GANDHI INSTITUTE OF TECHNOLOGY AND MANAGEMENT

(GITAM)

(Deemed to be University U/S 3 of UGC Act, 1956)

VISAKHAPATNAM

Accredited by NAAC with 'A' Grade

REGULATIONS & SYLLABUS

Master of Science
in
Biochemistry

Program Code : SPRBC 200803

(w.e.f admitted batch 2014 -15)

Website: www.gitam.edu

REGULATIONS

(w.e.f. admitted batch 2014-15)

1.0 ADMISSIONS

1.1 Admissions into M.Sc. (Biochemistry) programme of GITAM University are governed by GITAM University admission regulations.

2.0 ELIGIBILTY CRITERIA

2.1 A pass in any B.Sc. degree are equivalent with any two of the following subjects: Agriculture, Biochemistry, Bioinformatics, Botany, Biotechnology, B.Pharm, BPT, Chemistry, Environmental Science, Food and Nutrition, Genetics, Home science, Mathematics, Medical Lab Technology, Microbiology, Physics, Veterinary Sciences, Zoology or B.Tech in Biotechnology/Bio-medical Engineering/ Chemical Engineering.

2.2 Admissions into M.Sc. will be based on the following:

(i) Score obtained in GAT (PG), if conducted.

(ii) Performance in Qualifying Examination / Interview.

The actual weightage to be given to the above items will be decided by the authorities before the commencement of the academic year.

3.0 STRUCTURE OF THE M.Sc. PROGRAMME

3.1 The Programme of instruction consists of:

(i) A core programme imparting to the student specialization of the stream concerned.

(ii) Carry out a project approved by the Department and submit a report.

Each academic year consists of two semesters. M Sc programme has a curriculum and Name of the Course content (syllabi) for the Name of the Courses recommended by the Board of Studies concerned and approved by Academic Council.

3.3 Project Dissertation has to be submitted by each student individually.

4.0 CREDIT BASED SYSTEM

4.1 Each Name of the Course is assigned certain number of credits which will depend upon the number of contact hours (lectures & tutorials) per week.

4.2 In general, credits are assigned to the Name of the Courses based on the following contact hours per week per semester.

One credit for each Lecture / Tutorial hour.

One credit for two hours of Practicals.

Two credits for three (or more) hours of Practicals.

4.3 The curriculum of M.Sc. programme is designed to have a total of 80 credits for the award of M Sc degree. A student is deemed to have successfully completed a particular semester's programme of study when he / she earns all the credits of that semester i.e., he / she has no 'F' grade in any Name of the Course of that semester.

5.0 MEDIUM OF INSTRUCTION

The medium of instruction (including examinations and project reports) shall be English.

6.0 REGISTRATION

Every student has to register himself/herself for each semester individually at the time specified by the Institute / University.

7.0 CONTINUOUS ASSESSMENT AND EXAMINATIONS

7.1 The assessment of the student's performance in each Name of the Course will be based on continuous internal evaluation and semester-end examination. The marks for each of the component of assessment are fixed as shown in the Table 1.

Table 1: Assessment Procedure

S.No.	Component of assessment	Marks allotted	Type of Assessment	Scheme of Examination
1	Theory	30	Continuous evaluation	(i) Two mid semester examinations are to be conducted for 10 marks each. (ii) 5 marks are allocated forquiz. (iii) 5 marks are allocated for assignments.
		70	Semester-end examination	The semester-end examination question paper in theory Name of the Courses will be for a maximum of 70 marks.
	Total	100		
2	Practicals	100	Continuous evaluation	(i) One examination for a maximum of 20 marks will be conducted by the teacher handling the lab Name of the Course during mid of the semester (ii) One examination for a maximum of 70 marks will be scheduled at the end of the semester by the Head of the Department concerned. HoD will appoint one examiner from the department not connected with the conduct of regular lab, in addition to the teacher who handled the lab Name of the Course in the semester. (iii) 10 marks are allocated regular performance in the lab.
3	Project work (IV semester)	200	Project evaluation	(i) 150 marks are allocated for evaluation of the project work dissertation submitted by the candidate at the end of the semester. (ii) 50 marks are allocated for the presentation of the project work & viva-voce at the end of the semester
4	Viva -Voce	50	Viva-voce	50 marks are allocated for comprehensive viva to be conducted at the end of the each semester. HoD of the department concerned shall appoint two examiners.

8.0 REAPPEARANCE

8.1 A Student who has secured 'F' Grade in any theory Name of the Course / Practicals of any semester shall have to reappear for the semester end

examination of that Name of the Course / Practicals along with his / her juniors.

8.2 A student who has secured 'F' Grade in Project work shall have to improve his report and reappear for viva – voce Examination of project work at the time of special examination to be conducted in the summer vacation after the last academic year.

9.0 SPECIAL EXAMINATION

9.1 A student who has completed the stipulated period of study for the degree programme concerned and still having failure grade ('F') in not more than 5 Name of the Courses (Theory / Practicals), may be permitted to appear for the special examination, which shall be conducted in the summer vacation at the end of the last academic year.

9.2 A student having 'F' Grade in more than 5 Name of the Courses (Theory/practicals) shall not be permitted to appear for the special examination.

10.0 ATTENDANCE REQUIREMENTS

10.1 A student whose attendance is less than 75% in all the Name of the Courses put together in any semester will not be permitted to attend the end - semester examination and he/she will not be allowed to register for subsequent semester of study. He /She has to repeat the semester along with his / her juniors.

10.2 However, the Vice Chancellor on the recommendation of the Principal / Director of the University college / Institute may condone the shortage of attendance to the students whose attendance is between 66% and 74% on genuine medical grounds and on payment of prescribed fee.

11.0 GRADING SYSTEM

11.1 Based on the student performance during a given semester, a final letter grade will be awarded at the end of the semester in each Name of the Course. The letter grades and the corresponding grade points are as given in Table 2.

Table 2: Grades & Grade Points

Grade	Grade points	Absolute Marks
O	10	90 and above
A+	9	80 – 89
A	8	70 – 79
B+	7	60 – 69
B	6	50 – 59
C	5	40 – 49
F	Failed, 0	Less than 40

11.2 A student who earns a minimum of 5 grade points (C grade) in a Name of the Course is declared to have successfully completed the Name of the Course, and is deemed to have earned the credits assigned to that Name of the Course. However, a minimum of 28 marks is to be secured at the semester end examination of theory Name of the Courses in order to pass in the theory Name of the Course.

12.0 GRADE POINT AVERAGE

12.1 A Grade Point Average (GPA) for the semester will be calculated according to the formula:

$$GPA = \frac{\Sigma [C \times G]}{\Sigma C}$$

Where

C = number of credits for the Name of the Course,

G = grade points obtained by the student in the Name of the Course.

12.2 Semester Grade Point Average (SGPA) is awarded to those candidates who pass in all the Name of the Courses of the semester.

12.3 To arrive at Cumulative Grade Point Average (CGPA), a similar formula is used considering the student's performance in all the Name of the Courses taken in all the semesters completed up to the particular point of time.

12.4 The requirement of CGPA for a student to be declared to have passed on successful completion of the M Sc programme and for the declaration of the class is as shown in Table 3.

Table 3: CGPA required for award of Degree

Distinction	**≥ 8.0***
First Class	**≥ 7.0**
Second Class	**≥ 6.0**
Pass	**≥ 5.0**

* In addition to the required CGPA of 8.0, the student must have necessarily passed all the Name of the Courses of every semester in **first attempt**.

