RAMAIAH UNIVERSITY OF APPLIED SCIENCES

M. S. Ramaiah University of Applied Sciences

Program Structure and Course details of Bachelor of Medicine and of Bachelor of Surgery Program

Programme Code: 438

Batch 2022 Onwards

Registrar
M.S.Ramaiah University of Applied Sciences
Bangalore - 560 054

Shalini

Principal and Dean
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Bangalore-560054

Dean - Academics
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RAMAIAH UNIVERSITY OF APPLIED SCIENCES

M. S. Ramaiah University of Applied Sciences

Programme Specifications
Bachelor of Medicine and of Bachelor of Surgery

Batch 2022 Onwards

Programme code- 438

Ramaiah Medical College

M.S. Ramaiah University of Applied Sciences Bangalore

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University's Vision, Mission and Objectives

The M. S. Ramaiah University of Applied Sciences (MSRUAS) will focus on student-centric professional education and motivates its staff and students to contribute significantly to the growth of technology, science, economy and society through their imaginative, creative and innovative pursuits. Hence, the University has articulated the following vision and objectives.

Vision

MSRUAS aspires to be the premier university of choice in Asia for student centric professional education and services with a strong focus on applied research whilst maintaining the highest academic and ethical standards in a creative and innovative environment

Mission

Our purpose is the creation and dissemination of knowledge. We are committed to creativity, innovation and excellence in our teaching and research. We value integrity, quality and teamwork in all our endeavours. We inspire critical thinking, personal development and a passion for lifelong learning. We serve the technical, scientific and economic needs of our Society.

Objectives

1. To disseminate knowledge and skills through instructions, teaching, training, seminars, workshops and symposia in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences to equip students and scholars to meet the needs of industries, business and society

2. To generate knowledge through research in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences to meet the challenges that arise in industry, business and society

3. To promote health, human well-being and provide holistic healthcare

4. To provide technical and scientific solutions to real life problems posed by industry, business and society in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences

5. To install the spirit of entrepreneurship in our youth to help create more career opportunities in the society by incubating and nurturing technology product ideas and supporting technology backed business

6. To identify and nurture leadership skills in students and help in the development of our future leaders to enrich the society we live in

7. To develop partnership with universities, industries, businesses, research establishments, NGOs, international organizations, governmental organizations in India and abroad to enrich the experiences of faculties and students through research and developmental programmes

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Programme Specifications: MBBS

Faculty	Ramaiah Medical College
Programme Code	MB438
Programme Name	MBBS
Dean of the Faculty	Dr. Shalini C Nooyi

1. **Title of the Award:** MBBS
2. **Mode of Study:** Full-Time
3. **Awarding Institution /Body:** M. S. Ramaiah University of Applied Sciences, Bengaluru
4. **Joint Award:** Not Applicable
5. **Teaching Institution:** Faculty of Medicine, Ramaiah Medical College & Hospitals, Bengaluru
6. **Date of Programme Specifications:** July 2022
7. **Programme Approval** by the Academic Council of MSRUAS
8. **Programme Approving Regulating Body and Date of Approval:** National Medical Council of India
9. **Rationale of the programme:**

The undergraduate medical education programme is designed with a goal to create an "Indian Medical Graduate" (IMG) possessing requisite knowledge, skills, attitudes, values and responsiveness, so that she or he may function appropriately and effectively as a physician of first contact of the community while being globally relevant.

10. **Programme Mission: At the end of undergraduate program, the Indian Medical Graduate should be able to:**
    (a) Recognize "health for all" as a national goal and health right of all citizens and by undergoing training for medical profession to fulfill his/her social obligations towards realization of this goal.
    (b) Learn every aspect of National policies on health and devote her/him to its practical implementation.
    (c) Achieve competence in practice of holistic medicine, encompassing promotive, preventive, curative and rehabilitative aspects of common diseases.
    (d) Develop scientific temper, acquire educational experience for proficiency in profession and promote healthy living.
    (e) Become exemplary citizen by observance of medical ethics and fulfilling social and professional obligations, so as to respond to national aspirations.

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11. Graduate attributes of the Programme

1. Clinician who understands and provides preventive, promotive, curative, palliative and holistic care with compassion.

2. Leader and member of the health care team and system with capabilities to collect analyze, synthesize and communicate health data appropriately.

3. Communicator with patients, families, colleagues and community.

4. Lifelong learner committed to continuous improvement of skills and knowledge.

5. Professional, who is committed to excellence, is ethical, responsive and accountable to patients, community and profession.

12. Training period and time distribution:

Every learner shall undergo a period of certified study extending over 4 ½ academic years, divided into nine semesters from the date of commencement of course to the date of completion of examination which shall be followed by one year of compulsory rotating internship.

The period of 4 ½ years is divided as follows:

- **Pre-Clinical Phase [(Phase I)** - First Professional phase of 13 months preceded by Foundation Course of one month]: will consist of preclinical subjects – Human Anatomy, Physiology, Biochemistry, Introduction to Community Medicine, Humanities, Professional development including Attitude, Ethics & Communication (AETCOM) module and early clinical exposure, ensuring both horizontal and vertical integration.
- **Para-clinical phase [(Phase II)** - Second Professional (12 months)]: will consist of Para-clinical subjects namely Pathology, Pharmacology, Microbiology, Community Medicine, Forensic Medicine and Toxicology, Professional development including Attitude, Ethics & Communication (AETCOM) module and introduction to clinical subjects ensuring both horizontal and vertical integration.
- **Clinical Phase – [(Phase III)** Third Professional (28 months)]--(a) Part I (13 months) - The clinical subjects include General Medicine, General Surgery, Obstetrics & Gynecology, Pediatrics, Orthopedics, Dermatology, Otorhinolaryngology, Ophthalmology, Community Medicine, Forensic Medicine and Toxicology, Psychiatry, Respiratory Medicine, Radiodiagnosis & Radiotherapy and Anesthesiology & Professional development including AETCOM module.

(b) Electives (2 months) - To provide learners with opportunity for diverse learning experiences, to do research/community projects that will stimulate enquiry, self-directed experimental learning and lateral thinking [9.3].

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(c) Part II (13 months) - Clinical subjects include:

i. Medicine and allied specialties (General Medicine, Psychiatry, Dermatology Venereology and Leprosy (DVL), Respiratory Medicine including Tuberculosis)

ii. Surgery and allied specialties (General Surgery, Orthopedics [including trauma]), Dentistry, Physical Medicine and rehabilitation, Anesthesiology and Radiodiagnosis)

iii. Obstetrics and Gynecology (including Family Welfare)

iv. Pediatrics

v. AETCOM module

13. MBBS Program outcomes:

MBBS graduate, on completion of program will demonstrate the following outcomes. Graduates will be able to:

PO1. Demonstrate adequate critical skills in medical practice knowledge and enabling them to make valuable contributions to patients and health care as members of the health team.

PO2. Be competent physicians in the diagnosis and management of common health problems of the community and individuals of all age groups.

PO3. Communicate effectively both orally and in writing on treatment and management of a variety of health care issues.

PO4. Appreciate and understand the socio-psychological, cultural, economic and environmental factors affecting health.

PO5.Describe and demonstrate team work in management / leadership skills.

The program-specific objectives of the MBBS course are as follows:

PSO1. Clinician who understands and provides preventive, promotive, curative, palliative and holistic care with compassion and empathy.

PSO2. Leader and member of the health care team and system with capabilities to collect, plan, analyze, synthesize and communicate health data and management appropriately.

PSO3. Communicate with patients, families, colleagues, members of health team and community.

PSO4. Lifelong learner committed to continuous improvement of skills and knowledge.

PSO5 .Professional, who is committed to excellence, is ethical, professionally responsive and accountable to patients, community and profession.

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MAPPING OF CO MBBS WITH PO & PSO

Course-PO-PSO Mapping

Year	Course Code	Course Title	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
1st year	MBC101A	Anatomy-1	3	2	1	2	2	1	1	1	3	3
	MBC102A	Anatomy-2	3	2	1	2	2	1	1	1	3	3
	MBC103A	Biochemistry-1	3	2	1	2	2	1	1	1	3	3
	MBC104A	Biochemistry-2	3	2	1	2	2	1	1	1	3	3
	MBC105A	Physiology-1	3	2	1	2	2	1	1	1	3	3
	MBC106A	Physiology-2	3	2	1	2	2	1	1	1	3	3
	MBF101A	Foundation Course	2	1	2	2	2	1	1	1	3	3
	MBF102A	AETCOM-I	1	3	3	2	2	3	1	3	3	3
2nd Year	MBC201A	Pathology -1	3	3	2	2	2	2	2	2	3	3
	MBC202A	Pathology-2	3	3	2	2	2	2	2	2	3	3
	MBC203A	Pharmacology -1	3	3	2	2	2	2	2	2	3	3
	MBC204A	Pharmacology -2	3	3	2	2	2	2	2	2	3	3
	MBC205A	Microbiology-1	3	3	2	2	2	2	2	2	3	3
	MBC206A	Microbiology-2	3	3	2	2	2	2	2	2	3	3
	MBF202A	AETCOM-II	1	3	3	2	2	3	1	3	3	3
3rd Year	MBC301A	ENT	3	3	2	2	3	3	3	3	3	3
	MBC302A	Ophthalmology	3	3	2	2	3	3	3	3	3	3
	MBC303A	Forensic Medicine	3	3	2	2	3	3	3	3	3	3
	MBC304A	Community Medicine - 1	3	3	2	3	3	3	3	3	3	3
	MBC305A	Community Medicine -2	3	3	2	3	3	3	3	3	3	3
	MBF302A	AETCOM-III	2	3	3	2	2	3	1	3	3	3
4th Year	MBC401A	General Medicine-1	3	3	2	2	3	3	3	3	3	3
	MBC402A	General Medicine-2	3	3	2	2	3	3	3	3	3	3
	MBC403A	General Surgery-1	3	3	2	2	3	3	3	3	3	3
	MBC404A	General Surgery-2	3	3	2	2	3	3	3	3	3	3
	MBC405A	OBG-1	3	3	2	2	3	3	3	3	3	3
	MBC406A	OBG-2	3	3	2	2	3	3	3	3	3	3
	MBC407A	Paediatrics	3	3	2	2	3	3	3	3	3	3
	MBF402A	AETCOM-IV	2	2	3	2	2	3	1	3	3	3

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1. **Programme Delivery: As per Master timetable available- Annexure - 1**
   Teaching Learning Methodologies
   Theory
   1. Lectures
   2. Symposium/Panel Discussion
   3. Small Group Discussion
   4. Team Teaching
   5. Role Play

   Practical
   1. Demonstration using ICT /Physical Models
   2. Pre-Clinical Laboratories
   3. Advanced Learning Centre
   4. Projects
   5. Innovative methods – OSCE/OSPE

- **Self-Directed learning 1.** Assignment 2. Conferences/ seminars
- **Details shall be described in respective Course specification document.**

2. **Regulations and Assessment**

Attendance requirement is as per National Medical Commission regulations with amendments issued from time to time.

Eligibility to appear for Professional examinations

(a) Attendance

1. Attendance requirements are 75% in theory and 80% in practical /clinical for eligibility to appear for the examinations in that subject. In subjects that are taught in more than one phase – the learner must have 75% attendance in theory and 80% in practical in each phase of instruction in that subject.

2. If an examination comprises more than one subject (for e.g., General Surgery and allied branches), the candidate must have 75% attendance in each subject and 80% attendance in each clinical posting.

3. Learners who do not have at least 75% attendance in the electives will not be eligible for the Third Professional - Part II examination.

(a) **Internal Assessment**: Internal assessment shall be based on day-to-day assessment. It shall relate to different ways in which learners participate in learning process including assignments, preparation for seminar, clinical case presentation, preparation of clinical case for discussion, clinical case study/problem solving exercise, participation in project for health care in the community, proficiency in carrying out a practical or a skill in small research project, a written test etc.

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1. Regular periodic examinations shall be conducted throughout the course. There shall be no less than three internal assessment examinations in each Preclinical / Para-clinical subject and no less than two examinations in each clinical subject in a professional year. An end of posting clinical assessment shall be conducted for each clinical posting in each professional year.

2. When subjects are taught in more than one phase, the internal assessment must be done in each phase and must contribute proportionately to final assessment. For example, General Medicine must be assessed in second Professional, third Professional Part I and third Professional Part II, independently.

3. Day to day records and log book (including required skill certifications) should be given importance in internal assessment. Internal assessment should be based on competencies and skills.

4. The final internal assessment in a broad clinical specialty (e.g., Surgery and allied specialties etc.) shall comprise of marks from all the constituent specialties. The proportion of the marks for each constituent specialty shall be determined by the time of instruction allotted to each.

5. Learners must secure at least 50% marks of the total marks (combined in theory and practical / clinical; not less than 40 % marks in theory and practical separately) assigned for internal assessment in a particular subject in order to be eligible for appearing at the final University examination of that subject. Internal assessment marks will reflect as separate head of passing at the summative examination.

6. The results of internal assessment should be displayed on the notice board within a 1-2 weeks of the test. Universities shall guide the colleges regarding formulating policies for remedial measures for students who are either not able to score qualifying marks or have missed on some assessments due to any reason.

7. Learners must have completed the required certifiable competencies for that phase of training and completed the log book appropriate for that phase of training to be eligible for appearing at the final university examination of that subject.

University Examinations

1. University examinations are to be designed with a view to ascertain whether the candidate has acquired the necessary knowledge, minimal level of skills, ethical and professional values with clear concepts of the fundamentals which are necessary for him/her to function effectively and appropriately as a physician of first contact. Assessment shall be carried out on an objective basis to the extent possible.
2. Nature of questions will include different types such as structured essays (Long Answer Questions- LAQ), Short Answers Questions (SAQ) and objective type questions (e.g. Multiple Choice Questions - MCQ). Marks for each part should be indicated separately. MCQs shall be accorded a weightage of not more than 20% of the total theory marks. In subjects that have two papers, the learner must secure at least 40% marks in each of the papers with minimum 50% of marks in aggregate (both papers together) to pass.

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3. Practical/clinical examinations will be conducted in the laboratories and /or hospital wards. The objective will be to assess proficiency and skills to conduct experiments, interpret data and form logical conclusion. Clinical cases kept in the examination must be common conditions that the learner may encounter as a physician of first contact in the community. Selection of rare syndromes and disorders as examination cases is to be discouraged. Emphasis should be on candidate's capability to elicit history, demonstrate physical signs, write a case record, analyze the case and develop a management plan.

4. Viva/oral examination should assess approach to patient management, emergencies, and attitudinal, ethical and professional values. Candidate's skill in interpretation of common investigative data, X-rays, identification of specimens, ECG, etc. is to be also assessed.

5. There shall be one main examination in an academic year and a supplementary to be held not later than 90 days after the declaration of the results of the main examination.

6. A learner shall not be entitled to graduate after 10 years of his/her joining of the first part of the MBBS course.

7. University Examinations shall be held as under:

(a) First Professional

1. The first Professional examination shall be held at the end of first Professional training (1+12 months), in the subjects of Human Anatomy, Physiology and Biochemistry.
2. A maximum number of four permissible attempts would be available to clear the first Professional University examination, whereby the first Professional course will have to be cleared within 4 years of admission to the said course. Partial attendance at any University examination shall be counted as an availed attempt.

(b) Second Professional

1. The second Professional examination shall be held at the end of second professional training (11 months), in the subjects of Pathology, Microbiology and Pharmacology.

(c) Third Professional

1. Third Professional Part I shall be held at end of third Professional part 1 of training (12 months) in the subjects of Ophthalmology, Otorhinolaryngology, Community Medicine and Forensic Medicine and Toxicology
2. Third Professional Part II - (Final Professional) examination shall be at the end of training (14 months including 2 months of electives) in the subjects of General Medicine, General Surgery, Obstetrics & Gynecology and Pediatrics. The discipline of Orthopedics, Anesthesiology, Dentistry and Radiodiagnosis will constitute 25% of the total theory marks incorporated as a separate section in paper II of General Surgery.
3. The discipline of Psychiatry and Dermatology, Venereology and Leprosy (DVL), Respiratory Medicine including Tuberculosis will constitute 25% of the total theory marks in General Medicine incorporated as a separate section in paper II of General Medicine.

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Details shall be described in respective Course specification document.

Marks distribution for various subjects

Name of the Course	Course codes	Written- Theory – Total	Practical's/ Orals/ Clinicals	Pass Criteria
First Professional				Internal Assessment: 50% combined in theory and practical (not less than 40% in each) for eligibility for appearing for University Examinations University Examination Mandatory 50% marks separately in theory and practical (practical = practical/ clinical + viva)
Anatomy - 1	MBC101A	100	100	
Anatomy - 2	MBC102A	100		
Biochemistry - 1	MBC103A	100	100	
Biochemistry - 2	MBC104A	100		
Physiology - 1	MBC105A	100	100	
Physiology - 2	MBC106A	100		
Second Professional				
Pathology - 1	MBC201A	100	100	
Pathology - 2	MBC202A	100		
Pharmacology - 1	MBC203A	100	100	
Pharmacology - 2	MBC204A	100		
Microbiology-1	MBC205A	100	100	
Microbiology - 2	MBC206A	100		
Third Professional Part – I				
ENT	MBC301A	100	100	
Ophthalmology	MBC302A	100	100	
Forensic Medicine	MBC303A	100	100	
Community Medicine - 1	MBC304A	100	100	
Community Medicine - 2	MBC305A	100		
Third Professional Part – II				
General Medicine - 1	MBC401A	100	200	
General Medicine - 2	MBC402A	100		
General Surgery - 1	MBC403A	100	200	
General Surgery - 2	MBC404A	100		
Pediatrics – 1 paper	MBC407A	100	100	
OBG - 1	MBC405A	100	200	
OBG - 2	MBC406A	100		
Total Marks		2400		

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Note: At least one question in each paper of the clinical specialties should test knowledge - competencies acquired during the professional development programme (AETCOM module); Skills competencies acquired during the Professional Development programme (AETCOM module) must be tested during clinical, practical and viva.

In subjects that have two papers, the learner must secure at least 40% marks in each of the papers with minimum50% of marks in aggregate (both papers together) to pass in the said subject.

Criteria for passing in a subject: A candidate shall obtain 50% marks in University conducted examination separately in Theory and Practical (practical includes: practical/ clinical and viva voce) in order to be declared as passed in that subject.

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RAMAIAH UNIVERSITY OF APPLIED SCIENCES

Course Specifications

Human Anatomy

Code- MBC101A

Ramaiah Medical College

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Course Specifications

Course Title	Human Anatomy
Course Code	MBC101A
Course Type	Core Theory & Practical Course
Department	Anatomy
Faculty	Medicine

Introduction to Department:

The Human anatomy forms the basis of all medical sciences. A knowledge of human anatomy is essential for the comprehension of the physiological, biochemical and pathological mechanisms. Hence, a detailed anatomy curriculum is required as a foundation upon which the normal as well as the abnormal structure and functions can be explained.

The Department of Anatomy with experienced and competent faculty enable the learning of the students through a robust activity-based curriculum. The department is well equipped with modern infrastructure such as brightly lit dissection hall and histology practical lab. The **dissection hall** is well spaced and designed for small groups of students to dissect and study human anatomy specimens. It is well ventilated with good exhaust mechanism. The **histology practical lab** is designed for individual activity and has a capacity to accommodate around 100 students. Two large TV monitors are installed for better visualization of microscopic diagrams. The lab also has wall mounted microscopic pictures of various tissues to facilitate student learning. The anatomy museum is a part of the Central museum to promote integrated learning activities.

The teaching faculty of Anatomy are qualified and competent. They are trained to impart quality education. The faculty have excelled in recent advances, research and innovative teaching methodology. The department also promotes student research program to inculcate the basic research methodology concepts.

One of the best practices of the institution-**Voluntary body Donation program** coordinated by the department, facilitates adequate cadaver resources for realistic visualization of human organ systems by the students.

This document provides the required guidelines to implement the CBME curriculum framed by National Medical Commission (NMC) for effective teaching-learning and evaluation of students.

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Goal:

The main purpose of teaching anatomy is to enable the medical student with basic knowledge of various human anatomical structures and their relations to comprehend physiological mechanisms and correlate the anatomical basis with clinical conditions.

Objectives:

The student at the end of the course should be able to

Cognitive Domain:

1. Describe the anatomy of the basic tissues of the human body.
2. Enumerate the morphological features of various organs and relations with other structures.
3. Explain the attachment of muscles, nerve supply and action.
4. Describe the parts, relations and functions of the central nervous system.
5. Describe the morphological features of bones of the human body and their attachments
6. Explain the anatomical basis of various common clinical conditions and clinical procedures.
7. Describe the microscopic features of general and systemic tissues of the human body.
8. Describe the development of organ systems of the human body.
9. Correlate the embryological basis of congenital anomalies/syndromes.
10. Integrate the gross and microscopic anatomy with the physiological mechanisms and biochemical reactions of human organ systems.
11. Describe the normal karyotype, abnormal chromosomal conditions, genetic mechanism of Inheritance, Inborn errors of metabolism, teratogenesis and mutations.
12. Describe the prenatal diagnostic techniques, principles of genetic counseling and gene therapy.
13. Describe the principles of radiography and the advanced radiological techniques.

Psychomotor Domain:

1. Identify the gross anatomical features of organs.
2. Demonstrate the morphological features of organs and relations.
3. Demonstrate the surface marking of various organs and structures of the human body.
4. Discuss the microscopy of general and systemic tissues.
5. Identify the normal radiological and cross-sectional anatomy on Radiographs, Ultrasound, CT images and MRI.
6. Identify the normal developmental processes and associated anomalous conditions in embryology models/charts

Affective Domain:

1. Demonstrate humane behavior with mutual respect for each other - personal and professional.
2. Communicate effectively with teachers, technical staff, peers, patients during their learning activities.
3. Develop punctuality in attending academic sessions, submissions of records and assignments.
4. Demonstrate moral responsibility and accountability for their actions.
5. Demonstrate honesty and integrity in all learning activities.
6. Respect the cadaver as a teacher while handling the cadavers and specimens.
7. Discuss the professional qualities of a physician of first contact and his/her responsibilities.

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Course summary

Competencies in Anatomy				
No.	Topic	Competencies	Core	Non-Core
1	**General Anatomy**	35	22	13
2	**Gross Anatomy**			
A	Upper Limb	48	41	7
B	Thorax	29	25	4
C	Head and neck	68	44	24
D	Neuroanatomy	28	24	4
3	**Histology**			
A	General Histology	19	15	4
B	Systemic Histology	07	06	01
4	**Embryology**			
A	General Embryology	27	23	4
B	Systemic Embryology	16	10	06
5	**Osteology**	23	17	06
6	**Genetics**	15	11	4
7	**Surface Anatomy**	11	9	02
8	**Radiology**	9	5	4
9	**Cross Sectional Anatomy**	2	2	0

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General Anatomy

Sl. No.	Competency number	Competency
1	AN1.1	Demonstrate normal anatomical position, various planes, relation,comparison, laterality & movement in our body
2	AN1.2	Describe composition of bone and bone marrow
3	AN2.1	Describe parts, blood and nerve supply of a long bone
4	AN2.2	Enumerate laws of ossification
5	AN2.3	Enumerate special features of a sesamoid bone
6	AN2.4	Describe various types of cartilage with its structure & distribution in body
7	AN2.5	Describe various joints with subtypes and examples
8	AN2.6	Explain the concept of nerve supply of joints & Hilton's law
9	AN3.1	Classify muscle tissue according to structure & action
10	AN3.2	Enumerate parts of skeletal muscle and differentiate betweenA116tendons and aponeuroses with examples
11	AN3.3	Explain Shunt and spurt muscles
12	AN4.1	Describe different types of skin & dermatomes in body
13	AN4.2	Describe structure & function of skin with its appendages
14	AN4.3	Describe superficial fascia along with fat distribution in body
15	AN4.4	Describe modifications of deep fascia with its functions
16	AN4.5	Explain principles of skin incisions
17	AN5.1	Differentiate between blood vascular and lymphatic system
18	AN5.2	Differentiate between pulmonary and systemic circulation
19	AN5.3	List general differences between arteries & veins
20	AN5.4	Explain functional difference between elastic, muscular arteries andarterioles
21	AN5.5	Describe portal system giving examples
22	AN5.6	Describe the concept of anastomoses and collateral circulation withsignificance of end-arteries
23	AN5.7	Explain function of meta-arterioles, precapillary sphincters, arterio-venousanastomoses
24	AN5.8	Define thrombosis, infarction & aneurysm
25	AN6.1	List the components and functions of the lymphatic system
26	AN6.2	Describe structure of lymph capillaries & mechanism of lymph circulation

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27	AN6.3	Explain the concept of lymphoedema and spread of tumors via lymphaticsand venous system
28	AN7.1	Describe general plan of nervous system with components of central,peripheral & autonomic nervous systems
29	AN7.2	List components of nervous tissue and their functions
30	AN7.3	Describe parts of a neuron and classify them based on number of neurites,size & function
31	AN7.4	Describe structure of a typical spinal nerve
32	AN7.5	Describe principles of sensory and motor innervation of muscles
33	AN7.6	Describe concept of loss of innervation of a muscle with its appliedanatomy
34	AN7.7	Describe various type of synapse
35	AN7.8	Describe differences between sympathetic and spinal ganglia

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Gross Anatomy-Upper Limb

Sl. No.	Competency number	Competency
1	AN9.1	Describe attachment, nerve supply & action of pectoralis major andpectoralis minor
2	AN9.2	Breast: Describe the location, extent, deep relations, structure, age changes, blood supply, lymphatic drainage, microanatomy and appliedanatomy of breast
3	AN10.1	Identify & describe boundaries and contents of axilla
4	AN10.2	Identify, describe and demonstrate the origin, extent, course, parts,relations and branches of axillary artery & tributaries of vein
5	AN10.3	Describe, identify and demonstrate formation, branches, relations, area ofsupply of branches, course and relations of terminal branches of brachial plexus
6	AN10.4	Describe the anatomical groups of axillary lymph nodes and specify theirareas of drainage
7	AN10.5	Explain variations in formation of brachial plexus
8	AN10.6	Explain the anatomical basis of clinical features of Erb's palsy and Klumpke's paralysis
9	AN10.7	Explain anatomical basis of enlarged axillary lymph nodes
10	AN10.8	Describe, identify and demonstrate the position, attachment, nervesupply and actions of trapezius and latissimus dorsi
11	AN10.9	Describe the arterial anastomosis around the scapula and mention theboundaries of triangle of auscultation
12	AN10.10	Describe and identify the deltoid and rotator cuff muscles
13	AN10.11	Describe & demonstrate attachment of serratus anterior with its action
14	AN10.12	Describe and demonstrate shoulder joint for– type, articular surfaces, capsule, synovial membrane, ligaments, relations, movements, musclesinvolved, blood supply, nerve supply and applied anatomy
15	AN10.13	Explain anatomical basis of Injury to axillary nerve during intramuscularinjections
16	AN11.1	Describe and demonstrate muscle groups of upper arm with emphasis onbiceps and triceps brachii
17	AN11.2	Identify & describe origin, course, relations, branches (or tributaries),termination of important nerves and vessels in arm
18	AN11.3	Describe the anatomical basis of Venepuncture of cubital veins
19	AN11.4	Describe the anatomical basis of Saturday night paralysis
20	AN11.5	Identify & describe boundaries and contents of cubital fossa
21	AN11.6	Describe the anastomosis around the elbow joint
22	AN12.1	Describe and demonstrate important muscle groups of ventral forearmwith attachments, nerve supply and actions

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23	AN12.2	Identify & describe origin, course, relations, branches (or tributaries),termination of important nerves and vessels of forearm
24	AN12.3	Identify & describe flexor retinaculum with its attachments
25	AN12.4	Explain anatomical basis of carpal tunnel syndrome
26	AN12.5	Identify & describe small muscles of hand. Also describe movements ofthumb and muscles involved
27	AN12.6	Describe & demonstrate movements of thumb and muscles involved
28	AN12.7	Identify & describe course and branches of important blood vessels andnerves in hand
29	AN12.8	Describe anatomical basis of Claw hand
30	AN12.9	Identify & describe fibrous flexor sheaths, ulnar bursa, radial bursa anddigital synovial sheaths
31	AN12.10	Explain infection of fascial spaces of palm
32	AN12.11	Identify, describe and demonstrate important muscle groups of dorsalforearm with attachments, nerve supply and actions
33	AN12.12	Identify & describe origin, course, relations, branches (or tributaries),termination of important nerves and vessels of back of forearm
34	AN12.13	Describe the anatomical basis of Wrist drop
35	AN12.14	Identify & describe compartments deep to extensor retinaculum
36	AN12.15	Identify & describe extensor expansion formation
37	AN13.1	Describe and explain Fascia of upper limb and compartments, veins of upper limb and its lymphatic drainage
38	AN13.2	Describe dermatomes of upper limb
39	AN13.3	Identify & describe the type, articular surfaces, capsule, synovial membrane, ligaments, relations, movements, blood and nerve supply of elbow joint, proximal and distal radio-ulnar joints, wrist joint & first carpometacarpal joint
40	AN13.4	Describe Sternoclavicular joint, Acromioclavicular joint, Carpometacarpal joints & Metacarpophalangeal joint

Gross Anatomy - Thorax

Sl. No.	Competency number	Competency
1	AN21.3	Describe & demonstrate the boundaries of thoracic inlet, cavity and outlet
2	AN21.4	Describe & demonstrate extent, attachments, direction of fibres, nervesupply and actions of intercostal muscles
3	AN21.5	Describe & demonstrate origin, course, relations and branches of a typicalintercostal nerve
4	AN21.6	Mention origin, course and branches/ tributaries of:

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		1) anterior & posterior intercostal vesselsinternal thoracic vessels
5	AN21.7	Mention the origin, course, relations and branches of 1) atypical intercostal nerve superior intercostal artery, subcostal artery
6	AN21.8	Describe & demonstrate type, articular surfaces & movements of manubriosternal, costovertebral, costotransverse and xiphisternal joints
7	AN21.9	Describe & demonstrate mechanics and types of respiration
8	AN21.10	Describe costochondral and interchondral joints
9	AN21.11	Mention boundaries and contents of the superior, anterior, middle andposterior mediastinum
10	AN22.1	Describe & demonstrate subdivisions, sinuses in pericardium, blood supplyand nerve supply of pericardium
11	AN22.2	Describe & demonstrate external and internal features of each chamber ofheart
12	AN22.3	Describe & demonstrate origin, course and branches of coronary arteries
13	AN22.4	Describe anatomical basis of ischaemic heart disease
14	AN22.5	Describe & demonstrate the formation, course, tributaries and terminationof coronary sinus
15	AN22.6	Describe the fibrous skeleton of heart
16	AN22.7	Mention the parts, position and arterial supply of the conducting system ofheart
17	AN23.1	Describe & demonstrate the external appearance, relations, blood supply,nerve supply, lymphatic drainage and applied anatomy of oesophagus
18	AN23.2	Describe & demonstrate the extent, relations tributaries of thoracic ductand enumerate its applied anatomy
19	AN23.3	Describe & demonstrate origin, course, relations, tributaries and termination of superior venacava, azygos, hemiazygos and accessoryhemiazygos veins
20	AN23.4	Mention the extent, branches and relations of arch of aorta & descendingthoracic aorta
21	AN23.5	Identify & Mention the location and extent of thoracic sympathetic chain
22	AN23.6	Describe the splanchnic nerves
23	AN23.7	Mention the extent, relations and applied anatomy of lymphatic duct
24	AN24.1	Mention the blood supply, lymphatic drainage and nerve supply of pleura,extent of pleura and describe the pleural recesses and their applied anatomy
25	AN24.2	Identify side, external features and relations of structures which form rootof lung & bronchial tree and their clinical correlate
26	AN24.3	Describe a bronchopulmonary segment

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27	AN24.4	Identify phrenic nerve & describe its formation & distribution
28	AN24.5	Mention the blood supply, lymphatic drainage and nerve supply of lungs
29	AN24.6	Describe the extent, length, relations, blood supply, lymphatic drainageand nerve supply of trachea

Gross Anatomy- Head and Neck

Sl. No.	Competency number	Competency
1	AN27.1	Describe the layers of scalp, its blood supply, its nerve supply and surgicalimportance
2	AN27.2	Describe emissary veins with its role in spread of infection from extracranial route to intracranial venous sinuses
3	AN28.1	Describe & demonstrate muscles of facial expression and their nerve supply
4	AN28.2	Describe sensory innervation of face
5	AN28.3	Describe & demonstrate origin /formation, course, branches /tributaries offacial vessels
6	AN28.4	Describe & demonstrate branches of facial nerve with distribution
7	AN28.5	Describe cervical lymph nodes and lymphatic drainage of head, face andneck
8	AN28.6	Identify superficial muscles of face, their nerve supply and actions
9	AN28.7	Explain the anatomical basis of facial nerve palsy
10	AN28.8	Explain surgical importance of deep facial vein
11	AN28.9	Describe & demonstrate the parts, borders, surfaces, contents, relationsand nerve supply of parotid gland with course of its duct and surgical importance
12	AN28.10	Explain the anatomical basis of Frey's syndrome
13	AN29.1	Describe & demonstrate attachments, nerve supply, relations and actionsof sternocleidomastoid
14	AN29.2	Explain anatomical basis of Erb's & Klumpke's palsy
15	AN29.3	Explain anatomical basis of wry neck
16	AN29.4	Describe & demonstrate attachments of 1) inferior belly of omohyoid,2)scalenus anterior, 3) scalenus medius & 4) levator scapulae
17	AN30.1	Describe the cranial fossae & identify related structures
18	AN30.2	Describe & identify major foramina with structures passing through them
19	AN30.3	Describe & identify dural folds & dural venous sinuses
20	AN30.4	Describe clinical importance of dural venous sinuses
21	AN30.5	Explain effect of pituitary tumours on visual pathway
22	AN31.1	Describe & identify extra ocular muscles of eyeball
23	AN31.2	Describe & demonstrate nerves and vessels in the orbit

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24	AN31.3	Describe anatomical basis of Horner's syndrome
25	AN31.4	Enumerate components of lacrimal apparatus
26	AN31.5	Explain the anatomical basis of oculomotor, trochlear and abducent nervepalsies along with strabismus
27	AN32.1	Describe boundaries and subdivisions of anterior triangle
28	AN32.2	Describe & demonstrate boundaries and contents of muscular, carotid,digastric and submental triangles
29	AN33.1	Describe & demonstrate extent, boundaries and contents of temporal andinfratemporal fossae
30	AN33.2	Describe & demonstrate attachments, direction of fibres, nerve supply andactions of muscles of mastication
31	AN33.3	Describe & demonstrate articulating surface, type & movements of temporomandibular joint
32	AN33.4	Explain the clinical significance of pterygoid venous plexus
33	AN33.5	Describe the features of dislocation of temporomandibular joint
34	AN34.1	Describe & demonstrate the morphology, relations and nerve supply ofsubmandibular salivary gland & submandibular ganglion
35	AN34.2	Describe the basis of formation of submandibular stones
36	AN35.1	Describe the parts, extent, attachments, modifications of deep cervicalfascia
37	AN35.2	Describe & demonstrate location, parts, borders, surfaces, relations &blood supply of thyroid gland
38	AN35.3	Demonstrate & describe the origin, parts, course & branches subclavianartery
39	AN35.4	Describe & demonstrate origin, course, relations, tributaries and termination of internal jugular & brachiocephalic veins
40	AN35.5	Describe and demonstrate extent, drainage & applied anatomy of cervicallymph nodes
41	AN35.6	Describe and demonstrate the extent, formation, relation & branches ofcervical sympathetic chain
42	AN35.7	Describe the course and branches of IX, X, XI & XII nerve in the neck
43	AN35.8	Describe the anatomically relevant clinical features of Thyroid swellings
44	AN35.9	Describe the clinical features of compression of subclavian artery andlower trunk of brachial plexus by cervical rib
45	AN35.10	Describe the fascial spaces of neck
46	AN36.1	Describe the 1) morphology, relations, blood supply and applied anatomyof palatine tonsil 2) composition of soft palate
47	AN36.2	Describe the components and functions of Waldeyer's lymphatic ring
48	AN36.3	Describe the boundaries and clinical significance of pyriform fossa
49	AN36.4	Describe the anatomical basis of tonsillitis, tonsillectomy, adenoids andperi-tonsillar abscess
50	AN36.5	Describe the clinical significance of Killian's dehiscence
51	AN37.1	Describe & demonstrate features of nasal septum, lateral wall of

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		nose,their blood supply and nerve supply
52	AN37.2	Describe location and functional anatomy of paranasal sinuses
53	AN37.3	Describe anatomical basis of sinusitis & maxillary sinus tumours
54	AN38.1	Describe the morphology, identify structure of the wall, nerve supply, blood supply and actions of intrinsic and extrinsic muscles of the larynx
55	AN38.2	Describe the anatomical aspects of laryngitis
56	AN38.3	Describe anatomical basis of recurrent laryngeal nerve injury
57	AN39.1	Describe & demonstrate the morphology, nerve supply, embryological basis of nerve supply, blood supply, lymphatic drainage and actions of extrinsic and intrinsic muscles of tongue
58	AN39.2	Explain the anatomical basis of hypoglossal nerve palsy
59	AN40.1	Describe & identify the parts, blood supply and nerve supply of externalear
60	AN40.2	Describe & demonstrate the boundaries, contents, relations and functional anatomy of middle ear and auditory tube
61	AN40.3	Describe the features of internal ear
62	AN40.4	Explain anatomical basis of otitis externa and otitis media
63	AN40.5	Explain anatomical basis of myringotomy
64	AN41.1	Describe & demonstrate parts and layers of eyeball
65	AN41.2	Describe the anatomical aspects of cataract, glaucoma & central retinalartery occlusion
66	AN41.3	Describe the position, nerve supply and actions of intraocular muscles
67	AN42.1	Describe the contents of the vertebral canal
68	AN42.2	Describe & demonstrate the boundaries and contents of Suboccipital triangle
69	AN42.3	Describe the position, direction of fibers, relations, nerve supply, actions ofsemispinalis capitis and splenius capitis
70	AN43.1	Describe & demonstrate the movements with muscles producing the movements of atlantooccipital joint & atlantoaxial joint

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Neuroanatomy

Sl. No.	Competency number	Competency
1	AN 56.1	Describe & identify various layers of meninges with its extent & modifications
2	AN 56.2	Describe circulation of CSF with its applied anatomy
3	AN 57.1	Identify external features of spinal cord
4	AN 57.2	Describe extent of spinal cord in child & adult with its clinical implication
5	AN 57.3	Draw & label transverse section of spinal cord at mid-cervical & midthoracic level
6	AN 57.4	Enumerate ascending & descending tracts at mid thoracic level of spinal cord
7	AN 57.5	Describe anatomical basis of syringomyelia
8	AN 58.1	Identify external features of medulla oblongata
9	AN 58.2	Describe transverse section of medulla oblongata at the level of 1) pyramidal decussation, 2) sensory decussation 3) ION
10	AN 58.3	Enumerate cranial nerve nuclei in medulla oblongata with their functional group
11	AN 58.4	Describe anatomical basis & effects of medial & lateral medullary syndrome
12	AN 59.1	Identify external features of pons
13	AN 59.2	Draw & label transverse section of pons at the upper and lower level
14	AN 59.3	Enumerate cranial nerve nuclei in pons with their functional group
15	AN 60.1	Describe & demonstrate external & internal features of cerebellum
16	AN 60.2	Describe connections of cerebellar cortex and intracerebellar nuclei
17	AN 60.3	Describe anatomical basis of cerebellar dysfunction
18	AN 61.1	Identify external & internal features of midbrain
19	AN 61.2	Describe internal features of midbrain at the level of superior & inferior colliculus
20	AN 61.3	Describe anatomical basis & effects of Benedikt's and Weber's syndrome
21	AN 62.1	Enumerate cranial nerve nuclei with its functional component
22	AN 62.2	Describe & demonstrate surfaces, sulci, gyri, poles, & functional areas of cerebral hemisphere
23	AN 62.3	Describe the white matter of cerebrum
24	AN 62.4	Enumerate parts & major connections of basal ganglia & limbic lobe
25	AN 62.5	Describe boundaries, parts, gross relations, major nuclei and connections of dorsal thalamus, hypothalamus, epithalamus, metathalamus and subthalamus
26	AN 62.6	Describe & identify formation, branches & major areas of distribution of circle of Willis
27	AN 63.1	Describe & demonstrate parts, boundaries & features of IIIrd, IVth & lateral ventricle
28	AN 63.2	Describe anatomical basis of congenital hydrocephalus

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General Histology

Sl. No.	Competency number	Competency
1	AN 65.1	Identify epithelium under the microscope & describe the various types that correlate to its function
2	AN 65.2	Describe the ultrastructure of epithelium
3	AN 66.1	Describe & identify various types of connective tissue with functional correlation
4	AN 66.2	Describe the ultrastructure of connective tissue
5	AN 67.1	Describe & identify various types of muscle under the microscope
6	AN 67.2	Classify muscle and describe the structure-function correlation of the same
7	AN 67.3	Describe the ultrastructure of muscular tissue
8	AN 68.1	Describe & Identify multipolar & unipolar neuron, ganglia, peripheral nerve
9	AN 68.2	Describe the structure-function correlation of neuron
10	AN 68.3	Describe the ultrastructure of nervous tissue
11	AN 69.1	Identify elastic & muscular blood vessels, capillaries under the microscope
12	AN 69.2	Describe the various types and structure-function correlation of blood vessel
13	AN 69.3	Describe the ultrastructure of blood vessels
14	AN 70.1	Identify exocrine gland under the microscope & distinguish between serous, mucous and mixed acini
15	AN 70.2	Identify the lymphoid tissue under the microscope & describe microanatomy of lymph node, spleen, thymus, tonsil and correlate the structure with function
16	AN 71.1	Identify bone under the microscope; classify various types and describe the structure-function correlation of the same
17	AN 71.2	Identify cartilage under the microscope & describe various types and structure- function correlation of the same
18	AN 72.1	Identify the skin and its appendages under the microscope and correlate the structure with function
19	AN 52.2	Placenta & Umbilical cord

Systemic Histology

Sl. No.	AN 25.1	Competency
1	AN 43.2	Identify, draw and label a slide of trachea and lung
2	AN 43.3	Identify, describe and draw the microanatomy of pituitary gland, thyroid, parathyroid gland, tongue, salivary glands, tonsil, epiglottis, cornea, retina
3	AN 52.1	Identify, describe and draw microanatomy of olfactory epithelium, eyelid, lip, sclero-corneal junction, optic nerve
4	AN 52.2	Describe & identify the microanatomical features of Gastro-intestinal system: Oesophagus, Fundus of stomach, Pylorus of stomach, Duodenum, Jejunum, Ileum, Large intestine, Appendix, Liver, Gall bladder, Pancreas & Suprarenal gland

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5	AN 52.3	Describe & identify the micro anatomical features of: Urinary system: Kidney, Ureter & Urinary bladder Male Reproductive System: Testis, Epididymis, Vas deferens, Prostate. Female reproductive system: Ovary, Uterus, Uterine tube, Cervix.
6	AN 64.1	Describe & identify the microanatomical features of Cardiooesophageal junction, Corpus luteum
7	-----	Describe & identify the microanatomical features of Spinal cord, Cerebellum & Cerebrum

General Embryology

Sl. No.	Competency number	Competency
1	AN76.1	Describe the stages of human life
2	AN76.2	Explain the terms- phylogeny, ontogeny, trimester, viability
3	AN77.1	Describe the uterine changes occurring during the menstrual cycle
4	AN77.2	Describe the synchrony between the ovarian and menstrual cycles
5	AN77.3	Describe spermatogenesis and oogenesis along with diagrams
6	AN77.4	Describe the stages and consequences of fertilisation
7	AN77.5	Enumerate and describe the anatomical principles underlying contraception
8	AN78.1	Describe cleavage and formation of blastocyst
9	AN78.2	Describe the development of trophoblast
10	AN78.3	Describe the process of implantation & common abnormal sites of implantation
11	AN78.4	Describe the formation of extra-embryonic mesoderm and coelom,bilaminar disc and prochordal plate
12	AN78.5	Describe in brief abortion; decidual reaction, pregnancy test
13	AN79.1	Describe the formation & fate of the primitive streak
14	AN79.2	Describe formation & fate of notochord
15	AN79.3	Describe the process of neurulation
16	AN79.4	Describe the development of somites and intra-embryonic coelom
17	AN79.5	Explain embryological basis of congenital malformations, nucleuspulposus, sacrococcygeal teratomas, neural tube defects
18	AN79.6	Describe the diagnosis of pregnancy in first trimester and role of teratogens, alpha-fetoprotein
19	AN77.6	Describe teratogenic influences; fertility and sterility, surrogate motherhood, social significance of "sex-ratio".
20	AN 80.1	Describe formation, functions & fate of-chorion: amnion; yolk sac; allantois& decidua
21	AN 80.2	Describe formation & structure of umbilical cord
22	AN 80.3	Describe formation of placenta, its physiological functions, foeto maternal circulation & placental barrier
23	AN 80.4	Describe embryological basis of twinning in monozygotic & dizygotic twins
24	AN 80.5	Describe role of placental hormones in uterine growth & parturition
25	AN 80.6	Explain embryological basis of estimation of fetal age.
26	AN 80.7	Describe various types of umbilical cord attachments

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Systemic Embryology

Sl. No.	Competency number	Competency
1	AN 9.3	Describe development of breast
2	AN 13.8	Describe development of upper limb
3	AN 20.10	Describe basic concept of development of lower limb
	AN 25.2	Describe development of pleura, lung & heart
4	AN 25.4	Describe embryological basis of: 1) atrial septal defect, 2) ventricular septal defect, 3) Fallot's tetralogy & 4) tracheo-oesophageal fistula
5	AN 25.5	Describe developmental basis of congenital anomalies, transposition of great vessels, dextrocardia, patent ductus arteriosus and coarctation of aorta
6	AN 25.6	Mention development of aortic arch arteries, SVC, IVC and coronary sinus
7	AN 43.4	Describe the development and developmental basis of congenital anomalies of face, palate, tongue, branchial apparatus, pituitary gland, thyroid gland & eye
8	AN 52.4	Describe the development of anterior abdominal wall
9	AN 52.5	Describe the development and congenital anomalies of Diaphragm
10	AN 52.6	Describe the development and congenital anomalies of: Foregut, Midgut & Hindgut
11	AN 52.7	Describe the development of Urinary system
12	AN 52.8	Describe the development of male & female reproductive system
13	AN 64.2	Describe the development of neural tube, spinal cord, medulla oblongata, pons, midbrain, cerebral hemisphere & cerebellum
14	AN 64.3	Describe various types of open neural tube defects with its embryological basis

Osteology:

Sl. No.	Competency number	Competency
1	AN8.1	Identify the given bone, its side, important features & keep it in anatomical position
2	AN8.2	Identify & describe joints formed by the given bone
3	AN8.3	Enumerate peculiarities of clavicle
4	AN8.4	Demonstrate important muscle attachment on the given bone
5	AN8.5	Identify and name various bones in articulated hand, Specify the parts of metacarpals and phalanges and enumerate the peculiarities of pisiform
6	AN8.6	Describe scaphoid fracture and explain the anatomical basis of avascular necrosis
7	AN14.1	Identify the given bone, its side, important features & keep it in anatomical position
8	AN14.2	Identify & describe joints formed by the given bone

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9	AN14.3	Describe the importance of ossification of lower end of femur & upper end of tibia
10	AN14.4	Identify and name various bones in the articulated foot with individual muscle attachment
11	AN21.1	Identify and describe the salient features of sternum, typical rib, Ist rib and typical thoracic vertebra
12	AN21.2	Identify & describe the features of 2nd, 11th and 12th ribs, 1st, 11th and 12th thoracic vertebrae
13	AN21.3	Describe & demonstrate the boundaries of thoracic inlet, cavity and outlet
14	AN26.1	Demonstrate anatomical position of skull, Identify and locate individualskull bones in skull
15	AN26.2	Describe the features of norma frontalis, verticalis, occipitalis, lateralis and basalis
16	AN26.3	Describe cranial cavity, its subdivisions, foramina and structures passing through them
17	AN26.4	Describe morphological features of mandible
18	AN26.5	Describe features of typical and atypical cervical vertebrae (atlas and axis)
19	AN26.6	Explain the concept of bones that ossify in membrane
20	AN26.7	Describe the features of the 7th cervical vertebra
21	AN53.2	Demonstrate the anatomical position of bony pelvis & show boundaries of pelvic inlet, pelvic cavity, pelvic outlet
22	AN53.3	Define true pelvis and false pelvis and demonstrate sex determination in male & female bony pelvis
23	AN53.4	Explain and demonstrate clinical importance of bones of abdominopelvic region (sacralization of lumbar vertebra, Lumbarization of 1st sacral vertebra, types of bony pelvis & Coccyx)

Genetics

Sl. No.	Competency number	Competency
1	AN73.1	Describe the structure of chromosomes with classification
2	AN73.2	Describe technique of karyotyping with its applications
3	AN73.3	Describe the Lyon's hypothesis
4	AN74.1	Describe the various modes of inheritance with examples
5	AN74.2	Draw pedigree charts for the various types of inheritance & give examples of diseases of each mode of inheritance
6	AN74.3	Describe multifactorial inheritance with examples
7	AN74.4	Describe the genetic basis & clinical features of Achondroplasia, Cystic Fibrosis, Vitamin D resistant rickets, Haemophilia, Duchene's muscular dystrophy & Sickle cell anaemia
8	AN75.1	Describe the structural and numerical chromosomal aberrations
9	AN75.2	Explain the terms mosaics and chimeras with example
10	AN75.3	Describe the genetic basis & clinical features of Prader Willi syndrome, Edward syndrome & Patau syndrome

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11	AN75.4	Describe genetic basis of variation: polymorphism and mutation
12	AN75.5	Describe the principles of genetic counselling
13	AN81.1	Describe various methods of prenatal diagnosis
14	AN81.2	Describe indications, process and disadvantages of amniocentesis
15	AN81.3	Describe indications, process and disadvantages of chorion villus biopsy

Surface Anatomy

Sl. No.	Competency number	Competency
1	AN 13.6	Identify & demonstrate important bony landmarks of upper limb: Jugular notch, sternal angle, acromial angle, spine of the scapula, vertebral level of the medial end, Inferior angle of the scapula
2	AN 13.7	Identify & demonstrate surface projection of: Cephalic and basilic vein, Palpation of Brachial artery, Radial artery, Testing of muscles: Trapezius, pectoralis major, serratus anterior, latissimus dorsi, deltoid, biceps brachii, Brachioradialis
3	AN 20.7	Identify & demonstrate important bony landmarks of lower limb: -Vertebral levels of highest point of iliac crest, posterior superior iliac spines, iliac tubercle, pubic tubercle, ischial tuberosity, adductor tubercle, Tibial tuberosity, head of fibula, Medial and lateral malleoli, Condyles of femur and tibia, sustentaculum tali, tuberosity of fifth metatarsal, tuberosity of the navicular
4	AN 20.8	Identify & demonstrate palpation of femoral, popliteal, post tibial, anti tibial & dorsalis pedis blood vessels in a simulated environment
5	AN 20.9	Identify & demonstrate Palpation of vessels (femoral, popliteal, dorsalis pedis, post tibial), Mid inguinal point, Surface projection of: femoral nerve, Saphenous opening, Sciatic, tibial, common peroneal & deep peroneal nerve, Great and small saphenous veins
6	AN 25.9	Demonstrate surface marking of lines of pleural reflection, lung borders and fissures, trachea, heart borders, apex beat & surface projection of valves of heart
7	AN 43.5	Demonstrate- Palpation of carotid arteries, facial artery, superficial temporal artery, 3) Location of internal and external jugular veins, 4) Location of hyoid bone, thyroid cartilage and cricoid cartilage with their vertebral levels
8	AN 43.6	Demonstrate surface projection of- Thyroid gland, Parotid gland and duct, Pterion, Common carotid artery, Internal jugular vein, Subclavian vein, External jugular vein, Facial artery in the face & accessory nerve
9	AN 44.1	Describe & demonstrate the Planes (transpyloric, transtubercular, subcostal, lateral vertical, linea alba, linea semilunaris), regions & Quadrants of abdomen
10	AN 55.1	Demonstrate the surface marking of; Regions and planes of abdomen, Superficial inguinal ring, Deep inguinal ring , McBurney's point, Renal Angle & Murphy's point
11	AN 55.2	Demonstrate the surface projections of: Stomach, Liver, Fundus of gall bladder, Spleen, Duodenum, Pancreas, Ileocaecal junction, Kidneys & Root of mesentery

