

SYLLABUS OF BIOCHEMISTRY :

CBCS PATTERN FOR SEMISTER III AND SEMISTER IV

FROM ACADEMIC YEAR 2012- 2013

Second Year	Semester III		Semester IV	
4 Credits	<i>201:Biophysics & Instrumentation</i>		<i>204:Advance Techniques</i>	
	Unit 1:	Water, pH, Buffers, pH meter	Unit 1:	Microscopy
	Unit 2:	Adsorption, Viscosity, S.T, osmosis, Donnan	Unit 2:	Centrifugation & cell fractionation
	Unit 3:	Chromatography & Electrophoresis	Unit 3:	Radioisotopes & measurements
	Unit 4:	Colorimeter, Spectrophotometer. Spectrofluorimeter	Unit 4:	Analysis of Biochemical data (Biostatistics)
	<i>202:Cell biology &Physiology</i>		<i>205: Physiology of various systems</i>	
4 Credits	Unit 1:	Cell biology	Unit 1:	Respiratory system
	Unit 2:	Tissues (epithelial, connective, muscle, nerve)	Unit 2:	Digestive system
	Unit 3:	Physiological Chemistry.	Unit 3:	Excretory system
	Unit 4:	Circulatory system	Unit 4:	Blood
2.5 credits	<i>203: Practical</i>		<i>206: Practical</i>	
2 credits	<i>Sub Elective: 201:</i>		<i>Sub Elective: 202:</i>	

Semester III

201: Biophysics & Instrumentation

(4 credits)

Unit 1: Water, pH, Buffers, pH meter

Properties of water, Water a biological solvent, Fitness of the aqueous environment for living organisms, self Ionization of water: K_w and pK_w .

Acid, base, ampholytes, pH, pOH, pKa, weak and strong acids, Physiological importance of pH.

Buffers, buffer action, buffer capacity, Henderson – Hasselbalch equation, its limitations and uses, laboratory use of buffers, physiological importance of buffers in body fluids and tissues.

Measurement of pH: indicators, pH meter, different types of electrodes, advantages and disadvantages of different electrodes, principle, working, application, factors affecting pH determination

Unit 2: Biophysics

Poiseuille's equation, unit of viscosity, relative viscosity and its determination, factors affecting viscosity, physiological importance.

Principle of adsorption, Orientation of molecules on surface, factors affecting adsorption, application of adsorption.

Gibbs – Thomson principle of surface tension and its relation to ST, surface energy, factors affecting surface tension, methods to determine ST, applications of ST.

Mechanism of osmotic pressure, Van't Hoff's laws of osmotic pressure, Measurement of osmotic pressure (Pfeffer's, Berkley's method etc), physiological importance of osmotic pressure, counter current distribution, distribution of solutes between two immiscible solvents.

Donnan membrane equilibrium and its relation to osmotic pressure, membrane hydrolysis, importance of DM equilibrium in tissue fluids.

Unit 3: Chromatography & Electrophoresis

Principle, technique, applications, advantages and disadvantages of:

Ion exchange chromatography, Gel filtration chromatography, Affinity chromatography, Adsorption chromatography, Thin Layer Chromatography, Reverse phase chromatography, hydrophobic interaction chromatography, HPLC, GLC.

Principle, technique, factors affecting, detection, applications, advantages and disadvantages of:

Gel electrophoresis (PAGE, agarose, cellulose acetate, starch gel)

Detection methods (Staining, Densitometric), Isoelectrofocusing

2-D gel electrophoresis.

Unit 4: Colorimeter, Spectrophotometer. Spectrofluorometer

Beer-Lamberts Law, principle and working of single cell colorimeter, and double cell colorimeter.

Monochromators: filters, diffraction grating, prisms.

Principle and working of spectrophotometer and spectrofluorimeter.

Applications, merits and demerits of: colorimeter, spectrophotometer and spectrofluorimeter.

