

JSS Mahavidyapeetha
JSS COLLEGE FOR WOMEN (Autonomous)
Saraswathipuram, Mysuru



NEP

Bachelor of Science Syllabus

Department of Biochemistry

DEPARTMENT OF BIOCHEMISTRY

Syllabus for B.Sc. Biochemistry- 1-6 Semesters

NEP Scheme

2022-2023

Semester	Course Code	Title	Theory/ Practical	Credit L:T:P	Hours/ Week	CIE C1	CIE C2	SEE C3	Total Marks	Exam Duration in Hours
I	Theory	Chemical Foundation of Biochemistry-1	4:0:0	4	4	20	20	60	100	2.30
	Practical	Volumetric Analysis	0:0:2	4	4	10	15	25	50	3
II	Theory	Chemical Foundations of Biochemistry -2	4:0:0	4	4	20	20	60	100	2.30
	Practical	Qualitative and quantitative analysis-2	0:0:2	4	4	10	15	25	50	3
III	Theory	Bio-organic- Chemistry	4:0:0	4	4	20	20	60	100	2.30
	Practical	Bio-organic- Chemistry	0:0:2	4	4	10	15	25	50	3
IV	Theory	Analytical Biochemistry	4:0:0	4	4	20	20	60	100	2.30
	Practical	Analytical Biochemistry	0:0:2	4	4	10	15	25	50	3
V	Theory P-5	Biochemistryof Biomolecules and nutrition	4:0:0	4	4	20	20	60	100	2.30
	Practical P-5	Qualitative analysis of Biomolecules and Their Nutritional Aspects	0:0:2	4	4	10	15	25	50	3
	Theory P-6	Human physiology And Enzymology	4:0:0	4	4	20	20	60	100	2.30
	Practical P-6	Human physiology And Enzymology	0:0:2	4	4	10	15	25	50	3
VI	Theory P-7	Metabolism with clinical correlations	4:0:0	4	4	20	20	60	100	2.30
	Practical P-7	Metabolism with clinical correlations	0:0:2	4	4	10	15	25	50	3
	Theory P-8	Molecular biology And Immunology	4:0:0	4	4	20	20	60	100	2.30
	Practical P-8	Molecular biology And Immunology	0:0:2	4	4	10	15	25	50	3

SEMESTER – I
DSC 1–GMA 210 Chemical Foundation of Biochemistry-1

Total Hours: 56

Credits: 04

Course title	Chemical Foundation of Biochemistry-1
Couse code	DSC-1T: BC-101
Course credits	04
Total contact hours	56
Duration of ESA (Hour)	03
Formative assessment marks	30
Summative assessment marks	70

Unit 1: Scope of Biochemistry and Units of measurement

14 hrs

Origin of life, types of organisms, prokaryotes, eukaryotes, unicellular, multicellular, compartmentation of functions in lower and higher organisms, and common physiological events of organisms, chemical composition of living organisms, subcellular organelles, SI units, mass, volume, temperature, amount, length and time. An overview on the metric system, atomic weight, molecular weight, equivalent weight, basicity of acids, acidity of bases, Avogadro's number, molarity, normality, molality, Dalton concept, mole concept, concentration, mole to molar conversion, oxidation number and its significance, density and specific gravity and its significance.

Unit 2 : Atomic structure and Chemical bonds

14 hrs

Structure of an atom, electrons and Quantum numbers, orbitals, shapes of orbitals, s, p, d, and f subshells, K, L, M, N, O, P, and Q shells. Illustration of Pauli's exclusion principle, Aufbau principle, and Hund's rule, electron configuration, octet rule. Formation and properties of noncovalent and covalent bonds, hydrogen bonds, ionic bonds, van der Waals interactions, London forces, dipole-dipole interactions, electrostatic interactions, and hydrophobic interactions. Sigma, pi and co-ordinate bonds, back bonding. Corresponding energy associated, outline of theories of bonding.

Unit 3: Buffers and Colligative properties

14 hrs

Acids, bases, Arrhenius concept, proton transfer theory, Lewis concept, Lowry and Bronsted concepts. Buffers, composition, pH, pH scale, Henderson- Hasselbalch equation, titration curve of H₃PO₄, pK value, isoelectric pH, ionization of HCl, HNO₃, H₂SO₄. Colligative properties and anomalous colligative properties of solutions, structure of water, phase diagram of pure water, ionic product of water, special properties of water, buffers in animal system. Solutions and types, ionizable solutes, non-ionizable solutes, vapor pressure and its application in distillation, Vant Hoff law, Roul't's law, boiling point, freezing point, deicing, osmosis and osmotic pressure determination, reverse osmosis, surface tension.

Unit 4: Electrochemistry and Redox reactions

14 Hrs

Scope of electrochemistry, electrochemical cells, Daniel cell, galvanic cell, electrode potential and its measurement, electrolysis, types of electrolytes, primary and secondary batteries, electrodes, half-cell reaction, standard electrodes. Laws of thermodynamics, entropy and enthalpy, their relation, Gibb's energy, free energy change, Lewis concept, ions, redox reactions, redox potential,

application of redox potential, energy linked to redox reactions, reduction of oxygen, oxidation and reduction of iron in hemoglobin, biological active forms of zinc, calcium, nickel, molybdenum, selenium, and cobalt, NAD^+/NADH , $\text{NADP}^+/\text{NADPH}$, FAD/FADH_2 , FMN/FMNH_2 . Molecularity and order of a reaction.

References:

1. Advanced Inorganic Chemistry: A comprehensive Text, 1999, Cotton A and Geoffrey
2. Wilkinson, 6th edition, Wiley publication
3. Inorganic Chemistry, 2014, Miessler GL, Paul Fischer PJ, and Tarr DA, 5th edition, Pearson Publication
4. Inorganic Chemistry, 2004, Catherine E and Sharpe AG, ACS publication
5. Inorganic Chemistry, 2015, Overton, Rourke, Weller, Armstrong and Hagerman, Oxford Press.
6. Physical Chemistry: A molecular approach, 2019, Donald A, McQuarrie and Simon JD, Viva Books Publication
7. Physical chemistry 2019, Atkins P, Paula JD, Keeler J, 11th edition, Oxford press

SEMESTER – II
DSC -1 GMA 210P Volumetric analysis

Total Hours: 56

Credits: 02

1. Concept of molarity, molality and normality. Calculation and preparation of molar solutions. (Problems to be given in exams). Calculation and preparation of normal solutions and percent solutions and dilute solutions.
2. Calibration of volumetric glassware's (Burette, pipette).
3. Preparation of standard Sodium carbonate solution, standardization of HCl (Methylorange) and estimation of NaOH in the given solution. (methyl orange or phenolphthalein).
4. Preparation of standard Oxalic acid. Standardization of NaOH and estimation of H_2SO_4 in the given solution (phenolphthalein).
5. Preparation of standard Oxalic acid. Standardization of KMnO_4 and estimation of H_2O_2 in the given solution.
6. Preparation of standard $\text{K}_2\text{Cr}_2\text{O}_7$. Standardization of $\text{Na}_2\text{S}_2\text{O}_3$ and estimation of CuSO_4 in the given solution.
7. Preparation of ZnSO_4 . Standardization of EDTA and estimation of total hardness of water using Eriochrome-Black-T indicator.
8. Preparation of standard potassium biphthalate. Standardization of NaOH and estimation of HCl in the given solution. (Phenolphthalein).
9. Estimation of sulphuric acid and oxalic acid in a mixture using standard NaOH solution and standard KMnO_4 solution.
10. Preparation of standard Potassium dichromate and estimation of ferrous/ferric mixture using diphenylamine indicator (Demonstration).
11. Preparation of standard oxalic acid solution. Standardization of NaOH solution and estimation of acidity in vinegar.
12. Preparation of standard potassium bi-phthalate solution, standardization of sodium hydroxide solution and estimation of alkalinity of antacids
13. Preparation of standard Oxalic acid solution. Standardization of KMnO_4 solution and estimation of calcium in milk.
- 14.