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Radiology

Sl. No.	Competency number	Competency
1	AN 13.5	Identify the bones and joints of upper limb seen in anteroposterior and lateral view radiographs of shoulder region, arm, elbow, forearm and hand
2	AN 20.6	Identify the bones and joints of lower limb seen in anteroposterior and lateral view radiographs of various regions of lower limb
3	AN 25.7	Identify structures seen on a plain x-ray chest (PA view)
4	AN 25.8	Identify and describe in brief a barium swallow
5	AN 43.7	Identify the anatomical structures in 1) Plain x-ray skull, 2) AP view and lateral view 3) Plain x-ray cervical spine-AP and lateral view 4) Plain x ray of paranasal sinuses
6	AN 43.8	Describe the anatomical route used for carotid angiogram and vertebral angiogram
7	AN 43.9	Identify anatomical structures in carotid angiogram and vertebral angiogram
8	AN 54.1	Describe & identify features of plain X ray abdomen
9	AN 54.2	Identify features of plain X ray abdomen
10	AN 54.2	Describe & identify the special radiographs of abdominopelvic region (contrast X ray Barium swallow, Barium meal, Barium enema, Cholecystography, Intravenous pyelography & Hysterosalpingography)
11	AN 54.3	Identify the special radiographs of abdominopelvic region (contrast X ray Barium swallow, Barium meal, Barium enema, Cholecystography, Intravenous pyelography & Hysterosalpingography
12	AN 54.3	Describe role of ERCP, CT abdomen, MRI, Arteriography in radiodiagnosis of abdomen

AETCOM – 12 Hours

Sl. No.	Competency number	Competency
1	AN 82.1	Demonstrate respect and follow the correct procedure when handling cadavers and other biologic tissue
2	----	Enumerate and describe professional qualities and roles of a physician
3	----	Describe and discuss the commitment to lifelong learning as an important part of physician growth.
4	----	Describe and discuss the role of a physician in health care system
5	-----	Identify and discuss physician's role and responsibility to society and the community that she/ he serves

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INTEGRATION TOPICS

PHYSIOLOGY

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	PY3.1	Describe the structure and functions of a neuron and neuroglia; Discuss Nerve Growth Factor & other growth factors/cytokines		Human Anatomy
2	PY3.7	Describe the different types of muscle fibres and their structure		Human Anatomy
3	PY3.13	Describe muscular dystrophy: myopathies	Gen. Medicine	Human Anatomy
4	PY4.1	Describe the structure and functions of digestive system		Human Anatomy
5	PY5.1	Describe the functional Anatomy of heart including chambers, sounds; and Pacemaker tissue and conducting system.		Human Anatomy
6	PY5.6	Describe abnormal ECG, arrythmias, heart block and myocardial Infarction	Gen. Medicine	Human Anatomy
7	PY9.1	Describe and discuss sex determination; sex differentiation and their abnormities and outline psychiatry and practical implication of sex determination.		Human Anatomy
8	PY10.1	Describe and discuss the organization of nervous system		Human Anatomy
9	PY10.2	Describe and discuss the functions and properties of synapse, reflex, receptors		Human Anatomy
10	PY10.3	Describe and discuss somatic sensations & sensory tracts		Human Anatomy
11	PY10.4	Describe and discuss motor tracts, mechanism of maintenance of tone, control of body movements, posture and equilibrium & vestibular apparatus		Human Anatomy
12	PY10.5	Describe and discuss structure and functions of reticular activating system, autonomic nervous system (ANS)		Human Anatomy

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13	PY10.6	Describe and discuss Spinal cord, its functions, lesion & sensory disturbances		Human Anatomy
14	PY10.7	Describe and discuss functions of cerebral cortex, basal ganglia, thalamus, hypothalamus, cerebellum and limbic system and their abnormalities	Psychiatry	Human Anatomy
15	PY10.11	Demonstrate the correct clinical examination of the nervous system: Higher functions, Sensory system, motor Human Anatomy system, reflexes, Cranial Nerves in a normal volunteer or simulated environment		Human Anatomy

BIOCHEMISTRY

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	BI6.13	Describe the functions of the kidney, liver, thyroid and adrenal glands	Pathology, General Medicine	Physiology, Human Anatomy
2	BI6.14	Describe the tests that are commonly done in clinical practice to assess the functions of these organs (kidney, liver, thyroid and adrenal glands).	Pathology, General Medicine	Physiology, Human Anatomy
3	BI6.15	Describe the abnormalities of kidney, liver, thyroid and adrenal glands	Pathology, General Medicine	Physiology, Human Anatomy

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PATHOLOGY

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	PA28.10	Describe the etiology, pathogenesis, pathology, laboratory findings, distinguishing features progression and complications of acute and chronic pyelonephritis and reflux nephropathy	Human Anatomy, General Surgery	
2	PA31.1	Classify and describe the types, etiology, pathogenesis, pathology and hormonal dependency of benign breast disease	Human Anatomy, General Surgery	
3	PA32.1	Enumerate, classify and describe the etiology, pathogenesis, pathology and iodine dependency of thyroid swellings	Human Anatomy Physiology, General Medicine, General Surgery	
4	PA32.9	Describe the etiology, pathogenesis, manifestations, laboratory and morphologic features of adrenal neoplasms	Human Anatomy, Physiology, General Medicine, General Surgery	
5	PA33.1	Classify and describe the etiology, pathogenesis, manifestations, radiologic and morphologic features and complications of osteomyelitis	Human Anatomy, Orthopedics	Microbiology

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FORENSIC MEDICINE & TOXICOLOGY

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	FM2.28	Describe and discuss signs of intrauterine death, signs of live birth, viability of foetus, age determination of foetus, DOAP session of ossification centres, Hydrostatic test, Sudden infants death syndrome and Munchausen's syndrome by proxy.	Pediatrics, Human Anatomy	
2	FM3.1	Identification, Define and describe Corpus Delicti, establishment of identity of living persons including race, Sex, religion, complexion, stature, age determination using morphology, teeth-eruption, decay, bite marks, bones, ossification centres, medico-legal aspects of age.	Human Anatomy	

ANESTHESIOLOGY

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	AS4.2	Describe the Anatomy of the airway and its implications for general anaesthesia	Human Anatomy	
2	AS5.2	Describe the correlative Anatomy of the brachial plexus, subarachnoid and epidural spaces	Human Anatomy	
3	AS5.3	Observe and describe the principles and steps/ techniques involved in peripheral nerve blocks	Human Anatomy	
4	AS8.1	Describe the anatomical correlates and physiologic principles of pain	Human Anatomy, Physiology	

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ENT

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	EN1.1	Describe the Human Anatomy & physiology of ear, nose, throat, head & neck.	Human Anatomy	

OPHTHALMOLOGY

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	OP2.1	Enumerate the causes, describe and discuss the aetiology, clinical presentations and diagnostic features of common conditions of the lid and adnexa including Hordeolum externum/ internum, blepharitis, preseptal cellulitis, dacryocystitis, hemangioma, dermoid, ptosis, entropion, lid lag, lagopthalmos		Human Anatomy
2	OP4.1	Enumerate describe and discuss the types and causes of corneal ulceration		Human Anatomy
3	OP7.1	Describe the surgical anatomy and the metabolism of the lens	Biochemistry, Human Anatomy	
4	OP8.1	Discuss the aetiology, pathology, clinical features and management of vascular occlusions of the retina	Human Anatomy, Pathology	

DENTISTRY

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	DE1.1	Enumerate the parts of the tooth	Human Anatomy	
2	DE5.1	Enumerate the parts of the tooth and supporting structures	Human Anatomy	

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GENERAL MEDICINE

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	IM3.1	Define discuss describe and distinguish community acquired pneumonia, nosocomial pneumonia and aspiration pneumonia	Human Anatomy, Pathology, Microbiology	
2	IM13.9	Demonstrate in a mannequin the correct technique for performing breast exam, rectal examination and cervical examination and pap smear	Human Anatomy	General Surgery
3	IM17.1	Define and classify headache and describe the presenting features, precipitating factors, aggravating and relieving factors of various kinds of headache	Human Anatomy	
4	IM18.1	Describe the functional and the vascular anatomy of the brain	Human Anatomy	
5	IM19.1	Describe the functional anatomy of the locomotor system of the brain	Human Anatomy, Physiology	

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OBG

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	OG2.1	Describe and discuss the development and anatomy of the female reproductive tract, relationship to other pelvic organs, applied anatomy as related to Obstetrics and Gynaecology.	Human Anatomy	
2	OG4.1	Describe and discuss the basic embryology of fetus , factors influencing fetal growth and development, anatomy and physiology of placenta, and teratogenesis	Human Anatomy	
3	OG14.1	Enumerate and discuss the diameters of maternal pelvis and types	Human Anatomy	

GENERAL SURGERY

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	SU19.1	Describe the etiology and classification of cleft lip and palate	Human Anatomy	
2	SU19.2	Describe the Principles of reconstruction of cleft lip and palate	Human Anatomy	
3	SU22.1	Describe the Applied anatomy, and physiology of thyroid	Human Anatomy	
4	SU22.5	Describe the applied anatomy of parathyroid.	Human Anatomy	
5	SU23.1	Describe the applied anatomy of adrenal glands	Human Anatomy	
6	SU24.1	Describe the clinical features, principles of investigation, prognosis and management of pancreatitis.	Human Anatomy	
7	SU25.1	Describe applied anatomy appropriate investigations for breast disease	Human Anatomy	
8	SU28.2	Describe the clinical features, investigations and principles of management of congenital anomalies of Genitourinary system.	Human Anatomy	

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9	SU28.5	Describe the applied anatomy and physiology of esophagus	Human Anatomy Physiology	
10	SU28.7	Describe the applied anatomy and physiology of stomach.	Human Anatomy	
11	SU28.10	Describe the applied anatomy of liver. Describe the Clinical features, Investigations and principles of management of Liver abscess, hydatid disease, Injuries and Tumors of the liver	Human Anatomy	
12	SU28.11	Describe the applied anatomy of Spleen. Describe the clinical features, Investigations and principles of management of splenic injuries. Describe the Post-splenectomy sepsis-prophylaxis.	Human Anatomy	
13	SU28.12	Describe the applied anatomy of biliary system. Describe the clinical features, investigations and principles of management of diseases of biliary system.	Human Anatomy	
14	SU28.13	Describe the applied anatomy of small and large intestines	Human Anatomy	
15	SU28.16	Describe applied anatomy including congenital anomalies of the rectum and anal canal	Human Anatomy	
16	SU30.2	Describe the applied anatomy, clinical features, investigations and principles of management of Undescended testis.	Human Anatomy	
17	SU30.3	Describe the applied anatomy, clinical features, investigations and principles of management of Epidydimo-orchitis	Human Anatomy	
18	SU30.4	Describe the applied anatomy, clinical features, investigations and principles of management of Varicocele	Human Anatomy	
19	SU30.5	Describe the applied anatomy, clinical features, investigations and principles of management of Hydrocele	Human Anatomy	

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ORTHOPEDICS

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	OR2.1	Describe and discuss the mechanism of Injury, clinical features, investigations and plan management of fracture of clavicle	Human Anatomy	
2	OR2.2	Describe and discuss the mechanism of Injury, clinical features, investigations and plan management of fractures of proximal humerus	Human Anatomy	
3	OR2.3	Describe and discuss the mechanism of Injury, clinical features, investigations and plan management of supra condylar fracture of humerus	Human Anatomy	
4	OR2.4	Describe and discuss the mechanism of injury, clinical features, investigations and principles of management of fracture of shaft of humerus and intercondylar fracture humerus with emphasis on neurovasular deficit	Human Anatomy	
5	OR2.5	Describe and discuss the aetiopathogenesis, clinical features, mechanism of injury, investigation & principles of management of fractures of both bones forearm and Galeazzi and Monteggia injury	Human Anatomy	
6	OR2.6	Describe and discuss the aetiopathogenesis, mechanism of injury, clinical features, investigations and principles of management of fractures of distal radius	Human Anatomy	
7	OR2.7	Describe and discuss the aetiopathogenesis, mechanism of injury, clinical features, investigations and principles of management of pelvic injuries with emphasis on hemodynamic instability	Human Anatomy	

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8	OR2.8	Describe and discuss the aetiopathogenesis, mechanism of injury, clinical features, investigations and principles of management of spine injuries with emphasis on mobilisation of the patient	Human Anatomy	
9	OR2.9	Describe and discuss the mechanism of injury, Clinical features, investigations and principle of management of acetabular fracture	Human Anatomy	
10	OR2.10	Describe and discuss the aetiopathogenesis, mechanism of injury, clinical features, investigations and principles of management of fractures of proximal femur	Human Anatomy	
11	OR2.11	Describe and discuss the aetiopathogenesis, mechanism of injury, clinical features, investigations and principles of management of (a) Fracture patella (b) Fracture distal femur © Fracture proximal tibia with special focus on neurovascular injury and compartment syndrome	Human Anatomy	
12	OR2.12	Describe and discuss the aetiopathogenesis, clinical features, Investigation and principles of management of Fracture shaft of femur in all age groups and the recognition and management of fat embolism as a complication	Human Anatomy	
13	OR2.13	Describe and discuss the aetiopathogenesis, clinical features, Investigation and principles of management of: (a) Fracture both bones leg (b) Calcaneus (c) Small bones of foot	Human Anatomy	
14	OR2.14	Describe and discuss the aetiopathogenesis, clinical features, Investigation and principles of management of ankle fractures	Human Anatomy	
15	OR2.15	Plan and interpret the investigations to diagnose complications of fractures like malunion, non-union, infection, compartmental syndrome	Human Anatomy	

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16	OR2.16	Describe and discuss the mechanism of injury, clinical features, investigations and principles of management of open fractures with focus on secondary infection, prevention and management	Human Anatomy	
17	OR11.1	Describe and discuss the aetiopathogenesis, Clinical features, Investigations and principles of management of peripheral nerve injuries in diseases like foot drop, wrist drop, claw hand, palsies of Radial, Ulnar, Median, Lateral Popliteal and Sciatic Nerves	Human Anatomy	
18	OR12.1	Describe and discuss the Clinical features, Investigations and principles of management of Congenital and acquired malformations and deformities of: a. limbs and spine - Scoliosis and spinal bifida b. Congenital dislocation of Hip, Torticollis, c. congenital talipes equino varus	Human Anatomy	

PHYSICAL MEDICINE & REHABILITATION

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	PM2.1	Describe the causes of disability in the patient with a cerebrovascular accident	Human Anatomy	General Medicine
2	PM3.1	Describe and discuss the clinical features, types, evaluation, diagnosis and management of cerebral palsy	Human Anatomy	Pediatrics

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PEDIATRICS

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	PE32.1	Discuss the genetic basis, risk factors, complications, prenatal diagnosis, management and genetic counselling in Down's Syndrome	Human Anatomy	

Teaching Learning Methods:

The university incorporates the guidelines of the CBME curriculum prescribed by the National Medical Commission (NMC). The department uses various innovative teaching learning methods to facilitate effective student learning.

Cognitive:

Sl. No.	T-L Method	Number of Hours
1	Interactive Lectures	110
2	Small Group Learning Tutorials Visit to hospital OPDs and Wards Problem based Learning for Integrated sessions Museum visits for integration Competitions/Seminars videos/role play/live/simulation	64
3	Early Clinical Exposure	15
4	Self-Directed Learning	20

Psychomotor and Affective Domain

Sl. No.	T-L Method	Number of Hours
1.	Dissection and Prosection (cadaver specimen) Demonstrations-videos/role play/live/simulation/Virtual Reality Slide demonstrations	144

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Assessment methods:

Formative Assessment:

The department follows the concept of continuous assessment for evaluating the students. The department of Anatomy will conduct **monthly tests, part completion test and three internal assessments. Fourth internal assessment will be conducted for improvement of scores as a remedial measure.**

This facilitates to give feedback to students on their learning. These tests allow regular and timely revision by the students. It also prepares the student to attend the summative examination with confidence.

Sl. No.	Assessment methods
1	Modified Long essay, Short Essay (SE),
2	Short answer questions (SAQ)
3	Multiple choice questions (MCQ)
4	Short Seminars
5	Spotters
6	Structured Discussions
7	Table viva (Gross Anatomy)
8	Objective Structured Practical Examination (OSPE)

Guidelines for Internal assessment:

1) The department will conduct a minimum of three internal assessments.
2) The **1st internal assessment** to include **one short essay** on **AETCOM modules 1.1 and 1.5**.
3) The **third internal assessment** will be as per university **summative examination.**
4) The marks obtained in the formative assessment should be displayed on the notice board within 1 -2 weeks after conducting the tests.

Theory:

- The theory paper will be conducted for 60 marks for 1st and 2nd IA and 100 marks for third IA
- Blue print guidelines to be followed for question paper setting.
- The distribution of marks will be as follows:
    i. 40% of the subject questions will be based on clinical correlation and integration (LE, SE).
    ii. 40% of the subject questions will and comprehension level of questions (SE).
    iii. 20% of the subject questions will be of recall type. (SAQs and MCQs).

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- Each **Internal assessment weightage** will be as follows:

Sl. No.	Topics	Weightage
1	Gross Anatomy (AETCOM -1 SE in 1st IA)	65%
2	Histology	10%
3	Embryology	10%
4	Osteology/Genetics/General anatomy/recent advances.	15%

- **Scheme of Internal Assessment:**

Sl. No.	Type of Question	Marks	Marks
1.	Long Essay	(2X10)=20	(2X10)=20
2.	Short Essay	(5X5) = 25	(10X5) = 50
3.	SAQs	(5X3) =15	(10X3) 30
4.	**Total**	**60**	**100**

- **Scheme for practical assessment:**

Sl. No.	Assessment type	Marks
	A Gross Anatomy	
1	Spotter Test (10X1)	10
2	Discussion (2X10)	20
	B Histology	
1	Spotters (10 X1)	10
2	Discussion (2 X10)	20
Total		**60**

- The **histology record** and the **log book** should be evaluated on a continuous basis and certified by the department before the summative examination

The **pass criteria** in each internal assessment will be 40% separately in theory and practical. **Eligibility criteria** to take up summative examination, theory and practical cumulative should be 50%.

Regular monthly tests will be conducted in addition to the three internal assessments. These will be in the form of **SAQ test, MCQ test, SE test, Table viva, Spotter tests etc.**

These will be given weightage when considering internal assessment eligibility for summative examination.

LOG BOOK:

The anatomy log book should be completed and evaluated by the faculty on a timely basis. The same to be certified by the head of the department at the end of the program before summative examination.

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HISTOLOGY RECORD:

The Histology record should be certified before each internal assessment and final certification by the head of the department before summative examination.

Eligibility for Summative Examination:

Weightage of various assessments as eligibility criteria for Summative exam:

Sl. No.	Type of Assessment	Weightage
1.	Internal assessment	70%
2.	Monthly assessment (Part Completion test)	12%
3.	Professionalism	6%
4.	Histology records	6%
5.	Level of participation in ECE	6%

Sl. No.	Theory		Practical	
1	IA Theory	30	Gross and Histology	30
2	Monthly Assessments (Part completion Test)	5	Histology record	05
3	Professionalism	5	Level of participation in ECE	05
4	**Total**	**40**	**Total**	**40**

Another proposal

Formative assessment :			
Theory	**30 Marks**	**Practical**	**30 Marks**
Monthly Assessments - MCQs / SAQ tests / Viva voce etc.	05	Histology Practical records	05
Attitude	01		05
Written Assignments	02		
Attendance	02 (for T + P attendance > 90%) 01 (for T + P attendance between 80-90%) **Eligibility criteria for attendance is 80% (separately for theory & practical)**	ECE Participation	
Total	**40**		**40**

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The eligibility is calculated by considering the internal assessment/monthly assessment and Professionalism and ethics (**average should be 40% in theory and practical separately** and **50% in theory and practical combined**).

Attendance should be 75% in theory and 80% in practical, 75 % each for Foundation course and AETCOM.

If a student is found not to meet the criteria of eligibility for summative examination, remedial measures in the form of improvement tests/assignments should be given. The student can be allowed to take up summative examination if the remedial measures are fulfilled.

The internal assessment will appear as a separate subheading in the marks card and not be considered for pass criteria of final summative examination.

Summative Assessment:

Marks Distribution:

Sl. No.	Theory	Practical	Viva	Total
Marks	100	80 (Combined for MBC101A & MBC102A)	20 (Combined for MBC101A & MBC102A)	150

Theory: 1 paper of 100 marks each.

The portions of theory paper I:

General Anatomy, Upper limb, Thorax, Head and Neck, Neuroanatomy,. General embryology and relevant Systemic embryology. General histology and relevant Systemic histology.

Pattern of Assessment:

Theory: Maximum marks: 100

Theory paper I

Sl. No.	Type of Question	Number	Marks
1	Long Essay	2 X 10	20
2	Short Essay	6 X 5	30
3	Short answer questions	10 X 3	30
4	MCQs	20 X 1	20
5	**Total**	**38**	**100**

Marks Distribution for the various topics in Paper I

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Sl. No.	Region/Topic	Marks allotted (UL-LE) (Version-1)	Marks allotted (Thorax-LE) (Version - 2)
1	Upper limb	18	23
2	Thorax	20	15
3	Head and Neck	23	23
4	Neuroanatomy	14	14
5	General Anatomy	7	7
6	General embryology and relevant systemic embryology.	9	9
7	General histology and relevant systemic histology	9	9
8	**Total**	**100**	**100**

Practical: Maximum marks: 80

Sl. No.	Assessment type	Marks
	Gross Anatomy	
1	Spotters (15X1)	15
2	Discussion	
	Above diaphragm (1X15)	15
	Below diaphragm(1X15)	15
3	Muscle testing	05
	Histology	
1	Spotters (10X1)	10
2	Discussion	
	General(1X10)	10
	Systemic(1X10)	10
Total		**80**

Viva: Maximum marks: 20

Sl. No.	Viva Section	Marks
1	Osteology	05
2	Surface Anatomy	05

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3	Embryology	05
4	Radiology	05
5	Total	20

Pass Criteria:

The pass is determined by consideration of both Courses MBC101A &MBC102A assessments.

The student should secure **40% in each theory paper** and **50% of aggregate of the two papers.**

The student should secure 50% in **practical exam + viva.**

Supplementary Exam:

Supplementary exams to be conducted and results to be declared **within 60** days after announcement of results of main summative examination. If the student clears the supplementary exam he/she can join the regular batch.

Blueprint of Anatomy Paper I

Weightage of Marks

Sl. No.	Region	Long Essay	Short Essay	Short Answer Questions	MCQs	Total
1	**Head & Neck**	10	5	3	4	**22**
2	**Upper Limb (UL)**		5	3	3	**11**
3	**Thorax (TH)**	10		3	3	**16**
4	**General Embryology & relevant Systemic Embryology**	-	5	3	2	**10**
5	**General Histology and Relevant Systemic Histology**	-	5	3	2	**10**
6	**Osteology related to Head &Neck, UL, TH**	-	-	6 (UL-2)	2 (H&N-1, TH-1)	**8**
7	**Neuroanatomy**	-	10	3	2	**15**
8	**General Anatomy**	-	-	6	2	**8**
9	**Total**	**20**	**30**	**30**	**20**	**100**

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Sl. No.	Question	Region	Arter	Nerve	Muscle	Vei	Bones	Joints	Fossa & Triangles	Fascia	Organs	Others
1	LE 1	Head and neck										
2	LE 2	Thorax										
3	SE 1	Upper Limb										
4	SE 2	Head & Neck										
5	SE 3	Neuroanatomy										
6	SE 4	Neuroanatomy										
7	SE 5	General Histology/ Relevant systemic histology										
8	SE 6	General Embryology/ Relevant Systemic Embryology										
9	SAQ 1	General Anatomy										
10	SAQ 2	General Anatomy										
11	SAQ 3	General Embryology/ Relevant Systemic Embryology										
12	SAQ 4	General Histology/ Relevant systemic histology										
13	SAQ 5	Neuroanatomy										
14	SAQ 6	Upper Limb										
15	SAQ 7	Head and Neck										
16	SAQ 8	Thorax										
17	SAQ 9	Osteology (UL)										
18	SAQ 10	Osteology(UL)										

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Sl. No.	Question	Region	Artery	Nerve	Muscle	Vein	Bones	Joints	Fossa & Triangles	Fascia	Organs	Others
19	MCQ 1	Head and Neck										
	MCQ 2	Thorax										
	MCQ 3	Upper Limb										
	MCQ 4	Neuroanatomy										
	MCQ 5	Thorax										
	MCQ 6	Head and Neck										
	MCQ 7	Upper Limb										
	MCQ 8	General Anatomy										
	MCQ 9	General Embryology/Relevant Systemic Embryology										
	MCQ 10	General Histology/Relevant systemic histology										
20	MCQ 11	Head and Neck										
	MCQ 12	Thorax										
	MCQ 13	Upper Limb										
	MCQ 14	Neuroanatomy										
	MCQ 15	Osteology (TH)										
	MCQ 16	Head and Neck										
	MCQ 17	Osteology (H&N)										
	MCQ 18	General Anatomy										
	MCQ 19	General Embryology/Relevant Systemic Embryology										
	MCQ 20	General Histology/Relevant systemic histology										

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PRACTICAL PORTIONS

DISCUSSION TOPICS FOR MBBS PHASE-I

UPPER LIMB:

1. Structures under the cover of Pectoralis major muscle
2. Triangular & Quadrangular spaces
3. Axillary artery & branches
4. Structures under cover of deltoid muscle.
5. Flexor compartment of arm.
6. Brachial plexus in detail.
7. Brachial artery and branches.
8. Extensor compartment of arm.
9. Spiral/Radial groove – boundaries and contents in detail.
10. Shoulder joint.
11. Cubital fossa.
12. Flexor compartment of forearm-Muscles, vessels, nerves in detail.
13. Extensor compartment of forearm- "
14. Supinator and its relations.
15. Superficial palmar arch.
16. Deep palmar arch & deep branch of ulnar nerve.
17. Dorsum of hand.
18. Distribution of nerves in hand.
19. Flexor retinaculum of hand.
20. Extensor retinaculum of hand.

DISCUSSION TOPICS ON THORAX

1. Typical intercostal space-Boundaries & contents in detail.
2. Lungs (right & left) in detail with pleura.
3. Hilum and Root of lungs.
4. Pericardium and external features of heart.
5. Sinuses of Pericardium.
6. Blood supply of heart.
7. Interior of atrial chambers of heart.
8. Interior of ventricular chambers of heart.
9. Superior mediastinum in detail.
10. Posterior mediastinum in detail.
11. Arch of aorta & its branches.

DISCUSSION TOPICS OF HEAD & NECK:

1. Scalp
2. Sensory nerve supply of face
3. Muscles of facial expression.
4. Facial vessels. (Facial artery + Facial vein).
5. Extra cranial course of facial nerve.
6. Parotid gland and relations.

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7. Posterior triangle of neck
8. Deep cervical fascia.
9. Anterior triangles of Neck-Carotid and Digastric
10. Carotid sheath and contents
11. Thyroid gland
12. Midline structures of Neck
13. Carotid system of arteries and their branches (common external & internal)
14. Supra and infrahyoid muscles.
15. Submandibular Gland and relations
16. Relations of Hyoglossus
17. Nasal septum
18. Lateral wall of nose.
19. Tongue.
20. Pharynx
21. Larynx
22. Soft palate
23. Infra temporal fossa – boundaries and contents
24. Muscles of mastication.
25. Maxillary artery and branches.
26. Mandibular nerve and branches.
27. Interior of cranial cavity and identification of cranial nerves (Dural folds, dural venous sinuses)
28. Cavernous sinus and relations.

DISCUSSION TOPICS ON BRAIN

1. Sulci & Gyri of cerebral hemispheres. (Superolateral, medial & inferior surfaces)
2. Blood supply of brain.
3. Base of brain.
4. Median sagittal section of brain
5. White matter of cerebrum – corpus callosum
6. White matter of cerebrum – internal capsule
7. Lateral ventricles of Brain
8. Third ventricle of Brain
9. Fourth ventricle of Brain.
10. Horizontal section of brain at the level of I.V. Foramen.
11. Cerebellum.
12. Corpus callosum in detail.
13. Floor of 4th ventricle.
14. External features of Brain Stem
15. Blood supply of Brain Stem

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MBBS PHASE 1 - HISTOLOGY SLIDES (SPOTTERS AND DISCUSSION)

General Slides	
1	Collagen Fibre/Loose Areolar Tissue
2	Adipose Tissue
3	Hyaline Cartilage
4	White Fibro Cartilage
5	Elastic Cartilage
6	Bone.L.S
7	Bone.T.S
8	Skeletal Muscle.T.S
9	Skeletal Muscle.L.S
10	Cardiac Muscle
11	Peripheral Nerve.T.S
12	Elastic Artery
13	Muscular Artery
14	Vein
15	Serous Salivary Gland
16	Mucous Salivary Gland
17	Mixed Salivary Gland
18	Lymph Node
19	Thymus
20	Palatine Tonsil
21	Spleen
22	Spinal Ganglion
23	Sympathetic Ganglion
24	Thick Skin
25	Thin Skin
26	Placenta
27	Umbilical Cord
Systemic Slides	
28	Lacrimal Gland
29	Lip
30	Tongue-Filiform Papillae
31	Tongue-Circumvallate Papillae
32	Oesophagus
33	Trachea
34	Lung
35	Mammary Gland
36	Pituitary
37	Thyroid
38	Parathyroid
39	Cornea
40	Retina

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41	Eyelid
42	Optic Nerve
43	Spinal Cord
44	Cerebellum
45	Cerebrum

SURFACE MARKING TOPICS FOR MBBS PHASE-I

UPPER LIMB:

1. Axillary artery
2. Brachial artery
3. Radial and ulnar artery
4. Superifcial and deep palmar arch
5. Cephalic vein
6. Axillary vein
7. Radial nerve in the arm
8. Ulnar nerve
9. Median nerve
10. Extensor retinaculum
11. Flexor retinaculum

THORAX:

1. Internal thoracic (mammary) artery.
2. Ascending aorta, arch of aorta & descending thoracic aorta.
3. Superior vena cava.
4. Right & left brachiocephalic veins.
5. Thoracic duct.
6. Trachea with right & left principal bronchi.
7. Oesophagus.
8. Pleura- (Right & Left) - Anterior margin (C.M. line of reflection)
   Inferior margin (C.D line of reflection)
   Posterior margin
9. Lungs (Right & left)-Borders & fissures.
10. Heart-All borders.
11. Valves of heart.
12. Apex of heart.

HEAD & NECK:

BONY LANDMARKS: Bregma, Lambda, Nasion, Inion, Gonion, Glabella, Whitnall's tubercle, Pterion, Spine of 7th cervical Vertebra, Mastoid process, Head of mandible, Laryngeal prominence, Styloid process.

SURFACE MARKINGS:

1. Frontal sinus.
2. Facial artery and vein
3. Parotid gland and duct.
4. Thyroid gland
5. Middle meningeal artery
6. Spinal Accessory nerve

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7. Contents of carotid sheath-Carotid system of arteries, Internal jugular vein, Vagus nerve, Sympathetic chain.
8. Palatine tonsil.
9. External jugular vein.

BRAIN:

Course	Course Name	Course Outcome	
MBC101A	Anatomy 1 i)General Anatomy ii)Gross anatomy of Upper limb, Thorax, Head and Neck, Neuroanatomy, iii)General embryology and relevant Systemic embryology. iv)General histology and relevant Systemic histology. v)Attitude towards cadaver and communication skills	101A.1	Describe the basic structural and functional aspects of general anatomical tissues
		101A.2	Describe the anatomy, normal disposition, features, relations, functional, cross-sectional and radiological anatomy of upper limb, Thorax, Head & Neck and Neuroanatomy including bones of these regions.
		101A.3	DE demonstrate structures of upper limb, Thorax, Head & Neck, Neuroanatomy and bones of these regions and their surface anatomy.
		101A.4	Describe microscopic structure of general and relevant systemic Histology with their important functions.
		101A.5	Identify microscopic structure of general and relevant systemic Histology with their important functions.
		101A.6	Explain the principles & sequential development of general embryology and the relevant systemic Embryology and developmental basis of various major congenital anomalies.
		101A.7	demonstrate good attitude, ethical behaviour towards cadaver, fellow human beings and develop good communication skills.

Course Outcomes for Anatomy

At the end of the course, the students should be able to

1. Central sulcus.
2. Lateral sulcus.
3. Superior sagittal sinus

Course Content -Anatomy 1

1. General Anatomy
2. Gross anatomy of Upper limb, Thorax, Head and Neck, Neuroanatomy,
3. General embryology and relevant Systemic embryology.
4. General histology and relevant Systemic histology.
5. Attitude towards cadaver and communication skills

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CO -PO-PSO Mapping – Anatomy

Course Code and name	Course utcome	Program Outcomes					Program Specific Outcomes				
		PO1	PO2	PO3	PO4	PO5	PSO1	PS02	PSO3	PSO4	PSO5
MBC101 A Anatomy 1	101A.1	1	1				1			1	
	101A.2	3	3				3			1	
	101A.3	3	3	1			3		1	1	
	101A.4	3	3				3			1	
	101A.5	3	3	1			3		1	1	
	101A.6	3	3				3			1	
	101A.7			2	1	1					2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution											

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RECOMMENDED LIST OF TEXTBOOKS:

General Anatomy

(1) Text book of General Anatomy by Vishram Singh

OR

(2) General Anatomy by B.D.Chaurasia (by CBS Publishers)

Gross Anatomy

1) Anatomy of Upper Limb & Thorax (Vol I)
2) Anatomy of Lower Limb & Abdomen (Vol II)
3) Anatomy of Head & Neck (Vol III)
4) Anatomy of Brain (Neuroanatomy) (Vol IV)

By B.D.Chaurasia

OR

1) Anatomy of Upper Limb & Thorax (Vol I)
2) Anatomy of Lower Limb & Abdomen (Vol II)
3) Anatomy of Head, Neck
4) Text bood of Clinical Neuroanatomy

By Vishram Singh

(2) ATLAS OF GROSS ANATOMY: (for Practicals)

Netter Atlas of Human Anatomy

OR

Grants Atlas of Human Anatomy

Histology

Textbook of Human Histology (with color atlas) – By Yogesh Sontakke

OR

Text book of Histology – By I.B.Singh

diFiore's Atlas of Histology with functional correlations

Embryology

Textbook of Human Embryology – By Yogesh Sontakke

OR

Human Embryology – By Inderbir Singh

Clinical Anatomy

Snell's Clinical Anatomy

Keith and Moore's Clinical anatomy

Genetics:

Principals of Clinical Genetics – By Yogesh Sontakke

OR

Essentials of Genetics – By Renu Chauhan

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Other books

1. Selective anatomy – preparatory manual for undergraduates By Vishram singh (A Guide) – Vol. 1 & 2
2. Companion 10 years Question Bank of RGUHS Exams – By Singhi Yatiraj
3. Oxford's New Medical Dictionary (CBS)

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Course Specifications
Human Anatomy

Code- MBC102A

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Course Specifications

Course Title	Human Anatomy
Course Code	MBC102A
Course Type	Core Theory & Practical Course
Department	Anatomy
Faculty	Medicine

Introduction to Department:

The Human anatomy forms the basis of all medical sciences. A knowledge of human anatomy is essential for the comprehension of the physiological, biochemical and pathological mechanisms. Hence, a detailed anatomy curriculum is required as a foundation upon which the normal as well as the abnormal structure and functions can be explained.

The Department of Anatomy with experienced and competent faculty enable the learning of the students through a robust activity-based curriculum. The department is well equipped with modern infrastructure such as brightly lit dissection hall and histology practical lab. The **dissection hall** is well spaced and designed for small groups of students to dissect and study human anatomy specimens. It is well ventilated with good exhaust mechanism. The **histology practical lab** is designed for individual activity and has a capacity to accommodate around 100 students. Two large TV monitors are installed for better visualization of microscopic diagrams. The lab also has wall mounted microscopic pictures of various tissues to facilitate student learning. The anatomy museum is a part of the Central museum to promote integrated learning activities.

The teaching faculty of Anatomy are qualified and competent. They are trained to impart quality education. The faculty have excelled in recent advances, research and innovative teaching methodology. The department also promotes student research program to inculcate the basic research methodology concepts.

One of the best practices of the institution-**Voluntary body Donation program** coordinated by the department facilitates adequate cadaver resources for realistic visualization of human organ systems by the students.

This document provides the required guidelines to implement the CBME curriculum framed by National Medical Commission (NMC) for effective teaching-learning and evaluation of students.

Goal:

The main purpose of teaching anatomy is to enable the medical student with basic knowledge of various human anatomical structures and their relations to comprehend physiological mechanisms and correlate the anatomical basis with clinical conditions.

Objectives:

The student at the end of the course should be able to

Cognitive Domain:

1. Describe the anatomy of the basic tissues of the human body.
2. Enumerate the morphological features of various organs and relations with other structures.
3. Explain the attachment of muscles, nerve supply and action.
4. Describe the parts, relations and functions of the central nervous system.
5. Describe the morphological features of bones of the human body and their attachments
6. Explain the anatomical basis of various common clinical conditions and clinical procedures.
7. Describe the microscopic features of general and systemic tissues of the human body.

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8. Describe the development of organ systems of the human body.
9. Correlate the embryological basis of congenital anomalies/syndromes.
10. Integrate the gross and microscopic anatomy with the physiological mechanisms and biochemica reactions of human organ systems.
11. Describe the normal karyotype, abnormal chromosomal conditions, genetic mechanism of Inheritance Inborn errors of metabolism, teratogenesis and mutations.
12. Describe the prenatal diagnostic techniques, principles of genetic counseling and gene therapy.
13. Describe the principles of radiography and the advanced radiological techniques.

Psychomotor Domain:

1. Identify the gross anatomical features of organs.
2. Demonstrate the morphological features of organs and relations.
3. Demonstrate the surface marking of various organs and structures of the human body.
4. Discuss the microscopy of general and systemic tissues.
5. Identify the normal radiological and cross-sectional anatomy on Radiographs, Ultrasound, CT images anc MRI.
6. Identify the normal developmental processes and associated anomalous conditions in embryology models/charts

Affective Domain:

1. Demonstrate humane behaviour with mutual respect for each other - personal and professional.
2. Communicate effectively with teachers, technical staff, peers, patients during their learning activities.
3. Develop punctuality in attending academic sessions, submissions of records and assignments.
4. Demonstrate moral responsibility and accountability for their actions.
5. Demonstrate honesty and integrity in all learning activities.
6. Respect the cadaver as a teacher while handling the cadavers and specimens.
7. Discuss the professional qualities of a physician of first contact and his/her responsibilities

Course summary

Competencies in Anatomy				
No.	**Topic**	**Competencies**	**Core**	**Non-Core**
1	**General Anatomy**	35	22	13
2	**Gross Anatomy**			
A	Upper Limb	48	41	7
B	Thorax	29	25	4
C	Head and neck	68	44	24

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D	Neuroanatomy	28	24	4
3	**Histology**			
A	General Histology	19	15	4
B	Systemic Histology	07	06	01
4	**Embryology**			
A	General Embryology	27	23	4
B	Systemic Embryology	16	10	06
5	**Osteology**	23	17	06
6	**Genetics**	15	11	4
7	**Surface Anatomy**	11	9	02
8	**Radiology**	9	5	4
9	**Cross Sectional Anatomy**	2	2	0

General Anatomy

Sl. No.	Competency number	Competency
1	AN1.1	Demonstrate normal anatomical position, various planes, relation,comparison, laterality & movement in our body
2	AN1.2	Describe composition of bone and bone marrow
3	AN2.1	Describe parts, blood and nerve supply of a long bone
4	AN2.2	Enumerate laws of ossification
5	AN2.3	Enumerate special features of a sesamoid bone
6	AN2.4	Describe various types of cartilage with its structure & distribution in body
7	AN2.5	Describe various joints with subtypes and examples
8	AN2.6	Explain the concept of nerve supply of joints & Hilton's law
9	AN3.1	Classify muscle tissue according to structure & action
10	AN3.2	Enumerate parts of skeletal muscle and differentiate between A116tendons and aponeuroses with examples
11	AN3.3	Explain Shunt and spurt muscles
12	AN4.1	Describe different types of skin & dermatomes in body
13	AN4.2	Describe structure & function of skin with its appendages
14	AN4.3	Describe superficial fascia along with fat distribution in body
15	AN4.4	Describe modifications of deep fascia with its functions

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16	AN4.5	Explain principles of skin incisions
17	AN5.1	Differentiate between blood vascular and lymphatic system
18	AN5.2	Differentiate between pulmonary and systemic circulation
19	AN5.3	List general differences between arteries & veins
20	AN5.4	Explain functional difference between elastic, muscular arteries andarterioles
21	AN5.5	Describe portal system giving examples
22	AN5.6	Describe the concept of anastomoses and collateral circulation withsignificance of end-arteries
23	AN5.7	Explain function of meta-arterioles, precapillary sphincters, arterio-venousanastomoses
24	AN5.8	Define thrombosis, infarction & aneurysm
25	AN6.1	List the components and functions of the lymphatic system
26	AN6.2	Describe structure of lymph capillaries & mechanism of lymph circulation
27	AN6.3	Explain the concept of lymphoedema and spread of tumors via lymphaticsand venous system
28	AN7.1	Describe general plan of nervous system with components of central,peripheral & autonomic nervous systems
29	AN7.2	List components of nervous tissue and their functions
30	AN7.3	Describe parts of a neuron and classify them based on number of neurites,size & function
31	AN7.4	Describe structure of a typical spinal nerve
32	AN7.5	Describe principles of sensory and motor innervation of muscles
33	AN7.6	Describe concept of loss of innervation of a muscle with its appliedanatomy
34	AN7.7	Describe various type of synapse
35	AN7.8	Describe differences between sympathetic and spinal ganglia

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Gross Anatomy-Upper Limb

Sl. No.	Competency number	Competency
1	AN9.1	Describe attachment, nerve supply & action of pectoralis major and pectoralis minor
2	AN9.2	Breast: Describe the location, extent, deep relations, structure, age changes, blood supply, lymphatic drainage, microanatomy and applied anatomy of breast
3	AN10.1	Identify & describe boundaries and contents of axilla
4	AN10.2	Identify, describe and demonstrate the origin, extent, course, parts, relations and branches of axillary artery & tributaries of vein
5	AN10.3	Describe, identify and demonstrate formation, branches, relations, area ofsupply of branches, course and relations of terminal branches of brachial plexus
6	AN10.4	Describe the anatomical groups of axillary lymph nodes and specify theirareas of drainage
7	AN10.5	Explain variations in formation of brachial plexus
8	AN10.6	Explain the anatomical basis of clinical features of Erb's palsy and Klumpke's paralysis
9	AN10.7	Explain anatomical basis of enlarged axillary lymph nodes
10	AN10.8	Describe, identify and demonstrate the position, attachment, nerve supply and actions of trapezius and latissimus dorsi
11	AN10.9	Describe the arterial anastomosis around the scapula and mention the boundaries of triangle of auscultation
12	AN10.10	Describe and identify the deltoid and rotator cuff muscles
13	AN10.11	Describe & demonstrate attachment of serratus anterior with its action
14	AN10.12	Describe and demonstrate shoulder joint for– type, articular surfaces, capsule, synovialmembrane, ligaments, relations, movements, muscles involved, blood supply, nerve supply and applied anatomy
15	AN10.13	Explain anatomical basis of Injury to axillary nerve during intramuscular injections
16	AN11.1	Describe and demonstrate muscle groups of upper arm with emphasis onbiceps and triceps brachii
17	AN11.2	Identify & describe origin, course, relations, branches (or tributaries), termination of important nerves and vessels in arm
18	AN11.3	Describe the anatomical basis of Venepuncture of cubital veins
19	AN11.4	Describe the anatomical basis of Saturday night paralysis
20	AN11.5	Identify & describe boundaries and contents of cubital fossa
21	AN11.6	Describe the anastomosis around the elbow joint
22	AN12.1	Describe and demonstrate important muscle groups of ventral forearm with attachments, nerve supply and actions
23	AN12.2	Identify & describe origin, course, relations, branches (or tributaries), termination of important nerves and vessels of forearm

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24	AN12.3	Identify & describe flexor retinaculum with its attachments
25	AN12.4	Explain anatomical basis of carpal tunnel syndrome
26	AN12.5	Identify & describe small muscles of hand. Also describe movements of thumb and muscles involved
27	AN12.6	Describe & demonstrate movements of thumb and muscles involved
28	AN12.7	Identify & describe course and branches of important blood vessels and nerves in hand
29	AN12.8	Describe anatomical basis of Claw hand
30	AN12.9	Identify & describe fibrous flexor sheaths, ulnar bursa, radial bursa and digital synovial sheaths
31	AN12.10	Explain infection of fascial spaces of palm
32	AN12.11	Identify, describe and demonstrate important muscle groups of dorsal forearm with attachments, nerve supply and actions
33	AN12.12	Identify & describe origin, course, relations, branches (or tributaries), termination of important nerves and vessels of back of forearm
34	AN12.13	Describe the anatomical basis of Wrist drop
35	AN12.14	Identify & describe compartments deep to extensor retinaculum
36	AN12.15	Identify & describe extensor expansion formation
37	AN13.1	Describe and explain Fascia of upper limb and compartments, veins of upper limb and its lymphatic drainage
38	AN13.2	Describe dermatomes of upper limb
39	AN13.3	Identify & describe the type, articular surfaces, capsule, synovial membrane, ligaments, relations, movements, blood and nerve supply of elbow joint, proximal and distal radio-ulnar joints, wrist joint & first carpometacarpal joint
40	AN13.4	Describe Sternoclavicular joint, Acromioclavicular joint, Carpometacarpal joints & Metacarpophalangeal joint

Gross Anatomy - Thorax

Sl. No.	Competency number	Competency
1	AN21.3	Describe & demonstrate the boundaries of thoracic inlet, cavity and outlet
2	AN21.4	Describe & demonstrate extent, attachments, direction of fibres, nervesupply and actions of intercostal muscles
3	AN21.5	Describe & demonstrate origin, course, relations and branches of a typicalintercostal nerve
4	AN21.6	Mention origin, course and branches/ tributaries of: 2) anterior & posterior intercostal vesselsinternal thoracic vessels
5	AN21.7	Mention the origin, course, relations and branches of 2) atypical intercostal nervesuperior intercostal artery, subcostal artery

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6	AN21.8	Describe & demonstrate type, articular surfaces & movements of manubriosternal, costovertebral, costotransverse and xiphisternal joints
7	AN21.9	Describe & demonstrate mechanics and types of respiration
8	AN21.10	Describe costochondral and interchondral joints
9	AN21.11	Mention boundaries and contents of the superior, anterior, middle andposterior mediastinum
10	AN22.1	Describe & demonstrate subdivisions, sinuses in pericardium, blood supplyand nerve supply of pericardium
11	AN22.2	Describe & demonstrate external and internal features of each chamber ofheart
12	AN22.3	Describe & demonstrate origin, course and branches of coronary arteries
13	AN22.4	Describe anatomical basis of ischaemic heart disease
14	AN22.5	Describe & demonstrate the formation, course, tributaries and terminationof coronary sinus
15	AN22.6	Describe the fibrous skeleton of heart
16	AN22.7	Mention the parts, position and arterial supply of the conducting system ofheart
17	AN23.1	Describe & demonstrate the external appearance, relations, blood supply,nerve supply,lymphatic drainage and applied anatomy of oesophagus
18	AN23.2	Describe & demonstrate the extent, relations tributaries of thoracic ductand enumerate its applied anatomy
19	AN23.3	Describe & demonstrate origin, course, relations, tributaries and termination of superior venacava, azygos, hemiazygos and accessory hemiazygos veins
20	AN23.4	Mention the extent, branches and relations of arch of aorta & descendingthoracic aorta
21	AN23.5	Identify & Mention the location and extent of thoracic sympathetic chain
22	AN23.6	Describe the splanchnic nerves
23	AN23.7	Mention the extent, relations and applied anatomy of lymphatic duct
24	AN24.1	Mention the blood supply, lymphatic drainage and nerve supply of pleura,extent of pleura and describe the pleural recesses and their applied anatomy
25	AN24.2	Identify side, external features and relations of structures which form rootof lung & bronchial tree and their clinical correlate
26	AN24.3	Describe a bronchopulmonary segment
27	AN24.4	Identify phrenic nerve & describe its formation & distribution
28	AN24.5	Mention the blood supply, lymphatic drainage and nerve supply of lungs
29	AN24.6	Describe the extent, length, relations, blood supply, lymphatic drainageand nerve supply of trachea

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Gross Anatomy- Head and Neck

Sl. No.	Competency number	Competency
1	AN27.1	Describe the layers of scalp, its blood supply, its nerve supply and surgicalimportance
2	AN27.2	Describe emissary veins with its role in spread of infection from extracranial route to intracranial venous sinuses
3	AN28.1	Describe & demonstrate muscles of facial expression and their nerve supply
4	AN28.2	Describe sensory innervation of face
5	AN28.3	Describe & demonstrate origin /formation, course, branches /tributaries offacial vessels
6	AN28.4	Describe & demonstrate branches of facial nerve with distribution
7	AN28.5	Describe cervical lymph nodes and lymphatic drainage of head, face andneck
8	AN28.6	Identify superficial muscles of face, their nerve supply and actions
9	AN28.7	Explain the anatomical basis of facial nerve palsy
10	AN28.8	Explain surgical importance of deep facial vein
11	AN28.9	Describe & demonstrate the parts, borders, surfaces, contents, relationsand nerve supply of parotid gland with course of its duct and surgical importance
12	AN28.10	Explain the anatomical basis of Frey's syndrome
13	AN29.1	Describe & demonstrate attachments, nerve supply, relations and actionsof sternocleidomastoid
14	AN29.2	Explain anatomical basis of Erb's & Klumpke's palsy
15	AN29.3	Explain anatomical basis of wry neck
16	AN29.4	Describe & demonstrate attachments of 1) inferior belly of omohyoid, 2)scalenus anterior, 3) scalenus medius & 4) levator scapulae
17	AN30.1	Describe the cranial fossae & identify related structures
18	AN30.2	Describe & identify major foramina with structures passing through them
19	AN30.3	Describe & identify dural folds & dural venous sinuses
20	AN30.4	Describe clinical importance of dural venous sinuses
21	AN30.5	Explain effect of pituitary tumours on visual pathway
22	AN31.1	Describe & identify extra ocular muscles of eyeball
23	AN31.2	Describe & demonstrate nerves and vessels in the orbit
24	AN31.3	Describe anatomical basis of Horner's syndrome
25	AN31.4	Enumerate components of lacrimal apparatus
26	AN31.5	Explain the anatomical basis of oculomotor, trochlear and abducent nervepalsies along with strabismus
27	AN32.1	Describe boundaries and subdivisions of anterior triangle

