Bharatiya Vidya Bhavan

BHAVAN'S VIVEKANANDA COLLEGE
of Science, Humanities & Commerce
Sainikpuri, Secunderabad – 500094
Autonomous College - Affiliated to Osmania University
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Department of Biochemistry & Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY (2025-26)

SEMESTER I

PAPERS	Code	TITLE	Teaching hrs/week	Credits	Internal marks	Final exam marks	Total
Theory							
1	BI101	Chemistry of Biomolecules (**core**)	4	3	30	70	100
2	BI102	Endocrine biochemistry, Vitamins and Nucleic Acids **(core)**	4	3	30	70	100
3	BI103	Cell biology and Bioenergetics **(core)**	4	3	30	70	100
4	BI104	Basic Bio-Analytical Techniques **(core)**	4	3	30	70	100
Practicals							
5	BI 101P	Chemistry of Biomolecules	4	2	--	50	50
6	BI 102P	Endocrine biochemistry, Vitamins and Nucleic Acids	4	2	--	50	50
7	BI103P	Cell biology and Bioenergetics	4	2	--	50	50
8	BI104P	Basic Bio-Analytical Techniques	4	2	--	50	50
	Total		**32**	**20**	**120**	**480**	**600**

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PROGRAM NAME: M.Sc. BIOCHEMISTRY (2025-26)

SEMESTER-II

PAPERS	Code	TITLE	Teaching hrs/week	Credits	Internal marks	Final exam marks	Total
Theory							
1	BI201	Metabolism **(core)**	4	3	30	70	100
2	BI202	Enzymology **(core)**	4	3	30	70	100
3	BI203	Molecular Biology **(core)**	4	3	30	70	100
4	BI204	Biochemical Genetics **(core)**	4	3	30	70	100
Practicals							
5	BI201P	Metabolism	4	2	--	50	50
6	BI202P	Enzymology	4	2	--	50	50
7	BI203P	Molecular Biology	4	2	--	50	50
8	BI204P	Biochemical Genetics	4	2	--	50	50
	Total		**32**	**20**	**120**	**480**	**600**

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PROGRAM NAME: M.Sc. BIOCHEMISTRY (2025-26)

SEMESTER-III

PAPERS	CODE	TITLE	Course Type	Teaching hrs/week	Credits	Internal marks	Final exam marks	Total
			Theory					
1	BI301	Gene expression and Advanced Bioanalytical Techniques	DSC	4	3	30	70	100
2	BI302	Immunology and Immunotechnology	DSC	4	3	30	70	100
3	BI303	**Elective I** A: Nutrition and Clinical Biochemistry B: Nanobiochemistry	DSE	4	3	30	70	100
4	BI304	**Elective II** A: Physiology and Reproductive Biology B: Evolution, Ecology and Developmental Biology	DSE	4	3	30	70	100
5	BI305	MOOCS		4	2	-	50	50
			Practicals					
6	BI 301P	Gene expression and Advanced Bioanalytical Techniques		4	2	--	50	50
7	BI 302P	Immunology and Immunotechnology		4	2	--	50	50
8	BI 303P	**Elective I** A: Nutrition and Clinical Biochemistry B: Nanobiochemistry		2	1	-	25	25
9	BI 304P	**Elective II** A:Physiology and Reproductive Biology B: Evolution, Ecology and Developmental Biology		2	1	-	25	25
	Total			**32**	**20**	**120**	**480**	**600**

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PROGRAM NAME: M.Sc. BIOCHEMISTRY (2025-26)

SEMESTER-IV

PAPERS	CODE	TITLE	Course Type	Teaching hrs/week	Credits	Internal marks	Final exam marks	Total
			Theory					
1	BI401	Biostatistics &Bioinformatics	DSC	4	3	30	70	100
2	BI402	Cell-cell communication and Signalling	DSC	4	3	30	70	100
3	BI403	**Elective III** A: General Microbiology, Bacteriology and Virology B: Biotechnology	DSE	4	3	30	70	100
4	BI 404	Project work		7	5	50	100	150
			Practicals					
5	BI 401P	Biostatistics & Bioinformatics		4	2	--	50	50
6	BI 402P	Cell-cell communication and Signalling		4	2	--	50	50
7	BI 403P	**Elective III** A: General Microbiology, Bacteriology and Virology B: Biotechnology		4	2	-	50	50
	Total			**31**	**20**	**140**	**460**	**600**

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Department of Biochemistry & Nutrition
PROGRAM NAME: M.Sc. BIOCHEMISTRY
2025-26
COURSE NAME: GENE EXPRESSION AND ADVANCED BIOANALYTICAL TECHNIQUES

PAPER CODE: BI301 **PPW: 4**
YEAR/SEMESTER: II/III **NO OF CREDITS: 3**

COURSE OBJECTIVE: To familiarize the students with prokaryotic and eukaryotic gene regulation, genetic engineering methods as well as advanced bioanalytical techniques.

CREDITWISE COURSE OBJECTIVES:
COb1 To explain the prokaryotic and eukaryotic gene regulation mechanisms.
COb2 To discuss about various tools and techniques of recombinant DNA technology.
COb3 To explain the principle and applications of advanced bioanalytical techniques for analysis of biomolecules.

Credit 1 Gene Regulation in Prokaryotes and Eukaryotes **15h**

1. Operon concept for gene regulation. Positive (+ve) & Negative (-ve) control
2. Lac operon & Trp operon
3. Dual function of repressor ara operon
4. Lambda Phage: Lytic / lysogenic switch; anti-termination
5. Phase variation in Salmonella flagellar protein synthesis
6. Sporulation gene expression in Bacillus
7. Riboswitch, control of plasmid copy number
8. Chromatin structure in active and inactive regions DNA methylation.
9. Eu-chromatin, histone acetylation, histone code
10. Transcriptional control- cell specific expression promoters, enhancers, Transcription factors
11. RNA transport and stability; Translational feedback.
12. Gene silencing: regulation by siRNA.
13. Gene silencing: inactivation of mammalian X chromosome.
14. Gal operon of yeast, Antigenic variation in Trypanosoma
15. MAT locus and mating type switch in yeast

Credit 2 Recombinant DNA Technology and Genetic Engineering **15h**

1. Enzymes in rDNA technology: Restriction endonucleases (discovery, properties)
2. Enzymes in rDNA technology: DNA and RNA polymerases
3. Enzymes in rDNA technology: Nucleases, Kinases, Phosphatases and Ligases
4. Prokaryotic and Eukaryotic vectors (plasmids, cosmids, phage, phagemid, BAC,YAC)

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5. Shuttle vectors, Targeting vectors,
6. Construction of cDNA and genomic DNA libraries
7. Screening library (+ve) & (-ve) selection strategies, Preparation of probes
8. Yeast 2 hybrid assay
9. Phage display
10. Reporter genes GFP, beta- gal, luciferase
11. Expression in heterologous systems in bacteria,
12. Expression in heterologous systems in yeast cells.
13. Expression in heterologous system in insect cells.
14. Expression in heterologous system in mammalian cells
15. RFLP

Credit 3 Advanced Bioanalytical techniques **15h**

1. DNase – I hypersensitivity mapping
2. DNA – Foot printing
3. PCR, RT-PCR
4. Chromatin IP methods (ChIP)
5. Mass spectrometry – MALDI TOF, LC-MS, MS-MS,
6. ICP-MS, ICP-OES
7. Organic peptide synthesis
8. Atomic force microscopy
9. Light Sheet Fluorescence Microscopy
10. Atomic absorption spectroscopy
11. Dynamic and static light scattering
12. Zeta potential measurement – LASER Doppler Velocimetry
13. X-ray Crystallography
14. NMR
15. ESR

References:

