability, Conditional Probability, Bayes' Theorem. Random Variable and its types, Probability Mass Function, Probability Density Functions
Unit IV	Source of Vital Statistics and Demographic Data, Rates, ratio, proportion, Measures of Fertility, measures of mortality, measures of morbidity, Migration. Probability Distributions, Binomial Distribution, Poisson distribution, Geometric Distribution, Normal Distribution, Exponential Distribution
Block 3	**Digestive system and Respiration**
Unit V	About Hypothesis and its Types, Level of Significance, Critical Region, P Value, Types of errors, Chi-Square Tests, t-tests, z-tests.
Unit VI	**Respiration:** Analysis of Variance and Co-Variance, Basic Principles of ANOVA and ANCOVA. (One Way, Two Way and Three Way Analysis)

Suggested Text Book Readings:

1. Introduction to Statistics, David Lane, Rice University
2. Basic Statistics, B.L. Agrawal, New Age International Private Limited
3. Basic Statistics, Thomas Higher Education Textbooks
4. Computer Fundamentals : Concepts, Systems & Application, Priti Sinha, Pradeep K., Sinha , BPB Publications

Suggested online links:

1. Introduction to Descriptive Statistics: introduction-to-descriptive-statistics.pdf

2. Descriptive Statistics: Slide 1 (incois.gov.in) 3. Basic Probability Theory: 46628-0 Ash 1 (illinois.edu)
This course can be opted as an elective by the students of following subjects: NA
Suggested equivalent online courses (MOOCs) for credit transfer: 1. Introduction to Biostatistics: **Introduction to Biostatistics - Course (nptel.ac.in)**

Programme: **M.Sc**.	Year: 2023	Semester: **II**
Subject: **Biochemistry**		
Course Code: **PGBCH-108N**	Course Title: **Clinical Biochemistry**	

Course Objectives:

- To discuss the clinical process and chemical control
- To discuss the genetic and chemical control
- To discuss nutrition, drugs and digestion

Course Outcomes:

CO 1: Able to understand the role of clinical biochemistry in laboratory
CO 2: Able to know the composition of body fluids and macro and micronutrient
CO 3: Know genetic damage by ionization radiation
CO 4: Able to know the control of water and electrolyte metabolism
CO 5: Also able to know inborn errors of metabolism

Credits: **4**	Type of Course: **Core**
Max. Marks: **100**	Min. Passing Marks: **36**

Block 1	**Clinical process and chemical control**
Unit I	**Basic in clinical chemistry:** Role of clinical biochemistry in laboratory, clinical utility, blood samples, respiratory and metabolic control of pH, disorder of acid base balance, blood gases and its measurement, anion gap.
Unit II	**Genetic and chemical control:** DNA and genetic information, genetic damage by ionization radiation, mutation and carcinogens, cancer and tumors marker, transport, action and measurement of hormones, endocrine disorder, investigation of endocrine diseases.
Block 2	**Nutrition, drug and digestion**
Unit III	**Nutrition and drug:** Composition of body fluids, macro and micronutrient, assessment of nutritional status, therapeutic drugs monitoring, drugs overdose.
Unit IV	**Digestion:** Digestive process, gut hormones and clinical disorder, disorder of acid base balance anion gap.
Block 3	**Electrolyte transport and inborn errors of metabolism**
Unit V	**Control of water and electrolyte metabolism:** Water balance, osmolarity of sodium disorder, balance of water, electrolyte and potassium, measurement of sodium and potassium, control of calcium, disorders related to calcium metabolism.
Unit VI	Transport and Storage: plasma proteins, protein groups, measurement of plasma protein, lipids transport and lipids disorders, atherosclerosis, and specific proteins, lipoproteins.
Unit VII	**Inborn errors of metabolism:** Inheritance, Investigation of IBEM, Investigation of suspected IBEM, Parental diagnosis, Phenylketonuria, Cystic fibrosis.

Suggested Text Book Readings:

1. Clinical Biochemistry: Metabolic and Clinical Aspects: William J. Marshall, Elsevier
2. Practical Clinical Biochemistry Methods And Interpretations: Ranjna Chawla
3. Early Clinical Exposure: A Case Based Approach in Clinical Biochemistry: Anita Chalak, Jaypee Brothers Medical Publishers.
4. Clinical Biochemistry, Richard Luxton, Viva Books publisher

Suggested online links:

1. DNA: The Genetic Material: Ch10-1 Gen material.pdf (csun.edu)
2. Pathophysiology of Water and Electrolyte Metabolism: PowerPoint Presentation (bns-hungary.hu)
3. Inborn errors of metabolism: INBORN ERRORS of METABOLISM, Part 1 (ufl.edu)
4. Digestive System: PowerPoint Presentation (uc.edu)

This course can be opted as an elective by the students of following subjects: NA

Suggested equivalent online courses (MOOCs) for credit transfer: NA

Programme: M.**Sc.**	Year: **2023-24**	Semester: **II**
Subject: **Biochemistry**		
Course Code: **PGMP-02N**	Course Title: **Mini Project**	

Course Objectives:

- To discuss to project
- To discuss how to select the topic of project
- To know how writing the projects
- To discuss about needs of information for project

Course Outcomes:

CO 1: Able to learn about how to get information of project.
CO 2: Learn about journal and article and research manuals
CO 3: Able to know the role of primary, secondary and tertiary sources of project work.
CO 4: Also know how to use digital web resources for project work
CO 5: learn about writing of project

Credits: 4	**Type of Course:** Core
Max. Marks: 100	Min. Passing Marks: 36
Topic	Students shall make mini project on selected topic of their own choice (with or without any, Supervisor) and prepare the report and submit it to the University Examination Department and School of Science of the University for evaluation.