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28	AN32.2	Describe & demonstrate boundaries and contents of muscular, carotid, digastric and submental triangles
29	AN33.1	Describe & demonstrate extent, boundaries and contents of temporal andinfratemporal fossae
30	AN33.2	Describe & demonstrate attachments, direction of fibres, nerve supply andactions of muscles of mastication
31	AN33.3	Describe & demonstrate articulating surface, type & movements of temporomandibular joint
32	AN33.4	Explain the clinical significance of pterygoid venous plexus
33	AN33.5	Describe the features of dislocation of temporomandibular joint
34	AN34.1	Describe & demonstrate the morphology, relations and nerve supply of submandibular salivary gland & submandibular ganglion
35	AN34.2	Describe the basis of formation of submandibular stones
36	AN35.1	Describe the parts, extent, attachments, modifications of deep cervical fascia
37	AN35.2	Describe & demonstrate location, parts, borders, surfaces, relations & blood supply of thyroid gland
38	AN35.3	Demonstrate & describe the origin, parts, course & branches subclavianartery
39	AN35.4	Describe & demonstrate origin, course, relations, tributaries and termination of internal jugular & brachiocephalic veins
40	AN35.5	Describe and demonstrate extent, drainage & applied anatomy of cervicallymph nodes
41	AN35.6	Describe and demonstrate the extent, formation, relation & branches ofcervical sympathetic chain
42	AN35.7	Describe the course and branches of IX, X, XI & XII nerve in the neck
43	AN35.8	Describe the anatomically relevant clinical features of Thyroid swellings
44	AN35.9	Describe the clinical features of compression of subclavian artery and lower trunk of brachial plexus by cervical rib
45	AN35.10	Describe the fascial spaces of neck
46	AN36.1	Describe the 1) morphology, relations, blood supply and applied anatomyof palatine tonsil 2) composition of soft palate
47	AN36.2	Describe the components and functions of Waldeyer's lymphatic ring
48	AN36.3	Describe the boundaries and clinical significance of pyriform fossa
49	AN36.4	Describe the anatomical basis of tonsillitis, tonsillectomy, adenoids and peri-tonsillar abscess
50	AN36.5	Describe the clinical significance of Killian's dehiscence
51	AN37.1	Describe & demonstrate features of nasal septum, lateral wall of nose, their blood supply and nerve supply
52	AN37.2	Describe location and functional anatomy of paranasal sinuses
53	AN37.3	Describe anatomical basis of sinusitis & maxillary sinus tumours
54	AN38.1	Describe the morphology, identify structure of the wall, nerve supply, blood supply and actions of intrinsic and extrinsic muscles of the larynx
55	AN38.2	Describe the anatomical aspects of laryngitis

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56	AN38.3	Describe anatomical basis of recurrent laryngeal nerve injury
57	AN39.1	Describe & demonstrate the morphology, nerve supply, embryological basis of nerve supply, blood supply, lymphatic drainage and actions of extrinsic and intrinsic muscles of tongue
58	AN39.2	Explain the anatomical basis of hypoglossal nerve palsy
59	AN40.1	Describe & identify the parts, blood supply and nerve supply of externalear
60	AN40.2	Describe & demonstrate the boundaries, contents, relations and functional anatomy of middle ear and auditory tube
61	AN40.3	Describe the features of internal ear
62	AN40.4	Explain anatomical basis of otitis externa and otitis media
63	AN40.5	Explain anatomical basis of myringotomy
64	AN41.1	Describe & demonstrate parts and layers of eyeball
65	AN41.2	Describe the anatomical aspects of cataract, glaucoma & central retinal artery occlusion
66	AN41.3	Describe the position, nerve supply and actions of intraocular muscles
67	AN42.1	Describe the contents of the vertebral canal
68	AN42.2	Describe & demonstrate the boundaries and contents of Suboccipital triangle
69	AN42.3	Describe the position, direction of fibres, relations, nerve supply, actions ofsemispinalis capitis and splenius capitis
70	AN43.1	cribe & demonstrate the movements with muscles producing the movements of atlantooccipital joint & atlantoaxial joint

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Neuroanatomy

Sl. No.	Competency number	Competency
1	AN 56.1	Describe & identify various layers of meninges with its extent & modifications
2	AN 56.2	Describe circulation of CSF with its applied anatomy
3	AN 57.1	Identify external features of spinal cord
4	AN 57.2	Describe extent of spinal cord in child & adult with its clinical implication
5	AN 57.3	Draw & label transverse section of spinal cord at mid-cervical & midthoracic level
6	AN 57.4	Enumerate ascending & descending tracts at mid thoracic level of spinal cord
7	AN 57.5	Describe anatomical basis of syringomyelia
8	AN 58.1	Identify external features of medulla oblongata
9	AN 58.2	Describe transverse section of medulla oblongata at the level of 1) pyramidal decussation, 2) sensory decussation 3) ION
10	AN 58.3	Enumerate cranial nerve nuclei in medulla oblongata with their functional group
11	AN 58.4	Describe anatomical basis & effects of medial & lateral medullary syndrome
12	AN 59.1	Identify external features of pons
13	AN 59.2	Draw & label transverse section of pons at the upper and lower level
14	AN 59.3	Enumerate cranial nerve nuclei in pons with their functional group
15	AN 60.1	Describe & demonstrate external & internal features of cerebellum
16	AN 60.2	Describe connections of cerebellar cortex and intracerebellar nuclei
17	AN 60.3	Describe anatomical basis of cerebellar dysfunction
18	AN 61.1	Identify external & internal features of midbrain
19	AN 61.2	Describe internal features of midbrain at the level of superior & inferior colliculus
20	AN 61.3	Describe anatomical basis & effects of Benedikt's and Weber's syndrome
21	AN 62.1	Enumerate cranial nerve nuclei with its functional component
22	AN 62.2	Describe & demonstrate surfaces, sulci, gyri, poles, & functional areas of cerebral hemisphere
23	AN 62.3	Describe the white matter of cerebrum
24	AN 62.4	Enumerate parts & major connections of basal ganglia & limbic lobe
25	AN 62.5	Describe boundaries, parts, gross relations, major nuclei and connections of dorsal thalamus, hypothalamus, epithalamus, metathalamus and subthalamus
26	AN 62.6	Describe & identify formation, branches & major areas of distribution of circle of Willis
27	AN 63.1	Describe & demonstrate parts, boundaries & features of IIIrd, IVth & lateral ventricle
28	AN 63.2	Describe anatomical basis of congenital hydrocephalus

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General Histology

Sl. No.	Competency number	Competency
1	AN 65.1	Identify epithelium under the microscope & describe the various types that correlate to its function
2	AN 65.2	Describe the ultrastructure of epithelium
3	AN 66.1	Describe & identify various types of connective tissue with functional correlation
4	AN 66.2	Describe the ultrastructure of connective tissue
5	AN 67.1	Describe & identify various types of muscle under the microscope
6	AN 67.2	Classify muscle and describe the structure-function correlation of the same
7	AN 67.3	Describe the ultrastructure of muscular tissue
8	AN 68.1	Describe & Identify multipolar & unipolar neuron, ganglia, peripheral nerve
9	AN 68.2	Describe the structure-function correlation of neuron
10	AN 68.3	Describe the ultrastructure of nervous tissue
11	AN 69.1	Identify elastic & muscular blood vessels, capillaries under the microscope
12	AN 69.2	Describe the various types and structure-function correlation of blood vessel
13	AN 69.3	Describe the ultrastructure of blood vessels
14	AN 70.1	Identify exocrine gland under the microscope & distinguish between serous, mucous and mixed acini
15	AN 70.2	Identify the lymphoid tissue under the microscope & describe microanatomy of lymph node, spleen, thymus, tonsil and correlate the structure with function
16	AN 71.1	Identify bone under the microscope; classify various types and describe the structure-function correlation of the same
17	AN 71.2	Identify cartilage under the microscope & describe various types and structure- function correlation of the same
18	AN 72.1	Identify the skin and its appendages under the microscope and correlate the structure with function
19	AN 52.2	Placenta & Umbilical cord

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Systemic Histology

Sl. No.	Competency number	Competency
1	AN 25.1	Identify, draw and label a slide of trachea and lung
2	AN 43.2	Identify, describe and draw the microanatomy of pituitary gland, thyroid, parathyroid gland, tongue, salivary glands, tonsil, epiglottis, cornea, retina
3	AN 43.3	Identify, describe and draw microanatomy of olfactory epithelium, eyelid, lip, sclero-corneal junction, optic nerve
4	AN 52.1	Describe & identify the microanatomical features of Gastro-intestinal system: Oesophagus, Fundus of stomach, Pylorus of stomach, Duodenum, Jejunum, Ileum, Large intestine, Appendix, Liver, Gall bladder, Pancreas & Suprarenal gland
5	AN 52.2	Describe & identify the micro anatomical features of: Urinary system: Kidney, Ureter & Urinary bladder Male Reproductive System: Testis, Epididymis,Vas deferens, Prostate. Female reproductive system: Ovary, Uterus, Uterine tube, Cervix,.
6	AN 52.3	Describe & identify the microanatomical features of Cardiooesophageal junction, Corpus luteum
7	AN 64.1	Describe & identify the microanatomical features of Spinal cord, Cerebellum & Cerebrum

General Embryology

Sl. No.	Competency number	Competency
1	AN76.1	Describe the stages of human life
2	AN76.2	Explain the terms- phylogeny, ontogeny, trimester, viability
3	AN77.1	Describe the uterine changes occurring during the menstrual cycle
4	AN77.2	Describe the synchrony between the ovarian and menstrual cycles
5	AN77.3	Describe spermatogenesis and oogenesis along with diagrams
6	AN77.4	Describe the stages and consequences of fertilisation
7	AN77.5	Enumerate and describe the anatomical principles underlying contraception
8	AN78.1	Describe cleavage and formation of blastocyst
9	AN78.2	Describe the development of trophoblast
10	AN78.3	Describe the process of implantation & common abnormal sites ofimplantation
11	AN78.4	Describe the formation of extra-embryonic mesoderm and coelom,bilaminar disc and prochordal plate

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12	AN78.5	Describe in brief abortion; decidual reaction, pregnancy test
13	AN79.1	Describe the formation & fate of the primitive streak
14	AN79.2	Describe formation & fate of notochord
15	AN79.3	Describe the process of neurulation
16	AN79.4	Describe the development of somites and intra-embryonic coelom
17	AN79.5	Explain embryological basis of congenital malformations, nucleuspulposus, sacrococcygeal teratomas, neural tube defects
18	AN79.6	Describe the diagnosis of pregnancy in first trimester and role of teratogens, alpha-fetoprotein
19	AN77.6	Describe teratogenic influences; fertility and sterility, surrogate motherhood, social significance of "sex-ratio".
20	AN 80.1	Describe formation, functions & fate of-chorion: amnion; yolk sac; allantois& decidua
21	AN 80.2	Describe formation & structure of umbilical cord
22	AN 80.3	Describe formation of placenta, its physiological functions, foetomaternal circulation & placental barrier
23	AN 80.4	Describe embryological basis of twinning in monozygotic & dizygotic twins
24	AN 80.5	Describe role of placental hormones in uterine growth & parturition
25	AN 80.6	Explain embryological basis of estimation of fetal age.
26	AN 80.7	Describe various types of umbilical cord attachments

Systemic Embryology

Sl. No.	Competency number	Competency
1	AN 9.3	Describe development of breast
2	AN 13.8	Describe development of upper limb
3	AN 20.10	Describe basic concept of development of lower limb
	AN 25.2	Describe development of pleura, lung & heart
4	AN 25.4	Describe embryological basis of: 1) atrial septal defect, 2) ventricular septal defect, 3) Fallot's tetralogy & 4) tracheo-oesophageal fistula
5	AN 25.5	Describe developmental basis of congenital anomalies, transposition of great vessels, dextrocardia, patent ductus arteriosus and coarctation of aorta
6	AN 25.6	Mention development of aortic arch arteries, SVC, IVC and coronary sinus
7	AN 43.4	Describe the development and developmental basis of congenital anomalies of face, palate, tongue, branchial apparatus, pituitary gland, thyroid gland & eye
8	AN 52.4	Describe the development of anterior abdominal wall
9	AN 52.5	Describe the development and congenital anomalies of Diaphragm
10	AN 52.6	Describe the development and congenital anomalies of: Foregut, Midgut & Hindgut
11	AN 52.7	Describe the development of Urinary system
12	AN 52.8	Describe the development of male & female reproductive system
13	AN 64.2	Describe the development of neural tube, spinal cord, medulla oblongata, pons, midbrain, cerebral hemisphere & cerebellum
14	AN 64.3	Describe various types of open neural tube defects with its embryological basis

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Osteology:

Sl. No.	Competency number	Competency
1	AN8.1	Identify the given bone, its side, important features & keep it in anatomical position
2	AN8.2	Identify & describe joints formed by the given bone
3	AN8.3	Enumerate peculiarities of clavicle
4	AN8.4	Demonstrate important muscle attachment on the given bone
5	AN8.5	Identify and name various bones in articulated hand, Specify the parts of metacarpals and phalanges and enumerate the peculiarities of pisiform
6	AN8.6	Describe scaphoid fracture and explain the anatomical basis of avascular necrosis
7	AN14.1	Identify the given bone, its side, important features & keep it in anatomical position
8	AN14.2	Identify & describe joints formed by the given bone
9	AN14.3	Describe the importance of ossification of lower end of femur & upper endof tibia
10	AN14.4	Identify and name various bones in the articulated foot with individualmuscle attachment
11	AN21.1	Identify and describe the salient features of sternum, typical rib, 1st rib andtypical thoracic vertebra
12	AN21.2	Identify & describe the features of 2nd, 11th and 12th ribs, 1st, 11th and 12ththoracic vertebrae
13	AN21.3	Describe & demonstrate the boundaries of thoracic inlet, cavity and outlet
14	AN26.1	Demonstrate anatomical position of skull, Identify and locate individualskull bones in skull
15	AN26.2	Describe the features of norma frontalis, verticalis, occipitalis, lateralis andbasalis
16	AN26.3	Describe cranial cavity, its subdivisions, foramina and structures passingthrough them
17	AN26.4	Describe morphological features of mandible
18	AN26.5	Describe features of typical and atypical cervical vertebrae (atlas and axis)
19	AN26.6	Explain the concept of bones that ossify in membrane
20	AN26.7	Describe the features of the 7th cervical vertebra
21	AN53.2	Demonstrate the anatomical position of bony pelvis & show boundaries ofpelvic inlet, pelvic cavity, pelvic outlet
22	AN53.3	Define true pelvis and false pelvis and demonstrate sex determination inmale & female bony pelvis
23	AN53.4	Explain and demonstrate clinical importance of bones of abdominopelvicregion (sacralization of lumbar vertebra, Lumbarization of 1st sacral vertebra, types of bony pelvis & Coccyx)

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Genetics

Sl. No.	Competency number	Competency
1	AN73.1	Describe the structure of chromosomes with classification
2	AN73.2	Describe technique of karyotyping with its applications
3	AN73.3	Describe the Lyon's hypothesis
4	AN74.1	Describe the various modes of inheritance with examples
5	AN74.2	Draw pedigree charts for the various types of inheritance & give examples of diseases of each mode of inheritance
6	AN74.3	Describe multifactorial inheritance with examples
7	AN74.4	Describe the genetic basis & clinical features of Achondroplasia, Cystic Fibrosis, Vitamin D resistant rickets, Haemophilia, Duchene's muscular dystrophy & Sickle cell anaemia
8	AN75.1	Describe the structural and numerical chromosomal aberrations
9	AN75.2	Explain the terms mosaics and chimeras with example
10	AN75.3	Describe the genetic basis & clinical features of Prader Willi syndrome, Edward syndrome & Patau syndrome
11	AN75.4	Describe genetic basis of variation: polymorphism and mutation
12	AN75.5	Describe the principles of genetic counselling
13	AN81.1	Describe various methods of prenatal diagnosis
14	AN81.2	Describe indications, process and disadvantages of amniocentesis
15	AN81.3	Describe indications, process and disadvantages of chorion villus biopsy

Surface Anatomy

Sl. No.	Competency number	Competency
1	AN 13.6	Identify & demonstrate important bony landmarks of upper limb: Jugular notch, sternal angle, acromial angle, spine of the scapula, vertebral level of the medial end, Inferior angle of the scapula
2	AN 13.7	Identify & demonstrate surface projection of: Cephalic and basilic vein, Palpation of Brachial artery, Radial artery, Testing of muscles: Trapezius, pectoralis major, serratus anterior, latissimus dorsi, deltoid, biceps brachii, Brachioradialis

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3	AN 20.7	Identify & demonstrate important bony landmarks of lower limb: -Vertebral levels of highest point of iliac crest, posterior superior iliac spines, iliac tubercle, pubic tubercle, ischial tuberosity, adductor tubercle, Tibial tuberosity, head of fibula, Medial and lateral malleoli, Condyles of femur and tibia, sustentaculum tali, tuberosity of fifth metatarsal, tuberosity of the navicular
4	AN 20.8	Identify & demonstrate palpation of femoral, popliteal, post tibial, anti tibial & dorsalis pedis blood vessels in a simulated environment
5	AN 20.9	Identify & demonstrate Palpation of vessels (femoral, popliteal,dorsalis pedis,post tibial), Mid inguinal point, Surface projection of: femoral nerve, Saphenous opening, Sciatic, tibial, common peroneal & deep peroneal nerve, Great and small saphenous veins
6	AN 25.9	Demonstrate surface marking of lines of pleural reflection, lung borders and fissures, trachea, heart borders, apex beat & surface projection of valves of heart
7	AN 43.5	Demonstrate- Palpation of carotid arteries, facial artery, superficial temporal artery, 3) Location of internal and external jugular veins, 4) Location of hyoid bone, thyroid cartilage and cricoid cartilage with their vertebral levels
8	AN 43.6	Demonstrate surface projection of- Thyroid gland, Parotid gland and duct, Pterion, Common carotid artery, Internal jugular vein, Subclavian vein, External jugular vein, Facial artery in the face & accessory nerve
9	AN 44.1	Describe & demonstrate the Planes (transpyloric, transtubercular, subcostal, lateral vertical, linea alba, linea semilunaris), regions & Quadrants of abdomen
10	AN 55.1	Demonstrate the surface marking of; Regions and planes of abdomen, Superficial inguinal ring, Deep inguinal ring , McBurney's point, Renal Angle & Murphy's point
11	AN 55.2	Demonstrate the surface projections of: Stomach, Liver, Fundus of gall bladder, Spleen, Duodenum, Pancreas, Ileocaecal junction, Kidneys & Root of mesentery

Radiology

Sl. No.	Competency number	Competency
1	AN 13.5	Identify the bones and joints of upper limb seen in anteroposterior and lateral view radiographs of shoulder region, arm, elbow, forearm and hand
2	AN 20.6	Identify the bones and joints of lower limb seen in anteroposterior and lateral view radiographs of various regions of lower limb
3	AN 25.7	Identify structures seen on a plain x-ray chest (PA view)
4	AN 25.8	Identify and describe in brief a barium swallow
5	AN 43.7	Identify the anatomical structures in 1) Plain x-ray skull, 2) AP view and lateral view 3) Plain x-ray cervical spine-AP and lateral view 4) Plain x ray of paranasal sinuses
6	AN 43.8	Describe the anatomical route used for carotid angiogram and vertebral

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		angiogram
7	AN 43.9	Identify anatomical structures in carotid angiogram and vertebral angiogram
8	AN 54.1	Describe & identify features of plain X ray abdomen
9	AN 54.2	Identify features of plain X ray abdomen
10	AN 54.2	Describe & identify the special radiographs of abdominopelvic region (contrast X ray Barium swallow, Barium meal, Barium enema, Cholecystography, Intravenous pyelography & Hysterosalpingography)
11	AN 54.3	Identify the special radiographs of abdominopelvic region (contrast X ray Barium swallow, Barium meal, Barium enema, Cholecystography, Intravenous pyelography & Hysterosalpingography
12	AN 54.3	Describe role of ERCP, CT abdomen, MRI, Arteriography in radiodiagnosis of abdomen

AETCOM – 12 Hours

Sl. No.	Competency number	Competency
1	AN 82.1	Demonstrate respect and follow the correct procedure when handling cadavers and other biologic tissue
2	----	Enumerate and describe professional qualities and roles of a physician
3	----	Describe and discuss the commitment to lifelong learning as an important part of physician growth.
4	----	Describe and discuss the role of a physician in health care system
5	-----	Identify and discuss physician's role and responsibility to society and the community that she/ he serves

INTEGRATION TOPICS

PHYSIOLOGY

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	PY3.1	Describe the structure and functions of a neuron and neuroglia; Discuss Nerve Growth Factor & other growth factors/cytokines		Human Anatomy
2	PY3.7	Describe the different types of muscle fibres and their structure		Human Anatomy
3	PY3.13	Describe muscular dystrophy: myopathies	Gen. Medicine	Human Anatomy
4	PY4.1	Describe the structure and functions of digestive system		Human Anatomy

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5	PY5.1	Describe the functional Anatomy of heart including chambers, sounds; and Pacemaker tissue and conducting system.		Human Anatomy
6	PY5.6	Describe abnormal ECG, arrythmias, heart block and myocardial Infarction	Gen. Medicine	Human Anatomy
7	PY9.1	Describe and discuss sex determination; sex differentiation and their abnormities and outline psychiatry and practical implication of sex determination.		Human Anatomy
8	PY10.1	Describe and discuss the organization of nervous system		Human Anatomy
9	PY10.2	Describe and discuss the functions and properties of synapse, reflex, receptors		Human Anatomy
10	PY10.3	Describe and discuss somatic sensations & sensory tracts		Human Anatomy
11	PY10.4	Describe and discuss motor tracts, mechanism of maintenance of tone, control of body movements, posture and equilibrium & vestibular apparatus		Human Anatomy
12	PY10.5	Describe and discuss structure and functions of reticular activating system, autonomic nervous system (ANS)		Human Anatomy
13	PY10.6	Describe and discuss Spinal cord, its functions, lesion & sensory disturbances		Human Anatomy
14	PY10.7	Describe and discuss functions of cerebral cortex, basal ganglia, thalamus, hypothalamus, cerebellum and limbic system and their abnormalities	Psychiatry	Human Anatomy

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15	PY10.11	Demonstrate the correct clinical examination of the nervous system: Higher functions, Sensory system, motor Human Anatomy system, reflexes, Cranial Nerves in a normal volunteer or simulated environment		Human Anatomy

BIOCHEMISTRY

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	BI6.13	Describe the functions of the kidney, liver, thyroid and adrenal glands	Pathology, General Medicine	Physiology, Human Anatomy
2	BI6.14	Describe the tests that are commonly done in clinical practice to assess the functions of these organs (kidney, liver, thyroid and adrenal glands).	Pathology, General Medicine	Physiology, Human Anatomy
3	BI6.15	Describe the abnormalities of kidney, liver, thyroid and adrenal glands	Pathology, General Medicine	Physiology, Human Anatomy

PATHOLOGY

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	PA28.10	Describe the etiology, pathogenesis, pathology, laboratory findings, distinguishing features progression and complications of acute and chronic pyelonephritis and reflux nephropathy	Human Anatomy, General Surgery	

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2	PA31.1	Classify and describe the types, etiology, pathogenesis, pathology and hormonal dependency of benign breast disease	Human Anatomy, General Surgery	
3	PA32.1	Enumerate, classify and describe the etiology, pathogenesis, pathology and iodine dependency of thyroid swellings	Human Anatomy Physiology, General Medicine, General Surgery	
4	PA32.9	Describe the etiology, pathogenesis, manifestations, laboratory and morphologic features of adrenal neoplasms	Human Anatomy, Physiology, General Medicine, General Surgery	
5	PA33.1	Classify and describe the etiology, pathogenesis, manifestations, radiologic and morphologic features and complications of osteomyelitis	Human Anatomy, Orthopedics	Microbiology

FORENSIC MEDICINE & TOXICOLOGY

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	FM2.28	Describe and discuss signs of intrauterine death, signs of live birth, viability of foetus, age determination of foetus, DOAP session of ossification centres, Hydrostatic test, Sudden infants death syndrome and Munchausen's syndrome by proxy.	Pediatrics, Human Anatomy	

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2	FM3.1	Identification, Define and describe Corpus Delicti, establishment of identity of living persons including race, Sex, religion, complexion, stature, age determination using morphology, teeth-eruption, decay, bite marks, bones, ossification centres, medico-legal aspects of age.	Human Anatomy	

ANESTHESIOLOGY

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	AS4.2	Describe the Anatomy of the airway and its implications for general anaesthesia	Human Anatomy	
2	AS5.2	Describe the correlative Anatomy of the brachial plexus, subarachnoid and epidural spaces	Human Anatomy	
3	AS5.3	Observe and describe the principles and steps/ techniques involved in peripheral nerve blocks	Human Anatomy	
4	AS8.1	Describe the anatomical correlates and physiologic principles of pain	Human Anatomy, Physiology	

ENT

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	EN1.1	Describe the Human Anatomy & physiology of ear, nose, throat, head & neck.	Human Anatomy	

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OPHTHALMOLOGY

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	OP2.1	Enumerate the causes, describe and discuss the aetiology, clinical presentations and diagnostic features of common conditions of the lid and adnexa including Hordeolum externum/ internum, blepharitis, preseptal cellulitis, dacryocystitis, hemangioma, dermoid, ptosis, entropion, lid lag, lagopthalmos		Human Anatomy
2	OP4.1	Enumerate describe and discuss the types and causes of corneal ulceration		Human Anatomy
3	OP7.1	Describe the surgical anatomy and the metabolism of the lens	Biochemistry, Human Anatomy	
4	OP8.1	Discuss the aetiology, pathology, clinical features and management of vascular occlusions of the retina	Human Anatomy, Pathology	

DENTISTRY

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	DE1.1	Enumerate the parts of the tooth	Human Anatomy	
2	DE5.1	Enumerate the parts of the tooth and supporting structures	Human Anatomy	

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GENERAL MEDICINE

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	IM3.1	Define discuss describe and distinguish community acquired pneumonia, nosocomial pneumonia and aspiration pneumonia	Human Anatomy, Pathology, Microbiology	
2	IM13.9	Demonstrate in a mannequin the correct technique for performing breast exam, rectal examination and cervical examination and pap smear	Human Anatomy	General Surgery
3	IM17.1	Define and classify headache and describe the presenting features, precipitating factors, aggravating and relieving factors of various kinds of headache	Human Anatomy	
4	IM18.1	Describe the functional and the vascular anatomy of the brain	Human Anatomy	
5	IM19.1	Describe the functional anatomy of the locomotor system of the brain	Human Anatomy, Physiology	

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OBG

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	OG2.1	Describe and discuss the development and anatomy of the female reproductive tract, relationship to other pelvic organs, applied anatomy as related to Obstetrics and Gynaecology.	Human Anatomy	
2	OG4.1	Describe and discuss the basic embryology of fetus , factors influencing fetal growth and development, anatomy and physiology of placenta, and teratogenesis	Human Anatomy	
3	OG14.1	Enumerate and discuss the diameters of maternal pelvis and types	Human Anatomy	

GENERAL SURGERY

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	SU19.1	Describe the etiology and classification of cleft lip and palate	Human Anatomy	
2	SU19.2	Describe the Principles of reconstruction of cleft lip and palate	Human Anatomy	
3	SU22.1	Describe the Applied anatomy, and physiology of thyroid	Human Anatomy	
4	SU22.5	Describe the applied anatomy of parathyroid.	Human Anatomy	
5	SU23.1	Describe the applied anatomy of adrenal glands	Human Anatomy	
6	SU24.1	Describe the clinical features, principles of investigation, prognosis and management of	Human Anatomy	

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		pancreatitis.		
7	SU25.1	Describe applied anatomy appropriate investigations for breast disease	Human Anatomy	
8	SU28.2	Describe the clinical features, investigations and principles of management of congenital anomalies of Genitourinary system.	Human Anatomy	
9	SU28.5	Describe the applied anatomy and physiology of esophagus	Human Anatomy Physiology	
10	SU28.7	Describe the applied anatomy and physiology of stomach.	Human Anatomy	
11	SU28.10	Describe the applied anatomy of liver. Describe the Clinical features, Investigations and principles of management of Liver abscess, hydatid disease, Injuries and Tumors of the liver	Human Anatomy	
12	SU28.11	Describe the applied anatomy of Spleen. Describe the clinical features, Investigations and principles of management of splenic injuries. Describe the Post-splenectomy sepsis-prophylaxis.	Human Anatomy	
13	SU28.12	Describe the applied anatomy of biliary system. Describe the clinical features, investigations and principles of management of diseases of biliary system.	Human Anatomy	
14	SU28.13	Describe the applied anatomy of small and large intestines	Human Anatomy	
15	SU28.16	Describe applied anatomy including congenital anomalies of the rectum and anal canal	Human Anatomy	
16	SU30.2	Describe the applied anatomy, clinical features, investigations and principles of management of Undescended testis.	Human Anatomy	
17	SU30.3	Describe the applied anatomy, clinical features, investigations and principles of management of Epidydimo-orchitis	Human Anatomy	

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18	SU30.4	Describe the applied anatomy, clinical features, investigations and principles of management of Varicocele	Human Anatomy	
19	SU30.5	Describe the applied anatomy, clinical features, investigations and principles of management of Hydrocele	Human Anatomy	

ORTHOPEDICS

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	OR2.1	Describe and discuss the mechanism of Injury, clinical features, investigations and plan management of fracture of clavicle	Human Anatomy	
2	OR2.2	Describe and discuss the mechanism of Injury, clinical features, investigations and plan management of fractures of proximal humerus	Human Anatomy	
3	OR2.3	Describe and discuss the mechanism of Injury, clinical features, investigations and plan management of supra condylar fracture of humerus	Human Anatomy	
4	OR2.4	Describe and discuss the mechanism of injury, clinical features, investigations and principles of management of fracture of shaft of humerus and intercondylar fracture humerus with emphasis on neurovasular deficit	Human Anatomy	

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5	OR2.5	Describe and discuss the aetiopathogenesis, clinical features, mechanism of injury, investigation & principles of management of fractures of both bones forearm and Galeazzi and Monteggia injury	Human Anatomy	
6	OR2.6	Describe and discuss the aetiopathogenesis, mechanism of injury, clinical features, investigations and principles of management of fractures of distal radius	Human Anatomy	
7	OR2.7	Describe and discuss the aetiopathogenesis, mechanism of injury, clinical features, investigations and principles of management of pelvic injuries with emphasis on hemodynamic instability	Human Anatomy	
8	OR2.8	Describe and discuss the aetiopathogenesis, mechanism of injury, clinical features, investigations and principles of management of spine injuries with emphasis on mobilisation of the patient	Human Anatomy	
9	OR2.9	Describe and discuss the mechanism of injury, Clinical features, investigations and principle of management of acetabular fracture	Human Anatomy	

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10	OR2.10	Describe and discuss the aetiopathogenesis, mechanism of injury, clinical features, investigations and principles of management of fractures of proximal femur	Human Anatomy	
11	OR2.11	Describe and discuss the aetiopathogenesis, mechanism of injury, clinical features, investigations and principles of management of (a) Fracture patella (b) Fracture distal femur © Fracture proximal tibia with special focus on neurovascular injury and compartment syndrome	Human Anatomy	
12	OR2.12	Describe and discuss the aetiopathogenesis, clinical features, Investigation and principles of management of Fracture shaft of femur in all age groups and the recognition and management of fat embolism as a complication	Human Anatomy	
13	OR2.13	Describe and discuss the aetiopathogenesis, clinical features, Investigation and principles of management of: (a) Fracture both bones leg (b) Calcaneus (c) Small bones of foot	Human Anatomy	
14	OR2.14	Describe and discuss the aetiopathogenesis, clinical features, Investigation and principles of management of ankle fractures	Human Anatomy	

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15	OR2.15	Plan and interpret the investigations to diagnose complications of fractures like malunion, non-union, infection, compartmental syndrome	Human Anatomy	
16	OR2.16	Describe and discuss the mechanism of injury, clinical features, investigations and principles of management of open fractures with focus on secondary infection, prevention and management	Human Anatomy	
17	OR11.1	Describe and discuss the aetiopathogenesis, Clinical features, Investigations and principles of management of peripheral nerve injuries in diseases like foot drop, wrist drop, claw hand, palsies of Radial, Ulnar, Median, Lateral Popliteal and Sciatic Nerves	Human Anatomy	
18	OR12.1	Describe and discuss the Clinical features, Investigations and principles of management of Congenital and acquired malformations and deformities of: a. limbs and spine - Scoliosis and spinal bifida b. Congenital dislocation of Hip,Torticollis, c. congenital talipes equino varus	Human Anatomy	

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PHYSICAL MEDICINE & REHABILITATION

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	PM2.1	Describe the causes of disability in the patient with a cerebrovascular accident	Human Anatomy	General Medicine
2	PM3.1	Describe and discuss the clinical features, types, evaluation, diagnosis and management of cerebral palsy	Human Anatomy	Pediatrics

PEDIATRICS

Sl. No.	Competency number	Competency	Vertical Integration	Horizontal Integration
1	PE32.1	Discuss the genetic basis, risk factors, complications, prenatal diagnosis, management and genetic counselling in Down's Syndrome	Human Anatomy	

Teaching Learning Methods:

The university incorporates the guidelines of the CBME curriculum prescribed by the National Medical Commission (NMC). The department uses various innovative teaching learning methods to facilitate effective student learning.

Cognitive:

Sl. No.	T-L Method	Number of Hours
1	Interactive Lectures	110
2	Small Group Learning Tutorials Visit to hospital OPDs and Wards Problem based Learning for Integrated sessions Museum visits for integration Competitions/Seminars videos/role play/live/simulation	64
3	Early Clinical Exposure	15
4	Self-Directed Learning	20

Psychomotor and Affective Domain

Sl. No.	T-L Method	Number of Hours
1.	Dissection and Prosection (cadaver specimen) Demonstrations-videos/role play/live/simulation/Virtual Reality Slide demonstrations	144

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Assessment methods:

Formative Assessment:

The department follows the concept of continuous assessment for evaluating the students. The department o Anatomy will conduct **monthly tests, part completion test and three internal assessements. Fourth interna assessment will be conducted for improvement of scores as a remedial measure.**

This facilitates to give feedback to students on their learning. These tests allow regular and timely revision by the students. It also prepares the student to attend the summative examination with confidence.

Sl. No.	Assessment methods
1	Modified Long essay, Short Essay (SE),
2	Short answer questions (SAQ)
3	Multiple choice questions (MCQ)
4	Short Seminars
5	Spotters
6	Structured Discussions
7	Table viva (Gross Anatomy)
8	Objective Structured Practical Examination (OSPE)

Guidelines for Internal assessment:

5) The department will conduct a minimum of three internal assessments.
6) The **1st internal assessment** to include **one short essay** on **AETCOM modules 1.1 and 1.5**.
7) The **third internal assessment** will be as per university **summative examination.**
8) The marks obtained in the formative assessment should be displayed on the notice board within 1 - 2 weeks after conducting the tests.

Theory:

- The theory paper will be conducted for 60 marks for 1st and 2nd IA and 100 marks for third IA
- Blue print guidelines to be followed for question paper setting.
- The distribution of marks will be as follows:
  i. 40% of the subject questions will be based on clinical correlation and integration (LE, SE).
  ii. 40% of the subject questions will and comprehension level of questions (SE).
  iii. 20% of the subject questions will be of recall type. (SAQs and MCQs).
- Each **Internal assessment weightage** will be as follows:

Sl. No.	Topics	Weightage
1	Gross Anatomy (AETCOM -1 SE in 1st IA)	65%
2	Histology	10%
3	Embryology	10%
4	Osteology/Genetics/General anatomy/recent advances.	15%

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Scheme of Internal Assessment:

Sl. No.	Type of Question	Marks	Marks
1.	Long Essay	(2X10)=20	(2X10)=20
2.	Short Essay	(5X5) = 25	(10X5) = 50
3.	SAQs	(5X3) =15	(10X3) 30
4.	**Total**	**60**	**100**

Practical:

- The practical will be conducted for **60 marks**.
- **Scheme for practical assessment:**

Sl. No.	Assessment type	Marks
A Gross Anatomy		
1	Spotter Test (10X1)	10
2	Discussion (2X10)	20
B Histology		
1	Spotters (10 X1)	10
2	Discussion (2 X10)	20
Total		**60**

- The **histology record** and the **log book** should be evaluated on a continuous basis and certified by the department before the summative examination

The **pass criteria** in each internal assessment will be 40% separately in theory and practical. **Eligibility crit** take up summative examination, theory and practical cumulative should be 50%.

Regular monthly tests will be conducted in addition to the three internal assessments. These will be in the form of **SAQ test, MCQ test, SE test, Table viva, Spotter tests etc**.

These will be given weightage when considering internal assessment eligibility for summative examination.

LOG BOOK:

The anatomy log book should be completed and evaluated by the faculty on a timely basis. The same to be certified by the head of the department at the end of the program before summative examination.

HISTOLOGY RECORD:

The Histology record should be certified before each internal assessment and final certification by the head of the department before summative examination.

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Eligibility for Summative Examination:

Weightage of various assessments as eligibility criteria for Summative exam:

Sl. No.	Type of Assessment	Weightage
1.	Internal assessment	(70%)
2.	Monthly assessment (Part Completion test)	(12%)
3.	Professionalism	6%
4.	Histology records	6%
5.	Level of participation in ECE	6%

Sl. No.	Theory		Practical	
1	IA Theory	30	Gross and Histology	30
2	Monthly Assessments (Part completion Test)	5	Histology record	05
3	Professionalism	5	Level of participation in ECE	05
4	**Total**	**40**	**Total**	**40**

Formative assessment :			
Theory	**30 Marks**	**Practical**	**30 Marks**
Monthly Assessments - MCQs / SAQ tests / Viva voce etc.	05	Histology Practical records	05
Attitude	01	ECE Participation	05
Written Assignments	02		
Attendance	02 (for T + P attendance > 90%) 01 (for T + P attendance between 80-90%) **Eligibility criteria for attendance is 80% (separately for theory & practical)**		
Total	**40**		**40**

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Another proposal

The eligibility is calculated by considering the internal assessment/monthly assessment and Professionalism and ethics (**average should be 40% in theory and practical separately** and **50% in theory and practical combined**). **Attendance** should be 75% in theory and 80% in practical, 75 % each for Foundation course and AETCOM.

If a student is found not to meet the criteria of eligibility for summative examination, remedial measures in the form of improvement tests/assignments should be given. The student can be allowed to take up summative examination if the remedial measures are fulfilled.

The internal assessment will appear as a separate subheading in the marks card and not be considered for pass criteria of final summative examination.

Summative Assessment:

Marks Distribution:

Sl. No.	Theory	Practical	Viva	Total
Marks	100	80 (Combined with Course 101A & 102A)	20	150

Theory: 1 paper of 100 marks each.

The portions of theory paper II:

Abdomen and Pelvis, Lower Limb, relevant Systemic histology, relevant Systemic Embryology, Genetics

Pattern of Assessment:

Theory: Maximum marks: 100

Theory paper II

Sl. No.	Type of Question	Number	Marks
1	Long Essay	2 X 10	20
2	Short Essay	6 X 5	30
3	Short answer questions	10 X 3	30
4	MCQs	20 X 1	20
5	**Total**	**38**	**100**

Marks Distribution for the various topics in Paper II

Sl. No.	Region/Topic	Marks allotted (Abdomen -LE)	Marks allotted (Pelvis -LE)
1	Lower limb	21	21
2	Abdomen	24	29
3	Pelvis	22	17
4	Genetics	9	9
6	Relevant systemic embryology	12	12
7	Relevant systemic histology	12	12
8	**Total**	**100**	**100**

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Practical: Maximum marks: 80

Sl. No.	Assessment type	Marks
Gross Anatomy		
1	Spotters (15X1)	15
2	Discussion	
	Above diaphragm (1X15)	15
	Below diaphragm(1X15)	15
3	Muscle testing	05
Histology		
1	Spotters (10X1)	10
2	Discussion	
	General(1X10)	10
	Systemic(1X10)	10
Total		**80**

Viva: Maximum marks: 20

Sl. No.	Viva Section	Marks
1	Osteology	05
2	Surface Anatomy	05
3	Embryology	05
4	Radiology	05
5	Total	20

Pass Criteria:

The pass is determined by consideration of both Courses MBC101A &MBC102A assessments.

The student should secure **40% in each theory paper** and **50% of aggregate of the two papers**.

The student should secure 50% in **practical exam + viva.**

Supplementary Exam:

Supplementary exams to be conducted and results to be declared **within 60** days after announcement o results of main summative examination. If the student clears the supplementary exam he/she can join the regular batch.

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Blue Print for Paper II

Blueprint of Anatomy Paper II
Weightage of Marks

Sl. No.	Region	Long Essay	Short Essay	Short Answer Questions	MCQs	Total
1	Abdomen	10	5	6	4	**25**
2	Pelvis		5	6	4	**15**
3	Lower limb	10	5	6	4	**25**
4	Systemic Embryology	-	5	3	2	**10**
5	Relevant Systemic Histology	-	5	3	2	**10**
6	Osteology related to Abdomen & Pelvis	-	-	3	2	**05**
7	Genetics	-	5	3	2	**10**
8	Total	**20**	**30**	**30**	**20**	**100**

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Course Details of MBBS Anatomy 2022-2023

Sl. No.	Question	Region	Artery	Nerve	Muscle	Vein	Bones	Joints	Fossa & Triangles	Fascia	Organs	Others
1	L E 1	Abdomen & Pelvis										
2	L E 2	Lower Limb										
3	SE 1	Abdomen										
4	SE 2	Lower Limb										
5	SE 3	Pelvis										
6	SE 4	Systemic histology										
7	SE 5	Systemic Embryology										
8	SE 6	Genetics										
9	SAQ 1	Abdomen										
10	SAQ 2	Pelvis										
11	SAQ 3	Systemic Embryology										
12	SAQ 4	Systemic Histology										
13	SAQ 5	Lower limb										
14	SAQ 6	Genetics										
15	SAQ 7	Abdomen										
16	SAQ 8	Pelvis										
17	SAQ 9	Lower limb										
18	SAQ 10	Osteology										

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Sl. No	Question	Region	Artery	Nerve	Muscle	Vein	Bones	Joints	Fossa & Triangles	Fascia	Organs	Others
19	MCQ 1	Abdomen										
	MCQ 2	Pelvis										
	MCQ 3	Lower limb										
	MCQ 4	Genetics										
	MCQ 5	Osteology										
	MCQ 6	Systemic Embryology										
	MCQ 7	Systemic histology										
	MCQ 8	Abdomen										
	MCQ 9	Pelvis										
	MCQ 10	Lower limb										
20	MCQ 11	Abdomen										
	MCQ 12	Pelvis										
	MCQ 13	Lower limb										
	MCQ 14	Genetics										
	MCQ 15	Osteology										
	MCQ 16	Systemic Embryology										
	MCQ 17	Systemic histology										
	MCQ 18	Abdomen										
	MCQ 19	Pelvis										
	MCQ 20	Lower limb										

Professor & HOD

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PRACTICAL PORTIONS

DISCUSSION TOPICS FOR MBBS PHASE-I

LOWER LIMB:

1. Femoral triangle.
2. Femoral sheath and contents.
3. Structures in front of thigh.
4. Adductor canal.
5. Structures under the cover of Gluteus maximus.
6. Sciatic nerve in detail.
7. Back of thigh.
8. Hamstring muscles.
9. Popliteal fossa
10. Anterior compartment of leg.
11. Peroneal compartment of leg.
12. Posterior compartment of leg.
13. Knee joint in detail.
14. Flexor, Extensor & peroneal retinacula of leg.
15. Dorsum of foot.
16. Sole (Layers, plantar arch)

DISCUSSION TOPICS ON ABDOMEN AND PELVIS:

1. Rectus sheath and contents.
2. Inguinal canal.
3. Thoraco abdominal diaphragm.
4. Stomach.
5. Spleen.
6. Liver
7. Extra hepatic biliary apparatus (EHBA)
8. Duodenum
9. Pancreas.
10. Small intestine with mesentery.
11. Large intestine (colon, caecum and vermiform appendix).
12. Kidneys
13. Suprarenal glands.
14. Celiac trunk,
15. Superior mesenteric and inferior mesenteric vessels.
16. Urinary bladder.
17. Uterus
18. Fallopian tubes and ovaries.
19. Sections of the male pelvis (pelvic organs).
20. Sections of the female pelvis (pelvic organs).
21. Testis and spermatic cord.
22. Internal iliac artery and branches.
23. Posterior abdominal wall structures.

29. Mandibular nerve and branches.
30. Interior of cranial cavity and identification of cranial nerves (Dural folds, dural venous sinuses)
31. Cavernous sinus and relations.

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MBBS PHASE 1 - HISTOLOGY SLIDES (SPOTTERS AND DISCUSSION)

Systemic Slides
Stomach – Fundus
Stomach – Pylorus
Duodenum
Jejunum
Ileum
Colon
Appendix
Liver
Gall Bladder
Pancreas
Kidney
Ureter
Urinary Bladder
Testis
Epididymis
Vas Deferens
Prostate
Ovary
Uterus
Fallopian Tube
Suprarenal

SURFACE MARKING TOPICS FOR MBBS PHASE-I

LOWER LIMB:

1. Long (great) saphenous vein
2. Femoral artery
3. Popliteal artery
4. Anterior tibial artery
5. Posterior tibial artery
6. Dorsalis pedis artery
7. Sciatic nerve
8. Tibial nerve
9. Deep peroneal nerve
10. Flexor retinaculum
11. Extensor retinaculum
12. Tibial collateral ligament
13. Mid inguinal point.

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ABDOMEN AND PELVIS:

1. Planes and quadrants, linea semilunaris.
2. Superficial inguinal ring, deep inguinal ring, inguinal canal.
3. Mid inguinal point and mid point of inguinal ligament.
4. Inguinal ligament
5. Stomach-Cardiac orifice, pyloric orifice, lesser curvature, greater curvature and whole stomach.
6. Liver.
7. Gall bladder (fundus).
8. Duodenum.
9. Pancreas.
10. Spleen.
11. Root of mesentery.
12. Iliocaecal orifice
13. Caecum
14. Vermiform appendix.
15. Mc.Burney's point
16. Morris parallelogram for kidneys.
17. Hilum of both kidneys.
18. Ureters
19. Abdominal aorta.
20. Coeliac trunk.
21. Superior and inferior mesenteric arteries.
22. Inferior vena cava.
23. Root of sigmoid Mesocolon.

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Assessment methods:

Formative Assessment:

The department follows the concept of continuous assessment for evaluating the students. The department of Anatomy will conduct **monthly tests, part completion test and three internal assessements. Fourth internal assessment will be conducted for improvement of scores as a remedial measure.**

This facilitates to give feedback to students on their learning. These tests allow regular and timely revision by the students. It also prepares the student to attend the summative examination with confidence.

Sl. No.	Assessment methods
1	Modified Long essay, Short Essay (SE),
2	Short answer questions (SAQ)
3	Multiple choice questions (MCQ)
4	Short Seminars
5	Spotters
6	Structured Discussions
7	Table viva (Gross Anatomy)
8	Objective Structured Practical Examination (OSPE)

Guidelines for Internal assessment:

9) The department will conduct a minimum of three internal assessments.
10) The **1st internal assessment** to include **one short essay** on **AETCOM modules 1.1 and 1.5**.
11) The **third internal assessment** will be as per university **summative examination.**
12) The marks obtained in the formative assessment should be displayed on the notice board within 1 -2 weeks after conducting the tests.

Theory:

- The theory paper will be conducted for 60 marks for 1st and 2nd IA and 100 marks for third IA
- Blue print guidelines to be followed for question paper setting.
- The distribution of marks will be as follows:
  i. 40% of the subject questions will be based on clinical correlation and integration (LE, SE).
  ii. 40% of the subject questions will and comprehension level of questions (SE).
  iii. 20% of the subject questions will be of recall type. (SAQs and MCQs).
- Each **Internal assessment weightage** will be as follows:

Sl. No.	Topics	Weightage
1	Gross Anatomy (AETCOM -1 SE in 1st IA)	65%
2	Histology	10%
3	Embryology	10%
4	Osteology/Genetics/General anatomy/recent advances.	15%

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Scheme of Internal Assessment:

Sl. No.	Type of Question	Marks	Marks
1.	Long Essay	(2X10)=20	(2X10)=20
2.	Short Essay	(5X5) = 25	(10X5) = 50
3.	SAQs	(5X3) =15	(10X3) 30
4.	**Total**	**60**	**100**

Practical:

- The practical will be conducted for **60 marks**.
- **Scheme for practical assessment:**

Sl. No.	Assessment type	Marks
A Gross Anatomy		
1	Spotter Test (10X1)	10
2	Discussion (2X10)	20
B Histology		
1	Spotters (10 X1)	10
2	Discussion (2 X10)	20
Total		**60**

- The **histology record** and the **log book** should be evaluated on a continuous basis and certified by the department before the summative examination

The **pass criteria** in each internal assessment will be 40% separately in theory and practical. **Eligibility criteria** to take up summative examination, theory and practical cumulative should be 50%.

Regular monthly tests will be conducted in addition to the three internal assessments. These will be in the form of **SAQ test, MCQ test, SE test, Table viva, Spotter tests etc**.

These will be given weightage when considering internal assessment eligibility for summative examination.

LOG BOOK:

The anatomy log book should be completed and evaluated by the faculty on a timely basis. The same to be certified by the head of the department at the end of the program before summative examination.

HISTOLOGY RECORD:

The Histology record should be certified before each internal assessment and final certification by the head of the department before summative examination.

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Eligibility for Summative Examination:

Weightage of various assessments as eligibility criteria for Summative exam:

Sl. No.	Type of Assessment	Weightage
1.	Internal assessment	(70%)
2.	Monthly assessment (Part Completion test)	(12%)
3.	Professionalism	6%
4.	Histology records	6%
5.	Level of participation in ECE	6%

Sl. No.	Theory		Practical	
1	IA Theory	30	Gross and Histology	30
2	Monthly Assessments (Part completion Test)	5	Histology record	05
3	Professionalism	5	Level of participation in ECE	05
4	**Total**	**40**	**Total**	**40**

Another proposal

Formative assessment :			
Theory	**30 Marks**	**Practical**	**30 Marks**
Monthly Assessments - MCQs / SAQ tests / Viva voce etc.	05	Histology Practical records	05
Attitude	01	ECE Participation	05
Written Assignments	02		
Attendance	02 (for T + P attendance > 90%) 01 (for T + P attendance between 80-90%) **Eligibility criteria for attendance is 80% (separately for theory & practical)**		
Total	**40**		**40**

The eligibility is calculated by considering the internal assessment/monthly assessment and Professionalism and ethics (**average should be 40% in theory and practical separately** and **50% in theory and practical combined**).

Attendance should be 75% in theory and 80% in practical, 75 % each for Foundation course and AETCOM.

If a student is found not to meet the criteria of eligibility for summative examination,

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remedial measures in the form of improvement tests/assignments should be given. The student can be allowed to take up summative examination if the remedial measures are fulfilled.

The internal assessment will appear as a separate subheading in the marks card and not be considered for pass criteria of final summative examination.

Summative Assessment:

Marks Distribution:

Sl. No.	Theory	Practical	Viva	Total
Marks	100	80 (Combined with Course 101A & 102A)	20	150

Theory: 1 paper of 100 marks each.

The portions of theory paper II:

Abdomen and Pelvis, Lower Limb, relevant Systemic histology, relevant Systemic Embryology, Genetics

Pattern of Assessment:

Theory: Maximum marks: 100

Theory paper II

Sl. No.	Type of Question	Number	Marks
1	Long Essay	2 X 10	20
2	Short Essay	6 X 5	30
3	Short answer questions	10 X 3	30
4	MCQs	20 X 1	20
5	**Total**	**38**	**100**

Marks Distribution for the various topics in Paper II

Sl. No.	Region/Topic	Marks allotted (Abdomen -LE)	Marks allotted (Pelvis -LE)
1	Lower limb	21	21
2	Abdomen	24	29
3	Pelvis	22	17
4	Genetics	9	9
6	Relevant systemic embryology	12	12
7	Relevant systemic histology	12	12
8	**Total**	**100**	**100**

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Practical: Maximum marks: 80

Sl. No.	Assessment type	Marks
Gross Anatomy		
1	Spotters (15X1)	15
2	Discussion	
	Above diaphragm (1X15)	15
	Below diaphragm(1X15)	15
3	Muscle testing	05
Histology		
1	Spotters (10X1)	10
2	Discussion	
	General(1X10)	10
	Systemic(1X10)	10
Total		**80**

Viva: Maximum marks: 20

Sl. No.	Viva Section	Marks
1	Osteology	05
2	Surface Anatomy	05
3	Embryology	05
4	Radiology	05
5	Total	20

Pass Criteria:

The pass is determined by consideration of both Courses MBC101A &MBC102A assessments.