References

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009. Dr. O. P. Pandey, D. N. Bajpai, dr. S. Giri, Practical Chemistry S. Chand and Co. Ltd.,
3. Principles of Practical Chemistry- M. Viswanathan
4. Instrumental Methods of chemical Analysis B.K Sharma.
5. Experiments in Physical Chemistry R.C. Das and B. Behra, Tata McGraw Hill
6. Advanced Practical Physical Chemistry J.B.Yadav, Goel Publishing House
7. Advanced Experimental Chemistry. Vol-I J.N.Gurtu and R Kapoor, S.Chand and Co.
8. Practical Chemistry K.K. Sharma, D. S. Sharma (Vikas Publication).
9. General Chemistry experiment – Anil J Elias (University press).
10. Vogel textbook of quantitative chemical analysis G.H. Jeffery, J. Basset.
11. Quantitative chemical analysis S. Sahay (S. Chand & Co.).
12. Practical Chemistry Dr O P Pandey, D N Bajpai, Dr S Giri. S. Chand Publication
13. College Practical Chemistry. V K Ahluwalia, Sunitha Dingra, Adarsh Gulati
14. Practical Physical Chemistry- B. Viswanathan, P S Raghavan. MV Learning Publication.

SEMESTER – II
DSC 2 –GMB 210 Chemical Foundation of Biochemistry-2

Total Hours: 56

Credits: 04

Course title	Chemical Foundations of Biochemistry -2
Couse code	DSC-2T: BC-201
Course credits	04
Total contact hours	56
Duration of ESA (Hour)	03
Formative assessment marks	30
Summative assessment marks	70

Unit 1: Chemical Catalysis:

14 Hrs

Definition, characteristics, types, intermolecular, multifunctional, theories of catalysis, properties, characteristics of enzyme catalysis, autocatalysis, industrial catalysis and their role in biological systems (brief). Colloids: true solutions, classification, peptisation, purification, ultrafiltration, Brownian movements, electric properties, coagulation, mutual, lyophilic sols, boiling, dialysis, electro and persistent dialysis, addition of electrolytes, colloids in daily life and applications. Emulsion, types, micelles with biomolecules and its biological applications.

Unit 2: Nomenclature of Organic Compounds:

14 Hrs

Classification, naming- IUPAC nomenclature, compounds containing one, two functional groups with chains, homologous series. Stereochemistry, geometrical and structural Isomerism, conformation and free rotation. Optical isomerism, symmetry of elements, plane polarized light and optical purity. Nomenclature of enantiomers, epimers, racemic mixture, resolution. Fischer and Newman projection formulae, molecule with one and two chiral and achiral centers. Priority rules; E and Z (CIP rules), R and S, D and L notations, absolute (r and s) and relative (d and l) configuration. Role of stereochemistry in biological systems.

Unit 3: Organometallic Compounds:

14 Hrs

Metal atom linked organic compounds. Preparation of Grignard reagents and structure, limitations, protonolysis and reactions. Organolithium compounds, preparation and reactions. Organozinc compounds. Organoboranes its mechanisms. Ferrocenes.

Introduction to mineral and ores, classification, concentration, extraction, refining, uses of minerals and metals and its importance.

Porphyrins and Metal ions: Role of metal ions in biological systems, Fe, Cu, Zn, Structure and functions of porphyrins, metalloporphyrins and iron-sulphur clusters with suitable examples and their role in biological systems.

Unit 4: Inorganic Chemistry:

14 Hrs

Nomenclature of inorganic molecules and coordination compounds, formula. IUPAC nomenclature. Central metal ion, ligand, coordination number, sphere, complex ion, oxidation number of central atom, homoleptic and heteroleptic complexes. Isomerism in complexes, structural, ionisation, solvate, linkage and coordination, Stereoisomerism, geometrical, optical isomerism with simple inorganic complexes. Applications of qualitative, quantitative analysis, photographic, metallurgy, medicine, catalysis and biosystems.

Heavy Metal Poisons: Introduction, poisons, lead, mercury, aluminium, arsenic, corrosives, cyanide, irritants, phosphorus, CO₂, SO₂, SO₃, NO₂, halides and acid fumes, poisoning, sources, signs and symptoms. Free radicals: introduction, definition, generation and scavenger systems. Redox reactions, types, stock notations, change in oxidation number and combination. Endergonic and

exergonic reactions with examples. The Importance in biological systems.

References

1. Physical Chemistry 2006, Peter Atkins. 8th edition, W.H. Freeman and Company
2. Inorganic Chemistry: Principles of structure and Reactivity, 2006, Huheey JE, Keiter EA, Keiter RL, Pearson Education India
3. Stereochemistry: Conformation and Mechanism, 2009, Kalsi PS, New Age International Publications
4. Introduction to Stereochemistry 2012, Kurt Mislow, Dover Publications
5. A text book of Organic Chemistry 2016, Raj K Bansal, 6th edition, New Age International Publications
6. Advanced Inorganic Chemistry 1999, Cotton et al , 6th edition, A Wiley - International
7. Principles of physical Chemistry by Puri, Sharma and Pathania.
8. Physical Chemistry by R. L. Madan, G. D. Tuli. S. Chand and Co.
9. A Text Book of Physical Chemistry by K.L.Kapoor. Vol.2.Mc. Millan Publisher, India Ltd.
10. Advanced Organic Chemistry by Bahl and Arun Bahl.

SEMESTER – II
DSC 2- GMB 210P Qualitative and Quantitative analysis

Total Hours: 56

Credits: 02

1. Systematic Semi micro–Qualitative Analysis of Inorganic Salt Mixtures Systematic semi micro qualitative analysis of two acid and two basic radicals in the given inorganic salt mixture. The constituent ions in the mixture to be restricted to the following. (Any four binary mixtures shall be given)

Anions: HCO^- , CO_3^{2-} , Cl^- , Br^- , NO_3^- , BO_3^{3-} , SO_4^{2-} and PO_4^{3-} .

