Revised Ordinance Governing

MBBS DEGREE COURSE AND CURRICULUM

of phase I Subjects – November 2019 [Amended]

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SECTION I

Introduction to CBME based curriculum

The Medical Council of India has revised the undergraduate medical education curriculum so that the Indian Medical Graduate is able to recognize "health for all" as a national goal and should be able to fulfill his/her societal obligations. The revised curriculum has attempted to enunciate the competencies the student must be imparted and should have learnt, with clearly defined teachinglearning strategies and effective methods of assessment. Communicating effectively and sympathetically with patients and their relatives has been visualized as a core area of the revised curriculum. These and other goals identified in the curriculum are to be implemented in all medical colleges under the ambit of Medical Council of India from August 2019 and to smoothen this process Guidelines have been prepared for its effective implementation. In response to the need for a seamless introduction of the curriculum into the Undergraduate system, all medical colleges need to upgrade the teaching-learning skills of their faculty. Earlier experience with implementation of curricular changes suggests that a carefully managed, sustainable approach is necessary to ensure that every college has access to the new skills and knowledge enunciated in the new curriculum. Faculty training and development thus assumes a key role in the effective implementation and sustenance of the envisaged curricular reforms.

Curriculum Committees along with Medical Education Units/ Departments of Medical Colleges would help the colleges to implement the new UG curriculum including the AETCOM (Attitude, Ethics & Communication) program. Each college should develop the framework for the Foundation Course. The Foundation course which will be of 1-month duration after admission, aims to orient the students to national health scenarios, medical ethics, health economics, learning skills & communication, Basic Life Support, computer learning, sociology & demographics, biohazard safety, environmental issues and community orientation. Foundation course may also include 1) Orientation program 2) language and computer skills 3) communication skills and 4) time management skills and 5) Professional development program highlighting ethical and humanities issues. Each College should select elements of Foundation course as per local needs and develop faculty expertise from initial years. However, experts and other teachers may be invited as per need. It is emphasized that interactive case scenarios, movies, videos, and small group discussions may be used for each concept along with the principles of reflective learning.

Four of the many new key areas recommended in the Vision 2015, were identified for implementation across the entire duration of the course at Phase I. The areas identified were such that they would be helpful to initiate the process of curricular reforms from first year of the undergraduate course. These areas are Foundation course, Early Clinical Exposure, Integrated teaching & Learning & Skill development & training.

a. **Foundation Course:** This is a one month to orient medical learners to MBBS program and provide them with requisite knowledge, communication (including electronic), technical and language skills.

b. **Early clinical exposure:** The clinical training would start in the first year, focusing on communication, basic clinical skills and professionalism. There would be sufficient clinical exposure at the primary care level and this would be integrated with the learning of basic and laboratory sciences. Introduction of case scenarios for classroom discussion/case-based learning would be emphasized. It will be done as a coordinated effort by the pre-clinical, para-clinical and clinical faculty.

c. **Integrated teaching and learning:** The innovative new curriculum have been structured to facilitate horizontal and vertical integration between and among disciplines, bridge the gaps between theory & practice, between hospital-based medicine and community medicine. Basic and laboratory sciences (integrated with their clinical relevance) would be maximum in the first year and will progressively decrease in the second and third year of the training when clinical exposure and learning would be dominant.

d. **Skill development and learning** (throughout curriculum): A mandatory & desirable comprehensive list of skills has been planned and would be recommended for the Indian Medical Graduate. Certification of skills would be necessary before licensure.

e. **Electives**: The aim of adding electives is to allow flexible learning options in the curriculum and may offer a variety of options including clinical electives, laboratory postings or community exposure in areas that students are not normally exposed as a part of regular curriculum. This will also provide opportunity for students to do a project, enhance self-directed learning, critical thinking and research abilities. Examples: Bio-Informatics, Tissue Culture, Tissue Engineering/Processing, Computer and Computer applications, Immunology, Genetics, Human Nutrition, Sports Medicine, Laboratory Sciences, Research Methodology, Ethics, Accident and Emergencies (A&E), Community Projects, HIV Medicine, Pharmacokinetics/ Pharmacodynamics/ Pharmacoeconomics, Assisted Reproductive Technology, Ethics & Medical Education.