13.0 ELIGIBILITY FOR AWARD OF THE M.Sc. DEGREE

13.1 **Duration of the programme**:

A student is ordinarily expected to complete the M.Sc. programme in four semesters of two years. However a student may complete the programme in not more than four years including study period.

13.2 However the above regulation may be relaxed by the Vice Chancellor in individual cases for cogent and sufficient reasons.

13.3 A student shall be eligible for award of the M.Sc. degree if he / she fulfils all the following conditions.

a) Registered and successfully completed all the Name of the Courses and projects.

b) Successfully acquired the minimum required credits as specified in the curriculum corresponding to the branch of his/her study within the stipulated time.

c) Has no dues to the Institute, hostels, Libraries, NCC / NSS etc, and

d) No disciplinary action is pending against him / her.

13.4 The degree shall be awarded after approval by the Academic Council.

RULES

1. With regard to the conduct of the end-semester examination in any of the practical Name of the Courses of the programme, the Head of the Department concerned shall

appoint one examiner from the department not connected with the conduct of regular laboratory work, in addition to the teacher who handled the laboratory work during the semester.

2. In respect of all theory examinations, the paper setting shall be done by an external paper setter having a minimum of three years of teaching experience. The panel of paper setters for each Name of the Course is to be prepared by the Board of Studies of the department concerned and approved by the Academic Council. The paper setters are to be appointed by the Vice Chancellor on the basis of recommendation of Director of Evaluation / Controller of Examinations.
3. The theory papers of end-semester examination will be evaluated by two examiners. The examiners may be internal or external. The average of the two evaluations shall be considered for the award of grade in that Name of the Course.
4. If the difference of marks awarded by the two examiners of theory Name of the Course exceeds 14 marks, the paper will have to be referred to third examiner for evaluation. The average of the two nearest evaluations of the three shall be considered for the award of the grade in that Name of the Course.
5. Panel of examiners of evaluation for each Name of the Course is to be prepared by the Board of Studies of the department concerned and approved by the Academic Council.
6. The examiner for evaluation should possess post graduate qualification and a minimum of three years teaching experience.
7. The appointment of examiners for evaluation of theory papers will be done by the Vice Chancellor on the basis of recommendation of Director of Evaluation / Controller of Examinations from a panel of examiners approved by the Academic Council
8. Project work shall be evaluated by two examiners at the semester end examination. One examiner shall be internal and the other examiner will be external. The Vice Chancellor can permit appointment of second examiner to be internal when an external examiner is not available.

M.Sc. Biochemistry - Scheme of Instruction

I SEMESTER

Sl. No.	Course Code	Name of the Course	Credits	Scheme of Instruction			Scheme of Examination	
				Hours per week			Sem. End Exam.	Con. Eval.
				L/T	---	D/P		
1	SPRBC 101	Chemistry and Metabolism of Carbohydrates and Lipids	4	4			70	30
2	SPRBC 102	Biochemical Techniques	4	4	--	3	70	30
3	SPRBC 103	Enzymology and Enzyme Technology	4	4	--	3	70	30
4	SPRBC 104	Systems Physiology	4	4	--	3	70	30
PRACTICAL								
	SPRBC 111	Biochemical Techniques and Quantitative Analysis Lab	2	---	12	6	---	100
	SPRBC 112	Enzymology Lab	2	---	12	6	---	100
	SPRBC 113	Viva – voce	1	---	---		---	50
		Total	**21**				**650**	

M.Sc. Biochemistry - II SEMESTER

Sl. No.	Course Code	Name of the Course	Credits	Scheme of Instruction			Scheme of Examination	
				Hours per week			Sem. End Exam.	Con. Eval.
				L/T	---	D/P		
1	SPRBC 201	Chemistry and Metabolism of Proteins, Nucleic Acids and Porphyrins	4	4	---	3	70	30
2	SPRBC 202	Molecular Biology	4	4	---	3	70	30
3	SPRBC 203	Microbial Biochemistry and Genetics	4	4	---	3	70	30
4	SPRBC 204	Cell Biology and Cell Signalling	4	4	---	3	70	30
PRACTICALS								
	SPRBC 211	Microbiology and Genetics Lab	2	---	12	6	---	100
	SPRBC 212	Molecular Biology and Cell Biology Lab	2	---	12	6	---	100
	SPRBC213	Viva – voce	1	---	---	---	50	
		Total	**21**				**650**	

M.Sc. Biochemistry - III SEMESTER

Sl. No.	Course Code	Name of the Course	Credits	Scheme of Instruction			Scheme of Examination	
				Hours per week			Sem. End Exam.	Con. Eval.
				L/T	---	D/P		
1	SPRBC 301	Immunology and Immunotechnology	4	4	---	3	70	30
2	SPRBC 302	Genetic Engineering and Tissue Culture	4	4	---	3	70	30
3	SPRBC 303	Industrial Biochemistry	4	4	---	3	70	30
4	SPRBC 304	Computational Biology and Biostatistics	4	4	---	3	70	30
PRACTICALS								
	SPRBC 311	Immunology and Industrial Biochemistry Lab	2	---	12	6	---	100
	SPRBC 312	Genetic Engineering, Biostatics and Computational Biology Lab	2	---	12	6	---	100
	SPRBC 313	Viva – voce	1	---	---	--	50	
		Total	**21**				**650**	

M.Sc. Biochemistry – IV SEMESTER

Sl. No.	Course Code	Name of the Course	Credits	Scheme of Instruction			Scheme of Examination	
				Hours per week			Sem. End Exam.	Con. Eval.
				L/T	---	D/P		
1	SPRBC 401	Clinical Biochemistry and Stem Cell Biology	4	4	---	3	70	30
2	SPRBC 421 SPRBC 422 SPRBC 423	Cancer Biology Environmental Biochemistry Nutritional Biochemistry	4	4	---	3	70	30
PRACTICALS								
	SPRBC 411	Clinical Biochemistry and Cancer Biology/ Environmental Biochemistry /Nutritional Biochemistry Lab	2	---	12	3	70	30
	SPRBC 412	Viva – voce	1	---	---	--	---	50
	SPRBC 413	Project Work and Seminar	6	---	---	---	200	---
		Total	**17**				**550**	

M.Sc. Biochemistry (I Semester)

SPRBC 101: Chemistry and Metabolism of Carbohydrates and Lipids

UNIT -I

Classification and chemical properties of carbohydrates. Chemistry and biological roles of mono, di and polysaccharides, peptdiogycans, glycosaminoglycans and glycoproteins. Structural elucidation of polysaccharides.

UNIT -II

Glucose transporters. Glycolysis and its regulation. TCA cycle- function and regulation. Glyoxylate cycle, gluconeogenesis and its regulation, HMP shunt and its significance. Uronic acid pathway, glycogen metabolism and its regulation. Metabolism of fructose and galactose. Biogenesis of amino sugars, lactose, peptidoglycans and glycoproteins. Inborn errors of carbohydrate metabolism.

UNIT – III

Classification and physicochemical properties of lipids and fatty acids. Physicochemical properties of fats and oils. Structure, properties and biological roles of phospholipids and sphingolipids. Structure and properties of prostaglandins. Chemistry and properties of sterols and steroids.

