SRIDEV SUMAN UTTARAKHAND UNIVERSITY
TEHRI GARHWAL

CURRICULUM FOR M. Sc. BIOCHEMISTRY
(FOUR SEMESTER (TWO YEAR) MASTER'S DEGREE COURSE)
SEMESTER SYSTEM

1. All the courses of Semester I & Semester II shall be core courses.
2. In Semester III there will be 11 credits for core courses (2 Theory of 4 credits each + 1 practical of 3 credits based on core theory papers) & 9 credits for elective courses (2 theories of 3 credits each + 1 Practical of 3 credits based on elective theory papers). Besides core & elective courses students will have to take minimum one self study course of 3 credits in III or IV Semester. However, maximum 3 elective courses may be taken by the student during Semester III & IV.
3. Semester IV shall comprise of 2 core courses of 4 credits each (Total 8 credits) & elective courses of 9 credits (1 Project of 6 credits + 1 theory of 3 credits or 2 theory of 3 credits each & 1 Practical of 3 credits based on chosen elective theory courses).
4. All the ordinances applicable to masters program of HNB Garhwal University shall also be applicable to M.Sc. Biochemistry course.

SCHEME OF EXAMINATION

M. Sc. Previous **SEMESTER-I**

Paper No.	**Paper**	**Paper Code**	**Max. Marks (60 + 40 = 100)**			**Credits**
			Univ. Exam	**Sessional exam**	**Total Marks**	
I	Lab Course – 1	SOLS/Biochem/C001	60	40*	100	3
II	Lab Course – 2	SOLS/ Biochem/C002	60	40*	100	3
III	Biomolecules	SOLS/ Biochem/C003	60	40	100	3
IV	Cell Biology & Physiology	SOLS/ Biochem/C004	60	40	100	3
V	Plant Biochemistry	SOLS/ Biochem/C005	60	40	100	3
VI	Biochemical & Biophysical Techniques	SOLS/ Biochem/C006	60	40	100	3
Total of 6 core papers to be studied			360	240	600	18

* Sessional assessment of Lab Course includes assignment based seminar.

M. Sc. Previous **SEMESTER -II**

Paper No.	Paper	Paper Code	Max. Marks (60 + 40 = 100)			Credits
			Univ. Exam	Sessional exam	Total Marks	
VII	Lab Course – 3	SOLS/Biochem/C007	60	40*	100	3
VIII	Lab Course – 4	SOLS/Biochem/C008	60	40*	100	3
IX	Metabolism -I	SOLS/Biochem/C009	60	40	100	3
X	Metabolism -II	SOLS/Biochem/C010	60	40	100	3
XI	Basic & Industrial microbiology	SOLS/Biochem/C011	60	40	100	3
XII	Nutritional Biochemistry	SOLS/Biochem/C012	60	40	100	3
Total of 6 core papers to be studied			360	240	600	18

* Sessional assessment of Lab Course includes assignment based seminar.

M.SC. BIOCHEMISTRY

M. Sc. Final **SEMESTER -III**

Paper No.	Paper	Paper Code	Max. Marks (60 + 40 = 100)			Credits
			Univ. Exam	Sessional exam	Total Marks	
XIII	Lab Course – 5 (Based on 2 core courses)	SOLS/Biochem/C013	60	40*	100	3
XIV	Lab Course – 6 (Based on 2 elective courses)	SOLS/ Biochem/E004	60	40*	100	3
XV	Molecular Biology	SOLS/ Biochem/C014	60	40	100	4
XVI	Enzymology	SOLS/ Biochem/C015	60	40	100	4
XVII	Methods in Molecular biology	SOLS/ Biochem/E001	60	40	100	3
XVIII	Clinical Biochemistry	SOLS/ Biochem/E002	60	40	100	3
XIX	Outline of biotechnology	SOLS/ Biochem/E003	60	40	100	3
XXVII	Project	SOLS/ Biochem/E010	Project work will start at the beginning of Sem. III and will be evaluated at the end of Sem. IV			
Total of 6 papers (3 core 3 elective) to be studied			360	240	600	20

Student will opt for 2 out of 3 elective subjects (SOLS/Biochem/E001, SOLS/ Biochem/E002, SOLS/ Biochem/E003) and practical based on opted 2 elective subjects which will be an elective subject.

* Sessional assessment of Lab Course includes assignment based seminar.

M. Sc. Final **SEMESTER -IV**

Paper No.	Paper	Paper Code	Max. Marks (60 + 40 = 100)			Credits
			Univ. Exam	Sessional exam	Total Marks	
XX	Neurobiochemistry	SOLS/ Biochem/C016	60	40	100	3
XXI	Immunology	SOLS/ Biochem/C017	60	40	100	4
XXII	Bio-statistics, Bio-informatics &Quality Management	SOLS/ Biochem/E005	60	40	100	3
XXIII	Clinical Research and Pharmacology	SOLS/ Biochem/E006	60	40	100	3
XXIV	Drug design	SOLS/ Biochem/E007	60	40	100	3
XXV	Environmental Biochemistry & Toxicology	SOLS/ Biochem/E008	60	40	100	3
XXVI	Lab Course – 7 (Based on two elective Theory papers)	SOLS/ Biochem/E009	60	40*	100	3
XXVII	Project Work	SOLS/ Biochem/E010	120	80*	200	6
			300	200	500	16

*Sessional assessment of Project work will be based periodical presentations.

Total credits of M.Sc. Biochemistry = Sem. I + Sem. II + Sem. III + Sem. IV
18+18+20+16 = 72

Total Marks of M.Sc. Biochemistry = Sem. I + Sem. II + Sem. III + Sem. IV
600+600+600+500 = 2300

SUMMARY

Semester	Paper No.	Paper	Category	Paper Code	L	T	P	C
I	I	Lab Course – 1	Core	SOLS/Biochem/C001	0	0	9	3
	II	Lab Course – 2	Core	SOLS/ Biochem/C002	0	0	9	3
	III	Biomolecules	Core	SOLS/ Biochem/C003	3	0	0	3
	IV	Cell Biology & Physiology	Core	SOLS/ Biochem/C004	3	0	0	3
	V	Plant Biochemistry	Core	SOLS/ Biochem/C005	3	0	0	3
	VI	Biochemical & Biophysical Techniques	Core	SOLS/ Biochem/C006	3	0	0	3
II	VII	Lab Course – 3	Core	SOLS/Biochem/C007	0	0	9	3
	VIII	Lab Course – 4	Core	SOLS/Biochem/C008	0	0	9	3
	IX	Metabolism -I	Core	SOLS/Biochem/C009	3	0	0	3
	X	Metabolism -II	Core	SOLS/Biochem/C010	3	0	0	3
	XI	Basic & Industrial microbiology	Core	SOLS/Biochem/C011	3	0	0	3
	XII	Nutritional Biochemistry	Core	SOLS/Biochem/C012	3	0	0	3
III	XIII	Lab Course – 5 (Based on 2 core courses)	Core	SOLS/Biochem/C013	0	0	9	3
	XIV	Lab Course – 6 (Based on 2 elective courses)	Elective	SOLS/ Biochem/E004	0	0	9	3
	XV	Molecular Biology	Core	SOLS/ Biochem/C014	4	0	0	4
	XVI	Enzymology	Core	SOLS/ Biochem/C015	4	0	0	4
	XVII	Methods in Molecular biology	Elective	SOLS/ Biochem/E001	3	0	0	3
	XVIII	Clinical iochemistry	Elective	SOLS/ Biochem/E002	3	0	0	3
	XIX	Outline of biotechnology	Elective	SOLS/ Biochem/E003	3	0	0	3
IV	XX	Neurobiochemistry	Core	SOLS/ Biochem/C016	4	0	0	4
	XXI	Immunology	Core	SOLS/ Biochem/C017	4	0	0	4
	XXII	Bio-statistics, Bio-informatics &Quality Management	Elective	SOLS/ Biochem/E005	3	0	0	3
	XXIII	Clinical Research and Pharmacology	Elective	SOLS/ Biochem/E006	3	0	0	3
	XXIV	Drug design	Elective	SOLS/ Biochem/E007	3	0	0	3
	XXV	Environmental Biochemistry & Toxicology	Elective	SOLS/ Biochem/E008	3	0	0	3
	XXVI	Lab Course – 7 (Based on two elective Theory papers)	Elective	SOLS/ Biochem/E009	0	0	9	3

	XXVII	Project Work	Elective	SOLS/ Biochem/E010	0	0	18	6
Self Study Courses (to be studied during semester III or IV)								
III & IV	XXVIII	Environmental nanotechnology	Self study	SOLS/ Biochem/S001	0	0	0	3
	XXIX	Bio Nanotechnology	Self study	SOLS/ Biochem/S002	0	0	0	3
	XXX	Biosignaling	Self study	SOLS/ Biochem/S003	0	0	0	3
	XXXI	Fermentation Technology	Self study	SOLS/ Biochem/S004	0	0	0	3

Biochemistry syllabus - Semester wise W.E.F. 2011-2012

Note:

1. Admission eligibility: B.Sc. or equivalent (10+2+3) with Biochemistry or chemistry as a subject and with minimum 45% marks or the criteria decided by the university. Relaxations to different categories shall be applicable as per university rules.
2. In all 72 credits are to be completed in M. Sc. In each semester 18 credits shall be taken by students.
3. All the core courses are compulsory.