1. Genes VIII, Lewin, B, Publish Oxford University Press
2. Principles of Gene Manipulation: An introduction to GE – Old, R. and Primrose, S.B. Blackwell Sci. Pub
3. Molecular Biotechnology Glick, BR and Pasternak, JJ. Publish ASM Press
4. Molecular Biology of the Gene by Watson JD, Losick R. Pub Pearson Education

COURSE OUTCOMES

At the end of the course the student will be able to

BI301.CO1 Illustrate various gene regulatory strategies employed in both prokaryotes and eukaryotes.
BI301.CO2 Apply genetic engineering and recombinant DNA methods in biotech projects and industries
BI301.CO3 Identify suitable advanced bioanalytical techniques for analysis of Biomolecules

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PROGRAM NAME: M.Sc. BIOCHEMISTRY
2025-26
COURSE NAME: GENE EXPRESSION AND ADVANCED BIOANALYTICAL TECHNIQUES

PAPER CODE: BI301P **PPW: 4**
YEAR/SEMESTER: II/III **NO OF CREDITS: 2**

CREDITWISE COURSE OBJECTIVES

COb4 To demonstrate methods of recombinant DNA techniques and protein expression and identification.
COb5 To describe different advanced bioanalytical techniques and isolation and characterization of RNA

Credit 4 Recombinant DNA Technology **30h**

1. Isolation of plasmid DNA
2. Restriction mapping of DNA (experiment and problems
3. Restriction Ligation
4. RFLP (experiment & problems)
5. Gene cloning (demonstration)

Credit 5 Advanced Bioanalytical techniques **30h**

1. Atomic absorption spectroscopy: Estimation of metal ions (ppm)
2. ICPMS: Estimation of metal ions (ppb and ppt)
3. Dynamic Light Scattering: Determination of zeta potential of macromolecules
4. Isolation of RNA and its characterization
5. Agarose gel electrophoresis of DNA and gel documentation.

REFERENCES:

1. Introductory Practical Biochemistry (ed) Sawhney, S. K. Randhir Singh-Narosa Publications House.
2. An Introduction to Practical Biochemistry-Plummer, D.T. Tata McGraw –Hill.

COURSE OUTCOMES:

At the end of the course the student will be able to
BI 301P.CO4 apply the knowledge of recombinant DNA technology and protein expression methods in biotech industries
BI 301P.CO5 choose appropriate advanced bioanalytical methods for sample analysis in biotech and research labs.

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Department of Biochemistry & Nutrition
PROGRAM NAME: M.Sc. BIOCHEMISTRY
2025-26
COURSE NAME: IMMUNOLOGY AND IMMUNOTECHNOLOGY

PAPER CODE: BI 302 **PPW: 4**
YEAR/SEMESTER: II/III **NO OF CREDITS:3**

COURSE OBJECTIVE: To provide a basic understanding of the components and mechanism of immune system and the techniques for production of antibodies and vaccines.

CREDIT WISE COURSE OBJECTIVES:
COb1 To describe the components of immune system and the mechanisms involved in immune response.
COb2 To explain the concept of transplantation immunology, hypersensitivity and discuss the basis of autoimmune diseases.
COb3 To discuss the various immunological techniques and vaccine development methods.

Credit 1 Components of Immune System and Immune response **15h**

1. Elements of Immune system - Natural & acquired immunity, Specific & non-specific immune response.
2. Cells & organs induced in immune system
3. Antigenic determinants, Epitopes, Concept of haptens. T-Cell and B-Cell epitopes, Super-antigens
4. Classification, structure, and biological properties of immunoglobulins
5. Isotypes, allotype, idiotypes variations
6. Mucosal and neonatal immunity
7. Theories of antibody formation, Generation of antibody diversity
8. Genomic rearrangements & genes involved in antibody production
9. Humoral & cell-mediated immune response
10. T cell& B cell activation. T cell and B cell receptors
11. Antigen processing & presentation
12. MHC proteins structure & functions
13. Regulation of immune response.
14. Assembly and secretion of Ig. Class switching regulation
15. Cytokines in immune response

Credit 2 Complement system and Immune Disorders **15h**

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1. Complement system –. Complement activation and types
2. Classical, Alternative and Mannan-binding lectin pathways and its regulation,
3. Biological functions of complement fixation, Complement fixation test
4. Transplantation immunology (Types of graft rejection, mechanism of graft rejection,
5. Graft vs host response
6. Immune response to tumors
7. Hypersensitivity – Gel & Coombs classification. Allergen
8. Type I, II, III and V Hypersensitivity and mechanism of activation
9. Tests for diagnosis of hypersensitivity, Tuberculin test
10. Auto immune diseases; classification
11. Mechanism and study of selected autoimmune diseases
12. Immuno- deficiency disorders – primary and secondary. AIDS
13. Immunosuppressive drugs/agents & their mechanism of action
14. ADA Deficiency
15. Microbial evasion of immune response

Credit 3 Immunotechnology **15h**

1. Adjuvants – types of and their applications
2. Production of polyclonal antibodies. Experimental animals models for production of antibodies.
3. Methods of antibody purification (Salt precipitation, Affinity chromatography)
4. Hybridoma technology – production of monoclonal antibodies and their applications; antibody engineering
5. Antigen-antibody binding analysis - Equilibrium dialysis; Affinity and Avidity of antibodies
6. Antigen-antibody interactions , Agglutination reaction and visualization
7. Gel diffusion techniques (Ouchterlony, Mancini techniques),
8. Immune-electrophoresis (Rocket, counter-, 2-D),
9. Immuno-fluorescence, RIA,
10. Enzyme immune assay (ELISA) and their types
11. Western blotting
12. FACS techniques
13. Vaccines – Types, traditional vaccines and their applications
14. Newer vaccine strategies (DNA, recombinant DNA, RNA, peptide and anti-idiotypic vaccines)
15. Vaccination schedules. Benefits and adverse consequences of vaccination

References:

1. Kuby Immunology – Edited Thomas J. Kindt, Richard A Goldsby, Publisher WH Freeman & Co
2. Roitt's Essential Immunology, Tenth Edition, Ivan Roitt, Peter Delves
3. Veterinary Immunology: Ian R. Tizard, I.R. Thomson press
4. The Immune System. By Peter Parham Publisher Garland publishing

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COURSE OUTCOMES:

At the end of the course students will be able to:

BI 302.CO1 Identify the components of immune system and interpret cellular processes involved in immune reactions.

BI302.CO2 Interpret the causes of hypersensitive reactions, autoimmune diseases and response to immunosuppressive drugs.

BI302.CO3 Apply the principles of antigen-antibody interactions in immunological methods including diagnostics and also provides awareness on significance of vaccination.

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Department of Biochemistry & Nutrition
PROGRAM NAME: M.Sc. BIOCHEMISTRY
2025-26
COURSE NAME: IMMUNOLOGY AND IMMUNOTECHNOLOGY

PAPER CODE: BI 302P **PPW: 4**
YEAR/SEMESTER: II/III **NO OF CREDITS:2**

CREDIT WISE COURSE OBJECTIVES

COb4 To describe the methods for purification and characterization of IgG.
COb5 To demonstrate various methods of studying antigen-antibody interaction.

Credit 4 Immunology **30h**

1. Isolate Ig from serum (human/bovine) by ammonium salt precipitation.
2. Purify IgG by gel filtration.
3. Estimate the protein by Lowry's method in all fractions
4. SDS PAGE of Ig fractions
5. Characterize IgG by Western blot

Credit 5 Immunotechnology **30h**

1. Agglutination: ABO and D Ag typing
2. RID
3. ODD
4. Rocket immunoelectrophoresis
5. ELISA, sandwich ELISA

References:

1. Experimental Biochemistry: A Student companion- Sashidhar Rao, B and Deshpande, V. IK International (P) Ltd
2 . An Introduction to Practical Biochemistry. By: David T Plummer. Publisher Tata McGraw-Hill

COURSE OUTCOMES:

At the end of the course students will be able to:
BI 302P.CO4 apply appropriate methods for purification and characterisation of IgG in research/ industry.
BI 302P.CO5 choose suitable immunodiffusion methods to study antigen antibody interactions.

