GONDWANA UNIVERSITY

GADCHIROLI

SYLLABI AND COURSE OF STUDIES IN

BIOCHEMISTRY

FYPG SEMESTER I AND II
UNDER NEP 2020 PROGRAMME

SESSION 2024-25 ONWARDS

M.Sc. BIOCHEMISTRY PROGRAMME

PROGRAM OUTCOMES

By the end of the program the students will be able to:

PO1 - Knowledge and understanding of concepts of biochemistry and its application in medical, pharma, food, agriculture, bioenergy from waste, beverages, and bio-organic value added product industries.

PO2- The students become conversant with the fundamentals of Biochemistry.

PO3-Understanding of discipline, critical thinking, problem solving, analytical and scientificreasoning, research/industry related skills, etc.

PO4-Competent to apply the knowledge gained for conserving the environment and resolving the environmental related issues.

PO5- Will empower the students to develop their future career with a much better andmeaningful orientation.

PO6- Student become competent to enter into research field in biochemistry, biotechnology, vaccination, and other technology field.

PO7-Applying the knowledge acquired to undertake studies and identify specific remedial measures for the challenges in health, agriculture, and food sectors.

PO8-To enable the student to understand biomolecule structures, organization, bonds and forces that contribute to the stabiloize the conformation of biomolecules.

PO9- to learn the cellular processes in protein and other biomolecule synthesis and targeting to other organells

PO10-Demonstrate the ability to identify key questions in biochemical research, optimize research methods, and analyze outcomes by adopting scientific methods, thereby improving the employability.

PO11-Enhance and demonstrate analytical skills and apply basic computational and statistical techniques in the field of biochemistry.

PROGRAMME SPECIFIC OUTCOME

After completing the graduation in the Bachelor of Science the students are able to:

PSO1-Demonstrate effectively the applications of biochemical and biological sciences

PSO2-Inculcating proficiency in all experimental techniques and methods of analysis

PSO3 - Acquire, articulate, retain and demonstrate laboratory safety skills applicable to biochemical research or clinical methods, including accurately reporting observations and analysis

PSO4 - Communicate scientific information effectively, especially relating to biochemical process and their role in metabolism and health related issues in human as well as other organisms

PSO5-Be knowledgeable in proper procedures and regulations in handling and disposal of chemicals

PSO6 - Gain and understanding of biochemical and molecular processes that occur in and between cells to expand understanding of biology

NEP 2020
SEMESTER PATTERN
M.Sc. Biochemistry (PG)Program
Faculty of Science and Technology
(Affiliated Colleges)
(W.e.f. Academic Year2024-25)

Scheme of teaching and examination under semester pattern for M.Sc.Program in Biochemistry.

SEM	Core Course	Elective	Minor
SEMI	**Major1- STPG01BCH01** (4 Credits) (4 Hours/Week)	**STPG01BCH 04to STPG01BCH 06** **Elective Course -** Student shall select any one course. (4 Credits) (4Hours/Week)	**STPG01BCH 07** **Research Methodology** (3 Credits) (4 Hours/Week)
	Major2– STPG01BCH02 (4 Credits) (4 Hours/Week)		
	Major3– STPG01BCH03 (4 Credits) (4 Hours/Week)		
	Practical–I Based on Major Course (Credit 1)(3-8 Hour/Week)		

Total 20 Credits

SEM	Core Course	Elective	Minor
SEMII	**Major1- STPG02BCH 01** (4 Credits)(4 Hours/Week)	**STPG02BCH 04 to STPG02BCH 06** **Elective Course -** Student shall select any one course. (4Credits) (4Hours/Week)	**STPG02BCH 07** OJT (3 Credits)(4 Hours/Week)
	Major2– STPG02BCH 02 (4 Credits)(4 Hours/Week)		
	Major3– STPG02BCH 03 (4 Credits)(4 Hours/Week)		
	Practical–II Based on Major (Credit 1)(3-8 Hour/Week)		
Total 20 Credits			

MSc. Biochemistry Semester I

Teaching and examination scheme

Course code	Name of subject	Total credit	Lectures (L)	Tutorials (T)	Practical (P)	Total Hrs	University examination								
							Theory					Practical			
							UA	CA	Total mark	Duration of exam (Hrs)	Min Passing	UA	CA	Total mark	Min Passing
STPG01BCH01	Protein biochemistry	4	4	--	--	4	80	20	100	3	40				
STPG01BCH 02	Advanced Enzymology	4	4	--	--	4	80	20	100	3	40				
STPG01BCH 03	Tools and Techniques in Bioscience	4	4	--	--	4	80	20	100	3	40				
Elective (any One)															
STPG01BCH 04	Clinical Biochemistry	4	4	--	--	4	80	20	100	3	40				
STPG01BCH 05	Carcinogenesis and Cell signaling														
STPG01BCH 06	Medical and Environmental Biochemistry														
STPG01BCH 07	Research methodology	3	3	--	--	4	80	20	100	3	40				
STPG01BCH 08	Practical -I	1	--	--	04	4	--	--	--	--		30	20	50	25
		20	--			24	400	100	**500**	--		30	20	**50**	

MSc. Biochemistry Semester II

Teaching and examination scheme

Course code	Name of subject	Total credit	Lectures (L)	Tutorials (T)	Practical (P)	Total Hrs	University examination								
							Theory					Practical			
							UA	CA	Total mark	Duration of exam (Hrs)	Min Passing	UA	CA	Total mark	Min Passing
STPG02BCH01	Molecular biology	4	4	--	--	4	80	20	100	3	40				
STPG02BCH 02	Advanced Cell Biology	4	4	--	--	4	80	20	100	3	40				
STPG02BCH 03	Advanced Immunology	4	4	--	--	4	80	20	100	3	40				
Elective (any One)															
STPG02BCH 04	Plant Biochemistry	4	4	--	--	4	80	20	100	3	40				
STPG02BCH 05	Genetic Engineering														
STPG02BCH 06	Fermentation Technology														
STPG02BCH 07	On Job Training	3	3	--	--	4	80	20	100	3	40				
STPG02BCH 08	Practical -II	1	--	--	02	4	--	--	--	--		30	20	50	25
		20	--				400	100	**500**	--		30	20	**50**	