The student should secure **40% in each theory paper** and **50% of aggregate of the two papers**.

The student should secure 50% in **practical exam + viva.**

Supplementary Exam:

Supplementary exams to be conducted and results to be declared **within 60** days after announcement of results of main summative examination. If the student clears the supplementary exam he/she can join the regular batch.

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Blue Print for Paper II

Sl. No.	Question	Region	Artery	Nerve	Muscle	Vein	Bones	Joints	Fossa & Triangles	Fascia	Organs	Others
1	L E 1	Lower Limb										
2	L E 2	Abdomen/Pelvis										
3	SE 1	Lower Limb										
4	SE 2	Abdomen										
5	SE 3	Pelvis/ Abdomen										
6	SE 4	Pelvis/ Abdomen										
7	SE 5	Pelvis/ Abdomen										
8	SE 6	Genetics										
9	SE 7	Relevant systemic histology										
10	SE 8	Relevant Systemic Embryology										
11	SAQ 1	Lower Limb										
12	SAQ 2	Abdomen										
13	SAQ 3	Abdomen										
14	SAQ 4	Pelvis										
15	SAQ 5	Pelvis										
16	SAQ 6	Genetics										
17	SAQ 7	Relevant Systemic Embryology										
18	SAQ 8	Relevant Systemic Embryology										
19	SAQ 9	Relevant Systemic Histology										
20	SAQ 10	Relevant systemic histology										
21	MCQ 1	Lower Limb										
22	MCQ 2	Lower Limb										
23	MCQ 3	Lower Limb										
24	MCQ 4	Abdomen										
25	MCQ 5	Abdomen										
26	MCQ 6	Abdomen										
27	MCQ 7	Pelvis										
28	MCQ 8	Genetics										
29	MCQ 9	Relevant Systemic Histology										
30	MCQ 10	Relevant systemic histology										

** If Abdomen is main question, the pelvis should be compensated in Short Essay. Same thing applies if pelvis is the main question.

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PRACTICAL PORTIONS

DISCUSSION TOPICS FOR MBBS PHASE-I

LOWER LIMB:

17. Femoral triangle.
18. Femoral sheath and contents.
19. Structures in front of thigh.
20. Adductor canal.
21. Structures under the cover of Gluteus maximus.
22. Sciatic nerve in detail.
23. Back of thigh.
24. Hamstring muscles.
25. Popliteal fossa
26. Anterior compartment of leg.
27. Peroneal compartment of leg.
28. Posterior compartment of leg.
29. Knee joint in detail.
30. Flexor, Extensor & peroneal retinacula of leg.
31. Dorsum of foot.
32. Sole (Layers, plantar arch)

DISCUSSION TOPICS ON ABDOMEN AND PELVIS:

24. Rectus sheath and contents.
25. Inguinal canal.
26. Thoraco abdominal diaphragm.
27. Stomach.
28. Spleen.
29. Liver
30. Extra hepatic biliary apparatus (EHBA)
31. Duodenum
32. Pancreas.
33. Small intestine with mesentery.
34. Large intestine (colon, caecum and vermiform appendix).
35. Kidneys
36. Suprarenal glands.
37. Celiac trunk,
38. Superior mesenteric and inferior mesenteric vessels.
39. Urinary bladder.
40. Uterus
41. Fallopian tubes and ovaries.
42. Sections of the male pelvis (pelvic organs).
43. Sections of the female pelvis (pelvic organs).
44. Testis and spermatic cord.
45. Internal iliac artery and branches.
46. Posterior abdominal wall structures

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MBBS PHASE 1 - HISTOLOGY SLIDES (SPOTTERS AND DISCUSSION)

Systemic Slides
Stomach – Fundus
Stomach – Pylorus
Duodenum
Jejunum
Ileum
Colon
Appendix
Liver
Gall Bladder
Pancreas
Kidney
Ureter
Urinary Bladder
Testis
Epididymis
Vas Deferens
Prostate
Ovary
Uterus
Fallopian Tube
Suprarenal

SURFACE MARKING TOPICS FOR MBBS PHASE-I

LOWER LIMB:

14. Long (great) saphenous vein
15. Femoral artery
16. Popliteal artery
17. Anterior tibial artery
18. Posterior tibial artery
19. Dorsalis pedis artery
20. Sciatic nerve
21. Tibial nerve
22. Deep peroneal nerve
23. Flexor retinaculum
24. Extensor retinaculum
25. Tibial collateral ligament
26. Mid inguinal point.

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ABDOMEN AND PELVIS:

24. Planes and quadrants, linea semilunaris.
25. Superficial inguinal ring, deep inguinal ring, inguinal canal.
26. Mid inguinal point and mid point of inguinal ligament.
27. Inguinal ligament
28. Stomach-Cardiac orifice, pyloric orifice, lesser curvature, greater curvature and whole stomach.
29. Liver.
30. Gall bladder (fundus).
31. Duodenum.
32. Pancreas.
33. Spleen.
34. Root of mesentery.
35. Iliocaecal orifice
36. Caecum
37. Vermiform appendix.
38. Mc.Burney's point
39. Morris parallelogram for kidneys.
40. Hilum of both kidneys.
41. Ureters
42. Abdominal aorta.
43. Coeliac trunk.
44. Superior and inferior mesenteric arteries.
45. Inferior vena cava.
46. Root of sigmoid Mesocolon.

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Course Outcomes for Anatomy

At the end of the course, the students should be able to

Course Code	Course Name	Course Outcome	
MBC102A	Anatomy 2 i)Gross Anatomy of Abdomen and Pelvis & Lower Limb ii) Relevant Systemic histology iii) Relevant Systemic Embryology iv) Genetics	102A.1	Describe the normal disposition, features relations, functional, cross-sectional and radiological anatomy of Abdomen & Pelvis, lower limb including bones of these regions.
		102A.2	Demonstrate structures of Abdomen & Pelvis, Lower limb including bones of these regions and their surface anatomy.
		102A.3	Describe microscopic structure of relevant systemic Histology with their important functions.
		102A.4	Identify microscopic structure of relevant systemic Histology with their important functions.
		102A.5	Explain the principles & sequential development of the relevant systemic Embryology, the effects of common teratogens, genetic mutations & environmental hazards and developmental basis of various major congenital anomalies.
		102A.6	Describe the principles of genetics, chromosomes and karyotype with abnormalities, Inheritance, Prenatal diagnosis, Genetic Counseling, Gene therapy, Human Genome project

Course content- Anatomy 2

1. **Gross Anatomy of Abdomen and Pelvis & Lower Limb**
2. **Relevant Systemic histology**
3. **Relevant Systemic Embryology**
4. **Genetics**

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PO, PSO & CO Mapping – Anatomy

Course Code and name	Course Outcome	Program Outcomes					Program Specific Outcomes				
		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
MBC102A Anatomy 2	102A.1	3	3				3			1	1
	102A.2	3	3	1			3		1	1	
	102A.3	3	3				3			1	
	102A.4	3	3	1			3		1	1	1
	102A.5	3	3				3			1	
	102A.6	2	2	1			1	1	1		1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution											

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RECOMMENDED LIST OF TEXTBOOKS:

Gross Anatomy

5) Anatomy of Lower Limb & Abdomen (Vol II) — **By B.D.Chaurasia**

OR

2) Anatomy of Lower Limb & Abdomen (Vol II) — **By Vishram Singh**

(2) ATLAS OF GROSS ANATOMY: (for Practicals)

Netter Atlas of Human Anatomy

OR

Grants Atlas of Human Anatomy

Histology

Textbook of Human Histology (with color atlas) – By Yogesh Sontakke

OR

Text book of Histology – By I.B.Singh

diFiore's Atlas of Histology with functional correlations

Embryology

Textbook of Human Embryology – By Yogesh Sontakke

OR

Human Embryology – By Inderbir Singh

Clinical Anatomy

Snell's Clinical Anatomy

Keith and Moore's Clinical anatomy

Genetics:

Principals of Clinical Genetics – By Yogesh Sontakke

OR

Essentials of Genetics – By Renu Chauhan

Other books

2. Selective anatomy – preparatory manual for undergraduates By Vishram singh (A Guide) – Vol. 1 & 2

2. Companion 10 years Question Bank of RGUHS Exams – By Singhi Yatiraj

3. Oxford's New Medical Dictionary (CBS)

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Course Specifications

Biochemistry

Code- MBC103A

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Course Specifications

Course Title	Biochemistry
Course Code	MBC103A
Course Type	Core Theory & Practical Course
Department	Biochemistry
Faculty	Medical

INTRODUCTION TO THE DEPARTMENT

The teaching of Biochemistry focuses on the structure and function of cellular componentsand bio-molecules as well as integrates the application of this knowledge in a clinical scenario. This is essential to understand the complex biochemical interactions within the human body both in health and disease.

The team of teaching faculty is well balanced in terms of qualification, age and experience. Apart from the academic commitments in the medical college, the department renders round the clock services in the Biochemistry section of the Diagnostic laboratory which is NABL accredited, endowed with state of the art facilities, latest equipment, skilled laboratory personnel in an effort to provide quality health care service to patients.

Value additions to the teaching/learning of Biochemistry includes-a vast database of case scenarios, a well-stocked question bank, regular day to day assessments & Viva-voce sessions, interactive group discussions during practical's as well as lectures, meticulously planned integrated teaching /Linker sessions along with diagnostic laboratory visits, clinician conducted systems overview, opportunities to develop adult learning practices during self-directed learning sessions and learning by observation and co-relation during ECE sessions. All these, enable students to understand concepts, remove misconceptions regarding the chemistry aspect of the subject, highlight the role of biochemical mechanisms in health and causation of certain diseases and orients students towards planning and pursuing research projects. An attempt is made to draw the attention of students towards the role of Biochemistry in screening, diagnosis, treatment and management in Non-communicable diseases, Communicable diseases and in healthy subjects- Highlighting the importance of clinical biochemistry and diagnostic laboratory in hospital setup.

GOAL:

The broad goal is to teach Biochemistry to undergraduate students to make them understand the scientific basis of the life processes at the molecular level and to orient them towards the application of the knowledge acquired in solving clinical problems.

Objectives:

The student at the end of the course should be able to

Cognitive domain

a) Describe and apply biochemical principles to explain the normal state, abnormal disease conditions and mechanism of action used in the perception, diagnosis and treatment of diseases.

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b) Explain energy transactions in a living system, and describe importance of biomolecules in sustaining the life process.

c) Describe pathways of the intermediary metabolism along with their individual and integrated regulation and apply that in understanding the functioning of the body.

d) Describe and apply the concept of nutrition in health and disease, micro- and macronutrition and essential nutrients, and interlinks of nutrients with metabolism and functions of a living system.

e) Apply and integrate knowledge of molecular and metabolic conditions in normal and disease states for clinical problem solving and research

f) Acquire basic knowledge towards the evaluation and interpretation of molecular and metabolic disease states.

g) Evaluate, analyze and monitor disease states by applying relevant biochemical investigations and interpreting the clinical and laboratory data.

h) Able to integrate principles of immunology in biochemistry.

i) Demonstrate knowledge of basics of research methodology, develop a research protocol, analyse data using currently available statistical software, interpret results and disseminate these results and to have the potential ability to pursue further specializations and eventually be competent to guide students.

j) Describe the principles of teaching - learning technology towards application and take interactive classroom lectures, prepare modules for PBL, organize and conduct PBLs, case discussions, small group discussions, Seminars, Journal club and research presentations

k) Demonstrate knowledge of principles of Instrumentation.

l) Demonstrate knowledge about recent advances and trends in research in the field of clinical biochemistry.

Psychomotor domain

m) Able to select, justify, and interpret the results of clinical tests in biochemistry.

n) Predict effectiveness and adverse effects associated with disease intervention.

o) Demonstrate skills for clinical diagnosis, testing, understanding of biochemical conditions and diagnostic service.

p) Perform important biochemical, immunological and molecular biology techniques.

q) Observed working of important advanced techniques.

r) Demonstrate standard operating procedures of various methods and techniques used in clinical biochemistry.

s) Determination of enzyme activity and study of enzyme kinetics. Ideally it should be accompanied by purification (partial) of the enzyme from a crude homogenate to emphasize the concepts of specific activity.

t) Demonstrate presentation skills at academic meetings and publications

Affective domain

u) Effectively explain to patients from a variety of backgrounds, the molecular and metabolicbasis of disease states and lifestyle modifications.

v) Communicate biochemical reasoning effectively with peers, staff and faculty, and other members of the health care team.

w) Demonstrate empathy and respect towards patients regardless of the biochemical nature of their disease.

x) Demonstrate respect in interactions with patients, families, peers and other healthcare professionals.

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y) Demonstrate ethical behavior and integrity in one's work.
z) Demonstrate effective use of nutrition, lifestyle and genetic counseling.
aa) Be aware of the cost of diagnostic tests and economic status of patients.
bb) Acquire skills for self-directed learning to keep up with developments in the field and to continuously build to improve on skills and expertise

Course summary

	Competencies in Biochemistry	
Sl. no	**Topic**	**Competencies**
1.	Cell and organelles, cell membrane, Transportacross cell membrane	01
2.	Enzymes	07
3.	Chemistry and metabolism of carbohydrates	10
4.	Chemistry and metabolism of Lipids	07
5.	Chemistry and metabolism of Proteins	05
6.	Metabolism and Homeostasis	15
7.	Molecular Biology	07
8.	Nutrition	05
9.	Extracellular matrix	03
10.	Oncogenesis and Immunity	05
11.	**Total in Theory**	**65**
12.	**Biochemistry Laboratory Tests- Practicals**	**24**
13.	**TOTAL**	89

COURSE CONTENT

List of Competencies and SLOs to be covered in Phase I MBBS

RELEVANCE OF BIOCHEMISTRY IN MEDICINE (ORIENTATION LECTURE)

- State the importance of Biochemistry in health and disease with examples

CELL AND ORGANELLES, CELL MEMBRANE, TRANSPORT ACROSS CELLMEMBRANES

BI1.1 Describe the Molecular and Functional Organization of a cell and its Subcellular components

- Explain the differences between prokaryotic and eukaryotic cell

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- Describe structure and enumerate functions of sub-cellular organelles and cytoskeleton components (microtubules, microfilaments etc) with suitable diagrams
- List the Marker enzymes of cell membrane and sub-cellular organelles
- List the steps of the process used to separate cell organelles
- Describe structure and enumerate functions of cell membrane with suitable diagram (Fluid mosaic model)
- Explain components of cell membrane contributing to membrane asymmetry and membrane fluidity and their importance
- List different types of transport mechanism across cell membranes for small and large molecules along with examples.
- Describe different types of mechanism across cell membranes for small and large molecules including active (primary and secondary), passive (simple and facilitated diffusion), endocytosis and exocytosis with suitable examples
- Enumerate the disorders related to cell membrane and subcellular organelles
- List the types and functions of Aquaporins
- Enumerate the types and functions of ABC family of transporters.

ENZYMES

BI2.1 Explain fundamental concepts of enzyme, isoenzyme, alloenzyme, Coenzyme &co-factors.

- Define Enzymes, Coenzymes and Cofactors, Isoenzyme, Alloenzyme
- Proenzymes, Ribozymes with suitable examples
- Classify enzymes(IUBMB) with suitable examples
- Explain the role of Coenzymes and Cofactors in enzyme catalysed reaction with examples

BI2.2 Observe the estimation of SGOT & SGPT

- Observe the estimation of SGOT, SGPT and ALP and interpret the results in given sample accurately.

BI2.3 Describe and explain the basic principles of enzyme activity

- Describe the features of active site of enzyme and its relevance in enzyme action.
- Explain the mechanism of Enzyme action related to substrate binding (lock and key model and Koshland's induced fit theory) including concepts of activation energy, transition state and binding energy
- List different mechanisms of enzyme catalysis
- Explain different factors affecting enzyme activity, Explain the effect of substrate concentration on enzyme activity, Define Km and Vmax and explain their significance, List different types of Enzyme specificity with suitable examples
- Explain various mechanisms of short term regulation of enzyme activity with e.g. including Covalent modification, Zymogen activation, Allosteric regulation, Feedback regulation
- Explain various mechanisms of long term regulation of enzyme activity with examples including induction and repression

BI2.4 Describe and discuss enzyme inhibitors as poisons and drugs and as therapeutic enzymes

- Explain Competitive and Non-competitive inhibition with examples of clinical importance
- Explain Suicide inhibition with example
- Describe the role of enzymes as Therapeutic agents
- Explain the role of enzymes as toxins with example

BI 2.5 Describe and discuss the clinical utility of various serum enzymes as markers of pathological conditions.

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- Discuss the diagnostic importance of enzymes in cardiac, liver, pancreatic, bone and prostate disorders.
- Discuss the diagnostic importance of enzymes and isoenzymes in myocardial infarction
- Discuss the therapeutic importance of isoenzymes with examples.
- Enumerate the difference between functional and non-functional plasma enzymes with suitable examples
- Explain the possible mechanisms of alteration in enzyme and isoenzyme levels in circulationin different pathological conditions of heart, liver, pancreas, bone and prostate
- List the enzymes that are used as tumor markers

BI2.6 Discuss use of enzymes in laboratory investigations (Enzyme-based assays)

- Describe the use of enzymes in diagnostic assays.
- Describe the use of enzymes in techniques like recombinant DNA technology, PCR, etc
- Describe the use of enzymes as labels in techniques like ELISA, RIA

BI2.7 Interpret laboratory results of enzyme activities & describe the clinical utility of various enzymes as markers of pathological conditions.

- Interpret the lab test reports of enzymes and isoenzymes in cardiac disorders
- Interpret the lab test reports of enzymes and isoenzymes in liver disorders
- Interpret the lab test reports of enzymes and isoenzymes in of pancreatic disorders
- Interpret the lab test reports of enzymes and isoenzymes in bone disorders
- Interpret the lab test reports of enzymes and isoenzymes in prostate disorders

CHEMISTRY AND METABOLISM OF CARBOHYDRATES

BI3.1 Discuss and differentiate monosaccharides, disaccharides and polysaccharides giving examples of main carbohydrates as energy fuel, structural element and storage in the human body

- Define carbohydrates
- Explain the biomedical importance of carbohydrates as energy source, storage and structural element along with biological importance of glycolipids, glycoproteins, sialic acid and blood group substances.
- Classify carbohydrates with examples and biological importance. List the Monosaccharide derivatives
- Mention the clinical significance of Uronic acids, amino sugars, Glycosides, sorbitol, Mannitol
- Describe the biologically important disaccharides and oligosaccharides
- Define Polysaccharides, Homopolysaccharides, Heteropolysaccharides
- Explain the composition and importance of starch, glycogen, Dextran, Cellulose and Inulin.
- Explain the composition and importance of mucopolysaccharides.
- Differentiate between glycation and glycosylation

BI 3.2 Describe the processes involved in digestion and assimilation of Carbohydrates and [illegible]

- Describe the different types of Glucose transporters and importance.
- Explain Insulin dependent and Insulin independent uptake of glucose by tissues

BI 3.3 Describe and discuss the digestion and assimilation of carbohydrates from food.

- List the digestible and non-digestible dietary carbohydrates with their biological importance
- Explain the process of digestion of dietary carbohydrates
- Explain the mechanism of absorption of digested end products of dietary carbohydrates

- Explain the causes, biochemical basis of clinical features and management of lactose intolerance
- Define and differentiate the pathways of carbohydrate metabolism, (Glycolysis, gluconeogenesis, glycogen metabolism, HMP shunt).
- Describe the process of Glycolysis (aerobic and anaerobic) highlighting the significance, site, reactions, key steps, energetics, regulation and inhibitors, Explain the substrate level phosphorylation reactions in glycolysis. Differentiate between aerobic and anaerobic glycolysis
- Explain Rapaport Leubering cycle and its significance
- List the cofactors required for Pyruvate dehydrogenase (PDH) reaction
- Explain the significance, Site, reactions, key steps, energetics, regulation ofGluconeogenesis
- Explain the mechanism of transport of Lactate and Alanine from skeletal muscle to liver for gluconeogenesis
- Explain the role of adipose tissue in gluconeogenesis in prolonged fasting
- Explain the significance, Site, reactions, key steps, energetics, regulation of Glycogenesis
- Explain the significance, Site, reactions, key steps, energetics, regulation of Glycogenolysis
- Describe Glycogen storage disorders with enzyme defects and features
- Explain the significance of HMP shunt pathway
- Explain the significance of Uronic acid pathway

BI3.5 Describe and discuss the regulation, functions and integration of carbohydrate along withassociated diseases/disorders.

- Discuss the regulation of glycolysis, gluconeogenesis in well fed and fasting conditions
- Discuss the regulation of glycogen metabolism in well fed and fasting conditions
- Describe the features of Glucose – 6 – Phosphate dehydrogenate deficiency
- Name the enzyme defect in Galactosemia and describe the clinical features
- Name the enzyme defect and features of Essential Fructosuria, Hereditary fructose intolerance, Essential pentosuria

BI3.6 Describe and discuss the concept of TCA cycle as amphibolic pathway and its regulation.

- Describe the sequential steps of Citric acid cycle with significance, its key steps,energetics, regulation and inhibitors
- Explain the Amphibolic role of Citric acid cycle, Explain the Anaplerotic reactions of Citric acid cycle

BI3.7 Describe the common poisons that inhibit crucial enzymes of carbohydrate metabolism (eg.fluoride, arsenate)

- Explain the action of inhibitors on glycolytic enzymes and their importance
- Explain the action of inhibitors on enzymes of citric acid cycle and their importance

BI3.8 Discuss and interpret laboratory results of analytes associated with metabolism of carbohydrates.

- List the lab investigations done in Glycogen storage disorders, Galactosemia, Glucose-6-Phosphate dehydrogenase deficiency,
- Essential Fructosuria, Hereditary fructose intolerance
- Interpret the lab investigations done in Glycogen storage disorders, Galactosemia, Glucose-6-Phosphate dehydrogenase deficiency,
- Essential Fructosuria, Hereditary fructose intolerance

BI 3.9 Discuss the mechanism and significance of blood glucose regulation in health anddisease.

- State the normal plasma glucose levels in fasting, post prandial and random samples and interpret the given reports

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- Explain the mechanism of regulation of blood glucose levels in well fed condition andfasting/starvation.
- Explain the importance of blood glucose regulation in normal healthy individual in wellfed, overnight fasting and during exercise states
- Explain the derangements in blood glucose regulations in abnormal conditions ofdiabetes mellitus and starvation
- Explain various metabolic changes taking place in diabetes mellitus
- Describe the biochemical basis of acute complications of diabetes mellitus
- Describe the biochemical basis of chronic complications of diabetes mellitus
- Differentiate the hormonal regulation of blood glucose among obese and non obese individuals

BI3.10 Interpret the results of blood glucose levels and other laboratoryinvestigations related to disorders of carbohydrate metabolism.

- State the normal plasma levels of glucose in fasting, postprandial and random conditions
- Interpret the plasma glucose levels as hyperglycemia or hypoglycaemia against normal biological reference intervals
- Explain diagnostic criteria of diabetes mellitus including WHO and ADA guidelines
- List the complications of diabetes mellitus including acute metabolic, microvascular a macrovascular complications
- List the lab investigations done in diabetes mellitus and its relevance
- Define oral glucose tolerance test and list the indications, contraindications and differenttypes of GTT including classical, oral, intravenous, mini, clinical/physiological GTT, Explain the precautions advised to patients before GTT
- Interpret the oral GTT report against the recent recommendations of normal, impaired glucose tolerance (IGT), impaired fasting glucose (IFG) and diabetic levels, Explain the rationale behind glycated haemoglobin as an indicator of control status of diabetes mellitus
- Mention the normal glycated haemoglobin levels and interpret the given reports
- Describe the importance of measuring serum insulin and c peptide in diabetic individuals
- Describe the importance of glycosuria among diabetic individuals
- Explain the importance of microalbuminuria among diabetic individuals
- Explain the derangement in lipid status among diabetes individuals

CHEMISTRY AND METABOLISM OF LIPIDS

BI 4.1 Describe and Discuss main classes of lipids (essential/non-essential fatty acids, cholesterol and hormonal steroids, triglycerides, major phospholipids and sphingolipids) relevant to human system and their major functions

- Define lipids and explain the biomedical importance of lipids in the body. Classify lipids with examples
- Mention the essential fatty acids and their significance in the body. Explain the biological importance of MUFA and PUFA
- Describe the composition and importance of triacyglycerol
- Classify phospholipids, mention their composition and biological significance of the various phospholipids
- Explain the biochemical defect, clinical features and diagnosis of respiratory distress syndrome
- Mention the Composition and importance of glycolipids.
- Name the steroid ring present in Cholesterol &the biologically important products derived fm

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cholesterol.

BI 4.2 Describe the processes involved in digestion and absorption of Lipids and also the key features of their metabolism

- List the various dietary lipids
- Mention the sites and describe the role of various enzymes, hormones and bile salts in lipid digestion
- Explain the process and advantages of emulsification of fat and formation of micelles.
- Mention the end product of digestion of lipids, its absorption and transport into lymphatic's and blood vessels
- Define steatorrhea and explain the causes and biochemical diagnosis of steatorrhea.
- Mention the sites and outline the synthesis of triacylglycerol in the body
- List the various lipases and explain their physiological and pathological importance, describe the mobilisation of depot fat from adipose tissue and the factors regulating it.
- Describe the role of carnitine in fatty acid oxidation and explain why small and medium chain fatty acids can be oxidised in carnitine deficiency
- Describe in detail oxidation, regulation and energetics of beta oxidation of fatty acids and mention the differences between the same and alpha, omega, peroxisomal and odd chain fattyacid oxidations
- Mention the metabolic defect and clinical effects associated with propionyl CoA carboxylase deficiency and methyl malonic aciduria, acyl CoA dehydrogenase, Translocase and Carnitine deficiency, Refsums' disease, Zellweger syndrome and organic acidurias
- Outline the synthesis of palmitic acid in the body
- Mention the advantages of the fatty acid synthase complex in the body. Mention other multienzyme complexes.
- Describe the desaturase and chain elongation system involved in fatty acid synthesis andexplain why essential fatty acids cannot be synthesised by the body
- Differentiate between beta oxidation and synthesis of fatty acid
- Name the different ketone bodies and their importance.
- Mention the organ/tissue and subcellular location of synthesis of ketone bodies; describe thesynthesis of the 3 ketone bodies.
- Mention the organs that utilise ketone bodies and explain the steps involved in its utilization and the key enzyme required.
- Explain the biochemical basis for the signs and symptoms associated with ketoacidosis and the laboratory findings that help in the differential diagnosis and monitoring of this condition.
- Mention the biological importance of cholesterol in the body
- Mention the organ/tissue and subcellular location and describe the step, enzymes involved in the synthesis of cholesterol (up to mevalonate in detail)
- Explain the significance of HMG CoA reductase in cholesterol synthesis and the effect of lipid lowering drugs.
- Differentiate between HMG CoA synthase, HMG CoA reductase and HMG CoA lyase enzymes
- Explain the short term and long term regulation of cholesterol synthesis with special emphasis on the effect of dietary cholesterol receptor mediated uptake of LDL cholesterol.
- Explain the formation bile acids (primary and secondary) and bile salts as the end product ofcholesterol metabolism and its enterohepatic circulation.
- Describe the formation of pulmonary surfactant
- Mention the lipid storage disorders and the biochemical defect associated with it

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- Define and describe Fatty liver and its pathological effects
- Explain the effect of alcohol in development of fatty liver
- Differentiate between alcoholic fatty liver and non-alcoholic steatohepatitis (NASH)
- Mention the lipoptropic factors and their role in fatty liver

BI4.3 Explain the regulation of lipoprotein metabolism and associated disorders

B14.4 Describe the structure and functions of lipoproteins, their functions, interrelations and relations with atherosclerosis.

- Describe the structure , composition and function of various Lipoproteins
- Classify the lipoproteins based on separation technique
- Describe the Formation and cellular uptake and the fate of Chylomicrons, VLDL, LDLand HDL.
- Explain the role of various apoliporoteins, CETP, LCAT, ACAT in the metabolism of lipoproteins
- Explain the role of lipoprotein lipase and the effect of Km on its tissue specificactivity.
- Classify hyper and hypolipoproteinemias based on Frederickson's criteria, mention the biochemical defects associated and the laboratory findings
- Define Atherosclerosis – and explain the role of lipids in atherogenesis (oxLDL, Lp(a), Small dense LDL, HDL)
- Mention the important markers of atherosclerosis

BI4.5 BI 4.7 Interpret the laboratory results of analytes associated with metabolism of lipids

- Explain the various components of a Lipid profile
- Mention the biological reference intervals of total cholesterol, HDL, VLDL and Triglycerides as per current applicable (NCEP) guidelines
- Interpret the lipid profile and apolipoprotein analysis and arrive at the type of lipoprotein disorder.
- Mention other specific biochemical analytes associated with defects in metabolism of lipids (Ex MCAD levels in MCAD deficiency, propionyl CoA carboxylase and biotin levels in propionyl CoA carboxylase deficiency, urinary dicarboxylic acids in defective oxidation of fatty acid)

BI4.6 Describe the therapeutic uses of prostaglandins and inhibitors of eicosanoid synthesis

- Define Eicosanoids and differentiate prostaglandins, prostacyclins, thomboxanes and leukotrienes.
- List the important Prostaglandins and their source in the body , Compare and contrast the biological actions of various prostaglandins, Describe the therapeutic uses of prostaglandins in various conditions (Gastric ulcers,Bronchial asthma, hypertension, Induction of labour, PDA)
- Describe the of action of anti-inflammatory drugs on PG synthesis
- Mention the biological importance of thromboxanes and leukotrienes

METABOLISM AND HOMEOSTASIS

BI6.1 Discuss the metabolic processes that take place in specific organs in the body in the fedand fasting states.

- Describe metabolic adaptations/stages under well fed state, fasting and starvation
- Describe metabolic adaptations during re feeding after prolonged starvation
- Describe metabolic profile of brain, adipose tissue, skeletal muscle, cardiac muscle and liver during well fed state and fasting, Explain relative changes of important parameters during starvation
- Mention the effects of exercise on metabolic profile
- Explain feed fast cycle/starve feed cycle
- List the location of adipose tissue, its cells and functions, name the types of adipose tissue.
- List the features of White Adipose Tissue(WAT)
- Describe the metabolism of adipose tissue in fed and fasting states

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- Define adipokines giving examples and briefly describe the clinical significance of each.
- State the features & metabolism and of Brown adipose tissue.
- State the significance of blood sugar regulation, Name the Factors that add and remove glucose from the blood
- Define Renal threshold & state the importance of SGLT transporters
- Describe the Regulation of blood glucose during Post prandial and fasting states
- State the physiological effects of Insulin, Glucagon & other hyperglycemic hormones
- State the Blood glucose cut-offs-& terminologies-normo, hypo, hyper glycemia & glucose tolerance
- Define Diabetes Mellitus & classify State the WHO Criteria for diagnosis of Diabetes Mellitus
- Differentiate the features of Type 1 & 2 Diabetes Mellitus Describe the Metabolic derangements in DM & biochemical basis of the same. List the laboratory investigations done in a patient of DM

VITAMINS

BI6.5 Describe the biochemical role of vitamins in the body and explain the manifestations of their deficiency

- Define the role of vitamins in health and disease
- Classify vitamins and enumerate all the vitamins in each class, Differentiate the characteristics of water soluble and fat soluble vitamins
- Describe the structure and chemistry of vitamers of vitamin A and provitamin A List the sources of Vitamin A and beta carotene and RDA of vitamin A in adults andchildren, Discuss the digestion, transport and storage of vitamin A, functions of vitaminA &Wald's visual cycle with the help of a neat labeled diagram. Discuss the different stages of deficiency manifestations of vitamin A
- State the common manifestations of hypervitaminosis A. Enumerate the therapeutic uses of vitamin A
- State the provitamin forms of vitamin D. List the sources of Vitamin D and RDA of vitamin D in adults and children. Discuss the synthesis of vitamin D and its conversion to its active form Calcitriolaccurately. Enumerate the reasons to justify Vitamin D is a hormone
- Discuss the role of Calcitriol on calcium and phosphorus metabolism with reference to mineralization of bones
- Name the deficiency disorder of Vitamin D in children and adults, Discuss the causes and deficiency manifestation of Rickets
- Define renal rickets, vitamin D dependent rickets and hypophosphatemic rickets
- Enumerate the extra skeletal functions of calcitriol
- Name the structure and different forms of vitamin E Discuss the role of alpha tocopherol as an antioxidant with special reference to its role a schain breaking antioxidant in lipid peroxidation
- Describe the biochemical functions of Vitamin E, List the rich and moderate sources and RDA of Vitamin E. Describe the deficiency manifestation of Vitamin E
- Name the structure and different forms vitamin K, List the rich and moderate sources and RDA of vitamin K, Describe the biochemical functions of vitamin K, Describe the deficiency manifestation of vitamin K, Enumerate the common manifestations of Hypervitaminosis K
- Name the ring structure and coenzymes Thiamine, List the rich and moderate sources and RDA of Thiamine, Describe the major biochemical functions of Thiamine, Relate the function of TPP with carbohydrate metabolism, Describe the deficiency manifestation of Thiamine, Classify and distinguish the different types of Berberi accurately, Enumerate the antagonists of Thiamine
- Name the ring structure and coenzymes of Riboflavin, Illustrate the formation of FMN and FAD. List the common sources and RDA of Riboflavin, Describe the major biochemical functions of Riboflavin giving examples of different metabolic reactions in which FMN and FAD participate. Describe the deficiency manifestation of Riboflavin Enumerate the antagonists of Riboflavin
- Name the ring structure and coenzymes of Niacin, List the common sources and RDA of Niacin. Describe the biochemical functions of Niacin coenzyme NAD+/NADH giving an example each in carbohydrate,

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lipid and amino acid metabolism, State at least two reactions each of generation and utilization of $NADP^+$ and NADPH respectively, Enumerate the causes of Niacin deficiency, Describe the deficiency manifestation of Niacin, Enumerate the Therapeutic uses and toxicity of Niacin

- Name the components of Pantothenic acid structure, Enumerate the Coenzyme derivatives of pantothenic acid, Discuss the importance of acetyl CoA and Succinyl CoA pool, State the sources, RDA and deficiency manifestations of pantothenic acid
- Name the ring structure and different forms and coenzyme of Pyridoxine, List the common sources and RDA of Pyridoxine, Describe the biochemical functions of Pyridoxine with special reference to role of PLP inamino acid metabolism, Describe the deficiency manifestation, therapeutic uses and toxicity manifestations of Pyridoxine
- Name the components in structure of Biotin, List the common sources and RDA of Biotin, Describe the biochemical functions of Biotin, Mention the biotin independent reactions, State the deficiency manifestations of Biotin, State the role of Avidin - Biotin in clinical assays
- Mention the components in structure of Folic acid, Illustrate the formation of THF, List the common sources and RDA of Folic acid, Discuss the role of folic acid in one carbon metabolism, Describe the deficiency manifestation of Folic acid, List the tests to assess the Folic acid deficiency status, Enumerate the antifolate drugs and their therapeutic uses
- Name the ring structure with its components and co enzyme form of vitamin B12.List the common sources and RDA of Vitamin B12, Discuss the digestion and absorption of Vitamin B12 emphasizing role of intrinsic factorof castle, Describe the functions of Vitamin B12 stating the reaction in which methyl and adenosyl cobalamin participate. Describe the biochemical basis and deficiency manifestation of VitaminB12 and tests to assess the Vitamin B12 deficiency status
- Discuss the chemistry of vitamin C, List the common sources and RDA of vitamin Enumerate the biochemical functions of vitamin C, Describe the deficiency manifestation of vitamin Enumerate the therapeutic uses of vitamin C
- Enumerate the vitamin like substances and mention their structure and function

BIOLOGICAL OXIDATION

BI6.6 Describe the biochemical processes involved in generation of energy in cells.

- Define primary, secondary/intermediary and tertiary metabolism/internalrespiration/cellular respiration.
- Define substrate level and oxidative phosphorylation and enumerate its Sites and examples.
- Define high energy compounds and enumerate its examples.
- Describe the organization, components and flow of electrons in electron transport chain
- Explain the chemiosmotic theory.
- Describe the Binding change mechanism of ATP synthesis by ATP synthase.
- Explain the regulation of ATP synthesis by oxidative phosphorylation. Enumerate the inhibitors of electron transport chain and oxidative phosphorylation, Define uncouplers and enumerate its examples.
- Describe the role of brown adipose tissue in thermogenesis

ACID BASE BALANCE, WATER AND ELECTROLYTE BALANCE

BI6.7 Describe the processes involved in maintenance of normal pH, water & electrolyte balanceof body fluids and the derangements associated with these.

- Enumerate the functions of water.
- Outline the distribution of water in various body compartments.
- Explain the principles of water balance by considering water inputs sources and water output process. Explain the various regulatory mechanisms by which water balance is maintained.
- Illustrate the distribution of electrolytes in various body compartments
- State the serum reference range for measured electrolytes; sodium, potassium, chloride and bicarbonate Describe the concepts of osmolality, plasma osmolality and effective osmolality

- Describe the hormonal regulation of water and electrolyte balance Discuss the role of Renin – Angiotensin system in regulation of water and electrolyte balance. Discuss the causes, pathophysiology and biochemical alterations in conditions of dehydrationand over hydration
- Explain the composition and basis of dehydration management with ORS. Discuss briefly the causes, pathophysiology and manifestations of dehydration
- Define acids and bases, Discuss importance of Henderson Hasselbalch's equation

Define buffer, buffering capacity and its significance. Classify buffers in the body and plasma Explain role and mechanism of bicarbonate buffer system in maintenance of pH. Explain the role of phosphate buffer system and protein buffer system in maintenance of pH. Explain the role of respiratory system in maintaining acid balance. Explain the isohydric transport of CO_2 in blood. Highlight the importance of renal system in maintaining acid balance. Discuss the key mechanisms by which kidneys help in maintaining acid basebalance. Define titrable acidity

- Highlight the importance of glutaminase and ammonia in buffering acid-base balance. Classify acid base disorders based on the metabolic/ respiratory component and pH. Describe the causes, pathophysiology and compensatory mechanisms in metabolicacidosis
- Define Anion gap and write its reference range. Classify metabolic acidosis based on anion gap giving at least three causes in each type
- Describe the causes, pathophysiology and compensatory mechanisms in metabolicAlkalosis
- Classify metabolic alkalosis based on urinary chloride levels
- Recognize the relationship between serum potassium and metabolic Alkalosis

Describe the causes, pathophysiology and compensatory mechanisms in Respiratory acidosis

- Describe the causes, pathophysiology and compensatory mechanisms in Respiratory alkalosis

BI6.8 Discuss and interpret results of Arterial Blood Gas (ABG) analysis in various disorders

- Discuss the role of Arterial Blood Gas (ABG) analysis in diagnosing various acidbase disorders / Explain the application of ABG analysis in clinical practice
- Interpret results of Arterial Blood Gas (ABG) analysis data in the given cases

MINERALS

BI6.9 Describe the functions of various minerals in the body, their metabolism and homeostasis

Define major minerals and microminerals.

Enumerate RDA, dietary sources, functions, biological reference interval of calcium and phosphorus.

Explain distribution in the body, transport across cells, absorption and regulation of metabolism of calcium and phosphorus. Enumerate RDA, dietary sources, functions, proteins containing iron in the body, transport and storage forms of iron.

Explain distribution in the body, transport across cells, absorption, mucosal block theory of ironabsorption and regulation of metabolism of iron.

Enumerate functions, proteins containing and dietary sources of Copper, Zinc, Selenium, Magnesium and other trace elements like, iodine, nickel, molybdenum and chromium.

Enumerate functions, dietary sources, RDA and biological reference interval of sodium, potassium and chloride.

BI 6.10 Enumerate and describe the disorders associated with mineral metabolism

Enumerate the signs and symptoms, laboratory investigations and disorders associated with metabolism of calcium, phosphorus, iron, sodium and chloride

Describe the biochemical basis of signs and symptoms of disorders associated with metabolism of calcium, phosphorus, iron, sodium and chloride

Interpret the mineral status of calcium, phosphorus, iron, sodium and chloride in normal peopleand in associated disorders using laboratory investigations

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Enumerate the disorders associated with Copper, Zinc, Selenium, Magnesium & other trace elements like, iodine, nickel, molybdenum and chromium

NUTRITIONAND DIETETICS

BI8.1 Discuss the importance of various dietary components and explain importance of dietary fibre.

List the important dietary components of food

Define calorific value of food and list the calorific value of carbohydrate, protein and fat. List the sources, recommended daily intake and types of dietary carbohydrates

Discuss about the major dietary polysaccharide and cane sugar with their clinical importance

Define dietary fibre and their requirement per day and list the dietary fibres with examples. Enumerate the physiological effect of dietary fibre and their clinical importanceList the sources, different types of dietary fat and recommended daily Intake

List the different sources of cholesterol and the clinical importance of cholesterolDiscuss about polyunsaturated fatty acids, essential fatty acids

List the sources of dietary protein and recommended daily intake of proteinDiscuss about essential amino acids. Define nitrogen balance and enumerate their typesEnumerate the factors affecting nitrogen balance

List the indices used to assess the nutritional value of protein and add a note on amino acid Score. Discuss about limiting amino acid and mutual supplementation

BI8.2 Describe the types and causes of protein energy malnutrition and its Effects

Classify protein energy malnutrition

Enumerate the causes for protein energy malnutrition

Describe aetiology, clinical features, investigation and treatment of kwashiorkor and add a note on biochemical mechanism underlying the disease

Describe aetiology, clinical features, investigation and treatment of marasmus and add note on biochemical mechanism underlying the disease

Differentiate between kwashiorkor and marasmus Discuss marasmic kwashiorkor and its sequelae Discuss about treatment of protein energy malnutrition Define and list the causes of cachexia due to diseases

BI8.3 Provide dietary advice for optimal health in childhood and adult, in disease conditions like diabetes mellitus, coronary artery disease and in pregnancy

Define respiratory quotient and list the RQ of carbohydrate, fat, protein and mixed diet.

Define Basal Metabolic Rate, list the factors affecting BMR, different types of measurements of BMR and normal value of BMR

Describe Specific Dynamic Action (SDA)

List the different types of physical activity and add a note on energy requirement ofdifferent physical activity, List the components of balanced diet Discuss about food guide pyramid, Discuss the general principles prescribing a diet based on body weight, protein requirement, calorie requirement and SDA and importance of prescribing a dietDescribe the different steps of prescribing the diet for a 60kg sedentary man

Describe glycemic index with reference meal as 50gram of glucose and list the glycemic index of common foods

Describe the different steps of prescribing the diet for diabetic patient with respect to glycemic index and add a note on dietary guidelines to be followed by the diabetic patient

Describe the different steps of prescribing the diet for cardiac patient and add a note on dietary guidelines to be followed by the cardiac patient

Describe the different steps of prescribing the diet for pregnant ladies.Discuss about total parenteral nutrition

BI8.4 Describe the causes (including dietary habits), effects and health risks associated withbeing overweight/ obesity

Define obesity with respect to body mass index (BMI)

List the causes for overweight and obesity including genetic causes for obesity Discuss about regulators of appetite

Describe the different steps of prescribing the diet for overweight and obese individual and

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add a note on Atkin's diet
Enumerate the ill effects associated with overweight and obese
Discuss the steps to be followed for prevention and treatment of overweight and obese

BI8.5 Summarize the nutritional importance of commonly used items of food including fruitsand vegetables (macro-molecules & its importance)

List the common food items of Indian population and their ratio in diet
Discuss cereals and millets are the major sources of energy and their nutritional value
Discuss about mutual supplementation of cereals and pulses, Discuss, milk is a complete protein
Discuss, egg is the reference protein
Discuss the nutritional importance of fruits and vegetablesDiscuss, water is the essential nutrient of life

EXTRACELLULAR MATRIX

BI9.1 List the functions and components of the extracellular matrix (ECM).

- List the functions of extracellular matrix.Enumerate the different components of ECM. Describe the structure of collagen
- Describe the structure and functions of mucopolysaccharides
- Explain the role of mucopolysaccharides in formation of extracellular matrix
- Enumerate the functions of Proteoglycans in extracellular matrix
- Explain briefly the role of non-collagen proteins in extracellular matrix formation
- Explain the role of Laminin, Elastin and Fibronectin

BI9.2 Discuss the involvement of ECM components in health and disease.

- Enumerate the various genetic disorders from abnormalities in the synthesis of collagen
- Discuss briefly the pathophysiology of Ehler-Danlos syndrome, Marfan syndrome, Alport syndrome
- Explain the alterations of ECM components in osteoarthritis or rheumatoid arthritis

blockers, radiotherapy, hybridoma technology, monoclonal anti, body and their application

Summary of TL methods and list of competencies with integration to be covered in Phase I MBBS

INTEGRATION TOPICS

Sl.No	Topics and competency numbers	No. of. Hours	Department of Integration
1.	**Introduction & Scope of Biochemistry**	1 Lecture	
2.	**Cell and organelles, Cell membrane, Transportacross cell membranes (BI1.1)**	2 Lecture + 2 Integration	Physiology
3.	**Enzymes (BI2.1, BI2.3, BI2.4, BI2.5, BI2.6, BI2.7) General Enzymology-**	5 lecture +2 small group teaching+ 2 Case basedLearning	General Medicine &Pathology
4.	**Chemistry of Carbohydrates** (BI3.1)	3 lectures	
5.	**Chemistry of lipids (BI4.1, BI11.24)**	3 lectures	
6.	**Chemistry of amino acids and Proteins** (BI5.1,BI5.2)	3 lectures	
7.	**Plasma proteins (BI5.2)**	1 lecture + 2 Case Based Learning + 1 integrated teaching	Physiology, General Medicine & Pathology

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8.	**Immunology (BI10.3, BI10.4, BI10.5)**	1 lecture + 2 integrated teaching	Physiology, Microbiology, Pathology, Paediatrics, General Medicine, OBG, General Surgery
9.	**Vitamins (BI6.5)**	2 lectures + 4 Small group teaching + 6 Case Based Learning	General Medicine
10.	**Free Radicals and Antioxidants (BI7.6, BI7.7)**	1 lectures + 2 Small group teaching	Pathology, General Medicine
11.	**Heme metabolism (BI6.12, BI5.2)**	1 lecture + Integrated teaching	Physiology, Pathology, General Medicine
12.	**Heme metabolism (BI6.11, BI11.17)**	2 lectures + 4 Case Based Learning + 1 integrated teaching	Physiology, Pathology, General Medicine
13.	**Extracellular matrix (BI9.1, BI9.2)**	2 lectures + 2 Small Group Teaching	
14.	**Biological Oxidation (BI6.6)**	3 lectures	
15.	**Carbohydrate metabolism (BI3.2, BI3.3, BI3.4,BI3.5, BI3.6, BI3.7, BI3.9)**	8 lectures + 2 Small group teaching + 4 Case Based Learning	General Medicine [all topics] Physiology[glycolysis & TCA], Pathology [lab tests])
16.	**Lipid metabolism (BI4.2, BI4.3, BI4.4, BI4.6)**	8 lectures + 2 Small group teaching + 2 Case Based Learning	
17.	**Protein and amino acid metabolism (BI5.3, BI5.4, BI5.5, BI11.17)**	7 lectures + 2 Small group teaching + 4 Case Based Learning	General Medicine & Paediatrics
18.	**Metabolism and homeostasis (BI6.1, BI3.8, BI4.5, BI4.7, BI3.10, BI11.17)**	2 lectures + 4 Small group teaching + 2 integrated teaching	General Medicine & Pathology
19.	**Minerals (BI6.9, BI6.10)**	2 lectures + 4 Small group teaching + 2 Case Based Learning + 2 integrated teaching	General Medicine & Physiology
20.	**Chemistry of Nucleic acids (BI7.1)**	2 lectures	
21.	**Nucleotide metabolism (BI6.2, BI6.3, BI6.4)**	2 lectures + 2 Case Based Learning	General Medicine, Physiology
22.	**Molecular Biology (BI7.1, BI7.2, BI7.3, BI9.3) Case Based Learning- DNA Repair**	7 lectures + 4 Small Group Teaching	Paediatrics

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23.	**Molecular biology techniques and Gene therapy,(BI7.4), Core: Case Based Learning- Southern Blotting Technique**	2 lectures + 2 Small group teaching + 1 integrated teaching	General Medicine & Paediatrics
24.	**Biochemistry of Cancer (BI10.1, BI10.2) Case Based Learning- Prostate carcinoma, Breast carcinoma**	3 lectures + 2 Case Based Learning + 2 integrated teaching	Pathology, General Surgery & OBG)
25.	**Nutrition and dietetics (BI8.1, BI8.2, BI8.3, BI8.4, BI8.5, BI11.17, BI11.23, BI11.24)**	3 lectures + 2 Small group teaching + 2 Case Based Learning + 2 integrated teaching	Pathology, Community Medicine General Medicine & Paediatrics
26.	**Organ function tests (BI6.13, BI6.14, BI6.15, BI11.17)**	1 lectures + 4 Small group teaching + 6 Case Based Learning + 2 integrated teaching	Anatomy, Physiology, Pathology, General Medicine
27.	**Acid base balance (BI6.7, BI6.8, BI11.17)**	2 lectures + 2 Case Based Learning + 1 integrated teaching	Physiology, Pathology, General Medicine
28.	**Water and electrolyte balance (BI6.7)**	1 lectures + 2 Small Group Teaching + 1 integrated teaching	Physiology, General Medicine
29.	**Xenobiotics and Detoxification (BI7.5)**	1 Lecture	
30.	**Clinical chemistry (BI11.16)**	2 Small Group Teaching	

Teaching Learning Methods:

The university incorporates the guidelines of the CBME curriculum prescribed by the National Medical Commission (NMC). The department uses various innovative teaching learning methods to facilitate effective student learning.

Cognitive, Psychomotor and Affective Domain

Sl. No.	T-L Method	Number of Hours
1	Interactive Lectures	80
2	Practicals, Small Group Learning Tutorials Visit to hospital OPDs and Wards Case based Learning for Integrated sessions /Seminars/ videos/role play/live/simulation	150
3	Early Clinical Exposure	30
4	Self-Directed Learning	20

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Assessment methods:

Formative Assessment:

The department follows the concept of continuous assessment for evaluating the students. The department of Biochemistry shall conduct tutorials, **monthly tests, viva voce and three internal assessments. Fourth internal assessment will be conducted for improvement of scores as a remedial measure.**

This facilitates to give feedback to students on their learning. These tests allow regular and timely revision by the students. It also prepares the student to attend the summative examination with confidence.

Sl. No.	Assessment methods
1	Modified Long essay, Short Essay (SE),
2	Short answer questions (SAQ)
3	Multiple choice questions (MCQ)
4	Short Seminars
5	Case history
6	Tutorials
7	Table viva voce
8	Objective Structured Practical Examination (OSPE)- Performance and Response)

Guidelines for Internal assessment:

13) The department will conduct a minimum of three internal assessments.
14) The **3 rd internal assessment** to include **one short essay** on **AETCOM modules 1.4**.
15) The **third internal assessment** will be as per university **summative examination.**
16) The marks obtained in the formative assessment should be displayed on the notice board within 1 -2 weeks after conducting the tests.