PREAMBLE

The undergraduate medical curriculum of the medical council of India is created to ensure that the medical doctor who emerges from the MBBS training program is capable of assisting the nation to achieve its goal of health for all. In addition, it aspires to ensure that the "graduate" meets or exceeds global bench-mark in knowledge, attitude, skills and communication. This intent is at the core of the Graduate Medical Regulations, 2019.

The Graduate Medical Regulations, 2019 represents the first major revision to the medical curriculum since 1997 and hence incorporates changes in science and thought over two decades. A significant advance is the development of global competencies and subject-wise outcomes that define the roles of the "Indian Medical Graduate". Learning and assessment strategies have been outlined that will allow the learner to achieve these competencies/outcomes. Effective appropriate and empathetic communication, skill acquisition, student-doctor method of learning, aligned and integrated learning and assessment are features that have been given additional emphasis in the revised curriculum.

The revised curriculum is to be implemented by all medical colleges under the ambit of Medical Council of India from August 2019. The roll out will be progressive over the duration of the MBBS course.

This document represents a compilation of the resource material that was used in the Curricular Implementation Support Program (CISP) and has attempted to provide a stepwise and comprehensive approach to implement the curriculum. It details the philosophy and the steps required in a simple and richly illustrated manner. Teaching slide decks, faculty guides and online resource material supplement this document. The document is to be used in conjunction with the Competency document, AETCOM module and the GMR document.

This draft syllabus has been created from the list of competencies mentioned in the Competency Based Curriculum (CBC) developed by the Medical Council of India for the First MBBS Batch of 2019-20.

The content to be covered under each topic has been mentioned as bulleted points. For each topic, competency numbers have been mentioned as per the competency list mentioned above. The content that is related to non-core competencies (these competencies need not be assessed in the summative examination) have been marked by an asterisk (*).

Guidelines have been suggested for the various teaching and learning (TL) methods along with the time allotted for them in the curriculum. Relevant information has also been provided about the recent additions in the CBC, namely integration, early clinical exposure (ECE), self-directed learning (SDL), the AETCOM (attitude ethics and communication skills) modules and electives.

Regardless of the TL methods that are used, it is expected that they follow adult learning principles. The regulations related to the internal examination and university examination have been mentioned along with detailed suggestions for the conduct of the theory, practical and viva-voce examinations. The document ends with a list of learning resources that both the students and teachers can utilize.

INTEGRATION

Integration is a learning experience that allows the learner to perceive relationships from blocks of knowledge and develop a unified view of its basis and its application. It is recommended that the principles of integration be applied to such an extent that the curriculum retains the strengths of subject based education and assessment, while also providing experiences that will allow learners to integrate concepts. Integration must be horizontal (i.e. across disciplines in a given phase of the course) and vertical (across different phases of the course). As far as possible, it is desirable that teaching/learning occurs in each phase through study of organ systems or disease blocks in order to align the learning process. Clinical cases must be used to integrate and link learning across disciplines.

Alignment implies the teaching of subject material that occurs under a particular organ system / disease concept from the same phase in the same time frame i.e., temporally. It is recommended that alignment be the major method to be followed, allowing similar topics in different subjects to be learnt separately but during the same time frame.

Integration implies that concepts in a topic / organ system that are similar, overlapping or redundant are merged into a single teaching session in which subject based demarcations are removed. For the purpose of this document, topics from other phases that are brought into a particular phase for the purpose of reinforcement or introduction will also be considered as integrated topics. A linker is a session that allows the learner to link the concepts presented in an aligned topic. In a small proportion (not to exceed 20% of the total curriculum) an attempt can be made to share topics or correlate topics by using an integration or linker session. The integration session most preferred will be a case-based discussion in an appropriate format ensuring that elements in the same phase (horizontal) and from other phases are addressed.