Assessment and Evaluation		
Suggested Continuous Evaluation Methods:		
Internal Assessment (Theory**)** Continuous Internal Evaluation (CIE)	Class Test, Attendance, Assignment (Models/Seminar/Rural Service/Report of Excursion/Lab visit/Industrial visit/project or review work)	20
	Total	**20**
External Assessment Practical Exam	Experimentation, *Viva Voce, e*tc.	30
Practical Internal	Practical record and others	20
	Total	**50**
External Assessment University Theory Exam	Section(A)–one Long Question Or Two brief questions	16X1=16 8X2=16
	Section(B)–one Long Question Or Two brief questions	16X1=16 8X2=16
	Section(C)–one Long Question Or Two brief questions	16X1=16 8X2=16
	Section(D)–one Long Question Or Two brief questions	16X1=16 8X2=16
	Section(E)–Eight Short Question	2X8=16
	Total	**80**

General Rules and Regulations regarding pattern of question paper for the semester end examination:

A) Pattern of Question Paper

1. There will be four units in each paper.
2. Maximum marks of each theory paper will be 80.
3. Question paper will consist of five questions, each of 16 marks.
4. Four questions will be on four units with internal choice (One question on each unit).
5. Fifth question will be compulsory having 12 questions with 3 questions from each of the four units having equal weightage and of which 8 questions should be solved

B) Practical Examination

1. Each practical carries 50 marks. The scheme of marking shall be as per given in the syllabi of respective subjects.
2. Practical performance shall be jointly evaluated by the External and Internal Examiner. In case of discrepancy, the External Examiner's decision shall be final.
3. Duration of practical examination will be as per given in the syllabi of respective subjects.
4. The Practical Record of every student shall carry a certificate as shown below, duly signed by the teacher-in-charge and the Head of the Department. If the student fails to submit his / her certified Practical Record duly signed by the Teacher-In-Charge and the Head of the Department, he / she shall not be allowed to appear for the Practical Examination and no Marks shall be allotted to the student.

Paper Title

SEMESTER- I

SEM	Paper Code	Major (Mandatory)	Elective	Paper Code	Minor	Paper Code
I	STPG01BCH 01	Protein biochemistry	1 Clinical Biochemistry	STPG01BCH 04	Research Methodology	STPG01BCH 07
			2. Carcinogenesis and Cell signaling	STPG01BCH 05		
	STPG01BCH 02	Advanced Enzymology	3. Medical and Environmental Biochemistry	STPG01BCH 06		
	STPG01BCH 03	Tools and Techniques in Bioscience	**Note: - Student shall select anyone from above group**			
STPG01BCH 08 **- Practical - Based on Major Course**						

SEMESTER- II

SEM	Paper Code	Major (Mandatory)	Elective	Paper Code	Minor	Paper Code
II	STPG02BCH 01	Molecular biology	1. Plant Biochemistry	STPG02BCH 04	On Job Training	STPG02BCH 07
			2. Genetic Engineering	STPG02BCH 05		
	STPG02BCH 02	Advanced Cell Biology	3. Fermentation Technology	STPG02BCH 06		
	STPG02BCH 03	Advanced Immunology	**Note: -Student shall select any one from above group**			
STPG02BCH 08 **- Practical - Based on Major Course**						

MAJOR COURSE

Semester I Paper-

STPG01BCH 01

Protein Biochemistry

Course Code	Unit	Topic/Title	Credit
STPG01BCH01	Unit-I	**Basics study of proteins** 1. Amino acid: Structures, classification, uncommon amino acid 2. Peptide and Protein structure:- Peptide bonds, Primary structure of protein, Secondary structure, tertiary structure and quaternary structure of proteins. 3. Amino acid sequencing: Small peptide sequencing by Sanger's FDNB method, Edman degradation methods, 4. Large protein sequencing: Chemical and enzymatic method, mass spectrometry 5. chemical synthesis of Small Peptides and Proteins	04
	Unit-II	**Three dimensional structure of proteins I** 1. Protein conformation, Weak Interactions or forces which stabilized the Protein's Conformation 2. Detail structure of Peptide Bond, Ramchandran plot 3. Secondary structure of protein: alpha helix, beta conformation, beta turn 4. Protein Tertiary and Quaternary Structures: Fibrous protein (alpha keratin, collagen), globular proteins (myoglobin),	
	Unit-III	**Three-dimensional structure of proteins II** 1. Methods for Determining the Three-Dimensional Structure of a Protein (X-ray Diffraction, NMR,) 2. Super secondary structure (Motif), concept of domains, 3. Protein Quaternary Structures: concept of multimer, Oligomer, protomer), Rotational symmetry or helical symmetry. 4. Protein Denaturation and Folding (Renaturation), concept of *Tm,*	
	Unit-IV	**Protein function** 1. Concept of Ligand (Binding site), Reversible Binding of a Protein to a Ligand: Oxygen-Binding Proteins, co-operative binding of hemoglobin and myoglobin, Allosteric protein and ligand binding, A sigmoid (cooperative) binding curve 2. Quantitative decription of Protein-Ligand Interactions, Hill equation and Hill plot, 3. protein functions (Hemoglobin): Transports H^+ and CO_2, protein acts as buffers, regulation of Oxygen Binding by 2,3-Bisphosphoglycerate, 4. Complementary Interactions between Proteins and Ligands: The Immune System and Immunoglobulins, antibodies, epitope, T-Cell Receptor, Major Histocompatibility complex- etc.	

ReferenceBooks

1	Lehninger The principle of Biochemistry fourth edtion by Nelson and Cox, **www.whfreeman.com/lehninger4e**
2	Biochemistry (Fifth edition) – Jeremy M. Berg, John L. Tymoczko, Lubert Stryer – W. H. Freeman & Co. – New York.
3	Text Book of Biochemistry – West, Todd, Mason, Bruggen – Amerind Publishing Co. Pvt., Ltd.
4	Biochemistry- Powar & Chatwal
5	Outlines of Biochemistry – Conn& Stumpf.