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PROGRAM NAME: M.Sc. BIOCHEMISTRY
2025-26

COURSE NAME: (ELECTIVE I) NUTRITION AND CLINICAL BIOCHEMISTRY

PAPER CODE: BI303A **PPW: 4**
YEAR/SEMESTER: II/III **NO OF CREDITS: 3**

COURSE OBJECTIVE: To explain the importance of nutrition **in** daily life, biochemical tests for disease detection and role of liver in detoxification.

CREDITWISE COURSE OBJECTIVES:

COb1 To describe the concepts of nutrition and food quality for healthy life.
COb2 To discuss the use of biochemical tests as well as hormone tests in disease assessment.
COb3 To explain the role of liver in drug detoxification process and assessment of liver function.

Credit 1 Nutrition and Food Science **15h**

1. Ayurveda: multipronged approach to treatment – lifestyle, diet, and medicine, healthy aging
2. Balanced diet, Macro & Micro Nutrients, Calorific values of foods.
3. Nutritional composition of fruits, cereals, pulses, nuts and fibres, vegetables, milk and milk products
4. BMR, BMI and factors affecting them.
5. Absorption; Control of food intake (leptin, ghrelin, peptide YY)
6. Malnutrition (PEM, Marasmus, Kwashiorkor),
7. Obesity (BMI and other metrics)
8. Eating disorders; Anorexia and bulimia;
9. Diet and longevity, ageing.
10. Food spoilage and preservation
11. Food adulteration and hygiene, Principles of quality control
12. Food contaminants (metals, pesticides and aflatoxins) and food additives
13. Pre-biotics, Probiotics and Dietary fibres
14. Nutraceuticals and Functional foods (Millets)
15. RDA for infants, children, adults and expectant / nursing mothers

Credit 2 Clinical Biochemistry **15h**

1. Sample collection, serum, plasma and anticoagulants, factors affecting the sample collection – Place, time, temperature and posture, Deproteinization, Identification, transport and storage
2. Quality control and assurance in clinical biochemistry

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3. Complete Blood picture, prothrombin time, ESR and Erythrocyte metabolic disorders
4. Composition (including formed elements) and Coagulation of blood
5. Haemoglobin determination, Types and Abnormal Hbs.
6. Hemoglobinopathies – Sickle cell Anaemia and Thalassemia
7. Thrombosis and Thrombolysis
8. Complete Urine Examination – Normal and abnormal constituents
9. Acid and Bases in the body; Plasma buffers and electrolytes; Mechanism of acid-base balance
10. Water and Electrolyte balance. Assessment of Na^+, K^+ and Cl^- levels in the body
11. Respiratory and renal regulation of pH, Acidosis and alkalosis (both metabolic and respiratory).
12. Hormone tests – Thyroid function tests, Pregnancy test
13. Glucocorticoids- Cortisol, DHEA, Estrogen, Progesterone,
14. Glucocorticoids- FSH, Testosterone and Prostate Specific Antigen (PSA)
15. Enzymes as Tumor markers

Credit 3 Liver and Xenobiotics **15h**

1. Structure and anatomy of liver, Liver functions, Fatty liver.
2. Pharmacopeia drug deposition and mechanisms of drug detoxification
3. Cytochrome P450 enzymes, molecular biology, catalytic cycle, isozymes, inhibitors
4. Dose response relationship, drug-receptor interactions
5. Pharmacodynamics; pharmacokinetics
6. Phase I reactions - modifications
7. Phase II reactions – conjugation
8. Phase III reactions - modifications and elimination,
9. Environmental factors influencing drug metabolism
10. Effects and metabolism of model toxins: aflatoxins, bacterial exotoxins (types I, II, and III)
11. Serum enzymes in liver diseases- SGPT, GGT, SGOT, ALT
12. Alkaline phosphatase, Leucine amino peptidase
13. Liver function tests- conjugated and total bilurubin in serum, albumin: globulin ratio, Hippuric acid and bromsulphthalein tests.
14. Bile pigments in urine/faeces, carbohydrate tolerance
15. Nutrient drug interactions

References:

1. Nutritive value of Indian foods by C. Gopalan, B.V. Rama Sastri and S.C. Balasubramanian. National Institute of Nutrition, ICMR.
2. Essentials of Food and Nutrition –Swaminathan M. Bangalore Press
3. Manual of Nutritional Therapeutics, 2nd edition, Alpers (1991), Little Brown Publications, Washington.
4. Textbook of Medical Biochemistry by MN Chatterjea and Rana Shinde, Jaypee Brothers
5. Teitz Fundamentals of Clinical Biochemistry by Carl A. Burtis, Edward R. Ashwood and David E. Bruns. Saunders, Elsevier
6. Clinical Biochemistry: An Illustrated Colour Text (Paperback) 3rd Ed by Allan Gaw, Michael Murphy,Robert Cowan, Denis O'Reilly, Michael Stewart and James Shepherd. Churchill Livingstone.

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7. Davidson's Principles and Practice of Medicine: A Textbook for Students and Doctors (Hardcover) 15th Ed by LSP Davidson, J MacLeod and CRW Edwards. Publisher: Churchill Livingstone

COURSE OUTCOMES

At the end of the course, the students will be able to

BI303A.CO1 recommend appropriate diet to meet nutritional requirements of population
BI303A.CO2 interpret the results of biochemical tests and hormone tests in health and disease.
BI303A.CO3 apply the knowledge to assess liver functions and drug detoxification mechanisms in liver.

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PROGRAM NAME: M.Sc. BIOCHEMISTRY
2025-26
COURSE NAME: NUTRITION AND CLINICAL BIOCHEMISTRY

PAPER CODE: BI303AP **PPW: 2**
YEAR/SEMESTER: II/III **NO OF CREDITS: 1**

CREDIT WISE COURSE OBJECTIVE

COb4 To demonstrate the methods for nutritional assessment of foods and qualitative as well as quantitative analysis of blood and urine constituents.

CREDIT 4 Nutrition and Clinical Biochemistry **30h**

1. Nutritional assessment by clinical testing; Anthropometric and Biochemical testing. Proximate analysis of common foods, Determine total carbohydrate and lipid content in a food item, Detection of adulterants in Milk, Adulterants in oils and food stuffs
2. Sample collection: Blood sample collection, Separation of serum and plasma
3. Determination of A:G ratio in serum, Assay serum alkaline phosphatase, Assay serum ALT (SGPT)
4. Qualitative analysis of abnormal constituents in urine
5. Determine PCV, ESR, differential count, glycosylated haemoglobin (Hb1A), osmotic fragility of RBC

References

1. Practical Clinical Biochemistry –Varley, H. CBS Publications
2. Laboratory Manual and Practical Biochemistry., T. N. Pattabiraman, 4 edition.

COURSE OUTCOME

At the end of the course students will be able to:

BI 303AP.CO4 apply the methods for nutritional evaluation of food in food industries and also evaluate blood and urine constituents in diagnostic labs.

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PROGRAM NAME: M.Sc. BIOCHEMISTRY
2025-26
COURSE NAME: (ELECTIVE II) NANOBIOCHEMISTRY

PAPER CODE: BI303B **PPW: 4**
YEAR/SEMESTER: II/III **NO OF CREDITS: 3**

COURSE OBJECTIVE: To explain the synthesis, characterisation and biochemical applications of nanomaterials.