Care must be taken to ensure that achievement of phase-based objectives is given primacy - the integrative elements from other phases are used only to provide adequate recall and understand the clinical application of concepts. It must be emphasized that integration does not necessarily require multiple teachers in each class. Experts from each phase and subject may be involved in the lesson planning but not it in its delivery unless deemed necessary. As much as possible, the necessary correlates from other phases must also be introduced while discussing a topic in a given subject. Topics that cannot be aligned and integrated must be provided adequate time in the curriculum throughout the year. Assessment will continue to be subject based. However, efforts

must be made to ensure that phase appropriate correlates are tested to determine if the learner has internalized and integrated the concept and its application.

In summary:

Horizontal integration can be facilitated by the following methods.

- Alignment of timetables of the three first year subjects wherever possible
- Consciously connecting what is learned in one subject with the other subjects during teaching and learning activities
- Joint sessions by all the three departments which may be in the form of lectures, case-based learning or seminars

Vertical integration can be facilitated by the following methods

- Discussing relevant clinical case scenarios during teaching and learning sessions
- Guest lectures by clinicians or para-clinical faculty
- Hospital visits to see relevant patient presentations, radiological imaging and operative procedures.

EARLY CLINICAL EXPOSURE

Objectives: The objectives of early clinical exposure of the first-year medical learners are to enable the learner to:

a. Recognize the relevance of basic sciences in diagnosis, patient care and treatment
b. Provide a context that will enhance basic science learning
c. Relate to experience of patients as a motivation to learn
d. Recognize attitude, ethics and professionalism as integral to the doctor-patient relationship
e. Understand the socio-cultural context of disease through the study of humanities

Elements

a. Basic science correlation: i.e. apply and correlate principles of basic sciences as they relate to the care of the patient (this will be part of integrated modules).
b. Clinical skills: to include basic skills in interviewing patients, doctor-patient communication, ethics and professionalism, critical thinking and analysis and self-learning (this training will be imparted in the time allotted for early clinical exposure).
c. Humanities: To introduce learners to a broader understanding of the socio-economic framework and cultural context within which health is delivered through the study of humanities and social sciences.

Planning of activities & its distribution:

ECE has to be done in practically each of the sessions of basic sciences, preferably for first 10-15 minutes as we do not want it to happen in isolation but want it as an integral part of the basic science curriculum. Total allotted hours in first year (as per GMR, 2019) is 90 hours which has to be equally divided among the three preclinical subjects. Therefore, the time available for each subject is 30 hours, which can be further divided as follows:

a. Basic sciences correlation - 18 hours - 3-hour session per month for 6 months which can take place with charts, graphics, videos, reports, field visits etc. in classrooms / hospital labs.
b. Clinical Skills - 12 hours - one 3-hour session per month for four months per department. Students accompanied by preclinical faculty in small groups equipped with observation guides are introduced to specified cases being demonstrated by clinicians. Each 3-hour session of clinical skills will have:
    i. Introduction & instruction: 30 minutes
    ii. Hospital visit: 1 hour 30 minutes
    iii. Summary & conclusion: 30 minutes d. Reflection: 30 minutes
c. Humanities - will be merged with AETCOM (no additional time)

Some methods that may be utilized for ECE are as follows:

- Clinical case scenarios during lectures and dissections
- Guest lectures delivered by clinicians
- Videos of clinical presentations and procedures
- Performance of simple clinical procedures on cadavers or simulators
- Hospital / laboratory visits to see carefully selected patients and relevant procedure
- Demonstrations on peers after taking their consent

SELF-DIRECTED LEARNING

Self-Directed Learning (SDL) is defined as the "preparedness of a student to engage in learning activities defined by himself rather than a teacher". The Graduate Medical Education 2019 document brought out by the MCI lists life-long learning as one of the roles of the Indian Medical Graduate (IMG). One of the methods suggested achieving this is SDL. Seven key components of SDL have been described. These include the identification of learning needs, formulation of learning objectives, utilization of appropriate learning resources, employing suitable learning strategies, commitment to a learning contract, evaluating learning outcomes and the teacher as a facilitator. Dedicated time for SDL is provided for each subject in the first phase.