Cations: Pb^{2+} , Al^{3+} , Fe^{2+} , Fe^{3+} , Mn^{2+} , Zn^{2+} , Ca^{2+} , Sr^{2+} , Ba^{2+} , Mg^{2+} , K^+ , Na^+ and NH_4^+ .
2. Determination of density and viscosity of the given liquid using specific gravity bottle and Ostwald's viscometer.
3. Determination of density and surface tension of the given liquid using specific gravity bottle and stalagmometer.
4. Determination of molecular weight of non-volatile solute by Walker-Lumsden method.
5. Determination of rate constant of decomposition of H_2O_2 using KMnO_4 by volumetric analysis method using ferric chloride as catalyst.
6. Determination of distribution coefficient of benzoic acid between water and benzene or iodine between water and carbon tetrachloride.
7. Separation of Two Components from given Binary Mixture of Organic Compounds Qualitatively. (Types of binary mixtures- Solid – Solid, Solid – Liquid, Liquid – Liquid)
8. Verification of Beer's Law. Estimation of unknown concentration of a biomolecule by using colorimeter.
9. Calibration of pH meter and determination of pH of aerated soft drinks.

References

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
3. Dr. O. P. Pandey, D. N. Bajpai, dr. S. Giri, Practical Chemistry S. Chand and Co. Ltd.,
4. Principles of Practical Chemistry- M. Viswanathan
5. Instrumental Methods of chemical Analysis B.K Sharma.
6. Experiments in Physical Chemistry R.C. Das and B. Behra, Tata McGraw Hill
7. Advanced Practical Physical Chemistry J.B.Yadav, Goel Publishing House
8. Advanced Experimental Chemistry. Vol-I J.N.Gurtu and R Kapoor, S.Chand and Co.
9. Practical Chemistry K.K. Sharma, D. S. Sharma (Vikas Publication).
10. General Chemistry experiment – Anil J Elias (University press).
11. Vogel textbook of quantitative chemical analysis G.H. Jeffery, J. Basset.
12. Quantitative chemical analysis S. Sahay (S. Chand & Co.).
13. Practical Chemistry Dr O P Pandey, D N Bajpai, Dr S Giri. S. Chand Publication
14. College Practical Chemistry. V K Ahluwalia, SunithaDingra, Adarsh Gulati
15. Practical Physical Chemistry- B. Viswanathan, P S Raghavan. MV Learning Publication

SEMESTER – III
DSC 3 –GMC 210 BIO-ORGANIC CHEMISTRY

Total Hours: 56

Credits: 04

COURSE TITLE	BIO-ORGANIC CHEMISTRY
COURSE CREDITS	04
TOTAL CONTACT HOURS	56
DURATION OF ESA	03
FORMATIVE ASSESSMENT MARKS	40
SUMMATIVE ASSESSMENT MARKS	60

UNIT 1: Reaction mechanisms and aliphatic hydrocarbons

14 hours

Introduction, meaning of the term, kinetic and non-kinetic. Fundamental aspects: Homo and heterolytic cleavage. Concept of inductive effect, mesomeric effect, resonance, and hyper conjugation. Classification of organic reactions (substitution, addition, elimination, and re-arrangement), with two examples for each. Concepts Reactive intermediates of the following – free radicals, carbo cations and carbanions, free radicals, carbines, nucleophiles and electrophiles (Formation and Stability).

Hydrocarbons -Mechanism of addition of HCl to propene, Markownikoff's rule. Peroxide effect, Alkenes – Ozonolysis, oxidation. Alkynes – formation of acetylides and their importance. Dienes– types with examples. Conjugate dienes, 1,3-butadiene – stability, mechanism of addition of HBr. Conformational analysis of ethane and n-butane.

UNIT 2: Mechanism of substitution, elimination, and addition reactions

14 hours

SN1 and SN2 reactions on tetrahedral carbon, energy profile diagrams, Stereochemistry, factors affecting SN2 and SN1 reactions. The Elimination reactions- E2 reaction, Zaitsev rule, E1 reaction. Stereochemistry of E1 & E2 reactions, E2 & E1 elimination from cyclic compounds. Substitution and Elimination reactions in Synthesis. Addition reactions - Aldehydes and Ketones - nucleophilic addition of acetals & ketals. Addition of Ammonia, primary amines, and other ammonia derivatives. Conjugate addition. Conjugation addition in alpha and beta unsaturated aldehydes and ketones 1, 2 and 1,4 addition.

UNIT 3: Mechanism of electrophilic aromatic substitution reactions

14 hours

Aromatic compounds - aromaticity, criteria for aromaticity, anti-aromatic, and non-aromatic compounds with examples. Mechanism of electrophilic aromatic substitution reactions- Halogenation, nitration, sulfonation, Friedel crafts alkylation. Friedel crafts acylation- mechanism involved. Relative reactivity of substituted benzenes, polycyclic benzenoid hydrocarbons. The reaction of the coenzymes.

Overall view of metabolism, thiamine pyrophosphate- structure and its role in decarboxylation of alpha- keto acids. Biotin- structure and its role in carboxylation of some important biochemical reactions of carbohydrate and lipid metabolism.

Vit B2 its role in rearrangement reactions.

Vit B2 coenzymes its role in redox reactions with suitable examples.

UNIT 4: Bio-organic compounds

14 hours

Alcohols: Classification, monohydric alcohols: examples, general and distinguishing reactions. Dihydric alcohols: glycols, Tri hydric alcohols: glycerol – synthesis from propene, properties and uses.

Phenols: Classification, electronic interpretation of acidity of phenols, mechanism of Kolbe, Reimer–Tiemann and bromination reactions.

Hydroxy acids: Structure and properties: Lactic acid, Citric acid and Isocitric acid. Dicarboxylic acids: Maleic and Fumaric acid. Ketoacids: Pyruvic, α -Ketoglutaric, Oxaloacetic acid.

Carbonyl compounds: General properties, Keto-enol tautomerism. Mechanisms: addition of HCN to acetaldehyde, Claisen and aldol condensations. Quinones: o and p-benzoquinones- structure and properties.

Amines: Classification, properties, functional group – Basicity of amines, acylation. Reaction with HNO_2 & Schiff's base formation. Distinguishing reactions of primary, secondary and tertiary amines.

Heterocyclic compounds: Definition, classification with examples, structure and biological importance of furan, pyrrole, thiophene, pyridine, pyran, thiazole, pyrimidine, purine, indole, imidazole, quinoline and isoquinoline. Basicity of pyrrole and pyridine.

Terpenes: Definition, Isoprene rule, classification, isolation, structure and biological importance of menthol, camphor, farnesol, phytol, lanosterol, lycopene and dolichols.

Steroids: Basic ring structure in steroids. Structure and biological importance of cholesterol, phytosterols, ergosterol, cortisol, β -estradiol, testosterone, and aldosterone. Bile acids (Mono, Di & Tri cholic acids).

Alkaloids: Definition, classification based on their structure and biological functions, Isolation of alkaloids, structure and physiological action of morphine, nicotine and atropine.