CREDIT WISE COURSE OBJECTIVES

CObj1 To explain the classification, structure and properties of nanomaterials.
CObj2 To describe the methods for the synthesis and characterization of nanomaterials
CObj3 To discuss the biological applications of nanomaterials

Credit 1 Concept of Nanomaterials **15h**

1. Introduction to nanoscale.
2. Chronological development of Nano science
3. Classification of nanomaterial based on dimension (1D, 2D, 3D and QD)
4. Classification of nanomaterial based on composition (Carbon, metal, semiconductor, dendrimer, composite, hybrid)
5. Biological (cellular) nanostructures
6. Biomolecular motors
7. Thin films
8. Colloidal structure
9. Vesicular structure: nanovesicle, nanosphere, nanocapsule.
10. Asymmetric nanostructures: Nanorod, nanocube, nanotube, nanoprism, nanowire.
11. Nanopore: Sequencing
12. Self-assembly properties
13. Catalytic property and applications
14. Plasmonic (Noble metal) and fluorescence (QD, nanoclusters) properties
15. Bio-inspired nanomaterials (Ceramic scaffold: Alumina, Titanium dioxide)

Credit 2 Synthesis and characterization method **15h**

1. Top down and Bottom up approach
2. Top down approach: Solid phase methods (Grinding, Ball milling, mechanical alloying)

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3. Bottom up approach: Solid phase methods (Chemical methods: Chemical Vapour Deposition (CVD), plasma, thermal decomposition)
4. Bottom up approach: Solid phase methods (Physical methods: Vapour Deposition(PVD), flame hydrolysis, LASER, plasma, molecular beam epitaxy (MBE))
5. Bottom up approach: Liquid phase methods (Liquid/liquid type: Chemical reduction, pyrolysis, solvothermal synthesis)
6. Bottom up approach: Liquid phase methods (Sedimentation type: Sol-gel, co-precipitation, alkaline precipitation, hydrolysis, colloidal synthesis)
7. Nanolithography
8. Size and morphology: TEM and SEM
9. Finer structural details: Atomic force microscopy
10. Crystal plane alignment :X-ray diffraction
11. Elemental study: EDX, XPS
12. Hydrodynamic size: Dynamic light scattering
13. Molecular weight and solvent association: Static light scattering
14. Solution stability: Zeta potential measurement – LASER Doppler Velocimetry
15. Nanodrop

Credit 3 Applications of Nanobiochemistry **15h**

1. Drug delivery: Classification of candidates, structure, example (nanotubes, quantum dots, polymeric conjugates Dendritic nanostructure)
2. Drug delivery mechanism: active targeting and passive targeting
3. Factors influencing drug delivery route; balancing pharmacokinetics and pharmacodynamics.
4. Chemodynamic therapy (CDT)
5. Tumor starving therapy (TST)
6. Tumor targeted imaging: hybrid nanostructure (Fe/Au nanoshell)
7. Molecular nano submarine and its anti-cancer application
8. Nanobiosensor: principle and classification
9. Sugar biosensing using FRET (Fluorescence resonance energy transfer) and ECL (electro chemiluminescence)
10. DNA biosensing using Silica Nanowire (SiNW)
11. Nanomaterials for Photoablation and hyperthermia
12. Nanoengineered hydrogel
13. Nanozymes: Nanomaterial based artificial enzyme
14. Nanotoxicity: Developing genotoxicity and ecotoxicity
15. Nanotoxicity: Containment strategies

References

1. Introduction to Nanoscience and Nanotechnology" by Charles P. Poole
2. Textbook of Nanoscience and Nanotechnology" by B.S. Murty et al
3. Introduction to Nanotechnology" by S.M. Lindsay
4. Nanomaterials and Nanostructures" by Guozhong Cao

COURSE OUTCOMES

At the end of the course students will be able to:

BI303B.CO1 identify nanomaterials with suitable properties for biological applications.
BI303B.CO2 select suitable methods for synthesis and characterization of nanoparticles
BI303B.CO3 analyze the biochemical applications of nanoparticles.

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Department of Biochemistry & Nutrition
PROGRAM NAME: M.Sc. BIOCHEMISTRY
2025-26
COURSE NAME: (ELECTIVE II) NANOBIOCHEMISTRY

PAPER CODE: BI303BP **PPW: 2**
YEAR/SEMESTER: II/III **NO OF CREDITS: 1**

COURSE OBJECTIVE:

COb4 To demonstrate the synthesis and characterization of nanomaterials

Credit 4 Synthesis and characterization of nanomaterials **30h**

1. Chemical synthesis of nanoparticles (gold, silver nanoparticles).
2. Natural or green synthesis of metal nanoparticles.
3. Characterization of nanoparticles using UV-vis spectroscopy.
4. Quantitation of nanoparticles by ICPMS
5. Estimation of aqueous stability of various nanoparticles using DLS and Zeta potential.

References:

1. Nanotechnology Vol 1 (2017): Volume 1 [Paperback] Breck WM.
2. A textbook of Nanotechnology, Dr. Reddy Sunil, Dr. Chandra Shakhar Reddy, Dr. Shiva Kumar, Dr. Srikanth Parepalli

COURSE OUTCOME:

At the end of the course students will be able to:

BI 303BP.CO4 implement suitable methods for synthesis and characterization of nanomaterials in biotech industries.

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Department of Biochemistry & Nutrition
PROGRAM NAME: M.Sc. BIOCHEMISTRY
2025-26
COURSE NAME: ELECTIVE II- PHYSIOLOGY AND REPRODUCTIVE BIOLOGY

PAPER CODE: BI304A **PPW: 4**
YEAR/SEMESTER: II/I **NO OF CREDITS: 3**

COURSE OBJECTIVE: To provide basic understanding of nerve, muscle and reproductive physiology in humans.

CREDITWISE COURSE OBJECTIVES:

COb1 To outline the physiology of neurotransmission
COb2 To explain the physiology of muscle contraction and related disorders
COb3 To discuss reproductive biology in humans

CREDIT 1 Neurophysiology **15h**

1. Structure of Brain and typical nerve cells.
2. Division of vertebrate nervous system: CNS, PNS,
3. ANS, regions of the brain
4. Functioning of the sensory and motor nerves
5. Types of neuronal cells – Neuroglia, microglia, astrocytes,
6. Oligodendrocytes, Schwann, satellite and epididymal cells
7. Nerves: regeneration of nerve fibers, generation of nerve impulse, all or none principle.
8. Mechanism of synaptic transmission, transmission of nerve impulse.
9. Types of neurotransmitters and their receptors, mode of signaling
10. Electrical synapse and giant neurons
11. Sensory organs – eye, ear, Sensory organs: skin, tongue
12. Vision: visual system
13. Rhodopsin and classical GPCR mechanism, termination of visual signal
14. Cone cells, specialization in color vision, physiology of colour blindness
15. Similarity between vision, olfaction and gustation

CREDIT 2 Structure and Physiology of Muscle **15h**

1. Basic structure of muscle
2. Various types of muscle: striated, cardiac, smooth, fast twitch, slow twitch
3. Mechanism of muscle contraction

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4. Regulation of muscle contraction
5. Role of actin and myosin in non-muscle cells.
6. Role of Cytochalasins
7. Cytokinesis.
8. Muscle gene expression, regulation at transcriptional and posttranscriptional level.
9. Role of muscle proteins in cell locomotion
10. Neuro-muscular transmission
11. Electromyography, Sherrington starling Kymograph (recording drum)
12. Disorders of muscle: dystrophy, myopathy
13. Myositis, myotonia
14. Paralysis, Myasthenia gravis
15. Detection and treatment of muscle disorders

CREDIT 3 Human Reproductive Biology **15h**

1. Anatomy of Female reproductive system
2. Endocrinology of Female reproductive system
3. Anatomy of male reproductive system
4. Endocrinology of male reproductive system
5. Gametogenesis
6. Menstrual cycle
7. Fertilization
8. Implantation
9. Endocrinology of pregnancy
10. Endocrinology of parturition
11. Female infertility causes and treatment
12. Male infertility causes and treatment
13. Reproductive aging (menopause and andropause)
14. Methods of Birth control
15. Placenta as source of stem cells, cord banking

REFERENCES:

1. Human Physiology by Guyton and Hall Press Pub Saunders
2. Biochemistry, 4th Edition - Donald Voet, Judith G. Voet – Publisher John Wiley & Sons.
3. Human reproductive Biology by Jones and Lopez Pub
4. Principles of Biochemistry: Mammalian Biochemistry: Smith EL, Hill RL, White A, McGraw Hill

COURSE OUTCOMES:

At the end of the course students will be able to:

BI304A.CO1 apply the understanding of the physiological process of neurotransmission
BI304A.CO2 apply the knowledge of muscle physiology in health and disease conditions.
BI304A.CO3 correlate the knowledge of the human reproductive system to fertility and pregnancy.