Theory:

- The theory paper will be conducted for 60 marks for 1st and 2nd IA and 100 marks for third IA
- Blue print guidelines to be followed for question paper setting.
- The distribution of marks will be as follows:
    i. 40% of the subject questions will be based on clinical correlation and integration (LE, SE).
    ii. 40% of the subject questions will and comprehension level of questions (SE).
    iii. 20% of the subject questions will be of recall type. (SAQs and MCQs).
    - Each **internal assessment weightage** shall be as per the template mentioned under university exam pattern for topics mentioned under either paper

Distribution of topics for Paper 1 for assessment- Topic wise weightage

Sl No	Paper 1 Topics	Weight age Upto (in marks)
1	Cell, cellular organelles and membrane transport	5
2	Extra cellular matrix	3
3	Enzymes	13

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4	Carbohydrate Chemistry	5
5	Carbohydrate Metabolism	13
6	Lipid Chemistry	5
7	Lipid Metabolism	13
8	Metabolism and homeostasis	8
9	Biological Oxidation	5
10	Vitamins	13
11	Minerals	13
12	Nutrition	10
13	Acid Base Balance	13
14	Water and Electrolyte Balance	6

Note:

Weightage of marks assigned to topics may add to more than 100

Structured Long essay question should be from the topics with weightage of MORE THAN 10 marks. However, a part of structured long essay may be from other topics adhering to the weightage of marks allotted for that topic.

- **However, a strict division of the subject may not be possible andsome overlapping of topics is inevitable. Students should be prepared to answer overlapping topics.**

Scheme of Internal Assessment:

Sl.No	Type of questions	Marks	Marks
1.	Long Essay	(2X10)=20	(2X10)=20
2.	Short Essay	(5X5) = 25	(10X5) = 50
3.	SAQs	(5X3) =15	(10X3) 30
4.	**Total**	**60**	**100**

Practical:

- The practical will be conducted for **80 marks.**
- **Scheme for practical assessment:**

Sl. No.	Assessment type	Marks
A Quantitative and Qualitative Procedure		
1	Qualitative Experiments with discussion	20
2	Quantitative Experiments with discussion	20
B Case study and OSPE		
1	**Case studies** with discussion	20
2	OSPE(performance and response)	20
Total		**80**

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- The **biochemistry practical record** and the **log book** should be evaluated on a continuous basis and certified by the department before the summative examination

The **pass criteria** in each internal assessment will be 40% separately in theory and practical. **Eligibility criteria** to take up summative examination, theory and practical cumulative should be 50%.

Regular monthly tests will be conducted in addition to the three internal assessments. These will be in the form of **SAQ test, MCQ test, SE test, Table viva, OSPE tests etc**.

Scores obtained in monthly assessment will be given weightage when considering internal assessment eligibility for summative examination.

LOG BOOK:

The biochemistry log book should be completed and evaluated by the faculty on a timely basis. The same to be certified by the head of the department at the end of the program before summative examination.

Biochemistry Practical RECORD:

The Biochemistry record should be certified before each internal assessment and final certification by the head of the department before summative examination.

Eligibility for Summative Examination:

Weightage of various assessments as eligibility criteria for Summative exam:

Sl. No.	Type of Assessment	Weightage
1.	Internal assessment	75% (70%)
2.	Monthly assessment	7% (12%)
3.	Professionalism	6%
4.	Biochemistry practical records	6%
5.	Level of participation in ECE	6%

Sl. No.	Theory		Practical	
1	IA Theory	30	Experiments, case reports and OSPE	30
2	Monthly Assessments	5	Biochemistry record	05
3	Professionalism	5	Level of participation in ECE	05
4	**Total**	**40**	**Total**	**40**

Another Proposal

Formative assessment :			
Theory	**30 Marks**	**Practical**	**30 Marks**
Monthly Assessments - MCQs / SAQ tests / Viva voce etc.	05	Biochemistry Practical records	05
Attitude	01	ECE Participation	05
Written Assignments	02		
Attendance	02 (for T + P attendance > 90%) 01 (for T + P attendance between 80-90%) **Eligibility criteria for attendance is 80% (separately for theory & practical)**		
Total	40		40

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The eligibility is calculated by considering the internal assessment/monthly assessment and Professionalism and ethics (**average should be 40% in theory and practical separately** and **50% in theory and practical combined**).
Attendance should be 75% in theory and 80% in practical, 75 % each for Foundation course and AETCOM.
If a student is found not to meet the criteria of eligibility for summative examination, remedial measures in the form of improvement tests/assignments should be given. The student can be allowed to take up summative examination if the remedial measures are fulfilled.
The internal assessment will appear as a separate subheading in the marks card and not be considered for pass criteria of final summative examination.

Summative Assessment:

Marks

Sl. No.	Theory	Practical	Viva	Total
Marks	200	80	20	300

Distribution:

Theory: 2 papers of 100 marks each.

The portions of theory paper I:

Cell, cellular organelles and membrane transport, Extra cellular matrix, Enzymes, Carbohydrate Chemistry and Metabolism, Lipid Chemistry and Metabolism, Metabolism and homeostasis, Biological Oxidation, Vitamins, Minerals, Nutrition, Acid Base Balance, Water and Electrolyte Balance

Pattern of Assessment:

Theory: Maximum marks: 100

Theory paper I

Sl. No.	Type of Question	Number	Marks
1	Long Essay	2 X 10	20
2	Short Essay	6 X 5	30
3	Short answer questions	10 X 3	30
4	MCQs	20 X 1	20
5	**Total**	**38**	**100**

Paper I topics and Blue print for Question paper

Sl No	Paper 1 Topics	Weight age Upto (in marks)	Long Essay	Short Essay	Short answer	MCQ
1	Cell, cellular organelles and membrane transport	5		√	√	√
2	Extra cellular matrix	3		√	√	√
3	Enzymes	13	√	√	√	√

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4	Carbohydrate Chemistry	5		√	√	√
5	Carbohydrate Metabolism	13	√	√	√	√
6	Lipid Chemistry	5		√	√	√
7	Lipid Metabolism	13	√	√	√	√
8	Metabolism and homeostasis	8		√	√	√
9	Biological Oxidation	5		√	√	√
10	Vitamins	13	√	√	√	√
11	Minerals	13	√	√	√	√
12	Nutrition	10	√	√	√	√
13	Acid Base Balance	13	√	√	√	√
14	Water and Electrolyte Balance	6		√	√	√

Note:

- Weightage of marks assigned to topics may add to more than 100
- Structured Long essay question should be from the topics with weightage of MORE THAN 10 marks. However, a part of structured long essay may be from other topics adhering to the weightage of marks allotted for that topic.
- **The topics to different paper are generally evaluated under those sections. However, a strict division of the subject may not be possible and some overlapping of topics is inevitable. Students should be prepared to answer overlapping topics.**

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PRACTICAL:

Practical exercises – 80 marks

1. **Exercise 1: OSPE - 20 Marks**
2. **Exercise 2: Qualitative analysis of Normal or Pathological constituents of Urine - 20 Marks**
3. **Exercise 3: Quantitative estimation and interpretation - 20 Marks**
4. **Exercise 4: Case studies - 20 Marks**

Exercise 1: OSPE (20 Marks)

No. of Stations: 4 (1 performance station, 3 response stations)
Marks for Each Station: 5
Time for each station: Max 5 min

Exercise 2: Qualitative analysis of Normal or Pathological constituents of Urine (20 Marks)

Selection, principle and performance of tests :10 marks
Interpretation and Discussion :10 marks

Note: Alphabetically arranged test procedures shall be given.

Exercise 3: Quantitative estimation and interpretation (20 Marks)

Principle: 5 Marks
Performance, Calculation and Results: 5 Marks
Interpretation and Discussion: 10 Marks

Note : Procedure sheets shall be given.

Exercise 4: Case studies (20marks)

Total No. of case reports: 2
1 Major Case study for 12 marks and 1 Minor Case study for 8 marks
Suggested Major Case studies: Organ function tests/Diabetes mellitus/Acid base disorders/Myocardial infarction/Dyslipidemia/PEM

Note : Questions for Quantitative experiments may preferably be case based scenarios.

B. Viva voce : 20 marks

The viva - voce examination shall carry 20 marks and all examiners will conduct the examination. Viva should focus on application and interpretation. (viva marks to be added to practical and not theory)

Pass Criteria:

The student should secure **40% in each theory paper** and **50% of aggregate of the two papers**.
The student should secure 50% in **practical exam + viva.**

Supplementary Exam:

Supplementary exams to be conducted and results to be declared **within 60** days after announcement of results of main summative examination. If the student clears the supplementary exam he/she can join the regular batch.

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PRACTICAL PORTIONS

Topic: Biochemical Laboratory Tests Number of competencies: (24)Number of procedures that require certification: (05)

BI11.1 Describe commonly used laboratory apparatus and equipment, good safe laboratorypractice and waste disposal.

List commonly used laboratory glassware and equipments. Indicate commonly used laboratory glassware and equipments.Describe Good and safe laboratory practices.

Explain the current guidelines for Biomedical waste disposal

BI11.2Describe the preparation of buffers and estimation of pH.

Define buffers, molarity, normality, molar solution, normal solution, percentage solution.Identify the uses of at least 4 buffers in biochemistry laboratory.

Describe the method to prepare at least two commonly used buffers in Biochemistry laboratory.

Describe the importance of HH equation in determination of pH. Describe the principle, parts and uses of pH meter.

Explain the procedure to estimate pH using pH meter. Observe the estimation of pH of different buffers using pH meter

BI11.3 Describe the chemical components of normal urine.

List the chemical components of normal urine categorising under organic and inorganicconstituents

List the chemical tests to be performed to detect organic and inorganic components of normal urine

Explain the principles of all the chemical tests listed to detect organic and inorganiccomponents of normal urine

Describe the clinical significance of organic constituents of normal urine.Describe the clinical significance inorganic constituents of normal urine.

Interpret the physiological and pathological variations in organic and inorganic constituents of urine

BI11.4 Perform urine analysis to estimate and determine normal and abnormal **constituents**

Describe the ways of urine sample collection and the preservatives used.

Specific gravity under normal physiological conditions.

Describe the physical properties of urine for colour, odour, appearance, pH, Specific gravity inabnormal/diseased conditions.

Describe the abnormal constituents of urine in different diseases conditions.

Perform the physical analysis of normal urine for colour odour and appearance by observation.Estimate the pH of given urine sample using pH paper correctly by comparison of-color change by visual analysis.

Estimate the specific gravity of given urine sample using urinometer correctly withtemperature correction

Perform urine analysis to determine at least 3 organic and 3 inorganic constituents of normal ureby chemical tests according to the given procedure.

List the common abnormal constituents of urine. List the chemical tests to be performed to detect abnormal constituents of urine. Describe the principles of all the chemical tests listed to be performed to detect abnormalconstituents of urine.

Perform urine analysis to determine abnormal constituents like protein, reducing substance, ketone bodies, blood, bile salts, bile pigments by chemical tests according to the given procedure.

Perform the dipstick analysis of given urine sample for chemical constituents according to the given procedure and observe the findings

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BI11.5 Describe screening of urine for inborn errors & describe the use of paper chromatography

Enumerate the urine screening tests for inborn errors of metabolism.

Identify the urine screening tests for inborn errors of metabolism as positive or negative and interpret the findings.

Describe the principle and uses of paper chromatography. Interpret the given paper/TLCchromatogram of amino acids accurately.

Interpret the given lab reports of screening tests for inborn errors of metabolism

BI11.6 Describe the principles of colorimetry

Describe the principle of photoelectric colorimeter/spectrophotometer and the application of Beer Lamberts law,

Describe the parts of the photoelectric colorimeter using a labeled Diagram Explain the differences between colorimeter and spectrophotometer

I11.7 Demonstrate the estimation of serum Creatinine and Creatinine clearance

Explain the principle of Jaffe's method and modified Jaffe's method for estimation of serumCreatinine, Describe the principle of Jaffe's method for estimation of urine creatinine, standard test protocol. Perform the estimation of urine creatinine by Jaffe's method using colorimeter as per thestandard test protocol.

Calculate the creatinine clearance using the formula UV/P with given volume of urine output and the serum Creatinine and urine Creatinine determined in previous experiment.

Interpret the given serum creatinine, urine creatinine and creatinine clearance values againstbiological reference intervals.

Interpret the given serum creatinine, urine creatinine and creatinine clearance values inpathological conditions.

Explain the difference between measured and calculated eGFR and its clinical significance. Explain the use of urine Creatinine in expressing the excretion of other compounds as ratios.

BI11.8Demonstrate estimation of serum proteins, albumin and A:G ratio

Describe the principle of Biuret method for estimation of serum Total protein

Describe the principle of Dye binding method (BCG) for estimation of serum Albumin Perform the estimation of serum Total protein by Biuret method using colorimeter as per thestandard test protocol

Perform the estimation of serum Albumin by Dye binding (BCG) method usingcolorimeter as per the standard test protocol, Calculate A:G ratio using serum total protein and serum albumin values obtained in previous experiment, Interpret the given serum protein, albumin and A:G ratio values against biological reference intervals.

BI11.9 Demonstrate the estimation of serum total cholesterol and HDL- cholesterol

Describe the principle of chemical/enzymatic method for estimation of serum TotalCholesterol

Describe the principle of given method for estimation of serum HDL CholesterolPerform the estimation of serum Total cholesterol by chemical method using Colorimeter/Semi automated analyser as per the standard test protocol

Perform the estimation of serum HDL cholesterol by chemical method usingColorimeter/Semi automated analyser as per the standard test protocol

Interpret the given serum Total cholesterol and serum HDL Cholesterol values againstbiological reference intervals

BI11.10Demonstrate the estimation of triglycerides

Describe the principle of given method for estimation of serum triglycerides

Perform the estimation of serum triglycerides by given method using Colorimeter/Semi automated analyser as per standard test protocol

BI11.11Demonstrate estimation of calcium and phosphorous

Describe the principle of OCPC/Dye binding method for estimation of serum Total calcium,

Describe the principle of given method for estimation of serum phosphorous

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Perform the estimation of serum Total calcium by given method using Semiautomated analyser as per standard test protocol. Perform the estimation of serum phosphorous by chemical method using colorimeter as per the standard test protocol. Interpret the given serum Total calcium and serum phosphorous values against biological reference intervals

BI11.12Demonstrate the estimation of serum bilirubin

Describe the principle of given method for estimation of serum Total Bilirubin

Perform the estimation of serum Total bilirubin by given method using Colorimeter as per the standard test protocol

Interpret the given serum Total bilirubin values against biological reference intervals

BI11.13Demonstrate the estimation of SGOT/SGPT

Describe the principle of given method for estimation of serum SGOTDescribe the principle of given method for estimation of serum SGPT

Perform the estimation of serum SGOT by given method using Semi automated/autoanalyser as per the standard test protocol. Perform the estimation of serum SGPT by given method using Semi automated/autoanalyser as per the standard test protocol. Interpret the given serum SGOT and serum SGPT values against biological reference intervals

BI11.14Demonstrate the estimation of alkaline phosphatase

Describe the principle of given method for estimation of serum Alkaline phosphatase. Perform the estimation of serum alkaline phosphatase by given method using Colorimeter/Semi automated analyser as per the standard test protocol

Interpret the given serum alkaline phosphatase values against Biological reference intervals

BI11.15Describe & discuss the composition of CSF

Describe the normal physical properties of CSF

Describe the physical properties of CSF in abnormal conditionsDescribe the normal chemical composition of CSF. Discuss the alterations in chemical composition of CSF in abnormal conditions

BI11.16Observe use of commonly used equipment's/techniques in biochemistry

pH meter, Paper chromatography of aminoacid ,Protein electrophoresis, TLC,PAGE, Electrolyte analysis by ISE,ABG analyzer, ELISA , Immunodiffusion , Autoanalyser, Quality control, DNA isolation from blood/tissue

Observe the estimation of pH of any two buffers using pH meter and their applications. Observe the paper chromatography of aminoacids using standard amino acid mixtures andurine sample and their applications

Observe the Thin layer chromatography of aminoacids using standard amino acid mixtures and urine sample and their applications

Observe the agarose gel serum protein electrophoresis of normal and abnormal serum samples and their applications

Observe the agarose gel hemoglobin electrophoresis of normal and abnormal blood samples and their applications

Observe the PAGE for separation of proteins and their applications. Observe the serum electrolyte analysis by ISE and their applications Observe the blood gas analysis on ABG analyser and their applications

Observe the ELISA procedure with quantitation using plate reader and their applications

Observe the immunodiffusion technique and their applications

Observe the functioning of autoanalysers and describe the principles and advantages of autoanalysers in clinical biochemistry laboratory

Explain quality control process in clinical biochemistry laboratory and their use. Observe the isolation of DNA from blood/tissues and describe the application

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BI11.17 Explain the basis and rationale of biochemical tests done in the following conditions:

Diabetes Mellitus, Dyslipidemia, Myocardial infarction, Renal failure, gout, Proteinuria, Nephrotic syndrome, Edema, Jaundice, Liver diseases, pancreatitis, disorders of acid-base balance, Thyroid disorders.

List the lab tests used to diagnose diabetes mellitus List the tests used to monitor diabetes mellitus status

Explain the basis and rationale of glycated haemoglobin to monitor diabetic status Explain the basis and rationale of lipid profile in evaluation of cardiovascular riskassessment

Explain the basis and rationale of dyslipidemia in diabetes mellitus. Enumerate the tests used to evaluate cardiac function

Explain the basis and rationale of the tests used in diagnosis of Myocardial infarction

Explain the basis and rationale of the lab tests done to assess the functioning of kidney Discuss the commonly done renal function tests in renal failure

Explain the basis and rationale of serum uric acid in gout

Explain the basis and rationale of tests used in diagnosis of Nephrotic syndrome. Explain the lab evaluation for different types of Jaundice

Describe the lab tests done to assess the functioning of Liver Explain the basis and rationale of lab tests done in Liver disorders

Explain the basis and rationale of lab tests done to assess the functioning of pancreas. Discuss the lab tests done in pancreatic disorders

Explain the basis and rationale of lab tests done to assess the functioning of thyroid. Discuss the lab tests done in thyroid disorders

Discuss the lab tests done in acid base disorders Interpret the given lab report of patient with jaundice

Interpret the given lab report of patient with renal dysfunction Interpret the given lab report of pancreatic function tests Interpret the given lab report of thyroid function tests Interpret the given lab report of cardiac function tests

Interpret the given lab report of patient with type 2 diabetes mellitus

Interpret the given lab report of patient with acute chest pain presenting to emergencydepartment

Justify the given lab findings in patient presenting with arthritis

BI11.18 Discuss the principles of spectrophotometry.

Describe the principle of spectrophotometryDescribe the parts of spectrophotometer

BI11.19 Outline the basic principles involved in the functioning of instruments commonly used in a biochemistry laboratory and their applications.

Describe the principle and uses of colorimeter. Describe the principle and uses of spectrophotometer. Describe the principle and uses of urinometer Describe the principle and uses of pH meter

Describe the principle and uses of semiautomated analyser

Describe the principle and uses of fully automated chemistry analyser, describe the principle and uses of fully automated immune-analyser Describe the principle and uses of centrifuge

Describe the principle and uses of electrophoresis apparatus. Describe the principle and uses of glucometer

Describe the principle and uses of ABG analyser

Describe the principle and uses of electrolyte analyser by ISE

BI11.20Identify abnormal constituents in urine, interpret the findings and correlate these with pathological states.

Identify the abnormal constituents of urine from the given chemical Tests

Interpret the abnormal physical and chemical test findings of the given urine sample

Correlate the abnormal urine findings in given urine sample with pathological states

BI11.21 Demonstrate estimation of glucose, creatinine, urea and total protein in serum.

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Describe the principle of enzymatic method for estimation of serum glucose Perform the estimation of serum Glucose by enzymatic method using colorimeter Interpret the given serum glucose levels against biological reference intervals Describe the principle of Jaffe's method for estimation of serum creatinine Perform the estimation of serum creatinine by Jaffe's method using colorimeter Interpret the given serum creatinine levels against biological reference intervals Describe the principle of for estimation of serum urea by an end-point method Perform the estimation of serum urea by an end-point method using colorimeter Interpret the given serum glucose levels against biological reference intervals Describe the principle of Biuret method for estimation of serum total

BI11.20 Identify abnormal constituents in urine, interpret the findings and correlate thesewith pathological states.

Identify the abnormal constituents of urine from the given chemical tests.

Interpret the abnormal physical and chemical test findings of the given urine sample.Correlate the abnormal urine findings in given urine sample with pathological states

BI11.21 Demonstrate estimation of glucose, creatinine, urea and total protein in serum.

Describe the principle of enzymatic method for estimation of serum glucose Perform the estimation of serum Glucose by enzymatic method using colorimeter

Interpret the given serum glucose levels against biological reference intervals

Describe the principle of Jaffe's method for estimation of serum creatinine Perform the estimation of serum creatinine by Jaffe's method using colorimeter Interpret the given serum creatinine levels against biological reference intervals

Describe the principle of for estimation of serum urea by an end-point method Perform the estimation of serum urea by an end-point method using colorimeter Interpret the given serum glucose levels against biological reference intervals

Describe the principle of Biuret method for estimation of serum total protein Perform the estimation of serum Total protein by Biuret method using ColorimeterInterpret the given serum Total protein levels against biological reference intervals

BI11.22Calculate albumin: globulin(AG) Ratio and Creatinine clearance

Calculate A: G ratio using given serum total protein and serum albumin values andinterpret the results.

Calculate the creatinine clearance using the formula UV/P with given volume of urine outputand interpret the results.

BI11.23Calculate energy content of different food Items, identify food items with high and lowglycemic index and explain the importance of these in the diet

Calculate the energy content of different food items correctly based on their carbohydrate, protein and lipid content

Identify food items with high and low glycemic index

Explain the importance of low and high glycemic index food items in diet in normal anddiseased conditions

BI11.24Enumerate advantages and/or disadvantages of use of unsaturated, saturated andtrans fats in food.

Explain the advantages and/or disadvantages of use of unsaturated fats in food. Explain the advantages and/or disadvantages of use of saturated fats in food.

Explain the advantages and/or disadvantages of use of trans fats in food.

Course Outcomes for Biochemistry

At the end of the course, the students should be able to

Course Code	Course Name	Course Outcome	
MBC103A	Biochemistry 1	103A.1	Describe structure, function, and metabolic interrelationship/integration of biomolecules - Carbohydrates, Lipids, Vitamins, Minerals & Water in health and disease
		103A.2	Describe biochemical basis & associated consequences of Nutritional deficiency
		103A.3	Explain the biochemical basis, associated consequences, rationale of clinical laboratory tests for diseases, acid based disorders inborn errors of Carbohydrate & Lipid metabolism, and interpret the results in the clinical context.
		103A.4	Procedure to follow good laboratory practices; handle biological tissue, and body fluid along with judicious choice ofinvestigations for screening and diagnosis in health & disease.
		103A.5	Integrate the biochemistry knowledge with other medical subjects for better understanding of health andDiseases and demonstrate the skills of solving clinical problems and decision making.

PO, PSO & CO Mapping – Biochemistry

Course Code and name	Course Outcome	Program Outcomes					Program Specific Outcomes				
		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PS03	PSO4	PSO5
MBC103A Biochemistry 1	103A.1	3	3	2	3	3	3	3	2	3	3
	103A.2	3	3	3	2	3	3	3	3	2	3
	103A.3	3	3	2	3	3	3	3	2	3	3
	103A.4	3	3	3	2	3	3	3	3	2	3
	103A.5	3	3	2	3	3	3	3	2	3	3
		3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution									

Approved by the Academic Council at its 27th meeting held on 27 September 2022

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RECOMMENDED BOOKS

TEXT BOOKS: (Recent editions)

1. DM Vasudevan. Textbook of Biochemistry for Medical students
2. Lippincotts' Illustrated reviews – Biochemistry
3. S.K.Gupta. Biochemistry for MBBS
4. Pankaja Naik. Biochemistry
5. Dinesh Puri. Textbook of Medical Biochemistry
6. Namrata Chhabra. Case oriented approach towards Biochemistry
7. Divya shanti D'sza, Sowbhagyalakhsmi. An easy guide to Practical Biochemistry.

REFERENCE BOOKS: (Recent editions)

1. Harpers' Illustrated Biochemistry
2. Marshall and Bangert. Clinical Chemistry
3. Baynes and Dominiczak. Medical Biochemistry
4. Lehninger Principles of Biochemistry 7th International Edition by David L Nelson,Macmillan
5. Kuby Immunology, sixth edition, by Thomas J. Kindt et al.
6. Bhagavan and Ha. Essentials of Medical Biochemistry with clinical cases
7. Stryer. Biochemistry
8. James Watson. Molecular biology of gene
9. Syllabus for Biochemistry

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Course Specifications
Biochemistry

Code- MBC104A

Ramaiah Medical College

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Course Specifications

Course Title	Biochemistry
Course Code	MBC104A
Course Type	Core Theory & Practical Course
Department	Biochemistry
Faculty	Medical

INTRODUCTION TO THE DEPARTMENT

The teaching of Biochemistry focuses on the structure and function of cellular componentsand bio-molecules as well as integrates the application of this knowledge in a clinical scenario. This is essential to understand the complex biochemical interactions within the human body both in health and disease.

The team of teaching faculty is well balanced in terms of qualification, age and experience. Apart from the academic commitments in the medical college, the department renders round the clock services in the Biochemistry section of the Diagnostic laboratory which is NABL accredited, endowed with state of the facilities, latest equipment, skilled laboratory personnel in an effort to provide quality health care service to patients.

Value additions to the teaching/learning of Biochemistry includes-a vast database of case scenarios, a well-stocked question bank, regular day to day assessments & Viva-voce sessions, interactive group discussions during practical's as well as lectures, meticulously planned integrated teaching /Linker sessions along with diagnostic laboratory visits, clinician conducted systems overview, opportunities to develop adult learning practices during self-directed learning sessions and learning by observation and co-relation during ECE sessions. All these, enable students to understand concepts, remove misconceptions regarding the chemistry aspect of the subject, highlight the role of biochemical mechanisms in health and causation of certain diseases and orients students towards planning and pursuing research projects. An attempt is made to draw the attention of students towards the role of Biochemistry in screening, diagnosis, treatment and management in Non-communicable diseases, Communicable diseases and in healthy subjects- Highlighting the importance of clinical biochemistry and diagnostic laboratory in hospital setup.

GOAL:

The broad goal is to teach Biochemistry to undergraduate students to make them understand the scientific basis of the life processes at the molecular level and to orient them towards the application of the knowledge acquired in solving clinical problems.

Objectives:

The student at the end of the course should be able to

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Cognitive domain

a) Describe and apply biochemical principles to explain the normal state, abnormal disease conditions and mechanism of action used in the perception, diagnosis and treatment of diseases.

b) Explain energy transactions in a living system, and describe importance of biomolecules in sustaining the life process.

c) Describe pathways of the intermediary metabolism along with their individual and integrated regulation and apply that in understanding the functioning of the body.

d) Describe and apply the concept of nutrition in health and disease, micro- and macronutrition and essential nutrients, and interlinks of nutrients with metabolism and functions of a living system.

e) Apply and integrate knowledge of molecular and metabolic conditions in normal and disease states for clinical problem solving and research

f) Acquire basic knowledge towards the evaluation and interpretation of molecular and metabolic disease states.

g) Evaluate, analyze and monitor disease states by applying relevant biochemical investigations and interpreting the clinical and laboratory data.

h) Able to integrate principles of immunology in biochemistry.

i) Demonstrate knowledge of basics of research methodology, develop a research protocol, analyse data using currently available statistical software, interpret results and disseminate these results and to have the potential ability to pursue further specializations and eventually be competent to guide students.

j) Describe the principles of teaching - learning technology towards application and take interactive classroom lectures, prepare modules for PBL, organize and conduct PBLs, case discussions, small group discussions, Seminars, Journal club and research presentations

k) Demonstrate knowledge of principles of Instrumentation.

l) Demonstrate knowledge about recent advances and trends in research in the field of clinical biochemistry.

Psychomotor domain

m) Able to select, justify, and interpret the results of clinical tests in biochemistry.

n) Predict effectiveness and adverse effects associated with disease intervention.

o) Demonstrate skills for clinical diagnosis, testing, understanding of biochemical conditions and diagnostic service.

p) Perform important biochemical, immunological and molecular biology techniques.

q) Observed working of important advanced techniques.

r) Demonstrate standard operating procedures of various methods and techniques used in clinical biochemistry.

s) Determination of enzyme activity and study of enzyme kinetics. Ideally it should be accompanied by purification (partial) of the enzyme from a crude homogenate to emphasize the concepts of specific activity.

t) Demonstrate presentation skills at academic meetings and publications

Affective domain

u) Effectively explain to patients from a variety of backgrounds, the molecular and metabolic basis of disease states and lifestyle modifications.

v) Communicate biochemical reasoning effectively with peers, staff and faculty, and other members of the health care team.

w) Demonstrate empathy and respect towards patients regardless of the biochemical nature of their disease.

x) Demonstrate respect in interactions with patients, families, peers, and other healthcare professionals.

y) Demonstrate ethical behavior and integrity in one's work.

z) Demonstrate effective use of nutrition, lifestyle and genetic counseling.

a) Be aware of the cost of diagnostic tests and economic status of patients.

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1. Acquire skills for self-directed learning to keep up with developments in the field and to continuously build to improve on skills and expertise

Course summary

	Competencies in Biochemistry	
Sl. No	**Topic**	**Competencies**
1.	Cell and organelles, cell membrane, Transportacross cell membrane	01
2.	Enzymes	07
3.	Chemistry and metabolism of carbohydrates	10
4.	Chemistry and metabolism of Lipids	07
5.	Chemistry and metabolism of Proteins	05
6.	Metabolism and Homeostasis	15
7.	Molecular Biology	07
8.	Nutrition	05
9.	Extracellular matrix	03
10.	Oncogenesis and Immunity	05
11.	**Total in Theory**	**65**
12.	**Biochemistry Laboratory Tests- Practicals**	**24**
14.	**TOTAL**	89

COURSE CONTENT

List of Competencies and SLOs to be covered in Phase I MBBS

RELEVANCE OF BIOCHEMISTRY IN MEDICINE (ORIENTATION LECTURE)

- State the importance of Biochemistry in health and disease with examples

CHEMISTRY AND METABOLISM OF PROTEINS

BI5.1 Describe and discuss structural organization of proteins.

- Define amino acid, Classify amino acid based on structure with examples, Classify amino acid based on special groups and metabolic fate with examples, Classify amino acid based on Nutritional with examples and List

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Essential , Semiessential amino acid, Describe the relevance of Selenocysteine –the 21st amino acid

- Describe Isoelectric pH and its application, List nonstandard amino acid with examples
- Describe peptide bond and its role in protein formation, Describe Structural organization of proteins, Describe primary, secondary, super secondary structures/ motifs, domains, tertiary and quaternary structures with appropriate examples. Describe Bonds stabilizing protein structure
- Describe process of denaturation and its application
- List method to determine primary, secondary, tertiary and quaternary structure` of protein

BI5.2 Describe and discuss functions of proteins and structure-function relationships in relevant areas e.g. hemoglobin and selected hemoglobinopathies

- Classify the proteins based on functions (Structural, Hormonal, Catalytic, Transport with suitable examples)
- Classify plasma proteins and enumerate their function, Describe specific functions and clinical significance of plasma proteins including Albumin, α, β and γ globulins.
- Define an Acute phase reactant including positive and Negative function and enumerate their clinical significance.
- Describe primary structure of insulin and how it influences the function of a protein.

Describe α helix and beta -Pleated sheet and how it influences the secondary organizationof protein. Describe structure of myoglobin and how it influences the functional (three dimensional)organization of protein.

- Describe structure of hemoglobin and how it influences the quaternary organization of protein.
- Classify abnormal hemoglobin with respect to their alteration in structure and functionswith examples.
- Describe hemoglobinopathies. Describe biochemical basis and genetics of sickle cell anaemia and explain the basis of itsclinical features, investigations and principles of management.
- Describe biochemical basis and genetics of thalassemia and explain the basis of its clinical features investigations and principles of management.
- Differentiate between adult and fetal haemoglobin and Analyze the results of haemoglobin composition studies and use them to differentiate between the major hemoglobinopathies.

BI5.3 Describe the digestion and absorption of dietary proteins.

- List foodstuffs containing complete proteins.
- Describe process of digestion that occurs in different part of human gastrointestinal tract.
- Enumerate the various proteolytic enzymes involved in the digestion of proteins.
- Describe the absorption of digested amino acids in to the cells.
- Describe the dynamics of the free amino acid pool.
- Discuss how the absorbed amino acids get transported in the circulatory system.
- Discuss how to treat diseases associated with protein digestion andabsorption.BI5.4

Describe common disorders associated with protein metabolism.

- Describe the metabolic processes including Transamination, Deamination (Oxidative and nonoxidative) and their significance in degradation of proteins and amino acids.
- Describe sources and fate of ammonia including Trapping, Transport and Disposal ofammonia.
- Explain the basis of ammonia toxicity with clinical significance.
- Describe Significance, Site, reactions, key steps, energetics, regulation, and associated disorders of Urea cycle.
- Discuss disorders of urea cycle with respect to defective enzyme, clinical features, and treatment.
- Enumerate specialized products formed from Glycine and their importance.

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- Discuss biochemical basis of Metabolic disorders of Glycine, Glycinuria and Primary hyperoxaluria.
- Outline the metabolic (Catabolic and anabolic) pathwayof Phenylalanine and Tyrosine and discuss the synthesis of catecholamines and other specialised products formed and their importance
- Explain metabolic enzyme defect, clinical features, laboratory investigations and basis of treatment in Phenylketonuria, Tyrosinemia and Alkaptonuria.
- Outline the metabolism (Catabolic and anabolic) of Tryptophan and discuss the synthesis of serotonin, melatonin and other specialised products formed and their importance
- Explain biochemical basis, clinical features and basis of treatment in Carcinoid syndrome and Hartnup's disease.
- Outline the metabolism of Sulphur containing amino acids cysteine and methionine including their functions, synthesis of SAM, SAH, and Homocysteine and enumerate importance of transmethylation.
- Discuss biochemical basis of Cystinuria, Homocystinuria, their clinical features and treatment.
- Outline the metabolism of branch chain amino acid and its importance
- Discuss Metabolic defects of branched chain amino acids their clinical features and treatment including Maple syrup urine disease (MSUD)
- Describe Formation of Nitric oxide and its therapeutic importance. Define Polyamines and enumerate their clinical importance with examples.
- List important functions of and products formed from Histidine, Serine, Aspartate, Asparagine, glutamate, glutamine, serine, branched chain amino acids.
- Outline one carbon metabolism and describe its significance.

BI5.5 Interpret laboratory results of analytes associated with Metabolism of proteins

- Describe Inborn errors of metabolism of protein. Enumerate normal reference interval of blood urea and its importance in interpretation ofkidney disease.
- Enumerate normal reference interval of ammonia and its importance in interpretation of ureacycle disorders and hepatic coma.
- Enumerate normal reference interval of phenyl alanine in blood and urine, its importance in laboratory diagnosis of PKU.
- Enumerate screening tests for PKU and explain their significance including Guthrie test and ferric chloride test.
- Describe role of Paper and thin layer chromatographic in identification of Phenyl alanine,Tyrosine, Tryptophan, Glycine to detect inborn errors of amino acids.
- Enumerate normal reference interval of Homocysteine and its importance in Homocystinuria, myocardial infarction, stroke and pulmonary embolism.
- Enumerate normal reference interval of dopamine, nor epinephrine (noradrenaline), epinephrine (adrenaline) and significance of VMA in interpretation of Pheochromocytoma.
- Discuss excretion of 5-hydroxy indole acetate in urine in carcinoid syndrome and itsinterpretation in laboratory diagnosis.
- Enumerate normal reference interval of branch chain amino acids and its role in diagnosis ofmaple syrup urine disease.
- Enumerate techniques used to separate and identify amino acids and proteins including their principle including chromatography and electrophoresis.
- List Biological Reference range of serum total protein, albumin, total globulin, C reactive protein and enumerate the causes of their increased and decreased levels.

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- Discuss approach to the Laboratory investigation of Multiple Myeloma.

CHEMISTRY OF NUCLEIC ACIDS AND NUCLEOTIDE METABOLISM

BI6.2: Describe and discuss the metabolic processes in which nucleotides are involved

- Name the Purines and Pyrimidines, Distinguish the chemical structure of the various Purines and Pyrimidines
- Explain the structure of Nucleosides and Nucleotides, List the properties of nitrogenous bases/ nucleosides /Nucleotides, Enumerate the functions of Nucleotides.
- Explain the importance of cAMP, cGMP, SAM, PAPS, Enumerate the guanosine, uridine and cytidine derivatives and their function
- Enumerate the synthetic nucleotide analogues and their therapeutic importance, Name the carbon and nitrogen sources in purine and pyrimidine ring
- Explain purine Salvage pathways and its importance, explain pyrimidine Salvage pathways and its importance, Describe the degradation pathway of Purine nucleotides
- State the reference range of serum and urinary uric acid
- Enumerate the end products of pyrimidine catabolism and their Significance

BI6.3 Describe the common disorders associated with nucleotide metabolism.

- Discuss the, manifestation and biochemical basis of Lesch Nyhan Syndrome.
- Classify Gout and enumerate the causes of Gout
- Discuss the biochemical basis for severe combined immune deficiency Disorder

BI6.4 Discuss the laboratory results of analytes associated with gout & Lesch Nyhan syndrome

- State the reference range of serum and urinary uric acid in male and Female
- State the normal urate pool and its daily turnover
- Define Hyperuricemia and enumerate its causes
- Interpret the laboratory results of a patient suspected with gouty Arthritis

HAEM METABOLISM

BI6.11 Describe the functions of haem in the body and describe the processes involved in itsmetabolism and describe porphyrin in metabolism.

- List the functions of haem and haem containing compounds. Describe the biosynthesis and regulation of haem synthesis Enumerate and classify disorders of haem metabolism, associated porphyria's and therespective enzyme defects
- Describe the associated features and diagnosis of porphyria (Hereditary porphyria and acquiredporphyria) Describe catabolism of heam including generation of bilirubin, transport to liver, and conjugation in liver, excretion of bilirubin in bile and enterohepatic circulation.

BI6.12 Describe the major types of haemoglobin and its derivatives found in the body andtheir physiological/ pathological relevance.

- Describe the structure of hemoglobin including assembly of polypeptide chain and explain the structure function relationships.
- List the Function of hemoglobin, Explain Transport of oxygen, carbon di oxide and protons by haemoglobin Bohr Effect and Role of 2,3BPG.
- Enumerate major types of haemoglobin and the normal levels in blood of adults, neonates and children

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including HbA, HbA2, HbF and others

- Describe the difference in polypeptide composition of HbA, HbA2 and HbF
- Enumerate Normal & Abnormal hemoglobin derivatives
- Explain what are carboxy-haemoglobin, methemoglobin, sulf-haemoglobin and glycated haemoglobin and the in clinical relevance
- Describe the genesis and molecular pathology of hemoglobinopathies and thalassemias.
- Enumerate the sickle cell anemia, thalassemia and other hemoglobin variants, Explain the pathophysiology and laboratory diagnosis of thalassemia and hemoglobinopathies

- Define and classify anemia.
- Enumerate the functions of myoglobin

ORGAN FUNCTION TESTS

BI6.13 Describe the function of the kidney, liver, thyroid and adrenal glands

- Enumerate functions of kidney, liver, thyroid and adrenal glands.
- Describe the role of kidney in excretion of metabolic wastes, maintaining water andelectrolyte balance, activation of Vitamin D and synthesis of erythropoietin.
- Define GFR – Glomerular filtration rate
- Explain the role of glomerular filtration barrier in urine formation
- Describe role of liver in biochemical functions, including synthesis of plasma proteins, cholesterol, triacylglycerol and lipoprotein synthesis
- Describe role of liver in metabolism involving carbohydrates, ketogenesis, protein catabolism and TCA cycle, storage of fat soluble vitamins.
- Describe role of liver in detoxification including ammonia, bilirubin, cholesterol, and drug metabolites
- Explain synthesis, regulation and secretion of thyroid hormones using hypothalamus- hypophysial-thyroid axis.
- Describe metabolic effects of thyroid hormone including calorigenic effect, Basal metabolic rate, involvement in protein synthesis and protein catabolism, involvement in carbohydrate and fatty acid metabolism
- Explain synthesis, secretion, transport and metabolism of adrenal cortical hormones and adrenal medullary hormones
- Describe Biological effects of Adrenal hormones including glucocorticoids, gonadal hormones and catecholamines as neurotransmitters

BI6.14 Describe the tests that are commonly done in clinical practice to assess the function of these organs (kidney, liver, thyroid and adrenal glands)

- Classify renal function tests, liver function tests, thyroid function tests and adrenalfunction tests.
- Enumerate the physical properties, normal and abnormal constituents of urine

  Enumerate the tests performed to assess the physical properties, normal and abnormalconstituents of urine
- Define clearance and renal threshold, Classify clearance tests, Explain the relationship of GFR with

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clearance

- Describe the procedure of clearance test and formulae to calculate clearance(endogenous creatinine/urea clearance test, inulin clearance test)
- Enumerate the advantages and disadvantages of clearance tests (endogenous creatinine/urea clearance test, inulin clearance test)
- Explain the role of cystatin C as glomerular filtration marker
- Enumerate the markers of glomerular permeability
- Enumerate tubular function tests and describe their procedure (specific gravity,measurement of osmolality, concentration test, dilution test, urinary acidification test)
- Enumerate the immunological tests in renal disease
- Explain the clinical relevance of van Den Bergh reaction, serum total and direct bilirubin, urinary bilirubin and urobilinogen, serum total protein, albumin, A:G ratio, enzymes including AST, ALT, ALP, GGT, prothrombin time, blood ammonia, Special tests include ceruloplasmin, ferritin, alpha 1 antitrypsin in diagnosis of liver diseases.
- Enumerate the markers of excretory function, liver injury, cholestasis, chronic liver disease.
- Explain the clinical relevance of assay of thyroid hormones T3, T4, fT3, and fT4, plasma TSH, TRH response test and thyroid autoantibodies like anti TPO, serum hormones in thyroid diseases.
- Explain the clinical relevance of tests for adrenal functions including cortisol (morning and evening), urinary free cortisol, ACTH, ACTH stimulation test, 17 – hydroxy progesterone, testosterone adrenal disease.

BI6.15 Describe the abnormalities of kidney, liver, thyroid and adrenal glands

- Define and enumerate the causes of uremia, azotemia, polyuria, oliguria, anuria, isosthenuria, hematuria, hemoglobinuria, proteinuria, microalbuminuria, glycosuria and explain their clinical relevance.
- Define acute renal failure and chronic renal failure, Explain the grading of chronic kidney disease based on GFR
- Describe the salient clinical features of nephritic syndrome and nephritic syndrome
- Enumerate different types of renal stones and their cause
- Define, classify and enumerate salient features and laboratory investigations of jaundice
- Differentiate prehepatic, hepatic and post hepatic jaundice using salient features and laboratory investigations
- Enumerate the causes of congenital and acquired hyperbilirubinemia
- Enumerate the salient features of hepatitis, cholestasis, cirrhosis of liver, alcoholic liver disease, non-alcoholic fatty liver disease, Reye syndrome.
- Enumerate the causes and explain the salient features of primary and secondary causes of hyperthyroidism, hypothyroidism.
- Enumerate the causes and explain the salient features of Adrenal gland-dysfunction including Cushing's disease, Addison's disease, Conn's syndrome, pheochromocytoma.

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MOLECULAR BIOLOGY

BI7.1 Describe the structure and functions of DNA and RNA and outline the cell cycle.

- Enumerate the functions of DNA. Describe the structure of Watson and Crick model of DNA with the help of a neatlabelled diagram
- Enumerate different forms of DNA and their differences, Define Tm or melting temperature of DNA
- Enumerate the difference between DNA and RNA, Illustrate cell cycle with the help of a neat labelled diagram
- Recognize the phase where replication occurs in cell cycle
- Describe the structure and function of mRNA
- Describe the function structure of tRNA with the help of a neat labeled diagram. Compare and Contrast the difference between prokaryotic and eukaryotic ribosomes

BI7.2 Describe the processes involved in replication & repair of DNA and the transcription & translation mechanisms

- Define Replication
- Enumerate at least four salient features of Replication
- Discuss the role of various proteins in DNA replication process
- Describe the replication process in prokaryotes with the help of a neat labelled diagram
- Illustrate the Okazaki fragment formation with the help of a neat labelled diagram
- Enumerate the different types and functions of eukaryotic DNA Polymerases, Discuss replication Process in Eukaryotes with the help of a neat labelled diagram
- Enumerate at least three inhibitors in each of prokaryotic and eukaryotic replication process, Highlight the importance of Telomerase in health and disease condition
- List the DNA repair mechanisms, Discuss Mismatch repair mechanism with the help of a neat labeled diagram and its significance Discuss base excision repair mechanism with the help of a neat labeled diagram and its significance Discuss Nucleotide repair mechanism with the help of a neat labeled diagram and its significance
- Define Transcription, Enumerate the similarities and differences between Replication and Transcription, Discuss the DNA templates and prokaryotic enzyme for Transcription process
- Discuss the importance of Promoter region in initiation and regulation of transcription process
- Describe transcription in Prokaryotes with the help of a neat labeled diagram Enumerate the differences between prokaryotic and eukaryotic Transcription Discuss Transcription process in Eukaryotes with the help of a neat labelled diagram. Discuss the posttranscriptional modifications in hnRNA with the help of a neat labelled diagram. Discuss the post transcriptional modifications in, tRNA with the help of a neat labelleddiagram. Discuss the post transcriptional modifications in rRNA
- State the role of Ribozymes giving at least two examples, Discuss the role of reverse transcriptase in synthesis of cDNA. Enumerate the inhibitors of transcription process in prokaryotes and eukaryotes and statetheir significance
- Define codon Discuss the organization of genetic code Name the initiator and terminator codons Discuss the characteristic features of Genetic Code Define translation process
- Enumerate all the requirements of protein biosynthesis
- Illustrate the formation of charged tRNA

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- Discuss the initiation of protein biosynthesis with the help of a neat labelled diagram.
- Describe the elongation step of protein biosynthesis with the help of a neat labelleddiagram.
- Describe the termination step of protein biosynthesis with the help of a neat labelled diagram.
- Discuss the mechanism of inhibitors of protein biosynthesis in both prokaryotes andeukaryotes
- Define and state the importance of polysomes
- Discuss the common mechanisms of protein targeting to various destination and associateddisorder with example of I cell disease and others. Discuss the co and post translational modifications in protein biosynthesis process
- Describe briefly Protein folding mechanism and role of Chaperones and Heat shock proteins and associated disorders Alzheimer's disease, Prion diseases, Discuss briefly mitochondrial DNA, genes and related disorders

BI7.3 Describe gene mutations and basic mechanism of regulation of gene Expression

- Observe the estimation of SGOT, SGPT and ALP and interpret the results in given sampleaccurately
- Define Mutation, classify point mutations based on the type of nucleotide altered, categorize point mutations based on consequence citing examples
- Explain the frameshift mutations and its consequences in protein Biosynthesis, State the importance of regulation of gene expression, Discuss the types of gene regulation in prokaryotes
- Explain the gene expression in Prokaryotes giving example of Lac Operon, Explain the concept of intron, exon, cistron and Gene
- Enumerate at least four types of gene regulation in Eukaryotes, Explain briefly the role of transcriptional activators and co-regulators. Explain the gene amplification mechanism in regulation of gene expression in Eukaryotes
- Illustrate gene rearrangement mechanism in Antibody synthesis, Discuss briefly gene regulation at RNA level, Explain gene silencing by RNA interference (RNAi) in regulation of gene expression, Highlight the concepts of epigenetics in regulation of gene expression
- Briefly explain the concepts of Concept of Genomics, proteomics and Metabolomics

MOLECULAR BIOLOGY TECHNIQUES AND GENE THERAPY

BI7.4 Describe applications of molecular technologies like recombinant DNA technology, PCR in the diagnosis and treatment of diseases with genetic basis

- Define Recombinant DNA technology, Define Hybrid / chimeric/ Recombinant DNA,and Discuss on Restriction Endonucleases and their role in recombinant
- DNA technology, List and Explain the role of vectors in recombinant DNA technology
- Explain plasmids and their role in recombinant DNA technology
- Enumerate the host cells and process of DNA transfer into host cells in recombinant DNA technology
- Explain the process of recombinant DNA technology using plasmid as vector
- Discuss the construction of Genomic Library and its clinical significance. Explain the formation of cDNA and construction of cDNA library
- Define and illustrate the role of DNA Probes, Enumerate the applications of Recombinant DNA technology emphasizing on its application in field of Medicine

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- Define and discuss the process of Polymerase Chain Reaction, Enumerate the applications of Polymerase Chain Reaction, Explain Southern Blot technique and state its applications
- State the importance of Northern blot technique, State the importance of Western blot technique
- Explain briefly DNA microarray technique and its applications, Enumerate the DNA markers; SNP, VNTRs, RFLP and state their importance, State the importance of RFLP and write any two of its applications, Explain the basis of DNA fingerprinting/DNA Profiling with the help of neat labelleddiagram.
- Define and classify gene therapy, Explain the vectors used in gene therapy. Discuss the process of gene therapy giving example of gene therapy in SCID. Discuss role of gene therapy in cancer treatment
- Discuss the therapeutic role of RNAi (RNA interference) / Antigene and antisense therapyin cancer treatment. Give an overview of Human Genome Project (HGP)

XENOBIOTICS AND DETOXIFICATION

BI 7.5 Describe the role of xenobiotics in disease

- Define xenobiotics and biotransformation. List the common xenobiotics
- Mention the biological damage caused by xenobiotics (e.g.: mutagenic, carcinogenic, allergenic a nd the disease associated (Ex Cancer, teratogenic condition due to exposure to pesticides)
- Describe the phase 1 and phase 2 reactions involved in the metabolism of xenobiotics
- Explain other detoxification reactions such as reduction, hydrolysis, acetylation, methylation and reduction other detoxification reactions
- Explain the significance of cytochromes in detoxification, Describe the metabolic consequences of alcoholism

FREE RADICALS AND ANTIOXIDANTS

BI7.6 Describe the anti-oxidant defence systems in the body.

- Define Antioxidants, Classify antioxidants
- Explain enzymatic antioxidants and their significance
- Explain the role of Vitamin E as an antioxidant
- Explain the importance of Nutrient and Metabolic antioxidants

BI7.7 Describe the role of oxidative stress in the pathogenesis of conditions such as cancer, complications of diabetes mellitus and atherosclerosis

- Define Free Radicals and Reactive Oxygen Species (ROS) and list the different types of freeradicals
- Explain the different reactions and mechanisms involved in production of freeradicals
- Explain the free radical damage to various biomolecules with special reference to lipid peroxidation
- Discuss the role of oxidative stress in pathogenesis of inflammatory disorders ,respiratory disorders and cataract
- Describe the role of oxidative stress in the pathogenesis of cancer
- Describe the role of oxidative stress in the pathogenesis of complications of diabetes mellitus
- Describe the role of oxidative stress in the pathogenesis of atherosclerosis
- Mention the test to measure oxidative stress in serum

BI9.3 Describe protein targeting & sorting along with its associated disorders.

- Discuss briefly the co-translational and post translational modification of proteins inendoplasmic reticulum resulting in sorting of proteins
- Discuss the mechanism involving signal sequences by which proteins are targeted to a specific destination
- Explain the role of Golgi apparatus in protein glycosylation and protein sorting

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- Discuss the role of Chaperones and chaperonin system in protein folding, State the disorders associated with defective protein targeting
- Discuss briefly the pathophysiology of Zellweger syndrome, Refsum's disease and I-celldisease

BI10.1 Describe the cancer initiation, promotion, oncogenes & oncogene activation. Also focuson p53 & apoptosis

Define cancer and enumerate the causes of cancer including physical,chemical, genetic, biological
Explain different types of cell signaling including G protein coupled signaling, catalytic receptor signaling, steroid receptor signaling with suitable examples of hormones and growthfactors
Elaborate the role of mutagens and antimutagens in etiology of cancer. Explain the action of oncogenes and anti oncogenes. Describe the role of Oncogenic viruses and associated cancer.
Explain biochemical functions of oncogenes, proto-oncogenes and onco-suppressor genes. Compare characteristic features of tumor cells with normal cell
Elaborate the role of cell cycle, abnormal cell growth and programmed cell death (apoptosis) in causing cancer. Describe activation of oncogenes including point mutation of protooncogeneand insertional mutagenesis
Describe protective action of onco suppressor gene including p53, RB gene and effects of loss of its action. Explain apoptosis including requirement for apoptosis, apoptosis mediating gene, apoptosis protecting gene and mechanism of apoptosis

BI10.2 Describe various biochemical tumor markers and the biochemical basis of cancer therapy.