REFERENCES

1. Textbook of Organic Chemistry 22nd Edition S. Chand Publishers 2019.
2. Organic Chemistry. Vol. I Fundamental Principles. I. L. Finar. 6th Edn. ELBS, 2002
3. Organic Mechanisms, Peter Sykes, Longman, 1977
4. Organic Chemistry. R.T. Morrison and R.N. Boyd. 6th Edn. Prentice Hall, India, 2018
5. Lehninger- Principles of Biochemistry; DL Nelson and MM Cox [Eds], 6th Edn. Macmillan Publications 2012
6. Chemistry- An Introduction to General, Organic and Biological Chemistry, 7th Edn. Karen C. Timberlake, Benjamin Cummings, 1999
7. Reaction Mechanisms at a Glance, ed. M. Moloney, Blackwell Science 2000.

SEMESTER – III
DSC 3- GMC 210P BIO-ORGANIC CHEMISTRY

Total Hours: 56

Credits: 02

1. Systematic qualitative analysis of organic compounds (6 practicals)
Urea, aniline, Benzoic acid, salicylic acid, Benzaldehyde, Acetophenone, Chlorobenzene, Nitrobenzene.
2. Preparation of following organic compounds (2 practicals)
 - a. Acetylation: Preparation of acetyl salicylic acid from salicylic acid.
 - b. Oxidation: Preparation of benzoic acid from benzaldehyde.
 - c. Nitration: Preparation of m-dinitrobenzene from nitrobenzene.
 - d. Hydrolysis: Preparation of benzoic acid from ethyl benzoate.
3. Extractions
 - a. Extraction of caffeine from tea leaves
 - b. Extraction of starch from potatoes
 - c. Extraction of casein from milk

REFERENCES:

1. Practical Organic Chemistry: Qualitative Analysis by S.P. Bhutani, A. Chhikara 2009
2. Textbook of Practical Organic Chemistry Including Qualitative Organic Analysis by Arthur Israel Vogel 2003
3. Comprehensive practical organic chemistry- preparation and quantitative analysis. V. K. Ahluwalia and Renu Aggarwal 2004
4. Practical Hand Book of Systematic Organic Qualitative Analysis. Md. Rageeb Md. Usman, S. S. Patil 2017
5. Laboratory Manual of Inorganic & Organic Chemistry (Qualitative Analysis) Kalpa Mandal, Sonia Ratnani 2020

SEMESTER – IV
DSC 4–GMD 210 -ANALYTICAL BIOCHEMISTRY

Total Hours: 56

Credits: 04

COURSE TITLE	ANALYTICAL BIOCHEMISTRY
COURSE CREDITS	04
TOTAL CONTACT HOURS	56
DURATION OF ESA	03
FORMATIVE ASSESSMENT MARKS	40
SUMMATIVE ASSESSMENT MARKS	60

UNIT 1: Biological sample preparation and fractionation

14 hours

Introduction and objectives of "Bioanalysis and extraction of molecules from tissues and cells. Sample preparation types of sample living, postmortem extraction of macromolecules from tissues; liquid-liquid, liquid-solid and precipitation methods.

Centrifugation- Introduction, principles of centrifugation, Sedimentation, angular velocity, centrifugal field, relative centrifugal field. Types of centrifugations- Preparative and analytical. Differential, density gradient and ultra-centrifugation. Basic instrumentation; types of rotors and their design. Laboratory centrifuge; operational instruction and applications. Analytical Centrifuges- Optics; Application in sub-cellular fractionation. Sedimentation coefficient, care, and maintenance of instrument.

UNIT 2: Chromatography

14 hours

General principles of chromatography, history of chromatography. Classification based on 1. physical way stationary and mobile phase are brought together- Planar and column chromatography, 2. based on types of mobile and/or liquid phase adsorption and partition- Gas chromatography and liquid chromatography. Based on stationary phase-thin layer chromatography, Paper chromatography - ascending, descending and circular, 2-D chromatography, R_f values.

Classification of chromatography based on separation: Principles, methodologies and applications of adsorption, partition, ion-exchange, gel-filtration hydrophobic chromatography and affinity-chromatography. Advanced chromatography- HPLC and FPLC, UPLC and GLC.

UNIT 3: Electrophoretic and Isotopic methods

14 hours

Electrophoresis: General principle of electrophoresis, velocity of a charged molecule in the applied electric field,. Supporting media for electrophoresis; work of Tiselius, paper, agarose, polyacrylamide. Chemistry of polymerization of acrylamide gels, methodology and applications of native PAGE and SDS- PAGE, 2-D electrophoresis, Identification of proteins post electrophoresis- dyes and biological activities. Agarose gel and Pulse field electrophoresis, Applications of capillary electrophoresis and isoelectric focusing. Cellulose acetate electrophoresis. Principle and applications of immune- electrophoresis. Diagonal electrophoresis, Zymogram.

Radioisotopic methods: Radioactivity–Types of radioactive decay, Properties of α , β , γ radiations. Group displacement law. Decay law - decay constant, Half-life period and average life of a radioactive element. Detection of radioactivity – GM counter and scintillation counters (only

principal and working) Applications of radioisotopes – ^3H , ^{14}C , ^{131}I , ^{60}Co and ^{32}P . Biological effects of radiations. Radiolabeling, safety measure in handling radio isotopes. Heavy isotopes, Quantitation and applications.

UNIT 4: Spectroscopic methods of bio-analysis

14 hours

Spectroscopic methods: Wave particle duality of light, electromagnetic spectrum, transition in spectroscopy. Principle, design and application of UV-Vis spectrophotometer. Beer's law and its limitations, determination of molar absorption coefficient of molecules. Working principle and application of a colorimeter, flame photometer and Fluorescence and Phosphorescence fluorimeter. Principle and application of IR, and Raman, ESR and NMR spectroscopy.

REFERENCES:

1. Analytical techniques in Biochemistry and Molecular Biology; Katoch, Rajan. Springer 2011
2. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology 8th Edn. Andreas Hoffman and Samuel Clockie, Ed., Cambridge University Press, 2018.
3. Biochemistry and Molecular Biology; 5th Edn. D. Papachristodoulou, A. Snape, W.H. Elliott, and D. C. Elliott, Oxford University Press 2014

SEMESTER – IV
DSC 4 –GMD 210P -ANALYTICAL BIOCHEMISTRY

Total Hours: 56

Credits: 02

1. Haematology: WBC Counting: TC and DC (2 Practicals)
2. Determination of packed cell volume/ hematocrit
3. Resolution of basic, acidic and aromatic amino acids by descending and circular paper chromatography.
4. Separation of plant pigments by Adsorption chromatography.
5. Identification and resolution of pigments by thin layer chromatography.
6. Demonstration of Gel Filtration Chromatography.
7. Recording the absorption spectrum of riboflavin.
8. Colorimetric estimation of glucose by DNS method.
9. Estimation of DNA by diphenylamine method.
10. Electrophoretic separation of plasma proteins.