DETAILED SYLLABUS

M. Sc. Biochemistry (Previous -Semester I)

			L	T	P	C	MM
I	**SOLS/Biochem/C001**	**LAB COURSE - I**	**0**	**0**	**9**	**3**	**100**

1 Fractionation of egg proteins and its quantification
2 Carbohydrates: Qualitative analysis, quantitation of glucose and ribose.
3 Amino acids and proteins: Qualitative analysis, quantitation of proteins and amino acids.
4 Quantitation of free and bound phosphate.
5 Quantitation of vitamin C.
6 Fats: Acid number, saponification and iodine values.
7 Estimation of crude protein by micro-kjeldahl method.
8 Estimation of Phospholipids, Glycolipids and Sphingolipids.
9 To study mitosis in root tips of *Allium cepa.*
10 To study meiosis in floral buds of *Allium cepa.*
11 Subcellular fractionation of organelles.
12. Any other practical as per the facility in the department

			L	T	P	C	MM
II	**SOLS/ Biochem/C002**	**LAB COURSE -II**	**0**	**0**	**9**	**3**	**100**

1. Preparation of normal, molar & percent solutions.
2. Preparation of different buffers.
3. Determination of pKa value of acetic acid.
4. Determination of pKa values of aspartic acid and glycine.
5. Separation and identification of amino acids by TLC.
6. Separation of amino acids/ sugars by paper chromatography.
7. Verification of Beer- Lambert Law.
8. Extraction of lipids from tissue and their separation using TLC.

9. Separation of proteins by SDS-PAGE.
10. Isolation of casein from milk and its quantification
11. Estimation of carotenoids in the given leaf sample.
12. To estimate chlorophyll a and chlorophyll b in the given leaf sample.
13. Determination of glucose and starch content in a given plant material.
14. To extract and estimate lycopene present in tomato.
15. Any other practical as per the facility in the department

			L	T	P	C	MM
III	**SOLS/ Biochem/C003**	**BIOMOLECULES**	**3**	**0**	**0**	**3**	**100**

Note:

1. Eight questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining seven questions shall be set covering entire syllabus. The candidates shall be required to attempt Question No. 1 & Three more questions. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

Topics

1. **Carbohydrates – S**tructure, reactions and functions of monosaccharides, disaccharides polysaccharides and complex carbohydrates; amino sugars, proteoglycans and glycoproteins.
2. **Lipids -** Classification, structure, properties and functions of fatty acids, essential fatty acids, fats, phospholipids, sphingolipids, cerebrosides, steroids, bile acids, prostaglandins and lipoproteins.
3. **Nucleic acids -** Structure and function of nucleotides. Primary, secondary and tertiary structure of nucleic acids, organization of DNA, chromatin and chromosome. DNA forms and conformations.
4. **Proteins –** Primary, Secondary, Tertiary and Quaternary structures of proteins.
5. **Enzymes -** Historical perspective, general characteristics, nomenclature, Enzyme classification (specific examples), and Enzyme assays.
6. **Vitamins:** Structure classification and function of vitamins. Coenzymes and their role in various physiological and metabolic processes.

Suggested Reading:

1. Lehninger's Principles of Biochemistry (2nd Ed 2000) D.L Nelson and M.M. Cox, Macmillan Worth Pub. Inc. NY.
2. Biochemistry (4th edn. 1992) by Lubert Stryer WH Freeman & Co., NY.

			L	T	P	C	MM

IV	**SOLS/ Biochem/C004**	**CELL BIOLOGY & PHYSIOLOGY**	**3**	**0**	**0**	**3**	**100**

Note:

1. Eight questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining seven questions shall be set covering entire syllabus. The candidates shall be required to attempt Question No. 1 & Three more questions. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

Topics

1. **Cell Biology** - Cell classification, cell variability (size, shape, complexity, functions). Structural organization of prokaryotic and eukaryotic cells. The ultra structure of nucleus, mitochondria, endoplasmic reticulum (rough and smooth), Golgi apparatus, lysosomes & peroxisomes and their functions. The cytoskeleton – microtubules and microfilaments. Cell movement and chemotaxis.
2. **Blood -** Composition and functions of plasma, erythrocytes including Hb, Leucocytes and thrombocytes, plasma proteins. Blood Coagulation – mechanism and regulation. Transfer of blood gases – Oxygen and carbon dioxide, role of 2, 3-diphosphoglycerate, Bohr effect and chloride shift.
3. **Digestive system –** Composition, functions and regulation of saliva, gastric, pancreatic, intestinal and bile secretions. Digestion and absorption of carbohydrates, lipids, proteins, & nucleic acids.
4. **Respiration –** Air passages and fine structure of alveoli, pulmonary volumes, alveolar surface tension, work of breathing and its regulation.
5. **Endocrine system –** Secretion and functions of hormones of thyroid, pituitary and gonads. Mechanism of action of hormones.
6. **Excretory system –** Structure of nephron, glomerular filtration, tubular reabsorption of glucose, water and electrolytes. Tubular secretion. Homeostatic regulation of water and electrolytes, Acid-base balance.

Suggested Reading:

1. Molecular Biology of the Cells (3rd edn 1994) by Alberts et al., Garland Publications Inc. NY and London
2. Cell biology (1993) by E.S. Sedava, Jones and Barlett Publishers Boston, London.
3. Cell and Molecular Biology (8th ed. 2001) by E.D.P. de Robertis & E.M.F. de Robertis (Jr) Lippincott Williams & willkins, Philadelphia.
4. Principles of Cell Biology (1988) by Klein Smith and M. Kish, Harper-Cellins PUb. Inc. New Delhi.

5. Text book of Medical Physiology (10th ed. 2001) by A.C. Guyton and J.E. Hall, Harcourt Asia.

			L	T	P	C	MM
V	SOLS/ Biochem/C005	PLANT BIOCHEMISTRY	3	0	0	3	100

Note:

1. Eight questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining seven questions shall be set covering entire syllabus. The candidates shall be required to attempt Question No. 1 & Three more questions. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

Topics

1. **Electron transport system in plants -** Oxidative phosphorylation, mitochondrial respiratory complexes, order and organization of electron carriers, electrochemical gradient, chemiosmotic theory, ATP synthase and mechanism of ATP synthesis.
2. **Photosynthesis –** Photosynthetic apparatus, pigments of photosynthesis, role of carotenoids, photosystems I and II, their location; Hill reaction, photosynthetic electron transport and generation of NADPH & ATP, cyclic and non-cyclic photo-phosphorylations, complexes associated with thylakoid membranes; light harvesting complexes, path of carbon in photosynthesis – C_3 and C_4 pathway of carbon reduction and its regulation, Photorespiration.
3. **Nitrate assimilation** - Structural features of nitrate reductase and nitrite reductase, incorporation of ammonia into organic compounds, regulation of nitrate assimilation. **Sulphate assimilation:** Free and bound pathways of assimilation of sulphate into cysteine. Glutathione and its role in sulphur metabolism.
4. **Special features of secondary plant metabolism** - Terpenes (classification, biosynthesis), lignin, tannins, pigments, phytochrome, waxes, alkaloids, biosynthesis of nicotine, functions of alkaloids, cell wall components.
5. **Toxins of plant origin –** Mycotoxins, phytohemagglutinins, lathyrogens, nitriles, protease inhibitors, protein toxins.
6. **Stress metabolism in plants -** Environmental stresses, salinity, water stress, heat, chilling, anaerobiosis, pathogenesis, heavy metals, radiations and their impact on plant growth and metabolism, criteria of stress tolerance.
7. **Antioxidative defence system in plants –** Reactive oxygen species and their generation, enzymic and non-enzymic components of antioxidative defense mechanism.