UNIT -IV

Oxidation of fatty acids. Formation and utilization of ketone bodies. Biosynthesis of fatty acids and its regulation. Biosynthesis of triglycerides, metabolism of phospholipids and sphingolipids. Biosynthesis of cholesterol and its regulation. Formation of bile acids. Metabolism of arachidonic acid-formation of prostaglandins, thrombaoxanes and leukotrienes. Inborn errors of lipid metabolism.

UNIT -V

Principles of bioenergetics: Free energy, enthalpy and entropy. Redox potential. Oxidation and reduction enzymes. Phosphate group transfer potential of ATP and high energy compounds. Mitochondrial electron transport system-organization of components, inhibitors of ETC. Oxidative phosphorylation - mechanism and theories of oxidative phosphorylation and uncouplers of oxidative phosphorylation. Microsomal electron transport system.

Textbooks:

1. Text book of Biochemistry by West & Todd, 4th ed. Oxford and IBH
2. Principles of Biochemistry by Nelson Cox, 4th ed. Freeman
3. Biochemistry by Voet & Voet, 3rd ed. John Wiley and Sons
4. Biochemistry by David Rawn, 1st ed. Panima
5. Biochemistry by Matthews, Holde, Ahern, Pearson Edn, 3rd

M.Sc. Biochemistry (I Semester)

SPRBC 102: Biochemical Techniques

UNIT -I

Microscopy: Basic principles and applications – phase contrast, fluorescent, electron (SEM, TEM), confocal and atomic force microscopy. Principle of flow cytometry. Homogenization - Methods of disrupting cells and tissues. Centrifugation - Basic principles of sedimentation. Principle and applications of analytical and preparative ultracentrifugation.

UNIT –II

Chromatography: Principle and application of thin layer, ion exchange, gel permeation and affinity chromatography. GLC, HPLC and chromatofocussing.

UNIT –III

Electrophoresis: Principle and applications of polyacrylamide and agarose gel electrophoresis, SDS-PAGE, capillary electrophoresis, PFGE, isolelectric focusing, 2-D electrophoresis and DIGE.

UNIT -IV

Spectroscopy: Principle, instrumentation and applications of UV-Visible, IR, NMR, atomic absorption, Surface Plasmin Resonance (SPR), Isothermal titration calorimetry. Mass spectroscopy - GC-MS, LC-MS and MALDI-TOF. Spectroflourimetry. Circular Dichroism and X-ray diffraction.

UNIT -V

Radioactive tracer techniques: Nature and units of radioactivity, detection and measurement of radioactivity – GM and Scintillation counters. Autoradiography, radioactive labelling, Applications of radioisotopes in biology. Radiation hazards and safety methods. Disposal of radioactive isotopes.

Text books:

1. Practical Biochemistry by Keith Wilson and Walker 5th ed. Cambridge.
2. Physical Chemistry by R.Chang, 2nd ed. ALGC
3. Biophysical Chemistry by Upadhyay 2nd ed. Himalaya.
4. Biophysics by Madhu Arora and GR Chatwal. 1st ed. Himalaya .
5. Instrumental methods of chemical analysis by Chatwal and Anand

M.Sc. Biochemistry (I Semester)

SPRBC 103: Enzymology and Enzyme Technology

UNIT - I

Nature and remarkable properties of enzymes, classification and nomenclature of enzymes, Factors affecting enzyme activity. Active site - Common features and chemical modifications of active site groups. Nature of catalysis- acid-base, covalent and metal ion catalysis. Mechanism of action of chymotrypsin and lysozyme. Determination of enzyme mechanism by site directed mutagenesis. Ribozyme.

UNIT - II

Enzyme kinetics: Concept of ES complex, derivation of Michaelis – Menten equation for uni-substrate reaction. Determination of Km and V max and their significance. Importance of Kcat/Km. Classification of multi-substrate reactions with examples. Kinetic expression for non-sequential (Ping-pong) and sequential (ordered and random) mechanisms. King and Altman equation for multisubstrate kinetics.

UNIT – III

Enzyme inhibition: Reversible – Competitive, non-competitive and un-competitive mode of enzyme inhibition. Irreversible – adduct formation, transition state analogs and substrate analogs (suicide inhibition). Product and substrate inhibition. Feedback inhibition, Determination of Ki by Dixon plot.

UNIT – IV

Enzyme regulation: Covalent modification - glutamine synthetase, glycogen phosphorylase and digestive proteases. Allosteric enzymes, Cooperativity with special reference to ATCase and PFK. Model of allosteric enzymes. Hill and Scatchard plots. Significance of sigmoidal behaviour. Isoenzymes. Multienzyme complex - Mechanism of action and regulation of PDH.

UNIT – V

Immobilized enzymes: Properties, physical and chemical methods of immobilization, Factors affecting kinetics of immobilized enzymes, Applications in industry and medicine. Synzymes, catalytic antibodies and their applications.

Text books:

1. Fundamental of enzymology by Nicoles C. Price and Lewis Stevens, Oxford Uni. Press.
2. Understanding Enzymes by Trevor Palmer, Harvard publishing
3. Biochemistry by Voet & Voet, 3rd ed. John Wiley and Sons
4. Biochemistry by Stryer 4th ed. WH Freeman and CO.
5. Biochemistry by Lehninger, Kalyani Publishers.

M.Sc. Biochemistry (I Semester)

SPRBC 104: Systems Physiology

UNIT-I

Haemopoiesis, Composition of blood, properties and functions of plasma proteins, Coagulation of blood and fibrinolysis. Mechanism of respiration – Hemoglobin, transport and exchange of gases, role of 2, 3-Bisphosphoglycerate, Bohr's effect and chloride shift. Regulation of respiration.

UNIT-II

Structure of nephron, physiology of kidney- urine formation, concentration, excretion. Homeostasis - regulation of electrolytes, water and acid-base balance in the body. Physiology of heart, cardiac cycle, cardiovascular regulatory mechanisms. Reproductive processes-gametogenesis, ovulation, neuroendocrine regulation.

UNIT-III

Structure of neuron and synapse. Origin of membrane potential, propagation of nerve impulse in unmyelinated and myelinated nerve fibres, Synaptic transmission of adrenergic and cholinergic nerve endings. Neurotransmitters. Biochemistry of vision. Types of muscles, structure and organization of muscle cell. Molecular organization of contractile systems. Molecular mechanisms and Biochemical changes associated with muscle contraction and relaxation.

UNIT – IV

Endocrine glands. Functions and abnormalities of Pituitary hormones, Chemistry, biochemical functions and abnormalities of thyroid, parathyroid, adrenal and gonadal hormones. Biochemical functions of gastrointestinal, pancreatic and renal hormones. General mechanism of hormone action.

UNIT – V

Mechanism of photophosphorylation. Biochemistry of RuBISCO. Mechanism of CO_2 fixation in C3, C4 and CAM plants. Photorespiration. Phytochromes - Structure and role in developmental response and seed germination. Structure and mechanism of action of auxins in cell extension, gibberellins, abscisic acid and cytokinin in seed germination and dormancy. Mechanism of nitrogen fixation, NIF genes and their regulation. Role of phenolics, alkaloids, terpenes, lectins and antioxidant enzyme systems in plant defense mechanisms. Molecular mechanism of biotic and abiotic stress factors –pathogens, insects, heat shock, drought and salinity.