Ref:

1. Berg JM, and Tymoczko TJ, Stryer L,: Biochemistry (6th ed)
2. Daniel, C Harris: Quantitative Chemical Analysis
3. David Freifelder: Physical biochemistry (2nd ed) WH Freeman, USA)
4. Donald Voet and Voet J: Biochemistry (4th ed) 2011
5. Ghatak KL: Techniques and methods in Biology. PHI learning Pvt Ltd. 2011
6. Nelson DL and Cox MM: Lehninger's Principles of Biochemistry (5th ed) 2008
7. Oser: Hawks Physiological Chemistry (4th ed) 1965.
8. Upadhyay and Nath: Biophysical chemistry: Principles and Techniques (3rd ed)
9. Van Holde KE: Physical Biochemistry. Prentice Hall, NJ.
10. Vogel AI: A text book of quantitative inorganic analysis (3rd ed), 1975.
11. West and Todd: Text book of biochemistry ((4th ed) 1970
12. Wharton and McCarty: Experiments and methods in Biochemistry
13. Willard and Merrit: Instrumental methods of analysis (4th ed) 1971.
14. Wilson K and Walker J: Principles and Techniques of Biochemistry and Molecular Biology (6th ed) 2006. Cambridge University Press.

Semester III

202: Cell biology & Physiology

(4 credits)

Unit 1: Cell Biology

Structure, composition and functions of plant and animal cell organelles:
Cell Wall, Plasma Membrane, Endoplasmic Reticulum, Chloroplasts,
Mitochondria, Lysosomes, Golgi Bodies, Ribosomes, Nucleus, Peroxisomes, Cytosol,
Glyoxysomes.

Localization of enzymes in organelles, comparison of prokaryotic and eukaryotic cells
Cell fractionation methods to study cell organelles.

Unit 2: Tissues (epithelial, connective, muscle, nerve)

Epithelial tissue, structure of sarcomere, proteins present in muscle, muscle contraction,
sliding filament theory, regulation and role of hormones and calcium in muscle contraction

Structure and functions of nerve and glial cells, action potential and nerve conduction,
Chemical and electrical synapses, reflex action, neurotransmitters: eg. Acetyl Choline

Structure of bone, inorganic and organic phase, (collagen), bone cells, bone mineralization,
factors affecting bone remodeling, bone deformities .

Unit 3: Physiological Chemistry

Hormones: Introduction & Mechanism of hormone action (Gene activation, cAMP).
Pancreatic (Insulin & Glucagon) & Thyroid Hormones.

Vitamins as Coenzymes (B complex, vitamin C)
Structure of Vitamins & Coenzymes, Dietary Sources, Name of the deficiency diseases, and
Role of the Coenzyme in enzyme catalyzed reaction with an example.

Unit 4: Circulatory system

Structure and functions of heart, rhythmicity of heart, cardiac cycle, heart sounds, blood
pressure, factors affecting blood pressure, heart rate, factors affecting heart rate, cardiac
output, ECG, pulmonary and systemic circulation.

Ref:

1. Best and Taylor: Physiological basis of Medical practice
2. Bhagavan NV: Medical Biochemistry (4th ed), Jones and Bartlett Publishers
3. Charterjee: Human Physiology Vol. 1 and 2.
4. Chatterjee and Shinde: Text book of Medical Biochemistry
5. Das AK: Human Physiology
6. Ganong WF: Review of Medical Physiology (12th ed). Lange Medical Publishers
7. Guyton AG and Hall JE: Text book of Medical Physiology (11th ed) Harcourt Asia.
8. Murray RK, Granner DK, Mayes PA and Rodwell, VW: Harper's Biochemistry (25th ed) 2000, Prentice Hall publishers.
9. Sherwood: Human Physiology (5th ed) 2004
10. Talwar PC: Text book of Biochemistry and Human Physiology
11. Tortora G and Grabowski SR: Principles of Anatomy and Physiology (10th ed) 2003. John Wiley and sons.

203: Practicals

(2.5 credits)

Duration: 3hr

Marks: 100

Total 60 hrs

Experiments involving colorimeter

1. Sugar estimation by Nelson Somogyi method
2. Estimation of cholesterol by Zlatki's method.
3. Protein estimation by Folin-Ciocalteau method
4. Estimation of Urea by DAMO method.
5. Estimation of Creatinine by alkaline picrate method.
6. Estimation of Uric acid by phosphotungstic method.
7. Estimation of Iron by 2,2 dipyridyl method
8. Estimation of Phosphorus by Fiske-Subbaroa method.

Experiments involving Biophysics & Instrumentation

9. Electrophoresis of serum proteins(demonstration)
10. SDS-gel electrophoresis. (demonstration)
11. Paper chromatography for separation of simple sugars.
12. Paper chromatography for separation of amino acids.
13. Column chromatography for separation of plant pigments.
14. Thin layer chromatography for amino acids.
15. Viscosity measurement of olive oil.
16. pH measurements & numerical based on pH.
17. Preparation of buffer & numerical based on buffer.