Suggested Reading:

1. Handbook of photosynthesis (ed) Mohammad Pe sarakle, Marcel Dekkar, Inc. NY Basel, Hong Kong 1997.

2. Introduction to plant biochemistry (1983) T.W. Goodwin and EI Mercer. Pergaman Press, Oxford, NY, Toronto, Sydney, Paris, Frankfurt.
3. Seed: physiology of development and germination (2nd ed. 1994) J.D. Bewley and M. Black Plenum Press NY.
4. Biochemistry of energy utilization i plants D.T. dennis Blackie, Glasgow and Lodnon 1987.
5. Plant Biochemistry by P.M. Dey and J.B. Harborne. Harcourt Asia PTE Ltd., Singapore.

			L	T	P	C	MM
VI	**SOLS/ Biochem/C006**	**Biochemical & Biophysical Techniques**	**3**	**0**	**0**	**3**	**100**

Note:

1. Eight questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining seven questions shall be set covering entire syllabus. The candidates shall be required to attempt Question No. 1 & Three more questions. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

Topics

1. **Spectroscopy -** Concepts of spectroscopy, Laws of photometry. Beer-Lambert's law, Principles and applications of colorimetry. Visible and UV spectroscopy, ORD, CD, X-ray diffraction and NMR.
2. **Chromatography –** Principles and applications of paper, thin layer, ion exchange, affinity, gel permeation, adsorption and partition chromatography and HPLC.
3. **Centrifugation –** Principle of centrifugation, concepts of RCF, different types of instruments and rotors, preparative, differential and density gradient centrifugation, analytical ultra-centrifugation, determination of molecular weights and other applications, subcellular fractionation.
4. **Electrophoretic techniques –** Principles of electrophoretic separation. Types of electrophoresis including paper, cellulose, acetate/nitrate and gel. Electroporation, Pulse field gel electrophoresis.
5. **Electron microscopy –** Transmission and scanning, Video microscopy, specific staining of biological materials.
6. **Viscosity –** Viscosity measurement, Coefficient of Viscosity and Poiseuille Equation.

Suggested Reading:

1. Stereo chemistry of organic compounds (1994) by E.L. Ellel & SHW Awley, Inter Science Pub. 30, Wiley and Sons. Inc.
2. Organic Chemistry (6th ed. 2000) by R.T. Morrison & R.N. Boyd, Prentice Hall of India, New Delhi.
3. Organic Chemistry Vol. 1 Fundamental Principle (6th Ed. 1985) by IL Finar, ELBS.
   Vol. 2 Stereo Chemistry and the Chemistry of Natural Products (5th ed. 1985) by I.L. Finar, ELBS.
4. Principles and Techniques of Practical biochemistry (4th ed 1999) by K. wilson and J. walker (eds) Cambridge Univ. Press.

M. Sc. Biochemistry (Previous -Semester II)

VII	SOLS/ Biochem/C007	LAB COURSE -III	L	T	P	C	MM
			0	0	9	3	100

1. Molecular weight determination of enzyme by gel filtration.
2. Isozyme detection.
3. Estimation of Ascorbic acid in Citrus fruit.
4. Estimation of carotenoids in the given leaf sample.
5. To estimate chlorophyll a and chlorophyll b in the given leaf sample.
6. Determination of glucose and starch content in a given plan material
7. Assay of acid & alkaline Phosphatase and calculation of specific activity.
8. Extraction, partial purification and characterization of an enzyme.
9. Determination of amylase in given sample.
10. To extract and estimate lycopene present in tomato.
11. Preparation of MS media for plant tissue culture.
12. Any other practical as per the facility in the department

VIII	SOLS/ Biochem/C008	LAB COURSE -IV	L	T	P	C	MM
			0	0	9	3	100

1. Demonstration of enzyme immobilization.
2. Sterilization of explants and micropropagation.
3. Time course of enzymatic reaction.
4. Influence of substrate concentration on the rate of enzymatic reaction.
5. Effect of pH and temperature on the rate of enzyme reaction.
6. Specificity of enzyme action.
7. Immobilization studies:
8. Preparation of urease entrapped in alginate beads and determination of percent entrapment.
9. Study of the kinetics of the rate of urea hydrolysis by urease entrapped alginate beads.
10. Study of reusability and storage stability of urease entrapped alginate beads.
11. Immobilization of urease by covalent attachment to solid support.
12. Any other practical as per the facility in the department

IX	SOLS/ Biochem/C009	METABOLISM -I	L	T	P	C	MM
			3	0	0	3	100

Note:

5. Eight questions will be set in all.
6. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
7. The remaining seven questions shall be set covering entire syllabus. The candidates shall be required to attempt Question No. 1 & Three more questions. As far as possible, the questions shall be short answer type and not essay type.
8. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

Topics

1. **Bioenergetics –** Concept of free energy, standard free energy, determination of ΔG for a reaction. Relationship between equilibrium constant and standard free energy change, biological standard state & standard free energy change in coupled reactions. Biological oxidation-reduction reactions, redox potentials, relation between standard reduction potentials and free energy change (derivations and numericals included). High energy phosphate compounds – introduction, phosphate group transfer, free energy of hydrolysis of ATP and sugar phosphates alongwith reasons for high ΔG. Energy charge.
2. **Intermediary Metabolism –** Approaches for studying metabolism.
3. **Coenzymes and Cofactors –** Role and mechanism of action of $NAD^+/NADP^+$, FAD, lipoic acid, thiamine pyrophosphate, tetrahydrofolate, biotin, pyridoxal phosphate, B_{12} coenzymes and metal ions with specific examples.
4. **Carbohydrates –** Glycolysis, various forms of fermentations in micro-organisms, citric acid cycle, its function in energy generation and biosynthesis of energy rich bond, pentose phosphate pathway and its regulation. Gluconeogenesis, glycogenesis and glycogenolysis, glyoxylate and Gamma aminobutyrate shunt pathways, Cori cycle, anaplerotic reactions, Entner-Doudoroff pathway, glucuronate pathway. Metabolism of disaccharides. Hormonal regulation of carbohydrate metabolism. Energetics of metabolic cycle.
5. **Amino Acids –** General reactions of amino acid metabolism - Transamination, decarboxylation, oxidative and non-oxidative deamination of amino acids. Special metabolism of methionine, histidine, phenylalanine, tyrosine, tryptophan, lysine, valine, leucine, isoleucine and polyamines. Urea cycle and its regulation.

Suggested Reading:

1. Lehinnger's Principles of Biochemistry (2nd edn. 2000) by D.L. Nelson and M.M. Cox, Macmillan, worth Pub. Inc., NY.
2. Biochemistry (4th edn. 1992) by Lubert Stryer WH Freeman & Co., NY.
3. Harper's Biochemistry (25th ed.) by R.K. Murray and others. Appleton and Lange, Stanford.

			L	T	P	C	MM
X	SOLS/ Biochem/C010	METABOLISM II	3	0	0	3	100

Note:

1. Eight questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining seven questions shall be set covering entire syllabus. The candidates shall be required to attempt Question No. 1 & Three more questions. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

Topics

1. **Lipids –** Introduction, hydrolysis of tri-acylglycerols, α-, ß- and ω- oxidation of fatty acids. Oxidation of odd numbered fatty acids – fate of propionate, role of carnitine, degradation of complex lipids. Fatty acid biosynthesis, Acetyl CoA carboxylase, fatty acid synthase, ACP structure and function, Lipid biosynthesis, biosynthetic pathway for tri-acylglycerols, phosphoglycerides, sphingomyelin and prostaglandins. Metabolism of cholesterol and its regulation. Energetics of fatty acid cycle.
2. **Nucleotides –** Biosynthesis and degradation of purine and pyrimidine nucleotides and its regulation. Purine salvage pathway. Role of ribonucleotide reductase. Biosynthesis of deoxyribonucleotides and polynucleotides including inhibitors of nucleic acid biosynthesis.
3. **Biosynthesis of vitamins –** Ascorbic acid, thiamine, pantothenic acid and folic acid.
4. **Biochemistry** of **biological nitrogen fixation**.
5. **Porphyrins –** Biosynthesis & degradation of porphyrins. Production of bile pigments.
6. **Plant Hormones –** Growth regulating substances and their mode of action, molecular effects of auxin in regulation of cell extension, effects of gibberellic, abscisic acids and cytokinins in the regulation of seed dormancy, germination, growth and development.