Text books:

1. Textbook of human Physiology by Guyton, 11th ed.Elesvier.
2. Essentials of Medical Physiology by K. Sembulingam, Prema Sembulingam, 2nd ed. Jaypee
3. Textbook of Biochemistry & Human Biology by G.P.Talwar 3rd ed. PHI
4. Textbook of Medical Biochemistry by M.N.Chatterjee, 6th ed. Jaypee
5. Molecular Endocrinology by Bolander. 3rd ed. Elsevier

M.Sc. Biochemistry (I Semester)

SPRBC 111: Biochemical Techniques and Quantitative Analysis Lab

Biochemical Techniques

1. Calibration of pH meter using standard buffers.
2. Separation of amino acids/sugars by Paper chromatography.
3. Separation of amino acids/lipids by Thin layer chromatography.
4. Separation of plant pigments by silica gel column chromatography and identification by absorption spectra.
5. Fractionation of proteins by Ammonium sulphate precipitation.
6. Separation of protein based on specificity - Affinity Chromatography
7. Separation of protein based on charge - Ion-Exchange chromatography
8. Separation of blue dextran and cytochrome-c by Gel permeation chromatography
9. Determination of molecular weight of protein by SDS-PAGE
10. Analysis of flavonoids/alkaloids using HPLC

Quantitative analysis

11. Estimation of protein and DNA by Spectrophotometric method
12. Estimation of protein by Lowry method
13. Estimation of protein by Bradford method
14. Estimation of Fibrinogen in plasma
15. Estimation of total proteins, albumins and globulins
16. Determination of molar absorption coefficient of tyrosine/ tryptophan and adenine/cytosine

Reference Books:

1. Biochemical methods by Sadasivam and Manikam (Wiley Eastern Limited).
2. An introduction to practical Biochemistry by D.T.Plummer (Mc Graw Hill).
3. Laboratory manual in Biochemistry by J.Jayaraman (Wiley Eastern Limited).
4. Introductory Practical Biochemistry by S.K.Sawhney & Randhir Singh (Narosa).

M.Sc. Biochemistry (I Semester)

SPRBC112: Enzymology Lab

1. Assay of acid phosphatase in crude potato extract
2. Effect of time course on phosphatase activity
3. Effect of pH on phosphatase activity
4. Effect of temperature on phosphatase activity
5. Effect of substrate concentration on phosphatase activity and determination of Michaelis – Menton constant
6. Determination of Ki of acid phosphatase
7. Determination of trypsin activity
8. Effect of time course on trypsin activity
9. Effect of irreversible inhibitor (PMSF) on trypsin activity.
10. Effect of PCMB on papain activity.
11. Assay of Succinate dehydrogenase
12. Effect of competitive inhibitor (malonate) on Succinate dehydrogenase activity
13. Assay of RNase/DNase
14. Assay of catalase by spectrophotometric method
15. Assay of urease from Jack bean/ horse gram
16. Immobilization of amylase by sodium alginate
17. Protease activity by Zymography

Reference books:

1. Experimental Biochemistry: A student companion by Beedu Sashidhar Rao and Vijay Deshpande, I.K. International Pvt. Ltd., New Delhi.
2. Laboratory Manunal in Biochemistry by Jayaraman, New Age International Publishers, New Delhi.
3. Introductory practical biochemistry by SK Sawhney & Randhir singh. Narosa publications.
4. Biochemical methods by S Sadasivan & A Manickam. New Age international publishers

M.Sc. Biochemistry (II Semester)

SPRBC 201: Chemistry and Metabolism of Proteins, Nucleic Acids and Porphyrins

UNIT -I

Amino acids- classification, structure and physicochemical properties. Naturally occurring peptides. Solid phase peptide synthesis. Proteins – classification, purification and criteria of homogeneity. Structural organization, sequence determination and characterization of proteins. Conformation of protein structure – Ramachandran plot. Denaturation of proteins.

UNIT -II

General metabolic reactions of amino acids. Metabolic breakdown of individual amino acids. Ketogenic and glycogenic amino acids. Formation of creatine, ammonia and urea. Regulation of urea cycle. Biosynthesis and regulation of branched chain amino acids, aromatic amino acids, Histidine and methionine. Inborn errors of protein metabolism. Protein turnover- role of ubiquitin.

UNIT -III

Nucleic acids – bases, nucleosides, nucleotides. Physicochemical properties of nucleic acids. Cleavage of nucleic acid by enzymatic methods. Methylation of DNA. Chemical synthesis and sequencing of DNA. Structure of DNA, Different forms of DNA. Circular DNA and DNA supercoiling. Types and structures of RNA. Nucleotides as regulatory molecules, enzyme cofactors and mediators of chemical energy in cells.

UNIT -IV

Biosynthesis and degradation of purines and pyrimidines and their regulation. Structure, mechanism of action and regulation of ribonucleotide reductase. Formation of ribonucleotides, deoxyribonucleotides. Inhibitors of nucleotide biosynthesis. Inborn errors of nucleic acid metabolism.

UNIT -V

Porphyrins – structure and properties of porphyrins – heme, cytochromes and chlorophyll. Biosynthesis and degradation of heme. Chemistry, physiological role and dificiency disorders of fat soluble (A, D, E and K) and water soluble (C and B complex) vitamins.

Text books:

1. Principles of Biochemistry by Nelson and Cox 4th ed. Pearson
2. Biochemistry by Voet & voet 3rd ed. John Wiley and sons
3. Biochemistry by Matthews 3rd ed. PSN
4. Biochemistry by Lehninger 2nd ed. Kalyani Publishers
5. Biochemistry by Stryer 4th ed. WH Freeman and CO.

M.Sc. Biochemistry (II Semester)

SPRBC 202: Molecular Biology

UNIT-I

DNA Replication: DNA polymerases of Prokaryotes. Enzymes involved in DNA replication. Mechanism of replication in prokaryotes. Eukaryotic DNA polymerases. Mechanism of replication in eukaryotes.

UNIT-II

DNA Repair mechanisms - Direct repair, excision repair, mismatch repair, recombinational repair and SOS repair. Molecular mechanism of homologous and site specific recombination. Transposition of DNA.

UNIT – III

Transcription: Prokaryotic RNA polymerase. Nature of prokaryotic promoters. Mechanism of prokaryotic transcription- Initiation, elongation and termination. Eukaryotic RNA polymerases. nature of eukaryotic promoters, Mechanism of eukaryotic transcription. Inhibitors of transcription. Post transcriptional processing-Capping and Polyadenylation. Intron removal and exon splicing. Processing of r- RNA, Self-splicing of group-I and group-II introns, Processing of tRNA. RNA editing.

UNIT - IV

Translation: General features of genetic code and elucidation of genetic code. Structural components of prokaryotic and eukaryotic ribosomes. Mechanism of protein synthesis in prokaryotes and eukaryotes - aminoacylation of t-RNA, initiation, elongation and termination. Translational control in eukaryotes. Protein synthesis inhibitors. Protein processing and targeting.

UNIT - V

Prokaryotic gene regulation: Structure and function of Lac and Trp operons. Lytic and lysogenic phases of Bacteriophage λ life cycle. Sporulation in *Bacillus subtilis*.

Eukaryotic gene regulation: Interaction of eukaryotic transcriptional factors with DNA - helix-turn-helix motif, zinc finger motif, leucine zipper, helix-loop-helix motif. Steroid hormone induced gene expression. Role of chromatin in eukaryotic gene regulation.