Define and classify tumor markers with suitable examples
Enumerate diagnostic and prognostic application of tumor markers including their elevation in benign and malignant conditions
Explain the biochemical basis of cancer therapy, anticancer drugs and mode of action including alkylating agents, antimetabolites, topoisomerase inhibitors, antibiotics, hormones, receptor blockers, radiotherapy, hybridoma technology, monoclonal anti, body and their application

IMMUNOLOGY

BI10.3 Describe the cellular and humoral components of the immune system & describe the types and structure of antibody

Describe the central and peripheral lymphoid organs, Describe briefly the cells of the lymphoreticular system and their role in cell-mediatedimmune response. Describe the role of T-helper cells in immune responses
Describe the structure and functions of different types of antibody, Describe immunoglobulin class switching

BI 10.4 Describe and discuss innate and adaptive immune response, self/nonself recognitionand the central role of T helper cells in immune response

Describe innate and adaptive immune response Describe the role of T-helper cells in immune responses
Define an antigen and discuss the various determinants of antigenicity. Describe the concept of self/non-self antigens
Describe the concepts of immune tolerance and autoimmunityMention the basis for graft versus host rejection

BI 10.5 Describe antigens and concepts involved in vaccine development

Define and describe the different types of vaccines Describe the immunological basis of vaccine development

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Summary of TL methods and list of competencies with integration to be covered in Phase I MBBS

INTEGRATION TOPICS

Sl.No	Topics and competency numbers	No. of. Hours	Department of Integration
1.	Introduction & Scope of Biochemistry	1 Lecture	
2.	Cell and organelles, Cell membrane, Transportacross cell membranes (BI1.1)	2 Lecture + 2 Integration	Physiology
3.	Enzymes (BI2.1, BI2.3, BI2.4, BI2.5, BI2.6, BI2.7) General Enzymology-	5 lecture +2 small group teaching+ 2 Case based Learning	General Medicine & Pathology
4.	Chemistry of Carbohydrates (BI3.1)	3 lectures	
5.	Chemistry of lipids (BI4.1, BI11.24)	3 lectures	
6.	Chemistry of amino acids and Proteins (BI5.1,BI5.2)	3 lectures	
7.	Plasma proteins (BI5.2)	1 lecture + 2 Case Based Learning + 1 integrated teaching	Physiology,General Medicine & Pathology
8.	Immunology (BI10.3, BI10.4, BI10.5)	1 lecture + 2 integrated teaching	Physiology, Microbiology, Pathology, Paediatrics, General Medicine, OBG, General Surgery
9.	Vitamins (BI6.5)	2 lectures + 4 Small group teaching + 6 Case Based Learning	General Medicine
10.	Free Radicals and Antioxidants (BI7.6, BI7.7)	1 lectures + 2 Small group teaching	Pathology, General Medicine
11.	Heme metabolism (BI6.12, BI5.2)	1 lecture + Integrated teaching	Physiology, Pathology, General Medicine
12.	Heme metabolism (BI6.11, BI11.17)	2 lectures + 4 Case Based Learning + 1 integrated teaching	Physiology, Pathology, General Medicine
13.	Extracellular matrix (BI9.1, BI9.2)	2 lectures + 2 Small Group Teaching	
14.	Biological Oxidation (BI6.6)	3 lectures	
15.	Carbohydrate metabolism (BI3.2, BI3.3, BI3.4,BI3.5, BI3.6, BI3.7, BI3.9)	8 lectures + 2 Small group teaching + 4 Case Based Learning	General Medicine [all topics] Physiology[glycolysis & TCA], Pathology [lab tests])

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16.	**Lipid metabolism (BI4.2, BI4.3, BI4.4, BI4.6)**	8 lectures + 2 Small group teaching + 2 Case Based Learning	
17.	**Protein and amino acid metabolism (BI5.3, BI5.4, BI5.5, BI11.17)**	7 lectures + 2 Small group teaching + 4 Case Based Learning	General Medicine & Paediatrics
18.	**Metabolism and homeostasis (BI6.1, BI3.8, BI4.5, BI4.7, BI3.10, BI11.17)**	2 lectures + 4 Small group teaching + 2 integrated teaching	General Medicine & Pathology
19.	**Minerals (BI6.9, BI6.10)**	2 lectures + 4 Small group teaching + 2 Case Based Learning + 2 integrated teaching	General Medicine & Physiology
20.	**Chemistry of Nucleic acids (BI7.1)**	2 lectures	
21.	**Nucleotide metabolism (BI6.2, BI6.3, BI6.4)**	2 lectures + 2 Case Based Learning	General Medicine, Physiology
22.	**Molecular Biology (BI7.1, BI7.2, BI7.3, BI9.3) Case Based Learning- DNA Repair**	7 lectures + 4 Small Group Teaching	Paediatrics
23.	**Molecular biology techniques and Gene therapy,(BI7.4), Core: Case Based Learning- Southern Blotting Technique**	2 lectures + 2 Small group teaching + 1 integrated teaching	General Medicine & Paediatrics
24.	**Biochemistry of Cancer (BI10.1, BI10.2) Case Based Learning- Prostate carcinoma, Breast carcinoma**	3 lectures + 2 Case Based Learning + 2 integrated teaching	Pathology, General Surgery & OBG)
25.	**Nutrition and dietetics (BI8.1, BI8.2, BI8.3, BI8.4, BI8.5, BI11.17, BI11.23, BI11.24)**	3 lectures + 2 Small group teaching + 2 Case Based Learning + 2 integrated teaching	Pathology, Community Medicine General Medicine & Paediatrics
26.	**Organfunction tests (BI6.13,BI6.14, BI6.15, BI11.17)**	1 lectures + 4 Small group teaching + 6 Case Based Learning + 2 integrated teaching	Anatomy, Physiology, Pathology, General Medicine
27.	**Acid base balance (BI6.7, BI6.8, BI11.17)**	2 lectures + 2 Case Based Learning + 1 integrated teaching	Physiology, Pathology, General Medicine
28.	**Water and electrolyte balance (BI6.7)**	1 lectures + 2 Small Group Teaching + 1 integrated teaching	Physiology, General Medicine
29.	**Xenobiotics and Detoxification (BI7.5)**	1 Lecture	
30.	**Clinical chemistry (BI11.16)**	2 Small Group Teaching	

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Teaching Learning Methods:

The university incorporates the guidelines of the CBME curriculum prescribed by the National Medical Commission (NMC). The department uses various innovative teaching learning methods to facilitate effective student learning.

Cognitive, Psychomotor and Affective Domain

Sl. No.	T-L Method	Number of Hours
1	Interactive Lectures	80
2	Practicals, Small Group Learning Tutorials Visit to hospital OPDs and Wards Case based Learning for Integrated sessions /Seminars/ videos/role play/live/simulation	150
3	Early Clinical Exposure	30
4	Self-Directed Learning	20

Assessment methods:

Formative Assessment:

The department follows the concept of continuous assessment for evaluating the students. The department of Biochemistry shall conduct tutorials, **monthly tests, viva voce and three internal assessments. Fourth internal assessment will be conducted for improvement of scores as a remedial measure.**

This facilitates to give feedback to students on their learning. These tests allow regular and timely revision by the students. It also prepares the student to attend the summative examination with confidence.

Sl. No.	Assessment methods
1	Modified Long essay, Short Essay (SE),
2	Short answer questions (SAQ)
3	Multiple choice questions (MCQ)
4	Short Seminars
5	Case history
6	Tutorials
7	Table viva voce
8	Objective Structured Practical Examination (OSPE)- Performance and Response)

Guidelines for Internal assessment:

c. The department will conduct a minimum of three internal assessments.

d. The **3 rd internal assessment** to include **one short essay** on **AETCOM modules 1.4**.

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e. The **third internal assessment** will be as per university **summative examination.**
f. The marks obtained in the formative assessment should be displayed on the notice board within 1 -2 weeks after conducting the tests.

Theory:

- The theory paper will be conducted for 60 marks for 1st and 2nd IA and 100 marks for third IA
- Blue print guidelines to be followed for question paper setting.
- The distribution of marks will be as follows:
  i. 40% of the subject questions will be based on clinical correlation and integration (LE, SE).
  ii. 40% of the subject questions will and comprehension level of questions (SE).
  iii. 20% of the subject questions will be of recall type. (SAQs and MCQs).
    - Each **internal assessment weightage** shall be as per the template mentioned under university exam pattern for topics mentioned under either paper

- **Distribution of topics for Paper II for assessment- Topic wise weightage**

Sl No	Paper II Topics	WeightageUpto (in marks)
1	Protein Chemistry	6
2	Plasma proteins	5
3	Immunology	5
4	Protein and amino acid Metabolism	13
5	Nucleic acid Chemistry	6
6	Nucleotide metabolism	10
7	Molecular Biology	13
8	Molecular Biology Techniques	13
9	Biochemistry of Cancer	10
10	Heme Metabolism	13
11	Organ function tests	13
12	Free radicals and Antioxidants	6
13	Xenobiotics and Detoxification	3
14	Clinical Chemistry	5

Note:

Weightage of marks assigned to topics may add to more than 100

- Structured Long essay question should be from the topics with weightage of MORE THAN 10 marks. However, a part of structured long essay may be from other topics adhering to the weightage of marks allotted for that topic.
- **However, a strict division of the subject may not be possible as some overlapping of topics is inevitable. Students should be prepared to answer overlapping topics.**

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Scheme of Internal Assessment:

Sl.No	Type of questions	Marks	Marks
1.	Long Essay	(2X10)=20	(2X10)=20
2.	Short Essay	(5X5) = 25	(10X5) = 50
3.	SAQs	(5X3) =15	(10X3) 30
4.	**Total**	**60**	**100**

Practical:

Sl. No.	**Assessment type**	**Marks**
A Quantitative and Qualitative Procedure		
1	Qualitative Experiments with discussion	20
2	Quantitative Experiments with discussion	20
B Case study and OSPE		
1	**Case studies** with discussion	20
2	OSPE(performance and response)	20
Total		**80**

- The practical will be conducted for **80 marks.**
- **Scheme for practical assessment:**

- The **biochemistry practical record** and the **log book** should be evaluated on a continuous basis and certified by the department before the summative examination

The **pass criteria** in each internal assessment will be 40% separately in theory and practical. **Eligibility criteria** to take up summative examination, theory and practical cumulative should be 50%.

Regular monthly tests will be conducted in addition to the three internal assessments. These will be in the form of **SAQ test, MCQ test, SE test, Table viva, OSPE tests etc.**

Scores obtained in monthly assessment will be given weightage when considering internal assessment eligibility for summative examination.

LOG BOOK:

The biochemistry log book should be completed and evaluated by the faculty on a timely basis. The same to be certified by the head of the department at the end of the program before summative examination.

Biochemistry Practical RECORD:

The Biochemistry record should be certified before each internal assessment and final certification by the head of the department before summative examination.

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Eligibility for Summative Examination:

Weightage of various assessments as eligibility criteria for Summative exam:

Sl. No.	Type of Assessment	Weightage
1.	Internal assessment	75% (70%)
2.	Monthly assessment	7% (12%)
3.	Professionalism	6%
4.	Biochemistry practical records	6%
5.	Level of participation in ECE	6%

Sl. No.	Theory		Practical	
1	IA Theory	30	Experiments, case reports and OSPE	30
2	Monthly Assessments	5	Biochemistry record	05
3	Professionalism	5	Level of participation in ECE	05
4	**Total**	**40**	**Total**	**40**

Another Proposal

Formative assessment :			
Theory	**30 Marks**	**Practical**	**30 Marks**
Monthly Assessments - MCQs / SAQ tests / Viva voce etc.	05	Biochemistry Practical records	05
Attitude	01	ECE Participation	05
Written Assignments	02		
Attendance	02 (for T + P attendance > 90%) 01 (for T + P attendance between 80-90%) **Eligibility criteria for attendance is 80% (separately for theory & practical)**		
Total	**40**		**40**

The eligibility is calculated by considering the internal assessment/monthly assessment and Professionalism and ethics (**average should be 40% in theory and practical separately** and **50% in theory and practical combined**).
Attendance should be 75% in theory and 80% in practical, 75 % each for Foundation course and AETCOM.
If a student is found not to meet the criteria of eligibility for summative examination, remedial measures in the form of improvement tests/assignments should be given. The student can be allowed to take up summative examination if the remedial measures are fulfilled.
The internal assessment will appear as a separate subheading in the marks card and not be considered for pass criteria of final summative examination.

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Summative Assessment:

Marks Distribution:

Sl. No.	Theory	Practical	Viva	Total
Marks	200	80	20	300

Theory: 2 papers of 100 marks each.

The portions of theory paper II:

Protein Chemistry, Plasma proteins, Immunology, Protein and amino acid Metabolism, Nucleic acid Chemistry, Nucleotide metabolism, Molecular Biology, Molecular Biology Techniques, Biochemistry of Cancer, Heme Metabolism, Organ function tests, Free radicals and Antioxidants, Xenobiotics and Detoxification, Clinical Chemistry

Pattern of Assessment:

Theory: Maximum marks: 100

Theory paper II

Sl. No.	Type of Question	Number	Marks
1	Long Essay	2 X 10	20
2	Short Essay	6 X 5	0
3	Short answer questions	10 X 3	30
4	MCQs	20 X 1	20
5	**Total**	**38**	**100**

Paper II topics and Blue print for Question paper

Sl No	Paper II Topics	Weightage Upto (in marks)	Long Essay	Short Essay	Short answer	MCQ
1	Protein Chemistry	6		√	√	√
2	Plasma proteins	5		√	√	√
3	Immunology	5		√	√	√
4	Protein and amino acid Metabolism	13	√	√	√	√
5	Nucleic acid Chemistry	6		√	√	√
6	Nucleotide	10	√	√	√	√

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	metabolism					
7	Molecular Biology	13	√	√	√	√
8	Molecular Biology Techniques	13	√	√	√	√
9	Biochemistry of Cancer	10	√	√	√	√
10	Heme Metabolism	13	√	√	√	√
11	Organ function tests	13	√	√	√	√
12	Free radicals and Antioxidants	6		√	√	√
13	Xenobiotics and Detoxification	3		√	√	√
14	Clinical Chemistry	5		√	√	√

Note:

Weightage of marks assigned to topics may add to more than 100

- Structured Long essay question should be from the topics with weightage of MORE THAN 10 marks. However, a part of structured long essay may be from other topics adhering to the weightage of marks allotted for that topic.
- **The topics to different paper are generally evaluated under those sections. However, a strict division of the subject may not be possible and some overlapping of topics is inevitable. Students should be prepared to answer overlapping topics.**

PRACTICAL:

Practical exercises – 80 marks

1. **Exercise 1: OSPE - 20 Marks**
2. **Exercise 2: Qualitative analysis of Normal or Pathological constituents of Urine - 20 Marks**
3. **Exercise 3: Quantitative estimation and interpretation - 20 Marks**
4. **Exercise 4: Case studies - 20 Marks**

Exercise 1: OSPE (20 Marks)

No. of Stations: 4 (1 performance station, 3 response stations)
Marks for Each Station: 5
Time for each station: Max 5 min

Exercise 2: Qualitative analysis of Normal or Pathological constituents of Urine (20 Marks)

Selection, principle and performance of tests :10 marks
Interpretation and Discussion :10 marks

Note: Alphabetically arranged test procedures shall be given.

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Exercise 3: Quantitative estimation and interpretation (20 Marks)

Principle: 5 Marks
Performance, Calculation and Results: 5 Marks
Interpretation and Discussion: 10 Marks

Note : Procedure sheets shall be given.

Exercise 4: Case studies (20marks)

Total No. of case reports: 2
1 Major Case study for 12 marks and 1 Minor Case study for 8 marks
Suggested Major Case studies: Organ function tests/Diabetes mellitus/Acid base disorders/Myocardial infarction/Dyslipidemia/PEM

Note : Questions for Quantitative experiments may preferably be case based scenarios.

27.Viva voce : 20 marks

The viva - voce examination shall carry 20 marks and all examiners will conduct the examination. Viva should focus on application and interpretation. (viva marks to be added to practical and not theory)

Pass Criteria:

The student should secure **40% in each theory paper** and **50% of aggregate of the two papers**.
The student should secure 50% in **practical exam + viva.**

Supplementary Exam:

Supplementary exams to be conducted and results to be declared **within 60** days after announcement of results of main summative examination. If the student clears the supplementary exam he/she can join the regular batch.

PRACTICAL PORTIONS

Topic: Biochemical Laboratory Tests Number of competencies: (24) Number of procedures that require certification: (05)

BI11.1 Describe commonly used laboratory apparatus and equipment, good safe laboratorypractice and waste disposal.

List commonly used laboratory glassware and equipments. Indicate commonly used laboratory glassware and equipments.Describe Good and safe laboratory practices.

Explain the current guidelines for Biomedical waste disposal

BI11.2Describe the preparation of buffers and estimation of pH.

Define buffers, molarity, normality, molar solution, normal solution, percentage solution. Identify the uses of at least 4 buffers in biochemistry laboratory.

Describe the method to prepare at least two commonly used buffers in Biochemistry laboratory.

Describe the importance of HH equation in determination of pH.Describe the principle, parts and uses of pH meter.

Explain the procedure to estimate pH using pH meter. Observe the estimation of pH of different buffers using pH meter

BI11.3 Describe the chemical components of normal urine.

List the chemical components of normal urine categorising under organic and inorganicconstituents

List the chemical tests to be performed to detect organic and inorganic components of normalurine

Explain the principles of all the chemical tests listed to detect organic and inorganic components of

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normal urine

Describe the clinical significance of organic constituents of normal urine. Describe the clinical significance inorganic constituents of normal urine.

Interpret the physiological and pathological variations in organic and inorganic constituents of urine

BI11.4 Perform urine analysis to estimate and determine normal and abnormal **constituents**

Describe the ways of urine sample collection and the preservatives used.

Specific gravity under normal physiological conditions.

Describe the physical properties of urine for colour, odour, appearance, pH, Specific gravity in abnormal/diseased conditions.

Describe the abnormal constituents of urine in different diseases conditions.

Perform the physical analysis of normal urine for colour odour and appearance by observation.Estimate the pH of given urine sample using pH paper correctly by comparison of-color change by visual analysis.

Estimate the specific gravity of given urine sample using urinometer correctly withtemperature correction

Perform urine analysis to determine at least 3 organic and 3 inorganic constituents of normal urine by chemical tests according to the given procedure.

List the common abnormal constituents of urine. List the chemical tests to be performed to detect abnormal constituents of urine. Describe the principles of all the chemical tests listed to be performed to detect abnormalconstituents of urine.

Perform urine analysis to determine abnormal constituents like protein, reducing substance, ketone bodies, blood, bile salts, bile pigments by chemical tests according to the given procedure.

Perform the dipstick analysis of given urine sample for chemical constituents according to the given procedure and observe the findings

BI11.5 Describe screening of urine for inborn errors & describe the use of paper chromatography

Enumerate the urine screening tests for inborn errors of metabolism.

Identify the urine screening tests for inborn errors of metabolism as positive or negative and interpret the findings.

Describe the principle and uses of paper chromatography. Interpret the given paper/TLC chromatogram of amino acids accurately.

Interpret the given lab reports of screening tests for inborn errors of metabolism

BI11.6 Describe the principles of colorimetry

Describe the principle of photoelectric colorimeter/spectrophotometer and the application of Beer Lamberts law, Describe the parts of the photoelectric colorimeter using a labeled Diagram Explain the differences between colorimeter and spectrophotometer

I11.7 Demonstrate the estimation of serum Creatinine and Creatinine clearance

Explain the principle of Jaffe's method and modified Jaffe's method for estimation of serum Creatinine,Describe the principle of Jaffe's method for estimation of urine creatinine, standard test protocol.Perform the estimation of urine creatinine by Jaffe's method using colorimeter as per the standard test protocol.

Calculate the creatinine clearance using the formula UV/P with given volume of urine output and the serum Creatinine and urine Creatinine determined in previous experiment.

Interpret the given serum creatinine, urine creatinine and creatinine clearance values againstbiological reference intervals.

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Interpret the given serum creatinine, urine creatinine and creatinine clearance values inpathological conditions. Explain the difference between measured and calculated eGFR and its clinical significance. Explain the use of urine Creatinine in expressing the excretion of other compounds as ratios.

BI11.8Demonstrate estimation of serum proteins, albumin and A:G ratio

Describe the principle of Biuret method for estimation of serum Total protein

Describe the principle of Dye binding method (BCG) for estimation of serum Albumin Perform the estimation of serum Total protein by Biuret method using colorimeter as per thestandard test protocol

Perform the estimation of serum Albumin by Dye binding (BCG) method usingcolorimeter as per the standard test protocol, Calculate A:G ratio using serum total protein and serum albumin values obtained in previous experiment,Interpret the given serum protein, albumin and A:G ratio values against biological reference intervals.

BI11.9 Demonstrate the estimation of serum total cholesterol and HDL- cholesterol

Describe the principle of chemical/enzymatic method for estimation of serum TotalCholesterol

Describe the principle of given method for estimation of serum HDL CholesterolPerform the estimation of serum Total cholesterol by chemical method using Colorimeter/Semi automated analyser as per the standard test protocol

Perform the estimation of serum HDL cholesterol by chemical method usingColorimeter/Semi automated analyser as per the standard test protocol

Interpret the given serum Total cholesterol and serum HDL Cholesterol values againstbiological reference intervals

BI11.10Demonstrate the estimation of triglycerides

Describe the principle of given method for estimation of serum triglycerides

Perform the estimation of serum triglycerides by given method using Colorimeter/Semi automated analyser as per standard test protocol

BI11.11Demonstrate estimation of calcium and phosphorous

Describe the principle of OCPC/Dye binding method for estimation of serum Total calcium,

Describe the principle of given method for estimation of serum phosphorous

Perform the estimation of serum Total calcium by given method using Semiautomated analyser as per standard test protocol. Perform the estimation of serum phosphorous by chemical method using colorimeter as per the standard test protocol. Interpret the given serum Total calcium and serum phosphorous values against biological reference intervals

BI11.12Demonstrate the estimation of serum bilirubin

Describe the principle of given method for estimation of serum Total Bilirubin

Perform the estimation of serum Total bilirubin by given method using Colorimeter as per the standard test protocol

Interpret the given serum Total bilirubin values against biological reference intervals

BI11.13Demonstrate the estimation of SGOT/SGPT

Describe the principle of given method for estimation of serum SGOTDescribe the principle of given method for estimation of serum SGPT

Perform the estimation of serum SGOT by given method using Semi automated /autoanalyser as per the standard test protocol

Perform the estimation of serum SGPT by given method using Semi automated/autoanalyser as per the standard test protocol

Interpret the given serum SGOT and serum SGPT values against biological reference intervals

BI11.14Demonstrate the estimation of alkaline phosphatase

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Describe the principle of given method for estimation of serum Alkaline phosphatase. Perform the estimation of serum Alkaline phosphatase by given method using Colorimeter/Semi automated analyser as per the standard test protocol

Interpret the given serum alkaline phosphatase values against Biological reference intervals

BI11.15Describe & discuss the composition of CSF

Describe the normal physical properties of CSF

Describe the physical properties of CSF in abnormal conditionsDescribe the normal chemical composition of CSF

Discuss the alterations in chemical composition of CSF in abnormal conditions

BI11.16Observe use of commonly used equipment's/techniques in biochemistry

pH meter, Paper chromatography of aminoacid, Protein electrophoresis, TLC, PAGE, Electrolyte analysis by ISE, ABG analyzer, ELISA, Immunodiffusion, Autoanalyser, Quality control, DNA isolation from blood/tissue

Observe the estimation of pH of any two buffers using pH meter and their applications Observe the paper chromatography of aminoacids using standard amino acid mixtures andurine sample and their applications

Observe the Thin layer chromatography of aminoacids using standard amino acid mixturesand urine sample and their applications

Observe the agarose gel serum protein electrophoresis of normal and abnormal serum samples and their applications

Observe the agarose gel hemoglobin electrophoresis of normal and abnormal blood samples and their applications

Observe the PAGE for separation of proteins and their applications Observe the serum electrolyte analysis by ISE and their applications Observe the blood gas analysis on ABG analyser and their applications

Observe the ELISA procedure with quantitation using plate reader and their applications

Observe the immunodiffusion technique and their applications

Observe the functioning of autoanalysers and describe the principles and advantages of autoanalysers in clinical biochemistry laboratory

Explain quality control process in clinical biochemistry laboratory and their useObserve the isolation of DNA from blood/tissues and describe the application

BI11.17Explain the basis and rationale of biochemical tests done in the following conditions:

Diabetes Mellitus, Dyslipidemia, Myocardial infarction, Renal failure, gout, Proteinuria, Nephrotic syndrome, Edema, Jaundice, Liver diseases, pancreatitis, disorders of acid-base balance, Thyroid disorders.

List the lab tests used to diagnose diabetes mellitus List the tests used to monitor diabetes mellitus status

Explain the basis and rationale of glycated haemoglobin to monitor diabetic status Explain the basis and rationale of lipid profile in evaluation of cardiovascular risk assessment

Explain the basis and rationale of dyslipidemia in diabetes mellitus. Enumerate the tests used to evaluate cardiac function Explain the basis and rationale of the tests used in diagnosis of Myocardial infarction

Explain the basis and rationale of the lab tests done to assess the functioning of kidney, . ..Discuss the commonly done renal function tests in renal failure

Explain the basis and rationale of serum uric acid in gout. Explain the basis and rationale of tests used in diagnosis of Nephrotic syndrome. Explain the lab evaluation for different types of Jaundice

Describe the lab tests done to assess the functioning of Liver. Explain the basis and rationale of lab tests done in Liver disorders

Explain the basis and rationale of lab tests done to assess the functioning of pancreasDiscuss the lab tests done in pancreatic disorders

Explain the basis and rationale of lab tests done to assess the functioning of thyroid. Discuss the lab tests done in

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thyroid disorders

Discuss the lab tests done in acid base disorders Interpret the given lab report of patient with jaundice

Interpret the given lab report of patient with renal dysfunction. Interpret the given lab report of pancreatic function tests Interpret the given lab report of thyroid function tests Interpret the given lab report of cardiac function tests

Interpret the given lab report of patient with type 2 diabetes mellitus

Interpret the given lab report of patient with acute chest pain presenting to emergencydepartment

Justify the given lab findings in patient presenting with arthritis

BI11.18 Discuss the principles of spectrophotometry.

Describe the principle of spectrophotometryDescribe the parts of spectrophotometer

BI11.19 Outline the basic principles involved in the functioning of instruments commonly used in a biochemistry laboratory and their applications.

Describe the principle and uses of colorimeter Describe the principle and uses of spectrophotometerDescribe the principle and uses of urinometer Describe the principle and uses of pH meter

Describe the principle and uses of semiautomated analyser

Describe the principle and uses of fully automated chemistry analyser .Describe the principle and uses of fully automated immune-analyser Describe the principle and uses of centrifuge

Describe the principle and uses of electrophoresis apparatusDescribe the principle and uses of glucometer

Describe the principle and uses of ABG analyser

Describe the principle and uses of electrolyte analyser by ISE

BI11.20Identify abnormal constituents in urine, interpret the findings and correlate these with pathological states.

Identify the abnormal constituents of urine from the given chemical Tests

Interpret the abnormal physical and chemical test findings of the given urine sample

Correlate the abnormal urine findings in given urine sample with pathological states

BI11.21 Demonstrate estimation of glucose, creatinine, urea and total protein in serum.

Describe the principle of enzymatic method for estimation of serum glucose Perform the estimation of serum Glucose by enzymatic method using colorimeterInterpret the given serum glucose levels against biological reference intervals Describe the principle of Jaffe's method for estimation of serum creatinine Perform the estimation of serum creatinine by Jaffe's method using colorimeter Interpret the given serum creatinine levels against biological reference intervals Describe the principle of for estimation of serum urea by an end-point method Perform the estimation of serum urea by an end-point method using colorimeter Interpret the given serum glucose levels against biological reference intervals Describe the principle of Biuret method for estimation of serum total

BI11.20 Identify abnormal constituents in urine, interpret the findings and correlate thesewith pathological states.

Identify the abnormal constituents of urine from the given chemical tests.

Interpret the abnormal physical and chemical test findings of the given urine sample.Correlate the abnormal urine findings in given urine sample with pathological states

BI11.21 Demonstrate estimation of glucose, creatinine, urea and total protein in serum.

Describe the principle of enzymatic method for estimation of serum glucose Perform the estimation of serum Glucose by enzymatic method using colorimeter

Interpret the given serum glucose levels against biological reference intervals

Describe the principle of Jaffe's method for estimation of serum creatinine Perform the estimation of serum creatinine by Jaffe's method using colorimeter Interpret the given serum creatinine levels against biological reference intervals

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Describe the principle of for estimation of serum urea by an end-point method Perform the estimation of serum urea by an end-point method using colorimeter Interpret the given serum glucose levels against biological reference intervals

Describe the principle of Biuret method for estimation of serum total protein Perform the estimation of serum Total protein by Biuret method using Colorimeter Interpret the given serum Total protein levels against biological reference intervals

BI11.22Calculate albumin: globulin (AG) Ratio and Creatinine clearance

Calculate A: G ratio using given serum total protein and serum albumin values andinterpret the results.

Calculate the creatinine clearance using the formula UV/P with given volume of urine outputand interpret the results.

BI11.23Calculate energy content of different food Items, identify food items with high and lowglycemic index and explain the importance of these in the diet

Calculate the energy content of different food items correctly based on their carbohydrate,protein and lipid content

Identify food items with high and low glycemic index

Explain the importance of low and high glycemic index food items in diet in normal anddiseased conditions

BI11.24Enumerate advantages and/or disadvantages of use of unsaturated, saturated andtrans fats in food.

Explain the advantages and/or disadvantages of use of unsaturated fats in food.Explain the advantages and/or disadvantages of use of saturated fats in food.

Explain the advantages and/or disadvantages of use of trans fats in food.

Course Outcomes for Biochemistry

At the end of the course, the students should be able to

Course Code	Course Name	Course Outcome	
MBC104A	Biochemistry 2	104A.1	Describe structure, function, and metabolic interrelationship /integration of biomolecules - Proteins, Nucleic acids, Enzymes in health and disease along with organ function tests.
		104A.2	Describe the molecular mechanism of gene expression and regulation, principles of genetic engineering and their application in medicine.
		104A.3	Explain the biochemical basis, associated consequences, rationale of clinical laboratory tests for diseases, inborn errors of Proteins &Nucleic acid metabolism, and interpret the results in the clinical context.
		104A.4	Structure, Biosynthesis, Function and disorders associated with Hemoglobin and other plasma proteins
		104A.5	Perform routine and some special investigations making use of conventional instruments/techniques, analyze and interpret the biochemical investigation data.

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PO, PSO & CO Mapping – Biochemistry

Course Code and name	Course Outcome	Program Outcomes					Program Specific Outcomes				
		PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PS03	PSO4	PSO5
MBC104A Biochemistry 2	103A.1	3	3	3	2	3	3	3	3	2	3
	103A.2	3	3	2	3	3	3	3	2	3	3
	103A.3	3	3	3	2	3	3	3	3	2	3
	103A.4	3	3	2	3	3	3	3	2	3	3
	103A.5	3	3	3	2	3	3	3	3	3	3
		3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution									

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RECOMMENDED BOOKS

TEXT BOOKS: (Recent editions)

a. DM Vasudevan. Textbook of Biochemistry for Medical students

b. Lippincotts' Illustrated reviews – Biochemistry

c. S.K.Gupta. Biochemistry for MBBS

d. Pankaja Naik. Biochemistry

e. Dinesh Puri. Textbook of Medical Biochemistry

f. Namrata Chhabra. Case oriented approach towards Biochemistry

g. Divya shanti D'sza, Sowbhagya lakhsmi. An easy guide to Practical Biochemistry.

REFERENCE BOOKS: (Recent editions)

h. Harpers' Illustrated Biochemistry

i. Marshall and Bangert. Clinical Chemistry

j. Baynes and Dominiczak. Medical Biochemistry

k. Lehninger Principles of Biochemistry 7th International Edition by David L Nelson, Macmillan

l. Kuby Immunology, sixth edition, by Thomas J. Kindt et al.

m. Bhagavan and Ha. Essentials of Medical Biochemistry with clinical cases

n. Stryer. Biochemistry

o. James Watson. Molecular biology of gene

p. Syllabus for Biochemistry

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ACERTIFICATION OF SKILL ACQUISITION IN BIOCHEMISTRY

SL.NO	COMPETENCY NO	TOPIC	CERTIFICATION DATE	SIGNATURE OF FACULTY
1.	BI11.4	Perform urine analysis to estimate and determine normal and abnormal Constituents		
2.	BI11.20	Identify abnormal constituents in urine, interpret the findings and correlate these with pathological states.		
3.	BI11.21	Demonstrate estimation of blood /serum glucose		
4.	BI11.21	Demonstrate estimation of blood /serum urea		
5.	BI11.7/ BI11.21	Demonstrate estimation of serum creatinine and creatinine clearance		
6.	BI11.8/BI11.21	Demonstrate estimation of serum total proteins, albumin&A:G ratio		

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Certification of Competencies - Skill Acquisition(Biochemistry)

Suggested format for checklist

GeneralGuidelines

(All checklists for skill certification need not be essentially a part of log book. They should be used as a guide for evaluation)

Sl No	Assessment criteria	Date of each evaluation*		
	Overall performance (A/B/C)			
	Name of Evaluator			
	Signature of evaluator			

Competency Description:

***Number columns as per requirement**

Each criteria may be assessed by different tools (OSPE/Practical/viva) using appropriate scoring pattern.

Marking of each assessment criteria

√ if student meets the expectation for each criteria

X if student does not meet the expectation for each criteria

Overall Performance in these assessments can be graded as below:

- **Meets expectations (ME)**

  A: Student is able to perform all the test and report the test results with appropriateinterpretations independently and can be certified

- **Does not meet expectations (DME)** -

  Student needs further training to perform and report the test results with appropriateinterpretations independently and are evaluation to certify the same.

  B: > than 50% of criteria meets expectation, reevaluation needed only for criteria which have notmet the expectation.

  C: < than 50% of criteria meets expectation, reevaluation needed for the entire competency

Feedback to students: After each assessment, the respective faculty to give the feedback tostudents regards the areas for improvement/reassessment.

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Course Specifications
Physiology

Code- MBC105A

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Course Specification

Course Title	Physiology
Course Code	MBC105A
Course Type	Core Theory & Practical Course
Department	Physiology
Faculty	Medical

Introduction to the Department

Department of Physiology has state of the art facilities to impart quality medical education. Students are trained in basic principles, mechanism and homeostatic control of all the functions of human body as a whole. This includes teaching learning related to normal functions of all human organ systems, regulatory mechanisms and interactions of the various organs for well-coordinated total body function. Students understand the physiological aspects of normal growth and development and also learn to analyze physiological responses and adaptations to different stresses during life processes.

Teaching staff comprises of qualified and experienced Physiologists, training students to be adept with various Physiological concepts which will help the students in their professional career.

Department has well equipped human, clinical and hematology laboratories to demonstrate and acquire the skills to do the experiments for study of physiological functions and clinical examinations. There is a computer assisted lab for teaching animal experiments.

Department of Physiology conducts regular yoga sessions for physical and mental health of the students. Department also has research laboratory to analyze and interpret experimental and investigative data to update and to do advanced research in the field of Physiology.

This course is designed in such a way that the student will get the complete knowledge of normal functioning of cell, blood and its components, Cardiovascular system, Respiratory system, Gastrointestinal system, excretory system and their interactions for maintenance of homeostasis and pathophysiology of these systems. Students should be able to Acquire the skills to do experiments related to hematology, Human experiments / clinical examinations related to these systems.

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Goal:

The broad goal of the teaching of undergraduate students in Physiology aims at providing the student comprehensive knowledge of the normal functions of the organ systems of the body to facilitate an understanding of the physiological basis of health and disease.

Objectives:

a. Cognitive domain

At the end of the course the student will be able to:

1. Explain the normal functioning of all the organ systems and their interactions for well- coordinated total body function.
2. Assess the relative contribution of each organ system to the maintenance of the milieu interior.
3. Elucidate the physiological aspects of normal growth and development.
4. Describe the physiological response and adaptations to environmental stresses.
5. List the physiological principles underlying pathogenesis and treatment of disease.

b. Psychomotor domain

At the end of the course the student will be able to:

1. Conduct experiments designed for study of physiological phenomena.
2. Interpret experimental/investigative data.
3. Conduct and interpret clinical examination in normal healthy subject.
4. Distinguish between normal abnormal data derived as a result of tests, which he/she has performed and observed in the laboratory.

c. Affective domain

At the end of the course the student will be able to:

1. Show due respect to persons who volunteer to be examined for the purpose of learning clinical examination.
2. Communicate effectively with peers, teachers and volunteer in clinical examination.
3. Demonstrate the ability of teamwork.

d. Integration

At the end of the integrated teaching the student should acquire an integrated knowledge of organ structure and function and the regulatory mechanisms.

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Course summary

Sl. No.	Topic	Number of Competencies
1.	General Physiology	9
2.	Haematology	13
3.	Gastro intestinal Physiology	10
4.	Cardiovascular Physiology	16
5.	Respiratory Physiology	10
6.	Renal Physiology	9
	Total	67

Topic: General Physiology – 8 hrs

Number	Competency
PY 1.1	Describe the structure and function of a mammalian cell • Describe the structure of "Fluid-Mosaic" model of cell membrane • List the functions of the components of the cell membrane • List the cell organelles and describe their functions • List the components of cytoskeleton (microfilaments, microtubules, molecular motors) and explain their function inintra cellular transport
PY 1.2	Describe and discuss the principles of homeostasis • Describe the concept of Milieu interior • Discuss the regulatory systems that maintain homeostasis • Describe positive and negative feedback mechanisms with appropriate examples
PY 1.3	Describe intercellular communications • List the types of Intercellular junctions and describe their functions • Describe the various functional types of intercellular signaling (autocrine, paracrine, synapse, neuroendocrine andendocrine)
PY 1.4	Describe Apoptosis- Programmed cell death. • Define apoptosis • Describe the function of apoptosis • Briefly describe the pathways involved in apoptosis
PY 1.5	Describe and discuss transport mechanism across cell membrane • List the types of transports across cell membrane (passive, active, vesicular) • Distinguish between active and passive transport mechanisms

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	• Define simple diffusion and explain the factors affecting simple diffusion • Explain facilitated diffusion with examples. • List the differences between simple and facilitated diffusion • Define osmosis, osmotic pressure, tonicity of plasma. • Explain Primary active transport with examples. • Explain Secondary active transport with examples • Explain Vesicular transport: Endocytosis, exocytosis with physiological examples
PY1.6	Describe the fluid compartments of the body, its ionic composition & measurements. • List the Units of measuring tonicity: moles and equivalents • Explain the physiological importance of maintaining plasma tonicity • Explain the difference between Osmolarity and osmolality • Provide the normal value of total body water in normal healthy adult and list the factors which contribute to its variation. • Describe the distribution of total body water in different body fluid compartments. • List the difference in ionic composition of ECF and ICF and its importance in physiological functions • Explain the methods to assess body fluid compartments and list the specific indicators used for each compartment. • Explain the physiological basis of fluid replacement in dehydration / overhydration
PY 1.7	Describe the concept of pH & buffer systems in the body • Describe the concept of pH and state the normal pH of arterial blood. • Define a buffer • List the buffer systems in the body • Define acidosis and alkalosis.
PY1.8	Describe & discuss the molecular basis of resting membrane potential and action potential in the excitable tissue. • Define 'stimulus' and 'excitability' • Classify stimulus based on a) strength and b) modality • Define resting membrane potential and indicate its normal value (range) • Define the Nernst Potential of an ion • Describe the ionic basis of the resting membrane potential and the application of the Goldman-Hodgkin-Katzequation • Define Gibbs-Donnan effect and indicate its role in the genesis of the resting membrane potential • Define action potential. Draw and label an action potential • Describe the ionic basis of the action potential • List blockers of voltage gated channels that participate in the action potential • Distinguish between a local response (Graded Potential) and an action potential

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PY 1.9	Demonstrate the ability to describe and discuss the methods used to demonstrate the functions of the cells and its products, its communications and their applications in clinical care and research • Describe the methods to assess cellular physiology with respect to the following: ○ Cellular functions: ▪ Patch clamp technique ▪ microscopy – secretory/ active/ non-secretory cells ○ Cellular products and communication: immunohistochemistry, estimation of secretory products ○ Cell culture

Topic: Blood – 16 hrs

Number	Competency
PY2.1	Compositions and functions of blood • List the components of blood (cellular and noncellular) • and describe the functions. • State the normal packed cell volume (hematocrit) and describe its use in clinical medicine
PY2.2	Origin, forms, variations and functions of plasma • List the plasma proteins and give normal values and the A/G ratio • Describe the physiological role of the plasma proteins • Describe the role of plasma proteins in Starlings forces and in the pathophysiology of edema • Discuss the alterations in plasma protein levels in health and disease
PY2.3	Synthesis and functions of hemoglobin and its breakdown. Variants of hemoglobin • Explain structure of normal hemoglobin. • State the normal Hb range for males and females and explain the basis for the differences • List the types of Hemoglobin (normal and abnormal) • Explain the fate (breakdown) of hemoglobin • Discuss the variants of hemoglobin
PY2.4	RBC formation (erythropoiesis and its regulation) and its functions • Define hemopoiesis. • Define erythropoiesis. • Describe the morphology of RBC • State the normal life span of the RBC • Describe the clinical importance of determining PCV and ESR • List the sites of erythropoiesis in fetus and adult. • Describe the stages of erythropoiesis and its regulation. • Describe the morphology, normal count and clinical significance of reticulocytes
PY2.5	Different types of anemia and jaundice. • Define anemia and classify based on i) Morphology ii) Etiology • Explain the physiological basis of symptoms/signs of anemia

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	• Describe the causes and physiological basis of treatment of iron deficiency anemia • Describe the cause and treatment of megaloblastic anemia • List the types of polycythemia and discuss its consequences • List the RBC indices and describe the variations in disease • Define and classify jaundice. • Differentiate the different types of jaundice. • Describe Physiological jaundice
PY2.6	WBC formation (granulopoiesis) and its regulation. • Classify WBCs and state their normal counts and variations from normal counts • Describe the normal morphology and functions of each WBC • Describe the stages and factors required for leucopoiesis • Describe the stages of phagocytosis • Enumerate the classical signs of inflammation
PY 2.7	Formation of platelets, functions and variations. • Describe the morphology of the platelets • Discuss the normal count of platelets and its variations • Describe thrombopoiesis and factors regulating it • Explain the functional role of platelets
PY 2.8	Physiological basis of hemostasis and anticoagulants. Bleeding and clotting disorders (hemophilia, purpura) • Define hemostasis, and describe the sequence of events of hemostasis • List out the difference between temporary hemostatic plug and a clot • Enumerate the important clotting factors and their sites of production • Explain the mechanism of clotting via: a) Intrinsic and b) extrinsic pathways. • Describe the role of Vitamin K and calcium in coagulation • Explain the process of clot retraction • Lists the tests for hemostasis • Differentiate between Coagulation and Bleeding disorders • Explain the symptoms and the mode of inheritance of hemophilia • Describe the steps of fibrinolysis • List anticoagulants and their mechanism of action • Discuss the physiological basis of the treatment of DIC and thrombosis.
PY2.9	Different Blood groups and clinical importance of blood grouping, blood banking and transfusion. • List the blood group systems. Describe the ABO system, Rh system State the Landsteiner's Law • Describe the mode of inheritance of blood groups • Discuss the importance of blood groups • Discuss the importance and the methods of cross matching: direct and indirect • List the physiological basis of the symptoms and treatment of Rh incompatibility (erythroblastosis fetalis) • List the hazards of blood transfusion

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	• Describe the complications of mismatched blood transfusion • Describe how blood is stored and discuss the changes that occur in stored blood
PY2.10	Different types of immunity. Development of immunity and its regulation. Lymph-composition, circulation and functions • Define and classify immunity (Innate/ acquired; specific and non-specific; active / passive) with examples • List the cells and the organs which are responsible for immunity • Draw a diagram explaining the structure of an antibody • Discuss antigen presentation • Explain the mechanism of humoral immunity in relation to cells involved, type of antibodies and the role inimmunity • Explain the mechanism of cell mediated immunity in relation to cells involved, roles of each cell • Describe the role of cytokines in immunity • Compare the primary and secondary responses in immunity • Describe the basis of a) hypersensitivity reactions b) autoimmunity c) graft vs host reaction d) immune tolerance
PY2.11	Hb, RBC, TLC,RBC indices, DLC, blood groups, BT/ CT • Perform Hb, RBC, TLC,RBC indices, DLC, blood groups, BT/ CT
PY2.12	ESR, Osmotic fragility, Hematocrit. • Observe ESR, Osmotic fragility, Hematocrit
PY2.13	Steps for reticulocyte and platelet count. • Observe Steps for reticulocyte and platelet count.
Topic: Gastrointestinal physiology – 10 hrs	
Number	Competency
PY 4.1	Structure and functions of digestive system • Describe the general organization of Gastrointestinal System • Illustrate a typical section of the GI wall. • List the functions of digestive system • Describe the intrinsic and extrinsic innervations of GIT and their function. Add a note on the action of Acetylcholine and epinephrine.
PY 4.2	Describe the composition, mechanism of secretion , functions and regulation of saliva gastric, pancreatic intestinal juices and bile secretion • Classify salivary glands. • Describe the composition of salivary secretion and explain its functions • Describe the mechanism of salivary secretion and its regulation • Explain the functional anatomy and histology of stomach • Describe the composition of gastric secretion and explain its functions. Explain in detail the mechanism of HClsecretion.

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	• Enumerate the phases of Gastric secretion and describe their regulation. • Describe the experimental evidences to demonstrate the regulation of Gastric acid secretion. • Explain the effects of total gastrectomy • Explain the functional anatomy of the exocrine part of pancreas • Describe the composition of pancreatic secretion and explain its functions • Describe the mechanism of secretion and regulation of pancreatic juice. • Describe the functional anatomy and histology of the small intestine • Describe the composition and functions of succus entericus • Describe the pathophysiological basis of malabsorption syndrome • Describe the structural characteristics of the large intestine. • List the functions of the large intestine
PY 4.3	Describe GI movements , regulation and functions , describe defecation reflex, explain role of dietary fibre • Describe the events in the various phases of Deglutition • Discuss Basal Electrical rhythm and its ionic basis • Describe Gastric emptying and the various factors influencing it • Discuss the features and function of the Migrating Motor Complex • Define the law of Gut. Discuss different types of movements of the small intestine • Describe the movements of the large intestine. Add a note on Gastrocolic reflex. • Describe the defecation reflex. • Explain the formation and composition of faeces • Discuss the physiological role of dietary fibres • Describe the nervous and hormonal regulation of GI motility
PY 4.4	Describe the physiology of Digestion and absorption of nutrients • Describe the sites and mechanism of digestion and absorption of Carbohydrates. Add a note on Lactose intolerance. • Describe the sites and mechanism of digestion and absorption of Proteins. • Describe the sites and mechanism of digestion and absorption of Fats. Add a note on Steatorrhea • Describe the sites and mechanism of absorption of water • Discuss the mechanism of absorption of vitamins, and minerals from the GIT into blood stream. • Describe the pathophysiological basis of malabsorption syndrome
PY 4.5	Describe the source of GIT hormones, their regulations and functions • List the GI hormones and their sites of production • Describe the actions and regulation of the GI hormones.

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PY 4.6	Describe the gut brain axis • Describe the effect of Hypothalamic-Pituitary axis on GI function • Describe the role of Autonomic nervous system on regulation of GI functions • Discuss the role of gut microbiota and its influence on brain functions. Describe the effects of loss of Gut microbiotaand its management (role of drugs, probiotics etc) • Describe action of GI hormones/ peptides on the CNS
PY 4.7	Describe and discuss the structure and functions of Liver and gall bladder. • Describe the functional anatomy of hepatobiliary system. • Describe the enterohepatic circulation • Discuss the functions of liver • Describe the mechanism of secretion and regulation of bile secretion. • Discuss the composition and functions of bile secretion. Distinguish between hepatic and gall bladder bile • Discuss the functions of gall bladder. Add a note on the effects of cholecystectomy
PY 4.8	Describe and discuss Gastric function tests, pancreatic Exocrine function tests and liver function tests • Enumerate Gastric function tests with clinical significance of each • Enumerate Liver function tests with clinical significance of each • Enumerate the Pancreatic function tests for exocrine part of Pancreas with clinical significance of each
PY 4.9	Discuss the physiology aspects of Peptic ulcers, Gastroesophageal reflux disease, vomiting, diarrhoea, constipation, Adynamic ileus , hirshprungs disease • Discuss dysphagia and its causes. • Discuss the pathophysiology and effects of achalasia cardia • Describe the cause and features of o GERD o Hiatus hernia • Describe the pathophysiology, symptoms and management of peptic ulcer • Discuss the pathophysiology, presentation and management of acute and chronic pancreatitis • Discuss the pathophysiology of o Vomiting o Diarrhoea o Constipation o Discuss the pathophysiology and presentation of Hirchsprung's disease, adynamic ileus
PY 4.10	Demonstrate the correct clinical examination of the Abdomen in a normal volunteer or simulated environment • Perform clinical examination of abdomen

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Topic: Cardiovascular Physiology – 25 hrs	
Number	Competency
PY 5.1	Describe the functional anatomy of heart including chambers and pacemaker tissue and conducting system • Describe the functional anatomy of the heart and blood vessels ○ Differences between left and right side of the heart, ○ Describe the components of conducting system (with speed of conduction for each) ○ Types of blood vessels and their function • Differentiate between systemic & pulmonary circulations.
PY 5.2	Describe the Properties of cardiac muscle including its morphology, electrical , mechanical and metabolic functions. • Describe the functional features of cardiac muscle in relation to: a) excitability b) conductivity c) autorhythmicity d)contractility e) non-fatigability f) all or none law g) refractory period h) extrasystole and compensatory pause i) staircase phenomenon j) Frank Starling Law
PY 5.3	Discuss the events occurring during the cardiac cycle • Define cardiac cycle, list the phases & its durations. • Describe with illustration, the electrical and mechanical events during a single cardiac cycle (Wigger's diagram) • Explain the Right atrial pressure changes during cardiac cycle with a JVP tracing. • Mention the clinical significance of JVP. • List the different heart sounds & explain their basis
PY 5.4	Describe generation, conduction of cardiac impulse. • Explain with a graph, the ionic basis of pacemaker potential. • Explain the effects of sympathetic & parasympathetic stimulation on pacemaker potential. • Explain with a graph, the ionic basis of cardiac ventricular muscle AP. • Describe functional significance of long refractory period in cardiac muscle. • Describe with a diagram the pathway of sequential electrical excitation of the heart. • Explain the basis & importance of A-V nodal delay in impulse conduction. • Explain the basis of SAN acting as the primary pacemaker. • Define an Ectopic pacemaker
P Y 5.5	Describe the physiology of electrocardiogram(ECG) its application and the cardiac axis • Define Electrocardiogram & list its uses. • Explain the principle behind recording an ECG in relation to: The cardiac dipole, Einthoven's triangle andEinthoven's Law • Classify the leads in a 12 lead ECG and explain the procedure of recording a conventional 12 lead ECG. • Draw and label a normal Lead II ECG waveform. Define normal durations of segments and intervals of normal ECGwaves

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	• Define the term Cardiac vector. Give the normal range of the mean cardiac vector & its significance. • Determine the cardiac axis from a normal ECG. Define axis deviation & mention the causes for the same.
PY 5.6	Describe abnormal ECG, Arrythmias, heart block and myocardial infarction • Classify and describe arrhythmias based on its origin. • Define sinus arrhythmia & explain its basis. • Explain the different types of heart block • Describe ECG changes in fibrillation and flutter • Describe the ECG changes in Acute Myocardial Infarction & its basis. • Describe the ECG changes in left and right ventricular hypertrophy • Mention the salient ECG changes secondary to electrolyte disturbances
PY 5.7	Describe and discuss Haemodynamics of circulatory system • Describe the functional classification of blood vessels • Explain the hemodynamic principles governing blood flow through vessels (Poiseuille's law). • Differentiate between laminar & turbulent flow & factors determining the same (Reynold's number). • Describe the applications of the following: o Laplace law o Bernoulli's principle o Fahraeus Lindqvist effect
PY 5.8	Describe and discuss local and systemic cardiovascular regulatory mechanisms • Describe the regulation of local and systemic cardiovascular mechanisms
PY 5.9	Describe the factors affecting heart rate, regulation of cardiac output and blood pressure. • Mention the normal heart rate (range) & its variations. • List & explain the neural and hormonal mechanisms controlling heart rate. • Define arterial pulse. • Draw and label an arterial pressure pulse tracing • Define the terms- Cardiac output, Cardiac index, Stroke volume, Venous return; state their normal values • List & explain the factors determining cardiac output. • Explain the heterometric and homomeric regulation of cardiac output • List the methods of measuring cardiac output & explain their principles. • Mention the factors affecting venous return. • Define the terms & give their normal values: Blood pressure, Systolic blood pressure, Diastolic blood pressure, Pulsepressure & Mean arterial pressure • Describe the factors determining systolic & diastolic pressures. • List the various short-term mechanisms regulating blood pressure. • Describe the role of baroreceptor reflex mechanism in short term regulation of BP. • State & explain Marey's law.