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PROGRAM NAME: M.Sc. BIOCHEMISTRY
2025-26
COURSE NAME: PHYSIOLOGY AND REPRODUCTIVE BIOLOGY

PAPER CODE: BI 304AP **PPW: 2**
YEAR/SEMESTER: II/III **NO OF CREDITS: 1**

COURSE OBJECTIVE

COb4 to demonstrate the analytical methods for biomolecules related to nerve, muscle and reproductive physiology

CREDIT 4 Physiology and Reproductive Biology **30 h**

1. Histopathology: Techniques for tissue processing and slide staining. Histopathology of Uterus, Ovary, Oviduct and Placenta, Testes
2. Assay of serum AST (SGOT)/ALT (SGPT)/AST, Assay serum LDH.
3. Lipid profile: HDL/LDL cholesterol
4. Pregnancy test, Detection of hCG,
5. Estimation of dopamine (Spectrophotometric method)

References

1. Practical Clinical Biochemistry –Varley, H. CBS Publications
2. Laboratory Manual and Practical Biochemistry., T. N. Pattabiraman, 4 edition.

COURSE OUTCOME:

At the end of the course students will be able to:

BI304AP. CO4 analyse serum enzymes, lipid profile and neurotransmitters in biological samples.

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PROGRAM NAME: M.Sc. BIOCHEMISTRY

2025-26
COURSE NAME: EVOLUTION, ECOLOGY AND DEVELOPMENTAL BIOLOGY

PAPER CODE: BI304B **PPW: 4**
YEAR/SEMESTER: II/I **NO OF CREDITS: 3**

COURSE OBJECTIVE: To familiarize the students with the concepts of Evolution, Ecology and Developmental biology

CREDITWISE COURSE OBJECTIVES:
COb1 to effectively communicate the principles of evolution and its application to human biology
COb2 to explain the concepts of ecosystem, types of ecology, environmental toxicology and biodiversity
COb3 to provide the basic understanding of fertilization and embryogenesis

CREDIT 1 Evolution **15h**

1. Origin of life
2. Evolution of life forms – a theory
3. Evidences for evolution
4. Theories of evolution
5. Selection in action
6. Adaptive radiation
7. Biological evolution
8. Population and genetic evolution
9. Mechanism of evolution
10. Hardy-weinberg principle
11. Evolution above species level
12. Isolation
13. Speciation
14. A brief account of evolution
15. Origin and evolution of man

CREDIT 2 Ecology **15h**

1. Ecosystem structure and function, energy dynamics,
2. Distribution of Flora and Fauna
3. Types of ecology,

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4. Mineral cycling—(carbon and nitrogen) primary production and methods of measurement of primary productivity.
5. Population Ecology: Concept and Characteristics of a population, Population growth curves,
6. Species interactions: Types of interactions, Positive interactions- Mutualism, symbiosis,
7. 7. Commensalism, protocooperation, Herbivory, carnivory, antibiosis and competition
8. Community Ecology: Characteristics of communities,
9. Analytical, Quantitative- Frequency ,density, abundance ,cover and basal area
10. Qualitative—Physiognomy, phenology,
11. Stratification, sociability, vitality and life forms,
12. Raunkiaer concept, Ecotones.
13. Concept of climax- Monoclimax and Polyclimax theories
14. Environmental toxicology: Effects of Toxic chemicals, Pollutants, Natural contaminants.
15. Biodiversity: Levels of Biodiversity-Species, Ecosystem and Genetic Diversities,

CREDIT 3 Developmental biology **15 h**

1. Basic concepts of development : Potency, commitment, specification, induction, competence, determination and differentiation
2. Morphogenetic gradients
3. Cell fate and cell lineages
4. Stem cells
5. Genomic equivalence and the cytoplasmic determinants
6. Imprinting
7. Gametogenesis
8. Fertilization and early development
9. Embryo sac development and double fertilization in plants
10. Embryogenesis in plants, symmetry, seed formation and germination.
11. Embryogenesis in animals, Zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals.
12. Morphogenesis and organogenesis in animals
13. Axes and pattern formation in Drosophila, amphibia and chick; limb development and regeneration in vertebrates.
14. Differentiation of neurons, post embryonic development
15. Morphogenesis and organogenesis in plants

References

1. Fundamentals of Ecology, 2nd Edition, (2001) By MC Dash, Tata Graw Hill.
2. Cell Biology, Genetics, Molecular Biology and Ecology (2005) by P.S Verma and V.K. Agarwal, SS Chand and Company.

COURSE OUTCOMES:

At the end of the course students will be able to:

BI303B.CO1 develop basic understanding of the concepts and theories of evolution.
BI303B.CO2 identify various types of ecosystems, their diversity, functioning and conservation needs.
BI303B.CO3 distinguish the difference in the pattern of development among various species.

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PROGRAM NAME: M.Sc. BIOCHEMISTRY

2025-26

COURSE NAME: EVOLUTION, ECOLOGY AND DEVELOPMENTAL BIOLOGY

PAPER CODE: BI304BP **PPW: 2**
YEAR/SEMESTER: II/III **NO OF CREDITS: 1**

CREDIT WISE COURSE OBJECTIVE

COb4 To demonstrate the methods for analysis of ions and histology of embryogenesis in various species

CREDIT 4 Evolution, Ecology and Developmental Biology **15 h**

1. Determination of quantitative characters by random quadrat method -Abundance, Density, Frequency and Dominance
   To determine the important value index (IVI) of plant species in the campus
2. Similarity and Dissimilarity Index
   Estimation of Carbonates, Bicarbonates, Chlorides & Fluorine.
3. Estimation of Dissolved Oxygen, BOD, COD.
   Preparation of biological spectrum
   IUCN threatened categories: Rare, and Endangered
4. Vulnerable categories of plant species from Telangana.
   Mapping of in situ plant conservation in India.
   Ex situ conservation: Seeds of crop plants.
5. Histology of embryogenesis in plants
   Histology of embryogenesis in animals, Development of zebra fish

Reference

1. Fundamentals of Ecology, 2nd Edition, (2001) By MC Dash, Tata Graw Hill.
2. Cell Biology, Genetics, Molecular Biology and Ecology (2005) by P.S Verma and V.K. Agarwal, SS Chand and Company.