6	Harper's illustrated Biochemistry (26th edition), Robert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell published by /McGraw-Hill companies
7	Biochemistry by U. Satyanarayana and U. Chakrapani published by BOOKS AND ALLIED (P) Lro.
8	Molecular Components of Cells by Garrett and Grisham 2nd edition.

Semester-I
Paper- STPG01BCH 02
Advanced Enzymology

Course Code	Unit	Topic/Title	Credit
STPG01BCH 02	**Unit-I**	**Bioenergetics, Enzymes kinetics** Enthalpy, entrophy and Free energy, standard free energy, activation energy, and transition state energy, methods used for investigating the kinetics of enzyme catalyzed reaction. Overview of Michaelis-Menten equation and its transformation, Evaluation of kinetic parameters, Kinetics of bisubstrate reaction, multistep reactions, kinetics of enzyme inhibition, Classification of enzymes	04
	Unit-II	**Catalytic mechanisms** Concept of active site, determination of active site, acid –base catalysis, covalent catalysis, metal ion cofactors, proximity and orientation effects, preferential binding. Active site determination and mechanism of ribonuclease, lysozyme, Active site determination and mechanism of serine protease.	
	Unit-III	**Regulation of Enzyme activity** Allosterism, Kinetic analysis of allosteric enzymes Covalent Modification, Feed -back inhibition Membrane bound enzymes, isoenzymes and marker enzymes- LDH, multienzyme complex with mechanism Constituitive and inducible enzymes.	
	Unit-IV	**Techniques and application of enzymes** **Enzyme isolation and purification**-Importance of purification, methods of purification and fractionation, criteria of purity Protein**:** ligand binding studies: association and dissociation constants, co-operative ligand binding MWC or concerted model, sequential model. **Enzyme biosensors**: General concept, Definitions, history and market needs. Glucose biosensor. Industrial applications of enzymes. Immobilized enzymes, Protein engineering.	

REFERENCES:

1. Advances in Enzymology by Alton Meister (1996), Interscience Publishers.
2. Allosteric enzymes– kinetic Behavior by B.I Kurganov (1982) John Wiley and sons Inc., New York.
3. Biology enzymes in biotechnology by H.J.Rehm and G. Reed Verlag (1983) VCH Publishers. New York.
4. Enzymes as Drugs by John S. Hoilenberg and Joseph Roberts (2001). John Wiley and Sons NewYork.
5. Enzymes by Dixon, M., and E. C. Webb, 3rd edition, (1980), Academic Press. NewYork.
6. Enzymology by palmer
7. Hand Book of Enzyme Biotechnology by Wiseman (1985), Ellis Horwood.
8. Methods in Enzymology by W. A. Wood (1980) Academic Press NewYork.
9. Methods in Enzymology. Volume 22- Enzyme purification and related techniques by William B. Jakoby. Academic press, New York.
10. Methods of Enzymatic Analysis by Hans Ulrich. Bergmeyer (1974) Verlag Chemie.
11. Topics in enzymes and fermentation biotechnology by L. N. Weiseman, John wiley and Sons.
12. Enzymes: By: Trevor Palmer.
13. Enzyme structure and mechanism by: AlanFersht.
14. Methods in Enzymology By: S. Berger, A. Kimmel.

Semester-I
Paper- STPG01BCH03
Tools and Techniques in Bioscience

Course Code	Unit	Topic/Title	Credit
STPG01BCH03	**Unit-I**	**TECHNOLOGY FUNDAMENTALS (Life Science):** General scheme for purification of bio-components. Methods for studying cells and organelles. Sub-cellular fractionation and marker enzymes. Methods for lysis of plant, animal and microbial cell. Ultrafiltration, freeze drying and fractional precipitation. Use of detergents in isolation of membrane proteins	04
	Unit-II	**CHROMATOGRAPHY:** Basic principles and applications of ion-exchange, gel filtration, partition, affinity, HPLC and reverse phase chromatography, gas chromatography, TLC, Paper chromatography. Chromatofocussing. **CENTRIFUGATION:** Ultracentrifugation - velocity and buoyant density determination. Density gradientcentrifugation, molecular weight determination.	
	Unit-III	**ELECTROPHORESIS:** Basic techniques, poly acrylamide/ starch/ agarose gel electrophoresis, use of SDS/urea, isoelectric focusing, capillary electrophoresis. Pulse field gel electrophoresis. **TRACER TECHNIQUES:** Principles and applications of tracer techniques in biology, Measurement of alpha, beta and gamma radiations. Radiation dosimetry, Radioactive isotopes and half life of isotopes, Autoradiography, Cerenkov radiation, Liquid Scintillation spectrometry	
	Unit-IV	**DETERMINATION OF BIOPOLYMER STRUCTURE** (Principles and applications): X-ray diffraction, fluorescence, UV, visible, CD/ORD, ESR, NMR and Mass spectroscopy, atomic absorption spectroscopy. plasma emission spectroscopy. **MICROSCOPY:** Principles and application of light phase contrast, fluorescence, scanning andtransmission electron microscopy	

References

1) Protein Purification by Robert Scopes, Springer Verlag Publication, 1982
2) Tools in Biochemistry David Cooper
3) Methods of Protein and Nucleic acid Research, Osterman Vol I – III
4) Centrifugation D. Rickwood
5) Practical Biochemistry, V th edition, Keth, Wilson and Walker.

