Faculty of Medicine

JSS ACADEMY OF HIGHER EDUCATION & RESEARCH
(DEEMED TO BE UNIVERSITY) MYSURU

JSS Academy of Higher Education & Research
Deemed to be University)
Re-Accredited "A+" Grade by NAAC
Sri Shivarathreeshwara Nagara, Mysuru - 570 015, Karnataka

Regulation & Syllabus

M.Sc. IN MEDICAL BIOCHEMISTRY
2020

MSc

Regulations and Syllabus

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Postgraduate MSc in Medical Sciences

Programmes Offered

1. MSc Medical Anatomy
2. MSc Medical Physiology
3. MSc Medical Biochemistry
4. MSc Medical Pharmacology
5. MSc Medical Microbiology

Goals

The Goals of Postgraduate MSc in Medical Sciences is to produce

1. Competent medical and biomedical teachers with a sound knowledge in basic sciences.
2. Personnel with translational research knowledge
3. Skilled laboratory experts
4. Industry technical experts
5. Competent individuals with emotional intelligence

General Objectives

At the end of the postgraduate training in the discipline concerned the student should be able to:

1. Develop skills in using educational methods and techniques as applicable to the teaching of medical/biomedical/allied health sciences.
2. Demonstrate competence in developing diagnostic and analytical tools
3. Demonstrate competence in basic concepts of research methodology and be able to critically analyse relevant published research literature

Components of the course curriculum:

The major components of the Postgraduate curriculum shall be:

1. Theoretical knowledge
2. Practical skills
3. Diagnostic and analytical skills
4. Project skills.
5. Attitudes including communication skills.
6. Training in research methodology.
7. Self- learning mode- Seminars, assignments, group discussions, journal club presentations, Problem solving exercises.

Regulations

1. Branch of the study

Post graduate degree Programme

2. Courses offered in M.Sc Medical Sciences

- MSc in Anatomy
- MSc in Physiology
- MSc in Biochemistry
- MSc in Pharmacology
- MSc in Microbiology

3. Eligibility for Admission

A candidate seeking admission to MSc medical science course must have passed BSc with at least one subject of biological Sciences or BAMS or MBBS or BHMS or BPT or BPharm or any other Science/ professional graduates from a recognized University

4. Duration of the course

The duration of the course shall be a period of 3 years (6 semesters)

5. Medium of instructions

The medium of instruction and examination shall be in English

6. Method of Training

Training includes involvement in theory classes, practical skills, laboratory and experimental work, research studies, Self- learning mode - Seminars, assignments, group discussions, journal club presentations.

7. Attendance

Candidates should have attended at least 80% of the total number of classes conducted in each semester, from the date of commencement of the term to the last working day, as notified by the JSSAHER, in each of the subjects prescribed for that semester, separately in theory and practical, to be eligible to appear for the examinations.

8. Monitoring Progress of Studies

A) Formative Assessment

Formative assessment will be done continually to assess medical knowledge, procedural & academic skills, interpersonal skills, professionalism, self directed learning and ability to practice in the system.

Two Internal Assessment tests will be conducted for both theory and practical in

each semester covering all domains of learning and feedback will be provided for improvement of the student. Average of two internal assessments in theory and practical's separately will be considered for final internal assessment marks. A candidate should get minimum 50% IA marks separately in theory and practical to be eligible for final JSSAHER examinations.

The candidates who have failed in final examination shall be given an internal assessment improvement test and the best marks shall be submitted to JSSAHER when called for.

B) Summative Assessment

The end semester examination for core papers both for theory and practical will be conducted by JSS AHER. For allied papers, general electives and discipline specific electives examination will be conducted by respective colleges

C) Project Work

During study every candidate must perform a project on the selected topic under the guidance and supervision of a recognised postgraduate teacher. The project should be aimed to train a post graduate student in research methods and techniques. It includes identification of a problem, formulation of a hypothesis, search, review of literature, getting acquainted with recent advances, designing a research study, collection of data, critical analysis, and comparison of results and drawing conclusions.

The suggested time schedule for project work is

- Identification and selection of topic for project in third semester.
- Preparation of synopsis and submission of the synopsis for ethical clearance in third semester as per the dates notified by the ethical committee. Such synopsis will be reviewed, and the project topic will be registered by the JSS Academy of Higher Education and Research. No change in the project topic or guide shall be made without prior approval of the JSSAHER.
- Project work should start from third semester onwards.

Submission of Project Report

Four copies of the project report shall be submitted to the controller of examination of the JSSAHER two months before sixth semester examination or as per the dates notified by the JSSAHER.

The Project should be written under the following headings

i. Introduction
ii. Aims and objectives of study
iii. Review of Literature
iv. Material and Methods
v. Results
vi. Discussion

vii. Conclusion
viii. Summary
ix. References
x. Tables
xi. Annexure

The project shall be valued by examiners appointed by the JSS Academy of Higher Education and Research. Approval of project work is an essential precondition for a candidate to appear for the final examination.

A co-guide may be included provided the work requires substantial contribution from a sister department or from another medical institution recognized for teaching/training by JSS Academy of Higher Education and Research.

Project Evaluation: Every semester student shall present the progress of the project and monitored by the respective guide. Project work shall be presented during sixth semester examinations and carries 100 marks.

D) Maintenance of Logbook and Practical record

A diary showing each day's work must be maintained by the candidate, which shall be scrutinized by the Head of the department every month. A list of the seminars and journal reviews that have been attended and presented by the student has to be maintained which should be scrutinized by the Head of the Department.

Practical record must be maintained by every candidate and duly scrutinized and certified by the head of the department and to be submitted to the external examiner during the final examination.

E) Seminars, Journal clubs and Teaching:

Students are expected to actively participate in the departmental seminars and journal clubs. A record should be maintained for each student with the list of seminars and paper presented in journal club by each student.

Post graduate students should participate in undergraduate teaching, in theory, practical and tutorials.

9. Course of study

First and Second semester subjects are common to all medical MSc programmes. Students can choose one among the general electives and discipline specific electives mentioned in the respective semesters.

Course of study: Subjects and hours of teaching for theory, practical and clinical training

First Semester

Theory		Hrs	Credits
Core 1	Anatomy I: General anatomy, general histology, general embryology and thorax	40	4
Core 2	Physiology I	40	4
Core 3	General biochemistry	40	4
Practicals			
Module1	Anatomy I: General anatomy, general histology, general embryology and thorax	30	1
Module2	Physiology I	30	1
Module3	Basic biochemistry experiments Part I	30	1
Non- Core Subjects			
General Electives	Yoga/Music	30	2
Total		240	17

Second semester

Theory		Hrs	Credits
Core 4	Anatomy II: Abdomen, Pelvis, Head & Neck and Systemic histology	40	4
Core 5	Physiology II	40	4
Core 6	Energy metabolism and metabolism of biomolecules	40	4
Practicals			
Module1	Anatomy II: Abdomen, Pelvis, Head & Neck and Systemic histology	30	1
Module2	Physiology II	30	1
Module3	Basic Biochemistry Experiments: Part -II	30	1
Non-Core			
General Electives	Humanities/ Health economics	30	2
Total		240	17

MSc Medical Biochemistry

Third semester

Theory		Hrs	Credits
Core B1	Biochemical techniques	40	4
Core B2	Advanced biomolecules and thermodynamics	40	4
Core B3	Clinical Laboratory postings	40	4
Practicals			
Module B1	Biochemical Techniques	30	1
Module B2	Quantitative estimations & standard graph	30	1
Non-Core			
Allied 1	Research Methodology & Bioethics	30	2
General Electives	Soft skills / Teaching & Learning methodology	30	2
Total		240	18

Fourth semester

Theory		Hrs	Credits
Core B4	Metabolism of carbohydrates, proteins, lipids, nucleic acids and associated inborn errors	40	4
Core B5	Biochemistry of cellular communication and immunology	40	4
Core B6	Clinical Laboratory postings	40	4
Practicals			
Module B3	Clinical experiments - I	30	1
Module B4	Clinical experiments- II	30	1
Non-Core			
Allied 2	Biostatistics	30	2
DSE	Nutrigenomics/ Human Cytogenetics	30	2
Total		240	18

Fifth semester

Theory		Hrs	Credits
Core B7	Clinical biochemistry and medical genetics	40	4
Core B8	Cell biology and molecular biology	40	4
Core B9	Clinical Laboratory postings	40	4
Practicals			
Module5	Molecular biology practical-I	30	1
Module6	Molecular biology practical-II	30	1
Non - Core			
Skill enhancement	Internship training	--	14
DSE	Laboratory accreditation / Cell culture studies	30	2
Total		210+	30

Sixth Semester

Project work	20 credits
Value added programme: Workshops on career-life balance, CV-writing, and interviewing	10 credits
Total	30 credits

10. Conduct of Examination

The end semester examination for core papers will be held at the end of each semester for both Theory and Practical separately, conducted by JSS AHER. Examinations for non- core subjects will be conducted by respective Colleges. Division of marks for non - core paper will vary according to the subjects.

Theory Examination: – 3 hours paper, 100 marks for each core paper.

Pattern of theory question paper

Theory			
Type of Questions	**Number of Questions**	**Marks for each question**	**Total**
Long Essay	2	10	20
Short Essay	10	5	50
Short Answer	10	3	30
Total Marks			100

Examination Pattern

First Semester- JSSAHER Examination				
Theory Examination				
Category	**subjects**	**IA**	**Final Exam**	**Total**
Core 1	Anatomy I: General anatomy, general histology, general embryology and thorax	100	100	200
Core 2	Physiology I	100	100	200
Core 3	General biochemistry	100	100	200
Practicals				
Module1	Anatomy I: General anatomy, general histology, general embryology and thorax	100	100	200
Module2	Physiology I	100	100	200
Module3	Basic Biochemistry Experiments: Part -I	100	100	200
Non -Core subjects				
		Theory	Practical	Total
Gen Electives	Yoga/Music	25	25	50

Second Semester- JSSAHER Examination				
Theory Examination				
Category	**subjects**	**IA**	**Final Exam**	**Total**
Core 4	Anatomy II: Abdomen, Pelvis, Head & Neck and Systemic histology	100	100	200
Core 5	Physiology II	100	100	200
Core 6	Energy metabolism and metabolism of biomolecules	100	100	200
Practicals				
Module1	Anatomy II: Abdomen, Pelvis, Head & Neck and Systemic histology	100	100	200
Module2	Physiology II	100	100	200
Module3	Basic Biochemistry Experiments: Part -II	100	100	200

Non - Core subjects				
		Theory	Practical	Total
Gen Electives	Humanities/ Health economics	50	--	50

MSc Medical Biochemistry

Third Semester- JSSAHER Examination				
Theory Examination				
Category	**subjects**	**IA**	**Final Exam**	**Total**
Core B1	Biochemical techniques	100	100	200
Core B2	Advanced biomolecules and thermodynamics	100	100	200
Core B3	Clinical Laboratory postings	---	---	---
Practical				
Module B1 & B2	Biochemical Techniques & Quantitative estimations & standard graph	100	100	200
Non -Core subjects				
		Theory	Practical	Total
Allied 1	Research methodology & Bioethics	50	---	50
Gene Electives	Soft skills / Teaching & Learning methodology	50	---	50

- There will be no separate examination for Core B3 - Clinical Laboratory postings.
- 10-15% of questions in theory paper of Core B1 shall be from clinical laboratory training material.

Fourth Semester- JSSAHER Examination				
Theory Examination				
Category	**subjects**	**IA**	**Final Exam**	**Total**
Core B4	Metabolism of carbohydrates, proteins, lipids, nucleic acids and associated inborn errors	100	100	200
Core B5	Biochemistry of cellular communication and immunology	100	100	200
Core B6	Clinical Laboratory postings	---	---	---

Practicals				
Module B3 & B4	Clinical experiments – I & Clinical experiments- II	100	100	200
Non -Core subjects				
		Theory	Practical	Total
Allied 2	Biostatistics	50	---	50
DSE	Nutrigenomics / Human Cytogenetics	50	---	50

- There will be no separate examination for Core B6 - Clinical Laboratory postings.
- 10-15% of questions in theory paper of Core B4 shall be from clinical laboratory training material.

Fifth Semester- JSSAHER Examination				
Theory Examination				
Category	**subjects**	**IA**	**Final Exam**	**Total**
Core B7	Clinical biochemistry and medical genetics	100	100	200
Core B8	Cell biology and molecular biology	100	100	200
Core B6	Clinical Laboratory postings	---	---	---
Practicals				
Module 5 & 6	Molecular Biology Practical-I & Molecular Biology Practical-II	100	100	200
Non -Core subjects				
		Theory	**Practical**	**Total**
Skill enhancement	Industry exposure report	---	---	50
DSE	Laboratory accreditation / Cell culture studies	50	---	50

- There will be no separate examination for Core B9 - Clinical Laboratory postings.
- 10-15% of questions in theory paper of Core B7 shall be from clinical laboratory training material.

Medical Biochemistry: Sixth semester

Category	Marks
Project work	100
Subject Viva Voce	70
Pedagogy	30

11.Appointment of examiners:

There shall be at least two examiners in theory and practical examination. Any staff with MD or MSc, PhD degree with 3 years of teaching experience is eligible to become examiners.

12. Criteria for declaring as pass in JSSAHER examination

Candidate should secure minimum 50% marks in each subject Theory including IA marks and Practicals including IA Marks separately to declare pass both in core and non – core papers.

Theory and Practical shall be considered as separate course. If a candidate passes in practical examination but fails in theory paper, such candidate is exempted from reappearing for practical but shall have to appear for theory paper in which subject paper candidate in has failed the subsequent examinations or vice versa.

Those candidates who failed in one or more subjects shall have to appear only in the subject so failed, in the subsequent examinations

A candidate securing less than 50% of marks as described above shall be declared to have failed in the examination. Failed candidate may appear in subsequent examination upon payment of examination fee to the JSSAHER.