Text books:

1. Molecular Biology of the gene by Watson, 5th ed. Pearson
2. Molecular Biology of the cell by Alberts 4th ed. Garland science.
3. Biochemistry by Matthews 3rd ed. Pearson
4. Biochemistry by Voet & voet 3rd ed. John Wiley and sons
5. Molecular cell Biology by Lodish, 6th ed. Freeman
6. Principles of Biochemistry by Nelson cox. 4th ed. PALG
7. Biochemistry by L.Stryer 5th ed. Freeman
8. Molecular Biology by Robert F.Weaver, Mc Graw Hill

M.Sc. Biochemistry (II Semester)

SPRBC 203: Microbial Biochemistry and Genetics

UNIT –I

Major characteristics used in microbial taxonomy- physiological, metabolic, ecological, genetic and molecular characterization. Classification and structure of bacteria. Nutritional requirements for bacteria. Isolation and cultivation of bacteria. Bacterial growth curve. Staining techniques. Structure, classification and multiplication of viruses. Methods of assay and cultivation of virus. Inactivation of viruses by antiviral agents.

UNIT-II

Microbial interactions - mutualism, protocooperation, commensalism, predation, parasitism, competition and symbiosis. Economic and industrial importance of Algae. Microbes and biodeterioration- microbes in waste treatment. Microbiome

UNIT-III

Human diseases caused by bacteria: Pneumonia, Tuberculosis, Anthrax, Leprosy, Syphilis, tetanus, Cholera, Lyme, Plaque, Botulism. Human diseases caused by fungi and protozoa: Candidiasis, Amoebiasis, Malaria, Leishmaniasis. Human diseases caused by viruses: Polio, HIV, Hepatitis, Rabies.

UNIT-IV

Mendelian laws of inheritance. Concept of alleles and test for allelism. Non-mendelian inheritance: Pleiotropy, genomic imprinting, penetrance & expressivity. Linkage and crossing over, linkage maps, tetrad analysis, recombination. Transposition. Mapping with molecular markers, somatic cell hybrids and development of mapping population in plants.

UNIT-V

Microbial genetics: Methods of genetic transfer- transformation, conjugation, transduction, sex-duction. Mapping genes by interrupted mating, fine structure of rII locus- Benzers experiments, complementation testing. Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.

Quantitative genetics: Polygenic inheritance, heritability & its measurements, QTL mapping

Mutations - Types and molecular mechanisms of mutations, mutagens and their mechanism of action

Text books:

1. Brock's biology of Microorganisms by Michael T Madigan, 9th ed. Prentice
2. Microbiology by Prescott 7th ed. Tata McGraw -Hill
3. Textbook of Microbiology by Ananthnarayan.7th ed. ORIE
4. Microbiology by Pelczar 5th ed. Tata McGraw-Hill
5. Lange book of Microbiology

M.Sc. Biochemistry (II Semester)

SPRBC 204: Cell Biology and Cell Signaling

UNIT –I

Ultrastructure of typical cell, Organelles of plant and animal cells. Structure and functions of mitochondria, ER, Golgi, Lysosome, chloroplasts and peroxisomes. Internal organization of nucleus. Nature and organization of chromatin.

UNIT –II

Cellular membranes - over view of membrane functions, Models of plasma membrane. Chemical composition of membrane-Lipids, proteins and carbohydrates. Membrane fluidity, Dynamic nature of plasma membrane. Membrane channels and pumps. Transport mechanisms.

UNIT –III

Extracellular matrix of cells – Proteoglycans, Collagens, Vitronectin, Fibronectin and Laminin. Cell-cell and cell-matrix interactions, Intracellular communication-tight junctions, gap junctions and plasmodesmeta. Host parasite interaction - Recognition, entry and alteration of host cells by different pathogens like bacteria, viruses. Cytoskeleton-structure and major functions of microtubules, intermediary filaments and microfilaments.

UNIT –V

Signaling pathways – Basic elements of signaling system, G-protein coupled receptors and their second messengers. Protein – tyrosine phosphorylation as mechanism for signal transduction. Role of calcium and NO as intracellular messengers. c-fos as third messenger. Lipid based signal transduction – IP3 and DAG. Heat shock proteins as signal transducers. Role of Protein kinases and MAP kinases in signaling. Convergence, divergence and crosstalk among signaling pathways.

UNIT –V

Biochemistry of cancer cell – Mitosis, Meiosis, cell cycle and its regulation. Mechanism of chemical and radiation induced carcinogenesis. Tumor initiation, promotion and progression. Oncogenes (c-Myc) and tumor suppressor genes (p53). Epithelial and mesenchymal transition, biochemical characteristics of metastasis. Biochemical mechanisms of apoptosis and Angiogenesis.

Text books:

1. Molecular Biology of the cell by Alberts 4th ed. Garland science.
2. The cell – A molecular approach by Cooper. 4th ed. ASM
3. Molecular cell biology by Lodish, 6th ed. Freeman
4. Introduction to genetic analysis by Griffiths et al, 9th ed. W.H.
5. Principles of Genetics by Tamarin, 7th ed. TMH.

M.Sc. Biochemistry (II Semester)

SPRBC211: Microbiology and Genetics Lab

Microbiology

1. Isolation of bacteria from soil/ foods/marine sources/sewage/ body sources by streak and pour plate methods.
2. Isolation of Rhizobium from root nodules
3. Isolation of fungi from soil/ foods/marine sources/sewage/ body sources by spread plate methods.
4. Cultural characterization of bacterial isolates.
5. Morphological characterization of bacterial isolates by simple staining, Gram's staining, acid – fast staining, capsule staining and spore staining.
6. Motility of bacterial isolates by hanging drop technique.
7. Biochemical characterization of bacterial isolates – Sugar fermentation, IMViC and catalase enzymatic test.
8. Bacterial growth curve studies.
9. Screening of plant extracts for antimicrobial activity using disc diffusion and well diffusion methods.
10. Determination of minimum inhibition concentration of plant extracts using dilution technique.
11. Analysis of domestic and industrial effluents – MPN, BOD, COD and DO.
12. Determination of microbiological quality of milk- MBRT / Resazurin.
13. Isolation of ethyl methane sulphate (EMS) mutants by gradient plate method

Genetics

14. Problems on monohybrid cross
15. Problems on dihybrid cross
16. Problems on sex-linked inheritance

Reference books:

1. Miocrobiology: A laboratory manual by Cappuccino and Sherman, Pearson Education, 6th Ed.
2. Laboratory experiments in Microbiology by M.Gopal Reddy, M.N. Reddy, D.V.R.Saigopal and K.V.Mallaiah. Himalaya publishing house
3. Miocrobiology: A laboratory manual by S.M.Reddy and S.Ram Reddy 3rd Ed .Sri padmavathi publications

M.Sc. Biochemistry (II Semester)

SPRBC 212: Molecular Biology and Cell Biology Lab

Molecular Biology

1. Isolation of DNA from plant tissue/animal cells and determination of its purity
2. Isolation of plasmid DNA from bacteria and determination of its purity
3. Estimation of DNA by UV and Diphenylamine
4. Determination of Tm of DNA & estimation of G+C content
5. DNA electrophoresis in agarose gel
6. Estimation of RNA by UV and Orcinol
7. RNA electrophoresis in formaldehyde-agarose gel
8. Effect of UV radiation on the survival of *E.coli*
9. Study of repair mechanism by photoreactivation in *E.coli* after UV irradiation