REFERENCES:

1. Analytical techniques in Biochemistry and Molecular Biology; Katoch, Rajan. Springer, 2011
2. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology 8th Edn. Andreas Hoffman and Samuel Clockie, Ed., Cambridge University Press, 2018.
3. Biochemistry and Molecular Biology; 5th Edn. D. Papachristodoulou, A. Snape, W.H. Elliott, and D. C. Elliott, Oxford University Press, 2014

SEMESTER – V
DSC 5–GME 210 - BIOCHEMISTRY OF BIOMOLECULES and NUTRITION

Total Hours: 56

Credits: 04

COURSE TITLE	BIOCHEMISTRY OF BIOMOLECULES and NUTRITION
COURSE CREDITS	04
TOTAL CONTACT HOURS	60
DURATION OF ESA	04
FORMATIVE ASSESSMENT MARKS	40
SUMMATIVE ASSESSMENT MARKS	60

UNIT I: Carbohydrates

15hours

Definition, empirical formulae, Classification with examples (Haworth & cyclic structures). Biological importance. Stereochemistry – Concept of + & -, D & L, epimers, anomers, diastereomers and mutarotation.

Monosaccharides: Configuration relationship of D-aldoses, D-ketoses. General properties of aldoses and ketoses (Oxidation, reduction, reducing property, formation of glycosides, acylation, methylation, condensation – phenyl hydrazine, addition – HCN). Interconversion of aldoses and ketoses by chemical method. Ascending and descending series by chemical methods. Elucidation of open chain structure and ring structure of glucose. Conformation of glucose (only structures). Structure of galactose, mannose, ribose and fructose. Structure and biological importance of deoxy sugars (2'-deoxy- β -D- ribose), sugar acids (Glucuronic acids, Neuraminic acid & Muramic acid), amino sugars (Glucosamine & Galactosamine).

Disaccharides: Determination of nature of Glycosidic linkage of Sucrose and Lactose. structure and Biological Importance of Isomaltose, Trehalose and Maltose.

Polysaccharides:

Homopolysaccharides- Occurrence, Partial Structure & biological importance of storage & structural polysaccharides - Starch, Glycogen, Cellulose, Chitin, Pectin and Inulin.

Heteropolysaccharides- Hyaluronic acid, Chondroitin sulfate and Heparin.

Bacterial cell wall polysaccharides: Occurrence, Partial structure and biological importance of Peptidoglycan & Teichoic acid.

Nutritional aspects of Carbohydrates:

Dietary sources of carbohydrates, dietary fibers (types, beneficial & adverse effects), protein sparing action, Glycemic index- importance with examples, lactose intolerance.

UNITII: Amino acids and Proteins

15hours

Amino acids: Structure and classification of amino acids based on polarity with examples. Zwitterionic properties. pKa values, D & L notation. Reactions of the amino groups with HNO_2 , LiAlH_4 . Ninhydrin, Phenyl isothiocyanate, DANSYL Chloride, Fluorodinitro benzene. Reaction of

carboxyl group – Hydrazine.

Peptides: Peptide bond formation and structure , structure and biological importance of glutathione, Valinomycin. Synthetic peptides structure and biological importance of - polyglutamic acid, polylysine.

Proteins: Classification of proteins based on composition , structure and functions with examples.

Forces that stabilise the structure of proteins,

Primary structure of proteins, methods of determining N- and C- terminal aminoacids, amino acid composition, sequencing by Edman's degradation method.

Secondary Structure – α helix, β -sheet, β - bend.

Tertiary Structure - Globular protein - Myoglobin and Fibrous protein - Collagen.

Quaternary structure -Hemoglobin.

Denaturation and Renaturation of proteins- Anfinsen's experiment.

Nutritional aspects of Proteins:

Dietary sources of proteins, Essential amino acids, nutritional classification, nutritive value of proteins- Protein Efficiency Ratio (PER) and biological value (BV). Nitrogen balance, mutual Supplementation of proteins. Protein energy malnutrition (PEM): Kwashiorkor and Marasmus

UNIT III: Lipids and Nucleic acids

15hours

Classification and biological role of lipids, fatty acids – nomenclature of saturated and unsaturated fatty acids. Acylglycerols: Mono, di and triacylglycerols.

Chemical constants : Saponification, saponification value, iodine value, acid value and significance.

Physical and chemical properties - Hydrolysis, Hydrogenation and Rancidity.

Phosphoglycerides: Structure of lecithin (phosphatidylcholine), cephalins, phosphatidylinositol, plasmalogens, and cardiolipin. Biological role of phosphoglycerides.

Sphingolipids: Structure and importance of sphingomyelin.

Glycolipids:

Glycosphingolipids: structure and importance of gangliosides and cerebroside. Prostaglandins: Types, structure of PGE₂, PGI₂, PGD₂ and PGF₂ Alpha. Biological roles of thromboxanes, leukotrienes, cyclo-oxygenases and prostaglandins.

Plasma lipoproteins: Types and functions.

Nutritional aspects of Fats: Dietary sources of fats, visible and invisible fat, Trans fats, essential and omega fatty acids and their biological importance, role of DHA and EPA.

Nucleic acids: Composition of DNA and RNA. Nucleosides and Nucleotides. Other functions of nucleotides – source of energy, component of coenzyme and second messengers. Chargaff's rule. Watson and Crick model of DNA. Nucleic acid chemistry- UV absorption, Effect of alkali and acid on DNA, Chemical reactions of RNA and DNA. Melting of DNA (T_m). Types of RNA (mRNA, tRNA and rRNA), Secondary structures of tRNA – clover leaf model.

Unit V : Nutritional Biochemistry

15hours

Introduction: Concept of Nutrition, calorific value of foods and its determination (Bomb calorimeter). Respiratory quotient, Basal Metabolic Rate, factors affecting BMR. Specific dynamic action (SDA) of foods.

Vitamins: Biochemical functions and deficiency symptoms of Thiamine, Riboflavin, Niacin, Pantothenic acid, Pyridoxine, Biotin, Folic acid, Vit-B12 and Vit - C. Fat soluble vitamins- A, D, E and K.

Mineral Metabolism: Physiological functions and deficiency disorders of Ca, P, Na, K, Cl, Mg, Fe, I

Antinutritional factors: Sources and harmful effects of anti-vitamins (Eg. Avidin, Dicoumarol), Natural toxicants (Eg. Lathyrus sativa) and adulterants (Eg. butter yellow, lead chromate).