Suggested Text Book Readings:

1. Use different searching engine to get relevant information (Google scholar, chemical industry, Wiki-databases, chem Spider, Science Direct, SciFinder, Scopus.
2. Access to different online research library and research portal (Web resources, E-journals, journal access, TOC alerts)

Suggested online link:

1. You tube
2. Web resources
3. Hot articles
4. Science Direct
5. SciFinder, Scopus

Google scholar

Note: Students shall make mini project on selected topic of their own choice studied so far and prepare the report.

Instructions

1. 02 copies of Report will be submitted by learner to the study center.
2. The evaluation will be in 100 marks.
3. Internal assessment will be done by the counsellor of the study center under 30 percent marks and upload the marks to the university portal which is provided by examination department.
4. The coordinator of study center will send a one copy of report along with the print copy of uploaded internal marks (30 marks) to the concerned school for external evaluation. The external evaluation will be in 70 marks within the stipulated date.
5. The concerned school will send the external marks of evaluated reports to the examination department and also upload it on university portal.

The guideline for preparing report is available at link:
http://14.139.237.190/vc_school_main_page.php?slm=1&contid=206

Programme: **M.Sc**.	Year: 2023	Semester: **III**
Subject: **Biochemistry**		
Course Code: **PGBCH-111N**	Course Title: **Enzymology and Enzyme Technology**	

Course Objectives:

- To discuss the nomenclature and classification of enzymes
- To discuss the mechanical action of enzymes
- To discuss the enzyme kinetics and regulation

Course Outcomes:

CO 1: Able to understand the enzymes action and properties
CO 2: Able to know mechanism of enzyme action and regulation.
CO 3: Know the isolation and purification of enzymes
CO 4: Able to know the purification and large scale production of enzymes
CO 5: Also able to know the multi-enzymes complexes

Credits: **4**	Type of Course: **Core**
Max. Marks: **100**	Min. Passing Marks: **36**

Block 1	**Enzymes nomenclature and multi-enzymes complexes**
Unit I	**Introduction to enzymes:** Nomenclature and classification of enzymes, general properties of enzymes, cofactors and specificity, Criteria for enzyme homogeneity, bioenergetics of enzymes reactions, catalytic antibodies
Unit II	**Multi-enzymes complexes:** Isozymes, Coenzyme, artificial enzymes, catalytic antibodies, Enzyme engineering-strategies, directed evolution, degradation of unnatural substrates. Protein mediated transport, enzyme inhibition, determination of KI, suicide inhibitors.
Block 2	**Enzyme kinetics and regulation**
Unit III	**Enzyme kinetics:** Active sites, Enzyme specificity, Enzyme unit, Enzyme velocity, Activation energy and transition state enzymatic reaction mechanisms, Michaelis- Menten equation, Effect of substrate, pH, temperature and inhibitors on enzyme activity.
Unit IV	**Mechanism of enzyme action and regulation:** Active and regulatory sites, chemical modification, feedback inhibition, positive and negative cooperativity, allosteric enzymes, marker enzymes, enzyme region and stererio specificity.
Block 3	**Industrial enzymes and purification**
Unit V	**Industrial enzymes:** In detergent, food, leather, dairy, medicines and chemical industries. Enzyme immobilization: Introduction, methods, applications and limitations.
Unit VI	**Isolation and purification of enzymes:** Isolation, purification and large scale production of enzymes with principles and applications of the involved techniques, viz gel filtration, ion exchange and affinity chromatography, centrifugation and electrophoretic techniques

Suggested Text Book Readings:

1. David L. Nelson and Michael Cox, "Lehninger Principles of Biochemistry" International Edition-2021.
2. Dr J L Jain, "Fundamentals of Biochemistry" S. Chand and Company-2020.
3. P S Verma and V K Agarwal, "Cell Biology (Cytology, Biomolecule and Molecular

Biology" S. Chand Publication-2016.
4. Talwar and Srivastava, "Textbook of Biochemistry and Human Biology" Eastern Economy Edition, Prentice Hall, India-2002.
5. Satyanarayana U., "Biochemistry" Elsevier India,2021

Suggested online links:

1. Enzyme Kinetics: Enzyme Kinetics (columbia.edu)
2. Nomenclature and Classification of Enzymes: Enzymes_Nomenclature_and_Classification (amu.ac.in)
3. Mechanism of Enzyme Action: Mechanism of enzyme action (jrc.ac.in)
4. Applications of Enzyme: 45 Enzymes - Applications.pdf (du.ac.in)

This course can be opted as an elective by the students of following subjects: M.Sc. (Zoology) M.Sc. (Biotechnology)

Suggested equivalent online courses (MOOCs) for credit transfer: NA

Programme: **M.Sc**.	Year: 2023	Semester: **III**
Subject: **Biochemistry**		
Course Code: **PGBCH-112N**	Course Title: **Immunology**	

Course Objectives:

- To discuss the immunology and immune system
- To discuss the elements of immune system
- To discuss infectious diseases and immunology

Course Outcomes:

CO 1: Able to understand the architecture of immune system
CO 2: Able to know the role of T cells and stem cell.
CO 3: Know the antigens processing and presentation.
CO 4: Able to Understand the primary and secondary response,
CO 5: Also able to know the signal transduction properties

Credits: **4**	Type of Course: **Core**
Max. Marks: **100**	Min. Passing Marks: **36**