ELECTIVEPAPERS

ELECTIVE PAPERS
Paper– STPG01BCH 04
Clinical Biochemistry

Course Code	Unit	Topic/Title	Credit
STPG01BCH 04	**Unit-I**	**NUTRITION :** Major and minor nutrients, composition of food - calorific values, physiological fuelvalue, biological value and nitrogen balance. Protein calorie malnutrition, Kwashiorkar and Marasmus. Nutrition in childhood, pregnancy old age and disorders such as diabetes, obesity,coronary disorders and in starvation.	04
	Unit-II	**LABORATORY SETUP AND SAFETY:** Requirements of setting up of clinical laboratory, SI units in clinical laboratory, collection preparation, preservation, and handling of clinical samples, quality control, Safety measures in clinical laboratory. Formulation of clinical and diagnostic kits, Safety aspects. **ENZYMES AND ANALYTES IN CLINICAL BIOCHEMISTRY :** Use of LDH, SGPT, SGOT, acid and alkaline phosphatase, amylase, lipase, cholesterol, albumin, creatinine etc. in diagnosis and monitoring of disorders	
	Unit-III	**BLOOD :** Total and differential blood count, blood groups and Rh factor incompatibility, plasma proteins, types of anaemias and porphyries, molecular basis of hemoglobinopathies. **LIVER :** Bilirubin metabolism, types of jaundice and clinical assesment, Acute and chronic liver diseases, cirrhosis, viral, metabolic and drug induced/toxic liver diseases, liver cancer, liver function tests, non-invasive investigations of liver function.	
	Unit-IV	**KIDNEY :** Glomrular filtration rate, Renal threshold and clearance values, disorders of kidney, renal failure and proteinuria, renal tubular disorders and renal stones Renal functiontests, artificial kidney. **HEART** Ischemic heart disease, role of enzymes and other proteins in assessment of myocardial infarction. Hypertension – types and causes of hypertension, basis ofdrug therapy for hypertension.	

1. Clinical Biochemistry by Allan Gaw, M.J Murphy, R.A. Cowan, James Shephered
2. Textbook of Biochemistry for medical Students by, DM Vasudevan, Shreekumari S, Kannan Vaidyanathan
3. Clinical Biochemistry Metabolic and clinical Aspect by William J. Marshal
4. Postgraduate Biochemistry companion by Dr. Ritu Chandel
5. Textbook of Medical Biochemistry, Fifth Edition, By Dinesh Puri
6. Biochemistry by Dr. Prasad Munjeshwar

ELECTIVE PAPERS

Paper- STPG01BCH05

Carcinogenesis and Cell signaling

Course Code	Units	Topic/Title	Credit
STPG01BCH05	Unit-I	**CHEMICAL CARCINOGENESIS:** 1. Mutation - definition, significance, rates and frequency. Mutagenic agents. 2. Molecular basis of mutagenesis, induced and spontaneous mutations, crossing over andsegregation. 3. Various types of mutations - addition, deletion, inversion, reciprocal, translocation, insertional translocation, frameshift mutations. DNA damage and repair mechanism,recombinant repair system. 4. Chemical carcinogenesis - genetic and epigenetic carcinogens, procarcinogens and cocarcinogens, promoters and initiators, testing for carcinogenecity, Ames test.	
	Unit-II	**ONCOGEN AND BIOTRANSFORMATION** 1. Oncogenes - RNA and DNA tumor viruses, retroviruses and viral oncogenes. Src and Ras gene, mechanism and characteristic of cell transformation. 2. Radiation - effect of ionising radiations on DNA, chromosomal aberrations. 3. Genetic basis of cancer, metastasis, use of tumor markers in detection and monitoring ofcancer 4. BIOTRANSFORMATION: Drug metabolism and detoxification, toxicity testing,extramicrosomal enzymes and its role in detoxification.	
	Unit-III	**PLANT TISSUE CULTURE** 1. Media requirements, sterilization and role of growth regulators. Requirements of a planttissue culture laboratory. 2. Micropropogation, Somatic cell hybridization, Haploid (anther) culture, Embryo culture, Protoplast fusion, Somatic embryogenesis Somaclonal variations, Cybrides and Allopheny. 3. Cell suspension and callus culture. Agrobacterium mediated hairy root culture.Conditioning of tissue culture plants (weaning and hardening). 4. Active principles in medicinal plants and phytochemistry of the metabolites of medicinalimportance.	
	Unit-IV	**ANIMAL TISSUE CULTURE** 1. Media requirements, preparation of medium and sterilization techniques.Advantages and disadvantages of natural and synthetic media. 2. Culture methods – hanging drop, suspension and monolayer culture. 3. Behaviour and characteristics of cells in culture. 4. Primary and established cell lines,characteristics of transformed cells. Methods of cell preservation. 4. Organ culture – clot grid, chorioallantonic and ocular culture 5. Applications of animal tissue culture – vaccines, cell biology, drug testing, medicalapplications, etc. 6. Stem cells – concept of totipotency, Applications of stem cells In medicine and tissue engineering	

Reference Books

1. Cancer Biology by Raymond Ruddon
2. Oncogenes Burck Liu and Larrick
3. Toxicology by Stewart and Stoleman
4 Tissue Culture by John Paul
5 Plant cell tissue and Organ culture by Gamborg Phillips
6 Culture of Animal Cells by Ian Freshney
7 Molecular Biotechnology by S. B. Primrose

ELECTIVE PAPERS

Paper- STPG01BCH 06

Medical and Environmental Biochemistry

Course Code	Units	Topic/Title	Credit
STPG01BCH 06	Unit-I	**1. Blood:** Composition, Blood group, Types of Anaemias and Hemoglobinopathies **2. Metabolic disorders**: Molecular Basis of diabetes, types of diabetes, Atherosclerosis; Types of Jaundice and its assessment, Hypertension, Myocardialinfarction biochemical assessment and monitoring.	04
	Unit-II	**Inborn errors of metabolism**: Inborn errors of Carbohydrate, Lipid, Nucleicacids and Amino acid metabolism	
	Unit-III	**Disorders due to industrial toxicants** Teratogenesis, carcinogenesis, silicosis, toxicity of Hg^{++}, Cd^{++}, $Pb^{++,}$ F^{-} **Environmental pollution**: Air, Water, and Soil pollution, Control o pollution	
	Unit-IV	**Biodiversity**: Characterization, generation, maintenance and loss, magnitude and distribution of Biodiversity. Economic value, wild life biology, conservation strategiesand cryopreservation	

Reference Books

1. Clinical Chemistry by Kaplan L.A. and Pesce A. J. C. V. Mosby, 1989
2. Clinical Biochemistry by W. J. Marshall and S. K. Bangert, Churchill Livinston N.Y.1995
3. Practical Clinical Biochemistry (Varley) by Gowenlock
4. Biochemical Aspects of Human Diseases by Elkeles and Tavill
4. 5. Biodiversity by Hawksworth