REFERENCES

1. Principles of Biochemistry, Donald Voet, Judith G Voet, Charlotte W. Pratt, 4th Edition, John Wiley and Sons Inc, 2012
2. Lehninger-Principles of Biochemistry; D L Nelson and M M Cox [Eds], 6th Edn. Macmillan Publications 2012
3. Biochemistry-the chemical reactions of living cells, David E Metzler, 2nd Edition, Elsevier Academic Press,
4. Fundamentals of Biochemistry, Jain, J.L, S.Chand publication 6th Edition, 2005.
5. Biochemistry, Jeremy M. Berg, John L. Tymoczko, Lubert Stryer, Freeman and company, 7th Edition, 2010.
6. Harper's Illustrated Biochemistry, Victor W Rodwell, et.al, 31st edition, McGrawHill Education Lange ® 2018.
7. Biochemistry, Lubert Stryer 5th edition 2015

SEMESTER V

DSC 5- GME 210P- QUALITATIVE ANALYSIS OF BIOMOLECULES and THEIR NUTRITIONAL ASPECTS

Total Hours: 56

Credits: 02

1. **Carbohydrates:** monosaccharides (glucose, fructose, g) disaccharides (lactose, maltose, sucrose) Molisch Test, Iodine Test, Benedict's Test, Barfoed's Test, Seliwanoff's test, Bial's test, Fehling's Test, Picric Acid Test, Osazone Test.
2. **Proteins:** Biuret Test, Ninhydrin Test, Precipitation reactions of proteins- Precipitation by salts (half-saturation test), precipitation by organic solvents, precipitation by acidic reagents, precipitation by heavy metal ion, precipitation by heat; colour reactions of proteins (gelatin and albumin) and any five amino acids Xanthoproteic test, Millon's Test, Sakaguchi Test, Hopkins- Cole Test, Lead acetate test, Sullivan and McCarthy's Test, Isatin Test, Pauly's Diazo Test.
3. **Lipids:** solubility, acrolein test, Salkowski test, Lieberman-Burchard test.
4. **Nucleic acids:** diphenyl amine test, orcinol test
5. Estimation of amino acid by formal titration.
6. Nutrition experiments (Extractions and detection from natural sources, detection of food adulterants).
7. Extraction and estimation of iron from drumstick.
8. Extraction and estimation of vitamin C from lemon or gooseberry

REFERENCES:

1. Practical Biochemistry, Geetha Damodaran, Jaypee, 2011
2. Biochemical methods, S. Sadasivam, A. Manickam, 3rd Edition, New Age International Pvt Ltd, 2007
3. An Introduction to Practical Biochemistry, David Plummer, 3rd edition 2017
4. Laboratory manual in Biochemistry, J. Jayaraman 2011

SEMESTER V
DSC 6- GME 212- HUMAN PHYSIOLOGY and ENZYMOLOGY

Total Hours: 56

Credits: 04

Part- A: HUMANPHYSIOLOGY

UNIT I :

15hours

Nervous System: Brief outline of nervous system, Neurons – types, structure of multipolar neuron, mechanism of nerve impulse transmission- along axon, across synapse. Action potential & resting potential. Neurotransmitters – Excitatory & Inhibitory with examples.

Respiratory system: mechanism of respiration (pulmonary ventilation), gas exchange mechanism, biochemical events in the transport of gases & factors affecting, role of lungs in acid-base balance.

Cardio-vascular system: Blood vessels – types. Cardiac cycle, cardiac output, blood pressure, heart rate, ECG.

Body fluids – blood (composition, structure & functions of blood cells), blood clotting mechanism, Lymph and CSF.

Muscular System: Types of muscles and their structure. Ultra structure of skeletal muscle fibre. Contractile & regulatory proteins of muscle. Sliding filament model of skeletal muscle contraction.

UNIT II :

15hours

Bone and Cartilage: types of bone and cartilage. Long bone – Composition, structure, growth & remodeling, factors affecting.

Digestive System and GIT: Digestion, absorption & transport of carbohydrates, lipids and proteins. Role of various enzymes involved in digestive process.

Hepatic System: Structure of a liver lobule. Role of liver in metabolic, storage and detoxification.

Excretory System: Structure of Nephron. Formation of urine- Physiology of glomerular filtration and GFR, Tubular processing of the glomerular filtrate. Role of kidney in acid base balance

Endocrine System: Classification of hormones. Mechanism of action of hormones –Peptide hormones (water soluble)-second messenger concept (cAMP, cGMP, IP₃, DAG and Ca²⁺). Physiological role of hormones of hypothalamus, pituitary, adrenal, thyroid, pancreas and gonads. Regulation of their secretion.

Part-B: ENZYMOLOGY

UNIT III:

15hours

Introduction to enzymes: Nature of enzymes –protein and non-protein (ribozyme). Cofactor and prosthetic group, apoenzyme, holoenzyme, IUBMB classification of enzymes with examples. International Units of enzyme activity, specific activity.

Monomeric and oligomeric enzymes- multifunctional enzymes and multi- enzyme complexes, isoenzymes- lactate dehydrogenase, immobilized enzymes.

Features of enzyme catalysis- transition state theory, reaction rates and thermodynamics of reaction & Catalytic power.

Specificity of enzymes – Group, Optical, substrate and reaction specificity.

Concept of Active site - Salient features.

Mechanism of interaction- Lock and Key theory and Induced fit model.

UNIT IV:

15 Hours

Enzyme kinetics

Factors affecting enzyme activity- Substrate concentration - Michaelis- Menton equation (No derivation), Lineweaver-Burk plot-determination of K_m & V_{max} and their significance. pH, temperature, activators and inhibitors.

Enzyme kinetics of single substrate reactions:

Michaelis-Menten equation, equilibrium constant – mono substrate reactions, relationship between initial velocity and substrate concentration, Factors affecting the rate of chemical reactions - enzyme concentration, substrate concentration- pH, temperature and metal ions. Line weaver- Burk plot. Determination of V_{max} & K_m from L-B plot and their significance, K_{cat} and turnover number.

Enzyme inhibition:

Reversible inhibition- competitive, uncompetitive, non-competitive with graphical representations using L-B plots, Evaluation of K_m and V_{max} in presence of inhibitor mixed and substrate.

Irreversible inhibition-Suicide inhibition-antibiotics as inhibitors- penicillin.

REFERENCES:

1. Chatterjee C C, Human physiology, Medical allied gency. NewDelhi2020
2. Gerard Tortora, Bryan H Derrickson. Principles of anatomy and physiology, 13th edition, John Wiley & Sons 2000
3. Gytton and Hall, Textbook of medical physiology, 10thedition, Elsevier Health Sciences 2015
4. Sembulingam K & Prema Sembulingam, Essentials of medical physiology, 3rd edition, Jaypee Brothers, 2019.
5. Thomas D.Pollard,William C. Earnshaw, Jennifer Lippincott- Schwartzand Graham T. Johnson, Cell Biology, 3rd edition, Elsevier 2017.
6. Lodish,Berk,Kaiser,Kriegeretal,MolecularCellBiology,6thedition,2010
7. Bruce Alberts, Hopkin, Johnson Morgan, Raff, Roberts, and Walter, Essential Cell Biology, 5th edition, W.W. Norton & Company,2019
8. Cox,Michael M. Lehninger principles of biochemistry.Freeman, 2013.
9. Lubert Stryer.Biochemistry,5thedition,2006
10. Palmer,Understandingenzymes,4thedition,PrenticeHall/EllisHorward, Landon 2000
11. Price, Nicholas C., and Lewis Stevens. Fundamentals of Enzymology.Oxford Science Publications. Second edition. New York, 2010
12. Buchholz, Klaus, Volker Kasche, and U we The oBorn scheuer. Biocatalysts and enzyme technology. John Wiley & Sons, 2012.
13. Voet, Donald, Judith G. Voet, and Charlotte W.Pratt."Fundamentals of Biochemistry." New York: John Wiley & Sons2008.
14. Devlin,Thomas M.Textbook of biochemistry :with clinical correlations. John Wiley & Sons, 2011.