Block 1	**Immune system**
Unit I	**Introduction to immunology** Introduction to immunology, architecture of immune system, primary and secondary lymphoid organism, maturation and selection of T cells, types of immunoglobulin's, immunization, stem cell, immune technology, clonal selection theory.
Unit II	**Immunity:** Types of immunity-innate, acquired, adaptive and cellular immunity, immune response, inflammatory barrier, hormonal influence, peptide binding by class I and class II major histocompatibility complex.
Block 2	**Elements of Immune System**
Unit III	Cells and Organs of immune System, B-cells maturation, activation and differentiation, t-cell maturation, activation and differentiation, t-cells and bcellsreports, macrophages, dendrites cells, natural killer cells (NKcells), organization and expression of immunoglobulin genes.
Unit IV	Antigens processing and presentation, effecter responses of cell-mediated and humoral immunity, cytokines, complement system, classification of common vaccines for humans, vaccines (hepatitis, influenza, measles), blood groups and Rh factor.
Block 3	**Infection diseases and immunology**
Unit V	**Immune response to infection diseases:** Lymphocytes, primary and secondary response, signal transduction properties, antibody receptor structure, hypersensitivity.
Unit VI	Transplantation immunology, immunologic tolerance, immunology of tumors, cancer and AIDS.

Suggested Text Book Readings:

1. A Textbook Of Immunology: Latha P. Madhavee, S Chand & Company, publication
2. Immunology, Dulsy Fatima, Saras Publication
3. Basics Of Immunology, Preeti Sharma, IP Innovative Publication
4. Immunology, David Male, Elsevier publication

Suggested online links:

1. Introduction to Immunology: Immunology.pdf (hmmcollege.ac.in)

2. Components of Immune system: components of immune system (dhingcollegeonline.co.in)
3. Immune System: Immune System_Handout (Soinc.Org)

This course can be opted as an elective by the students of following subjects: NA

Suggested equivalent online courses (MOOCs) for credit transfer:
Biochemistry of Biomolecules:Biochemistry of Biomolecules - Course (swayam2.ac.in)

Programme: **M.Sc**.	Year: 2023	Semester: **III**
Subject: **Biochemistry**		
Course Code: **PGBCH-113N**	Course Title: **Basic Biotechnology**	

Course Objectives:

- To discuss the basic history and scope of biotechnology.
- To discuss the molecular biology and recombinant DNA technology.
- To discuss the medical biotechnology
- To discuss the agriculture and food biotechnology

Course Outcomes:

CO 1: Able to understand the role of biotechnology in medial
CO 2: Able to understand the role of biotechnology in agriculture and food biotechnology
CO 3: To know about cell molecular biology
CO 4: Learn about plant and animal biotechnology.
CO 5: Also able to know the recombinant DNA technology

Credits: **4**	Type of Course: **Core**
Max. Marks: **100**	Min. Passing Marks: **36**

Block 1	**Biotechnology and molecular biology**
Unit I	**Biotechnology:** An overview-definition, scope and importance of Biotechnology, useful products of biotechnology, A brief account of microbes in industry and agriculture, Fermented and Probiotic foods, Food spoilage and preservation, Metabolic engineering for over production of metabolites, Biotransformation.
Unit II	**Molecular Biology & Recombinant DNA Technology:** Concept of Recombinant DNA Technology and Gene Cloning, advance methods of molecular biology, Vectors, Vector engineering, Enzymes involved in RDT, Recombinant gene construction, Gene Transfer methods, Gene expression studies, Polymerase Chain Reaction (PCR).
Block II	**Agricultural Biotechnology and Animal & Plant Biotechnology**
Unit III	**Agriculture, Food and Environmental Biotechnology:** Role of biotechnology to Improve yield and nutritional values of crop, GM Foods, Labeling of GM Foods, Risks (Health, Environment etc) associated with GM Foods, Biobusiness, Biosafety, Role of Biotechnology in pollutants remediation (air, water and soil) and energy productions, Bioremediation,RestorationofdegradedlandsandConservationofbiodiversity.
Unit: IV	**Plant and Animal Biotechnology:** Introduction to plant tissue culture and its applications, Gene transfer methods in plants, transgenic plants, In-vitro fertilization and embryo transfer in humans and livestock, Transfection techniques and transgenic animals, Animal Cloning.
Block 3	**Block–III: Biotechnology and Molecular biology**
Unit V	**Medical Biotechnology:** Biotechnology in medicine, Vaccines, Diagnostic, Forensic, Gene therapy, Nano Medicine & Drug Delivery Cell &Tissue Engineering, Genetic disorders, Molecular methods of disease diagnosis
Unit VI	Hybridoma technology, Gene therapy, Stem cell for treatment of diseases, Therapeutic molecule, Immunological techniques. Different types of culture

	media.

Suggested Text Book Readings:

1. Advanced Biotechnology, Dubey R.C. S Chand & Company publisher
2. Biotechnology: A Problem Approach, Biotechnology: A Problem Approach, Pathfinder Publication
3. Basic Biotechnology, Ratledge Colin, ambridge University Press
4. Plant biotechnology, Adrain Slater et al., South Asia Edtion.