13. Grading of performances

Letter grades and grade points allocations:

Based on the performances, each student shall be awarded a final letter grade at the end of the semester for each course.

Letter grades and grade points equivalent to Percentage of marks and performances

Percentage of Marks Obtained	Letter Grade	Grade Point	Performance
90.00 – 100	O	10	Outstanding
80.00 – 89.99	A	9	Excellent
70.00 – 79.99	B	8	Good
60.00 – 69.99	C	7	Fair
50.00 – 59.99	D	6	Average
Less than 50	F	0	Fail
Absent	AB	0	Fail

A learner who remains absent for any subject(s) in the end semester examination shall be assigned a letter grade of AB and a corresponding grade point of zero. He/she should reappear for the same in due course.

The Semester grade point average (SGPA)

The performance of a student in a semester is indicated by a number called 'Semester Grade Point Average' (SGPA). s. It is the ratio of total credit points secured by a student in various courses in a semester and the total course credits of that semester. It shall be expressed up to two decimal places. The credit point (CP) of a course is equal to Credits (C) x Grade Point (G). Total Credit Point of a semester is sum of credit points (CP) of all courses of that semester.

Thus the SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses in a semester and the sum of the number of credits of all the courses in that semester, i.e

$SGPA = \sum(Ci \times Gi) / \sum Ci$

Where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

For example, if a student takes five courses (Theory/Practical) in a semester with credits C1, C2, C3, C4 and C5 and the student's grade points in these courses are G1, G2, G3, G4 and G5, respectively, and then students' SGPA is equal to:

$$SGPA = \frac{C1G1 + C2G2 + C3G3 + C4G4 + C5G5}{C1 + C2 + C3 + C4 + C5}$$

The SGPA shall be expressed up to two decimal places. The SGPA for each semester shall be calculated and awarded only for those students who have passed all the courses of that semester.

Cumulative Grade Point Average (CGPA)

It is a measure of overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places. CGPA shall be awarded only on successful completion of the programme (all eight semesters) and it is given in final semester grade report card/final transcript.

CGPA shall be calculated as follows:

$$\text{CGPA} = \frac{CP1 + CP2 + CP3 + CP4 + CP5 + CP6}{C1 + C2 + C3 + C4 + C5 + C6}$$

Where CP1, CP2, CP3,…. is the total credit points for semester I,II,III,…. and C1, C2, C3,…. is the total number of credits for semester I,II,III,….

14. Declaration of class

Class shall be awarded only on successful completion of the programme (all eight semesters) and it is given in final semester grade report card/final transcript. The class shall be awarded on the basis of CGPA as follows:

First Class with Distinction	= CGPA of. 8.00 and above
First Class	= CGPA of 7.00 to 7.99
Second Class	= CGPA of 6.00 to 6.99

The candidates who secure a CGPA of 8.00 or above and have passed in all the subjects in all the semesters in first attempt shall be declared to have obtained First Class with Distinction.

15. Carry over system:

A candidate who has failed in one or more subject in the First semester JSSAHER examinations can be permitted to enter II semester and so on. However, candidate should have passed JSSAHER examinations of all core and non- core papers from first to fifth semester to appear for Sixth semester examinations.

16. Award of Degree: A candidate who has passed all the subjects of I semester to VI Semester shall be eligible for award of Degree

17. Award of Ranks/Medals: Ranks and medals shall be awarded on the basis of final CGPA. However candidates who fail in one or more courses during the programme shall not be eligible for the award of ranks.

18. Duration for completion of the course of study

The duration for the completion of the course shall be fixed as double the actual duration of the course and the students have to pass within the said period, otherwise they have to get fresh Registration.

19. Revaluation I Retotalling of answer papers

There is no provision for revaluation of the answer papers of failed candidates in any examination. However, the failed candidates can apply for retotalling.

20. Re-admission after break of study

Candidate who seeks re-admission to the course after break of study has to get the approval from the JSSAHER by paying a condonation fee.

No condonation is allowed for the candidate who has more than 2 years of break up period and he/she have to rejoin the course by paying the required fees.

MSc Medical Biochemistry

Objectives

MSc post-graduate in Biochemistry should understand the theory and practical aspects of :

1. The chemical and three-dimensional structures of the various classes of biomolecules such as carbohydrates, proteins, lipids and nucleic acids as a prelude to understand the correlation between structure and function.
2. The metabolic pathways of the major classes of biomolecules, regulatory mechanisms, interactions and significance in health and diseases.
3. The Mechanism of energy release, conservation, utilization and derangements thereof.
4. The Role of micro and macro nutrients such as vitamins and minerals in health and the pathophysiology of nutritional disorders.
5. The Mechanism involved in the storage, transmission and expression of genetic information.
6. The physiological and pathological process affecting biochemical investigations.
7. LIS (Lab information system) and understand pre-analytical, analytical and post analytical procedures
8. Application of basic science knowledge and various research methodologies in biomedical and translational research.

Programme outcomes

After completing the three years of MSc in Medical Biochemistry, the post graduate should be able to:

1. Emerge as qualified technologists and medical teachers
2. Carry out clinical lab investigations & instrument maintenance
3. Perform Quality control procedures in the lab and develop required knowledge/ skills towards accreditation of labs.
4. Competent to work in research labs to pursue Ph.D.

First Semester

Core 1: Anatomy I- General anatomy, general histology, general embryology, and thorax

Specific Learning Objectives: During the course of the study students should be able to

1. Describe & demonstrate normal anatomical position, various planes, relation,
2. comparison, laterality & movement in our body
3. Describe the parts, blood and nerve supply of a long bone
4. Describe various joints with subtypes and examples
5. Describe superficial fascia & deep fascia along with fat distribution in body
6. Describe & differentiate between blood vascular and lymphatic system
7. Describe & demonstrate the microscopic structure of epithelial tissue, skin, blood vessels, connective tissue, cartilages, bones, nervous tissue, muscular tissue, salivary glands & lymphatic tissue
8. Describe & demonstrate the first 8 weeks of development of embryo with its anomalies
9. Describe & demonstrate the structures of thorax

THEORY **40 hrs**

1.General anatomy **(10 hrs)**

- Introduction: Anatomical terms & terminology/body regions.
- Connective tissue
- Bones.
- Muscles.
- Joints.
- Blood vessels & Lymphatic system.
- Nervous system.
- Blood vessels and nerves of upper limb
- Blood vessels and nerves of lower limb.
- Musculoskeletal system: Names of muscles & bones of upper & lower limb

2.General histology **(10 hrs)**

- Histology of Epithelium.
- Histology of Connective tissue & Cartilages.
- Histology of Muscles.
- Histology of bones.
- Histology of blood vessels.
- Histology of lymph node & spleen.
- Histology of Tonsil & thymus.
- Histology of nervous tissue & Ganglia
- Histology of skin.
- Histology of salivary glands.

3.General Embryology. (10 hrs)

- Gametogenesis.
- Fertilization, cleavage &Implantation.
- Second week of development.
- Third week of development (Gastrulation, notochord, allantois)
- Fourth week of development
- Fetal membranes
- Development of Placenta
- Teratogens & Developmental anomalies
- Genetics: Introduction, Chromosomes, Inheritance, Karyotyping & Chromosomal abnormalities. (2Hrs)

4. Thorax (10 hrs)

- Thoracic wall & intercostal spaces & muscles (01 hr)
- Mediastinum (01hrs)
- Lungs, trachea & Pleura. (02hrs)
- Heart & pericardium (02hrs)
- Diaphragm (01hr)
- Histology of trachea & lungs (01 hr)
- Histology of GIT, Liver, gall bladder, pancreas (02hrs)

Module I: Anatomy (Practicals): 30 hrs.

- Demonstration of bones of limbs (02 hrs)
- Demonstration of slides of general Histology and slides of trachea & lung, GIT, Liver & gall bladder (10 hrs)
- Embryology models (02 hrs)
- Demonstration of bones of Thorax (2 hrs)
- Demonstration of thoracic wall & mediastinum (02 hrs)
- Demonstration of pleura, lung & trachea (06 hrs)
- Demonstration of pericardium & heart (06 hrs)

1. Practical Evaluation: 100 marks

Description	Marks
Spotters: 20*2mark	40
Gross specimen discussion: 2*20 marks	40
Histology Slide discussion: 1*20marks	20
Total	100

RECOMMENDED TEXT BOOKS

Gross Anatomy

- Dutta A.K. Human Anatomy vol. I-III, Current publisher.
- Dutta A.K. Principle of General Anatomy. Current Publisher.
- Keith and Moore Clinical Oriented Anatomy. Lippincot Williams and Willkins.
- Vishram Singh. Textbook of general anatomy. Elsevier.
- Frank H. Netter. Atlas of Human Anatomy. Saunders Elsevier.

Histology

- Difiore's. Atlas of histology with functional co-relation.
- Text book of histology Inderbir Singh

Genetics:

- Medical genetics by SD GANGANE

Embryology

- Human Embryology by INDERBIR SINGH
- Vishram singh Textbook of clinical Embryology

Core 2- Physiology I

Specific Learning Objectives: During the course of the study students should be able to

1. Describe the structure and functions of cell, cell membrane & cell organelles, Transport across cell membrane and membrane potentials.
2. Describe the composition, formation and functions of different blood components
3. Describe the structure & properties of nerve and different types of muscle. Describe the mechanism of muscle contraction
4. Describe the composition, functions and regulation of secretions of GIT and describe the movements of GIT.
5. Describe the mechanism of formation of urine and micturition process
6. Describe the electrical events, mechanical events and haemodynamics of cardiovascular system

Theory **40 hrs**

I. GENERAL PHYSIOLOGY **04 Hours**

- Organization of the cell, Cell membrane & its function, cell organelles
- Intercellular communications
- Transport across cell membrane
- Membrane potentials – RMP & Action potential

- Body fluid compartments
- Homeostasis, concepts of physiological norms, range and variations.

II. BLOOD **08 Hours**

- Composition and functions of blood, Plasma Proteins
- Red Blood cells – Erythropoiesis, Morphology of RBC, Functions, Normal values, Variations, PCV and ESR
- Haemoglobin - Structure, Functions, Types, Derivatives.
- Life span and destruction of RBC & Haemoglobin, Jaundice
- Leucocytes – Leucopoiesis, Morphology of different types of leucocytes, functions, Variations, Humoral & Cell mediated Immunity
- Platelets – thrombopoiesis, morphology, functions, normal values & Variation.
- Hemostasis and blood coagulation – definition, clotting factors.
- Mechanism of clotting, Bleeding disorders, anticoagulants
- Blood groups –ABO system and Rh factor. Blood transfusion

III. NERVE AND MUSCLE PHYSIOLOGY **05 Hours**

- Structure of a neuron and classification of nerve fibers, Properties, Degeneration and regeneration of nerve fibers, Neuroglia.
- Muscle: Types, Structure of skeletal muscle.
- Neuromuscular junction and transmission across it
- Mechanism of muscle contraction and its molecular basis. Types of contraction- isotonic and isometric contractions.
- Types of skeletal muscle fibres
- Energetics of muscle contraction– Rigor mortis.
- Smooth muscle – Structure & Mechanism of contraction

IV. GASTROINTESTINAL SYSTEM **06 Hours**

- Introduction – Anatomy of G.I. tract, composition, functions of saliva
- Mastication & Deglutition
- Stomach – Compositions, functions of gastric juice, Mechanism of secretion of HCl, Gastric Motility
- Exocrine pancreas – Compositions, functions of Pancreatic juice.
- Liver and gall bladder – Function of liver, Composition and functions of bile. Function of gall bladder,
- Small intestine – Composition and functions of succus entericus , Small intestine movements.
- Large intestine – Functions and motility

V. RENAL SYSTEM , SKIN AND TEMPERATURE REGUALTION 07 Hours

- Functional anatomy of kidney, Types of nephrons, JG Apparatus and Renal blood flow , Non excretory functions of kidney.
- G.F.R- Definition, Mechanism of filtration and its regulation.
- Tubular function – Glucose, Water, Sodium and Chloride Reabsorption, concentration mechanism of urine, acidification of urine
- Micturition and Cystometrogram, Renal function tests.
- Skin & its functions and temperature.

VI. CARDIO VASCULAR SYSTEM 10 Hours

- Functional anatomy of heart, Properties of cardiac muscle, Innervation of the heart
- Conducting system of Heart, Origin & Spread of cardiac impulse, ECG
- Cardiac cycle.
- Heart rate and regulation of heart rate.
- Cardiac output definitions, variations, Regulation .
- Blood flow & factors affecting it.
- Blood pressure – Normal values, measurement, factors affecting and regulation
- Regional circulation – coronary
- Shock, Cardiopulmonary resuscitation
- Cardio vascular changes during muscular exercises.

Practicals: 30 hrs 01 credit

Module 2: Physiology I

1.	Study of the microscope & Effect of different concentrations of Saline on RBC	04 hrs
2.	Haemoglobin estimation	06 hrs
3.	Study of Hemocytometer	02 hrs
4.	Enumeration of Red Cell Count	08 hrs
5.	Demonstration of Packed cell volume and ESR	02 hrs
6.	Determination of Bleeding time and clotting time	06 hrs
7.	Demonstration of ECG	02hrs

Practicals Evaluation: 100 Marks

Haematology

Major	-	50 marks
Minor	-	30 marks
Spotters	-	20 marks

VII. RECOMMENDED TEXT AND REFERENCE BOOKS

TEXT BOOKS

1. A K JAIN - Complete Medical Physiology Avichal Publishers Delhi
2. INDU KHURANA - Textbook of Physiology for Undergraduates, Elsevier,
3. Venktesh & Sudhakar

REFERENCE BOOKS

1. GUYTON & HALL - Text of Physiology, Elsevier, 13th Edition
2. GANONG's Review of Medical Physiology, Lange Publications, 27th edition

PRACTICAL MANUALS

1. G.K.PAL – Textbook of Practical Physiology – University Press
2. A.K.JAIN - Manual of Practical Physiology, Arya` Publishers Delhi

CORE 3: GENERAL BIOCHEMISTRY

Specific Learning objectives:

- During the study, students shall be able to Understand the principles and structure, functional and interaction of biomolecules.
- Understand the properties of carbohydrates, proteins, lipids, cholesterol, Nuclieic acid- DNA, RNA, glycoproteins and glycolipids and their importance in biological systems.
- Understand the basic concepts of enzymes, vitamins, and minerals along with their role in metabolizing biomolecules.