AETCOM MODULE:

The overall goal of undergraduate medical education program as envisaged in the revised Graduate Medical Education Regulations - 2019 is 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. In order to fulfill this goal, the IMG must be able to function appropriately, ethically and effectively in her/his roles as clinician, leader and member of the health care team and system, communicator, lifelong learner and as a professional. In order to effectively fulfill the above-mentioned roles, the IMG must obtain a set of competencies at the time of graduation. In order to ensure that training is in alignment with the goals and competencies, Medical Council of India has proposed new teaching learning approaches including a structured longitudinal programmeon attitude, ethics and communication

Five AETCOM modules will be taught in first phase and following departments will be responsible for implementation and assessment of these modules

- **MODULE 1.1 AND MODULE 1.5 ANATOMY**
- **MODULE 1.2 AND MODULE 1.3 PHYSIOLOGY**
- **MODULE 1.4 BIOCHEMISTRY**

GUIDELINES: Reflection writing to be recorded in practical record/log book in each subject

ELECTIVES

An elective can be defined as a brief course made available to the learner during his/her undergraduate study period, where she/he can choose from the available options depending upon their interest and career preferences. Introduction of electives in undergraduate medical curriculum is an important step for providing flexible choices in student's areas of interest, direct individual experience and this will help in developing self- directed learning skills. The range of electives that can be offered to the students will depend upon the local logistics and resources available for the medical institutions (within or nearby). These can be in a wide range that can include electives from educational, community and research-project related, directly or indirectly with health care, super- specialty clinical electives and specific laboratory electives.

Method:

- Two months are allotted for elective rotations after completion of the exam at end of the third MBBS Part I examination and before commencement of third MBBS Part II.
- It is compulsory for learners to do an elective. The protected time for electives should not be used to make up for missed clinical postings, shortage of attendance or any other purpose.
- The learner shall rotate through two elective blocks of 04 weeks each.

- Block 1 shall be done in a pre-selected preclinical or para-clinical or other basic sciences laboratory OR under a faculty researcher in an ongoing research project. During the electives regular clinical postings shall continue.
- Block 2 shall be done in a clinical department (including specialties, super-specialties, ICUs, blood bank and casualty) from a list of electives developed and available in the institution OR as a supervised learning experience at a rural or urban community clinic.
- Institutions will determine the number and nature of electives beforehand, names of the supervisors, and the number of learners in each elective based on the local logistics, available resources and faculty.
- Each institution will develop its own mechanism for allocation of electives.
- It is preferable that electives are made available to the learners in the beginning of the academic year.
- The learner must submit a learning logbook based on both blocks of the elective.

75% attendance in the electives and submission of logbook maintained during elective is mandatory for eligibility to appear in the final MBBS examination.

Students will be assessed in between and at the end of each elective posting.

Feedback, comments and /or grades about the student's performance by the faculty mentor can be documented with the help of a checklist where both professional and academic attributes can be included.

The performance of the students in the electives will also contribute towards internal marks. Student's feedback about the elective also needs to be documented in a structured format. This will help in gathering student's perceptions about various aspects of elective posting and help in program evaluation.

Institutions may use part of this time for strengthening basic skill certification. The list of electives offered by the institution must be displayed for students.

Each elective should have well defined objectives, expected outcomes, expectations from the students, their assessment mechanism and faculty guide or mentors.

A faculty mentor should guide the student, monitor their learning activities and assess the students' performance with regular feedback.

Examples of general electives include bioinformatics, tissue engineering / processing, computer and computer applications, genetics, human nutrition, laboratory sciences, research methodology, ethics and medical education.