COURSE OUTCOME:
At the end of the course students will be able to:
BI304BP.CO4 analyse quantitatively ions and interpret histology of embryogenesis

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Department of Biochemistry & Nutrition
PROGRAM NAME: M.Sc. BIOCHEMISTRY

2025-26
COURSE NAME: BIOSTATISTICS AND BIOINFORMATICS

PAPER CODE: BI401 **PPW: 4**
YEAR/SEMESTER: II/IV **NO OF CREDITS: 3**

COURSE OBJECTIVE: To explain the concepts of statistical methods and bioinformatics methods in biological data analysis

CREDIT WISE COURSE OBJECTIVES

COb1 To discuss the appropriate statistical method for data analysis in biochemistry
COb2 To explain the different databases and sequence alignment methods for genomes and proteomes
COb3 To describe the methods for sequencing of genomes and proteomes and applications of genomics

Credit 1 Biostatistics **15h**

1. Biostatistics fundamentals (sample, population, variable); Types of variables, Measurement and measurement scales
2. Measures of central tendency (mean, median, mode)
3. Measurement of dispersion (range, variance, standard distribution)
4. Study of bivariate data: correlation and regression; Regression to calculate concentration of DNA/protein, molecular weight of DNA/protein
5. Graphical methods to depict data (histograms, bar-plots, pie charts, line graphs)
6. Probability in biology, Laws of Probability, Bayesian probability
7. Normal distribution, Binominal distribution and Poisson distribution
8. Student's t – test
9. F – test , Chi – square test; Contingency tests
10. CRD: Completely Randomized Design; 1-way ANOVA
11. RCBD: Randomized Complete Block Design; 2-way ANOVA
12. Non-parametric tests: sign test, Wilcoxon signed rank test
13. Non-parametric tests: Mann-Whitney test, Kruskal-Wallis test, and Friedman tests
14. Design of experiments: factorial experiments
15. Quality control in biochemistry

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Credit 2 Bioinformatics **15h**

1. Introduction of Bioinformatics: scope, history
2. Bioinformatics web portals- NCBI, EBI, ExPASy
3. DNA sequence databases-GenBank, EMBL, DDBJ
4. Protein sequence databases- UniProt, SWISSPROT, PIR, TreMBL
5. Protein structure databases- PDB, SCOP, CATH, DSSP, CCDC
6. Functional database- KEGG, SWISS 2D-PAGE, COGs, PROSITE
7. Secondary or sequence cluster database - ProDom, SYSTERS, ProtoMap.
8. Sequence alignment: Dot matrix, match, mismatch, scoring method, gap penalty.
9. Comparing DNA/ protein sequences: pairwise local and global alignment
10. BLAST and FASTA- principle, classification and variation.
11. Scoring matrices- PAM and BLOSUM matrices
12. Multiple sequence alignments- Clustal-W, COBALT
13. Proteins motifs and MS profiles databases
14. Comparing protein sequences, alignment methods
15. Predicting secondary structure-ab initio, Homology folding, threading

Credit 3 Genomics and Proteomics **15h**

1. Genomics and its branches
2. HGP and Strategies for sequencing genomes (shotgun and hierarchical sequencing)
3. 1st generation sequencing methods (Maxam and Gilbert Method; Sanger's method)
4. 2nd and 3rd Generation DNA sequencing methods (Next Generation Sequencing: Pyrosequencing, Solexa, SoLiD, Helicos, SMRT, IonTorrent)
5. Genetic and Physical maps of the genome, EST, STS
6. Genome annotation, re-sequence mapping and GWAS
7. Gene and genome duplications, and transposable elements
8. Epigenomics
9. Metagenomics
10. Paleogenomics and synthetic genomics
11. Relation of proteome to genome and transcriptome
12. Post-translational modification (kinome, glycosylation)
13. HUPO goals and accomplishments
14. Methods for sequencing proteins: Edman degradation
15. 2D gels and peptide maps

References:

1. Statistics, Basic Concepts and Methodology for the Health Sciences Daniel WW, Pub Wiley India
2. Biostatistics –Arora & Malhan, Himalaya Publishing House
3. Introduction to Bioinformatics- Attwood T K and parry –smith, D.J. Pearson Education
4. Bioinformatics (Sequence and Genome Analysis) Mount David W, Press CSH
5. Discovering Genomics, Proteomics and Bioinformatics – Campell&Heyer, Benjamin / Cummings pub

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COURSE OUTCOMES:

At the end of the course, students will be able to

BI401.CO1 choose relevant statistical methods for biological data analysis.
BI401.CO2 use genome and protein databases and sequence alignment methods for retrieval and alignment of sequences
BI401.CO3 apply the knowledge of genome and proteome sequencing methods in genome and proteome analysis

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Department of Biochemistry & Nutrition
PROGRAM NAME: M.Sc. BIOCHEMISTRY
2025-26
COURSE NAME: BIOSTATISTICS AND BIOINFORMATICS

PAPER CODE: BI401P **PPW: 4**
YEAR/SEMESTER: II/IV **NO OF CREDITS: 2**

COURSE OBJECTIVE: To describe the use of statistical methods and bioinformatics tools in biological data analysis.

CREDIT WISE COURSE OBJECTIVES:

COb4 To explain statistical methods in data analysis and the use of biological databases.
COb5 To discuss the *in silico* tools and techniques in bioinformatics

Credit 4 Applications of Biostatistics and Bioinformatics databases **30h**

1. Descriptive statistics (Mean, median, mode, range, variance and standard deviation)
2. Graphical methods to depict data (bar plots, pie charts, line graphs)
3. Correlation and Regression
4. OMIM database and human genetic disorders and KEGG database for pathways
5. Retrieve DNA sequence, protein sequence, protein structure from database (NCBI, PDB)

Credit 5 Sequence alignment techniques and *in silico* processes **30h**

1. Local and global alignment of DNA, protein
2. Multiple sequence alignments
3. Primer design for PCR and *in silico* PCR
4. *In silico* restriction mapping
5. *In silico* translation, R programming

References

1. Bioinformatics- Databases, Tools and Algorithms. Orpita Bosu and Simminder Kaur Thukral, Oxford publication.
2. Biostatistics by Khan and Khanum.

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COURSE OUTCOMES:

At the end of the course, the students will be able to

BI401P.CO4 perform basic statistical analysis of biological data and retrieve DNA and protein sequences and structure from databases

BI401P.CO5 use suitable tools of bioinformatics to align, amplify and translate nucleotide sequences and align protein sequences.

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Department of Biochemistry & Nutrition
PROGRAM NAME: M.Sc. BIOCHEMISTRY

2025-26
COURSE NAME: CELL-CELL COMMUNICATION AND SIGNALING

PAPER CODE: BI402 **PPW: 4**
YEAR/SEMESTER: II/IV **NO OF CREDITS:3**

COURSE OBJECTIVE: To explain the importance of extracellular matrix and tumor suppressor genes in animals and signal transduction in bacteria and plants.

COb1 To discuss the molecules of extracellular matrix and tumor suppressor genes in cancer biology
COb2 To explain the types of signalling molecules in cell-cell communication.
COb3 To discuss the mechanisms of signal transduction in bacteria and plants

Credit 1 Extracellular matrix (ECM), cytoskeleton and cancer biology **15h**

1. Molecules in ECM of animal tissue, Collagen, Elastin, Fibronectin.
2. Molecules of ECM- Laminins, proteoglycans, integrins
3. ECM remodeling
4. Cell-Cell junctions and cadherin's
5. Functions and origin of cytoskeleton
6. Myosin and actin
7. Cell polarization and mechanism of cell polarization
8. cell migration
9. Proto – oncogenes,
10. Modes of action of oncogenes
11. monomeric G – proteins
12. Ras, c-Myc and leukemia
13. Tumor suppressor genes- p53
14. Tumor suppressor genes-RB and retinoblastoma
15. BRCA and breast cancer

Credit 2 Cell Signaling and Signal Transduction **15h**

1. Cell communication and type of signaling molecules.
2. Types of receptors and their structure.

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3. Signal cascades their importance
4. GPCR, mechanism of signal transduction; inhibitory and stimulatory G alpha (one eg each)
5. GPCR signal termination
6. Tyrosine kinase receptors mediated signaling
7. Insulin, growth factors EGF, VEGF signaling mediated
8. MAPK pathway, role in signaling
9. JAK-STAT pathway
10. Second messengers – Calcium and calmodulin
11. Phosphoinositides
12. NO, cAMP, cGMP
13. Important signaling enzymes and their regulation: PKC, CAM-kinases
14. PI3-kinase
15. Phospholipases and Phosphatases