Theory **40 hrs**

UNIT – I: INTRODUCTION TO MEDICAL BIOCHEMISTRY (1 hrs)

Importance and scope of medical biochemistry in prevention, diagnosis, and therapeutics of diseases.

UNIT-II Cell Biology and Cell membrane (2 hrs)

Structure and functions of subcellular organelles and cell membrane. Membrane transport: Passive transport, Simple diffusion, Active transport (primary and secondary), Symport, Uniport, Antiport and Facilitated diffusion. Exocytosis, Endocytosis, Pinocytosis and Receptor mediated transport.

UNIT – III: CARBOHYDRATES CHEMISTRY (4 hrs)

Carbohydrates: Definition, Biological importance of Carbohydrates. Optical and Stereoisomerism of sugars [Glucose]. Mutarotation, Haworths structure, Epimers and Anomers. Monosaccharides -Classification, Structure and Biological importance

of Trioses, Tetroses, Pentoses and Hexosesugars; Reactions of monosaccharides. Disaccharides-Structure and Biological importance of Sucrose, Lactose and Maltose. Polysaccharides: Homopolysaccharides; Structure, Biological functions of Starch, Glycogen, Cellulose. Chitin, Dextrin, and Inulin. Heteropolysaccharides; Structure, Biological functions of Hyaluronic acid, Chondroitin sulphate and Heparin. Proteoglycans and Glycoproteins.

UNIT – IV: LIPIDS CHEMISTRY (4hrs)

Definition, Classification and Biological importance of lipids. Simple lipids, Properties and Characterization of fats- Hydrolysis, Saponification, Rancidity. Compound lipids- Structure and function of phospholipids Lecithin, Cephalin, PhosphatidylInositol, Phosphatidylserine and Sphingomyelin. Glycolipids (Gangliosides and Cerebrosides). Derivedlipids-Classification, structure and properties of saturated and unsaturated fatty acids; Essential and Non-essential fatty acids. Sterols – Structure, Function and Properties of Cholesterol, Bileacids and lipoproteins biological importance and significance. Eicosanoids, Prostaglandins, Leukotrienes and Thromboxanes.

UNIT – V: AMINOACIDS AND PROTEINS (4 hrs)

Aminoacids:Definition, Structure and classification, Chemical reaction of aminoacids.Essential and Non-essentialaminoacids. Proteins: Definition and classification-based on solubility, shape and function. Protein structure: Primary structure of proteins (Eg.Insulin), Secondary structure ofproteins– Alpha helix and Beta-pleated sheet, fibrous proteins; α-keratins,collagen.Tertiary structure of proteins (Eg.Myoglobin) globular proteins, Quaternary structure of proteins (Eg.Haemoglobin),Bonds stabilizing the Protein structure. Determination of protein sequencing in brief (Sanger's and Edman methods). Biologically important peptides-Glutathione, bradykinin.Plasma proteins and their biological importance.

UNIT – VI: NUCLEIC ACIDS CHEMISTRY (4 hrs)

Chemistry of purines, pyrimidines,nucleosides and nucleotides. Functions of nucleotides. DNA: base composition, primary and secondary structure of DNA. Double helical structure and types of DNA (B, A and Z forms); stabilizing forces secondary structure. Physicochemical properties of nucleic acid: Denaturation, Chemical and enzymatic hydrolysis of nucleic acids. Hybridization and its significance. RNA and its types: Structure, types mRNA, tRNA and rRNA. Primary, secondary, and tertiary structure of tRNA and Functions of RNAs.

UNIT – VII: ENZYMES (6 hrs)

Enzyme definition and classification, nomenclature, Properties, specificity, cofactors and coenzymes. Enzyme kinetics: factors influencing velocity of enzyme

action, Mechanism of enzyme action[Km value and Vmax],Inhibition and types, regulation of enzymeaction, isoenzymes, clinicalenzymology. Immobilized enzymes- applications, Diagnostics, Therapeutics, and analytical use of Enzymes.

UNIT – VIII: VITAMINSANDMINERALS (10hrs)

Definition and Classification of Vitamins - Fat soluble , water soluble and Pro Vitamins. Dietary source, structures, RDA, biochemical functions and deficiency manifestations. Hypervitaminosis and antivitamins. Macro and micro Minerals: Iron, calcium, phosphorus, magnesium, iodine, Zinc, and copper- Dietary source, RDA, biochemical functions, deficiency and toxicity manifestations.

UNIT – IX: NUTRITION (4hrs)

Nutrients, Calorific value of food, BMR, SDA, respiratory quotient, and its applications. Balanced diet based on age, sex and activity, biological value of proteins, nitrogen balance. Proteinenergymal- nutrition– kwashiorkor, marasmus and Marasmickwashiorkor. Dietaryfibres,anditsbiologicalimportance. Biochemistry of obesity. Total Parenteral Nutrition(TPN), Nutritionaldisorders.

UNIT –X FREE RADICALS AND ANTIOXIDANTS (1 hrs)

Definition and Examples, Formation of reactive oxygen species, Exogenous causes of formation of Free Radicals, Antioxidants

SEMESTER I – PRACTICALS (30 Hrs)

MODULE-3A- Basic biochemistry experiments PART-I

QUALITATIVE ANALYSIS OF SUBSTANCE OF PHYSIOLOGICAL IMPORTANCE- 15 Hrs

1. Introduction to Biochemistry Practical's.
2. Qualitative analysis of carbohydrates-
3. Qualitative analysis of amino acids
4. Reactions of NPN substances
5. Identification of substance of physiological importance

MODULE-3A-PART-II

QUANTITATIVE ESTIMATIONS 15 Hrs

1. Principles of colorimetry & spectrophotometry
2. Estimation of serum total protein
3. Estimation of glucose by GOD-POD method.
4. Estimation of blood urea by DAM method
5. Estimation of urine creatinine.

Practical Evaluation B1 & B2-100 marks

1. Spotters-Reagents, Tests, Glassware's., Instruments, equipments- 20 marks
2. Qualitative analysis of substance of physiological importance & interpretation- 40 marks
3. Quantitative estimation & interpretation- 40 marks

Recommended books

1. DL Nelson and MM Cox (2013) Lehninger, Principles of Biochemistry, WH Freeman Publication, 6th Edition
2. D Voet and JG Voet (2010) Biochemistry, John Willey & Sons Publication, 4th Edition
3. T. Palmer (2004) Enzymes: Biochemistry, biotechnology, clinical chemistry; Affiliated East West Press Private Limited.
4. L. Stryer (2002) Biochemistry; W H Freeman & Co., 5th edition.
5. Robert A. Weinberg, The Biology of Cancer, Garland Science; 2nd edition, 2013

Non- Core Subjects
General Electives-Yoga/Music
Yoga

INTRODUCTION

Yoga has gained acceptance and popularity across the Globe. It offers solace for the restless mind and a traditional and time-tested way of keeping the mind and body fit. Some use it for developing memory, intelligence and creativity. With its multi fold advantages it is becoming a part of education as a mandate or elective course. Specialists use it to unfold deeper layers of consciousness in their move towards perfection.

OBJECTIVES

In this unit you will be learning the benefits of yoga at the muscular level, breathing level, mental level, intellectual level, emotional level and the manifestations of divinity in all walks of life and the yoga way of life taking man from animal level to perfection. The application of yoga in health, in warding off executive tensions also mentioned along with work for practitioner of yoga.

BENEFITS AS MENTIONED IN YOGASUTRAS, HATHA YOGA ETC

Yoga is a process of all-round personality development by

1. Deep relaxation at muscular level,
2. Slowing down of breath and maintaining balance at Pranic Level,
3. Increasing the intellect and calming down the mind at intellectual level,
4. Sharpening the intellect and calming down the mind at intellectual level,
5. Enhancing the happiness in life and equipoise at emotional level, and
6. Manifesting the innate divinity in man in all aspects of life.

Loosening Exercises

Stage I: Slow Jogging
Stage II: Backward Jogging
Stage III: Forward Jogging
Stage IV: Side Jogging
Stage V: Mukha Dhauti to relax

Forward and Backward Bending
Side Bending
Twisting
Suryanamaskara

Asanas in Standing Postures
Tadasana
Vrukshasana
Ardhakati Chakrasana
Ardha Chakrasana
Pada Hastasana

Asanas in Sitting Postures
Vajrasana
Ustrasana
Pascimottanasana
Asanas in Prone Postures
Bhujangasana
Salabhasana

Asanas in Supine Postures
Sarvangasana
Halasana
Shavasana (Quick Relaxation Technique)

Assessment plan
Theory: 25 marks
Short essay- 3 questions x 5 marks = 15 marks
Short answers- 5 questions x 2 marks= 10 marks
Practicals- 25 marks
Performing any two Asanas- 25 marks

Music
Syllabus and teaching plan

Unit 1	Brief introduction to Indian Music Knowledge of technical terms; Naada, Shruthi, Swara
Unit 2	Knowledge of Laya,Taala, sulaadisapthataala Classification of musical instruments
Unit 3	Music as medicine
Unit 4	Basic lesson 1SaraleVarase - 4, JantiVarase - 1
Unit 5	Basic lesson 2 PillariGeethe - 1, SanchariGeethe -1
Unit 6	Patriotic song, Bhajan
Unit 7	Devaranaama, Bhaavageethe
Unit 8	Vachana

Gen Elective - Music	**Hours Per week**	**Theory Evaluation**	**Practical evaluation**	**Total Marks**
	2	**25**	**25**	**50**

Semester 2

Core 4: Anatomy II- Abdomen, Pelvis, Head & Neck and Systemic histology

Specific learning Objectives: At end of the semester students should be able to

1. Describe & demonstrate the structures of abdominal organs
2. Describe & demonstrate the anterior and posterior abdominal wall
3. Describe & demonstrate the structures of pelvis & perineum
4. Describe & demonstrate the structures of head & neck
5. Describe the parts of brain and spinal cord, Blood supply of brain & spinal cord and Cranial nerves
6. Describe & demonstrate the microscopic structure of abdominal organs, pelvic organs & head & neck organs

(Theory): 40 hours

I. Abdomen & pelvis (20 hrs)

a. Anterior abdominal wall & Inguinal Region (01 hr)
b. Posterior abdominal wall (01 hr)
c. Peritoneal cavity and Peritoneum (01 hr)
d. GIT: Stomach, Duodenum, Jejunum and Ilium, Cecum and Appendix, & spleen (04 hrs)
e. Pancreas, Liver, Extra hepatic biliary apparatus, Portal venous system (02 hrs)
f. Urinary system: Kidney, Urinary bladder, Urethra (02 hrs)
g. Supra renal gland (01 hr)
h. Male genital system (02 hrs)
i. Female genital system (02hrs)
j. Anal canal & rectum (01 hr)
k. Perineal pouches (01hr)
l. Ischiorectal fossa (01hr)
m. Internal & external iliac arteries (01hr)

II.Head & neck (16 hrs)

a. Scalp (01hr)
b. Face: Muscles of Facial expression, facial artery, Parotid region with parotid gland (01hr)
c. Neck: Anterior Triangle of the Neck, Posterior Triangle of the Neck, Thyroid and parathyroid gland, Sub-occipital region (03hrs)
d. Temporal & infra-temporal regions & TM Joint (02hrs)
e. Submandibular region (01hr)
f. Interior of skull: Dural venous sinuses and Pituitary gland, Orbit and extra ocular muscles (02hrs)
g. Cut section of Neck: Oral Cavity and Tongue, Nose and nasal cavity, Paranasal air sinuses, Pharynx, Larynx, Auditory tube & palatine tonsil (04hrs)
h. Central nervous system: Parts of brain and spinal cord, Blood supply of brain & spinal cord, Cranial nerves (02hr)

III. Systemic histology **(04 hrs)**

a. Histology of Kidney, ureter, urinary bladder
b. Histology of male & female genital system: uterus, uterine tube, ovary, testis, prostate, epididymis
c. Histology of tongue, retina & cornea.
d. Histology of Endocrine glands: Thyroid, suprarenal, pituitary

Practical: **30hrs.**

a. Demonstration of lumbar vertebrae, bony pelvis (02 hrs)
b. Demonstration of slides of Histology and slides of Kidney, ureter, urinary bladder, Male & female genital system, Tongue, Retina & cornea, Thyroid , suprarenal & pituitary gland (06 hrs)
c. Demonstration of organs of abdomen & pelvis (20 hrs)
d. Demonstration of anterior & posterior abdominal wall (02hrs)

Practical Evaluation: 100 marks

Description	**Marks**
Spotters: 20*2mark	40
Gross specimen discussion: 2*20 marks	40
Histology Slide discussion: 1*20marks	20
Total	100

RECOMMENDED TEXT BOOKS

Gross Anatomy:

- Dutta A.K. Human Anatomy vol. I-III, Current publisher.
- Dutta A.K. Principle of General Anatomy. Current Publisher.
- Keith and Moore Clinical Oriented Anatomy. Lippincot Williams and Willkins.
- Vishram Singh. Textbook of general anatomy. Elsevier.
- Frank H. Netter. Atlas of Human Anatomy. Saunders Elsevier.

Histology:

- Difiore's. Atlas of histology with functional co-relation.
- Text book of histology Inderbir Singh

Genetics:

- Medical genetics by SD GANGANE

Embryology

- Human Embryology by INDERBIR SINGH
- Vishram singh Textbook of clinical Embryology

Core 5- Physiology II

Specific learning Objectives: During the course of the study students should be able to

1. Describe the mechanics of breathing, diffusion & transport of gases, regulation of respiration and applied aspects.
2. Describe the synthesis, actions and regulation of secretion of various endocrine hormones
3. Describe the structure and function of male & female reproductive system
4. Describe the mechanism of perception of sensations and motor control
5. Describe the structure and mechanism of special sensations.