Suggested Reading:

1. Lehinnger's Principles of Biochemistry (2nd edn. 2000) by D.L. Nelson and M.M. Cox, Macmillan, worth Pub. Inc., NY.
2. Biochemistry (4th edn. 1992) by Lubert Stryer WH Freeman & Co., NY.
3. Harper's Biochemistry (25th ed.) by R.K. Murray and others. Appleton and Lange, Stanford.

			L	T	P	C	MM
XI	SOLS/ Biochem/C011	Basic & Industrial microbiology	3	0	0	3	100

Note:

1. Eight questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining seven questions shall be set covering entire syllabus. The candidates shall be required to attempt Question No. 1 & Three more questions. As far as possible, the questions shall be short answer type and not essay type.

4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

Topics

1. History of Microbiology: Discovery of Microorganisms. Spontaneous generation versus biogenesis. Establishment of role of microorganisms in diseases, transformation of organic and inorganic matter and soil transformation. Contributions of various Microbiologists. Microscopy: Light and Electron microscopy
2. Morphology and ultra structure of bacteria: General morphology of bacterial cell, morphological types of bacteria. Ultra structure of bacterial cell. Cell wall of Gram-negative and Gram - positive bacteria and archaebacteria. Structure and function of cell membranes flagella, cilia, gas vesicles, bacterial genomes, plasmids, capsule-spore and cysts. Classification of bacteria, Whittaker's five kingdom concept, three domain concept of Carl Woes. Modern bases of classification DNA - DNA hybridization, 16SrRNA sequencing. Bergey's system of classification.
3. Bacterial growth and cultivation: Cultivation of aerobic and anaerobic bacteria, nutritional types, culture media. Bacterial growth curve and generation time, growth kinetics, measurement of growth, factors affecting growth, Control of microbial growth: physical and chemical methods, disinfectants and radiations.
4. Viruses, Fungi and Protozoa: Classification and general features, of major fungal divisions, their morphology nutrition and reproductive methods. Protozoa - morphology, nutrition, encystment, locomotory organs and reproduction. Viruses - Morphology and ultra structure, capsids and their arrangements. Chemical composition, viral genome. Bacteriophages.
5. Fermentation Technology: Shake flask culture, batch, fed-batch and continuous cultures. Fermenter design - basic stirred tank bioreactor and other different types of fermenters. Instrumentation and control. Aeration and agitation, mass transfer and oxygen transfer. Downstream processing. Primary and secondary metabolites. Industrial production of antibiotics (β-lactam), ethanol, enzymes: lipases, protease, cellulose and amylases.

Suggested Reading:

1. Microbial World (5th edn, 1987) R Y Stanier, Hampshire-Macmillan Press.
2. Medical Microbiology (12th edn. 1973) Cruckishank R and others, ELBS Press, London.
3. Microbiology (1967) B D Davis, R Delbecco, H M Eisent H S Ginsberg, Hoeber Med Divn. NY
4. Microbiology (5th ed 2000) Michael J Pelczar (Jr) ESC Chan, N R Kreig, Tata McGraw Hill.

XII	SOLS/Biochem/C012	Nutritional Biochemistry	L	T	P	C	MM
			3	0	0	3	100

Note:

1. Eight questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining seven questions shall be set covering entire syllabus. The candidates shall be required to attempt Question No. 1 & Three more questions. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

Topics

1. Basic concepts of biochemical nutrients. Fibers and their importance in nutrition. Energy content of foods. Measurement of energy expenditure. Direct & indirect calorimetry. Definition of BMR and SDA and factors affecting these.
2. Thermogenic effects of foods. Antinutrients: Naturally occurring food born toxicants, Protease inhibitors, Hemagglutin, hepato-toxins, allergens, oxalates, toxin from mushrooms, animal food stuffs and sea foods.
3. Food additives: Antioxidants, antimicrobial agents, non-nutritive and low calorie sweetners, stabilizers and thickners.
4. Protein energy malnutrition: etiology, clinical features, metabolic disorders and management of Marasmus and kwashiorkar diseases.
5. Starvation; Techniques for the study of starvation. Protein metabolism prolonged fasting. Protein sparing treatments during fasting.
6. Obesity: Definition and classification. Genetic and environmental factors leading to obesity. Obesity related diseases and management of obesity. Nutritive values of common Indian food: Cereals and millets, sugar and starch foods, pulses and legumes, oil seeds and nuts, food of animal origin.
7. Clinical Nutrition: Role of diet & nutrition in the prevention and treatment of disease: **dental caries. Fluorosis, Renal failure, hyperlipidemia, Atherosclerosis & rheumatic** disorders, inherited metabolic disorders Phenylketonuria, Maple syrup urine disease, hoymocystinuria, Gout.

Suggested Reading:

1. Tietz Fundamentals of Clinical Chemistry - (5th edn.) C A Burtis, E R Ashwood (eds.) Saunders WB Co.
2. Notes on Clinical Chemistry - Whitby L G, A F Smith, G J Beckett, S M Walker, Blackwell Sci Inc.
3. Principles of Internal Medicine (1983) Harrison T R, McGraw Hill, NY.
4. Text book of Medical Physiology (10th ed. 2001) by A.C. Guyton and J.E. Hall, Harcourt Asia.
5. Nutrition: An integrated approach (3rd edn. 1984) R L Pike and M L Borwn, Willey & Sons Inc., Ny.
6. Text Book of Biochemistry and Human Biology G P Talwar, Prentice Hall.
7. Mechanism and Theory in Food Chemistry (1996) DWS Wong, CBS, New Delhi.

8. Text Book of Human Nutrition (1996) M S Bamji N Pralhad Rao and V Raddy, Oxford & IBH Publishers.
9. Principles of Food Science - I (Food Chemistry) Fennemone D R
10. Human Nutrition and Dietetics (8th Ed. 1982) by Davidson and Passmore ELBS.
11. Modern Nutrition in Health and Diseases (7th ed. 1988) by Maurice E Skills and V R Young K M Varghese Co. Bombay.

M. Sc. BIOCHEMISTRY (THIRD SEMESTER)

			L	T	P	C	MM
XIII	**SOLS/ Biochem/C013**	**LAB COURSE -5**	**0**	**0**	**9**	**3**	**100**

- Quantitative determination of nucleic acids.
- Determination of melting temperature (Tm) of DNA from thermal denaturation characteristics.
- Isolation and purification of genomic DNA from animal, plant and bacterial sources.
- Isolation and purification of plasmid DNA by alkaline lysis & Quick method.
- Determination of Molecular weight of DNA.
- Preparation of restriction enzyme digests of DNA samples.
- Demonstration of transformation.
- Demonstration of PCR.
- Gel electrophoresis of serum proteins, SDS-PAGE of proteins.
- Determination of α-amylase of saliva.
- Any other practical as per the facility in the department
-

			L	T	P	C	MM
XIV	**SOLS/ Biochem/E004**	**LAB COURSE -6**	**0**	**0**	**9**	**3**	**100**

- Estimation of blood sugar.
- Determination of liver function test.
- Determination of renal function test.
- Determination of Lipid Profile.
- Pathological analysis of Urine.
- Isolation and estimation of serum cholesterol.
- Qualitative and quantitative analysis of following in urine:
    - Urea
    - Uric acid
    - Glucose
    - Proteins
    - Cl^-, PO_3^{3-}, Ca^{2+}
- Estimation of hemoglobin by canomethemoglobin
- Quantification of serum proteins
- Determination of A/G ratio in serum
- Estimation of serum glucose, creatinine and uric acid.
- Assay of serum enzymes : alkaline phosphatase, SGOT, SGPT
- Any other practical as per the facility in the department
- Any other practicals relevant to chosen elective courses.