Titration

1. Estimation of sugar from Urine by Benedict's method.
2. Study tour to teach advance chromatography technique (HPLC, Ion Exchange and Gas Chromatography, Spectrophotometer, Fluorimeter And Ultracentrifuge. Etc)

Ref:

1. Oser: Hawk's Physiological Chemistry (14th ed)
2. Plummer: An introduction to practical Biochemistry
3. Sheela Sharma: Experiments and Techniques, 2007.
4. Thomas and Schalkhammer: Analytical Biochemistry, 2002
5. Varlery H: Practical Clinical Biochemistry
6. Whatton and McCarty: Experimental methods in Biochemistry
7. Willard and Merrit: Instrumental methods of analysis.

Second Year	Semester III		Semester IV	
4 Credits	<i>201: Biophysics & Instrumentation</i>		<i>204: Adv. Techniques</i>	
	Unit 1:	Water, pH, Buffers, pH meter	Unit 1:	Microscopy
	Unit 2:	Adsorption, Viscosity, S.T, osmosis, Donnan	Unit 2:	Centrifugation & cell fractionation
	Unit 3:	Chromatography & Electrophoresis	Unit 3:	Radioisotopes & measurements
	Unit 4:	Colorimeter, Spectrophotometer. Spectrofluorimeter	Unit 4:	Analysis of Biochemical data (Biostatistics)
	<i>202: Cell biology & Physiology</i>		<i>205: Physiology of various systems</i>	
4 Credits	Unit 1:	Cell biology	Unit 1:	Respiratory system
	Unit 2:	Tissues (epithelial, connective, muscle, nerve)	Unit 2:	Digestive system
	Unit 3:	Physiological Chemistry	Unit 3:	Excretory system
	Unit 4:	Circulatory system	Unit 4:	Blood
2.5 credits	<i>203: Practical</i>		<i>206: Practical</i>	
2 credits	<i>Sub Elective: 201</i>		<i>Sub Elective: 202</i>	

Semester IV

204: Adv. Techniques

(4 credits)

Unit 1: Microscopy

Definitions, relationship between magnification, numerical aperture, angular aperture, resolving power and limit of resolution.

Path of light, study of important lens systems, objective lens system, condenser lens system, ocular lens system, dark field microscopy, fluorescent microscopy, TEM, SEM, preparation of samples for electron microscope.

Unit 2: Centrifugation

Principle of sedimentation, factors affecting sedimentation
Types of rotors used in centrifuges, separation methods in different rotors

Preparative centrifuges: Differential centrifugation, sub cellular fractionation, Density gradient centrifugation, applications, preparation of gradients, sample collection methods, zonal rotors

Analytical centrifuges: Ultracentrifugation, working and applications
Care and maintenance of centrifuges

Unit 3: Radioisotopes and Measurements

Radioactive decay, units of radioactivity
Measurement of radioactivity based on ionization, design and working of GM counters

Measurement of radioactivity based on scintillation, design and working of scintillation counters

Measurement of radioactivity: autoradiography
Applications of radioactivity in biological sciences
Hazards of radioactivity

Unit 4: Analysis of Biochemical data (Biostatistics)

Sampling methods, representation of data (tally, histogram, frequency polygons, pie chart etc)

Measures of central tendency (mean, median, mode). Its application in biological research.

Measures of deviation (range, MD, SD and coefficient of variation). Its application in biological research.

Normal distribution, standard error,

Null hypothesis, Test of significance, Its application in biological research.

Ref:

1. Berg JM, and Tymoczko TJ, Stryer L,: Biochemistry (6th ed)
2. Daniel, C Harris: Quantitative Chemical Analysis
3. David Freifelder: Physical biochemistry (2nd ed) WH Freeman, USA)
4. Donald Voet and Voet J: Biochemistry (4th ed) 2011
5. Ghatak KL: Techniques and methods in Biology. PHI learning Pvt Ltd. 2011
6. Nelson DL and Cox MM: Lehninger's Principles of Biochemistry (5th ed) 2008
7. Oser: Hawks Physiological Chemistry (4th ed) 1965.
8. Upadhyay and Nath: Biophysical chemistry: Principles and Techniques (3rd ed)
9. West and Todd: Text book of biochemistry ((4th ed) 1970
10. Wharton and McCarty: Experiments and methods in Biochemistry
11. Willard and Merrit: Instrumental methods of analysis (4th ed) 1971.
12. Wilson K and Walker J: Principles and Techniques of Biochemistry and Molecular Biology (6th ed) 2006. Cambridge University Press.