Theory: 40 hrs

I. RESPIRATORY SYSTEM 08 Hours

1. Introduction – Functional anatomy of respiratory system
2. Pulmonary Ventilation – Mechanism of ventilation, Muscles, pressure changes, Lung volume & capacities Surfactant , compliance, Airway resistance.
3. Alveolar ventilation, dead space ventilation, Ventilation Perfusion ratio
4. Respiratory membrane, partial pressure of gases. Diffusion of gases and factors affecting it.
5. Oxygen transport – O2 –Hb dissociation curve and CO2 transport
6. Regulation of respiration – Neural & Chemical
7. Hypoxia - types, Periodic breathing.
8. Decompression sickness
9. Respiratory adjustments during muscular exercise.

VIII ENDOCRINES 08 Hours

1. Introduction to endocrinology, classification and mechanism of action of hormones.
2. Pituitary gland:
   - Anterior pituitary hormones, their actions, Regulation of secretion and disorders,
   - Posterior pituitary hormones - Actions, Control and disorders
3. Thyroid hormones - Synthesis, actions, Regulation of secretion and disorders
4. Parathyroid hormones - Actions, Regulation of secretion and disorders
5. Calcium homeostasis
6. Endocrine pancreas – Insulin & Glucagon.
   - a) Source b) Actions c) regulation d) Clinical disorders
7. Adrenal gland:
   - a) Adrenal cortical hormones – Actions, Regulation and Disorders.
   - b) Adrenal medullary hormones – actions

IX REPRODUCTIVE SYTEM **06 Hours**

1. Introduction.
2. Male reproductive system
   - Physiological anatomy, spermatogenesis and its regulation
   - Testosterone, compositon of semen.
3. Female reproductive system
   - Oogenesis, Oestrogen & Progesterone
   - Menstrual cycle
   - Physiology of Pregnancy
   - Contraceptive measures

X CENTRAL NERVOUS SYSTEM **12 Hours**

1. Organization of central nervous system
2. Synapse : Transmission and properties, excitatory and inhibitory neurotransmitters
3. Receptors and properties
4. Sensory system: Primary sensations : ascending tracts and sensory cortex
5. Pain sensation and thalamus
6. Spinal cord: Reflexes.
7. Pyramidal and extra pyramidal tracts
8. Functions of Basal ganglia, Cerebellum and Vestibular apparatus.
9. Functions of hypothalamus, ANS, Limbic system
10. Sleep and EEG
11. CSF and blood brain barrier (BBB)

XI SPECIAL SENSES

Vision:

1. Functional anatomy, Aqueous humor & IOP
2. Image forming mechanism, Errors of refractions
3. Retina – structure and Photochemistry of vision
4. Visual activity, Visual pathway and its lesion , visual cortex
5. Accommodation, Dark adaptation, Pupillary reflexes,
6. Colour vision

Hearing

1. Functional anatomy of Ear
2. Role of tympanic membrane, middle ear and cochlea in hearing.
3. Auditory pathway and auditory cortex.
4. Tests for hearing and deafness.

Taste and smell

1. Modalities, receptors, pathways

Practical **30 hrs**

Module 4: Physiology

1. Total Leucocyte count	06 hrs
2. Differential leucocyte count	12 hrs
3. Absolute Eosinophil count	06 hrs
4. Blood grouping	04 hrs
5. Demonstration of Spirometry	02 hrs

Practicals evaluation: 100 Marks

Haematology

Major	-	50 marks
Minor	-	30 marks
Spotters	-	20 marks

RECOMMENDED TEXT AND REFERENCE BOOKS

TEXT BOOKS

- A K JAIN - Complete Medical Physiology Avichal Publishers Delhi
- INDU KHURANA - Textbook of Physiology for Undergraduates, Elsevier,
- Venktesh & Sudhakar

REFERENCE BOOKS

- GUYTON & HALL - Text of Physiology, Elsevier, 13th Edition
- GANONG's Review of Medical Physiology, Lange Publications, 27th edition

PRACTICAL MANUALS

- G.K.PAL – Textbook of Practical Physiology – University Press
- A.K.JAIN - Manual of Practical Physiology, Arya` Publishers Delhi

CORE 6: ENERGY METABOLISM AND METABOLISM OF BIOMOLECULES

Specific Learning objectives:

1. Students will understand the role of High energy compounds, Importance of reducing equivalents Electron transport chain and Oxidative Phosphorylation.
2. Students will understand the process of Digestion and absorption of Carbohydrates, Lipids and Proteins with associated disorders.
3. Students will understand the synthesis and utilisation of Carbohydrates, Specialised pathways, Glucose tolerance and transport, Regulation of Blood Glucose and Diabetes Mellitus.
4. Students will understand the synthesis and utilisation of lipids including lipoprotein metabolism, regulation and associated Disorders
5. Students will learn about basic of molecular biology and immunology

Theory **40 hrs**

UNIT – I: BIOENERGETICS AND BIOLOGICAL OXIDATION (2 hrs)

Highenergy compounds. Oxidative phosphorylation: Enzymes involved with special reference to oxygenases and Redoxpotential. Components and organization of respiratory chain in mitochondria. Shuttle mechanisms. Formation of ATP and itsregulation. Inhibitorsandun- couplers (Brown adipose tissue andthermogenesis).

UNIT – II: DIGESTION AND ABSORPTION (3 hrs)

a. Carbohydrate
b. Lipids
c. Proteins
d. Malabsorption syndromes and other related disorders

Digestion: Digestion and absorption of Carbohydrates, proteins and fats. Role of gastro intestinal hormones in digestion.

UNIT – III: METABOLISM OF CARBOHYDRATES (6 hrs)

Glycolysis, TCAcycle, glycogen metabolism, coricycle, gluconeogenesis, HMP shunt pathway, uronic acid pathway, metabolism of fructose and galactose (Regulation- and energetics is mandatory). Hormonal regulation of blood glucose and GTT.

UNIT – IV: METABOLISM OF AMINO ACIDS AND PROTEINS (6 hrs)

Amino acid pool and protein turnover. Tranamination and deamination reactions of aminoacids. Formation, transport and disposal of ammonia (urea cycle). Metabolism of amino acids – glycine, serine, aromatic amino acids, sulphur con- tainingaminoacids, histidine, arginine, glutamicacid, branched chain aminoacids [in brief] and metabolic disorders associated with them along with laboratory diagnosis. Specialized products obtained from amino acid metabolism and their importance in brief(Polyamines, creatine, nitric oxide), one carbonmetabolism.

UNIT – V: METABOLISM OF LIPIDS (7 hrs)

Oxidation (beta)of odd and even chain fattyacids, biosynthesis of fatty acids and regulation, ketone bodies formation and utilization, cholesterol metabolism and regulation, Lipoprotein metabolism, Hyperlipoproteinemia and hypolipoproteinaemia, metabolism of TAG, sphingolipids, phospholipids, atherosclerosis, Role of PUFA, lipid storage diseases and Eicosanoids, Fatty liver.

UNIT – VI: METABOLISM OF NUCLEIC ACIDS (2 hrs)

Biosynthesis and catabolism of purine and pyrimidine nucleotides. Salvage pathways and disorders

UNIT – VII: INTERMEDIARY METABOLISM (2 hrs)

Integration of carbohydrate, protein and lipid metabolism. Regulation by hormones instarvation and wellfedstate. Methods of study of intermediary metabolism.

UNIT – VIII: HEMOGLOBIN METABOLISM (4hrs)

Biosynthesis of heme, regulation and porphyrins. Breakdown of haemoglobin. Biochemical basis of jaundice and distinguishing features of different types of jaundice. Haemoglobin variants and Hb derivatives. Abnormal haemoglobins, hemoglobinopathies and thalassemia

UNIT – IX: GENETICS AND MOLECULAR BIOLOGY (5 hrs)

DNAreplication.Transcriptionand post transcriptional modifications, reversetranscriptase. Geneticcode, translation, posttranslational modifications. Regulationofgene expression, mutation, Polymerase Chain Reaction, Recombinant DNA technology, gene therapy, blotting techniques, Restriction Fragment Length Polymorphism, DNA fingerprinting, Variable number of tandem repeats(VNTR).

UNIT – X: IMMUNOLOGY (3 hrs)

Immune system, T & B lymphocytes, antigen presenting cells, humoral and cell mediated immunity, lymphokines, immune regulation, monoclonal antibodies, applications of immunological techniques- RIA, Immunodiffusion, Micro Array.

SEMESTER II- PRACTICALS

Basic Biochemistry Experiments: Part -II

1. Qualitative analysis of urine and blood

- Analysis of normal urine
- Analysis of abnormal urine
- Spectroscopic examination of Blood
- Screening test for amino acids.

2. Demonstration experiments

- Chromatography
- Electrophoresis
- ELISA
- Oral Glucose tolerance test

3. Quantitative Experiments

- Estimation of serum creatinine by Jaffe's method & calculation of creatinine clearance.
- Estimation of total cholesterol and HDL cholesterol CHOD-POD method
- Estimation of serum AST & ALT by Reitman &Fankel method
- Estimation of serum total & direct bilirubin
- Estimation of Uric acid in serum

Practical assessment plan **100 marks**

1. Spotters-Reagents, Tests, Glassware's., Instruments, equipments, demonstration experiments- 20 marks
2. Qualitative analysis of urine, blood & its interpretation- 40marks
3. Quantitative estimation & interpretation- 40 marks

Recommended books

1. Lehninger's Principles of Biochemistry, Nelson, David l. and Cox, 2000 M.M. Macmillan/ worth,.NY
2. Fundamentals Of Biochemistry, Donald Voet, Judith G.Voet and Charlotte W Pratt, 1999, John Wiley & Sons, NY
3. Outlines of Biochemistry, Eric E.Conn, P.K. Stumpf, G.Brueins and Ray H.Doi, 1987. John Wiley & Sons, NY
4. Biochemistry, Lubert stryer, 1994. 3rd Edn., W H freeman and co, Sanfrancisco.
5. Text book of biochemistry,Thomas M Devlin, 1997 4th edition ,A John Wiley, In
6. Principles of Biochemistry , Garrette & Grisham, 1994. Saunders college Publishing
7. Harper's Biochemistry, R.K. Murray and others, 25 ed 2009. Appleton and Lange, Stanford
8. Regulation in Metabolism , E.A.Newshome ,C. Start, John Wiley & Sons.

Non Core subjects

General electives- Humanities/Health economics

Humanities

Specific Learning objectives: At the end of this paper the student should be able to

1. Discuss concept and importance of health humanities in patient care practices
2. Describe various principles of health humanities in health care delivery
3. Demonstrate different components of health humanities in patient care
4. Develop and demonstrate the skills of reflective practice in health care delivery

Syllabus and teaching plan of health humanities

Sl No	Title of the topic	No of hours	Method of instruction
1.	Introduction to health humanities	01	Lecture
2.	History of medicine	02	Lecture
3.	Understanding the self- What is me?	01	Games and discussion
4.	How to interpret situations	01	Games and discussion
5.	What it means to be sick	01	Role play Group discussion
6.	What it means to be a patient	01	Role play Group discussion
7.	What it means to be an attendant	01	Role play Group discussion
8.	Team building	01	Games and discussion
	Trusting the team	01	Games and discussion
9.	Communication skills – Verbal	02	Video, group discussion
10.	Communication skills – Non verbal	01	Video, group discussion
11.	Empathy – module 1	01	Games and discussion
12.	Empathy – module 2	01	Games and discussion
13.	Breaking the bad news	01	Video, role play, discussion
14.	Interpersonal relationships	02	Lecture, video, group discussion

15.	Leadership module -1	01	Video, group discussion
	Leadership module – 2	01	Role play and discussion
16.	Developing professional identity	02	Lecture
17.	Reflective thinking for action	02	Lecture and group discussion
18.	Ethics and humanities	02	Lecture and group discussion
19	Practicing professionalism	02	Lecture and group discussion
20	Theatre and Humanities	02	Theatre

Assessment plan

Formative: Reflective writing and active participation in the session

Summative examination for 50 marks

- MCQ – 10 Marks
- Reflective writing on a given scenario – 10 marks
- Short essays –3 questions of 5 marks each=15marks
- Short answers – 5 questions of 3 marks each=15marks

Health economics

Specific learning objectives: At the end of the course, the student will be able to

- Explain basic economic theories and models of regulation which are applied to health care Sector
- Interpret and appropriately apply the key concepts of economics within the context of the health system
- Describe and apply key steps in critically reviewing economic evaluations and to understand their use in the decision-making process
- Understand and describe the main features of the Indian health system- in particular how it differs from other salient national health systems according to how services are delivered and purchased

Module 1 - Introduction to Economics

Introduction to economics, definition, scope, basic assumptions, economic analysis-micro, macro, positive and normative, short run, long run, equilibrium-partial, and general. Basic questions of economics, economic model-circular flow of economics, Production Possibility Curve.

Module 2 - Health Economics

Introduction, area of health economics, importance of health economics, scope,

concept of health and health characteristics, need of health economics, uniqueness of health as goods and service, health and economic development, causes of health problems in India, economics evaluation methods-cost benefit, cost minimization, cost utility analysis.

Module 3 - Law of Demand

Introduction to demand, law of demand, demand in health care, elasticity in demand for health care, determinants of health care demand.

Module 4 - Law of Supply

Supply in health, law of supply, determinants of supply, elasticity of supply, relation of demand and supply.

Module 5 - Healthcare Innovation

Recent trends in Healthcare market, Start ups in Healthcare- Concepts and Cases, Health care technology from a business perspective.