Suggested online links:

1. Biotechnology history: Biotechnology all lecture notes - Lecture 1- Biotechnology history Biotechnology definition- any - Studocu
2. Introduction to biotechnology, history and concepts definition: fsba-module-2-unit-1-notes-english.pdf (rug.nl)
3. Recombinant DNA Technology: Chapter14.pdF (richmond.edu)
4. Animal Biotechnology: 1589512953_Z(H)-VI-Biotech-4.pdf (deshbandhucollege.ac.in)
5. Medical biotechnology: Medical Biotechnology (vu.edu.pk)

This course can be opted as an elective by the students of following subjects: NA

Suggested equivalent online courses (MOOCs) for credit transfer: NA

Programme: M.**Sc.**	Year: **2023-24**	Semester: **III**
Subject: **Biochemistry**		
Course Code: **PGRT-03N**	Course Title: **Basics in Research Tools**	

Course Objectives:

- To discuss the application of MS office
- To discuss different research tools for research work.
- To discuss application of software's.
- To discuss about reference management tools

Course Outcomes:

CO 1: Able to learn about basic computer application of research work.
CO 2: Learn about Latex tools with MS-XL
CO 3: Able to know the role of Chem-Draw, Origin, SPSS, R-software, Octave, Matlab
CO 4: Gain knowledge about application of Mendeley-software.
CO 5: Also know about RefWorks and Zotero, etc

Credits: **4**	**Type of Course:** Core
Max. Marks: **100**	Min. Passing Marks: **36**

Topic 1	**Application of MS Office/Latex in research** Uses and application of MS Office/ Latex Tools with MS-XL, Power point Presentation.
Topic 2	**Application of Software's** Uses and application of Softwares such as plagiarism software, Chem-Draw, Origin, SPSS, R-software, Octave, Matlab, Mercury, etc.
Topic 2	**Reference management tools** Uses and application of Mendeley-software, EndNote, RefWorks and Zotero, etc.

Suggested Text Book Readings:

1. Microsoft office: Microsoft Office Essentials - IT Essentials: a Practical Guide - Subject Guides at University of York
2. How to Convert an Excel Table to a Latex table: How to Convert an Excel Table to a Latex table - YouTube
3. SPSS – What Is It: SPSS - Quick Overview & Beginners Introduction (spss-tutorials.com)
4. Video Processing in MATLAB: Video Processing in MATLAB - Video - MATLAB & Simulink (mathworks.com)
5. ChemDraw Tutorial: ChemDraw Tutorial - YouTube

Note:- In this paper, learner itself study the objectives and prepare a report.

Instructions

1. 02 copies of Report will be submitted by learner to the study center.
2. The evaluation will be in 100 marks.
3. Internal assessment will be done by the counsellor of the study center under 30 percent marks and upload the marks to the university portal which is provided by examination department.
4. The coordinator of study center will send a one copy of report along with the print copy of uploaded internal marks (30 marks) to the concerned school for external evaluation. The external evaluation will be in 70 marks within the stipulated date.
5. The concerned school will send the external marks of evaluated reports to the examination department and also upload it on university portal.
6. The guideline for preparing report is available at link: http://14.139.237.190/vc_school_main_page.php?slm=1&contid=206

Programme: **M.Sc**.	Year: 2023	Semester: **IV**
Subject: **Biochemistry**		
Course Code: **PGBCH-116N**	Course Title: **Biosafety and IPR**	

Course Objectives:

- To discuss the history and process of biosafety
- To discuss the patent and convention process
- To discuss the Gene and GMO
- To discuss the patents and agreement

Course Outcomes:

CO 1: Able to understand the biosafety and risk assessment.
CO 2: Able to know the role of WTO and international agreement
CO 3: To know about laboratory and environment biosafety
CO 4: Able to known the ecological aspects of GMOs and impact on biodiversity
CO 5: Learn to know the risk management and intellectual properties right

Credits: **4**	Type of Course: **Core**
Max. Marks: **100**	Min. Passing Marks: **36**

Block 1	**Biosafety and convention**
Unit I	Bio-safety and risk assessment tissues, regulatory framework, National biosafety Policies and law, The Cartagen a protocol on biosafety.
Unit II	**WTO and Agreement:** WTO and other international agreements related to biosafety; Cross border Movement of germplasm; Risk management issues containment. The WTO and other international agreements; Intellectual properties, copyrights, trademarks, trade secret, patents, geographical indications, etc.
Block 2	**GENE AND GMO**
Unit III	General principles for the laboratory and environmental biosafety; healthy aspects; toxicology, allergenicity, antibiotic resistance etc. Impact on environment
Unit IV	**Gene flow:** Gene flow in natural and artificial ecologies; Sources of gene escape, tolerance of Target organisms, creation of super-weeds/super viruses etc.
Block III	**Patent and agreements**
Unit V	**Ecological aspects:** Ecological aspects of GMOs and impact on biodiversity; Monitoring strategies and methods for detecting transgenics; Radiation safety and non-isotopic procedures; Benefits of transgenics to human health, society and the environment.

Suggested Text Book Readings:

1. IPR, Biosafety and Bioethics: Deepa Goel, Shomini Parashar; Pearson, 2013
2. Bioethics and Biosafety: M.K. Sateesh, I. K. International Pvt Ltd, 2013
3. Plant Biotechnology: Principles and Applications, Malik Zainul Abdin, Usha Kiran, Kamaluddin, Athar AlI, Springer, 2017
4. General Biochemistry: J.H.Weil., Wiley Eastern, Limited, 1990
5. An Introduction to Ethical, Safety and Intellectual Property Rights Issues in biotechnology: Padma Nambisan, Academic press 20107.