SEMESTER V
DSC 6- GME 212P- HUMAN PHYSIOLOGY and ENZYMOLOGY

Total Hours: 56

Credits: 02

HUMAN PHYSIOLOGY

1. Determination of ABO blood grouping
2. Enumeration of WBC count using Haemocytometer
3. Separation of Serum and Plasma from Blood
4. Estimation of hemoglobin content in blood
5. Examination of prokaryotic & eukaryotic cells
6. Study of different stages of mitosis & meiosis in onion root tip- squash preparation method.

ENZYMOLOGY

1. Salivary amylase/ β -amylase
2. Construction of Maltose/ glucose calibration curve by DNS method and determination of activity of amylase
3. Determination of specific activity of amylase
4. Determination of pH optimum of amylase.
5. Determination of K_m and V_{max} of amylase.
6. Determination of initial velocity [time kinetics] of amylase.
7. Determination of optimum temperature of amylase.
8. Determination of titrable acidity and ammonia in urine.

REFERENCES

- Essentials of Medical Physiology, K.Sembulingam and P.Sembulingam. Jaypee brothers medical publishers, New Delhi, 2019
- Text book of Medical Physiology-C, Guyton and John .E. Hall. Miamisburg, O H, U.S.A, 12th edition 2011
- Textbook of Practical Physiology, C.L.Ghai, Jaypee brother's medical publishers, New Delhi, 10th edition 2022
- A Handbook of practical Microbiology, R.Saravanan, D.Dhachina moorthi, CH. MM.PrasadaRao, 2019
- Essentials of Medical Physiology, K.Sembulingam and P.Sembulingam. Jaypee brothers medical publishers, New Delhi, 2019
- An introduction to Practical Biochemistry, David Plummer, 3rd edition 2017
- Laboratory manual in Biochemistry, Jayaraman J, New Age International publications, 2011
- Practical Manual of Biochemistry, Sattanathan G., Swaminathan P. and Balasubramanian B. Sky fox press, 2020
- Practical manual of Biochemistry, S.P Singh, 7th edition, CBS publications, 2013.
- Sawhney, S.K., and Randhir Singh. Introductory practical biochemistry. Alpha Science Int'l Ltd., 2000.

SEMESTER VI
DSC 7- GMF 210- METABOLISM WITH CLINICAL CORRELATIONS

Total Hours: 56

Credits: 04

COURSE TITLE	METABOLISM WITH CLINICAL CORRELATIONS
COURSE CREDITS	04
TOTAL CONTACT HOURS	60
DURATION OF ESA	04
FORMATIVE ASSESSMENT MARKS	40
SUMMATIVE ASSESSMENT MARKS	60

UNIT I : **15 hours**

Bioenergetics: Laws of thermodynamics, free energy change, equilibrium constant, energy charge, ATP cycle, phosphorylation potential, and phosphoryl group transfers. Chemical basis of high standard energy of hydrolysis of ATP.

Oxidative phosphorylation: Proton gradient generation, redox loop, Q cycle, Proton pumping. The electron transport chain. Peter-Mitchell ChemiOsmotic hypothesis. osmotic hypotheisis – proton motive force, Fo-F1 ATP synthase - structure and mechanism of ATP synthesis.

UNIT II : **15 hours**

Metabolism: Anabolism and catabolism, compartmentalization of metabolic pathways.

Metabolism of Carbohydrates: Reactions and energetics of glycolysis, entry of fructose, galactose, mannose and lactose into glycolytic pathway. Fates of pyruvate - conversion of pyruvate to lactate, alcohol and acetyl CoA. Cori's cycle.

Reactions and energetics of TCA cycle, amphibolic and integrating roles of TCA cycle. Anaplerotic reactions. Regulatory steps of glycolysis and TCA cycle, Gluconeogenesis and glycogenolysis. Pentose phosphate pathway and its significance.

Disorders of Carbohydrate metabolism – Glycogen storage diseases and Diabetes Mellitus.

UNIT III: **15hours**

Metabolism of Lipids:

Introduction, hydrolysis of triacylglycerols, transport of fatty acids into mitochondria, β - oxidation of saturated and unsaturated fatty acids, ATP yield from fatty acid oxidation. Biosynthesis of saturated and unsaturated fatty acids. Fatty Acid Synthase complex, Lipogenesis (De novo synthesis of Fatty acid), Elongation of Fatty acid (Mitochondrial elongation). Biosynthesis of TAG, Phospholipids (Lecithin and Cephalin). Cholesterol metabolism.

Metabolism. Disorders of lipid metabolism – Tay-Sach's disease, Niemann-Pick disease.

Nucleic Acid metabolism: Degradation of nucleic acids, action of nucleases-DNase I and II, RNase and phosphodiesterases. Catabolism of purines and pyrimidines. Salvage pathways. De novo biosynthetic pathways of purine and pyrimidine nucleotides. Conversion of ribonucleotides to deoxy ribonucleotides.

Disorders of purine and pyrimidine metabolism: Gout, Lesch-Nyhan syndrome

UNIT IV:**15hours**

Metabolism of Amino acids: General mechanism of amino acid metabolism: Deamination-oxidative and non – oxidative deamination, transamination, decarboxylation (biologically important amines) and desulphuration. Catabolism of carbon skeleton of amino acids, glycogenic and ketogenic amino acids. Urea cycle and its significance. Synthesis and catabolism of alanine, serine and cysteine.

Disorders of amino acid metabolism: Phenyl ketonuria, Alkaptonuria, Maple syrup urine disease.

REFERENCES

1. Principles of Biochemistry, Donald Voet, Judith G Voet, Charlotte W.Pratt,4th Edition, John Wiley and Sons Inc, 2012
2. Lehninger-Principles of Biochemistry ; D L Nelson and M M Cox[Eds), 6th Edn. Macmillan Publications 2012
3. Biochemistry-the chemical reactions of living cells, David E Metzler,2ndEdition, Elsevier Academic Press,
4. Fundamentals of Biochemistry, Jain, J.L, S.Chand publication 6th Edition, 2005.
5. Biochemistry, Jeremy M. Berg,JohnL. Tymoczko, Lubert Stryer,Freeman and company, 7th Edition, 2010.
6. Harper's Illustrated Biochemistry, Victor W Rodwell, et.al,31st edition, McGraw Hill Education Lange ® 2018.

SEMESTER VI
DSC 7- GMF 210P- METABOLISM WITH CLINICAL CORRELATIONS

Total Hours: 56

Credits: 02

1. Estimation of Blood glucose
2. Estimation of Urea
3. Estimation of Uricacid
4. Estimation of creatinine
5. Estimation of cholesterol
6. Qualitative analysis of urine for
7. urea, uricacid, creatinine and aminoacids. Chlorides, sulphates, phosphates and ammonia.
8. Abnormal constituents such as glucose, albumin, bile pigments, bile salts and ketone bodies.
9. Liver function test-Assay of SGOT, SGPT and alkaline phosphates.