Books for Reference

1. Economics Principles and Applications (Indian Edition)-Gregory Mankiw
2. Managerial Economics Principles and World wide Applications- Dominic Salvatore, Sidhartha K Rastogi
3. Health Economics- N.K Anand and Shikha Goel
4. Health Economics for Hospital Management- Shuvendu Bikash Dutta

Assessment Plan- Theory 50 marks

5 marks x 4 questions= 20 marks

2 marks x 15 questions=30 marks

SEMESTER 3

CORE: B1: BIOCHEMICAL TECHNIQUES–
Specific learning objectives: At the end of the course student will be able to

1. Understand the Principle & Applications of various biochemical techniques & Immunoassays which can be used in diagnosis and treatment such as Chromatography, Electrophoresis, Ion Selective Electrodes, Chemiluminescence, Immunoassays [ELISA] and radioimmunoassay (isotopes, radioactivity)
2. Describe and apply the principle involved in Preparation of Buffers
3. Describe the principle and explain working of various instruments such as Colorimeter, Spectrophotometer, Fluorimeter, Osmometer, Nephelometer, Atomic Absorption Spectroscopy, Centrifuges and Autoanalysers (Automation)
4. Discuss the principles and application of various molecular biology techniques used in diagnoses of various diseases.

Theory **40 hours**

UNIT I: Chromatography **(6 Hrs)**
Definition and types with principle, procedure, applications, advantages and disadvantages-paper, TLC, ion exchange, affinity, gel filtration, gas liquid, HPLC.

UNIT II: Electrophoresis **(6 Hrs)**
Agarose, Paper. PAGE, SDS-PAGE, Immunoelectrophoretic, Isoelectric focusing, Blotting techniques - principle, procedure and applications.

UNIT III: Principle and application of Ion selective electrodes, centrifugation-types, ultracentrifugation, isoelectric focussing technique **(4 Hrs)**

UNIT IV: Concept of pH and buffers, Henderson-Hasselbalch equation, principle and procedure of determination of pH **(2 Hrs)**

UNIT V: Instrumentation **(6 Hrs)**
Principle and application of colorimetry, spectrophotometry, fluorimetry, osmometry, nephelometry and atomicabsorptionspectroscopy

UNIT VI: Chemiluminescence, Immunoassays [ELISA] and radioimmunoassay [isotopes, radioactivity- detection, measurement and their application in diagnosis and treatment **(4 Hrs)**

UNIT VII: Automation- Autoanalyzer's, Blood gas analyser, Mass spectroscopy and NMR **(4 hrs)**

UNIT VIII: Molecular Biology techniques - PCR-types and its application, QPCR and its applications, RT PCR, blotting techniques [in detail], Recombinant DNA technology, RFLP, Finger printing and transgenic and knock out animals. **(8 Hrs)**

Recommended books:

1. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics.
2. Fundamentals Of Biochemistry, Donald Voet, Judith G.Voet and Charlotte W Pratt, John Wiley & Sons, NY
3. Biochemistry, Zubay G L.4th edition W M C Brown Publishers
4. Baynes and Dominiczak. Medical Biochemistry

CORE-B2: ADVANCED BIOMOLECULES AND THERMODYNAMICS

Specific learning objectives: The students will be able to

1. Understand chemical nature, catalytic efficiency, specificity and regulation of enzymes.
2. Understand thermodynamic variables, high energy compounds and mitochondrial respiration.
3. Understand sources, effects, biomedical importance of reactive oxygen species and the antioxidant action.
4. Understand the chemical structure, synthesis and degradation of heme along with their clinical significance.
5. Understand the properties, function and disorders of water balance and the clinical significance of radioisotopes.

Theory: 40 hrs

UNIT I: ENZYMES (10 Hrs)

Classification and Nomenclature: Properties, Specificity, Coenzymes, mechanism of enzyme action and factors effecting enzyme activity. Isolation and purification of enzymes. Enzyme inhibition- types and their importance. Applications of enzymes & Iso enzymes in research and clinical (diagnosis and therapy)

UNIT II: BIOENERGETICS AND BIOLOGICAL OXIDATION (6 Hrs)

Concept of bioenergetics in relation to thermodynamics: Laws of thermodynamics; Concept of free energy, and standard free energy change; Highenergy compounds Biological oxidation: Enzymes involved with special reference to oxygenases and Redo potential. Components and organization of respiratory chain in mitochondria. Shuttle mechanisms. Oxidative phosphorylation. Formation of ATP Mechanism and its regulation. Inhibitors and un- couplers (Brown adipose tissue andthermogenesis).

UNIT III: FREE RADICALS IN BIOSYSTEM (6 Hrs)

Introduction and chemistry of reactive oxygen species (ROS), Lipid peroxidation-

measurement and protection against lipid peroxidation. Antioxidants types and mechanism of action-Catalase, Glutathione peroxidase, Glutathione reductase, Glutathione-S-transferase and superoxide dismutase (SOD) and Ageing.

UNIT IV: OXIDATIVE STRESS RELATED DISORDERS (8 Hrs)

Role of oxidative stress in various cancers, role of free radicals in Type I and II diabetes mellitus, various inflammatory disorders associated with free radicals, oxidative stress in neurodegenerative diseases: Alzheimer's disease, Parkinson's disease, Huntington's disease and Amyotrophic Lateral Sclerosis, Prions.

UNIT V: HEME METABOLISM (6 Hrs)

Heme biosynthesis, regulation and porphyrins. hemoglobin structural motif Degradation of haemoglobin. Biochemical basis of jaundice and types of jaundice, Hemoglobin variants and Hb derivatives, abnormal haemoglobins, hemoglobinopathies and thalassemia, Shunt bilirubin and congenital hyperbilirubinemia.

UNIT VI: WATER AND ELECTROLYTE BALANCE (2 Hrs)

Body water compartments, Donnan membrane equilibrium, osmolality, electrolytes concentration in body fluid compartments, water balance, regulation of water balance. Electrolyte balance, regulation and its disorders.

UNIT VII: RADIOISOTOPES (2 Hrs)

Half-life, units of radioactivity, Detection and measurementof radioactive isotopes. Application of isotopes in research, clinical biochemistry, diagnosis and treatments, radiation hazards.

SEMESTER III – PRACTICALS
MODULE- B1 (30 Hrs)
PART A- TECHNIQUES

1. Preparation of buffers- normality, molarity, percentage solution preparation & calculation.
2. Measurement of pH by pH meter.
3. Calibration of pipettes
4. Electrophoresis- serum & haemoglobin
5. SDS-PAGE
6. ELISA
7. Paper chromatography of amino acids & carbohydrates.
8. Gel permeation chromatography
9. Sterilization techniques
10. Absorption spectra of phenylalanine, tyrosine and tryptophan
11. Absorption spectra of purines and pyrimidines

MODULE- B2 **(30 Hrs)**

PART B- QUANTATIVE ESTIMATIONS & STANDARD GRAPH

1. Estimation of glucose by ortho toluidine method
2. Estimation of glucose by DNS method
3. Estimation of serum proteins by BCA method, Bradford's & Lowry's method.
4. Estimation of total albumin by dye binding method
5. Estimation of ketohexose – fructose by resorcinol method
6. Estimation of serum creatinine by Jaffe's method.
7. Estimation of total cholesterol and HDL cholesterol CHOD-POD method.
8. Estimation of antioxidant activity using FRAP – Ferric reducing antioxidant power.
9. Estimation of antioxidant activity using DPPH – 2,2-diphenyl-1-picrylhydrazyl method
10. Estimation of serum inorganic phosphate
11. Estimation of serum calcium
12. Estimation of protein by Folin's method, includes preparation of Folin's reagent

Practical Examination: B1 & B2

Part A:

1. Buffer preparation – 10 marks
2. Techniques – 20 marks
3. Quantitative experiment – 20 marks

Part B:

1. Standard graph – 25 marks
2. Quantitative estimation – 25 marks

Recommended books

1. DM Vasudevan. Textbook of Biochemistry for Medical students
2. Rafi MD. Textbook of Biochemistry for Medical students
3. Dinesh Puri. Textbook of Biochemistry
4. PankajaNaik. Biochemistry
5. Dinesh Puri. Textbook of Biochemistry

Core B3- Clinical Laboratory postings

A.Primary sample collection-

Patient Identification, Patient preparation, Labelling of samples, Venous blood sample collection, Arterial Blood sample collection, Spot & 24-hour Urine sample collection

B. Preanalytical Phase

Pre analytical variables- Controllable & Uncontrollable variables.
Sample processing-Centrifugation, Sample Rejection Criteria,
Laboratory Information System: Sample receiving to approval of test results.

C. Analytical Phase

1. Spectrophotometry: Principle, Procedure and applications
2. Immunoassay: Principle, Procedure and applications
3. Standard Operating Procedures of all Equipment, Maintenance & trouble shooting
4. Quality Control-Internal Quality control & External Quality assurance
5. Blood glucose estimation, Diabetes Mellitus, Insulin, C-peptide
6. Renal function tests: parameters, method of estimation, reference range and clinical importance
7. Liver function tests: parameters, method of estimation, reference range and clinical importance
8. Lipid profile: parameters, method of estimation, reference range and clinical importance
9. Clinical Enzymology: parameters, method of estimation, reference range and clinical importance
10. Thyroid profile: parameters, method of estimation, reference range and clinical importance
11. Cardiac markers: parameters, method of estimation, reference range and clinical importance
12. Body Fluid analysis: parameters, method of estimation, reference range and clinical importance

D. Post analytical Phase:

1. Reporting of results: Interpretation of test results, Intimation of Critical results, Turnaround time, Auto validation, Delta check
2. Lab Safety: Hand hygiene, Biomedical waste management, Needle stick injury

Non - Core Subjects

Allied-1- Research Methodology & Bioethics

Specific Learning objectives

At the end of this paper the student should be able to,

1. Describe the concept, uses and types of biomedical research
2. Discuss various steps involved in conducting the biomedical research
3. Describe various steps in developing research protocol and scientific communication
4. Describe concept and principles of ethics in biomedical research

Theory: 30hrs

Sl No	Title of the topic	No of hours	Method of instruction
1.	Introduction to health research	01	Lecture
2.	Identifying research topics	01	Lecture + Group discussion
3.	Literature search with Hands on activity	02	Lecture Hands on exercise
4.	Literature matrix	01	Lecture Hands on exercise
5.	Writing research question and objectives	01	Lecture Hands on exercise
6.	Study designs -1 – Descriptive studies	01	Lecture
7.	Study designs -2 – Analytical studies	01	Lecture
8.	Study designs -3 – Experimental studies	01	Lecture
9.	Diagnostic validation studies	01	Lecture
10.	Sampling techniques	01	Lecture Hands on exercise
11.	Sample size estimation	01	Lecture Hands on exercise
12.	Tools for data collection	01	Lecture

13.	Designing and validation of a questionnaire	01	Lecture Hands on exercise
14.	Describing study designs in molecular studies	01	Lecture
15.	Animal experiments	01	Lecture
16.	Role of statistics in research methodology	01	Lecture
17.	Role of computers in health research	01	Lecture
18.	Designing a research protocol	02	Workshop
19.	Research to publication	01	Lecture
20.	Funding opportunities and requirements	01	Lecture
21.	Introduction to Bio ethics	01	Lecture
22.	History and Principles of ethics	01	Lecture
23.	Guidelines for research ethics	02	Lecture
24.	ICH-GLP- GCP Guidelines	02	Lecture
25.	Institutional Ethics Committee	01	Lecture
26.	Informed consent	01	Lecture

Assessment plan

Formative : MCQ Based Tests, Unit tests

Summative examination for 50 marks

- MCQ – 10 Marks
- Writing research protocol for given problem statement – 20 marks
- Short essays –2 questions of 4 marks each=08marks
- Short answers – 4 questions of 3 marks each=12 marks

General electives

Soft skills/ Teaching learning Methodology

Soft skills

Specific learning objectives:

At the end of this elective, the student should be able to,

1. Understand the importance of soft skills in health profession
2. Demonstrate the attributes of professionalism and soft skills in working environment

3. Understand the methods of problem solving and conflict management in work place
4. Understand and demonstrate the leadership skills in health care setting

Hrs: 30

Sl No	Title of the topic	No of hours	Method of instruction
1	Introduction to soft skills	01	Lecture
2	General soft skills	02	Lecture Video
3	Technical soft skills	01	Case scenario based Group discussion
4	Communication skills, written communication skills, skills of writing email	01	Video Group discussion
5	Critical and structured thinking, scientific presentation skills.	02	Group discussion
6	Problem solving skills	01	Case scenario based Group discussion
7	Creativity	01	Case scenario based Group discussion
8	Team work capabilities Negotiating skills	02	Game based exercises
	Self management Time management	01	Lecture
9	Conflict management Cultural awareness	02	Role play Lecture
10	Common knowledge Responsibility	02	Lecture
11	Etiquette and good manners Courtesy	01	Role play Group discussion
12	Self esteem Sociability	02	Role play Group discussion
13	Integrity/honesty Empathy	01	Role play Group discussion
14	Work ethics ; work attitude and professionalism Business management	02	Case scenario based Group discussion
15	Leadership skills	02	Video Role play followed by discussion

16	Networking skills, public speaking skills	03	Lecture
17	Flexibility and adaptability Organizational skills, emotional intelligence	03	Role play followed by discussion

Assessment plan

Formative : Reflective writing and active participation in the session

Summative examination for 50 marks

- MCQ – 10 Marks
- Reflective writing on a given scenario – 10 marks
- Long essay of Problem solving- One question of 10 marks.
- Short essays – 2 questions of 4 marks each=8 marks
- Short answers – 4 questions of 3 marks each=12 marks

Teaching learning Methodology

Specific learning objectives

At the end of completing this elective the student should be able to

1. Understand and apply adult learning principles in teaching learning methods
2. Enlist and apply the interactive teaching learning methods at classroom and clinical setting
3. Describe and use the techniques of self-directed learning
4. Understand the concept of E learning in health professional education