Cell Biology

10. Identification of nuclei by DAPI staining
11. Identification of different phases of cell cycle using flow cytometer
12. Identification of different stages of mitosis in onion root tip
13. Identification of different stages of meiosis in onion flower bud

Reference books:

1. Lab manual in Biochemistry by J. Jayaraman, Wiley Eastern Limited
2. Biochemistry – a lab course by J.M. Becker, Academic Press
3. Experimental Biochemistry: A student companion by Beedu Sashidhar Rao and Vijay Deshpande, I.K. International Pvt. Ltd., New Delhi.
4. Biochemical methods by S Sadasivan & A Manickam. New Age international publishers

M.Sc. Biochemistry (III Semester)

SPRBC 301: Immunology and Immunotechnology

UNIT-I

Types of immunity – Innate and Adaptive immunity. Structure and functions of organs and cells of immune system- Thymus, Bone marrow, spleen and lymph nodes, T cells, B cells and their receptors. B and T cell ontogeny. Antigens-types of antigens, Haptens and specificity of immune response. Superantigens. Adjuvants.

UNIT-II

Antigen presenting cells, Processing and presentation of antigens, Clonal selection of lymphocytes. Humoral and cell-mediated responses. Cytokines, Interleukins and Interferons – their role in immune response. Major Histocompatibility Complex- H-2, HLA, MHC restriction and its role in immune response. MHC polymorphism

UNIT-III

Immunoglobulin classes and biological activities. Structure of immunoglobulins. Isotypes, Allotypes and Idiotypes. Immunoglobulin genes and antibody diversity.
Complement components and biological consequences of Complement activation. Antigen-Antibody interactions- Precipitation reactions- Immunodiffusion, Radial Immunodiffusion, double immunodiffusion. Agglutination reactions- Hemagglutination and Complement fixation. Immunoelectrophoresis, Rocket Immunoelectrophoresis, Immunoflourescence, FACS, RIA, ELISA, Immunoblotting.

UNIT-IV

Hypersensitivity: Immediate and delayed hypersensitivity reactions. Immuodeficiencies-SCID and AIDS. Autoimmunity and breakdown of self-tolerance. Organ-specific and systemic autoimmune diseases. Immunological tolerance and immunosuppression. Tumour immunology- Tumour antigens, Immunological surveillance of cancer. Transplantation immunology.

UNIT-V

Hybridoma technology: Monoclonal antibodies and their applications. Vaccines-Vaccine production, Conventional and new generation vaccine technology, DNA vaccines, Recombinant vaccines. Development of diagnostic kits for AIDS and Malaria.

Text books:

1. Immunology by Janis Kuby. 5th ed. Freeman & Co.
2. Essential Immunology by Ivan Roitt, 9th ed., Blackwell Science
3. Introduction to Immunology by Tizard, 2nd ed.,Harcourt Publishers Ltd
4. Immunology: Essential & Fundamental by Pathak. 2nd ed., N.H.: Science Publishers
5. Introduction to Immunology by Fahim Khan, Pearson

M.Sc. Biochemistry (III Semester)

SPRBC 302: Genetic Engineering and Tissue Culture

UNIT – I

Outlines of recombinant DNA technology. Restriction endonucleases, RFLP, restriction maps. Mapping genes – chromosomal walking, chromosomal jumping. Isolation of gene fragments using restriction endonucleases, cDNA, PCR, RACE PCR. Chemical synthesis of genes. Ligation of fragments.

UNIT – II

Cloning vectors – plasmids, bacteriophages, cosmids, Ti-plasmid. Expression vectors, Construction of gene libraries – cDNA library, genomic library, YAC, BAC library. Cloning strategies – shot gun experiments, cDNA cloning in bacteria. Screening of libraries

UNIT – III

Gene transfer techniques: Biological delivery systems- Agrobacterium tumefaciens, SV40, Retroviral systems, Artificial delivery systems- Gene gun, Microinjuction, Lipofection, Electroporation, Ca-DNA coprecipitation. Identification of recombinants. Expression of cloned genes in bacteria, plant and animal cells. Blot analysis southern, northern and western blot, dot and slot blot.

UNIT – IV

Principles of tissue culture. General composition of plant and animal tissue culture media. Regeneration pathways of plant tissue culture. Use of plant tissue culture in the production of transgenics – golden rice, human proteins.

UNIT – V

Types of animal cell and organ cultures. Production of medically important biomolecules – insulin, growth hormones, blood clotting factor, interferons. High level expression of proteins in different host systems (E.coli, yeast, insect, mammalian cells).

Text books:

1. Human Molecular Genetics 3rd ed by Tom Strachan and Andrew Read. Taylor & Francis Publisher.
2. Molecular Biology of the cell by Alberts 4th ed. Garland science.
3. Principles of gene manipulation & genomics by Primrose & Twyman 7th ed. Oxford
4. Molecular cell biology by Lodish 6th ed. Freeman
5. Molecular Biotechnology-Principles and applications of Recombinant DNA by Glick 2nd ed. AMER
6. Genome by T.A. Brown

M.Sc. Biochemistry (III Semester)

SPRBC 303: Industrial Biochemistry

UNIT – I

Fermentation technology- surface, submerged and continuous culture techniques. Design and operation of fermentors, Agitation and Aeration, selection and growth of microorganisms in controlled environments, medium development. Downstream processing, Strategies for improvement and maintenance of the industrial strains, Bioreactors.

UNIT – II

Production of fermented milks, cheese, alcoholic beverages, breads by yeast. Fermentation production of Antibiotics- pencillin, streptomycin, Organic acid-citric acid, lactic acid, Enzymes –amylase, proteases, Amino acid-glutamic acid, lysine and Vitamins-B12 and vitamin C.

UNIT – III

Microbial transformation – types, techniques and commercial applications. Bioleaching and biosorption, Biodegradation and Bioremediation, Biomass and Bioenergy, Biopolymers and Biosurfactants. Enzyme electrodes and biosensors. Sewage water treatment – primary, secondary and tertiary treatments.

Bio-control agents- Insecticidal toxins of *Bacillus thuringiensis*.

UNIT – IV

Bioethicals and Biosafety, biosafety guideline and regulations, animals in research, Legal and socio-economic impacts of Biotechnology, Ethical, legal and social implications (ELSI) of HGP. Bioethics in biodiversity. Ethics in clinical trials. Intellectual property rights and protections for biological inventions. Patent and process involved in patenting.

UNIT – V

Nanobiotechnology: Types of nanoparticles, DNA based nanostructures, nanosized carriers for drug delivery. Role of nanoparticles in drug delivery. Nanobiotechnology in gene therapy, tissue engineering, transplantation and oragan replacement.

Text books:

1. Industrial Microbiology by Prescott, 4th ed. CBS Publishers.
2. Biotechnology by Crueger, PANI Publishhers.
3. Principles of Fermentation Technology by Stanbury
4. Industrial Microbiology by A.H.Patel

M.Sc. Biochemistry (III Semester)

SPRBC 304: Computational Biology and Biostatistics

UNIT- I

Basics of computers: Hardware and software; Anatomy of computers, Operating systems- Windows, Unix and Linux; Internet concepts

UNIT- II

Databases and Sequence analysis: Sequence databases (Genbank, EMBL, DDBJ, SwissProt); Structural databases (PDB, SCOP, CATH); Database search (BLAST and FASTA); Pair wise sequence alignment- global and local. Immunoepitope database (IEDB) and immunopolymorphism database (IPD)

UNIT -III

Phylogeny and Genomics: Multiple sequence alignment; Molecular phylogeny- Introduction, Tree construction methods and evaluation; Fragment and map assembly, Structural and comparative genomics.