MINOR COURSE

Paper – STPG01BCH 07

RESEARCH METHODOLOGY

Course Code	Units	Topic/Title	Credit
STPG01BCH 07	Unit-I	**Research Fundamentaland Terminology** • Definition and objective of research, criteria of good research study, scientific method. • Study design and variations, basic, applied, historical and exploratory experimental, ex-post-facto, case study, diagnostic research, case control design, cohort study design, multifactorial design.	04
	Unit-II	**Defining Research problem and data collection and analysis** • Hypothesis, theory and scientific law: structure, conditions, sources, formulation, explanation of hypothesis and scientific laws and principle. • Methods and techniques of data collection and analysis of data – types, methods of data collection – Primary (Construction/ experimentation/ questionnaire/ case/ pilot study method.) Secondary data collection (Internal/External)	
	Unit-III	**Sampling and sampling distributions** • Sampling frame, probability sampling, simple/random sampling, systematic sampling, stratified sampling, random sampling, cluster sampling, problems due to unintended sampling, ecological and stratified pollution in the lab. • Variables–Nominal, ordinal, discontinuous, continuous, derived.	
	Unit-IV	**Data collection, analysis and report writing** • **Experimental data collection and data processing:**Data : Method validation, observation, data processing strategies and tools with statistically package (Sigma, STAT, SPSS, for students (t- test, ANOVA etc.) Soft computing in data analysis- computer and its role in research, use of statistic software SPSS, GRETL etc. in research. **Report writing and presentation** • Significance of report writing • Different steps in writing report, • Layout of research report writing • Precautions in writing research report. Conclusion and Appendices, Research Ethics, IPR and scholarly publishing- Ethical issue, Ethical committees, IPR law and patent law, copywrite, royalty, trade related aspects. • Design of resear chpaper: Citation, acknowledgement, plagiarism, reproducibility and accountability.	

ReferenceBooks

1. Kumar, R.2005, Research methodology-Astep-by-stepguideforbeginners(2nd edition), Singapore, pearson Eduction.
2. Bhattacharya, D.K.,200^, ResearchMehtodology(IInd edition)NewDelhi, Excek Books.

3. Pannerselvam,R.2012,ResearchMethodology,NewDelhi,PHIlearning.
4. KhanIrfanAli(2008),FundamentalsofBiostatistics.sUkaazpublications.
5. Katz,J.M.,2009,Formresearchonresearchmanuscript:Aguidetoscientificwriting,USA, Springer science.
6. Gargem, B.L.,Karadia, R. AgrawalU.K., 2002,AnIntroductionto ResearchMethodology, RBSA publishers.
7. Sinha,S.C.,andDhiman,A.K.,2002,ResearchMethodology,EssEsspublications, volume-2
8. Wadehre,B.L.,2000,Lawrelatingtopatents,trademarks,copyrightdesignandgeographical indications. Universal Law Publishing

LABCOURSE

PRACTICALS

PRACTICALS

STPG01BCH 08- Practical–I

Based on Paper- STPG01BCH 1, STPG01BCH 02, and STPG01BCH 03

1. Quantitative estimation of Amino acid by Ninhydrin reagent from unknown source
2. Quantitative estimation of Protein by Folin-Lowry (Phenol-Cio-Catcheu Reagent) method
3. Quantitative estimation of Protein by Bradfords Dye Binding assay
4. Separation of proteins oligomer by agarose gel electrophoresis
5. Separation of proteins by Disc gel electrophoresis
6. Enzyme assay of enzyme (amylase) by DNS reagent method
7. Assay of specific activity verses total activity of enzyme
8. Determination of optimum temperature of enzyme activity
9. Determination of optimum pH of enzyme
10. Detection of enzyme activity of lipase, Urease, invertase, and protease
11. Determination of kinetic constant of amylase: -Amylase activity, V_{max}. K_m.
12. Effect of inhibitors on amylase activity.
13. UV absorption of proteins, DNA and RNA.
14. Determination of pka of an amino acid.
15. Separation of amino acid by two dimensional paper chromatography
16. Separation of protein by SDS-PAGE Gel electrophoresis
17. Determination of Serum Amylase
18. Determination of serum lactate dehydrogenase

(Mandatory to perform 9 practical)

SEMESTER II

Semester-II

Paper- STPG02BCH 01
Molecular Biology

CourseCode	Unit	Topic/Title	Credit
STPG02BCH 01	**Unit-I**	**Genome organization** Organization of bacterial genome, Structure of eucaryotic chromosomes; role of nuclear matrix in chromosome organization and function, matrix binding proteins, heterochromatin and euchromatin, molecular components, DNA reassociation kinetics (Cot curve analysis), repetitive and unique sequences, kinetics and sequence complexities, satellite DNA, DNA melting and buoyant density, packing and organization of chromatin, nucleosome phasing, DNase I hypersensitive regions, DNA methylation & Imprinting **Mutation** Nonsense, missense and point mutations, intragenic and intergenic suppression,frameshift mutations, physical, chemical and biological mutagens	04
	Unit-II	**DNA Replication, Repair & Recombination** Concepts of replication initiation, elongation and termination in prokaryotes and eukaryotes, enzymes and accessory proteins involved in DNA replication, Fidelity in replication, replication of single stranded circular DNA. Gene stability and DNA repair, DNA repair enzymes, photoreactivation, nucleotide excision repair, mismatch correction, SOS repair. Recombination: homologous and non-homologous recombination, site specific recombination, Holliday structure, resolution, chi sequences in prokaryotes, gene targeting, gene disruption, FLP/FRT and Cre/Lox recombination RecA and other recombinases.	
	Unit-III	**Prokaryotic & Eukaryotic Transcription** Prokaryotic Transcription & Regulation: Promoters, Regulatory elements, Transcription unit, constitutive and inducible promoter, operators, Initiation, Attenuation, Termination, Rho-dependent and independent termination, Anti-termination, Transcriptional regulation, positive and negative regulation, operon concept, Regulation of transcription of lac, trp, ara, his, and gal operons, transcriptional control in lambda phage, Transcript processing, Processing of tRNA and rRNA Eucaryotic transcription and regulation: RNA polymerase structure and assembly, RNA polymerase I, II, III, Eukaryotic promoters and enhancers, General Transcription factors, TATA binding proteins (TBP) and TBP associated factors (TAF), Activators and repressors, transcription initiation, elongation and termination, activation and repression, Transcriptional and post-transcriptional gene silencing, expression and processing of heterogeneous nuclear RNA, tRNA, rRNA, 5'-Cap formation,3'-end processing and polyadenylation, Splicing, RNA editing, Nuclear export of mRNA, mRNA stability, catalytic RNA	