Hrs: 30

Sl No	Title of the topic	No of hours	Method of instruction
1	Introduction to Teaching Learning Methodologies	01	Lecture
2	Androgogy and Pedagogy	02	Small Group Discussions
3	Large Group Teaching; Lectures (Dydactic lectures and interactive lectures)	02	Lecture and demonstrations
4	Flipped Class Rooms	01	Instructional directives and discussion
5	Small Group teaching (Tutorials, seminars)	02	Instructional directives and discussion
6	Brainstorming / Snow Balling/ Role Playing	02	Role play Group discussion

7	Journal Clubs/ Problem based learning (PBL)	01	Group discussion
8	Clinical teaching (Bed side teaching)	01	Role play Group discussion
9	Team-based learning (TBL) and Case – based Learning (CBL)	02	Role play Instructional directives and discussion
10	Independent Learning; Self-Directed Learning (SDL)	02	Instructional directives and discussion
11	Teaching of Procedural skills: Learn, see, practice, prove, do and maintain	02	Video, group discussion
12	Simulators (Mannequins and models)	02	Instructional directives and discussion
13	Simulated patients and virtual patients	01	Instructional directives and discussion
14	e-learning	02	Instructional directives and discussion
15	Innovative Teaching-Learning Methods : Pecha-Kucha Technique, Cine-meducation.	02	Video, role play, discussion
16	Collaborative Learning: Peer assisted Learning System (PALS), Peer to peer learning (P2P)	02	Lecture, video, group discussion
17	Massive Open Online Courses (MOOCs)	03	Lecture and group discussion Instructional directives and discussion

Assessment plan

Formative : Reflective writing and active participation in the sessions
Summative examination for 50 marks

- MCQ – 10 Marks
- Reflective writing on a given scenario – 10 marks
- Long essay of Problem solving- One question of 10 marks.
- Short essays – 2 questions of 4 marks each
- Short answers – 4 questions of 3 marks each

IV-SEMESTER

CORE- B4: METABOLISM OF CARBOHYDRATES, PROTEINS, LIPIDS, NUCLEIC ACIDS AND ASSOCIATED INBORN METBOLISM

Specific Learning objective

- Students will understand the role of High energy compounds, Importance of reducing equivalents Electron transport chain and Oxidative Phosphorylation.
- Students will understand the process of Digestion and absorption of Carbohydrates, Lipids and Proteins with associated disorders.
- Students will understand the synthesis and utilisation of Carbohydrates, Specialised pathways, Glucose tolerance and transport, Regulation of Blood Glucose and Diabetes Mellitus.
- Students will understand the synthesis and utilisation of lipids including lipoprotein metabolism, Regulation and Associated Disorders
- Students will understand the catabolism of Proteins, Deamination and Transamination Reaction, Transport and Detoxification of Ammonia with associated Disorders. Students will be able to appreciate the role of amino acids in synthesising specialised Products and importance of proteins in Nutrition
- Students will understand the synthesis and degradation of Purines and pyrimidines with associated disorders.

Theory: 40 hrs

UNIT I: DIGESTION AND ABSORPTION (3hrs)

- Carbohydrates,
- Protein
- lipids

UNIT II: METABOLISM OF CARBOHYDRATES (9hrs)

Glucose transporters. Glycolysis. Oxidation of pyruvate. TCA cycle. Gluconeogenesis, Cori's cycle, Metabolism of glycogen (glycogenesis, glycogenolysis, storage disorders). HMP shunt pathway. Metabolism of fructose, galactose, uronic acid pathway, inborn errors associated with them. Blood glucose regulation. Diabetes Mellitus-Etiology, metabolism in Diabetes Mellitus, biochemical basis of acute and chronic complications, laboratory diagnosis and monitoring (Glycated Hb,). Glucose tolerance test

UNIT III: METABOLISM OF LIPIDS (9hrs)

Oxidation of fatty acids –beta oxidation of odd chain and even chain fatty acids along with disorders. Alpha and Omega oxidation. Formation and utilization of ketone bodies and ketosis. De novo synthesis of fatty acids, elongation and desaturation.

Triglycerides and Phospholipids(lecithinandcephalinonly)–formation and breakdown. Synthesis of cholesterol, Fate of cholesterol and compounds derived from cholesterol. Lipoproteins – classification, metabolism, functions and disorders. Lipid storage disorders and atherosclerosis and role of PUFA in preventing atherosclerosis. Metabolism in adipose tissue, fattyliver and lipoatrophic factors.

UNIT IV: METABOLISM OF PROTEINS (10 hrs)

Amino acid pool and protein turnover. Tranamination and deamination reactions of aminoacids. Formation, transport and disposal of ammonia (urea cycle). Metabolism of amino acids – glycine, serine, aromatic amino acids, sulphur containingaminoacids, histidine, arginine, glutamic acid, branched chain aminoacids [in brief] and metabolic disorders associated with them along with laboratory diagnosis. Specialized products obtained from amino acid metabolism and their importance in brief(Polyamines, creatine, nitric oxide), one carbon metabolism.

UNIT V: NUCLEIC ACID METABOLISM (5hrs)

De novo synthesis of purines and pyrimidines, salvage pathway, associated disorders and degradation

UNIT VI: INTERMEDIARY METABOLISM (2hrs)

Integration of carbohydrate, protein and lipidmetabolism. Intermediary compounds and central hub points of metabolism. Methods of study of intermediary metabolism.

UNIT VII: INBORN ERRORS OF METABOLISM (2hrs)

Diseases associated with carbohydrates, proteins and lipids and their enzyme defects

Recommended Books

1. Lehninger's Principles of Biochemistry, Nelson, David l. and Cox, 2000 M.M. Macmillan/worth, NY
2. Fundamentals Of Biochemistry, Donald Voet, Judith G. Voet and Charlotte W Pratt, 1999, John Wiley & Sons, NY
3. Outlines of Biochemistry, Eric E. Conn, P.K. Stumpf, G. Brueins and Ray H. Doi, 1987. John Wiley & Sons, NY
4. Biochemistry, Lubertstryer, 1994. 3rd Edn., W H freeman and co, Sanfrancisco.
5. Text book of biochemistry,Thomas M Devlin, 1997 4th edition ,A John Wiley, In
6. Biochemistry, Zubay G L, 1988.4th edition W M C Brown Publishers.
7. Principles of Biochemistry, Garrette & Grisham, 1994. Saunders college Publishing
8. Harper's Biochemistry, R.K. Murray and others, 25 ed 2009. Appleton and Lange, Stanford 9. Regulation in Metabolism, E.A. Newshome, C. Start, John Wiley & Sons

CORE- B5: BIOCHEMISTRY OF CELLUAR COMMUNICATION AND IMMUNOLOGY

Specific Learning objectives

- Students will understand Classification and general mechanism of Hormones.
- Students will be able to comprehend the biosynthesis, functions of Hypothalamic, pituitary, Thyroid and adrenal Hormones with associated disorders and biochemical basis of endocrinal diseases.
- Students will understand biochemistry of conception, reproduction and contraception
- Explain the importance of phagocytosis and natural killer cells in innate body defense.
- Describe the roles of different types of T cells, B cells and APCs.
- Compare and contrast the origin, maturation process, and general function of B and T lymphocytes.
- Compare and contrast primary and secondary immune response and describe the mechanisms of hypersensitivity reactions.
- Discuss about role of MHC in immune system

Hrs: 40 hrs

UNIT I: ENDOCRINOLOGY (15hrs)

1. Classification and general mechanism of action of hormones.
2. Biogenesis, secretion, control, transport and mechanism of action of following-hypothalamic peptides, adenohypophyseal and neurohypophyseal hormones, thyroid parathyroid hormones, calcitonin, pancreatic hormones, adrenocortical and medullary hormones, gonadal hormones (ovary; oestrogens and progesterone and testis; testosterone), gastrointestinal hormones, opioid peptides, para hormones, cytokines, chemokines, placental hormones.
3. Biochemistry of conception, reproduction.
4. Endocrine interrelationship and their involvement in metabolic regulation neuromodulators and their mechanism of action, physiological significance.

UNIT II: IMMUNOLOGY (20hrs)

1. Types of immunity Innate Immunity and Adaptive Immunity; Cells and organs of immunity: Primary and secondary lymphoid organs; T cells, B cells, macrophages and effecter cells; Macrophage plasticity; Humoral and cellular immunity; Antigens and immunogens; Immunoglobulins: types and structure; CDRs; Immunoglobulin fold; Isotypes, allotypes and idiotypes; Valency, affinity and avidity;
2. Primary and secondary immune response; Immunological memory; Clonal selection theory. Immune responses: T & B cell interaction The immunoglobulin

genes: organization and assembly; Generation of immunological diversity; Major histocompatibility complex (MHC): structure and organization of MHC class I and class II molecules; Antigen processing and presentation; T-cell receptor: αβ and γδ TCR; T cell maturation, activation and differentiation; Types of B cells; B cell generation, activation and differentiation; T-dependent and T-independent antigens.

3. Immune effector mechanisms B cell mediated effector responses; Cell mediated effector responses; Cytokines: properties and functions of lymphokines, monokines, interleukins and chemokines; Complement and mechanism of complement fixation; Hypersensitivity; Types of hypersensitivity reactions.
4. Immune-mediated diseases and Immuno technology tolerance and autoimmunity; Immunoregulation; Immune response to infectious diseases; Viral, bacterial and protozoal infections; H1N1; Cancer immunotherapy; Mucosal immunity; Adjuvants; Immunotherapy.

UNIT III VACCINES (5 Hrs)

Active and passive immunization, vaccine designs, subunit vaccines, DNA vaccines

Recommended books

1. T J Kindt, B A Osborne, R Goldsby (2006) Kuby Immunology, W H Freeman publication, 6th Edition
2. W E Paul (2003) Fundamental Immunology, Lipincott Williams and Wilkins publication, 4th Edition
3. P J Delves, S J Martin, D R Burton, I M Roitt (2017) Roitt's Essential Immunology, Wiley Blackwell publication, 13th edition.
4. Endocrinology, Mac E. Hadley, 2006, 4th Edition. Prentice Hall International Inc
5. Textbook of Medical Physiology, Guyton and Hall, 2000. 10 Edition, Saunders Publishing Co.
6. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics

SEMESTER 4 - PRACTICALS

MODULE- B3: CLINICAL EXPERIMENTS- I **30 Hrs**

1. Estimation of urine creatinine by Jaffe's method and calculation of creatinine clearance
2. Estimation of cholesterol by Zak method & CHOD-POD method.
3. Estimation of amino acids by Ninhydrin method
4. Estimation of uric acid by Caraway method
5. Biomedical waste management.
6. ECLIA
7. OGTT
8. Estimation of glucose by glucose oxidase method
9. Estimation of serum total & direct bilirubin

MODULE- B4: CLINICAL EXPERIMENTS- II **30 Hrs**

1. Arterial blood gas(ABG)
2. Effect of enzyme and substrate on trypsin or chymotrypsin by caseinolytic method and determination of Km value
3. Effect of pH and temperature on trypsin or chymotrypsin by caseinolytic method and determination of Km value
4. Estimation of vitamin E in plasma by Emmorie Engel reaction
5. Estimation of total carbohydrates by phenol sulphuric acid method
6. Estimation of serum AST & ALT
7. Salivary amylase assay- Specific activity, pH, Temperature, Km and Vmax
8. Estimation of serum acid phosphatase
9. Estimation of serum alkaline phosphatase

Practical Examination
MODULE B3 & B4

1. Standard graph – 30 marks
2. Quantitative estimation – 20 marks
3. OGTT (procedure & chart) – 20 marks
4. Enzyme activity – 30 marks

Core B 6- Clinical Laboratory postings

A. Primary sample collection-

1. Patient Identification, Patient preparation, Labelling of samples,
2. Venous blood sample collection, Arterial Blood sample collection, Spot & 24 hour Urine sample collection

B. Preanalytical Phase

1. Pre analytical variables- Controllable & Uncontrollable variables.

2. Sample processing-Centrifugation, Sample Rejection Criteria,
3. Laboratory Information System: Sample receiving to approval of test results.
4. Pre analytical errors

C. Analytical Phase

1. Routine Biochemical analysis
2. Bone profile : parameters, method of estimation, reference range and clinical importance
3. Anemia Profile: parameters, method of estimation, reference range and clinical importance
4. Fertility profile: parameters, method of estimation, reference range and clinical importance
5. Tumor markers: parameters, method of estimation, reference range and clinical importance
6. Electrophoresis: Protein & Hemoglobin electrophoresis- Principle, Procedure and applications
7. New Born screening: Principle, Procedure and applications

D. Post analytical Phase:

1. NABH & NABL accreditation: Quality Policy, Vision, Mission, Hospital Emergency codes
2. Observation of DNA Isolation, FISH & Karyotyping techniques

Allied 4 – Biostatistics

Specific learning objectives: The course will enable the student to understand how to effectively collect data, describe data, and use data to make inferences and conclusions about real world phenomena. After finishing this course, students should be able to:

1. Recognize the importance of data collection and its role in determining scope of inference.
2. Demonstrate a solid understanding of interval estimation and hypothesis testing.
3. Choose and apply appropriate statistical methods for analyzing one or two variables.
4. Use technology to perform descriptive and inferential data analysis for one or two variables.
5. Interpret statistical results correctly, effectively, and in context.
6. Understand and critique data-based claims.
7. Appreciate the power of data.
8. Apply the basic terminology and definitions of epidemiology.

Unit – I **2 Hours**

Introduction :Introduction to Biostatistics; levels of measurement – nominal, ordinal, interval and ratio scales; Types of Data- quantitative and qualitative

Unit –II **2 Hours**

Descriptive statistics – central tendency, dispersion, skewness and kurtosis.

Unit – II **3 Hours**

Sampling : Probability and non-probability; simple random, stratified, systematic, cluster and multistage sampling; sampling and non – sampling errors

Unit III **3 Hours**

Sample size estimation : Sample size determination for estimation : sample size determination for estimation of mean, estimation of proportion, comparing two means and comparing two proportions.