XV	**SOLS/ Biochem/C014**	**Molecular Biology**	**L**	**T**	**P**	**C**	**MM**
			4	**0**	**0**	**4**	**100**

Note:

1. Eight questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining seven questions shall be set covering entire syllabus. The candidates shall be required to attempt Question No. 1 & Three more questions. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

Topics

1. **Chromatin –** Heterochromatin, euchromatin. Histone and non-histone proteins, general properties of histone, packing density, nucleosomes, size, variable linkers, solenoid structure, packaging of DNA, satellite DNA.
2. **DNA Replication -** Mechanism of replication, the replicons, origin, primosome and replisomes, properties of prokaryotic and eukaryotic DNA polymerases, synthesis of leading and lagging strands, difference between prokaryotic and eukaryotic replication.
3. **Mechanism of Transcription –** Prokaryotic transcription, promoters, properties of bacterial RNA polymerase; initiation, elongation and termination. Eukaryotic transcription, promoters, enhancers, factors & properties of RNA polymerase I, II, & III. Reverse transcription. Inhibitors of transcription.
4. **Post transcriptional Processing -** Maturation of rRNA, mRNA and tRNA; RNA splicing, introns and exons, consensus sequence function. Poly A tail, 5' capping.
5. **Recombination –**General recombination, site specific recombination and replicative recombination.
6. **Genetic Code –** Deciphering of the codons, reading frame of a sequence, Start/stop codons, degeneracy of the genetic code, Wobble hypothesis, variations to the standard genetic code.
7. **Translation in Pro- and Eukaryotes –** Ribosomes, structure, functional domain and subunit assembly, cell free protein synthesis, direction of protein synthesis (Dintzis experiment), adaptor role of tRNA, formation of initiation complex, chain elongation, translocation & termination, and role of respective factors involved therein. Inhibitors of protein biosynthesis. Comparison of protein biosynthesis in prokaryotes with eukaryotes. Post Translational processing – Proteolytic cleavage, covalent modifications, glycosylation of proteins, disulfide bond formation.
8. **Protein Localization** – Co- and post-translational protein traslocation; chaperones and protein folding, signal sequences, translocons, leader sequences.

Suggested Reading:

1. Biochemistry (2nd ed 1995) by Donald Voet and Judith Voet.
2. Molecular Biology of the gene (IV ed 1987) J. watson NH Hopkin J.W. Roberts J.P. Stertz a m Weiner, Freeman PUb., San Francisco.
3. Genes VII Benjamin Lewin (2000) Oxford Univ Press. London.
4. Biochemistry (4th edn. 1992) by Lubert Stryer WH Freeman & Co., NY.

			L	T	P	C	MM
XVI	**SOLS/ Biochem/C015**	**ENZYMOLOGY**	**4**	**0**	**0**	**4**	**100**

Note:

1. Eight questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining seven questions shall be set covering entire syllabus. The candidates shall be required to attempt Question No. 1 & Three more questions. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

Topics

1. **Introduction** – IUB enzyme classification (specific examples), enzyme specificity, methods for isolation, purification and characterization of enzymes, tests for homogeneity of enzyme preparation.
2. **Kinetics of enzyme action –** Concept of ES complex, active site, specificity, derivation of Michaelis-Menten equation for uni- substrate reactions. Different plots for the determination of K_m & V_{max} and their physiological significances. Importance of K_{cat}/K_m. Kinetics of zero & first order reactions. Significance and evaluation of energy of activation. Michaelis – pH functions and their significance. Classification of multi-substrate reactions with examples of each class. Derivation of the rate of expression for Ping Pong, random & ordered Bi-Bi mechanisms. Use of initial velocity, inhibition and exchange studies to differentiate between multi-substrate reaction mechanisms. Reversible and irreversible inhibition. Competitive, non-competitive, uncompetitive, linear-mixed type inhibitions and their kinetics, determination of K_i and numerical based on these. Suicide inhibitor.
3. **Mechanism of Enzyme Action –** Acid-base catalysis, covalent catalysis, proximity, orientation effect. Strain and distortion theory. Chemical modification of active site groups. Site directed mutagenesis of enzymes. Mechanism of action of chymotrypsin, lysozyme, glyceraldehyde 3-phosphate dehydrogenase, aldolase, carboxypeptidase, triose phosphate isomerase and alcohol dehydrogenase.
4. **Enzyme Regulation –** General mechanisms of enzyme regulation, product inhibition. Reversible (glutamine synthase & phosphorylase) and irreversible (proteases) covalent modification of enzymes. Mono-cyclic and multi-cyclic cascade systems with specific examples. Feedback inhibition and feed forward stimulation. Allosteric enzymes, qualitative description of "concerted" & "sequential" models for allosteric enzymes. Half site reactivity, positive and negative co-operativity with special reference to aspartate transcarbamoylase and phosphofructokinase. Protein-ligand binding measurement, analysis of binding isotherms, Hill and Scatchard plots.
5. **Multienzyme system –** Occurrence, isolation and their properties: Mechanism of action and regulation of pyruvate dehydrogenase complex. Enzyme-enzyme interaction, multiple forms of enzymes with special reference to lactate dehydrogenase.

Suggested Reading:

1. The chemical kinetics of enzyme action by K.J. Laidler and P.S. Bunting, Oxford University Press, London.
2. Enzymes by M. Dixon, E.C. Webb, CJR Thorne and K.F. Tipton, Longmans, London.
3. Enzyme structure and mechanism (1977) by Alan Fersht, Reading, USA.
4. Enzymatic reaction mechanism (1979) by christopher Walsh, Freeman PUb., San Francisco.
5. Immobilized enzymes(1978) by inhiro Chibata, Halsted Press Book

6. Enzyme structure and function by S. Blackburn (1976) Marcel Dekker, Inc., NY.
7. Fundamentals of Enzymology , by Price, N. C. and Stevens, L. (1999) 3rd Edn. Oxford University Press, London.

			L	T	P	C	MM
XVII	**SOLS/ Biochem/E001**	**Methods in Molecular Biology**	**3**	**0**	**0**	**3**	**100**

Note:

1. Eight questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining seven questions shall be set covering entire syllabus. The candidates shall be required to attempt Question No. 1 & Three more questions. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

Topics

1. **Regulation of Transcription and Translation -** Positive and negative control, Repressor & Inducer, concept of operon, lac-, ara-, trp-operons, attenuation, catabolite repression, autogenous regulation, lytic cycle of bacteriophage, stringent response of rRNA synthesis. Hormonal control, transcription factors, steroid receptors. DNA binding motifs in pro- & eukaryotes, helix-turn-helix, zinc fingers, leucine zippers/b zip, helix-loop-helix motifs.
2. **Genes –** Prokaryotic and eukaryotic genes, pseudogenes, split genes, super gene family, transposons, C-value paradox. Reassociation kinetics.
3. **Mutation –** Types of mutations, mechanism of mutation, mutagenic agents. DNA repair: UV repair system in *E. coli*.
4. **Recombinant DNA methods –** Features of commonly used vectors, strategies for cloning in various vectors and Identification of bacterial colonies containing recombinant plasmids, and bacteriophage vectors. Restriction enzymes.
5. **Construction and analysis of c-DNA and genomic libraries** - Protocols and strategies for c-DNA cloning, analysis of genomic DNA by southern hybridization, amplification of DNA by the polymerase chain reaction, preparation of radio-labeled DNA and RNA probes, synthetic oligonucleotide probes, expression of cloned genes in cultured cells, screening expression with antibodies and oligonucleotides.
6. **DNA sequencing –** Rapid DNA sequencing methods; Maxam-Gilbert technique, Sanger's Dideoxynucleotide sequencing, gene walking, foot printing, RNA sequencing.
7. **Application of recombinant technology –** production of insulin, drug, vaccines, diagnostic probe of genetic diseases. Gene therapy.

Suggested Reading:

1. Biochemistry (2nd ed 1995) by Donald Voet and Judith Voet.
2. Molecular Biology of the gene (IV ed 1987) J. watson NH Hopkin J.W. Roberts J.P. Stertz a m Weiner, Freeman PUb., San Francisco.
3. Genes VII Benjamin Lewin (2000) Oxford Univ Press. London.
4. Biochemistry (4th edn. 1992) by Lubert Stryer WH Freeman & Co., NY.