UNIT-IV

Proteomics and Drug Design: Basic laboratory methods for proteomics; Protein structure prediction (Primary, Secondary and tertiary); Outline of Drug Designing and Molecular Docking.

UNIT -V

Biostatistics: Applications and significance of statistical methods in biology, Measures of central tendency (Mean, Median and Mode); Measures of dispersion (Range, Variance, SD and SE); Probability theory and Bayes theorem; Distribution: Binomial, Poisson and normal; t-distribution, Chi-square distribution, ANOVA; Correlation coefficient and regression analysis.

Text books:

1. Introductory Biostatistics for the Health Sciences by Michael R. Chernick and Robert H. Friis., A. John Wiley & Sons Publication.
2. Introduction to Bioinformatics by Arthur M Lesk., Oxford University Press
3. Bioinformatics by Jin XIONG
4. Bioinformatics – Sequence & Genome Analysis by David Mount., CSHL Press

M.Sc. Biochemistry (III Semester)

SPRBC311: Immunology and Industrial Biochemistry Lab

Immunology

1. Determination of human ABO and Rh blood groups
2. Determination of nature of antigen using Ouchterlony double immunodiffusion assay
3. Quantification of Antigens by Radial Immunodiffusion
4. Partial purification of human Immunoglobulin by Ammonium sulphate precipitation
5. Detection of antibodies in serum against *Salmonella* antigen by Widal test
6. Detection of antibodies in serum against *Treponema* antigen by VDRL test
7. Detection of human chorionic gonadotropin in urine for Pregnancy
8. Techniques of Immunization and bleeding in inbred mice
9. Production of polyclonal response against BSA
10. Immunoprecipitation and Precipitin curve
11. Separation of antibody in serum by immunoelectrophoresis
12. Quantification of antigen by Rocket immunoelectrophoresis
13. Determination of antibody concentration by ELISA
14. Detection of protein by Western blotting

Industrial Biochemistry

15. Fermentative production and quantification of citric acid
16. Fermentative production and quantification of amylase / protease
17. Fermentative production and quantification of glutamic acid
18. Fermentative production and quantification of Ethyl alcohol / fruit wine and calculation of fermentation efficiency

Reference books:

1. A manual of Industrial Microbiology and Biotechnology by Demain A.L.
2. Immobilization of enzymes and cells: Methods in Biotechnology vol. I by Bickerstaff G.F.
3. Principle of fermentation technology by Stanbury.

M.Sc. Biochemistry (III Semester)

SPRBC312: Genetic Engineering, Biostatistics and Computational Biology Lab

Genetic engineering

1. Isolation of DNA and construction of restriction map using restriction enzymes
2. Ligation of restricted DNA fragments
3. DNA finger printing using RFLP and RAPD techniques
4. Amplification of DNA using specific and random primers by PCR
5. Quantification of cDNA using real time PCR
6. Preparation of competent *E.coli* cells, transformation and expression of cloned gene
7. *Agrobacterium* – mediated gene transfer into plants
8. Expression of transferred gene in bacteria (LacZ) and plants (GUS)
9. Dot / Southern Blot for identification of abiotic stress tolerant gene
10. Inoculation of cotyledon / leaf and root (carrot) explants for callus induction and regeneration on MS medium

Biostatistics and Computation biology

11. Finding out mean, median, mode, range, variance, standard deviation and standard error of the given data.
12. Find out the probability of the given data.
13. Perform Student‘t’ test for given data.
14. Perform Chi square test for the given data.
15. Calculate correlation coefficient and regression lines of the given data.
16. Working with biophysical parameters of the protein sequence data.
17. Structural and functional gene annotation for given sequence.
18. Construct a phylogenetic tree from a set of sequence data using multiple alignment and various tree construction methods.
19. Predict the protein structure of the given sequence.

Reference books:

1. Biostatistics by Daniel, Wiley
2. Biostatistics by S.C.Gupta
3. Bioinformatics A Practical Guide to the Analysis of Genes and Proteins – Andreas D. Baxevanis

M.Sc. Biochemistry (IV Semester)

SPRBC 401: Clinical Biochemistry and Stem Cell Biology

UNIT – I

Disorders of gastric function, methods of evaluation. Pancreatic exocrine disorders-common pancreatic diseases, steatorrhea, malabsorption syndromes. Pancreatic endocrine disorders-Diabetis mellitus, hypoglycemea, GTT.

UNIT –II

Clinical interrelations of plasma lipids, lipoproteins & apolipoproteins and their abnormalities. Role of ROS in atherosclerosis. Diagnostic enzymology - cardiac & skeletal muscle enzymes. Disorders of erythrocyte metabolism - hemoglobinopathies, thalassemias and anemias. Plasma protein abnormalities, CSF- in health and disease.

UNIT – III

Liver function tests, liver diseases - Jaundice, Hepatitis, Cirrhosis, Gallstones, Fatty liver, Detoxification mechanism. Kidney function tests, Renal disorders.

UNIT –IV

Prenatal diagnosis of inborn errors of metabolism, amniotic fluid (Acetyl choline esterase) and fetal blood examination. Diagnosis of genetic diseases by molecular biology techniques (DNA probes, RFLP, PCR) - cystic fibrosis, hemachromatosis, thalassemias, sickle cell diseases.

UNIT – V

Stem cell Biology: characteristic features of stem cells. Types of stem cells. Identification and culture of embryonic and adult stem cells. Isolation of embryonic stem cells from cord blood and their preservation. Role of stem cells in diabetes, parkinson's disease, cancer.

Text books:

1. Biochemical aspects of human disease- RS Elkeles and AS.Tavil, Blackwell Scientific publications.
2. Textbook of Medical Biochemistry by M.N.Chatterjee, 6th ed. Jaypee
3. Clinical Biochemistry in diagnosis and treatment – Joan F.Zilva and P.R.Pannall, Lloyd – luke medical books limited.
4. Textbook of Biochemistry with clinical corelationships by Devlin, 6th ed. JOHN.
5. Textbook of Biochemistry by S. Nagini, Scitech pub
6. Clinical Biochemistry – S.Ramakrishna and Rajiswami.

M.Sc. Biochemistry (IV Semester)

SPRBC 421: Cancer Biology

UNIT – 1

Fundamentals of cancer: Overview of cancer, etiology of cancer, types of cancer, hall marks of cancer, Oncogenes and tumor suppressor, genomic instability-types and factors affecting genomic instability, models of cancer study-gene knockouts, transgenesis and regulatable systems.

UNIT – II

Cancer Metastasis: Sign and symptoms of metastasis, classical and alternative theories of metastasis, metastasis and primary cancer, routes of metastasis, molecular mechanism of metastasis, signaling pathways of metastasis. Epithelial and mesenchymal transition.

UNIT – III

Angiogenesis: General principles of vessel growth, Angiogenic switch, molecular mechanism of angiogenesis, factors involved in tumor angiogenesis and mechanism of action of angiogenic inhibitors, angiogenesis as therapeutic target.