	Unit-IV	**Translation & Transport** The translation machinery, ribosomes, composition and assembly, Universal genetic code, degeneracy of codons, termination codons, is accepting tRNA, wobble hypothesis. Mechanism of initiation, elongation and termination, Co- and post-translational modifications, genetic code in mitochondria. Protein synthesis, Transport of proteins and molecular chaperones, protein stability, protein turnover and degradation	

References:

1. Stryer L (1995) Biochemistry, 4 th edition, W. H. Freeman & company, New York.
2. Watson J. D., Hopkins, N. H., Roberts, J. W., Steitz, J. A. and Weiner, A. M. (1988) Molecular biology of the gene, 4 th edition, The Benjamin/Cummings publishing companies, inc, California.
3. Benjamin Lewin (1999) Genes VII, oxford University Press, Oxford.
4. Weaver R. F. (1999) Molecular biology, WCB McGraw-Hill companies, Inc, NewYork.
5. Brown T A (1995) Essential molecular biology, vol. I, A practical approach, IRL press, Oxford.
6. Genes and Genomes Maxine Singer and Paul Berg

Semester-II

Paper- STPG02BCH 02
Advanced Cell Biology

CourseCode	Unit	Topic/Title	Credit
STPG02BCH 02	**Unit-I**	**Structure and organization of membranes** Mitochondria, endoplasmic reticulum, prokaryotic membrane, membrane junctions (Gap & tight junctions), techniques for membrane study: electron microscopic method, membrane vesicles, differential scanning colorimetry, fluorescence photobleaching recovery, flow cytometry.	04
	Unit-II	**Membrane Transport** Active and Passive transport, uniport, ATP powered pumps, non-gated ion channels, cotransport by symporters and antiporters, transepithelialtransport.	
	Unit-III	**Signal Transduction** General concept of cell signaling, G-protein coupled receptors and their effectors. RTK and MAPKinases. Down regulations of pathways. Cytokine receptors and their mechanism (JAK-STAT pathway).	
	Unit-IV	**Bacterial signal transduction** Basic two component system. Histidine kinase pathway Sporulationas a model of bacterial signal transduction. Osmoregulatory pathways. Heat shock proteins. Mating types of yeast.	

References:

1.The Biochemistry of copper By: Jack Peisach, Phillip Aisen.
2, Biochemistry: -By: Rex Montgomery.
3.LehningerPrinciplesofBiochemistryBy: -DavidL.NelsonandCox4. Principles of Biochemistry. By: Donald J. voet, Judith G. Voet, Charlotte W.Pratt.
5. Getzenberg, R.H.andE.E.Bittar, Cell Structure and Signalling, Elsevier Science.
6. Ernet,J.M. Helmreich, TheBiochemistry of Cell Signalling, Oxford Press.
7. Boyer,P.D. The ATPsynthase-Asplendid molecular machine. Ann.Rev.
8. Cossartetal., Cellular Microbiology
9. S. Ram Reddy and S.M.Reddy, Microbial Physiology, Scientific Pub, Jodhpur.
10. Dawes, I.W., Sutherland, I. WMicrobial Physiology2nd ed London: Blackwell scientific Publishers

Semester-II

Paper- STPG02BCH 03

Advanced Immunology

CourseCode	Unit	Topic/Title	Credit
STPG02BCH 03	**Unit-I**	1. Overview of immune system, cells and organs of immune system 2. Antigen: immunogenicity verses antigenecity, Types of antigen, Epitopes, Hapten 3. Antibody: Chemical and enzymatic method to ellustrate the structre of antibodies, Basic structure of antibody, types of antibodies, B-Cell receptor, Immunoglobin superfamillies, Monoclonal antibodies 4. Biological activities (Functions) of antibodies, opsonization, antibodies activated complement, Antibody dependent cell mediated cytoxicity (ADCC), Transcytosis.	04
	Unit-II	Roll of Ag presenting Cell, endocytic pathway, exocytic pathway Cell mediated immune response: Effectors Response, Cytotoxic T Cell, Natural Killer cell, Antibody dependent Cell Mediated cytotoxicity. Complement system: Function of complement, complement activation (Classical pathway, alternative pathwate, MAC complex),	
	Unit-III	1. Vaccine: Active and passive immunization, Types of Vaccine, Whole organism vaccine, purified macromolecule vaccine, DNA vaccine, multivalent subunit vaccine, Recombinant Vector Vaccine. 2. Immune tresponce in health and disease condition, Viral inferction, Bacterial Infection, Protozoan Infection, Helminth Infections, AIDS and other immunodeficiency disorder	
	Unit-IV	1. Hypersensitivity: Gell and coombs classification, IgE mediated (Type I) hypersensitivity, allergens, antibody mediated cytotoxic (Type II) hypersensitivity, Immune complex mediated (Type III) Hypersensitivity, Delayed type (Type IV) hypersensitivity. 2. Autoimmunity: Organ specific autoimmune disease, systemic autoimmune disease, mechanism of autoimmunity. 3. Transpantation immunity: Graft rejection, immunosuppressant, Immune tolerance to allograft.	