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	• Describe the role of CNS ischemic response & Cushing's reflex in the regulation of BP. • Explain the basis of postural hypotension • Describe the regulation of cardiovascular activity by the vasomotor center & higher brain areas. • Describe the role of long-term regulation of BP. • Describe the role of Renin-Angiotensin-Aldosterone mechanism in long term increase in BP. • List the various intermediate mechanisms for BP regulation. • Explain the operational principles of: Stress-relaxation mechanism, Capillary fluid shift mechanism & Renin-Angiotensin mechanism in intermediate term regulation of BP. • Define the terms – Hypertension, Hypotension
PY 5.10	Describe and discuss Regional circulation including microcirculation, Coronary circulation , Cerebral , Capillary, Cutaneous , Lymphatic , Foetal, Pulmonary and splanchnic circulation • Define microcirculation & describe with a diagram the structure of microcirculation. • List the functions of capillary circulation. • Describe the pattern & regulation of blood flow through capillaries. • List the factors governing movement of substances across the capillary wall. • Explain the Starling's forces determining Net filtration pressure for fluid movement across the capillary wall • Define edema & describe the basis of edema formation. • Describe the composition, formation & functions of lymph. • Explain the factors regulating lymph flow along the lymphatics. • Describe the organization & functions of venous system. • Define central venous pressure & give its normal value. • Describe the factors determining peripheral venous pressure & flow of blood through it. • Describe the method of measuring central venous pressure • Explain the intrinsic methods for acute auto regulation of blood flow. (myogenic, metabolic, perfusion theories) • Explain the mechanisms involved in long term local blood flow regulation. • List the humoral vasoconstrictor & vasodilator agents regulating local blood flow. • Mention the salient features of coronary circulation • Explain the regulation of coronary blood flow • Mention the causes & effects of coronary insufficiency • Describe the clinical features of Ischemic heart disease with its basis • Mention the salient features of cerebral circulation • Explain the regulation of cerebral blood flow • Define cerebral stroke & mention the causes for the same • List the salient features of splanchnic circulation

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	• Define 'triple response' & explain the basis for the same • Mention the circulatory readjustments which occur at birth
PY 5.11	Describe the pathophysiology Shock , syncope and Heart failure • Define shock, mention the types & causes for each • Describe the stages of shock • Explain the principle in the management of shock • Discuss the physiological basis of vasovagal syncope • Define heart failure
PY 5.12	Record blood pressure and pulse at rest and in different grades of exercise and posture in a volunteer or simulated environment. • Perform recording of blood pressure and pulse at rest and in different grades of exercise and posture in a volunteer or simulated environment
PY 5.13	Record and interpret normal ECG in a volunteer or simulated environment • Record and interpret a normal ECG
PY 5.14	Observe cardiovascular autonomic function tests in a volunteer or simulated environment. • Observe cardiovascular autonomic function tests
PY 5.15	Demonstrate the correct clinical examination of the cardiovascular system in a normal volunteer or simulated environment. • Perform clinical examination of cardiovascular system
PY 5.16	Record arterial pulse tracing using finger plethysmography in a volunteer or simulated environment • Observe arterial pulse tracing using finger plethysmography
Topic: Respiratory Physiology – 12 hrs	
Number	Competency
PY 6.1	Describe the functional anatomy of respiratory tract • List the structures of the respiratory system with their functions. • Describe the structural divisions of airways with their function. • Draw the layers of respiratory membrane • List the respiratory & non-respiratory functions of respiratory system • Describe the special features of pulmonary circulation
PY6.2	Describe the mechanics of normal respiration, pressure changes during ventilation, lung volume and capacities, alveolar surface tension, compliance, airway resistance, ventilation, V/P ratio, diffusion capacity of lungs • List the primary & accessory muscles of inspiration & expiration • Describe the mechanism of inspiration and expiration • Define the physical laws applicable in respiratory physiology • Describe the genesis of negative intrapleural pressure • Draw a diagram to show the changes in air flow, intrapleural pressure and intra alveolar pressure during a breathingcycle • Define pulmonary compliance and list the factors altering the

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	compliance • Distinguish between static and dynamic compliance. • Draw the lung compliance curve & explain the basis for its pattern • Describe the synthesis, composition & functions of pulmonary surfactant. Add a note on Respiratory distresssyndrome • Define closing volume, list the factors determining closing volume & mention its significance • Define dead space with normal value, list its types and list the methods of determining dead space volume • Explain the effect of shunt on physiological dead space • Explain with illustration the relationship between alveolar ventilation & oxygen / carbon-di-oxide partial pressuresin the alveolus • Define Alveolar Ventilation-Perfusion ratio & mention its regional differences and explain its physiological basis • Define Fick's law of diffusion and explain the factors affecting diffusion of gases across the respiratory membrane
PY6.3	Describe and discuss the transport of respiratory gases: Oxygen and Carbon dioxide • List the methods of transport of oxygen in blood. • Describe with illustration oxygen binding characteristics of hemoglobin. • Describe the oxy-hemoglobin dissociation pattern at rest & during exercise. • List & explain the factors causing right / left shift of oxy-hemoglobin dissociation curve. • Compare and contrast the oxy-hemoglobin dissociation curve of fetal hemoglobin with that of adult hemoglobin. • List the three methods of carbon-di-oxide transport in blood and explain each of them. • Explain the chloride shift phenomenon in the transport of carbon-di-oxide as bicarbonate ions. • Describe the carbon-di-oxide dissociation curve and list the factors affecting carbon-di-oxide dissociation curve. • Explain the role of Bohr & Haldane effects on right / left shift of carbon-di-oxide dissociation curve. • Explain the effects hyper & hypo ventilation on blood carbon-di-oxide levels. • List the peripheral & central chemoreceptors regulating respiration & explain the mechanism of chemical regulationof respiration. • List the centers of respiration in medulla & pons and describe their role in the control of respiration. • Describe the role of Hering-Breuer reflex in neural regulation of respiration. • List the different types abnormal patterns of breathing & explain the basis. • Discuss with diagrams the types of periodic breathing and list the causes of each type.

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	• Briefly describe the mechanism of cough reflex, sneezing reflex & deglutition apnoea.
PY 6.4	Describe and discuss the physiology of high altitude and deep sea diving. • Describe the process of acclimatization to high altitude. • Describe the features of acute and chronic mountain sickness & basis of its treatment. • Mention the hazards of deep-sea diving and explain the basis of various hazards of deep sea diving with specific reference to nitrogen narcosis and Decompression sickness Bends, Caisson's disease) • Explain how Decompression sickness can be prevented and treated
PY6.5	Describe and discuss the principles of artificial respiration, oxygen therapy, acclimatization and decompression sickness. • List the different methods of artificial respiration and cardiopulmonary resuscitation and its principle. • Define hypoxia, classify hypoxia with examples • Describe the role of oxygen therapy in hypoxia and list the side effects of 100% oxygen therapy.
PY6.6	Describe and discuss the pathophysiology of dyspnoea, hypoxia, cyanosis asphyxia; drowning, periodic breathing • Define hypoxia. List the causes and types of hypoxia and discuss the pathophysiology of each types in detail. • Define apnoea • Define dyspnoea and understand the concept of dyspneic index. • Define asphyxia and list few major causes. • Describe the mechanism of death in drowning • Define cyanosis. Differentiate between central and peripheral cyanosis and list the causes.
PY6.7	Describe and discuss lung function tests & their clinical significance • Describe the various lung volumes & capacities with its normal ranges • Draw and label a normal spirogram • List the static & dynamic lung volumes & capacities. • Briefly discuss the methods of determining FRC & RV • Draw a flow-volume loop and explain the determinants of its components • Define minute ventilation, alveolar ventilation, maximum voluntary ventilation, breathing reserve and calculate thenormal values • Explain the differences in obstructive & restrictive lung pathologies using a flow – volume loop. • Differentiate between obstructive & restrictive lung diseases • Describe the application of lung function tests in clinical practice
PY6.8	Demonstrate the correct technique to perform & interpret Spirometry • Perform spirometry

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PY6.9	Demonstrate the correct clinical examination of the respiratory system in a normal volunteer or simulated environment • Perform clinical examination of respiratory system
PY6.10	Demonstrate the correct technique to perform measurement of peak expiratory flow rate in a normal volunteer or simulated environment • Perform recording of peak expiratory flow rate
Topic: Renal Physiology – 12 hrs	
Number	Competency
PY 7.1	Describe structure and function of kidney • Describe the functional anatomy of kidney • Describe the blood supply of the kidney and list its peculiarities • Describe the regulation of blood flow to the kidneys and state how it is measured • List the excretory functions of kidney • List the non-excretory functions of kidney • Define nephron. Describe the various parts of nephron • Distinguish between cortical and juxta medullary nephrons
PY 7.2	Describe the structure and functions of juxta glomerular apparatus and role of renin-angiotensin system • Describe the Juxta Glomerular Apparatus with a labelled diagram • List the functions of Juxta Glomerular Apparatus • List the factors that activate the renin-angiotensin-aldosterone system (RAAS) • With a flow diagram indicate the RAAS pathway • Discuss the role of the RAAS with regards to (a) blood pressure regulation (b) fluid and volume balance
PY 7.3	Describe the mechanism of urine formation involving processes of filtration, tubular reabsorption & secretion; concentration and diluting mechanism • Discuss the characteristics of the filtration membrane • Define Glomerular Filtration rate and state its normal value • Discuss the determinants of glomerular filtration rate • Explain how GFR can be measured • Explain Tubulo-glomerular feedback and glomerulo-tubular balance • Describe the Proximal tubular functions • Describe the renal handling of sodium • Describe the renal handling of potassium • Describe the renal handling of water • Explain obligatory and facultative reabsorption of water • Explain the renal handling of glucose • Discuss the concept of transport maximum and renal plasma threshold for glucose • Explain the reabsorption of amino acids, urea • Describe renal handling of calcium, magnesium, and phosphate

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	• Describe the factors influencing genesis of medullary gradient • Describe the role of countercurrent multiplier and exchanger systems • List various conditions leading to loss of concentrating and diluting ability of nephron • Indicate the site and mechanisms action of common diuretics
PY 7.4	Describe & discuss the significance & implication of Renal clearance • Define clearance • Describe how renal clearance can be used to measure GFR with specific regard to (a) substances used (b) limitations of different substances • Describe how renal clearance can be used to measure Renal plasma flow (RPF) • Given representative values, calculate GFR and RPF using the principle of renal clearance and interpret the result
PY 7.5	Describe the renal regulation of fluid and electrolytes & acid-base Balance • Discuss the methods of acidification of urine in different parts of the renal tubules • Discuss the regulation of HCO3- reabsorption • Discuss the role of osmoreceptors, thirst and Angiotensin II in regulating water balance • Describe the role of ADH in water balance. To list the clinical features of diabetes insipidus and explain the physiological basis
PY 7.6	Describe the innervations of urinary bladder, physiology of micturition and its abnormalities • Describe the functional anatomy of urinary bladder • Describe the innervation of urinary bladder with the help of a diagram • Describe micturition reflex • Describe the functional abnormalities of urinary bladder
PY 7.7	Describe artificial kidney, dialysis and renal transplantation • List the types of renal failure (acute, Chronic) and list the clinical features • Describe the principle of dialysis • List the differences between haemodialysis and peritoneal dialysis
PY 7.8	Describe & discuss Renal Function Tests • List tests for urine analysis • List blood analysis for renal function • List the different concentration and dilution tests of urinary function
PY 7.9	Describe cystometry and discuss the normal cystometrogram • Describe the method by which a cystometrogram is generated • Draw and label a normal cystometrogram • Discuss the phases of the cystometrogram

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Integration Topics

HUMAN ANATOMY				
Sl No	**Competency Number**	**Competency**	**Vertical Integration**	**Horizontal Integration**
1	AN3.1	Classify muscle tissue according to structure & action		Physiology
2	AN5.1	Differentiate between blood vascular and lymphatic system		Physiology
3	AN5.2	Differentiate between pulmonary and systemic circulation		Physiology
4	AN5.6	Describe the concept of anastomoses and collateral circulation with significance of end-arteries	General Medicine	Physiology
5	AN5.7	Explain function of meta-arterioles, precapillary sphincters, arterio- venous anastomoses		Physiology
6	AN5.8	Define thrombosis, infarction & aneurysm	Pathology	Physiology
7	AN7.2	List components of nervous tissue and their functions		Physiology
8	AN7.3	Describe parts of a neuron and classify them based on number of neurites, size & function		Physiology
9	AN7.5	Describe principles of sensory and motor innervation of muscles	General Medicine	Physiology
10	AN7.7	Describe various types of synapse		Physiology
11	AN21.9	Describe & demonstrate mechanics and types of respiration		Physiology
12	AN22.2	Describe & demonstrate external and internal		Physiology

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		features of each chamber of heart		
13	AN22.3	Describe & demonstrate origin, course and branches of coronary arteries		Physiology
14	AN22.4	Describe anatomical basis of ischaemic heart disease	General Medicine	Physiology
15	AN22.7	Mention the parts, position and arterial supply of the conducting system of heart	General Medicine	Physiology
16	AN24.1	Mention the blood supply, lymphatic drainage and nerve supply of pleura, extent of pleura and describe the pleural recesses and their applied anatomy	General Medicine	Physiology
17	AN24.2	Identify side, external features and relations of structures which form root of lung & bronchial tree and their clinical correlate	General Medicine	Physiology
18	AN24.3	Describe a bronchopulmonary segment	General Medicine	Physiology
19	AN25.3	Describe fetal circulation and changes occurring at birth	General Medicine	Physiology
20	AN25.4	Describe embryological basis of: 1) atrial septal defect, 2) ventricular septal defect, 3) Fallot's tetralogy & 4) tracheo-oesophageal fistula	General Medicine, Pediatrics	Physiology
21	AN25.5	Describe developmental basis of congenital anomalies, transposition of great vessels, dextrocardia, patent ductus arteriosus and coarctation of aorta	General Medicine, Pediatrics	Physiology
22	AN25.9	Demonstrate surface marking of lines of pleural reflection, Lung borders and fissures, Trachea, Heart borders, Apex beat & Surface projection of valves	General Medicine, Pediatrics	Physiology

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		of heart		
23	AN56.2	Describe circulation of CSF with its applied anatomy	General Medicine	Physiology
24	AN57.4	Enumerate ascending & descending tracts at mid thoracic level of spinal cord	General Medicine	Physiology
25	AN57.5	Describe anatomical basis of syringomyelia	General Medicine	Physiology
26	AN58.3	Enumerate cranial nerve nuclei in medulla oblongata with their functional group		Physiology
27	AN58.4	Describe anatomical basis & effects of medial & lateral medullary syndrome	General Medicine	Physiology
28	AN59.1	Identify external features of pons		Physiology
29	AN60.3	Describe anatomical basis of cerebellar dysfunction	General Medicine	Physiology
30	AN61.3	Describe anatomical basis & effects of Benedikt's and Weber'ssyndrome	General Medicine	Physiology
31	AN62.2	Describe & demonstrate surfaces, sulci, gyri, poles, & functional areas of cerebral hemisphere	General Medicine	Physiology
32	AN62.3	Describe the white matter of cerebrum	General Medicine	Physiology
33	AN62.4	Enumerate parts & major connections of basal ganglia & limbic lobe	General Medicine	Physiology
34	AN62.5	Describe boundaries, parts, gross relations, major nuclei and connections of dorsal thalamus, hypothalamus, epithalamus, metathalamus and subthalamus	General Medicine	Physiology
35	AN62.6	Describe & identify formation, branches & major areas of distribution of circle of Willis	General Medicine	Physiology
36	AN63.1	Describe & demonstrate parts, boundaries & features		Physiology

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		of IIIrd, IVth & lateral ventricle		
37	AN63.2	Describe anatomical basis of congenital hydrocephalus	Pediatrics	Physiology
38	AN66.1	Describe & identify various types of connective tissue with functional correlation		Physiology
39	AN67.2	Classify muscle and describe the structure-function correlation of the same		Physiology
40	AN68.2	Describe the structure-function correlation of neuron		Physiology
41	AN69.2	Describe the various types and structure-function correlation of blood vessel		Physiology

BIOCHEMISTRY

Sl No	Competency Number	Competency	Vertical Integration	Horizontal Integration
1	BI1.1	Describe the molecular and functional organization of a cell and its sub-cellular components.		Physiology
2	BI3.7	Describe the common poisons that inhibit crucial enzymes of carbohydrate metabolism (eg; fluoride, arsenate)		Physiology
3	BI5.2	Describe and discuss functions of proteins and structure-function relationships in relevant areas eg, hemoglobin and selected hemoglobinopathies	Pathology, GeneralMedicine	Physiology

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4	BI6.3	Describe the common disorders associated with nucleotide metabolism.		Physiology
5	BI6.7	Describe the processes involved in maintenance of normal pH, water & electrolyte balance of body fluids and the derangements associated with these.	General Medicine	Physiology
6	BI6.9	Describe the functions of various minerals in the body, their metabolism and homeostasis.	General Medicine	Physiology
7	BI6.11	Describe the functions of haem in the body and describe the processes involved in its metabolism and describe porphyrin metabolism.	Pathology, GeneralMedicine	Physiology
8	BI6.12	Describe the major types of haemoglobin and its derivatives found in the body and their physiological/ pathological relevance.	Pathology, GeneralMedicine	Physiology
9	BI6.13	Describe the functions of the kidney, liver, thyroid and adrenal glands.	Pathology, GeneralMedicine	Physiology, Human Anatomy
10	BI6.14	Describe the tests that are commonly done in clinical practice to assess the functions of these organs (kidney, liver, thyroid and adrenal glands).	Pathology, GeneralMedicine	Physiology, Human Anatomy

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11	BI6.15	Describe the abnormalities of kidney, liver, thyroid and adrenal glands.	Pathology, GeneralMedicine	Physiology, Human Anatomy
12	BI10.4	Describe & discuss innate and adaptive immune responses, self/non-self recognition and the central role of T-helper cells in immune responses.	General Medicine, Pathology	Physiology
13	BI11.4	Perform urine analysis to estimate and determine normal and abnormal constituents	General Medicine	Physiology

PATHOLOGY

Sl No	Competency Number	Competency	Vertical Integration	Horizontal Integration
1	PA26.3	Define and describe the etiology, types, pathogenesis, stages, morphology and complications and evaluation of Obstructive airway disease (OAD) and bronchiectasis	Physiology, General Medicine	Microbiology
2	PA27.3	Describe the etiology, types, stages pathophysiology pathology and complications of heart failure	General Medicine, Physiology	
3	PA27.8	Interpret abnormalities in cardiac function testing in acute coronary syndromes	Physiology, General Medicine	
4	PA27.9	Classify and describe the etiology, types, pathophysiology, pathology, gross and microscopic features, diagnosis and	General Medicine, Physiology	

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		complications of cardiomyopathies		
5	PA28.5	Define and classify glomerular diseases. Enumerate and describe the etiology, pathogenesis, mechanisms of glomerular injury, pathology, distinguishing features and clinical manifestations of glomerulonephritis	Physiology, General Medicine	
6	PA32.1	Enumerate, classify and describe the etiology, pathogenesis, pathology and iodine dependency of thyroid swellings	Human Anatomy, Physiology, General Medicine, General Surgery	
7	PA32.2	Describe the etiology, cause, iodine dependency, pathogenesis, manifestations, laboratory and imaging features and course of thryotoxicosis	Physiology, General Medicine	
8	PA32.3	Describe the etiology, pathogenesis, manifestations, laboratory and imaging features and course of thyrotoxicosis/ hypothyroidism	Physiology, General Medicine	
9	PA32.4	Classify and describe the epidemiology, etiology, pathogenesis, pathology, clinical laboratory features, complications and progression of diabetes mellitus	Physiology, General Medicine	
10	PA32.5	Describe the etiology, genetics, pathogenesis, manifestations, laboratory and morphologic features of hyperparathyroidism	Physiology, General Medicine	
11	PA32.7	Describe the etiology, pathogenesis, manifestations, laboratory, morphologic features, complications of adrenal insufficiency	Physiology, General Medicine	

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12	PA32.8	Describe the etiology, pathogenesis, manifestations, laboratory, morphologic features, complications of Cushing's syndrome	Physiology, General Medicine	
13	PA32.9	Describe the etiology, pathogenesis, manifestations, laboratory and morphologic features of adrenal neoplasms	Human Anatomy, Physiology, General Medicine, General Surgery	

PHARMACOLOGY				
Sl No	**Competency Number**	**Competency**	**Vertical Integration**	**Horizontal Integration**
1	PH1.15	Describe mechanism/s of action, types, doses, side effects, indications and contraindications of skeletal muscle relaxants	Anesthesiology, Physiology	
2	PH1.19	Describe the mechanism/s of action, types, doses, side effects, indications and contraindications of the drugs which act on CNS, (including anxiolytics, sedatives & hypnotics, antipsychotic, antidepressant drugs, anti-maniacs,opioid agonists and antagonists, drugs used for neurodegenerative disorders, antiepileptics Drugs)	Psychiatry, Physiology	
3	PH1.25	Describe the mechanism/s of action, types, doses, side effects, indications and contraindications of the drugs acting on blood, like anticoagulants, antiplatelets, fibrinolytics, plasma expanders	Physiology, General Medicine	
4	PH1.26	Describe mechanisms of	Physiology,	

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		action, types, doses, side effects, indications and contraindications of the drugs modulating the renin angiotensin and aldosterone system	General Medicine	
5	PH1.35	Describe the mechanism/s of action, types, doses, side effects, indications and contraindications of drugs used in hematological disorders like: D rugs used in anemias Colony Stimulating factors	General Medicine, Physiology	Pharmacology

FORENSIC MEICINE AND TOXICOLOGY

Sl No	Competency Number	Competency	Vertical Integration	Horizontal Integration
1	FM14.7	Demonstrate & identify that a particular stain is blood and identify the species of its origin.	Pathology, Physiology	
2	FM14.8	Demonstrate the correct technique to perform and identify ABO & Rh blood group of a person.	Pathology, Physiology	

ANAESTHESIOLOGY

Sl No	Competency Number	Competency	Vertical Integration	Horizontal Integration
1	AS7.3	Observe and describe the management of an unconscious patient	Physiology	General Medicine
2	AS7.4	Observe and describe the basic setup process of a	Physiology	General Medicine

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		ventilator		
3	AS8.1	Describe the anatomical correlates and physiologic principles of pain	Human Anatomy, Physiology	
4	AS8.2	Elicit and determine the level, quality and quantity of pain and its tolerance in patient or surrogate	Physiology	

OPHTHALMOLOGY

Sl No	Competency Number	Competency	Vertical Integration	Horizontal Integration
1	OP1.1	Describe the physiology of vision.	Physiology	

GENERAL MEDICINE

Sl No	Competency Number	Competency	Vertical Integration	Horizontal Integration
1	IM1.1	Describe and discuss the epidemiology, pathogenesis clinical evolution and course of common causes of heart disease including: rheumatic/ valvular, ischemic, hypertrophic inflammatory.	Pathology, Physiology	
2	IM1.2	Describe and discuss the genetic basis of some forms of heart failure	Pathology, Physiology	
3	IM1.3	Describe and discuss the aetiology microbiology pathogenies and clinical evolution of rheumatic fever, criteria, degree of rheumatic activity and rheumatic valvular heart disease and its complications including infective endocarditis	Pathology, Physiology, Microbiology	
4	IM1.4	Stage heart failure	Pathology, Physiology	

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5	IM1.5	Describe discuss and differentiate the processes involved in R Vs L heart failure, systolic vs diastolic failure	Pathology, Physiology	
6	IM1.6	Describe and discuss the compensatory mechanisms involved in heart failure including cardiac remodelling and neurohormonal adaptations	Pathology, Physiology	
7	IM1.7	Enumerate, describe and discuss the factors that exacerbate heart failure including ischemia, arrythmias anemia, thyrotoxicosis, dietary factors drugs etc.	Pathology, Physiology	
8	IM1.8	Describe and discuss the pathogenesis and development of common arrythmias involved in heart failure particularly atrial fibrillation	Pathology, Physiology	
9	IM2.1	Discuss and describe the epidemiology, antecedents and risk factors for atherosclerosis and ischemic heart disease	Pathology, Physiology Community Medicine	
10	IM2.2	Discuss the aetiology of risk factors both modifiable and non modifiable of atherosclerosis and IHD	Pathology, Physiology	
11	IM2.3	Discuss and describe the lipid cycle and the role of dyslipidemia in the pathogenesis of atherosclerosis	Physiology, Biochemistry	
12	IM2.4	Discuss and describe the pathogenesis, natural history, evolution and complications of atherosclerosis and IHD	Pathology, Physiology	

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13	IM5.1	Describe and discuss the physiologic and biochemical basis of hyperbilirubinemia	Pathology, Physiology	
14	IM5.2	Describe and discuss the aetiology and pathophysiology of liver injury	Pathology, Physiology	
15	IM8.1	Describe and discuss the epidemiology, aetiology and the prevalence of primary and secondary hypertension	Pathology, Physiology	
16	IM8.2	Describe and discuss the pathophysiology of hypertension	Pathology, Physiology	
17	IM11.22	Enumerate the causes of hypoglycaemia and describe the counter hormone response and the initial approach and treatment.	Pathology, Physiology	
18	IM12.1	Describe the epidemiology and pathogenesis of hypothyroidism and hyperthyroidism including the influence of iodine deficiency and autoimmunity in the pathogenesis of thyroid disease	Pathology, Physiology	
19	IM12.3	Describe and discuss the physiology of the hypothalamopituitary - thyroid axis, principles of thyroid function testing and alterations in physiologic function	Pathology, Physiology	
20	IM15.3	Describe and discuss the physiologic effects of acute blood and volume loss	Pathology, Physiology	General Surgery
21	IM18.6	Distinguish the lesion based on upper vs lower motor neuron, side, site and most probable nature	Physiology	

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		of the lesion		
22	IM18.7	Describe the clinical features and distinguish, based on clinical examination, the various disorders of speech	Physiology	
23	IM18.8	Describe and distinguish, based on the clinical presentation, the types of bladder dysfunction seen in CNS disease	Physiology	
24	IM19.1	Describe the functional anatomy of the locomotor system of the brain	Human Anatomy, Physiology	
25	IM22.1	Enumerate the causes of hypercalcemia and distinguish the features of PTH vs non PTH mediated hypercalcemia	Pathology, Physiology	
26	IM22.9	Enumerate the causes and describe the clinical and laboratory features of metabolic acidosis	Physiology	
27	IM22.10	Enumerate the causes of describe the clinical and laboratory features of metabolic alkalosis	Physiology	
28	IM22.11	Enumerate the causes and describe the clinical and laboratory features of respiratory acidosis	Physiology	
29	IM22.12	Enumerate the causes and describe the clinical and laboratory features of respiratory alkalosis	Physiology	
30	IM22.13	Identify the underlying acid based disorder based on an ABG report and clinical situation	Physiology	
31	IM23.1	Discuss and describe the methods of nutritional assessment in an adult and calculation of caloric requirements during illnesses	Physiology, Biochemistry	Pediatrics

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32	IM23.2	Discuss and describe the causes and consequences of protein caloric malnutrition in the hospital	Physiology, Biochemistry	Pediatrics
33	IM23.3	Discuss and describe the aetiology, causes, clinical manifestations, complications, diagnosis and management of common vitamin deficiencies	Physiology, Biochemistry	Pediatrics
34	IM23.4	Enumerate the indications for enteral and parenteral nutrition in critically ill patients	Physiology, Biochemistry	Pediatrics
35	IM24.22	Describe and discuss the aetiopathogenesis, clinical presentation, complications, assessment and management of nutritional disorders in the elderly	Physiology, Biochemistry	

OBSTETRICS AND GYNAECOLOGY

Sl No	Competency Number	Competency	Vertical Integration	Horizontal Integration
1	OG3.1	Describe the physiology of ovulation, menstruation, fertilization, implantation and gametogenesis	Physiology	
2	OG7.1	Describe and discuss the changes in the genital	Physiology	

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		tract, cardiovascular system, respiratory, haematology, renal and gastrointestinal systems in pregnancy		

PAEDIATRICS				
Sl No	Competency Number	Competency	Vertical Integration	Horizontal Integration
1	PE7.2	Explain the physiology of lactation	Physiology	
2	PE7.3	Describe the composition and types of breast milk and discuss the differences between cow's milk and human milk	Physiology	
3	PE10.1	Define, describe the etio-pathogenesis, classify including WHO classification, clinical features, complication and management of severe Acute Malnourishment and Moderate Acute Malnutrition	Physiology Biochemistry	
4	PE10.2	Outline the clinical approach to a child with SAM and MAM	Physiology, Biochemistry	
5	PE10.3	Assessment of a patient with SAM and MAM, diagnosis, classification and planning management including hospital and community based intervention, rehabilitation and prevention	Physiology, Biochemistry	
6	PE11.1	Describe the common etiology, clinical features and management of Obesity in children	Physiology, Biochemistry, Pathology	
7	PE11.2	Discuss the risk approach for obesity and discuss the prevention strategies	Physiology, Pathology	
8	PE12.7	Describe the causes,	Biochemistry,	

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		clinical features, diagnosis and management of Deficiency / excess of Vitamin D (Rickets and Hypervitaminosis D	Physiology, Pathology	
9	PE12.8	Identify the clinical features of dietary deficiency of Vitamin D	Biochemistry Physiology Pathology	
10	PE12.9	Assess patients with Vitamin D deficiency, diagnose, classify and plan management	Biochemistry, Physiology, Pathology	
11	PE12.13	Discuss the RDA, dietary sources of Vitamin K and their role in health and disease	Biochemistry, Physiology, Pathology	
12	PE12.14	Describe the causes, clinical features, diagnosis, management and prevention of of Deficiency of Vitamin K	Biochemistry, Physiology, Pathology	
13	PE23.1	Discuss the Hemodynamic changes, clinical presentation, complications and management of Acyanotic Heart Diseases –VSD, ASD and PDA	Physiology Pathology	
14	PE23.2	Discuss the Hemodynamic changes, clinical presentation, complications and management of Cyanotic Heart Diseases – Fallot's Physiology	Physiology Pathology	
15	PE23.3	Discuss the etio-pathogenesis, clinical presentation and management of cardiac failure in infant and children	Physiology Pathology	
16	PE23.4	Discuss the etio-pathogenesis, clinical presentation and management of Acute	Physiology Pathology	

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		Rheumatic Fever in children		
17	PE23.5	Discuss the clinical features, complications, diagnosis, management and prevention of Acute Rheumatic Fever	Physiology Pathology	
18	PE23.6	Discuss the etio-pathogenesis and clinical features and management of Infective endocarditis in children	Physiology, Pathology, Microbiology	
19	PE29.1	Discuss the etio-pathogenesis, Clinical features, classification and approach to a child with anaemia	Pathology, Physiology	
20	PE29.2	Discuss the etio-pathogenesis, clinical features and management of Iron Deficiency anaemia	Pathology, Physiology	
21	PE29.3	Discuss the etiopathogenesis, Clinical features and management of VIT B12, Folate deficiency anaemia	Pathology, Physiology	
22	PE29.4	Discuss the etio-pathogenesis, clinical features and management of Hemolytic anemia, Thalassemia Major, Sickle cell anaemia, Hereditary spherocytosis, Auto-immune hemolytic anaemia and hemolytic uremic syndrome	Pathology Physiology	

GENERAL SURGERY				
Sl No	**Competency Number**	**Competency**	**Vertical Integration**	**Horizontal Integration**
1	SU1.1	Describe basic concepts of homeostasis, enumerate the metabolic changes in injury and their mediators	Physiology, Biochemistry	

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2	SU2.1	Describe Pathophysiology of shock. Types of shock. Principles of resuscitation including fluid replacement and monitoring	Pathology, Physiology	
3	SU4.1	Elicit, document and present history in a case of Burns and perform physical examination. Describe Pathophysiology of Burns.	Physiology	
4	SU12.1	Enumerate the causes and consequences of malnutrition in the surgical patient.	Physiology	
5	SU12.2	Describe and Discuss the methods of estimation and replacement the Fluid and electrolyte requirements in the surgical patient	Physiology	
6	SU28.5	Describe the applied Anatomy and physiology of esophagus	Human Anatomy, Physiology	

RESPIRATORY MEDICINE

Sl No	Competency Number	Competency	Vertical Integration	Horizontal Integration
1	CT2.1	Define and classify obstructive airway disease	Physiology, Pathology	
2	CT2.2	Describe and discuss the epidemiology risk factors and evolution of obstructive airway disease	Physiology, Pathology	
3	CT2.4	Describe and discuss the physiology and pathophysiology of hypoxia and hypercapneia	Physiology, Pathology	
4	CT2.5	Describe and discuss the genetics of alpha 1 antitrypsin deficiency in emphysema	Physiology, Pathology	
5	CT2.11	Describe, discuss and interpret pulmonary	Physiology, Pathology	

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		function tests		

Summary of TL methods and list of competencies to be covered in Physiology Phase I MBBS and Assessment methods

Sl. No.	Topic, Teaching hours and type	Competency numbers	Assessment methods
1.	General Physiology - 8 hrs Lecture, Interactive, SGD	PY1.1 -1.9	Written, Viva voce
2.	Haematology – 16 hrs Lecture, Interactive, SGD DOAP	PY2.1-2.10 PY2.11-2.13	Written, Viva voce Practical/OSPE/ Viva voce
3.	Gastro intestinal Physiology – 10 hrs Lecture, Interactive, SGD DOAP	PY 4.1-4.9 PY4.10	Written, Viva voce Skill assessment/ Viva voce/OSPE
4.	Cardiovascular Physiology – 25 hrs Lecture, Interactive, SGD DOAP	PY 5.1-5.11 PY5.12-5.16	Written, Viva voce Skill assessment/ Viva voce/OSPE
5.	Respiratory Physiology – 12 hrs Lecture, Interactive, SGD DOAP	PY 6.1-6.7 PY 6.8-6.10	Written, Viva voce Skill assessment/Practical/Viva voce/OSPE
6.	Renal Physiology – 10 hrs Lecture, Interactive, SGD	PY 7.1-7.9	Written, Viva voce

SCHEME OF EXAMINATION:

FORMATIVE ASSESSMENT

Scheme for calculation of Internal Assessment marks:

Formative assessment :			
Theory	**30 Marks**	**Practicals**	**30 Marks**
Day to Day Assessments/MCQs/Viva / tests	05	Practical records	05
Attitude/Communication	01	ECE Participation/Skill	05

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skills		certification	
Written Assignments	02		
Attendance	02 (for Theory + Practical attendance >90%) 01 (for Theory + Practical attendance 80-90%)		
Total	**40**		**40**

General Guidelines

(Includes eligibility for Summative assessment and Pass criteria)

- Regular periodic examinations shall be conducted throughout the course. There shall be minimum three internal assessment examinations in Physiology.
- The third internal examination shall be conducted on the lines of the university examination.
- There shall be one short essay on ECE in each internal assessment.
- There shall be at least one short question from AETCOM in the internal assessment.
- Questions on ECE and AETCOM in Internal Assessments must be assessed by the faculty of the respective pre-clinical departments (Anatomy/Physiology/Biochemistry).
- An average of the marks scored in the three internal assessment examinations will be considered as the final internal assessment marks.
- Learners must secure not less than 40 % marks in theory and practical separately and not less than 50% marks of the total marks (combined in theory and practical) assignedfor internal assessment in a particular subject in order to be eligible for appearing at the final University examination of that subject.
- A candidate who has not secured requisite aggregate in the internal assessment may be subjected to remedial measures by the institution. If he/she successfully completes the remediation measures, he/she is eligible to appear for University Examination. Remedialmeasures shall be completed before submitting the internal assessment marks online to the university.
- Learners must have completed the required certifiable competencies in and completed the logbook to be eligible for appearing at the final Physiology university examination.

SUMMATIVE ASSESSMENT

A. Theory: 100 marks

There shall be two theory papers of 100 marks each and duration of each paper will be 3 hours.

Theory paper I

Sl. No.	Type of Question	Number	Marks
1	Long Essay	2 X 10	20

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2	Short Essay	6 X 5	30
3	Short answer questions	10 X 3	30
4	MCQs	20 X 1	20
5	**Total**	**38**	**100**

Blue print for theory question papers

Paper 1 (Max 100 marks)	
Systems	**Marks allotted**
General Physiology	05
Hematology	20
Cardiovascular Physiology	25
Respiratory Physiology	20
Gastrointestinal Physiology	15
Renal Physiology	15

Practical: 80 marks

Practical session	Allotted topics	Marks allotted
Practical – I	Clinical examination – I (CNS – sensory / motor/ reflexes / cranial nerve)	15
	Chart: Clinical case histories	5
	Total	**20**
Practical – II	Clinical examination-II (CVS / RS)	15
	Clinical examination (general physical examination / abdomen examination)	5
	Total	**20**
Practical – III	Human experiments • Mosso's ergography • Effect of posture / exercise on BP and Pulse rate • Effect on BP and pulse rate during exercise using the Harvard step test • Record and interpret Lead II ECG • Spirometry and PEFR • Perimetry • Demonstrate BLS	15
	Chart: Amphibian charts (nerve muscle / cardiac)	5

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	Total	**20**
Practical – IV	Hematology • RBC count • WBC count • Making a peripheral smear + DLC on the provided stained slide • BT + blood group • CT + blood group • Hb + blood group	15
	Chart: calculations / problem solving	5
	Total	**20**
	GRAND TOTAL	**80**

Viva-voce: 20 marks

- The viva-voce examination shall carry 20 marks and all examiners will conduct the examination.
- Viva will focus on application and interpretation.
- Viva marks to be added to practical and not theory.

Physiology Course outcomes

Course Code	Course Name	Course Outcome	
MBC105A General Physiology Haematology CVS, RS, GIT, Renal systems	**Physiology 1**	**CO-1**	Explain the normal functioning of cell, blood and its components,Cardiovascular system, Respiratory system,Gastrointestinal system, excretory system and their interactions for maintenance of homeostasis
		CO-2	Discuss the basic principles, mechanisms, pathophysiology of disease states of Cardiovascular system, Respiratory system, Gastrointestinal system, renal system, components of blood and their management

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		CO-3	Acquire the skills to do experiments related to hematology, Human experiments / clinical examinations for study of Physiological functions and interpret the report critically.
		CO-4	Gained the skills required to Communicate effectively and show respect towards the subject / peer during clinical examinations be an efficient leader, health care team member with ethical principles

PO, PSO & CO Mapping – Physiology

Course Code	Course Outcomes	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)			
		PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4
MBC105A Physiology 1	CO-1	3	2	2	3	1	3	2	2	3
	CO-2	3	3	2	3	1	3	2	2	3
	CO-3	3	3	2	2	1	2	3	2	3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution										

SUGGESTED TEXT BOOKS

Note: A single text book may not cover the entire curriculum. Referring to more than one book is recommended.

TEXT BOOKS (Latest editions)

1. Guyton and Hall. Text book of Medical Physiology.
2. Ganong's Review of Medical Physiology.
3. Vander's Human Physiology.
4. Berne and Levy Physiology. BM Koeppen, BA Stanton
5. Human Physiology. Lauralee Sherwood.

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6. Text book of medical physiology. G K Pal.
7. Principles of Medical Physiology. Sabyasachi Sircar
8. Text book of Medical Physiology. Indu Khurana
9. Text book of Medical Physiology. D Venkatesh, H H Sudhakar
10. Essentials of Medical Physiology. ABS Mahapatra

Reference books for practical

1. McLeod's Clinical Examination
2. Hutchison's Clinical Methods.
3. Text book of practical physiology. GK Pal and Pravati Pal
4. A textbook of Practical Physiology. CL Ghai

Course Specifications

Physiology

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Code- MBC106A

Course Specification

Course Title	Physiology
Course Code	MBC106 A
Course Type	Core Theory & Practical Course
Department	Physiology
Faculty	Medical

Introduction to the Department

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Department of Physiology has state of the art facilities to impart quality medical education. Students are trained in basic principles, mechanism and homeostatic control of all the functions of human body as a whole. This includes teaching learning related to normal functions of all human organ systems, regulatory mechanisms and interactions of the various organs for well-coordinated total body function. Students understand the physiological aspects of normal growth and development and also learn to analyze physiological responses and adaptations to different stresses during life processes.

Teaching staff comprises of qualified and experienced Physiologists, training students to be adept with various Physiological concepts which will help the students in their professional career.

Department has well equipped human, clinical and hematology laboratories to demonstrate and acquire the skills to do the experiments for study of physiological functions and clinical examinations. There is a computer assisted lab for teaching animal experiments.

Department of Physiology conducts regular yoga sessions for physical and mental health of the students. Department also has research laboratory to analyze and interpret experimental and investigative data to update and to do advanced research in the field of Physiology.

Goal:

The broad goal of the teaching of undergraduate students in Physiology aims at providing the student comprehensive knowledge of the normal functions of the organ systems of the body to facilitate an understanding of the physiological basis of health and disease.

Objectives:

a. Cognitive domain

At the end of the course the student will be able to:

1. Explain the normal functioning of all the organ systems and their interactions for well- coordinated total body function.
2. Assess the relative contribution of each organ system to the maintenance of the milieu interior.
3. Elucidate the physiological aspects of normal growth and development.
4. Describe the physiological response and adaptations to environmental stresses.
5. List the physiological principles underlying pathogenesis and treatment of disease.

b. Psychomotor domain

At the end of the course the student will be able to:

1. Conduct experiments designed for study of physiological phenomena.
2. Interpret experimental/investigative data.
3. Conduct and interpret clinical examination in normal healthy subject.
4. Distinguish between normal abnormal data derived as a result of tests, which he/she has performed and observed in the laboratory.

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c. Affective domain

At the end of the course the student will be able to:

1. Show due respect to persons who volunteer to be examined for the purpose of learning clinical examination.
2. Communicate effectively with peers, teachers and volunteer in clinical examination.
3. Demonstrate the ability of teamwork.

d. Integration

At the end of the integrated teaching the student should acquire an integrated knowledge of organ structure and function and the regulatory mechanisms.

Course summary

Sl. No.	Topic	Number of Competencies
1	Nerve & Muscle Physiology	18
2	Endocrine Physiology	6
3	Reproductive Physiology	12
4	Neurophysiology	20
5	Integrated Physiology	14
	Total	70

Topic: Nerve and Muscle Physiology – 10 hrs	
Number	Competency
PY 3.1	Describe the structure and functions of a neuron and neuroglia; Discuss Nerve Growth Factor & other growth factors/cytokines • Describe the structure and functions of a neuron • List the different types of neuroglia and list their functions • Discuss the actions of Nerve Growth Factor & other growth factors
PY 3.2	Describe the types, functions & properties of nerve fibers • Define absolute and relative refractory period • Discuss the implications of the absolute and relative refractory period • Define All or None Law • Distinguish between temporal and spatial summation • Explain with the help of a diagram, the concept of 'local currents' in a nerve

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	• Distinguish between orthodromic and antidromic nerve conduction • List the factors which affect conduction velocity in a nerve and indicate whether they increase or decrease conduction • Explain the basis of how myelination and diameter affect nerve conduction • Classify nerve fibres.
PY 3.3	Describe the degeneration and regeneration in peripheral nerves • Classify nerve injuries • Describe the features of Wallerian degeneration with the help of a diagram • List some common causes of neuropathy • List the factors affecting nerve regeneration
PY 3.4	Describe the structure of neuro-muscular junction and transmission of impulses • Describe structure of the neuromuscular junction • List in sequence the events that occur at the neuromuscular junction • Distinguish between the end plate potential and an action potential
PY 3.5	Discuss the action of neuro-muscular blocking agents • Identify, with examples potential sites where neuromuscular transmission can be affected (pre-synaptic, synapticand post-synaptic) • Explain the mechanism of action of the drugs acting at the neuromuscular junction.
PY 3.6	Describe the pathophysiology of Myasthenia gravis • Describe the physiological basis of the cause and clinical features of myasthenia gravis • List the principles of treatment. • Distinguish between myasthenia gravis and Eaton Lambert syndrome
PY 3.7	Describe the different types of muscle fibres and their structure • Compare and contrast the structure and functions of skeletal, cardiac and smooth muscle. • Distinguish between fast and slow muscle fibres • List the phenomena associated with increasing frequency of stimulation (Beneficial effect, Treppe, Clonus, Tetanus)and explain the basis of the phenomena • Draw a diagram depicting the length-tension relationship (Starling's Law) and explain its basis • Draw a diagram depicting the load-velocity relationship and explain the phenomena • Define muscle fatigue and explain the mechanisms for it • Explain the basis for the phenomenon of Quantal summation

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PY 3.8	Describe action potential and its properties in different muscle types (skeletal & smooth) • Describe action potential, it's ionic basis and its properties in skeletal muscle • Describe action potential, its ionic basis and its properties in smooth muscle and compare it with the action potential seen in skeletal muscle
PY 3.9	Describe the molecular basis of muscle contraction in skeletal and in smooth muscles • Draw and label the sarco-tubular system of the skeletal muscle • List the steps involved in excitation-contraction coupling • Describe a sarcomere • List the molecular events associated with contraction and relaxation of skeletal muscle • Explain the phenomenon of a) rigor mortis b) heat rigor • List the processes of heat formation in the muscle • Describe the structure of smooth muscle • Describe the types of smooth muscles with their features • Describe the following properties of smooth muscle: ○ Single muscle twitch ○ Latch bridge mechanism ○ plasticity • Explain the molecular basis of smooth muscle contraction
PY 3.10	Describe the mode of muscle contraction (isometric and isotonic) • Distinguish between isometric and isotonic muscle contraction • List examples of isometric and isotonic muscle contraction
PY 3.11	Explain energy source and muscle metabolism • Describe the sources of energy for skeletal muscle • Describe the phenomenon of oxygen debt in skeletal muscle and explain its basis • Distinguish between muscle hypertrophy and muscle hyperplasia • List different ways in which performance enhancing drugs act on skeletal muscle
PY 3.12	Explain the gradation of muscular activity • Discuss the methods used to grade exercise (extent of exertion: Borg exertion scale, Metabolic equivalents, percentage of maximal heart rate) / Vo2 max.
PY 3.13	Describe muscular dystrophy: myopathies • Briefly describe how muscle strength and muscle mass is assessed • Briefly describe what the muscular dystrophies are • List the common causes of myopathies
PY 3.14	Perform Ergograph • Perform ergography

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PY 3.15	Demonstrate effect of mild, moderate and severe exercise and record changes in cardiorespiratory parameters • Demonstrate the effect of mild, moderate and severe exercise and record changes in cardiorespiratory parameters (Pulse and BP.
PY 3.16	Demonstrate Harvard Step test and describe the impact on induced physiologic parameters in a simulated environment • Perform Harvard step test
PY 3.17	Describe Strength-duration curve • Draw, label and explain the strength duration curve (SDC) • List the changes that are seen in the SDC during nerve injury and in response to treatment
PY 3.18	Observe with Computer assisted learning (i) amphibian nerve - muscle experiments (ii) amphibian cardiac experiments • Observe (i) amphibian nerve - muscle experiments (ii) amphibian cardiac experiments through computer assisted learning
Topic: Endocrine Physiology – 16 hrs	
Number	Competency
PY 8.1	Describe the physiology of bone and calcium metabolism • List the bone cells and enumerate their functions • Enumerate normal serum calcium and the important functions of calcium • Describe the normal distribution and daily requirements of calcium in the body • Describe the hormonal regulation of calcium homeostasis (parathyroid, Calcitonin, Vitamin D)
PY 8.2	Describe the synthesis, secretion, transport, physiological actions, regulation and effect of altered (hypo and hyper) secretion of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas and hypothalamus. • Define hormone • List all the endocrine organs and the major hormones secreted in each. • Describe the mechanism of action and regulation of secretion of hormones • Define second messenger system • List the various second messenger systems • Describe upregulation and down regulation. • Differentiate between genomic and non-genomic effects • Define the term paracrine and autocrine and give an example for each • List the methods of assessing Hormone levels (bioassays, RIA, ELIZA) • Describe the synthesis, secretion, transport, physiological actions, regulation and effect of altered (hypo and hyper) secretion of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas and hypothalamus.