Suggested online links:

1. Cartagena Protocol on Biosafety: Biosafety: 1527_CBD_40pgs-layout

2. Text of the Convention: Text of the Convention (cbd.int) 3. WTO Agreements: WTO Agreements, an overview of WTO agreements, TRIPS, TRIMS, AOA, GATS, international business ugc - YouTube 4. Environmental Aspects: Environmental Aspects (usda.gov)
This course can be opted as an elective by the students of following subjects: NA
Suggested equivalent online courses (MOOCs) for credit transfer: NA

Programme: M.**Sc.**	Year: **2023**	Semester: **IV**
Subject: **Environmental Science**		
Course Code: **PGBCH-117N/PGEVS 120N**	Course Title: **Environmental Toxicology & Occupational Health Hazards**	

Course Objectives:

- To discuss about environmental toxicity and toxicant
- To discuss about rout of environmental toxicant of human beings
- To discuss about occupational toxicology and its effects on human health
- To discuss the transformation of toxicant and systematic toxicity

Course Outcomes:

CO 1: Able to know the toxicity of environment and its effect
CO 2: Learn the duration and exposure of toxicant.
CO 3: Able to know the distribution, binding and storage, and excretion of toxicant.
CO 4: Know the different types of systematic toxicity.
CO 5: Also learn the occupational toxicant exposure and limits

Credits: **4**	**Type of Course:** Core
Max. Marks: **100**	Min. Passing Marks: **36**

Block 1	**Toxicity and Toxicants**
Unit I	**Introduction to Toxicology:** Definition, history and scope of toxicology, toxicant, types of toxicant, toxicity and toxic agent, factor effects toxicants, target and non organ toxicity, dose effects and dose response relationship.
Unit II	**Toxicants**: Classification of toxic agents, natural toxins, animal toxins, plant toxins, food toxins, genetic poisons and chemical toxins.
Unit III	**Duration and exposure of toxicant:** Acute exposure, chronic exposure, types of human exposure- internal exposure, occupational exposure, environmental exposure, accidental poisoning and internal poisoning
Block 2	**Toxicity and Public Health**
Unit IV	**Fate of toxicant in human body**: Toxicant absorption, distribution, binding and storage, and excretion, active and passive transport of toxicant.
Unit V	**Chemical toxicity in human:** Alcohol toxicity, toxicity of ketones, minerals toxicity-sodium, potassium, iodine, iron, nitrogen, calcium, zinc, copper, selenium and manganese toxicity, toxicity of dioxins.
Unit VI	**Public Health**: Toxicologists and public health, laws and regulations governing toxicants, epidemiological approaches to toxicants, Blacklisted toxic chemicals, pesticide, automobile emission.
Block 3	**Systematic Toxicity**
Unit VII	**Renal toxicity** Renal toxicity- Renal structure and functions, susceptibility of kidney to toxic insult, chemically induced renal injury.
Unit VIII	**Cutaneous toxicology**: Dermatological effects of toxic agents, Allergic contact dermatitis, Cutaneous carcinogenesis

Unit IX	**Pulmonary and Hepatic toxicity**: Toxicant causing respiratory dysfunction, mechanism of entry of toxicant into the lungs, Systematic lung toxins, Actions of toxins on the liver, Chronic liver injury.
	Carcinogenesis and Testing methods
Unit X	**Carcinogenesis and mutagenicity:** Carcinogens and carcinogenesis, types of carcinogens, mechanism of carcinogenesis, Mutation and mutagenicity, types of mutation, mechanism of mutagenesis
Unit XI	**Transformation of toxicants**: Bioaccumulation, biomagnifications, biotransformation, types of biotransformation, biotransformation of DDT, toxic material in environment.
Unit XI	**Occupational toxicology:** Occupational toxicants, exposure limits, Risks associated with hazardous substances, Risk assessment and management guidelines, Occupational/Industrial hygiene, Hazard control.

Suggested Text Book Readings:

1. Environmental Toxicology, Kees van Gestel, Vrije University, Amsterdam, Environmental Toxicology
2. Environmental Toxicology, Third Edition, Sigmund F. Zakrzewski, oxford university press
3. A Textbook of Modern Toxicology: Ernest Hodgson A John Wiley & Sons, Inc., Publication
4. Principles of Environmental Toxicology, I. Shaw, J. Chadwick, CRC Press
5. Occupational Toxicology, Chris Winder, Neill H. Stacey, CRC Press

Suggested online link:

1. Introduction to Toxicology Introduction to Toxicology: Introduction to toxicology (europa.eu)
2. Introduction to Toxicology: Introduction to Toxicology | Part 1 | Complete Toxicology | NEET PG 2021 | Dr. Ambuj Mittal - YouTube
3. Chemical toxicology: chemical toxicology part 2 || effects of heavy metals like arsenic | mercury,chromium,cadmium lead - youtube
4. Drug-induced nephrotoxicity: https://www.scielo.br/j/ramb/a/TC7wp7jkjgSjPMZ9ZNnqdMF/?lang=en&format=pdf
5. Toxicology in Occupational and Environmental Setting: c01 (wiley-vch.de)

This course can be opted as an elective by the students of following subjects: M.Sc. (Zoology) M.Sc. (Environmental Science)

Suggested equivalent online courses (MOOCs) for credit transfer: NA

Programme: **M.Sc**.	Year: 2023	Semester: **IV**
Subject: **Biochemistry**		
Course Code: **PGBCH-118N/ PGZY 121N**	Course Title: **Genetic Engineering**	

Course Objectives:

- To discuss the basics of genetic engineering
- To discuss the nucleic acids, enzymes and cloning vectors
- To discuss the PCR, DNA finger printing and recombinant DNA technology (RDT)
- To discuss the Immunotechnology, blotting techniques and transgenic animals

Course Outcomes:

CO 1: Able to understand the basics of molecular biology and its applications
CO 2: Able to understand the genes expression, nucleic acids and their applications
CO3: Able to understand the cloning vectors, blotting techniques and RDT
CO3: Also able to understand isolation of nucleic acids, DNA finger printing and Immuno technology