Unit – IV **5 Hours**

Hypothesis testing : formulation and types; null hypothesis, alternate hypothesis, type I and type II errors, level of significance, power of the test, p –value , concept of standard error and confidence interval . Concept of Probability "probability distribution – normal, poisson, binomial

Unit – V **3 Hours**

Epidemiological studies : Rates – Prevalence and incidence; types – Prospective and retrospective studies; Diagnostic Efficiency Statistics (Sensitivity, specificity, predictive values); Risk Estimation – odds ratio and survival analysis.

Unit – V **4 Hours**

Tests of significance – Parametric tests: requirements, "t" test, normal z – test , and "F' test including post – hoc tests, one – way and two-way analysis of variance, analysis of covariance, repeated measures analysis of variance, simple linear correlation and regression.

Unit – VI **3 Hours**

Test of significance – Non – parametric tests: Assumptions; one – sample tests (sign test, McNemar test); two – sample test (Mann whitney U test, Wilcoxon rank sum test); k –sample tests (Kruskal wallies test, and Friedman test) and chi-square test.

Unit – VII **5 Hours**

Multivariate analysis : Introduction, Multiple regression, logistic regression, factor analysis, cluster analysis,

Essential references :

- B.L (2007). Qualitative Research : Methods for the social sciences (6th ed.) New york: Pearson education.
- Daniel, W.W. (2005). Biostatistics: a foundation for analysis in health sciences (8th ed.) New York: John wiley and Sons.
- Dillon, W.R. & Goldstein, M. (1984). Multivariate analysis: Methods & Applications. New York: John Wiley & Sons.
- Hassart, T.H (1991). Understanding Biostatistics. ST. Louis: Mosby year Book.
- Kerlinger, F.N. (1995). Foundations of Behavioral research. New York: Holt Rineheart & Winston.
- Kothari, C.R.(2003) Research Methodology. New Delhi: Wishwa Prakshna.
- Siegal, S. & castellan, N.J (1988). Non – parametric statistics for the behavioral sciences. McGraw Hill: New Delhi

Assessment Plan- Theory 50 marks

5 marks x 4 questions= 20 marks

2 marks x 15 questions=30 marks

Discipline Specific Electives
Nutrigenomics /Human Cytogenetics
Nutrigenomics

Specific Learning objectives

- The students will be familiar with the basic concepts in nutritional genomics
- Develop an understanding of genomics and gene regulation with respect to diet
- Obtain an appreciation for the role and importance of nutrition in prevention of polygenic diseases.

Theory **30 hrs**

Unit 1

Introduction to gene-diet interactions

Nutrigenomics: Scope and Importance to Human Health and Industry

Transporter gene polymorphisms -interaction with effects of micronutrients in humans. Polymorphisms in genes affecting the uptake and transport of omega-6 and omega-3 polyunsaturated fatty acids: interactions with dietary lipids and chronic disease risk. Nutrigenomics approaches to unraveling physiological effects of complex foods.

The intestinal microbiota - role in nutrigenomics.

Unit II

Modifying disease risk through nutrigenomics:

Modulating the risk of cardiovascular disease through nutrigenomics; Modulating the risk of diabetes through nutrigenomics; Modulating the risk of inflammatory bowel diseases through nutrigenomics; Modulating the risk of obesity through nutrigenomics; Modulating the risk of cancer through nutrigenomics; Modulating the malnutrition through nutrigenomics

Unit III

Technologies in nutrigenomics

GENOMICS TECHNIQUES: Different sequencing approaches, Microarray, Massarray, SNP genotyping, PCR and RT-PCR techniques

PROTEOMICS TECHNIQUES: 1-D, 2-D gel electrophoresis, DIGE, novel peptide identification, peptide sequencing methods

METABOLOMICS TECHNIQUES: Chromatography and mass spectrometry techniques, Discovery and validation of biomarkers for important diseases and disorders

COMPUTATIONAL APPROACHES: Introduction to different types of public domain databases, data mining strategies, primer designing.

Unit IV

Bringing nutrigenomics to industry, health professionals, and the public:

Bringing nutrigenomics to the food industry: Industry-Academia partnerships as

an important challenge; Bringing nutrigenomics to the public: Is direct-to-consumer testing the future of nutritional genomics? Interaction with health professionals in bringing nutrigenomics to the public; Is contemporary society ready for nutrigenomic science? Public health significance of nutrigenomics and nutrigenetics

Recommended books

1. Journal Nutrients 2012, 4, 1898-1944; Molecular Nutrition Research—The Modern Way Of Performing Nutritional Science.
2. Journal Nutrients 2013, 5, 32-57; Nutrigenetics and Metabolic Disease: Current Status and Implications for Personalized Nutrition
3. J Nutrigenetics Nutrigenomics 2011;4:69–89; Nutrigenetics and Nutrigenomics: Viewpoints on the Current Status and Applications in Nutrition Research and Practice.
4. J Am Diet Assoc. 2006;106:569-576; Nutrigenomics: From Molecular Nutrition to Prevention of Disease
5. Lynnette R. Ferguson (2013), Nutrigenomics and Nutrigenetics in Functional Foods and Personalized Nutrition 1st edition, CRC Press.

Assessment Plan- Theory 50 marks

5 marks x 4 questions= 20 marks

2 marks x 15 questions=30 marks

Human Cytogenetics

Specific learning objectives:

1. The student will be able to demonstrate an advanced knowledge of Human cytogenetics & human disease
2. The student will be able to diagnose and interpret pathology of Human chromosomes
3. The student will be able to understand and investigate the cause and effect of chromosome abnormalities and associated human disease
4. The student will be able to demonstrate professional knowledge of cytogenetic disorders and clinical diagnosis

Unit I – Introduction to Cytogenetics and Clinical Cytogenetics (2 Hrs)

History of human cytogenetics, confirmation of human chromosome number, morphology of human chromosomes, non-banding techniques, classification of human chromosomes into different groups (A-G), international system for human cytogenetic nomenclature, various conferences held to discuss chromosome nomenclature; karyotyping.

Unit II – Introduction to Cytogenetic Techniques (4 Hrs)

Conventional banding patterns of chromosomes; specialized banding techniques – Q- banding, G- banding, C banding, silver staining for nucleolus organizer re-

gion (NOR), R-banding, sister chromatid exchange (SCE), chromosome analysis, chromosome band nomenclature, Identification and definition of chromosome landmarks, regions, bands and sub-bands, high resolution banding (HRB); immortalization of cells – Epstein-Barr virus (EBV) transformation of lymphocytes to generate lymphoblastoid cell lines.

Unit III – Application of Cytogenetics in Medical Genetics (4 Hrs)

General principles, Chromosome abnormalities and human genetic diseases: numerical and structural (markers, isochromosomes, ring chromosomes, deletion, duplication, insertions, translocations and inversions) abnormalities; sex chromosome abnormalities, autosomal abnormalities, uniparental disomy, Chromosome breakage Studies (chromatid and chromosome breaks) and their Applications.

Unit IV – International System for Human Cytogenetic Nomenclature (ISCN) and Quality Assurance (2 Hr)

General principles, specification of breakpoints, designating structural chromosome aberrations by breakpoints and band composition, short system for designating structural chromosome aberrations, two break rearrangements, three break, four break rearrangements and more complex rearrangements, detailed system for designating structural chromosome aberrations, additional symbols, derivative chromosomes, recombinant chromosomes, questionable identification, uncertain breakpoint designations, alternative interpretations. Variations in heterochromatic segments, satellite stalks and satellites, fragile sites, inversions as normal variations.

Unit V – Introduction to Cancer Cytogenetics (2 Hrs)

Application of cytogenetics in cancer diagnosis (karyotyping), analysis and interpretation of results, quality assurance, Clones and clonal evolution, definition of a clone, clone size, mainline, stemline, sideline, clonal evolution, composite karyotype, unrelated clones, modal number, constitutional karyotype, chromosome markers found in different Lymphomas and leukemias (CML, AML, APML, myelodysplastic syndromes etc.,) and solid tumors (Sarcomas and carcinomas).

Unit VI – Introduction to Molecular Cytogenetics (1 Hr)

History of molecular cytogenetics, various molecular techniques applied in clinical cytogenetics, advantages and applications in clinical cytogenetics.

Unit VII – Clinical Applications of Fluorescence in situ Hybridization (FISH) (2 Hrs)

Principles, procedure, labelling of DNA (Direct and Indirect methods), antibodies used to detect the probe signals, probe amplification, advantages of FISH, various tissue samples used for FISH study.

Kinds of FISH probes – Alpha satellite, telomeric, NOR specific, chromosome specific paint probes, unique sequence specific, repetitive sequence etc., and their

applications in clinical diagnosis of various syndromes giving examples of normal and abnormal results.

Unit VIII – Application of FISH in Prenatal Diagnosis and confirming Microdeletion syndrome (3 Hrs)

Principles and procedure involved, alpha satellite and unique sequence FISH probes used in prenatal diagnosis of genetic abnormalities on cultured and uncultured cells using appropriate examples.

Prenatal diagnosis of trisomies that could lead to live birth. Postnatal diagnosis of microdeletion syndromes (Prader-Willi, Angelman, Williams, DiGeorge etc.,) using FISH probes, confirmation of cryptic translocations by FISH using appropriate examples.

Unit IX – Application of FISH in Cancer Diagnosis (4 Hrs)

Principles and procedure, details of FISH probes used in detecting various markers [(BCR/ABL, t(15;17), t(8;21) etc.,] found in Leukemia and solid tumors(HER-2/neu, C-myc, p53 etc.,), use of single fusion, dual fusion, break apart and multi-panel probes used in cancer detection, confirmation of probe amplifications seen in breast cancer and solid tumors, section in situ hybridization used to study probe amplifications on tissue sections, RNA in situ hybridization on tissue sections using appropriate examples.

Unit X – Advanced Molecular Cytogenetic Techniques (4 Hrs)

Principles and procedures involved and their applications in clinical diagnosis of genetic abnormalities (including complex chromosomal translocations – CCRs etc.,) – Primed in situ labeling (PRINS), comparative genomic hybridization (CGH), Spectral karyotyping (SKY), multicolor FISH (mFISH) and multicolor banding (mBAND), Fiber FISH, etc., using appropriate examples.

Unit XI – Quality Assurance (2 Hrs)

Interpretation and Reporting of normal and abnormal reports using International System for Human Cytogenetic Nomenclature (ISCN) for FISH.

Reference books

1. T Strachan and AP Read (2011), Human Molecular Genetics, Garland Science/ Taylor and Francis Group Publication, 4th Edition. 12. Robert L. Nussbaum, Roderick R, McInnes C M, Huntington F Willard (2015), Thompson & Thompson Genetics in Medicine, 8th edition, Elsevier.
2. Steven L. Gersen and Martha B. Keagle (1999) The Principles of Clinical Cytogenetics Humana Press
3. Orlando J. Miller (2000) Human Chromosomes Springer-Verlag New York
4. Morgan Key (2015) Cytogenetics: Techniques and Applications CALLISTO REFERENCE

5. Swansbury (2003) Cancer Cytogenetics Humana Press
6. Wan, Thomas (2017) Cancer Cytogenetics Humana Press
7. RL Nussbaum, RR. McInnes and HF Willard (2007) Thomson and Thomson Genetics in Medicine, Saunders, Elsevier Publication
8. JL Hamerton (2013) Human Cytogenetics: Clinical Cytogenetics, Academic Press
9. S Gersen and MB Keagel (2013) The Principles of Clinical Cytogenetics, Springer Science and Business Media Publication
10. LB Jorde, JC Carey and MJ Bamshad (2009) Medical Genetics, Elsevier Publication
11. S Heim, F Mitelman (2011) Cancer Cytogenetics: Chromosomal and Molecular Genetic Aberrations of Tumor Cells, John Willey and Sons Publications

Assessment Plan- Theory 50 marks

5 marks x 4 questions= 20 marks

2 marks x 15 questions=30 marks

V-SEMESTER

CORE- B7: CLINICAL BIOCHEMISTRY AND MEDICAL GENETICS

Specific Learning objectives:

- The students will be acquiring knowledge about collection and preservation of biological fluids (blood, urine & CSF), handling of clinical samples, normal and abnormal values and their significance in maintaining good health.
- Student will learn about requirements and knowledge about setting up of clinical laboratory, Quality control, standardization and Safety measures in clinical laboratory
- To learn normal and abnormal constituents of biological fluids such as urine, blood and their relationship with various diseases
- Student will learn about various disorders of metabolism like carbohydrates, lipids, and their relationship with various diseases
- Learn about various Tumour markers and their importance in diagnosis of various disease
- To get acquainted with the role of enzymes in diagnosis of various diseases
- Exposure to the mechanisms of causation of diseases of liver and kidney
- The student will be able to describe the fundamental molecular principles of genetics and define dominant and recessive
- The student will understand the relationship between phenotype and genotype in human genetic traits

Theory: 40 hrs

UNIT-I: INTRODUCTION TO CLINICAL BIOCHEMISTRY (2 Hrs)

Scope of clinical biochemistry in disease diagnosis, collection, and preservation of biological fluids. Safety measures in clinical laboratory. Normal and abnormal values of important constituents of blood, CSF, and urine. Collection preparation, preservation, and handling of clinical samples.

Knowledge and requirements about setting up of clinical laboratory, Quality control & standardization.

Biological materials- Methods of estimation, normal range in blood serum, plasma and Urine of Glucose, Proteins, Urea, Uric acid, Creatinine, Cholesterol, Bilirubin.

UNIT-II: CLINICAL ENZYMOLOGY (6 Hrs)

Methods of estimation and principles ,normal range in tissues and clinical conditions leading to abnormal levels of Plasma specific and non-plasma specific enzymes of diagnostic, prognostic importance and their interpretation of amylase, SGOT, SGPT ,Creatinine kinase, cholinesterase's, lactate dehydrogenase, phosphohexose isomerase, Alkaline phosphatase, Acid phosphatase.