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SECTION II

REGULATIONS GOVERNING MBBS DEGREE COURSE
[Eligibility for Admission, Duration, Attendance and Scheme of Examination]

1. ELIGIBILITY

As per guidelines of Medical Council of India

2. DURATION OF THE COURSE

<table>
<tr><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
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DISTRIBUTION OF SUBJECTS BY PROFESSIONAL PHASE

Phase and Year of MBBS Training	Subjects and new teaching elements	Duration	University examination
First professional MBBS	• Foundation course (1month) • Human Anatomy, Physiology& Biochemistry • Introduction of Community Medicine, Humanities • Early Clinical Exposure • Attitude. Ethics and Communication Module (AETCOM)	1+13 months	I Professional
Second professional MBBS	• Pathology, Microbiology, Pharmacology, Forensic Medicine And Toxicology • Introduction to clinical subjects including community Medicine • Clinical postings • AETCOM	12 months	II Professional
Third professional MBBS-part I	• General Medicine ,General Surgery, OBG, Paediatrics, Orthopaedics, Dermatology, Pyschiatry, Otorhinolaryngology, Ophthalmology, Community Medicine, Forensic Medicine and Toxicology, Respiratory Medicine, Radiodiagnosis & Radiotherapy, Anaesthesiology • Clinical Subjects /postings • AETCOM	12 months	III Professionalpart I
Electives	• Electives ,skills and assessment	2 months	
Third professional MBBS-part II	• General Medicine ,Paediatrics, General Surgery, Orthopaedics, Obstetrics and Gynaecology, including Family welfare and allied specialties • Clinical Postings /subjects • AETCOM	13 months	III Professionalpart II

FOUNDATION COURSE

Subjects/contents	Total Teaching hours
Orientation[1]	30
Skills Module[2]	35
Field visit to Community Health Centre	8
Professional Development including ethics	40
Sports and Extracurricular Activities	22
Enhancement of language/computer skills[3]	40
Total teaching hours	175

1. **Orientation course will be completed as single block in the first week and will contain elements outlined in 9.1. (**(vide Medical Council of India Notification on Graduate Medical Education (Amendment) Regulations 2019, published in the Gazette of India Part III, Section 4, Extraordinary issued on 4th November 2019**)**
2. **Skills modules will contain elements outlined in 9.1.**
3. **Based on perceived need of learners, one may choose language enhancement (English or local spoken or both) and computer skills. This should be provided longitudinally through the duration of the Foundation Course.**

Note:

- **Teaching of Foundation Course will be organized by pre-clinical departments**
- **The Foundation Course will have compulsory 75% attendance. This will be certified by the Dean of the college**

3. ATTENDANCE

Every candidate should have **attendance not less than 75% of the total classes conducted in theory which includes didactic lectures, early clinical exposure and self-directed learning and not less than 80% of the total classes conducted in practical which includes small group teaching, tutorials, integrated learning and practical sessions** in each calendar year calculated from the date of commencement of the term to the last working day as notified by the University in each of the subjects prescribed to be eligible to appear for the university examination. **75% attendance in Professional Development Programme (AETCOM Module) is required for**

eligibility to appear for final examination in each professional year (vide Medical Council of India Notification on Graduate Medical Education (Amendment) Regulations 2019, published in the Gazette of India Part III, Section 4, Extraordinary issued on 4th November 2019)

The Principal should notify at the College the attendance details at the end of each term without fail under intimation to this University.

A candidate lacking in the prescribed attendance and progress in any subject(s) in theory or practical should not be permitted to appear for the examination in that subject(s).