UNIT – IV

Programmed cell death: Concept, morphological features of apoptosis, apoptosis and necrosis, molecular mechanism of apoptosis, regulation of apoptosis-Bcl2 family and signaling pathways that regulate apoptosis, malfunctioning of apoptosis, significance of apoptosis.

UNIT – V

Innate and adaptive antitumor immunity, cancer immunosurveillance. Effector cells in tumor immunity – dendritic cells, T-cells and NK-cels. Tumor antigens. Cancer diagnosis and therapy: Grade and stages of cancer, diagnosis of cancer, cancer prevention, chemotherapy, radiotherapy, gene therapy, immunotherapy and surgery.

Text books:

1. An Introduction to Cellular and Molecular Biology of Cancer, Oxford Medical publications, 1991.
2. The Biology of Cancer, 2nd Ed, Janice Gabriel, John Wiley & Sons Ltd.
3. Cancer Biology, Raymond W. Ruddon, 4th Ed, Oxford University Press, Inc.,
4. Introduction to Cancer Biology, Momna Hejmadi, Ventus Publishers
5. Molecular Biology of Human Cancers, Wolfgang Arthur Schulz, Springer Science, Business Media, Inc.

M.Sc. Biochemistry (IV Semester)

SPRBC 422: Environmental Biochemistry

UNIT - I

Definition, scope and importance. Concept of an ecosystem. Structure and functions of ecosystem. Producers, consumers and decomposers. Energy flow in an ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Causes, effects and control measure of, Air pollution, Water pollution, Soil pollution, Bioleaching.

UNIT- II

Ecotoxicology and its environmental significance. Pharmacodynamics and chemodynamics. Xenobiotic metabolism - phase I reaction - oxidation-reduction, hydrolysis, phase-II reaction - conjugation and methylation, detoxification, pesticide toxicity - insecticides, fungicides, herbicides and biopsticides. Toxicology of food additives. Metal toxicity - arsenic, mercury, lead and cadmium.

UNIT- III

Mechanisms of toxicity: disturbance of excitable membrane function. Altered calcium homoeostasis. Covalent binding to cellular macromolecules & genotoxicity. Tissue specificity of toxicity. Toxicity testing- genetic toxicity testing. Toxicity control.

UNIT- IV

Bioremediation, advantages and disadvantages; In situ and ex-situ bioremediation; Bioremediation of contaminated ground water and phytoremediation of soil metals; microbiology of degradation of xenobiotics

UNIT- V

Pollution Control: Reducing environment impact of industrial effluents, chemical pesticides, herbicides and fertilizers. Current levels of biodiversity and gene banks. Biofuels and biological control of air pollution, plant derived fuels, biogas.

Text books:

1. An Introduction to Environmental Biotechnology by Milton Wain Wright. Kluwar Acad Publ. Group, Springer, 1999.
2. Klaassen C D, Amdur M O & Doull J (1986) Casarett and Doull's Toxicology, 3rd edition, Macmillan publishing company, New York. 26
3. Hayes A W (1988) Principles and methods of toxicology, 2nd edition, Raven press New York.
4. Basic Environmental Toxicology : Lorris G. Corkerhem and Barbara S. S. Shane CRP Press Inc.

M.Sc. Biochemistry (IV Semester)

SPRBC 423: Nutritional Biochemistry

UNIT – I

Nutrients and their classification. Carbohydrates – dietary requirements, glycemic index. Proteins - determination of protein quality, SDA, improvement, supplementation and fortification. Nitrogen balance. Nutritional aspects of Lipids.

UNIT – II

Regulation of food intake, energy value of foods, energy requirements, BMR. Water: daily requirements, regulation of water metabolism, distribution of body water, electrolytes, types, sources, composition of body fluids. Maintenance of fluid and electrolyte balance, over hydration, dehydration and water intoxication, electrolyte imbalances.

UNIT – III

An overview of vitamins and minerals – criteria of food sources, requirements, functions, deficiency disorders and toxicity. Enrichment and fortification of vitamins. Antioxidant and oxidative stress. Importance of nutrition under stress conditions.

UNIT – IV

Biological effects of non-nutrients – dietary fiber, Anti-nutrients-protease inhibitors, hemeagglutinins, hepato toxins, goitrogens, cyanogenic glucosides, oxalates. Biological effects of food contaminants – pesticide residues, microbialtoxins, mycotoxins, food additives, drugs and antibiotics.

UNIT – V

Clinical nutrition – role of diet and nutrition in prevention of atherosclerosis and obesity, role of leptin and regulation of body mass. Protein sparing treatment during fasting. Dietary guidelines for disease prevention. Dietary influences in the process of carcinogenesis and role of diet.

Text books:

1. Advanced text book on Food & Nutrition by Dr. M. Swaminathan.
2. Text book of Human Physiology by G.P. Talwar.
3. Toxic Constituents of Plant food stuffs by Liener, T.E., Academic press, NewYork
4. Trace elements in Human health and diseases by Prasad A.S. (Ed) Academic press, NewYork
5. Human nutrition and dietetics by Davidson and Passmore R., Bock, J.F, and Truswell, A.S. 7th Ed. New York Churchill Living stone.
6. Basic issues in combating malnutrition by Gopalan, C., NFI Publication.

M.Sc. Biochemistry (IV Semester)

SPRBC 411: Clinical Biochemistry and Cancer Biology/ Environmental Biochemistry/ Nutritional Biochemistry Lab

Section – A

Clinical Biochemistry

1. Collection and preservation of clinical samples
2. Estimation of Hemoglobin, Total count (TC), Differential count (DC), Packed cell volume(PCV) and erythrocyte sedimentation rate (ESR)
3. Estimation of blood glucose by enzymatic method
4. Estimation of total cholesterol and triglycerides
5. Estimation of serum Creatine and Creatinine
6. Estimation of Uric acid in serum
7. Estimation of serum Bilirubin
8. Determination of serum GOT
9. Determination of serum GPT
10. Determination of serum Acid Phosphatase
11. Determination of serum Alkaline Phosphatase
12. Estimation of serum Chlorides
13. Estimation of serum Calcium
16. Qualitative tests and microscopic examination of urine
17. Glucose Tolerance Test (Group experiment)

Section – B

Cancer Biology

1. Maintenance and culturing of cancer cells
2. Determination of cell proliferation using MTT assay
3. Demonstration of cell migration by wound healing assay
4. Demonstration of tumour angiogenesis
5. Determination of apoptotic cells

OR

Section – C

Environmental Biochemistry

1. Determination of frequency, density and abundance of species growing in urban area using quadrate method
2. Estimation of phosphates and nitrates in different water samples

3. Estimation of chromium content in different samples by spectrophotometric method.
4. Determination of density of microbial content in air samples.
5. Determination of soil microbial activity in response to xenobiotic compounds.

OR

Section – D

Nutritional Biochemistry

1. Estimation of calorific value of foods
2. Estimation of moisture and mineral (Ca, P, Fe and Zn) content in food samples
3. Estimation of Vitamin A, Vitamin C, Thiamine, and Riboflavin in food samples
4. Estimation of antioxidants
5. Determination of antinutrients in food samples

Reference books:

1. Practical Clinical Biochemistry by Harold Varlley.
2. Experimental Biochemistry by Beedu Sashidhar Rao, Vijay Deshpande IKI Pvt. Ltd.

M.Sc. Biochemistry (IV Semester)

SPRBC 413: Project Work & Seminar