			L	T	P	C	MM

XVIII	**SOLS/ Biochem/E002**	**Clinical Biochemistry**	**3**	**0**	**0**	**3**	**100**

Note:

1. Eight questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining seven questions shall be set covering entire syllabus. The candidates shall be required to attempt Question No. 1 & Three more questions. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

Topics

1. **Disorders of Carbohydrate Metabolism -** Diabetes mellitus, glucose and galactose tolerance tests, sugar levels in blood, renal threshold for glucose, factors influencing blood glucose level, glycogen storage diseases, pentosuria, galactosemia.
2. **Disorders of Lipids –** Plasma lipoproteins, cholesterol, triglycerides and phospholipids in health and disease, hyperlipidemia, hyperlipoproteinemia, Gaucher's disease, Tay-Sach's and Niemann-Pick disease, ketone bodies, Abetalipoproteinemia.
3. **Inborn Errors of metabolism –** Phenylketonuria, alkaptonuria, albinism, tyrosinosis, maple syrup urine disease, Lesch-Nyhan syndrome, sickle cell anemia, histidinemia.
4. **Disorders of liver and kidney –** Jaundice, fatty liver, normal and abnormal functions of liver and kidney. Inulin and urea clearance.
5. **Electrolytes and acid-base balance –** Regulation of electrolyte content of body fluids and maintenance of pH, reabsorption of electrolytes.
6. **Diagnostic Enzymes –** Enzymes in health and diseases. Biochemical diagnosis of diseases by enzyme assays – SGOT, SGPT, CPK, cholinesterase, LDH.
7. **Blood Clotting –** Disturbances in blood clotting mechanism – hemorrhagic disorders – hemophilia, von Willebrand's disease, purpura, Rendu-Osler-Werber disease, thrombotic thrombocytopenic purpura, disseminated intravascular coagulation, acquired prothrombin complex disorders, circulating anticoagulants.
8. **Cancer –** Cellular differentiation, carcinogens and cancer therapy.

Suggested Reading:

1. Tietz Fundamentals of Clinical Chemistry - (5th edn.) C A Burtis, E R Ashwood (eds.) Saunders WB Co.
2. Notes on Clinical Chemistry - Whitby L G, A F Smith, G J Beckett, S M Walker, Blackwell Sci Inc.

XIX	**SOLS/ Biochem/E003**	**Outlines of Biotechnology**	**L**	**T**	**P**	**C**	**MM**
			3	**0**	**0**	**3**	**100**

Note:

1. Eight questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining seven questions shall be set covering entire syllabus. The candidates shall be required to attempt Question No. 1 & Three more questions. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

Topics

1. **Plant genetic engineering** - Prospects of improving crop productivity, gene isolation, gene transfer systems, T_i plasmid, plant virus vectors, electroporation, microinjection, microprojectile technology, gene expression, regeneration. Application in relation to protein quality, photosynthetic efficacy, nitrogen fixation efficiency and resistance to environmental stresses.
2. **Tissue culture –** Plant tissue culture, anther and pollen culture, protoplast culture, protoplast fusion, embryo rescue, animal cell lines and organ culture.
3. **Transgenic plants and animals** – Advances in producing transgenics, transgenic animals.
4. **Hybridoma technology –** Monoclonal antibodies, selection of hybrids, hybridomas, purification and application of monoclonal antibodies.
5. **Xenobiotic metabolism –** Biodegradation, detoxification of xenobiotics by micro-organisms, biodegradation of hydrocarbons, pesticides, surfactants, polyaromatic hydrocarbons, dyes; role of cytochrome P_{450} in detoxification.
6. **Proteomics –** Genome to Proteome, steps and tools for proteome analysis, 2 D-Electrophoresis, BN-PAGE.
7. **Enzyme Technology -** Large scale production of enzymes, enzyme reactors, immobilization of enzymes by chemical and physical methods. Effect of partition on kinetics and on changes in pH and hydrophobicity. Applications: synthetic organic chemistry, industry, food technology, medicines. Synzymes, enzyme electrodes and biosensors. Enzyme Engineering.

M. Sc. BIOCHEMISTRY (FORTH SEMESTER)

			L	T	P	C	MM
XX	SOLS/ Biochem/C016	Neurobiochemistry	4	0	0	4	100

Note:

1. Eight questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining seven questions shall be set covering entire syllabus. The candidates shall be required to attempt Question No. 1 & Three more questions. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

Topics

1. **Muscle Biochemistry –** Skeletal muscle structure. Actin, myosin, tropomyosin, troponin. Molecular mechanism of contraction. Functional classification of skeletal muscle fibers. Twitch. The motor unit. Role of calmodulin.
2. **Neuromorphology –** Organisation of neuron, dendrites and axons. Glial cells – astrocytes, oligodendrocytes, ependymal cells, Schwan cells.
3. **Neurophysiology** – Generation and conduction of monophasic action potential, saltatory conduction. Synaptic transmission, Neurotransmitters and their action. Blood Brain CSF barrier – Characteristics.
4. **Transport across membranes –** Types of transport (simple diffusion, passive-facilitated diffusion), active transport – primary and secondary group translocation, transport ATPases, transport by vesicle formation.
5. **Neurological disorders –** Headache, facial pain, migraine, epilepsy, multiple sclerosis, Myasthenia Gravis.

Suggested Reading:

1. Biochemistry by Lubert Stryer, Freeman & Co. NY
2. Principles of Biochemistry, Smith, Lehman, Lefkowtz, Handler and Smith
3. Lehninger's Principles of Biochemistry: D L Nelson and M M Cox, Macmillan Worth Pub Inc NY
4. Biochemistry of Lipids, Lipoproteins and Membrane (1991)- D E Vance and J E Vance Elsevier Sci.

			L	T	P	C	MM
XXI	SOLS/ Biochem/C017	Immunology	4	0	0	4	100

Note:

1. Eight questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.

3. The remaining seven questions shall be set covering entire syllabus. The candidates shall be required to attempt Question No. 1 & Three more questions. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

Topics

1. **Introduction to immune system –** Innate and acquired immunity. Structure and functions of primary and secondary lymphoid organs.
2. **Cells involved in immune responses –** Lymphoid cells (B-lymphocytes, T-lymphocytes and Null cells), mononuclear cells (phagocytic cells and their killing mechanisms), granulocytic cells (neutrophils, eosinophils and basophils), mast cells and dendritic cell.
3. **Nature of antigen and antibody –** Immunogenicity vs antigenicity, factors influencing immunogenicity, epitopes, haptens, adjuvants and mitogens. Classification, fine structure and functions of immunoglobulins, antigenic determinants on immunoglobulins, isotypic, allotypic and ideotypic variants.
4. **Generation of Diversity in Immune system –** Clonal selection theory - concept of antigen specific receptor. Organization of immunoglobulin genes: generation of antibody diversity, T-cell receptor diversity.
5. **Immune effector Mechanisms –** Kinetics of primary and secondary immune responses, complement activation and its biological consequences, cytokines and co-stimulatory molecules: role in immune responses, Antigen processing and presentation. Cell signaling – Role of MAP kinases.
6. **Major histocompatibility complex (MHC) genes and products –** Polymorphism of MHC genes, role of MHC antigens in immune responses, MHC antigens in transplantation.
7. **Measurement of antigen–antibody interactions –** Agglutination, precipitation and opsonization, gel diffusion (Ouchterlony double immunodiffusion and Mancini's Radial immunodiffusion), immunoblotting, RIA, ELISA and ELISPOT.
8. **Tolerance vs activation of immune system –** Immune tolerance, hypersensitivity (Types I, II, III, IV).
9. **Disorders of immune system –** Autoimmunity, congenital immunodeficiencies, acquired immunodeficiencies.

Suggested Reading:

1. Immunology (4th edn. 1998) by Ivan Roitt, J Brostoff and David Mole (4th edn) Mosby Times Mirror Int. Publ. Ltd.,
2. Essential Immunology (9th ed. 1997) by Ivan Roitt Blackwell Science ltd.
3. Immunology (1992) by Janis Kuby W H Freeman and Co. Ltd. USA.
4. Immunology (2nd edn. 1991) by Edwards S Golub, Sinauer Associate, Sunderland.