Reference:

1. Immunology, Fifth edition, By Kuby.
2. Immunology by. I KAannan, MJP Publication
3. Fundamental of microbiology and Immunology by Ajit K Bannerjee, Nirmalaya Nanerjee, N.C.B.A publication
4. Immunology by Dulsy Fatima, N. Arumugam, Saras Publication. 2016
5. Immunology by N.V. Shastri
6. Immunology By N. Das

ELECTIVEPAPERS

ELECTIVE

PAPERS SEMII– STPG02BCH 04

Plant Biochemistry

Course Code	Unit	Topic/Title	Credit
STPG02BCH 04	Unit-I	**Plant cell:** Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins, stomatal movement, transpiration, photoperiodism and biological clocks, plant movement. **Photosynthesis:** Photosynthetic apparatus, pigments of photosynthesis, Calvin cycle (C3 plants), Hatch slack (C4 plants) & CAM pathways of carbon reduction and its regulation, Structure, function and regulation of RUBISCO, Crassulacean acid metabolism in plants. **Photorespiration:** photorespiration pathway and significance, cyanide resistance, relationship between photosynthesis, photorespiration.	04
	Unit-II	**Phytohormones:** Biosynthesis, transport, physiological effects, mode of action and signal transduction of auxins, gibberlic acid, abscisic acid, ethylene and cytokinins in germination, embryogenesis, growth and development of plant.	
	Unit-III	**Nitrogen metabolism:** Nitrogen fixation, nitrogenise complex, biochemistry and genetics of nitrogen fixation and ammonium assimilation, structure of 'NIF' genes and its regulation, structural features of nitrate reductase and nitrite reductase, regulation of nitrate and sulphate assimilation. **Secondary plant metabolites:** Nature, distribution, biosynthesis and function of plant metabolites, biosynthesis of nicotine. Biochemistry of plant toxins, phytohemagglutinins, lathyrogens, nitriles, protease inhibitors, protein toxins, role of secondary metabolites in chemical defence.	
	Unit-IV	**Plant stress physiology:** Plant stress, plant responses to abiotic and biotic stresses, salinity, water, heat, chilling, anaerobiosis, heavy metals, radiations and their impact on plant growth and metabolism, mechanisms of resistance to biotic stress and abiotic stress, antioxidative defence mechanism. **Plant defense:** Genetic basis of plant-pathogen interactions, antio R-Avr gene interactions and isolation of R genes, hypersensitive response (HR), systemic acquired resistance (SAR) and induced systemic resistance (ISR).	

Reference Books

1. Introduction of Plant Biochemistry, by Goodwin T. W. and E.I. Mercer, Pergamon Press, Oxford, 1983.
2. Plant Physiology, 5th Edition, by Lincoln Taiz and Eduardo Zeiger, Amazon press, 2012
3. Introduction of Plant Biochemistry, by Goodwin T. W. and E.I. Mercer, Pergamon Press, Oxford. Buchanan BB, Gruissem W & Jones RL. 2000.
4. Biochemistry and Molecular Biology of Plants. 2nd Ed. John Wiley. Dey PM &Harborne JB. 1997.
5. Plant Biochemistry. Academic Press. Heldt HS. 1997.
6. Plant Biochemistry and Molecular Biology. Oxford Univ.Press.

Elective

Paper SEMII- STPG02BCH 05

Genetic Engineering

Course Code	Units	Topic/Title	Credit
STPG02BCH 05	Unit-I	**DNA & Basics Of Recombinant DNA Technology** Structure of DNA: A-,B-,Z-, and triplex DNA, measurement of properties, spectrophotometric, CD, AFM, and electron microscope analysis of DNA structure. Restriction analysis: Types of restriction enzyme, Type I, II and III, restriction modification systems, type II restriction endonucleases and properties, isoschizomers and neoschizomers, mcr/mrr genotypes, Cohesive and blunt end ligation, linkers, adaptors, homopolymeric tailing. Labeling of DNA: Nick translation, random priming, radioactive and non-radioactive probes, use of Klenow enzyme, T4 DNA polymerase, bacterial alkaline phosphatase, polynucleotide kinase. Hybridization techniques: Northern, Southern and Colony hybridization, Fluorescence *in situ* hybridization Restriction maps and mapping techniques, DNA fingerprinting, chromosome walking & chromosome jumping DNA-Protein Interactions: Electro mobility shift assay, DNase I footprinting, methyl interference assay	04
	Unit-II	**Cloning Vectors** Gene Cloning Vectors: Plasmids, bacteriophages, Cloning in M13 mp vectors,phagemids, Lambda vectors; insertion and replacement vectors, EMBL, λDASH, λgt10/11, λZAP etc. Cosmid vectors. Artificial chromosome vectors (YACs, BACs), Animal Virus derived vectors- SV-40, vaccinia/bacculo & retroviral vectors. Expression vectors; pMal, GST, pET-based vectors. Protein purification; His-tag, GST-tag, MBP-tag etc. Restriction proteases, intein-based vectors. Inclusion bodies, methodologies to reduceformation of inclusion bodies. Baculovirus and pichia vectors system	
	Unit-III	**Cloning Methodologies** Insertion of Foreign DNA into Host Cells: Transformation, Transfection: Chemical and physical methods, liposomes, microinjection, macroinjection, electroporation, biolistics, somatic cell fusion, gene transfer by pronuclear microinjection, Plant transformation technology: Basis of tumor formation, hairy root, features of Ti and Ri plasmids, mechanism of DNA transfer, role of virulence genes, use of Ti and Ri as vectors. Cloning and expression in yeasts (Saccharomyces, Pichia etc.), animal and plants cells, methodsof selection and screening, cDNA and genomic cloning, expression cloning, jumping and hopping libraries, southwestern and far western cloning, yeast two hybrid system, phage display, Construction of cDNA libraries in plasmids and screening methodologies, Construction of cDNA and genomic DNA libraries in lambda vector. Principles in maximizing gene expression, Site-directed mutagenesis	
	Unit-IV	**PCR and Its Applications** Primer design, Fidelity of thermostable enzymes, DNA polymerases, multiplex, nested, reverse transcriptase, real time PCR, touchdown PCR, hot start PCR, colony PCR, cloning of PCR products, T-vectors, proof reading enzymes, PCR in gene recombination, deletion, addition, overlap extension, and SOEing, site specific mutagenesis, PCR in	

		molecular diagnostics, viral and bacterial detection, PCR based mutagenesis. **Applications** Sequencing methods: Enzymatic DNA sequencing, Chemical sequencing of DNA, principle of automated DNA sequencing, RNA sequencing. Chemical Synthesis of oligonucleotides. Gene silencing techniques: Introduction to siRNA and siRNA technology, micro RNA, construction of siRNA vectors, principle and application of gene silencing. Gene knockouts and Gene Therapy: Creation of knock out mice, disease model, somatic and germ-line therapy in vivo and ex-vivo, suicide gene therapy, gene replacement, gene targeting Other applications: Transgenics, Genome projects and their implications, application in global gene expression analysis. Applications of recombinant DNA technology in medicine, agriculture, veterinary sciences