UNIT-III: HORMONES **(4 Hrs)**

Endocrine system: Laboratory diagnosis and investigations related to disorders of thyroid, pituitary, adrenal cortex, adrenal medula, testes, ovaries - plasma and urinary assays of hormones related to endocrinal disorders.

Methods of estimation and principles, normal range in serum and clinical conditions leading to abnormal levels of Androgens, Pregnonediol, estrogens, corticosteroids, catecholamine, thyroid, prolactin, growth hormones. FSH, LH, testosterone, β-HCG

Tumour markers: Methods of estimation, principles, normal ranges in tissue and clinical conditions of tumour markers CEA, AFP (α-β proteins), CA199, CA121

UNIT-IV: VITAMINS AND MINERAL **(4 Hrs)**

Estimation Methods and principles, normal range in serum and clinical conditions leading to abnormal levels of: Vitamin A, thiamine, Niacin, Pyridoxine, Ascorbic acid, Vitamin D3

Mineral metabolism - Laboratory investigations in disorders related to iron, copper, iodine, calcium, phosphorus, magnesium and zinc and their importance in health and disease. Cerebrospinal fluid - Composition in normal and diseases laboratory results of CSF constituents in health and disease.

UNIT-V: DISORDERS OF METABOLISM **(10 hrs)**

Disorders of carbohydrates metabolism - Glucose level in normal blood, hyper and hypoglycemia and glycosuria - qualitative tests for sugars in urine - GTT and other types. Fructose levels in blood lab diagnosis of early and latent diabetes mellitus - diabetic coma, secondary degenerative changes associated with diabetes mellitus - Glycogen storage disorders.

Disorders of lipid metabolism - Plasma lipoproteins, cholesterol triglycerides and phospholipids in health and diseases, ketosis, fatty liver.

Disorders of nitrogen metabolism - Excretion of nitrogen with reference to ammonia, urea, uric acid, creatine, creatinine - excretion of nitrogenous waste products - abnormalities of nitrogen metabolism including uremia, porphyrias, porphyrinurias, aminoaciduria.

Acid base balance - Blood pH within normal range disturbances in acid base balance - acidosis, alkalosis, mixed disturbances - laboratory parameters - blood gas analysis.

UNIT-VI: ORGAN FUNCTION TEST **(3 Hrs)**

Liver function tests: Abnormalities of bilirubin metabolism, changes in plasma proteins, excretion, and detoxification. Role of serum enzymes in diagnosis of liver disorders. Management of jaundice, hepatitis, cirrhosis, liver failure, hepatic coma and gall stones, fatty liver

Kidney function tests: Abnormal constituents of urine, biochemical findings, Pathogenesis, Glomerular and tubular function tests. Biochemical changes, diagnosis, and prognosis: Nephrotic syndrome, Glomerular nephritis, kidney failure, Creatinine clearance

Gastric functional tests: Qualitative and quantitative analysis of gastric contents and duodenal contents Pancreatic disorders in relation to exocrine functions, malabsorption causes and laboratory parameters useful in diagnosing diseases of GT Tract. Diagnosis and management of Ulcer

UNIT VII: INTRODUCTION TO GENETICS (4 Hrs)

Basic Mechanisms of inheritance and genetics in biology, Concept of gene: Allele, Mendelian laws, Concept of Linkage and crossing over, Multiple alleles, Pleiotropy, Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, Pedigree analysis of Autosomal inheritance- dominant, recessive

UNIT VIII: GENETICS IN MEDICAL PRACTICE (4 Hrs)

Genetic Principles and their application in medical practice, Case studies (Interacting with patients, learning family history and drawing pedigree chart); Syndromes and disorders: definition and their genetic basis - Cystic fibrosis and Tay Sach's Syndrome; Phenylketonuria and Galactosemia; Ethical issues with clinical genetics.

UNIT XI: MOLECULAR DIAGNOSTICS (3 Hrs)

Role of molecular diagnostics in present diagnostic era, Benefits of molecular diagnostics over serological diagnostic tests, Ethical issues related to molecular diagnostics, Basic techniques used in molecular diagnostics, Molecular diagnostics of HIV, Tuberculosis, cholera and pathogenic E. Coli

CORE- B8: CELL BIOLOGY AND MOLECULAR BIOLOGY

- Specific Learning objective
- Students will understand the structure of cell and various cellular events in the biological system.
- Students will acquire knowledge about cell cycle, cell division and cell death mechanisms
- Student will understand composition and structure of bio membranes, transport mechanisms across biological membranes.
- Students will learn about the function of various subcellular organelles
- The student will be able to describe the general principles of gene organization and expression in both prokaryotic and eukaryotic organisms.
- The students will learn about importance of the molecular diagnostics in modern era, ethical issues molecular diagnosis in medical practise

Theory: 40 hrs

UNIT I: CELL BIOLOGY (10 Hrs)

1. Introduction to cell [cell theory and modern cell biology] and salient feature of subcellular organelles, Methods to study cell function- microscopy, tissue culture and flow cytometry.
2. Membrane biology- structure and function, transport across cell membrane, gap junctions.
3. Regulation of cell function-Cell cycle and its regulation, Cell signalling in development and differentiation, Signal transduction; Receptors and ligands; Proteins and molecules involved in transduction of signal into the cell; G proteins and G protein coupled receptors; Growth factors and receptor tyrosine kinase; Second messengers; Characteristics of tumour cells; Mechanism of transformation; Angiogenesis, apoptosis and autophagy.
4. Hydrophobic effect and organisation of lipids in micelles monolayers, bilayers, liposomes, motion of lipids and proteins in membranes - organisation of proteins in membranes, protein lipid interaction - assembly membrane flow cycling - targeting signals and adaptor proteins, membrane lipids - transport, different lipid components, flip-flop asymmetry of membranes

UNIT II: CHROMOSOMES AND REPLICATION (8 Hrs)

Structures of chromatin & chromosomes, Unique & Repetitive DNA, Heterochromatin, Euchromatin, Transposons. Denaturation kinetics & Tm. Extra chromosomal DNA, DNA replication, Concept of replicon, Origin of replication in prokaryotes &eukaryotes. Regulation of replication, Role of Ori-C & DNA methylation in regulation of replication, Fidelity of replication, DNA damage & repair mechanisms

UNIT III: GENE EXPRESSION AND REGULATION I (8 Hrs)

Structure of gene in eukaryotes & prokaryotes. Operon concept (Lac and Trp Operons), gene transcription, Transcription factors & machinery, Formation of initiation complex in eukaryotes & prokaryotes, Transcription activators & repressors, RNA polymerases in eukaryotes & prokaryotes. Termination of transcription in eukaryotes and prokaryotes. (Post-transcriptional modifications) RNA processing, editing, capping, splicing & polyadenylation. Structure & function of different types of RNA

UNIT IV: GENE EXPRESSION & REGULATION II (8 Hrs)

Protein synthesis: Ribosome, formation of initiation complex in prokaryotes and eukaryotes, initiation factors and their regulation, elongation, and elongation factors in prokaryotes viz eukaryotes, termination; Genetic code, Aminoacylation of tRNA, tRNA-identity, translational proof-reading, translational inhibitors. (Post-translational modifications of proteins), Control of gene expression at translation level: Regulation of viruses, prokaryotic and eukaryotic gene expression, role of chromatin in regulating gene expression and gene silencing.

UNIT- V CANCER BIOLOGY **(6 Hrs)**

Different stages in cancer development, hallmarks of cancer, causes and properties of cancer cells, oncoviruses, oncogenes, functions of oncogene, Oncogene and signal transduction, oncogene and G-proteins, oncogene, and cell survival. Tumor suppressor genes, functions of tumor suppressor genes, Cancer pathways, Diagnosis, prevention, and treatment of cancer.

SEMESTER 5 PRACTICALS

MODULE- B5: MOLECULAR BIOLOGY PRACTICALS **30 Hrs**

1. Isolation and purification of genomic DNA
2. Isolation and purification of plasmid DNA
3. Isolation of total RNA
4. Molecular hybridization- Southern blotting (DNA), Northern blotting (RNA), Western blotting (proteins)
5. Amplification of DNA by Polymerase chain reaction (PCR)

MODULE- B6: MOLECULAR BIOLOGY PRACTICALS **30 Hrs**

1. Restriction digestion and DNA Ligation
2. Preparation of genomic DNA from whole blood by CTAB method
3. Isolation of DNA from blood samples by Phenol-Chloroform method
4. Qualitative and quantitative determination of DNA
5. Denaturation of DNA.

PRACTICAL EXAM

PART A-50

Case studies - 25

Counselling, taking family history and drawing pedigree chart- 25 Marks

PART-B-50

Isolation of DNA or RAN -25

Quantitative, qualitative analysis of DNA by agarose gel electrophoresis and amplification of DNA by PCR-25

Reference Books:

1. Genetics: Analysis of Genes and Genomes by Hartl, Jones
2. Molecular Biology of the gene by Watson, Roberts, Staitz and Weiner
3. Molecular biology by Robert Weiver
4. Molecular Biotechnology by Bernard R. Glick and Jack J Pasternak
5. Primrose, S.B.: Animal Biotechnology Blackwell Scientific Publication, London.
6. Watson, J.D. et al.: Cell and Molecular Biology, John Wiley.
7. Freifelder, D.: Molecular Biology, Jones and Bartlett, USA.

Skill enhancement-Internship training

Students will be trained in reputed laboratories/industries for a period of 2 months. Only those students who have passed all the courses in all the semesters can enter the industry internship. The student must maintain the logbook which has to be certified by the concerned authority in the industry on a daily basis. At the end of the internship, the student should have attained the defined competencies and write his reflection which will be certified by the Laboratory/industry authorities

along with their feedback. This will be submitted to the head of the department. Based on the logbook, his/her reflection and the feedback from the laboratory/ industry marks will be allotted from a maximum mark of 50.

Discipline specific electives
Laboratory accreditation/Cell culture studies

Laboratory accreditation

Specific learning objectives: The student should be able to

1. To understand the importance of accreditation and types of accreditation in a Health care system
2. To understand the benefits of NABH & NABL accreditation

Outcomes

1. The student will have the opportunity to understand the importance of Accreditation in Health care system: Hospital as well as Medical Laboratories
2. The student will be able to understand the overall processes involved in the NABH accreditation: various standards, objective elements.
3. The student will be able to understand the overall processes involved in the NABL accreditation: Technical requirements, Management requirements and related clauses.
4. The student will be able to understand the need of accreditation and the benefits of accreditation
5. The student gains the competency to participate and play an active leadership role in health care set-ups, who are in the process of applying for accreditation

Theory
Accreditation of Health Care Systems:

Ensuring quality is a critical component of high-performing health care systems. Patients who enter the health care system—whether a clinic, a hospital, or laboratory— need to be confident that they will receive care that is safe, effective and consistent with the latest clinical evidence.

Accreditation can be the single most important approach for improving the quality of health care structures. In an accreditation system, institutional resources are evaluated periodically to ensure quality of services on the basis of defined standards. Accreditation is rather, a means to improve quality.

The Hospital Accreditation" approach is a concept and practice that yields beneficial results to patients, customers, hospital personnel, the hospital, the Faculty of Medicine, the society and the country as a whole.

National Accreditation Board for Hospitals & Healthcare Providers (NABH) is a constituent board of Quality Council of India, set up to establish and operate accredi-

tation programme for healthcare organisations.
National Accreditation Board for Testing and Calibrating Laboratories (NABL) is a Constituent Board of Quality Council of India. NABL has been established with the objective of providing Government, Industry Associations and Industry in general with a scheme of Conformity Assessment Body's accreditation which involves third-party assessment of the technical competence of testing including medical and calibration laboratories, proficiency testing providers and reference material producers.

Benefits of Accreditation:

- Enhanced health care network.
- Continuous quality improvement:
- High quality of care & patient safety
- Improved decision-making
- Provides opportunity to the healthcare unit to benchmark with the best
- Improved accountability and regulation

Overall, Accreditation provides access to reliable and certified information on facilities, infrastructure and level of care.

Exam pattern:
Theory:
Preparation of a QSP – 10 marks
Preparation of a SOP – 10 marks
Short Essays – 3 questions – 5 marks each – 15 marks
Short Answer – 5 questions – 3 marks each – 15 marks

Cell Culture Techniques
Specific Learning Objectives

- Students will be familiar with the basic concepts of cell culture techniques
- Understanding the importance of cell culture and its applications
- The laboratory experience will provide practical knowledge of the course lectures and enable the students to gain skills to be able to do cell culture work.

Total: 30 hrs (Theory- 26 hours and Practical- 4 hours)

Unit 1:
Introduction to good cell culture practice
Cell culture laboratory- Laboratory design and layout
Cell culture equipments and materials
Aseptic techniques
Safety aspects of cell culture and Bioethics

Biological contamination
Waste disposal
Care and maintenance of laboratory areas

Unit 2:
Basics of cell culture
Sourcing of cell lines
Cell types and culture characteristics
Cell environment- media, supplements and other key requirements
Maintenance of cell culture: Thawing, sub culturing and freezing of cells
Good cell line banking
Cell line authentication

Unit 3:
Cell culture based assays
Cell viability assay, cell proliferation assay, cytotoxicity assay, cell senescence assay, cell death assay- apoptosis, autophagy and necrosis, gene knockdown assay and other cell based assays widely used in the field of biomedical research.

Unit 4:
Applications of cell culture
The use of cell culture as a model system
Applications of cell culture in toxicity testing, cancer research, vaccine production, genetic engineering, drug screening and development

References:
1. A Text book on "Culture of animal cells: A manual of basic technique and specialized applications". Author- R. Ian Freshney.
2. A Text book on "Principles of animal cell culture: Student compendium". Author- Sinha Basant K.
3. A handbook on "Cell culture basics" from Gibco (available online)
4. A text book on "Basic cell culture protocols". Edited by Cheryl D. Helgason and Cindy L. Miller

Exam pattern
1. Long Essay – 1 question – 10 marks
2. Short Essay – 5 questions – 5 marks each – 25 marks
3. Short Answer – 5 questions – 3 marks each – 15 marks