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PY 8.3	Describe the physiology of Thymus and Pineal gland. • Discuss the functions of the thymus. • Describe the physiological actions of melatonin. • List functions of Pineal gland • Discuss the effects of thymectomy
PY 8.4	Describe function tests: Thyroid gland, Adrenal cortex, Adrenal medulla and Pancreas. • Describe thyroid, adrenal cortex, adrenal medulla and pancreatic function tests.
PY 8.5	Describe the metabolic and endocrine consequences of obesity and metabolic syndrome, stress response. Outline the psychiatry component pertaining to metabolic syndrome. • Define obesity • Classify the different types of obesity • List the criteria to diagnose metabolic syndrome • Discuss obesity as a risk factor for enhanced cardio-metabolic disease • Discuss the effects of stress response. • Discuss the psychological /psychiatric components of eating disorders and the psychological/psychiatric consequences of obesity (stigma, labeling, self-esteem etc.)
PY 8.6	Describe and differentiate the mechanism of action of steroid, protein and amine hormones. • List the various types of hormone-receptors with examples for each • Define Hormone-receptor interaction • Describe & differentiate the mechanism of action of steroid, protein and amine hormones.
Topic: Reproductive Physiology – 10 hrs	
Number	Competency
PY 9.1	Describe and discuss sex determination, sex differentiation and their abnormalities and outline psychiatry and practical implication of sex determination • Distinguish sex chromosomes from somatic chromosomes • Describe the basis of chromosomal sex differentiation • Describe Barr bodies and their use • Describe the basis of gonadal differentiation • Describe the regulation of sex differentiation and development • Describe the intra-uterine differentiation of the internal and external genitalia • Discuss the legal implications of sex determination prenatally • List the physiological basis for the key features of the following conditions: ✓ Klinefelter syndrome ✓ Turner's syndrome ✓ True hermaphrodite

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	✓ Pseudohermaphrodite
PY 9.2	Describe and discuss Puberty: onset, progression, stages; early and delayed puberty and outline adolescent clinical and psychological association. • Define the terms: puberty, menarche and adrenarche • State the age range at which puberty occurs in males and females • Describe the factors that affect the onset of puberty • Describe the normal stages of puberty as described by Marshall and Turner • Describe the secondary sexual characteristics in males and females • Briefly describe: a) precocious puberty b) delayed puberty • List the psychological changes that are associated with normal, early and delayed puberty
PY 9.3	Describe Male reproductive system: functions of testis and control of spermatogenesis & factors modifying it and outline its association with psychiatric illness • Describe the functional anatomy of the male reproductive system • Describe the functions of the testis, prostate gland and seminal vesicles • List the stages of spermatogenesis with a diagram • Describe the factors that control and affect spermatogenesis • Describe the biological actions of testosterone (including mood, cognition and behavior) • Describe the hypothalamo–pituitary-gonadal axis in male. • Describe the characteristic features and components of semen • Describe the endocrine functions of testis • Explain the functions of Sertoli cells • Briefly describe: a) Cryptorchidism b) Hypogonadism in males c) Male infertility d) Vasectomy
PY 9.4	Describe Female reproductive system: (a) functions of ovary and its control; (b) menstrual cycle - hormonal, uterine and ovarian changes • Describe the functional anatomy of the female reproductive system • With regard to the ovary: o List the ovarian hormones and describe the physiological actions of each o Describe the control of ovarian function • List the phases of the normal menstrual cycle and indicate their approximate durations • Describe with diagrams the uterine changes of the menstrual cycle with hormonal basis. • Describe with diagrams the ovarian cycle with hormonal basis

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	• Describe the hypothalamo-pituitary-gonadal axis in females. • Describe the tests for ovulation • Explain the following terms a) amenorrhea b) menorrhagia c) menopause d) anovulatory menstrual cycle
PY 9.5	Describe and discuss Physiological effects of sex hormones. • List the sex hormones in the male and female • Describe the regulation of sex hormone secretion in the male and female • List the actions of the sex hormones on the different organs/systems of the body • List clinical conditions where sex hormones may need to be suppressed or administered
PY 9.6	Enumerate the contraceptive methods for male and female. Discuss their advantages & disadvantages. • Classify the contraceptive methods for male and female. Describe briefly the mechanism of action of each • List the advantages and disadvantages of each method • Describe the permanent methods of contraception in male and female
PY 9.7	Describe and discuss the effects of removal of gonads on physiological functions • List the functions of the gonads in the male and female • Describe the effects of removal of the gonads at different stages of life
PY 9.8	Describe and discuss the physiology of pregnancy, parturition lactation and outline the psychology and psychiatry-disorders associated with it. • Describe the development of the fertilized ovum to an early embryo • Describe the structure and functions of the placenta • List the placental hormones and describe their functions • Describe the function of the feto-placental unit • Briefly describe the physiological changes in the mother during pregnancy. • List the factors that increase uterine contractility at birth • Describe the mechanics of parturition and its stages • Describe the hormonal regulation of breast development and lactation • Describe the milk ejection reflex • Briefly describe the emotional changes that a mother experiences during and after pregnancy
PY 9.9	Interpret a normal semen analysis report including (a) sperm count, (b) sperm morphology and (c) sperm motility, as per WHO guidelines and discuss the results • Describe the normal semen parameters in terms of (a) volume (b) sperm count, (c) sperm morphology and (d) sperm motility • Discuss the factors that can affect sperm count and quality • Define the following terms (a) oligospermia (b) azoospermia
PY 9.10	Discuss the physiological basis of various pregnancy tests • List the various tests of pregnancy with physiological basis. • Discuss the immunological methods used to confirm pregnancy

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PY 9.11	Discuss the hormonal changes and their effects during perimenopause and menopause • Define perimenopause and menopause • Discuss the hormonal changes that occur during perimenopause and menopause and functional changes that occurin different systems • Discuss the uses and side effects of hormone replacement therapy (HRT)
PY 9.12	Discuss the common causes of infertility in a couple and role of IVF in managing a case of infertility. • List the common causes of infertility in the male and female • Discuss the approach and tests for infertility • List the new reproductive technologies that are available for an infertile couple
Topic: Neurophysiology – 37 hrs	
Number	Competency
PY 10.1	Describe and discuss the organization of nervous system. • Describe the organization and functions of nervous system • Describe a neuron and its types • Enumerate the types and function of Glial Cells. • List the structural features of the blood brain barrier • State the sites of production and removal of CSF • Tabulate the composition of CSF against plasma • List the functions of CSF • Discuss clinical applications of CSF analysis • Describe the procedure and uses of a lumbar puncture • Describe the different types of hydrocephalus
PY 10.2	Describe and discuss the functions and properties of synapse, reflex, receptors. • Draw a diagram of a synapse and label its parts • List different types of synapses • Describe synaptic transmission • Enumerate and explain the properties of synapses • Distinguish between electrical and chemical synapse • Differentiate between EPSP and IPSP • Define receptors. Classify receptors based on types of stimulus and location • Describe the structure and functions of each sensory receptor • Define receptor potential. Describe the mechanism of genesis of receptor potential • Define the receptive field and indicate its importance • Discuss the properties of receptors. • Draw and label a reflex arc

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	• Classify reflexes and discuss the properties of reflexes
PY 10.3	Describe and discuss somatic sensations and sensory tracts. • List and classify sensory modalities. • Discuss the arrangement of tracts of ascending pathways in the cross section of spinal cord. • Describe the anterolateral pathway with a neat labelled diagram. List the sensations carried it. • Describe the dorsal column pathway with a neat labelled diagram. List the sensations carried by it. • Compare and contrast the dorsal column and spinothalamic tracts. • Define and classify pain. List the nociceptive stimuli. Enumerate types of pain • Describe the pain pathways with neat labelled diagrams. (Neospinothalamic and Paleospinothalamic tracts) • Discuss the gate control theory of pain • Explain the differences between somatic and visceral pain • Define referred pain. Explain the theories of referred pain • Describe the endogenous analgesic / pain modulating systems
PY 10.4	Describe and discuss motor tracts, mechanism of maintenance of tone, control of body movements, posture and equillibrium and vestibular apparatus. • List the descending tracts • Describe the cortico bulbar and cortico spinal tract (pyramidal tract) from its origin to termination with a diagramand list its functions • Describe the extrapyramidal tracts (vestibulospinal, rubrospinal, reticulospinal, olivospinal, tectospinal) and theirfunctions • Distinguish between upper and lower motor neuron lesion • Define hemiplegia and describe the clinical features • Describe the structure of the muscle spindle and its innervation in a diagram • Define muscle tone • Describe the importance of alpha-gamma co-activation • Describe the Golgi tendon organ and its function. • Describe the following reflexes: stretch, inverse-stretch, withdrawal, crossed extensor reflex • Distinguish between decerebrate and decorticate rigidity. • Distinguish between classical and ischemic decerebrate rigidity. • Describe the righting reflexes. • Enumerate and describe the structures constituting the vestibular apparatus • Describe the neuronal connections of vestibular apparatus with the central nervous system. • List the functions of the vestibular apparatus • Enumerate the clinical disorders associated with the

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	vestibular apparatus, and the tests that are performed in suspected vestibular dysfunction. • Classify the lobes of cerebellum according to their physiological functions (Cerebellum also covered in PY 10.4) • List the layers of the cerebellum and describe the internal circuitry and its function • List the deep nuclei of cerebellum and their function • List the afferent and efferent pathways of cerebellum and their functions • Enumerate the functions of cerebellum • List the features of cerebellar lesions and the clinical tests performed for cerebellar dysfunctions
PY 10.5	Describe and discuss structure and functions of reticular activating system, autonomic nervous system (ANS.) • Describe the location of the reticular activating system and its connections • List the functions of the reticular activating system • Describe the organization and functions of the autonomic nervous system (ANS) • List the neurotransmitters involved in the ANS and common blockers that are used clinically • List the common causes and symptoms of autonomic dysfunctions • List the tests of autonomic function
PY 10.6	Describe and discuss spinal cord, its functions, lesion and sensory disturbances. • Describe the parts of the spinal cord and the arrangement of spinal nerves • Depict in a cross-sectional diagram of the spinal cord the location of ascending and descending tracts • Describe and explain the effects of hemi section and complete transection of the spinal cord • Describe the features of spinal shock • Describe and explain briefly other spinal cord lesions like Tabes dorsalis and Syringomyelia
PY 10.7	Describe and discuss functions of cerebral cortex, basal ganglia, thalamus, hypothalamus, cerebellum and limbic system and their abnormalities. • Name the lobes of cerebral cortex. • Describe the functions of the different lobes, the motor and sensory cortical areas and the association areas • Describe the layers of the cerebral cortex and their function • Describe the motor and sensory homunculus and its characteristics • Name the nuclei of the Basal Ganglia • Describe the neuronal circuits of the basal ganglia • Enumerate the functions of basal ganglia • Indicate the cause and features of Parkinson's disease and the principle of treatment • Describe other abnormal movements associated with lesions of parts

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	of the basal ganglia • Describe the functions of the different nuclei of the thalamus • Describe the cause and features associated with Thalamic Syndrome • Describe the functions of the different parts of hypothalamus • List the anatomical structures comprising the Limbic System and in particular Papez circuit. • List the functions of Limbic system. • Describe Kluver Bucy Syndrome • Describe Sham rage • Describe connections and functions of cerebellum and cerebellar function tests.
PY 10.8	Describe and discuss behavioral and EEG characteristics during sleep and mechanism responsible for its production. • List the different 'wave forms' of EEG and state their characteristics • Describe the physiological basis of EEG • List the uses of EEG • List the stages of sleep • List the features of different stages of sleep • Discuss the physiological basis of sleep • Compare and contrast REM and NREM sleep • List the essential features of common sleep disorders
PY 10.9	Describe and discuss the physiological basis of memory, learning and speech. • Tabulate the differences of the Rt and Lt Cerebral hemispheres • Classify memory and list the stages of memory storage • Describe the physiological basis of learning and memory • Describe the key features of classical and operant conditioning • Define and classify amnesia and describe the basic features of these disorders and of Alzheimer's disease • Describe the pathways and areas in the brain involved in speech • List the types of Aphasias and give the salient features of each.
PY 10.10	Describe and discuss chemical transmission in the nervous system, (Outline the psychiatry element) • Define neurotransmitters • Explain the general characteristics of action of neurotransmitters • Give the physiological classification of neurotransmitters and explain their functions • Discuss the role of neurotransmitters in common psychiatric disorders like depression, psychoses, schizophrenia
PY 10.11	Demonstrate the correct clinical examination of the nervous system, higher functions, sensory system, motor system, reflexes, cranial nerves in a normal volunteer and simulated environment. • Perform the correct clinical examination of the nervous system, higher functions, sensory system, motor system, reflexes, cranial nerves
PY 10.12	Identify normal EEG forms • Given the EEG recording, Identify the various waves of the EEG (alpha block, sleep spindles)

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PY 10.13	Describe and discuss perception of smell and taste sensation • List the primary taste receptors and their distribution • Explain the mechanism of taste receptor stimulation for different taste sensation • Trace the taste pathway with the help of a diagram • With the help of a diagram illustrate the structure of olfactory receptors • Trace the olfactory pathway
PY 10.14	Describe and discuss pathophysiology of altered smell and taste sensation • List and describe disorders of taste and smell • Describe the clinical tests for taste and smell
PY 10.15	Describe and discuss functional anatomy of ear and auditory pathways & physiology of hearing • Describe the various structural components of human ear • List the parts of the middle ear • Describe the functions of the middle ear • Describe the cochlea. • Draw and describe the organ of Corti • Describe the endocochlear potential • Describe the theories of hearing • Trace the auditory pathway
PY 10.16	Describe and discuss pathophysiology of deafness. Describe hearing tests • Describe the types of deafness and some common causes • Describe the tuning fork tests to assess deafness • Describe the role of audiometry in assessing deafness and list its advantages over tuning fork tests • Describe the role of tympanogram
PY 10.17	Describe and discuss functional anatomy of eye, physiology of image formation, physiology of vision including colour vision, refractive errors, colour blindness, physiology of pupil and light reflex • Define refractive index. • Draw a reduced eye. • List the errors of refraction and indicate diagrammatically how they can be corrected. • Define accommodation of the eye and explain the mechanisms involved • Describe Purkinje Sanson images and their use • Describe how aqueous humor is formed and drained. List and describe the different types of glaucoma • Describe layers of the retina • Differentiate between the rods and cones • Describe the transduction of light • Define photopic and scotopic vision; describe the phenomenon of dark and light adaptation • Explain theories of color vision

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	• List the types of color blindness and the methods used to test for them • List the pupillary reflexes and trace their pathways • List the features of Argyl Robertson pupil
PY 10.18	Describe and discuss the physiological basis of lesion in visual Pathway • Trace the visual pathways • List and describe disorders of visual fields in relation to the visual pathway • List the cortical visual areas and their function
PY 10.19	Describe and discuss auditory & visual evoke potentials • Explain evoked potential • Discuss the physiological and clinical uses of auditory and visually evoked potentials
PY 10.20	Demonstrate (i) Testing of visual acuity, colour and field of vision and (ii) hearing (iii) Testing for smell and (iv) taste sensation in volunteer/ simulated environment • Perform (i) Testing of visual acuity, colour and field of vision and (ii) hearing (iii) Testing for smell and (iv) taste sensation
Topic: Integrated Physiology – 6 hrs	
Number	Competency
PY 11.1	Describe and discuss mechanism of temperature regulation • Define the normal range of body temperature • Discuss the modes of heat loss from the body • Describe the mechanisms of heat production in the body • Discuss the role of the skin in regulation of body temperature • Describe the function of Hypothalamus as the thermostat of the body
PY 11.2	Describe and discuss adaptation to altered temperature (heat and cold) • Describe the changes occurring in the body when exposed to higher temperatures • Describe the changes occurring in the body when exposed to lower temperatures • List the behavioral methods used to control ambient and body temperature
PY 11.3	Describe and discuss mechanism of fever, cold injuries and heat Stroke • Discuss the abnormality in body temperature regulation in fever • Describe the pathophysiology and management of heat stroke • Describe the pathophysiology and management of frost bite
PY 11.4	Describe and discuss cardio-respiratory and metabolic adjustments during exercise; physical training effects • Describe the acute cardio respiratory and metabolic responses to whole body isotonic and resistance exercise • Distinguish between endurance and resistance physical training • List the tests to evaluate progress with endurance / resistance physical

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	training • Describe the whole body and skeletal muscle effects of sustained endurance / resistance training • Define exercise, grading, type, oxygen debt
PY 11.5	Describe and discuss physiological consequences of sedentary Lifestyle • Define sedentary lifestyle. (what is physical inactivity) • Describe the physiological consequences of sedentary lifestyle • What are current recommendations for Physical activity? • List the methods to assess physical activity of an individual • Describe the pathways through which sedentary lifestyle increases cardio-metabolic risk
PY 11.6	Describe physiology of infancy. • Define the following terms i) perinatal ii) neonatal iii) infancy • Describe the changes in infancy (the first year of life) with regard to the following: o growth and weight gain o developmental milestones o nervous system changes o cardiovascular system o respiratory system o gastrointestinal system o endocrine system o renal and urinary system o hematological and immune function
PY 11.7	Describe and discuss physiology of aging; free radicals and antioxidants • Distinguish between chronological and biological age • List the various theories of aging • Describe the role of free radicals and the antioxidants in aging • Describe the system wise changes that occur with aging (including diseases of ageing) • Define cellular senescence
PY 11.8	Discuss & compare cardio-respiratory changes in exercise (isometric and isotonic) with that in the resting state and under different environmental conditions (heat and cold) • Compare and contrast the acute cardiac, vascular and respiratory responses to isometric and isotonic exercise in thermoneutral conditions • Compare and contrast cardiac, vascular and respiratory responses to exercise in conditions of acute and chronicheat and cold conditions. • Highlight the differences in cardiorespiratory responses to exercise in heat and cold from those in thermoneutralconditions
PY 11.9	Interpret growth charts • Define growth chart • List the types of growth chart

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	• Define: stunting, wasting, failure to thrive • Interpret the WHO / IAP weight-for-age growth chart for the given data (case history)
PY 11.10	Interpret anthropometric assessment of infants List the parameters used for anthropometric assessments in infants - height, weight, head circumference, mid arm circumference. Mention the normal values. Clinical implications of anthropometric assessments in infants
PY 11.11	Discuss the concept, criteria for diagnosis of Brain death and its Implications • Define brain death • List the criteria for diagnosing brain death (distinguish from coma) • Explain the implications of brain death (including legal and organ donation issues)
PY 11.12	Discuss the physiological effects of meditation • Describe the physiological changes seen with meditation with regards to: o Neuroendocrine (cognitive, autonomic function, EEG, sleep, HPA axis) o cardiorespiratory function o metabolic activity
PY 11.13	Obtain history and perform general examination in the volunteer / simulated environment • Perform general physical examination after obtaining history
PY 11.14	Demonstrate Basic Life Support in a simulated environment • Perform Basic life support

Integration Topics

HUMAN ANATOMY				
Sl No	**Competency Number**	**Competency**	**Vertical Integration**	**Horizontal Integration**
1	AN3.1	Classify muscle tissue according to structure & action		Physiology
2	AN5.1	Differentiate between blood vascular and lymphatic system		Physiology
3	AN5.2	Differentiate between pulmonary and systemic		Physiology

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		circulation		
4	AN5.6	Describe the concept of anastomoses and collateral circulation with significance of end-arteries	General Medicine	Physiology
5	AN5.7	Explain function of meta-arterioles, precapillary sphincters, arterio- venous anastomoses		Physiology
6	AN5.8	Define thrombosis, infarction & aneurysm	Pathology	Physiology
7	AN7.2	List components of nervous tissue and their functions		Physiology
8	AN7.3	Describe parts of a neuron and classify them based on number of neurites, size & function		Physiology
9	AN7.5	Describe principles of sensory and motor innervation of muscles	General Medicine	Physiology
10	AN7.7	Describe various types of synapse		Physiology
11	AN21.9	Describe & demonstrate mechanics and types of respiration		Physiology
12	AN22.2	Describe & demonstrate external and internal features of each chamber of heart		Physiology
13	AN22.3	Describe & demonstrate origin, course and branches of coronary arteries		Physiology
14	AN22.4	Describe anatomical basis of ischaemic heart disease	General Medicine	Physiology
15	AN22.7	Mention the parts, position and arterial supply of the conducting system of heart	General Medicine	Physiology
16	AN24.1	Mention the blood supply, lymphatic drainage and nerve supply of pleura, extent of pleura and describe the pleural recesses and their applied anatomy	General Medicine	Physiology

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17	AN24.2	Identify side, external features and relations of structures which form root of lung & bronchial tree and their clinical correlate	General Medicine	Physiology
18	AN24.3	Describe a bronchopulmonary segment	General Medicine	Physiology
19	AN25.3	Describe fetal circulation and changes occurring at birth	General Medicine	Physiology
20	AN25.4	Describe embryological basis of: 1) atrial septal defect, 2) ventricular septal defect, 3) Fallot's tetralogy & 4) tracheo-oesophageal fistula	General Medicine, Pediatrics	Physiology
21	AN25.5	Describe developmental basis of congenital anomalies, transposition of great vessels, dextrocardia, patent ductus arteriosus and coarctation of aorta	General Medicine, Pediatrics	Physiology
22	AN25.9	Demonstrate surface marking of lines of pleural reflection, Lung borders and fissures, Trachea, Heart borders, Apex beat & Surface projection of valves of heart	General Medicine, Pediatrics	Physiology
23	AN56.2	Describe circulation of CSF with its applied anatomy	General Medicine	Physiology
24	AN57.4	Enumerate ascending & descending tracts at mid thoracic level of spinal cord	General Medicine	Physiology
25	AN57.5	Describe anatomical basis of syringomyelia	General Medicine	Physiology
26	AN58.3	Enumerate cranial nerve nuclei in medulla oblongata with their functional group		Physiology
27	AN58.4	Describe anatomical basis & effects of medial & lateral medullary syndrome	General Medicine	Physiology
28	AN59.1	Identify external features of pons		Physiology

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29	AN60.3	Describe anatomical basis of cerebellar dysfunction	General Medicine	Physiology
30	AN61.3	Describe anatomical basis & effects of Benedikt's and Weber's syndrome	General Medicine	Physiology
31	AN62.2	Describe & demonstrate surfaces, sulci, gyri, poles, & functional areas of cerebral hemisphere	General Medicine	Physiology
32	AN62.3	Describe the white matter of cerebrum	General Medicine	Physiology
33	AN62.4	Enumerate parts & major connections of basal ganglia & limbic lobe	General Medicine	Physiology
34	AN62.5	Describe boundaries, parts, gross relations, major nuclei and connections of dorsal thalamus, hypothalamus, epithalamus, metathalamus and subthalamus	General Medicine	Physiology
35	AN62.6	Describe & identify formation, branches & major areas of distribution of circle of Willis	General Medicine	Physiology
36	AN63.1	Describe & demonstrate parts, boundaries & features of IIIrd, IVth & lateral ventricle		Physiology
37	AN63.2	Describe anatomical basis of congenital hydrocephalus	Pediatrics	Physiology
38	AN66.1	Describe & identify various types of connective tissue with functional correlation		Physiology
39	AN67.2	Classify muscle and describe the structure-function correlation of the same		Physiology
40	AN68.2	Describe the structure-function correlation of neuron		Physiology
41	AN69.2	Describe the various types and structure-function correlation of blood vessel		Physiology

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BIOCHEMISTRY				
Sl No	Competency Number	Competency	Vertical Integration	Horizontal Integration
1	BI1.1	Describe the molecular and functional organization of a cell and its sub-cellular components.		Physiology
2	BI3.7	Describe the common poisons that inhibit crucial enzymes of carbohydrate metabolism (eg; fluoride, arsenate)		Physiology
3	BI5.2	Describe and discuss functions of proteins and structure-function relationships in relevant areas eg, hemoglobin and selected hemoglobinopathies	Pathology, General Medicine	Physiology
4	BI6.3	Describe the common disorders associated with nucleotide metabolism.		Physiology
5	BI6.7	Describe the processes involved in maintenance of normal pH, water & electrolyte balance of body fluids and the derangements associated with these.	General Medicine	Physiology
6	BI6.9	Describe the functions of various minerals in the body, their metabolism and homeostasis.	General Medicine	Physiology
7	BI6.11	Describe the functions of haem in the body and describe the processes involved in its metabolism and describe porphyrin metabolism.	Pathology, General Medicine	Physiology

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8	BI6.12	Describe the major types of haemoglobin and its derivatives found in the body and their physiological/ pathological relevance.	Pathology, General Medicine	Physiology
9	BI6.13	Describe the functions of the kidney, liver, thyroid and adrenal glands.	Pathology, General Medicine	Physiology, HumanAnatomy
10	BI6.14	Describe the tests that are commonly done in clinical practice to assess the functions of these organs (kidney, liver, thyroid and adrenal glands).	Pathology, General Medicine	Physiology, HumanAnatomy
11	BI6.15	Describe the abnormalities of kidney, liver, thyroid and adrenal glands.	Pathology, General Medicine	Physiology, HumanAnatomy
12	BI10.4	Describe & discuss innate and adaptive immune responses, self/non-self recognition and the central role of T-helper cells in immune responses.	General Medicine, Pathology	Physiology
13	BI11.4	Perform urine analysis to estimate and determine normal and abnormal constituents	General Medicine	Physiology

PATHOLOGY

Sl No	Competency Number	Competency	Vertical Integration	Horizontal Integration
1	PA26.3	Define and describe the etiology, types, pathogenesis, stages, morphology and complications and evaluation of Obstructive airway disease (OAD) and bronchiectasis	Physiology, General Medicine	Microbiology
2	PA27.3	Describe the etiology, types, stages pathophysiology pathology and complications of heart failure	General Medicine, Physiology	

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3	PA27.8	Interpret abnormalities in cardiac function testing in acute coronary syndromes	Physiology, General Medicine	
4	PA27.9	Classify and describe the etiology, types, pathophysiology, pathology, gross and microscopic features, diagnosis and complications of cardiomyopathies	General Medicine, Physiology	
5	PA28.5	Define and classify glomerular diseases. Enumerate and describe the etiology, pathogenesis, mechanisms of glomerular injury, pathology, distinguishing features and clinical manifestations of glomerulonephritis	Physiology, General Medicine	
6	PA32.1	Enumerate, classify and describe the etiology, pathogenesis, pathology and iodine dependency of thyroid swellings	Human Anatomy, Physiology, General Medicine, General Surgery	
7	PA32.2	Describe the etiology, cause, iodine dependency, pathogenesis, manifestations, laboratory and imaging features and course of thryotoxicosis	Physiology, General Medicine	
8	PA32.3	Describe the etiology, pathogenesis, manifestations, laboratory and imaging features and course of thyrotoxicosis/ hypothyroidism	Physiology, General Medicine	
9	PA32.4	Classify and describe the epidemiology, etiology, pathogenesis, pathology, clinical laboratory features, complications and progression of diabetes mellitus	Physiology, General Medicine	
10	PA32.5	Describe the etiology, genetics, pathogenesis, manifestations, laboratory	Physiology, General Medicine	

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		and morphologic features of hyperparathyroidism		
11	PA32.7	Describe the etiology, pathogenesis, manifestations, laboratory, morphologic features, complications of adrenal insufficiency	Physiology, General Medicine	
12	PA32.8	Describe the etiology, pathogenesis, manifestations, laboratory, morphologic features, complications of Cushing's syndrome	Physiology, General Medicine	
13	PA32.9	Describe the etiology, pathogenesis, manifestations, laboratory and morphologic features of adrenal neoplasms	Human Anatomy, Physiology, General Medicine, General Surgery	

PHARMACOLOGY

Sl No	Competency Number	Competency	Vertical Integration	Horizontal Integration
1	PH1.15	Describe mechanism/s of action, types, doses, side effects, indications and contraindications of skeletal muscle relaxants	Anesthesiology, Physiology	
2	PH1.19	Describe the mechanism/s of action, types, doses, side effects, indications and contraindications of the drugs which act on CNS, (including anxiolytics, sedatives & hypnotics, antipsychotic, antidepressant drugs, anti-maniacs,opioid agonists and antagonists, drugs used for neurodegenerative disorders, antiepileptics Drugs)	Psychiatry, Physiology	
3	PH1.25	Describe the mechanism/s of action, types, doses, side effects, indications and	Physiology, General Medicine	

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		contraindications of the drugs acting on blood, like anticoagulants, antiplatelets, fibrinolytics, plasma expanders		
4	PH1.26	Describe mechanisms of action, types, doses, side effects, indications and contraindications of the drugs modulating the renin angiotensin and aldosterone system	Physiology, General Medicine	
5	PH1.35	Describe the mechanism/s of action, types, doses, side effects, indications and contraindications of drugs used in hematological disorders like: D rugs used in anemias Colony Stimulating factors	General Medicine, Physiology	Pharmacology

FORENSIC MEICINE AND TOXICOLOGY

Sl No	Competency Number	Competency	Vertical Integration	Horizontal Integration
1	FM14.7	Demonstrate & identify that a particular stain is blood and identify the species of its origin.	Pathology, Physiology	
2	FM14.8	Demonstrate the correct technique to perform and identify ABO & Rh blood group of a person.	Pathology, Physiology	

ANAESTHESIOLOGY

Sl No	Competency Number	Competency	Vertical Integration	Horizontal Integration
1	AS7.3	Observe and describe the management of an unconscious patient	Physiology	General Medicine
2	AS7.4	Observe and describe the basic setup process of a ventilator	Physiology	General Medicine

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3	AS8.1	Describe the anatomical correlates and physiologic principles of pain	Human Anatomy, Physiology	
4	AS8.2	Elicit and determine the level, quality and quantity of pain and its tolerance in patient or surrogate	Physiology	

OPHTHALMOLOGY

Sl No	Competency Number	Competency	Vertical Integration	Horizontal Integration
1	OP1.1	Describe the physiology of vision.	Physiology	

GENERAL MEDICINE

Sl No	Competency Number	Competency	Vertical Integration	Horizontal Integration
1	IM1.1	Describe and discuss the epidemiology, pathogenesis clinical evolution and course of common causes of heart disease including: rheumatic/ valvular, ischemic, hypertrophic inflammatory.	Pathology, Physiology	
2	IM1.2	Describe and discuss the genetic basis of some forms of heart failure	Pathology, Physiology	
3	IM1.3	Describe and discuss the aetiology microbiology pathogenies and clinical evolution of rheumatic fever, criteria, degree of rheumatic activity and rheumatic valvular heart disease and its complications including infective endocarditis	Pathology, Physiology, Microbiolog	
4	IM1.4	Stage heart failure	Pathology, Physiology	

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5	IM1.5	Describe discuss and differentiate the processes involved in R Vs L heart failure, systolic vs diastolic failure	Pathology, Physiology	
6	IM1.6	Describe and discuss the compensatory mechanisms involved in heart failure including cardiac remodelling and neurohormonal adaptations	Pathology, Physiology	
7	IM1.7	Enumerate, describe and discuss the factors that exacerbate heart failure including ischemia, arrythmias anemia, thyrotoxicosis, dietary factors drugs etc.	Pathology, Physiology	
8	IM1.8	Describe and discuss the pathogenesis and development of common arrythmias involved in heart failure particularly atrial fibrillation	Pathology, Physiology	
9	IM2.1	Discuss and describe the epidemiology, antecedents and risk factors for atherosclerosis and ischemic heart disease	Pathology, Physiology Community Medicine	
10	IM2.2	Discuss the aetiology of risk factors both modifiable and non modifiable of atherosclerosis and IHD	Pathology, Physiology	
11	IM2.3	Discuss and describe the lipid cycle and the role of dyslipidemia in the pathogenesis of atherosclerosis	Physiology, Biochemistry	
12	IM2.4	Discuss and describe the pathogenesis, natural history, evolution and complications of atherosclerosis and IHD	Pathology, Physiology	
13	IM5.1	Describe and discuss the physiologic and biochemical basis of hyperbilirubinemia	Pathology, Physiology	
14	IM5.2	Describe and discuss the aetiology and pathophysiology of liver injury	Pathology, Physiology	
15	IM8.1	Describe and discuss the epidemiology, aetiology and the prevalence of primary and	Pathology, Physiology	

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		secondary hypertension		
16	IM8.2	Describe and discuss the pathophysiology of hypertension	Pathology, Physiology	
17	IM11.22	Enumerate the causes of hypoglycaemia and describe the counter hormone response and the initial approach and treatment.	Pathology, Physiology	
18	IM12.1	Describe the epidemiology and pathogenesis of hypothyroidism and hyperthyroidism including the influence of iodine deficiency and autoimmunity in the pathogenesis of thyroid disease	Pathology, Physiology	
19	IM12.3	Describe and discuss the physiology of the hypothalamopituitary - thyroid axis, principles of thyroid function testing and alterations in physiologic function	Pathology, Physiology	
20	IM15.3	Describe and discuss the physiologic effects of acute blood and volume loss	Pathology, Physiology	General Surgery
21	IM18.6	Distinguish the lesion based on upper vs lower motor neuron, side, site and most probable nature of the lesion	Physiology	
22	IM18.7	Describe the clinical features and distinguish, based on clinical examination, the various disorders of speech	Physiology	
23	IM18.8	Describe and distinguish, based on the clinical presentation, the types of bladder dysfunction seen in CNS disease	Physiology	
24	IM19.1	Describe the functional anatomy of the locomotor system of the brain	Human Anatomy, Physiology	
25	IM22.1	Enumerate the causes of hypercalcemia and distinguish the features of PTH vs non PTH	Pathology, Physiology	

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		mediated hypercalcemia		
26	IM22.9	Enumerate the causes and describe the clinical and laboratory features of metabolic acidosis	Physiology	
27	IM22.10	Enumerate the causes of describe the clinical and laboratory features of metabolic alkalosis	Physiology	
28	IM22.11	Enumerate the causes and describe the clinical and laboratory features of respiratory acidosis	Physiology	
29	IM22.12	Enumerate the causes and describe the clinical and laboratory features of respiratory alkalosis	Physiology	
30	IM22.13	Identify the underlying acid based disorder based on an ABG report and clinical situation	Physiology	
31	IM23.1	Discuss and describe the methods of nutritional assessment in an adult and calculation of caloric requirements during illnesses	Physiology, Biochemistry	Pediatrics
32	IM23.2	Discuss and describe the causes and consequences of protein caloric malnutrition in the hospital	Physiology, Biochemistry	Pediatrics
33	IM23.3	Discuss and describe the aetiology, causes, clinical manifestations, complications, diagnosis and management of common vitamin deficiencies	Physiology, Biochemistry	Pediatrics
34	IM23.4	Enumerate the indications for enteral and parenteral nutrition in critically ill patients	Physiology, Biochemistry	Pediatrics
35	IM24.22	Describe and discuss the aetiopathogenesis, clinical presentation, complications, assessment and management of nutritional disorders in the elderly	Physiology, Biochemistry	

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OBSTETRICS AND GYNAECOLOGY				
Sl No	Competency Number	Competency	Vertical Integration	Horizontal Integration
1	OG3.1	Describe the physiology of ovulation, menstruation, fertilization, implantation and gametogenesis	Physiology	
2	OG7.1	Describe and discuss the changes in the genital tract, cardiovascular system, respiratory, haematology, renal and gastrointestinal systems in pregnancy	Physiology	

PAEDIATRICS				
Sl No	Competency Number	Competency	Vertical Integration	Horizontal Integration
1	PE7.2	Explain the physiology of lactation	Physiology	
2	PE7.3	Describe the composition and types of breast milk and discuss the differences between cow's milk and human milk	Physiology	
3	PE10.1	Define, describe the etio-pathogenesis, classify including WHO classification, clinical features, complication and management of severe Acute Malnourishment and Moderate Acute Malnutrition	Physiology Biochemistry	
4	PE10.2	Outline the clinical approach to a child with SAM and MAM	Physiology, Biochemistry	
5	PE10.3	Assessment of a patient with SAM and MAM, diagnosis, classification and planning management including hospital and community based	Physiology, Biochemistry	

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		intervention, rehabilitation and prevention		
6	PE11.1	Describe the common etiology, clinical features and management of Obesity in children	Physiology, Biochemistry, Pathology	
7	PE11.2	Discuss the risk approach for obesity and discuss the prevention strategies	Physiology, Pathology	
8	PE12.7	Describe the causes, clinical features, diagnosis and management of Deficiency / excess of Vitamin D (Rickets and Hypervitaminosis D	Biochemistry, Physiology, Pathology	
9	PE12.8	Identify the clinical features of dietary deficiency of Vitamin D	Biochemistry Physiology Pathology	
10	PE12.9	Assess patients with Vitamin D deficiency, diagnose, classify and plan management	Biochemistry, Physiology, Pathology	
11	PE12.13	Discuss the RDA, dietary sources of Vitamin K and their role in health and disease	Biochemistry, Physiology, Pathology	
12	PE12.14	Describe the causes, clinical features, diagnosis, management and prevention of of Deficiency of Vitamin K	Biochemistry, Physiology, Pathology	
13	PE23.1	Discuss the Hemodynamic changes, clinical presentation, complications and management of Acyanotic Heart Diseases –VSD, ASD and PDA	Physiology Pathology	
14	PE23.2	Discuss the Hemodynamic changes, clinical presentation, complications and management of Cyanotic Heart Diseases – Fallot's Physiology	Physiology Pathology	
15	PE23.3	Discuss the etio-pathogenesis, clinical presentation and management of cardiac failure in infant and children	Physiology Pathology	
16	PE23.4	Discuss the etio-pathogenesis,	Physiology	

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		clinical presentation and management of Acute Rheumatic Fever in children	Pathology	
17	PE23.5	Discuss the clinical features, complications, diagnosis, management and prevention of Acute Rheumatic Fever	Physiology Pathology	
18	PE23.6	Discuss the etio-pathogenesis and clinical features and management of Infective endocarditis in children	Physiology, Pathology, Microbiology	
19	PE29.1	Discuss the etio-pathogenesis, Clinical features, classification and approach to a child with anaemia	Pathology, Physiology	
20	PE29.2	Discuss the etio-pathogenesis, clinical features and management of Iron Deficiency anaemia	Pathology, Physiology	
21	PE29.3	Discuss the etiopathogenesis, Clinical features and management of VIT B12, Folate deficiency anaemia	Pathology, Physiology	
22	PE29.4	Discuss the etio-pathogenesis, clinical features and management of Hemolytic anemia, Thalassemia Major, Sickle cell anaemia, Hereditary spherocytosis, Auto-immune hemolytic anaemia and hemolytic uremic syndrome	Pathology Physiology	

GENERAL SURGERY				
Sl No	**Competency Number**	**Competency**	**Vertical Integration**	**Horizontal Integration**
1	SU1.1	Describe basic concepts of homeostasis, enumerate the metabolic changes in injury and their mediators	Physiology, Biochemistry	
2	SU2.1	Describe Pathophysiology of shock. Types of shock.	Pathology, Physiology	

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		Principles of resuscitation including fluid replacement and monitoring		
3	SU4.1	Elicit, document and present history in a case of Burns and perform physical examination. Describe Pathophysiology of Burns.	Physiology	
4	SU12.1	Enumerate the causes and consequences of malnutrition in the surgical patient.	Physiology	
5	SU12.2	Describe and Discuss the methods of estimation and replacement the Fluid and electrolyte requirements in the surgical patient	Physiology	
6	SU28.5	Describe the applied Anatomy and physiology of esophagus	Human Anatomy, Physiology	

RESPIRATORY MEDICINE

Sl No	Competency Number	Competency	Vertical Integration	Horizontal Integration
1	CT2.1	Define and classify obstructive airway disease	Physiology, Pathology	
2	CT2.2	Describe and discuss the epidemiology risk factors and evolution of obstructive airway disease	Physiology, Pathology	
3	CT2.4	Describe and discuss the physiology and pathophysiology of hypoxia and hypercapneia	Physiology, Pathology	
4	CT2.5	Describe and discuss the genetics of alpha 1 antitrypsin deficiency in emphysema	Physiology, Pathology	
5	CT2.11	Describe, discuss and interpret pulmonary function tests	Physiology, Pathology	

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Summary of TL methods and list of competencies to be covered in Physiology Phase I MBBS and Assessment methods

Sl. No.	Topic, Teaching hours and type	Competency numbers	Assessment methods
1.	Nerve & Muscle Physiology -10hrs Lecture, Interactive, SGD	PY3.1-3.13	Written, Viva voce
	DOAP, CAL	PY3.14-3.16, 3.18	Practical/OSPE/ Viva voce
2.	Endocrine Physiology – 16 hrs Lecture, Interactive, SGD	PY 8.1-8.6	Written, Viva voce
3.	Reproductive Physiology – 10 hrs Lecture, Interactive, SGD	PY 9.1-9.12	Written, Viva voce
4.	Neurophysiology – 37 hrs Lecture, Interactive, SGD	PY 10.1-10.19	Written, Viva voce
	DOAP	PY 10.11 & 10.20	Skill assessment/ Practical/Vivavoce/OSPE
5.	Integrated Physiology – 6 hrs Lecture, Interactive, SGD	PY 11.1-11.12	Written, Viva voce
	DOAP	PY 11.13 & 11.14	Skill assessment/ Viva voce/ OSPE

I MBBS – PHYSIOLOGY PRACTICAL SKILLS TO BE CERTIFIED

1. PY 5.12 Record blood pressure and pulse rate at rest.
2. PY 5.12 Record blood pressure and pulse rate in different grades of exercise.
3. PY 5.12 Record blood pressure and pulse rate in different postures.
4. PY 6.9 Demonstrate clinical examination of respiratory system.
5. PY 10.11 Demonstrate clinical examination of higher functions.
6. PY 10.11 Demonstrate clinical examination of sensory system.
7. PY 10.11 Demonstrate clinical examination of motor system.
8. PY 10.11 Demonstrate clinical examination of reflexes.
9. PY 10.11 Demonstrate clinical examination of cranial nerves.
10. PY 10.20 Demonstrate testing of visual acuity, colour vision and field of vision.
11. PY 10.20 Demonstrate testing of hearing.

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12. PY 10.20 Demonstrate testing for smell.

13. PY 10.20 Demonstrate testing for taste sensation.

SCHEME OF EXAMINATION:

FORMATIVE ASSESSMENT

Scheme for calculation of Internal Assessment marks:

Formative assessment :			
Theory	**30 Marks**	**Practicals**	**30 Marks**
Day to Day Assessments/MCQs/Viva / tests	05	Practical records	05
Attitude/Communication skills	01	ECE Participation/Skill certification	05
Written Assignments	02		
Attendance	02 (for Theory + Practical attendance >90%) 01 (for Theory + Practical attendance 80-90%)		
Total	**40**		**40**

General Guidelines

(Includes eligibility for Summative assessment and Pass criteria)

- Regular periodic examinations shall be conducted throughout the course. There shall be minimum three internal assessment examinations in Physiology.
- The third internal examination shall be conducted on the lines of the university examination.
- There shall be one short essay on ECE in each internal assessment.
- There shall be at least one short question from AETCOM in the internal assessment.
- Questions on ECE and AETCOM in Internal Assessments must be assessed by the faculty of the respective pre-clinical departments (Anatomy/Physiology/Biochemistry).
- An average of the marks scored in the three internal assessment examinations will be considered as the final internal assessment marks.
- Learners must secure not less than 40 % marks in theory and practical separately and not less than 50% marks of the total marks (combined in theory and practical) assignedfor internal assessment in a particular subject in order to be eligible for appearing at the final University examination of that subject.
- A candidate who has not secured requisite aggregate in the internal assessment may be subjected to remedial measures by the institution. If he/she successfully completes the remediation measures, he/she is eligible to appear for University Examination. Remedialmeasures shall be completed before submitting the internal assessment marks online to the university.
- Learners must have completed the required certifiable competencies in and completed the logbook to be eligible for appearing at the final Physiology university examination.

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SUMMATIVE ASSESSMENT

B. Theory: 100 marks

There shall be two theory papers of 100 marks each and duration of each paper will be 3 hours.

Theory paper I

Sl. No.	Type of Question	Number	Marks
1	Long Essay	2 X 10	20
2	Short Essay	6 X 5	30
3	Short answer questions	10 X 3	30
4	MCQs	20 X 1	20
5	**Total**	**38**	**100**

Blue print for theory question papers

Paper 2 (Max 100 marks)	
Systems	**Marks allotted**
Nerve and muscle Physiology	12
Endocrine physiology	20
Reproductive physiology	15
Central nervous system	35
Special senses	10
Integrated Physiology	08

C. i) Practical: 80 marks

Practical session	Allotted topics	Marks allotted
Practical – I	Clinical examination – I (CNS – sensory / motor/ reflexes / cranial nerve)	15
	Chart: Clinical case histories	5
	Total	**20**
Practical – II	Clinical examination-II (CVS / RS)	15

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	Clinical examination (general physical examination / abdomen examination)	5
	Total	**20**
Practical – III	Human experiments • Mosso's ergography • Effect of posture / exercise on BP and Pulse rate • Effect on BP and pulse rate during exercise using the Harvard step test • Record and interpret Lead II ECG • Spirometry and PEFR • Perimetry • Demonstrate BLS	15
	Chart: Amphibian charts (nerve muscle / cardiac)	5
	Total	**20**
Practical – IV	Hematology • RBC count • WBC count • Making a peripheral smear + DLC on the provided stained slide • BT + blood group • CT + blood group • Hb + blood group	15
	Chart: calculations / problem solving	5
	Total	**20**
	GRAND TOTAL	**80**

B. ii) Viva-voce: 20 marks

- The viva-voce examination shall carry 20 marks and all examiners will conduct the examination.
- Viva will focus on application and interpretation.
- Viva marks to be added to practical and not theory.

Course outcome

Course Code	Course Name	Course Outcome	
MBC106A Nerve Muscle Endocrine, Reproductive,	**Physiology 2**	**CO-1**	Acquired the knowledge of Nerve-Muscle Physiology, Endocrine Physiology, Nervous System, Special Senses, Reproductive and integrated Physiology.

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Neurophysiology(CNS, Special senses), Integrated Physiology		CO-2	Describe the pathophysiology of disease affecting muscular, nervous, endocrine, reproductive systems and their management.
		CO-3	Be conversant with applied, integrated, clinical investigation tests, recent advances relevant to muscular, nervous, endocrine, reproductive Physiology and interpret the results in the clinical context.
		CO-4	Acquire the skill to communicate effectively and show respect towards the subject / peer during clinical examinations.

PO, PSO & CO Mapping – Physiology

Course Code	Course Outcomes	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
		PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
MBC106A Physiology 2	CO-1	3	2	2	3	1	3	2	2	3	3
	CO-2	3	3	2	3	1	3	2	2	3	3
	CO-3	3	3	2	2	1	2	3	2	3	3
	CO-4	2	2	3	2	3	3	3	3	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution											

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SUGGESTED TEXT BOOKS

Note: A single text book may not cover the entire curriculum. Referring to more than one book is recommended.

TEXT BOOKS (Latest editions)

11. Guyton and Hall. Text book of Medical Physiology.
12. Ganong's Review of Medical Physiology.
13. Vander's Human Physiology.
14. Berne and Levy Physiology. BM Koeppen, BA Stanton
15. Human Physiology. Lauralee Sherwood.
16. Text book of medical physiology. G K Pal.
17. Principles of Medical Physiology. Sabyasachi Sircar
18. Text book of Medical Physiology. Indu Khurana
19. Text book of Medical Physiology. D Venkatesh, H H Sudhakar
20. Essentials of Medical Physiology. ABS Mahapatra

Reference books for practical

5. McLeod's Clinical Examination
6. Hutchison's Clinical Methods.
7. Text book of practical physiology. GK Pal and Pravati Pal
8. A textbook of Practical Physiology. CL Ghai

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Annexure- Ia

SUGGESTED FORMAT FOR CERTIFICATION OF SKILLS IN PHYSIOLOGYGENERAL INSTRUCTIONS

General information:

1. There are 13 skills that need to be certified in Physiology
2. These skills will be tested in normal, healthy volunteers or simulated environment
3. The focus will be on whether students perform the procedures correctly
4. Since these are skills that need to be recertified at the end of clinical training, this certificationis a **"First level Certification"**

Role of the certifier:

1. Observe the student perform the skill without any prompting or interference
2. At the end of the assessment ask the specific questions that need to be asked (based on the skill checklist)
3. Grade the student (A, B, C, D – see below)
4. Give feedback to the student on the errors, if any, at the end of the skill assessment.
5. Fill in the Certification Sheet

Assessment

Professional conduct and communication:

1. Is the student adequately groomed
2. Does the student introduce him/herself, greet the subject and obtain consent?
3. Does the student use the hand sanitizer?
4. Does the student give clear instructions to the subject?
5. Does the student thank the subject?
6. Does the student use the hand sanitizer at the end of the session?

Skill specific assessment:

1. Has the student conducted the given assessment completely?
2. Has the student conducted the given assessment correctly?
   (for the above two points please refer to the checklist for the specific skill)
3. How do you rate the student for this session?

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Annexure Ib

CERTIFICATION SHEET – Blank Template:

Name of Student:

Subject:

Skill:

Competency Number:

Grading of Student (please circle the appropriate letter – A, B, C, D)

A	Student has performed the assessment without any error
B	Student has performed the assessment with minor errors that need to be rectified
C	Student has performed the assessment with major errors
D	Student has not been able to perform the assessment

SKILL CHECKLIST

	Attempt I Date:	**Attempt II Date:**	**Attempt 'n' ..... Date:**
Professional conduct and communication			
Steps • .... • ...			
Grade			
Name and Signature of the assessor			
I have received detailed feedback on my performance including my grade, the errors that I have committed and actions to be taken. (student's signature)			

Satisfactory (√), unsatisfactory (X)

Certifiers name and signature with date of certification:

Signature of the student:

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Annexure II

FORMAT FOR ASSESSING PARTICIPATION IN EARLY CLINICALEXPOSURE SESSIONS

Session number: **Date:**

Roll No:

Department visited:

Objectives:

1.Briefly describe what you learnt from this session/ clinical visit in relation to the objectives.

2.Apart from the above learning, what did you observe that influenced (Positive/negative)you?

Remarks of teacher: Satisfactory / Not satisfactory

Name and Signature of Teacher with date:

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Annexure III

SUGGESTED FORMAT FOR AETCOM SESSIONS

Name of the Facilitator: **Date:**

AETCOM module Number: **Session number:**

AETCOM topic:

Competencies / Objectives:

1.Briefly describe what you learnt from this AETCOM session in relation to the objectives.

2. Apart from the above learning, what did you observe that influenced (Positive/negative)you during this session?

Remarks by Facilitator:

Signature of Facilitator:

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Bangalore - 560 054

ANNEXURES FOR FIRST PROFESSIONAL

COURSE

ANNEXURE-1: FORMAT FOR ASSESSING PROFESSIONALISM

Signature of Faculty mentor

Signature of HOD

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Guidelines for assessment:

Sl. No.	Overall attendance (5)	Timely submission of record books /assignments (5)	Behaves respectfully with peers and teachers (5)
1			
2			
3			

Attendance

Grade	Percentage
5	95-100%
4	90-94%
3	85-89%
2	80-84%
1	< 80%

Submission of record books /assignments

Grade	Criteria
5	Always submits the record/assignments on time
4	Often submits the record/assignments on time
3	Frequently submits the record/assignments on time
2	Rarely submits the record on time
1	Has not submitted at all

Behaves respectfully with peers and teachers

Grade	Criteria
5	Demonstrates appropriate respectful behavior with peers and teachers always
4	Demonstrates appropriate respectful behavior with peers and teachers

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	most of the time
3	Demonstrates appropriate respectful behavior with peers and teachers frequently
2	Demonstrates appropriate respectful behavior with peers and teachers rarely
1	Is arrogant and disrespectful to peers and teachers

ANNEXURE-2: FORMAT FOR ASSESSING PARTICIPATION IN ECE SESSIONS

Name of the Student:

Date:

ECE session

5-Strongly agree 4-Agree 3 Not sure 2 Disagree 1-Strongly disagree

Sl. No.	Criteria	5	4	3	2	1
1	**Critical Appraisal**					
a	Clarifies, defines and analyses the problem from the scenario / interaction with patient					
b	Identifies learning objectives					
c	Demonstrates initiative and curiosity					
2	**Utilization of learning resources**					
a	Utilizes relevant resource materials effectively					
b	Applies knowledge to new situations to solve problems and to reach decisions					
3	**Group work**					
a	Organized and prepared for small group sessions					
b	Shares thoughts and opinions with peers actively					
4	**Attitudes and Communication Skills**					
a	The oral expression is clear enough to be understood					
b	Provides and accepts constructive feedback					

Shalini

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c	Contributes to group harmony (listens to conflicting opinions and tolerates shortcomings of others)					

Suggested format for participation in - Early Clinical Exposure

Name of the Facilitator:

ECE session No: **Area/Specialty visited:**

Clinical Skills (Concepts learnt during ECE sessions):

Objectives

1.

2.

3.

Briefly describe what you learnt from this clinical visit in relation to the objectives. (in 100-150 words)

Apart from the above learning, what did you observe that influenced (Positive/negative)you? (in 100-150 words)

Signature of Facilitator

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ANNEXURE-3: SUGGESTED FORMAT FOR MONITORING ACADEMIC PERFORMANCE AND *PROVIDING FEEDBACK*

Sl. No.	Marks obtained		Feedback provided		Date	Signature of student	Signature of mentor
			Positive	Could be improved			
	Test 1						
1.	1st Internal Examination						
	Theory						
	Practical						
	Overall 1st quarter marks						
	Test 2						
2.	2nd Internal Examination						
	Theory						
	Practical						
	Overall 2nd quarter marks						
	Test 3						
3.	3rd Internal Examination						
	Theory						
	Practical						
	Overall 3rd quarter marks						

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ANNEXURE-4: LOG OF SEMINARS

Sl no	Date	Topic	Level of participation [attended/presented]	Remarks if any	Signature of faculty/mentor
1.					
2.					
3.					
4.					
5.					

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ANNEXURE-5: SUGGESTED FORMAT FOR SELF DIRECTED LEARNING TOPICS

Name of the Facilitator:

SDL Topic:

SUMMARY OF CONCEPTS LEARNT (Concept map):

Signature of Facilitator

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