Credits: **4**	Type of Course: **Core**
Max. Marks: **100**	Min. Passing Marks: **36**

Block 1	**Material and Tools- I**
Unit I	**History of genetics:** Basic molecular biology- gene expression in prokaryotes and eukaryotes
Unit II	**Working with nucleic acids:** Isolation of DNA and RNA, Radiolabelling of nucleic acids- end labeling, nick translation, by primer extension, Principle of nucleic acid hybridization, DNA sequencing methods- Maxam-Gilbert and Sanger-Coulson sequencing.
Unit III	**Enzymes as tools:** Restriction enzymes- Type II, uses and restriction mapping**,** DNA modifying enzymes- Nucleases, Polymerases, and end-modifying enzymes**,** DNA ligases
Block II	**Genetic Engineering- I**
Unit IV	**Cloning vectors:** Plasmids- pBR322, pUC8,Lambda (λ)-phage vector, M13 Phage, Cosmids, Phasmids, Shuttle vector, Bacterial artificial chromosome (BAC), Yeast artificial chromosome (YAC), Mammalian artificial chromosome (MAC)
Unit V	**cDNA and its applications:** Synthesis of cDNA from mRNA, Cloning cDNA in plasmid and bacteriophage vectors, Expression of cloned cDNA molecules, cDNA library
Block II	**Genetic Engineering- II**
Unit VI	**Cloning from genomic DNA:** Genomic DNA and library, Preparation of DNA fragment for cloning, Ligation, packaging and amplification of libraries
Unit VII	**Polymerase chain reaction (PCR):** Basic PCR, RT (reverse transcribed)- PCR, Real Time PCR, Applications of PCR in genetic engineering
Unit VIII	**DNA Finger printing:** History, DNA markers, Minisatellites, Microsatellites**,** Methods and applications
Unit IX	**Screening and analysis of recombinants:** Use of chromogenic substrates**,** Genetic selection methods**,** Nucleic acid probes- Chromosome walking and jumping**,** Screening cloned banks**,** Immunological screening for expressed genes**,** Blotting techniques
Block IV	**Genetic Engineering-II**

X	**Genetic engineering in action:** Analysis of gene structure and function**,** Techniques- Gel retardation, DNA foot printing, DNA finger printing, Primer, extension, S_1 mapping, and Dot-blot analysis.
XI	**Immuno-technology:** Hybridoma technology, Monoclonal antibodies and its production, Antibody engineering, Uses of monoclonal antibodies
XII	**Transgenic animals** Transgenic animals Vs cloned animals, Producing transgenic animals, Applications of transgenic animals

Suggested Text Book Readings:

1. Karp's Cell and Molecular Biology, 9th Edition, by Gerald Karp, Wiley publication.
2. Principles of Molecular Biology, Rastogi, scientific international
3. Genetic Engineering and Biotechnology by Tourte, Taylor & Francis
4. David L. Nelson and Michael Cox, "Lehninger Principles of Biochemistry" International Edition-2021.
5. Biotechnology , by B.D. Singh, Kalyani publishers

Suggested online links:

1. History of Genetics: History of Genetics.pdf (colorado.edu)
2. Enzymes used in Genetic Engineering: lec20.pdf (eagri.org)
3. DNA Fingerprinting: 100004146.pdf (amu.ac.in)
4. Immunological methods and applications: Online_Chapter.pdf (roitt.com)
5. DNA cloning: Chapter14.pdf (blackwellpublishing.com)
6. Gene Cloning: e200402-301.pdf (cheric.org)

This course can be opted as an elective by the students of following subjects: M.Sc. (Zoology) M.Sc. (Boyany)

Suggested equivalent online courses (MOOCs) for credit transfer: **N**A

Programme: **M.Sc**.	Year: 2023	Semester: **IV**
Subject: **Biochemistry**		
Course Code: **PGBCH-120N**	Course Title: **Microbiology and Toxicology**	

Course Objectives:

- To discuss the microbial diversity and culture
- To discuss the methods in microbiology
- To discuss the nutritional microbiology and chemotherapy
- To discuss the role of microbes in agriculture and environment

Course Outcomes:

CO 1: Able to understanding of history and scope of microbes
CO 2:Abe to understand the microbial diversity and its growth
CO 3: Able to learn the methods of microbial culture and techniques
CO 4: know the role of microbes in agriculture
CO 5: Also able to discuss the environmental microbiology and its toxicity

Credits: **4**	Type of Course: **Core**
Max. Marks: **100**	Min. Passing Marks: **36**

Block 1	**Microbial diversity and culture**
Unit I	**Microbial diversity and systematic:** Modern approaches to bacterial taxonomy, polyphasic classification, General characteristics of primary domains and of Taxonomic groups belonging to Bacteria, Archaea and Eukarya, Nomenclature and outline of bacterial classification as per Bergey's Manual, Accessing microbial diversity using molecular methods such as Denaturing Gradient Gel Electrophoresis (DGGE)
Unit II	**Methods in Microbiology:** Theory and practice of sterilization, Pure culture techniques, Principles of microbial nutrition, Construction of culture media, Enrichment culture techniques, Isolation and culture of aerobic and anaerobic bacteria, Culture collection, preservation and maintenance of microbial cultures.
Block II	**Microbial Nutrition and Chemotherapy**
Unit III	**Metabolic Diversity among Microorganism:** Microbial Nutrition, nutritional types and modes of nutrition in bacteria, Extremophiles. Microbial growth: The definition of growth, mathematical expression of growth, growth curve, measurement of growth and growth yields; Synchronous growth and Continuous culture.
Unit IV	**Chemotherapy/Antibiotics Antimicrobialagents;** Antibiotics: Penicillins and Cephalosporins and Broad-spectrum antibiotics, sulfa drugs, Antifungal antibiotics, Mode of action, Molecular mechanism of drug resistance. Bacterial Genetic System: Transformation, Conjugation, Transduction, Recombination, Bacterial genetic map with reference to Ecoli.
Block III	**Microbial diseases and Environmental Toxicology**
Unit V	Microbial diseases: Bacterial and virus diseases with reference to tuberculosis, Cholera, AIDS, Rabies, food born diseases.
Unit VI	Introduction to Environmental Toxicology, Bioconcentration, Bioaccumulation, and Biomagnification, Toxicokinetics, Xenobiotics Compounds, Biotransformation of Xenobiotics, Environmental Xenobiotic.