Credit 3 Signal Transduction in Bacteria and Plants **15h**

1. Introduction of signaling components in bacteria
2. Chemotaxis, Protein kinases in bacteria
3. His - kinases: structure and role
4. Plant signaling system : an overview
5. Response of plants to light, temperature and environmental factors
6. Cell surface Receptors in plants
7. Phytochromes and Cryptochromes
8. Stress signaling in plants (biotic)
9. Stress signaling in plants (abiotic)
10. Role of growth regulators in plants: Ethylene, auxins
11. Role of Cytokinins, Giberrelins and Abscissic acid
12. Signaling in yeast
13. STAT pathway in yeast
14. Protein - Protein interactions in signaling
15. Drugs: targeting signaling molecules

References:

1. The Biochemistry of Cell Signaling, Helmreich JM, Oxford Press
2. Cell signaling – John T Hancock, Oxford University press
3. Cell biology. Second edition: Edited by C A Smith and E J Wood. Chapman & Hall publ.
4. Molecular Cell Biology, 4th edition. Harvey Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore, and James Darnell. New York: W. H Freeman.
5. Molecular Cell Biology, 4th edition. Alberts B, Johnson A, Lewis J, et al New York: Garland Science; 2002

COURSE OUTCOMES:

At the end of the course students will be able to:

BI 402.CO1 apply the knowledge of extracellular matrix molecules and tumor suppressor genes in cancer progression
BI 402. CO2 identify the role of signaling molecules in signal transduction
BI 402. CO3 distinguish between the signaling pathways in bacteria and plants.

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Department of Biochemistry & Nutrition
PROGRAM NAME: M.Sc. BIOCHEMISTRY
2025-26
COURSE NAME: CELL-CELL COMMUNICATION AND SIGNALING

PAPER CODE: BI 402P **PPW: 4**
YEAR/SEMESTER: II/IV **NO OF CREDITS: 2**

COURSE OBJECTIVES
COb 4 To demonstrate basic experiments of cell culture to understand cell cell communication
COb 5 To explain basic experiments of bacterial and yeast growth

Credit 4 Basic experiments: Cell-cell communications **30h**

1. Cell line assays: Preparation of suspension and adherent cells
2. Trypan blue and MTT assays,
3. Analysis of phosphoproteins
4. Chemotaxis assay-eukaryotes
5. Egg experiments – Osmosis, Diffusion

Credit 5 Basic experiment: Signal transduction in Bacteria and Yeast **30h**

1. Sterilization methods: autoclaving & surface sterilization Preparation of culture media
2. Isolation of pure cultures, Bacterial growth curve
3. Gram Staining, Differential staining: Acid fast staining, Giemsa
4. Chemotaxis-bacteria
5. Yeast budding experiment

References

1. Practical Medical Microbiology by R Panjarathinam. Jaypee Brothers Medical Publishers (P) Ltd.
2. Practical Medical Microbiology by Mackie &Mc Cartney. Elsevier
3. Microbiology – A Laboratory Manual by Cappuccino and Sherman. Pearson Education India.
4. Practical Medical Microbiology by Chandra Prakash Bhatt. A.K. Books and Educational Enterprises
5. A Practical guide to Clinical Virology by L. R. Haaheem, John R. Pattison and Richard J. Whitley
6. Virology Methods Manual by Brian WJ Mahy and Hillar O Kangro. Elsevier

COURSE OUTCOMES
At the end of the course the student will be able:

BI 402P.CO4 employ the methods of cell culture in industry/ research
BI 402P.CO5 identify and characterize the bacteria, isolated from various samples.

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Department of Biochemistry & Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY

2025-26

COURSE NAME: GENERAL MICROBIOLOGY, BACTERIOLOGY AND VIROLOGY

PAPER CODE: BI403A **PPW: 4**
YEAR/SEMESTER: II/IV **NO.OF CREDITS: 3**

COURSE OBJECTIVE: This course gives an overview of the fundamentals related to bacterial and viral growth, culture methods, their classification, purification and life cycles.

CREDIT WISE COURSE OBJECTIVES

CObl To explain the classification of microorganisms and their isolation, assay methods, cultivation and purification.
COb2 To outline the Photosynthesis, Morphology, Reproduction and pathogenesis of bacteria and their role in probiotics and antibiotics.
COb3 To discuss the diversity, structure, pathogenicity, life cycles of viruses and phage application in therapy.

Credit 1 General and Applied Microbiology **15h**

1. Introduction and Classification of Microorganisms
2. General Characteristics and structure of Bacteria
3. General Characteristics and structure of Archae
4. General Characteristics and structure of Fungi
5. General Characteristics and structure of Algae
6. Sub viral agents: viroids, virusoids and prions
7. Type of media for Bacterial cultures– Selective and Enriched media
8. Methods of sterilization - Physical and chemical methods
9. Isolation of pure cultures
10. Bacterial growth curve and kinetics of growth.
11. Batch, Continuous and synchronous cultures
12. Isolation and purification of viruses by filtration, ultracentrifugation and affinity chromatography
13. Cultivation and propagation of viruses
14. Viruses: One step growth, single burst and eclipse experiments
15. Viral assay methods – Plaque assays, pock assay, hemagglutination assay, transformation assay.

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Credit 2 Bacteriology **15h**

1. Classification of Bacteria
2. Bacterial Photosynthesis
3. Introduction to medical bacteriology. Infections – Types and transmission
4. Gram positive pathogens, Morphology, Reproduction and pathogenesis – Staphylococcus
5. Gram negative pathogens Morphology, Reproduction and pathogenesis – E.coli and Salmonella
6. Morphology, Reproduction and pathogenesis of Mycobacterium tuberculosis
7. Analysis of air, water and milk borne bacteria
8. Probiotic bacteria and their relevance to health
9. Domestic, municipal and industrial wastes Disposal. Microorganisms in the recycling process
10. Biodegradation of lignocellulosic waste, phenolic compounds and hydrocarbons.
11. Biotransformation of antibiotics and steroids.
12. Bioremediation of pollutants, metals and metallothioneins
13. Microbial metabolism – Autotrophs and Heterotrophs
14. Industrial uses of Bacteria
15. Antibacterial agents

Credit 3 Virology (Prokaryotic and Eukaryotic viruses) **15h**

1. Classification of viruses (Bacteriophages, plant and animal viruses):
2. Baltimore & ICTV systems, Genome diversity
3. Structure and composition of bacteriophages
4. Life cycle of model bacteriophages infecting E coli – λ (lytic lysogenic)
5. Life cycle of ϕ X 174, M13
6. Life cycle of T4, T7
7. Life cycle of Qß, Mu
8. Applications of phages - therapy; Concern over phage contamination in industry (dairy)
9. Eukaryotic viruses Host – virus interactions, permissive/non - permissive hosts; Cytopathic effects
10. Structure, life cycle and pathogenicity of Gemini virus
11. Structure, life cycle and pathogenicity of TMV
12. Structure, life cycle and pathogenicity of Adenovirus and SV 40 virus
13. Structure, life cycle and pathogenicity of Rotavirus and Rubella,
14. Structure, life cycle and pathogenicity of Influenza and Measles viruses
15. Structure, life cycle and pathogenicity of HIV and Hepatitis B Virus

References:

1. Microbiology by Pelczar M.J., Ried, RD and Chan, ECS.
2. Microbiology by Gerard J. Tortora, Berdell Ra. Funke and Christine L. Case. Publ: Pearson Education Inc
3. Medical Microbiology-David Green wood
4. Jawetz-Medical Microbiology-Geo F.Brooks,Janet S Butel.
5. Principles of Virology, (Vol I & II) Flint SJ, Enquist LW, Racaniello VR, Skalka AM Pub ASN Press
6. Introduction to Modern Virology – Dimmock
7. Basic Virology – Wagner
8. Virology – Saravanan
9. Virology – Maharajan
10. Molecular Virology – A. J. Cann
11. An introduction to Viruses – Biswas

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COURSE OUTCOMES:

At the end of the course students will be able to:

BI403A. CO1 identify appropriate bacterial and virus culturing methods.
BI403A. CO2 categorize the pathogenic bacteria and industrial important bacteria in probiotics and antibiotics.
BI403A.CO3 categorize the viruses and identify suitable purification and assay methods for isolation of viruses.