ReferenceBooks

1. Sambrook J, Fritsch E. F. and Maniatis (1989) Molecular cloning, vol. I, II, III, II nd edition, Cold spring harbor laboratory press, New York.
2. DNA Cloning : A practical approach D.M. Glover and D.B. Hames, RL Press,Oxford, 1995
3. Molecular and cellular methods in Biology and Medicine, P.B. Kaufman, W. Wu , D.Kim and L.J. Cseke, CRC Press Florida 1995
4. Methods in Enzymology Guide to Molecular Cloning Techniques, Vol. 152 S.L.Berger and A. R. Kimmel, Academic Press Inc, San Diego, 1996
5. Methods in Enzymology Gene Expression Technology, Vol. 185D. V. Goedel,Academic Press Inc, San Diego, 1990
6. DNA Science: A First Course in Recombinant Technology, D. A. Mickloss and G. AFreyer, Cold Spring Harbor Laboratory Press, New York, 1990
7. Molecular Biotechnology, 2nd Ed. S. B. Primrose, Blackwell Scientific publishers,Oxford, 1994
8. Milestones in Biotechnology, Classic Papers on Genetic Engineering, J. A. Davis and W. S. Reznikoff, Butterworth-Heinemann Boston 1992
9. Route Maps in Gene Technology, M. R. Walker, and R. Rapley, Blakwell Science,Oxford, 1997
10. Genetic Engineering: An Introduction to Gene Analysis and Exploitation in Eukaryotes, S. M. Kingsman, Blackwell Scientific Publications, Oxford, 1998

Elective

Paper SEMII- STPG02BCH 06

Fermentation technology

Course Code	Units	Topic/Title	Credit
STPG02BCH 06	Unit-I	**Upstream Processing** Microbial cell growth, kinetics and Stoichiometry, various Methods for growth measurement, Strain improvement by mutation, genetic engineering, etc. Overproductionof metabolites, alternative carbon and nitrogen sources and their composition. Development of innocula for industrial fermentation, design of industrial production media. Alternate metabolic routines for utilization of carbon sources with their regulation and inter-linkage especially for glucose and hydrocarbons, preservation andmaintenance of microbes	04
	Unit-II	**Fermentation** Design of fermenter, construction materials, various sterilization techniques for solid, liquid and gases, aeration and agitation, foam, auxillary equipments. Control of variousparameters – online and offline monitoring, rheological properties of fermenter, role of computer in fementer operation,	
	Unit-III	Batch, fed-batch and continuous fermentation. Effluent treatment, scale up and scale down. Types of fermenters, solid statefermentation, process economics, fermentation economics.	
	Unit-IV	**Downstream Processing** Principle, methodology, instrumentation an applications of cell homogenization techniques liquid-liquid extraction centrifugation, filtration, , distillation, ultrafiltration,precipitation, adsorption chromatography, ion exchange chromatography, gel filtration and affinity chromatography in clarification, concentration, isolation and purification ofvarious metabolites from fermented media.	

Reference Books

1) Moo-Young M. ed. (1985) Comprehensive Biotechnology vol: I & II, PergamonPress N.Y.
2) Ratledge C and Kristiansen B. eds. (2001) Basic Biotechnology 2nd ed.Cambridge Univ Press Cambridge.
3) Old R.W and Primose S.D (1995) Principles of Gene Manipulation 5th ed.Blackwell Scientific Pub. Oxford.
4) Bailey J.E and Ollis D.F. (1986) Biochemical Engineering Fundamentals 2nd ed.McGraw Hill Book Company, N. Delhi.
5) Aiba S, Humphrey A. E. and N. F. Millis (1973) Biochemical Engineering, 2ndEdition University of Tokyo Press, Tokyo, Japan.
6) Stanbury P.F., Whitaker A, and Hall S.J. (1997) Principles of FermentationTechnology 2 nd ed.Aditya Books Pvt. Ltd, N.Delhi.
7) Mukhopadhaya S.N. (2001) Process Biotechnology Fundamentals.Viva BooksPvt. Ltd. N.Delhi.
8) Rehm H.J and Reed G. (1985) Biotechnology vol. I & II. VCH, Basel.
9) Stainer R. Y. Ingrahm J. L., Wheelis M. L. and Painter P. R. (1987) GeneralMicrobiology 5th Edition, Macmillan Press Ltd. London

LABCOURSE

PRACTICALS

PRACTICALS

(STPG02BCH 08) PRACTICAL- II

Based on STPG02BCH 01, STPG02BCH 02 and STPG02BCH 03

1. Separation of DNA by agarose gel electrophoresis
2. Estimation of DNA by Diphenylamine method.
3. Estimation of RNA by Orcinol method.
4. Separation of amino acids by paper chromatography.
5. Separation of serum proteins by paper electrophoresis.
6. SDS-Page of proteins.
7. Induction of beta-galactosidase in strain of *Escherichia coli*
8. Demonstration of blotting technique.
9. The effect of different inducers on the induction of beta-galactosidase
10. Demonstration of isolation of bacterial DNA
11. Isolation of chloroplasts from spinach leaves
12. Demonstration of Ouchterlony immunodiffusion
13. The detection and assay of a myeloma protein
14. The determination of albumin by laurel Rocket immunoelectrophoresis
15. The spectrophotometric assay of the Hill reaction and the estimation of chlorophyll
16. The respiration of mitochondria and oxidative phosphorylation
17. Purification of immunoglobuline by ion exchange chromatography
18. The evaluation of oxygen by isolated chloroplasts using Hill oxidation

(Mandatory to perform 9 practical)