Suggested Text Book Readings:

1. Prescott' microbiology, eighth edition by By Joanne Willey and Kathleen Sandman and Dorothy Wood.
2. A textbook of Microbiology, R.C. Dubey and D.K. Maheshwari,, S Chand & Company P Ltd, New Delhi
3. Text book of microbiology by Ananthanarayan and paniker's, Seventh edition, Orient longman private limited.
4. Foundations in Microbiology, By Kathleen Park Talaro and Barry Chess, 10 edition
5. Microbiology: An Introduction, 13th Edition by Gerard J. Tortora, Berdell R. Funke and Christine L. Case.

Suggested online links:

1. Microbial diversity and systematic: 1075X_CH03_025.qxd (jblearning.com)
2. Microbiological Laboratory Techniques: Microbiological Laboratory Techniques (mowr.gov.in)
3. Antibiotics and chemotherapeutic agents: Micro 260 Antibiotic agents and Modes of Action.pdf (spokane.edu)
4. Environmental Toxicology: Environmental Toxicology 3rd edition.pdf (unp.ac.id)
5. Introduction to environmental toxicology: Introduction to Environmental Toxicology: Molecular Substructures to Ecological Landscapes (routledge.com)

This course can be opted as an elective by the students of following subjects: NA

Suggested equivalent online courses (MOOCs) for credit transfer: NA

Programme: **M.Sc**.	Year: 2023	Semester: **IV**
Subject: **Biochemistry**		
Course Code*:* **PGBCH-121N**	Course Title: **Industrial Biotechnology**	

Course Objectives:

- To discuss the process and fermentation
- To discuss the process of industrial production
- To discuss the food technology and isolation process
- To discuss the isolation process

Course Outcomes:

CO 1: Able to understand the bioprocess technology.
CO 2: Able to understanding fermentation process.
CO 3: To the process of bioreactor and stability of microbial reactions.
CO 4: Able to understand the downstream process.
CO 5: Learn the sterilization and pasteurization process of food.

Credits: **4**	Type of Course: **Core**
Max. Marks: **100**	Min. Passing Marks: **36**

Block 1	**Bioprocess and fermentation**
Unit I	Introduction to bioprocess technology, bioreactors, Isolation, preservation and maintenance of industrial microorganisms, kinetics of microbial growth and death, media for industrial fermentation, air and media sterilization.
Unit II	**Types of fermentation processes:** Analysis of batch, fed-batch, and continuous bioreactors, stability of microbial reactors, analysis of mixed microbial populations, specialized bioreactors (pulsed, photo bioreactors etc.) measurement and control of bioprocess parameters.
Block II	**Processing and industrial production**
Unit III	**Downstream processing:** Introduction, removal of microbial cells and solid matter, foam separation, precipitation, filtration, centrifugation, cell disruptions, liquid-liquid extraction, chromatography, Membrane process, Drying and crystallization, Whole cell immobilization and its industrial applications.
Unit IV	**Industrial production of chemicals:** Alcohol (ethanol), acids (citric, acetic and gluconic), Solvents (glycerol, acetone, butanol), Antibiotics (penicillin, streptomycin, tetracycline).
Block III	**Food technology and isolation process**
Unit V	**Introduction to food technology:** Elementary idea of canning and packing, Sterilization and pasteurization of food products,Technology of typical food/food products (bread, cheese, idli).
Unit VI	**Isolation process:** Isolation and screening of industrially important microorganism, different Processes of biofuels production, petroleum microbiology.

Suggested Text Book Readings:

1. Industrial Biotechnology, Wim Soetaert and Erick J. Vandamme, Wiley-VCH publication.
2. Modern industrial microbiology and biotechnology, Nduka Okafor, Science Publishers
3. Industrial Biotechnology,Varun Shastri, Disha Books
4. Industrial Biotechnology, Kavita, A.I.T.B.S. Publishers, India
5. Cruegers Biotechnology: A Textbook of Industrial Microbiology, Wulf Crueger,

Medtech.