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Department of Biochemistry & Nutrition
PROGRAM NAME: M.Sc. BIOCHEMISTRY
2025-26
COURSE NAME: (ELECTIVE III) BIOTECHNOLOGY

PAPER CODE: BI403B **PPW: 4**
YEAR/SEMESTER: II/IV **NO.OF CREDITS: 3**

COURSE OBJECTIVE: To describe various resources available in the production of biotechnological products for the welfare of human life.

CREDITWISE COURSE OBJECTIVES:

COb1 To explain the production of various metabolites by microbes and concepts of immobilization
COb2 To discuss the strategies in genetic engineering of plants and their use as bioreactors and concept of nanotechnology.
COb3 To describe the tools and techniques in engineering animal and the latest developments in the field of protein engineering.

CREDIT 1 Microbial Biotechnology **15 h**

1. Large scale cultivation of microbes; Fermenter design and control of growth
2. Downstream processing, Production of biomass, single cell protein
3. Production of low molecular weight primary and secondary metabolites
4. Microbial insecticides
5. Production of enzymes for research (restriction enzymes)
6. Production of enzymes for industry (high fructose corn syrup, cheese, food processing)
7. Microbial polysaccharides-Xanthan gum, Dextran, Pullulan,
8. Mannan, Curdlan, Alginate
9. Microbial mining (heavy metal mining, mineral leaching, Sulfur cycle)
10. Microbial production of human insulin,
11. Microbial production of human growth hormone
12. Microbial production of interferon, tissue plasminogen activator
13. Superbug and microbial degradation of oil (bioremediation)
14. Methods and applications of immobilized cells
15. Methods and applications of immobilized enzymes

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CREDIT 2 Plant Biotechnology and Nanotechnology **15 h**

1. Plant cell culture: callus, differentiation into plantlets
2. Isolation of protoplasts and protoplast fusion
3. Plant vectors
4. Agrobacterium tumefaciens and Ti plasmids
5. Transgenic technology
6. GM plants, GM foods, Genetic engineering appraisal committee (GEAC)
7. IPR and farmers' rights in GM plants
8. Terminator technology
9. Antisense RNA,Antisense DNA
10. Plantibodies (example dental caries)
11. Case studies (genes involved, commercial value, problems) of StarLink corn, Bt Cotton
12. Case studies of Zeneca tomato paste, FlavrSavr tomato
13. Case studies of Golden rice, Herbicide resistant plants (Roundup Ready)
14. Nanomaterials- structure, properties and types. Chemical and green synthesis of nanoparticles.
15. Nanobiotechnology and its applications

CREDIT 3 Animal Biotechnology and Protein engineering **15 h**

1. Development, maintenance and growth of animal cell lines
2. Cloning of mammalian and non-mammalian species (Polly, Molly, and Dolly)
3. Production of viral vaccines
4. Production high value therapeutics, interferon, PEGylated interferon
5. Plasminogen activator, urokinase
6. Chimeric antibodies and antibody engineering
7. Immunotoxins as therapeutic agents
8. Gene knockouts
9. Human gene therapy
10. "Humanized" animals as organ farms
11. Large-scale and site-directed mutagenesis, high throughput screening tools in protein engineering
12. Altering kinetic properties and pH dependence of enzymes
13. Increasing stability, enhancing specific activity of enzymes
14. Natural and recombinant fusion proteins, tags for protein purification
15. Methods of drug design and delivery

References:

1. Introduction to Biotechnology, William J. Thieman, Michael A. Palladino, Benjamin Cummings Publ
2. Biotechnology- Arora, Himalaya pub. House
3. Principles of Gene Manipulation, by R.W. Old, S.B. Primrose, Wiley-Blackwell Publications.
4. Biotechnology, Applying the genetic revolution. David P Clark and Nanette J. Pazdernik. Academic Press.
5. Culture of animal cells. 6th Edition. A manual of Basic technique and specialized applications, By R Ian Freshney. Wiley Blackwell publishers.
6. Text book of Nanoscience and Nanotechnology by Murty B.S., Shankar, P., Raj, B., Rath, B.B and Murday, J. Springer.
7. Text book of Nanoscience and Nanotechnology by T. Pradeep, McGraw Hill Education (India) Private Limited.

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COURSE OUTCOMES:

At the end of the course students will be able to:

BI403B.CO1 apply the knowledge for production of metabolites by downstream processing

BI403B.CO2 apply genetic engineering methods to use plants as bioreactors and use appropriate methods to synthesize nanoparticles.

BI403B.CO3 Design protocols for the production of biotechnological products using animal systems and apply the knowledge of protein engineering in development of novel proteins or drugs.

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Department of Biochemistry & Nutrition
PROGRAM NAME: M.Sc. BIOCHEMISTRY

2025-26
COURSE NAME: BIOTECHNOLOGY

PAPER CODE: BI403A/BP **PPW: 4**
YEAR/SEMESTER: II/IV **NO.OF CREDITS: 2**

CREDITWISE COURSE OBJECTIVES

COb4 To demonstrate the methods for culturing, isolation and identification of bacteria and fungi.
COb5 To learn the strategies involved in the production of important metabolites and their applications

Credit 4 General Microbiology **30h**

1. Methods of Isolation and identification of fungi.
2. Antibiotic sensitivity: Paper disc and agar well diffusion assay,
3. Broth dilution assay -Determination of MIC
4. Bacterial motility: Hanging drop method.
5. Widal Test/ VDRL test

Credit 5 Biotechnology **30h**

1. Biotransformation of Antibiotics and Steroids
2. Biodegradation of phenolic compounds hydrocarbons, Dye decolourization by microorganisms
3. Isolation of protoplasts, regeneration and protoplast fusion
4. Production and isolation of industrially important enzymes
5. Green synthesis of nanoparticles.

References:

1. Introduction to Biotechnology, William J. Thieman, Michael A. Palladino, Benjamin Cummings Publ
2. Biotechnology- Arora, Himalaya pub. House
3. Principles of Gene Manipulation, by R.W. Old, S.B. Primrose, Wiley-Blackwell Publications
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COURSE OUTCOMES:

At the end of the course students will be able to:

BI403A/BP.CO4 employ the methods of isolation and identification of bacteria or fungi from various sources in biotech lab/ industry or in research.

BI403A/BP.CO5 implement the appropriate methods to produce industrially important metabolites for various application.

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Department of Biochemistry & Nutrition

PROGRAM NAME: M.Sc. BIOCHEMISTRY
2025-26
COURSE NAME: PROJECT

PAPER CODE: BI404 **PPW: 7**
YEAR/SEMESTER: II/IV **NO.OF CREDITS: 5**

COURSE OBJECTIVE: To inculcate research aptitude and train to propose and execute research project independently

COb1 To discuss a suitable research topic and present a research design seminar.
COb2 To explain the progress of proposed research through seminars
COb3 To report the research findings in the form of dissertation
COb4 To explain the results of the research work in the form of a power point presentation
COb5 To discuss and present the results during viva voce.

Internal Assessment		
Credit 1	Research Design Seminar	25 marks
Credit 2	Progress Seminar 1	25 marks
Semester end Assessment		
Credit 3	Dissertation	25 marks
Credit 4	Final presentation	50 marks
Credit 5	Viva Voce during final presentation	25 marks

COURSE OUTCOMES

At the end of the course students will be able to:
BI404.CO1 implement the knowledge in designing the research work and execute it effectively.
BI404.CO2 to analyze the results of their project work through progress seminar
BI404.CO3 to interpret the research data and prepare a detailed report
BI404.CO4 organise their research work in the form of a final presentation'
BI404.CO5 defend the results of their project work and apply the strategies followed for the research work in R & D labs

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