XXII	**SOLS/ Biochem/E005**	**Bio-statistics, Bio-informatics & Quality Management**	**L**	**T**	**P**	**C**	**MM**
			3	**0**	**0**	**3**	**100**

Note:

1. Eight questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.

3. The remaining seven questions shall be set covering entire syllabus. The candidates shall be required to attempt Question No. 1 & Three more questions. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

Topics

1. Introduction and scope of biostatistics: Presentation of data, frequency distribution, graphical representation of data by histogram, frequency curve and cumulative frequency curve. Central tendency and measures of dispersion, mean, median, mode and their properties partition value standard deviation and coefficient of variation.

2. Simple correlation coefficient and regression coefficient, regression lines. Tests of significance: t-test, z-test, chi-square tests of heterogeneity and independence of attributes, F-test. Analysis of variance (ANOVA): Principles of experimental designs, randomized block & latin square designs.

3. Introduction to computers: general idea of classification and characteristics of computers, microprocessor input / output devices, internal representation of date (bits & bytes; binary, octal & hexadecimal system), Types of languages: machine, assemble & high level languages.

4. Programming Language (BASIC): BASIC as a high language characters, constants variable names and arithmetic expressions. Programming in C++.
   Brief idea of software: M.S. Office (World, Excel, Power Point), DATA bases. Internet uniform resource locator (URL) World wide Web HTPP internet access: Netscape navigators Internet explorer. PDP, NRL - 3D

5. Quality Management: Introduction to QMS, EMS, OHSAS, QMS: Different, ISO9001:2000, quality management systems, objective of the QMS, quality system, quality planning, quality policy, management review, documentation and standard operating procedure, control of inspection, measuring and test equipment, control of non confirming product, corrective & preventive action, statistical techniques.
6. EMS: Environmental aspects, objective & targets, EMP, management review, general requirement, EMS documentation & operational control, document control monitoring & measurement, nonconformance and corrective & preventive action, emergency preparedness, ISO 14001, what is ISO, ISO 14001, benefits of EMS, ISO14001 status in India, ASO14001: PDCA cycle.
7. OHSAS: What is OHSAS, OHSAS18001:1999, occupational health & safety assessment series, what is OH & S management system, application of OHSAS 18001, principle of OHSAS 18001, elements of OHSAS, scope & structure PDCA cycle (Plant Do-Check-Adjust), hazard identification, risk assessment & risk control, legal & other requirements Global Issues: warning, acid rain, ozone depletion, desertification, deforestration, depletion of water resources, persistent organic pollutants, pops.

Introduction to 5S, modern housekeeping concept.

Suggested Reading:

1. Biostatistics: a foundation for analysis in the health. (7th ed. 1999) by W W Daniel Jhon Wiley and Sons Inc. New York.

XXIII	**SOLS/ Biochem/E006**	**Clinical Research & Pharmacology**	**L**	**T**	**P**	**C**	**MM**
			3	**0**	**0**	**3**	**100**

Note:

1. Eight questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining seven questions shall be set covering entire syllabus. The candidates shall be required to attempt Question No. 1 & Three more questions. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

Topics

1. History of development of pharmacology, introduction & general principles of route of drug administration, pharmacokinetics (absorption, distribution, metabolism and excreation) and pharmacodynamics (general mechanism of drug action)
2. Elementary introduction to adverse drug reactions and drug interactions, drug allergy.
3. Bio-assays: General principles, general methods, biological variations and animal ethics.
4. Bioassays of insulin, heparin, d-tubocurarin, digitalis, acetylocholine, adrenaline, histamine.
5. General principles of screening of drugs, general screening methods, Screening methods for evaluation of anti-inflammatory, analgesics, antipyretics and antiulcer anticonvulsants, hepatoprotective, antidiabetic, diuretic and drugs acting on CNS.
6. Clinical trial and drug development: Study of drug discovery, preclinical studies and phases of clinical trials in drug development.

Suggested Reading:

1. K. D. Tripathi Essentials of medical pharmacology by Jaypee brothers, 5th edition 2003
2. R. S. Saloskar and S. D. Bhandarkar Pharmacology and pharmacotherapeutics 17th edition 2007
3. Gandhi and Derasari Text book of elemental pharmacology.
4. Ray and Dales Pharmacology by Churchill Livingstone 6th edition 2005
5. W. Lippincott Ilustrated Pharmacology by Wolters Kluwer 2nd edition 2010

			L	T	P	C	MM
XXIV	**SOLS/ Biochem/E007**	**Drug Design**	**3**	**0**	**0**	**3**	**100**

Note:

1. Eight questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining seven questions shall be set covering entire syllabus. The candidates shall be required to attempt Question No. 1 & Three more questions. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

Topics

1. Drug receptors: Basic concepts and classification of receptors.
   Chemical forces involved in drug-receptor interactions.
   Receptor agonism and antagonism.
   Simple kinetics of drug-receptor interaction.
2. Concepts of isosterism, bioisosterism and their applications in drug-design.
3. Drug-design and discovery. Rational drug-design.
   Basic strategies of drug discovery.
   Role of molecular docking and molecular modeling in designing drugs.
   Computer aided drug design.
4. QSAR: Quantitative structure activity relationships.
   Classification of parameters used in QSAR.
   Hansch and denovo models of QSAR.
   Hammett and Taft equations of QSAR.
   Applications of QSAR in drug design.

Suggested Reading:

1. Wiliam O Foye, Principles of Medicinal Chemisr, 3rd edition, Varghese Publishing House

2. Jaime N. Delgada & Williams A Remers, Wilson and Gisvold's, Text Book of Organic Medicinal and Pharmaceutical Chemistry 9th ed. J. B. Lipponcott Company Philaidelphia, 1991.

3. Manfred E. Wolff, Burger's Medicinbal Chemistry and Drug Discovery, Vol 1 to V, 5th ed., A. Wiley- Interscience publication John Wiley & sons Inc (New York) 1995

4. Kadam & Mahadik, Bothara, Principles of Medicinal Chemistry Vol I & II, 4th ed. Nirali Prakash Pune, 1997

			L	T	P	C	MM
XXV	**SOLS/ Biochem/E008**	**Environmental Biochemistry &Toxicology**	**3**	**0**	**0**	**3**	**100**

Note:

5. Eight questions will be set in all.
6. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
7. The remaining seven questions shall be set covering entire syllabus. The candidates shall be required to attempt Question No. 1 & Three more questions. As far as possible, the questions shall be short answer type and not essay type.
8. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

Topics

1. Definition and scope of toxicology: Eco-toxicology and its environmental significance. Toxic effects: Basis for general classification & nature. Dose - Response relationship: Synergism and Antagonism, Determination of ED_{50} and LD_{50}. Acute and Chronic exposures, Factors influencing Toxicity.
2. Principles and procedures of testing for acute toxic effects: Regulatory guidelines, Mammalian systems affected and the clinical signs of Systemic Toxicity Factors affecting acute Toxicity studies.
3. Xenobiotic metabolism: Absorption and distribution. Phase I reactions. Oxidation, Reduction, Hydrolysis and Hydration. Phase II reactions/Conjugation: Methylation, Glutathione and amino acid conjugations.
4. Biochemical basis of toxicity: Mechanisms of Toxicity: disturbance of Excitable membrane function, Altered calcium Homeostasis. Covalent binding to cellular macromolecules and Genotoxicity.
5. Toxicity testing: Test Protocol, Genetic toxicity testing and Mutagenesis assays:
6. In vitro Test systems - Bacterial Mutation Tests: Reversion Test, Ames test, Fluctuation Tests and Eukaryotic Mutation Tests.
7. In vivo Mammalian Mutation tests - Host mediated assay and Dominant Lethal Test. Use of Drosophila in Toxicity testing.
8. Pesticide toxicity, Metal toxicity, Environmental factors affecting metal toxicity - effect of light, temperature and pH. Industrial effluent toxicology and Environmental health.

Suggested Reading:

1. General and applied toxicology 1995 by Mars and Turner, Macmilian Press Ltd.
2. Basic environmental toxicology 1994 by Lorris G Corkerhem and Barbara S S Shane CRP Press Inc.
3. Introduction to Food Technology by Takayunki Shibarnato & Leonard F Bzeldanes.
4. Molecular Biotechnology 2nd ed 1994 by Barnard R Glick & J J Pastemak.