Suggested online links:

1. Bioprocess/Fermentation Technology: Bioprocess/Fermentation Technology (Chapter 4) - Biotechnology (Cambridge.Org)
2. Downstream Processing**:** Validation (Biomanufacturing.Org)
3. Biotechnology for Clean Industrial Products and Processes: 931998031 (Page 1) (Oecd.Org)
4. Isolation, Screening and Strain Improvement: isolation, screening and strain improvement (ub.ac.id)
5. Introduction to Food Technology, General Aspect of Food Industry: microsoft word - 1. introduction to food technology, general aspect of food industry.doc.docx (nptel.ac.in)

This course can be opted as an elective by the students of following subjects: NA

Suggested equivalent online courses (MOOCs) for credit transfer: NA

Programme: **M.Sc**.	Year: 2023	Semester: **IV**
Subject: **Biochemistry**		
Course Code: **PGBCH-122N**	Course Title: **Bioinformatics**	

Course Objectives:

- To discuss the history and scope of bio information.
- To discuss the molecular phylogeny
- To discuss the 3D protein structure and classification of database
- To discuss the data base management

Course Outcomes:

CO 1: Able to understand the role of bioinformatics in biochemistry.
CO 2: Able to understand Simulation and drug designing
CO 3: To know about protein data base
CO 4: Able to known the role of national center for biotechnology information
CO 5: Learn the process of protein data base bank management

Credits: **4**	Type of Course: **Core**
Max. Marks: **100**	Min. Passing Marks: **36**

Block 1	**Bioinformatics and Biological data bases**
Unit I	**Introduction to bioinformatics:** Introduction of bioinformatics, Aim, scope, and research are as of bioinformatics, use of internet and search engines (WWW, HTML, URLs, Netscape, Explorer, Google, PUBMED) database Management system, database browsing
Unit II	Biological databases-Sequence and molecular file formats, introduction, Sequence file formats, sequence conversion tools, molecular file formats, Molecular file format conversion sequence alignments, scoring matrices, PAM, BLOSUM, alignment of pairs of sequences, multiple sequence Alignment (MSA).
Block II	**Phylogeny and sequence databases**
Unit III	**Molecular phylogeny:** Introduction of phenotypic, phylogeny and molecular phylogeny, representation of phylogeny, molecular clocks, methods of phylogeny, statistical evaluation of the obtained phylogenetic.
Unit IV	**Biological sequence databases:** Biological databases, classification scheme of biological databases, biological database retrieval systems, national center for biotechnology information (NCBI), tool and databases of NCBI, data base retrieval tool, sequence submission to NCBI,
Block III	**Protein database, Simulation and drug designing**
Unit V	Blast, PSO-blast, nucleotide database, protein database, gene expression database, structural database, chemical database, other database, Molecular Simulation and drug designing.
Unit VI	Protein 3D structure and classification database, protein data base bank, Harnessing data from PDB, data deposition tools, PDB Data, RCSB PDB Structural genomics in formation portal, retrieval of structural data base from MMDB, converted domain database (CDD).

Suggested Text Book Readings:

1. Bioinformatics, Principal and Application: Ghosh and Malik, Oxford University Press publication
2. Bioinformatics, Principal and Application: Harshwardhan P. Bal, Oxford University Press publication
3. Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery, S. C. Rastogi, PHI Publication
4. Bioinformatics Sequence and Genome Analysis 2ed: Mount D. W , CBS Publisher
5. Introduction to Bioinformatics, Lesk, Oxford University Press publication

Suggested online links:

1. Introduction to bioinformatics: bioinformatics (mgcub.ac.in)
2. Molecular phylogeny and evolution: PowerPoint Presentation (fh-muenster.de)
3. Biological Databases: Biological databases: why? (rlacollege.edu.in)
4. Protein databases: Microsoft PowerPoint - Protein databases .ppt (amherst.edu)

This course can be opted as an elective by the students of following subjects: NA

Practical work

PGBCH -104 N(P)	Practical's based on PGBCH-101N,102Nand 103N
PGBCH -109N(P)	Practical's based on PGBCH-106N,107N and 108N
PGBCH -114N(P)	Practical's based on PGBCH-111N,112N and 113N
PGBCH-119N(P)	Practical's based on PGBCH-116N, 117N and 118N
PGBCH-123N(P)	Practical's based on PGBCH-120N, 121N and 122N
Note: The topic of practical will be selected form relevant theory paper as per suggestion of relevant faculty members of study centre.	

PGBCH-124(D)N

Dissertation/Industrial training/Internship with Viva Voce

Course Objective:

Project and Dissertation

In second year (fourth semester) of Masters the main objective of the exposure of students' dissertation/Industrial training/ Internship is to elevate their understanding into the practical and experimental aspects of some targeted areas of Biochemistry. This course will develop their analytical ability and it will provide them an apt exposure to work in any research group and will motivate them to execute research in the area of their interest in Bio-chemical sciences.

Course Outcome:

CO-1. Students will be able to plan and strategize a scientific problem, and implement it within a reasonable time frame.

CO-2. It is expected that after completing this project dissertation, students will learn to work independently and how to keep accurate/readable record of assigned project.

CO-3. In addition, students will be able to know biochemical data analysis and their interpretation that will be very helpful for biochemical/biotechnological and pharmaceutical research work.

CO-4. Also, students will be able to become as expert in field of clinical biochemistry, biotechnology, bioinformatics and genetic engineering.

CO-5. Subsequently, the students should be able to critically examine research articles, and improve their scientific writing/communication skills and power point presentation.

Note: Students shall make dissertation on selected topic of their own choice studied so far and prepare the report.

Instructions

1. 02 copies of Report will be submitted by learner to the study center.
2. The evaluation will be in 100 marks.
3. Internal assessment will be done by the counsellor of the study center under 30 percent marks and upload the marks to the university portal which is provided by examination department.
4. The coordinator of study center will send a one copy of report along with the print copy of uploaded internal marks (30 marks) to the concerned school for external evaluation and viva voce.
5. The concerned school will send the external marks of evaluated reports to the examination department and also upload it on university portal.

The guideline for preparing report is available at link:
http://14.139.237.190/vc_school_main_page.php?slm=1&contid=206

APPENDIX-II

Guidelines for preparing Research Project/Dissertation is available at link:

http://14.139.237.190/upload_pdf/01_02_2023_Guidelines_fo_Project_Lit_Survey_Dissertation.pdf