Semester IV

205: *Physiology of various systems*

(4 credits)

Unit 1: Respiratory system

Respiratory unit, External and internal respiration, diffusion of gases, factor affecting the diffusion of gases, transport of gases, saturation curve of haemoglobin, Bohr's effect, chloride bicarbonate shift, acid base balance, acidosis and alkalosis, role of lungs in maintaining acid base balance.

Unit 2: Digestive system

Anatomy of GI tract and its function, types of digestive glands, digestion in oral cavity, stomach and intestine.

Composition, secretion and regulation of saliva, gastric juice, pancreatic juice, intestinal juice and bile.

Digestion, absorption, and role of various hormones and enzymes in carbohydrates, proteins and lipids, role of bile salts in lipid digestion and absorption

Formation of faeces, intestinal putrefaction, fermentation.

Unit 3: Excretory system

Structure and functions of kidney, structure of nephron, normal and abnormal constituents of urine.

Mechanism of urine formation, function of glomerular membrane, GFR, T_{max}, structure, function and characteristics of tubules, tubular load, plasma clearance, threshold substances,

filtration pressure, selective reabsorption, selective secretion, active and passive transport of sugars, amino acids, urea, and Creatinine, acidification and ammonia formation, role of aldosterone, ADH

Unit 4: Blood

Functions of Blood, Composition, and functions of plasma proteins.

Cells:

Normal count, variation of RBCs, morphology and functions of RBC. ESR.

Derivatives, functions and properties of haemoglobin.

Classification of WBCs, differential count, variations, composition, and functions.

Stem cells and Haematopoiesis (Show the flowchart only)

Composition, count and functions of platelets, Mechanism of Blood Coagulation, Intrinsic and extrinsic pathways of blood clotting, list the blood clotting factors, fibrinolytic system, importance of coagulation.

Blood groups and grouping systems (Rh, ABO), Clinical importance of blood groups, HDN and hazards of incompatible blood transfusion, Importance of blood group studies.

Ref:

1. Best and Taylor: Physiological basis of Medical practice
2. Bhagavan NV: Medical Biochemistry (4th ed), Jones and Bartlett Publishers
3. Charterjee: Human Physiology Vol. 1 and 2.
4. Chatterjee and Shinde: Text book of Medical Biochemistry
5. Das AK: Human Physiology
6. Ganong WF: Review of Medical Physiology (12th ed). Lange Medical Publishers
7. Guyton AG and Hall JE: Text book of Medical Physiology (11th ed) Harcourt Asia.
8. Murray RK, Granner DK, Mayes PA and Rodwell, VW: Harper's Biochemistry (25th ed) 2000, Prentice Hall publishers.
9. Sherwood: Human Physiology (5th ed) 2004
10. Talwar PC: Text book of Biochemistry and Human Physiology
11. Tortora G and Grabowski SR: Principles of Anatomy and Physiology (10th ed) 2003. John Wiley and sons.

206: Practicals

(2.5 credits)

Duration: 3hr

Marks: 100

Total 60 hrs

1. Introduction to centrifuge and its use in separation of molecules.(A/G method of separation of globulin from serum)
2. Data collection and its statistical analysis (problem solving eg, BMI measurements, Mean & standard deviation).

Haematology practicals

3. Hb estimation by Sahli's method
4. Bleeding time and clotting time by capillary tube method
5. Determination of PCV or Hematocrit (Demonstration)
6. RBC count
7. Total WBC count
8. Differential WBC count
9. Blood group determination
10. E.S.R (Demonstration)

Qualitative analysis of urine.

11. Examination of physico-chemical properties of urine.
12. Examination of normal or physiological constituents of urine.
13. Examination of abnormal or pathological urine samples.

Other practicals

14. Qualitative test for starch digestion by amylase.
15. Extraction of lipid from oil seeds by Soxhlet method.(ground nuts)
16. Separation of plant alkaloids by TLC.(Curcuma longa, turmeric).
17. Estimation of Proline by Ninhydrin method.
18. Estimation of sugar by Folin-Wu method.
19. Extraction and estimation of Vitamin C from lemon.

Ref:

1. Oser: Hawk's Physiological Chemistry (14th ed)
2. Plummer: An introduction to practical Biochemistry
3. Sheela Sharma: Experiments and Techniques, 2007.
4. Thomas and Schalkhammer: Analytical Biochemistry, 2002
5. Varlery H: Practical Clinical Biochemistry
6. Whatton and McCarty: Experimental methods in Biochemistry
7. Willard and Merrit: Instrumental methods of analysis.