			L	T	P	C	MM

XXVI	**SOLS/ Biochem/E009**	Lab Course – 7 (Based on two elective theory papers)	**0**	**0**	**9**	**3**	**100**

Minimum ten experiments based on chosen two elective theory papers.

			L	**T**	**P**	**C**	**MM**
XXVII	**SOLS/ Biochem/E010**	Project Work	**0**	**0**	**18**	**6**	**100**

It will start at beginning of Semester III but will be evaluated & its credit will considered in semester IV.

SELF-STUDY COURSES

XXVIII	**SOLS/ Biochem/S001**	**Environmental nanotechnology**	**L**	**T**	**P**	**C**	**MM**
			3	**0**	**0**	**3**	**100**

Note:

1. Eight questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining seven questions shall be set covering entire syllabus. The candidates shall be required to attempt Question No. 1 & Three more questions. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

Topics

Nanomaterials for Environmental Protection: Nano technology processes – Nano Engineering materials for Pollution Prevention, Green Chemistry, Energy efficient resources and materials, Nano technology products- Nanomaterials (nanostructures) Nanodevices and nanosystems.
Synthesis of Nanomaterials: Synthesis of nanomaterials by Physico-chemical approaches.

Bionancomposites : Nano particles and Microorganisms, Microbial Synthesis of Nano materials, Biological Methods for Synthesis of nano-emulsions using bacteria, Fungi and 5 Actinomycetes, Plants based nanoparticle synthesis, Nano composite biomaterials – Fibres, Devices and Structures, Nano Bio systems.

Advanced Characterization Methods: Optical Microscopy, Scanning Electron Microscopy, Transmission Electron Microscopy, Atomic Force Microscopy, Scanning Tunneling Microscopy, Optical Absorption and Emission Spectroscopy, Thermogravimetric Analysis, Differential Scanning Calorimetry, Thermomechanical Analysis, X-Ray, neutron diffraction.

Text/ References:

1. Environanotechnology by Mao Hong fan, Chin-pao Huang, Alan E Bland, Z Honglin Wang, Rachid Sliman, Ian Wright. Elsevier, 2010.
2. Nanotechnology: Importance and Application by M.H. Fulekar, IK International, 2010.
3. Nanotechnologies, Hazards and Resource efficiency by M. Steinfeldt, Avon Gleich, U. Petschow, R. Haum. Springer, 2007.
4. Nanotechnlogy: Health and Environmental risk by Jo Anne Shatkin. CRC press, 2008.
5. Handbook of Nanofabrication. Edited by Gary Wiederrcht. Elsevier, 2010.
6. Nanoporous materials: Advance techniques for characterization, Modeling and Processing. Edited by Nick Kanello Poulos. CRC press, 2011.
7. Inorganic Nanoparticles: Synthesis, Application and Perspectives. Edited by Claudia Altavilla and Enrico Ciliberto. CRC Press, 2011.

8. Nanostructured conductive polymers. Edited by Ali Eftekhari. Wiley, 2010.
9. Adsorption and diffusion in nanoporous material by Rolando M.A. Raque Malherbe. CRC press, 2007.
10. Introduction to Nanoscience by Gabor L. Hornyak, Joydeep Dutta, Harry F. Tibbals, Anil K. Rao. CRC Press, 2008.

			L	T	P	C	MM
XXIX	**SOLS/ Biochem/S002**	**Bio Nanotechnology**	**3**	**0**	**0**	**3**	**100**

Note:

1. Eight questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining seven questions shall be set covering entire syllabus. The candidates shall be required to attempt Question No. 1 & Three more questions. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

Topics

Bionanotechnology Concept: Biodefence application of nanotechnology, Optical meteorology for Bionanotechnology, Biological, scanning probe microscopy, Single molecule micro- spectroscopy, Structural principle of Bionanotechnology, Function of Biological Nanomolecules, DNA computers and DNA microprocessors, Biotechnology based genetic engineering, Bionanotechnology: Examples, Structural Principle of Bionanotechnology, Function of Biological Nanomolecules, Molecular motors, force, elasticity, damping, mechano-chemical coupling, Bionanomachines in Action, Biofilm inhibition by nanoparticles, small angle scattering.

Nanotechnology in Drug Delivery: Introduction, Manufacturing of Nanoparticles, Nanoparticles, Drug deliveries, Drug delivery system, Nanoparticle in Drug delivery- Available applications, Nanotechnology future application understanding for treatment.Manufacture of Nanoparticles, Nanoparticles, Drug Delivery, Drug Delivery Systems, Nanopowder and Nanocrystals, Targeting Ligands Applications of Nanoparticle in Drug Delivery, Cancer Treatment, Nanoparticle, Mediated Delivery of Sirna, Nanonephrology, Nanosystems in Inflammation, Targeting Macrophages to Control Inflammation, Tissue Regeneration, Growth And Repair, Tissue Bioengineering; Nanotechnology, Future Understanding for Treatment, Drug Delivery Technology Significance, Impact of Drug Discovery and Development.

Text/ References:

1. Nanotechnology: Importance and Application by M.H. Fulekar, IK International, 2010.
2. Nanotechnology in Biology and Medicine: Methods, Devices and Application by Tuan Vo-Dinh .CRC press, 2007.
3. Nanosystem characterization tools in the life sciences by Challa Kumar. Wiley-VCH, 2006.
4. Environanotechnology by Mao Hong fan, Chin-pao Huang, Alan E Bland, Z Honglin Wang, Rachid Sliman, Ian Wright. Elsevier, 2010.
5. Introduction to Nanoscience by Gabor L. Hornyak, Joydeep Dutta, Harry F. Tibbals, Anil K. Rao. CRC Press, 2008.

XXX	SOLS/ Biochem/S003	Biosignaling	L	T	P	C	MM
			3	0	0	3	100

Note:

1. Eight questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining seven questions shall be set covering entire syllabus. The candidates shall be required to attempt Question No. 1 & Three more questions. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

Topics

1 Molecular Mechanisms of Signal Transduction

2 Gated Ion Channels

3 Receptor Enzymes

4 G Protein-Coupled Receptors and Second Messengers

5 Multivalent Scaffold Proteins and Membrane Rafts

6 Signaling in Microorganisms and Plants

7 Sensory Transduction in Vision, Olfaction, and Gustation

8 Regulation of Transcription by Steroid Hormones

9 Regulation of the Cell Cycle by Protein Kinases

10 Oncogenes, Tumor Suppressor Genes, and Programmed Cell Death

XXXI	SOLS/ Biochem/S004	Fermentation Technology	L	T	P	C	MM
			3	0	0	3	100

Note:

1. Eight questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining seven questions shall be set covering entire syllabus. The candidates shall be required to attempt Question No. 1 & Three more questions. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

Topics

1. Introduction to fermentation technology & History of fermentation: Interaction among

chemical engineering, Microbiology and Biochemistry. Microbial culture selection for fermentation processes. Media formulation and processes optimization.

2. Bioreactors
3. Isolation, preservation and maintenance of industrial microorganisms.
4. Kinetics of microbial growth and death.
5. Air and media sterilization.
6. Types of fermentation processes: analysis of batch, fed-batch and continuous bioreactors, stability of microbial reactors, analysis of mixed microbial populations, specialized bioreactors (pulsed, fluidiz3ed, photo bioreactors etc.)
7. Measurement and control of bioprocess parameters.
8. Downstream processing: Introduction, removal of microbial cells and solid matter, foam separation, precipitation, filtration, certification, cell disruptions, liquid-liquid extraction, chromatography, membrane process, drying and crystallization. Effluent treatment: D.O.C. and C.O.D, treatment and disposal of effluents.
9. Enzyme and whole cell Immobilization and their industrial applications.
10. Industrial production of metabolites, antibiotics, amino acids & single cell protein.
11. Use of microbes in mineral beneficiation and Oil recovery.

References :

1. Biely, J.E. and Ollis D.F. Bio Chemical Engineering Fundamentals (1986) Megraw Hills.
2. Rehm, H.J. and Reed G (ed), Biotechnology, Vol 1-2, Verlag chemie.
3. Stanbury, P.E. and Whitaker A., Principles of Fermentation Technology (1984) Pergamon Press.
4. Pirt, S.J. Principles of Microbial and Cell Cultivation. Blackwell Scientific Publication, London.
5. Moo-young M. Comprehensive Biotechnology Vol. 1-4 Pergamon Press Oxford