II :Report:

Visit to scientific / research institute /Clinical laboratory-Tour report.

OR

Submission of assignment on recent trends in biochemistry

REFERENCES:

1. Practical Biochemistry, Geetha Damodaran, Jaypee, 2011
2. Biochemical methods, S.Sadasivam, A.Manickam, 3rd Edition, NewAge International Pvt Ltd, 2007
3. An Introduction to Practical Biochemistry, DavidPlummer, 3rd edition 2017
4. Laboratory manual in Biochemistry, J.Jayaraman 2011.

SEMESTER VI
DSC 8- GMF 212- MOLECULAR BIOLOGY AND IMMUNOLOGY

Total Hours: 56

Credits: 04

COURSE TITLE	MOLECULAR BIOLOGY AND IMMUNOLOGY
COURSE CREDITS	04
TOTAL CONTACT HOURS	60
DURATION OF ESA	04
FORMATIVE ASSESSMENT MARKS	40
SUMMATIVE ASSESSMENT MARKS	60

MOLECULAR BIOLOGY

UNIT I:

15hours

DNA Replication and Mutation

History: Identification of DNA as genetic material- Experiments of Griffith, Hershey and Chase: Watson and Crick model of DNA. Central dogma of molecular biology and its modification

Replication: Types of replication -Conservative, semi conservative and dispersive. Evidence for semiconservative replication – Messelson and Stahl experiment. Mechanism of semi conservative replication - Steps involved in replication, Enzymes and proteins involved in replication.

Mutation: Concept of mutation, Mutagens – chemical and physical, Molecular basis of mutation. spontaneous and induced mutations, effect of HNO₂, alkylating agents, intercalating agents and UV- radiation. Point mutations: Concept of missense, nonsense and frame shift mutations.

UNIT II:

15hours

Transcription, Genetic code, Translation and Regulation of gene expression

Transcription: Types of RNA, structure of RNA polymerases, promoters, enhancers, silencers, role of sigma factor, Structure of mRNA in prokaryotes, Mechanism- initiation, elongation and termination (Rho- dependent and independent), post transcriptional modification - capping, splicing and poly adenylation.

Genetic code: characteristics of genetic code, wobble hypothesis.

Translation: Mechanism of translation - amino acid activation, charging of tRNA, initiation, elongation, and termination; Post-translational modification; Inhibition of protein synthesis by antibiotics.

Regulation of Gene expression :

General aspects of regulation, transcriptional regulation - inducible and repressible system, Operon concepts - lactose , tryptophan operons, Regulation of translation. Brief account of Eukaryotic gene expression.

GENETIC ENGINEERING

UNIT III:

15hours

Historical development, Aim and scope of genetic engineering.

Isolation of DNA Cutting of DNA by restriction endonucleases–staggered cut and blunt end.

Outline of techniques of genetic engineering: Cutting genomic DNA, Separation of fragments by agarose gel electrophoresis. Vectors, plasmids-PBR322, insertion of Foreign DNA into

Vectors. Transfections of vectors into host cells. cDNA (brief discussion), principles of polymerase chain reaction (PCR) and applications.

Blotting techniques: Principle of Southern, Northern blotting and Western blotting. Applications of Genetic engineering - Transgenic plants, transgenic animals and gene therapy. Human genome project.

IMMUNOLOGY

UNIT IV:

15 hours

Immunity: Cellular and humoral immunity, cellular basis of immunity. Role of immunologically important organs and cells- bone marrow, thymus, spleen and lymphocytes. Formation and functions of T & B Lymphocytes and macrophages. Helper T-cells and killer T-cells.

Antigens: Definition, Haptens, Epitopes, antigens and antigenicity.

Antibodies: Definition, types and their functions. Structure of a typical Immunoglobulin (IgG-Light chain, heavy chain, hyper-variable region, constant domains, Fab and Fc regions).

Immunization: Vaccination-Vaccines and their preparations, primary and secondary response.

Immunological disorders: Allergy (hypersensitivity reactions), AIDS.

Immunological techniques: Precipitation reaction, Immuno diffusion, RIA & ELISA

REFERENCES:

1. Cox, Michael M. Lehninger principles of biochemistry. Freeman, 2013.
2. Lubert Stryer. Biochemistry, 5th edition, 2006
3. Owen, Judith A., Jenni Punt, and Sharon A. Stranford. Kuby immunology. New York: WH Freeman, 2013.
4. Delves, Peter J., Seamus J. Martin, Dennis R. Burton, and Ivan M. Roitt. & Roitt's essential immunology. Vol. 20. John Wiley & Sons, 2011.
5. Molecular Biology –David Friefelder, Narosa Publication-house Pvt. Ltd. New Delhi, 2020
6. A Textbook of Biochemistry: Molecular and Clinical Aspects S. Nagini . 2nd edition . SciTech Publ., Chennai, 2007
7. Principles of Biochemistry, Donald Voet, Judith G Voet, Charlotte W. Pratt, 4th Edition, John Wiley and Sons Inc, 2012
8. Lehninger- Principles of Biochemistry; DL Nelson and MM Cox [Eds], 6th Edn. Macmillan Publications 2012
9. Biochemistry, Lubert Stryer, W.H Freeman and Company Limited
10. T.A. Brown, Gene cloning: An introduction, Chapman and Hall, 1995.

SEMESTER VI
DSC 8- GMF 212P- MOLECULAR BIOLOGY AND IMMUNOLOGY

Total Hours: 56

Credits: 02

1. Isolation of DNA from banana /endosperm of coconut /bacteria /any other source
2. Isolation of RNA from spinach leaves/ any other source
3. Determination of DNA
4. Determination of RNA
5. Visualization of DNA by agarose gel electrophoresis.(Demo)
6. Demonstration of Western blotting technique. (2 practical
7. Demonstration of DOT ELISA and sandwich ELISA
8. Immuno diffusion technique – ODD
9. Photographic identification of IgGs.
10. Radialimmune diffusion test.
11. Extraction and quantification of DNA (2 practical).

REFERENCES:

1. Molecular Biology: A Laboratory Manual by by Ashwani Kumar S. K.G akhar, Monika Miglani, 2019
2. Wilson And Walkers Principles And Techniques of Biochemistry And Molecular Biology 8th ed (Sae) by Hofmann,1983
3. Laboratory Manual of Microbiology, Biochemistry and Molecular Biology by J. Saxena, M. Baunthiyal, I. Ravi , 2015
4. Biochemical methods, S.Sadasivam ,A. Manickam,3rd Edition, New Age International Pvt Ltd, 2007
5. An Introduction to Practical Biochemistry, David Plummer, 3rd edition 2017
6. Laboratory manual in Biochemistry, J.Jayaraman 2011
7. A hand book of practical and clinical immunology, 2017 G.P Talwar and S.KGupta
8. Practical Immunology, 2000, Frank C Hey, Publisher: John Wiley and Son Ltd
9. An Introduction to Practical Biochemistry, David Plummer, 3rd edition 2017
10. Laboratory manual in Biochemistry, J.Jayaraman 2011.