4. TEACHING HOURS

Subjects	Lecture hours	Small group teaching/tutorials/integrated teaching/practical (hours)	Selfdirected learning (SDL)	Total (hours)
Human anatomy	220	415	40	675
Physiology	160	310	25	495
Biochemistry	80	150	20	250
Early clinical exposure*	90	-	0	90
Community Medicine	20	27	5	52
Attitude, Ethics & Communication module (AETCOM)**	-	26	8	34
Sports and extracurricular activities	-	-	-	60
Formative assessment and term examinations	-	-	-	80
Total	-	-	-	1736

*Early clinical exposure hours to be divided equally in all three subjects **AETCOM module shall be a longitudinal programme

SCHEME OF EXAMINATION

5. INTERNAL ASSESSMENT:

General guidelines

- Regular periodic examinations shall be conducted throughout the course. There shall be **minimum three internal assessment examinations** in each preclinical subject. In addition, there shall be **one Internal Assessment in Community Medicine in Phase I MBBS**.
- The **third internal examination** should be conducted on the lines of the university examination.
- There shall be one short essay on ECE in each internal assessment in each subject.
- There should be **at least one short question from AETCOM** in each subject in any of 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)** assigned for 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. Remedial measures shall be completed before submitting the internal assessment marks online to the university.
- **Internal assessment marks will reflect under separate head in the marks card of the university examination. The internal assessment marks (theory/practical) will not be added to the marks secured (theory/practical) in the university examination for consideration of pass criteria.**
- **The results of IA should be displayed on the notice board within a 1-2 week of the test.**
- Learners must have completed the required certifiable competencies for that phase of training and completed the logbook appropriate for that phase of training to be eligible for appearing at the final university examination of that subject.

6. UNIVERSITY EXAMINATION

Examination schedule

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General guidelines

- 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.

- Nature of questions will include different types such as structured essays (Long Answer Questions - LAQ), Short Essays and Short Answers Questions (SAQ). Marks for each part should be indicated separately.

- The learner **must secure at least 40% marks in each of the two papers with minimum 50% of marks in aggregate (both papers together) to pass.**

- Practical/clinical examinations will be conducted in the laboratories. The objective will be to assess proficiency and skills to conduct experiments, clinical examination, interpret data and form logical conclusion, wherever applicable.

- Viva/oral examination should assess candidate's skill in analysis and interpretation of common investigative data, X-rays, identification of specimens, ECG, etc. [wherever applicable] and attitudinal, ethical and professional values.

- **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 phase I university examination.**
- **A learner shall not be entitled to graduate after 10 years of his/her joining of the first part of the MBBS course.**

Phase 1 university examination

- 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.

- 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.

Phase I

Table: Examination components, Subjects and Distribution of Marks

THEORY	ANATOMY	PHYSIOLOGY	BIOCHEMISTRY
Written Paper			
No. of Papers & Maximum Marks for each paper.	**2×100=200**	**2×100=200**	**2×100=200**
Total theory	**200**	**200**	**200**
PRACTICAL			
1. Practical exam	**80**	**80**	**80**
2. Viva-voce	**20**	**20**	**20**
Total practical	**100**	**100**	**100**
Internal assessment*			
Internal Assessment (Theory)	**40**	**40**	**40**
Internal assessment (Practical)	**40**	**40**	**40**

*** Internal assessment marks will reflect under separate head in the marks card of the university examination.**

Table: Type, number of questions and distribution of marks for written paper

TYPES OF QUESTION	NUMBER OF QUESTIONS	MARKS FOR EACH QUESTION
Long essay	**2**	**10**
Short essay	**10**	**5**
Short answers	**10**	**3**

7. SUBMISSION OF LABORATORY RECORD

a. At the time of Practical Examination each candidate shall submit to the Examiners his/her laboratory record duly certified by the Head of the Department as a bonafide record of the work done by the candidate.

8. ELIGIBILITY FOR EXAMINATION

The following criteria to be met by the students to be eligible for the university exams:

a. Shall have undergone satisfactorily the approved course of study in the subject/subjects for the prescribed duration.
b. Shall have attended not less than 75% of the total classes conducted in theory and not less than 80% of the total classes conducted in practical separately to become eligible to appear for examination in that subject/subjects.
c. Minimum of 40% marks to be obtained **separately** in theory and practical to appear for University exam. At least 50% marks of the total marks **combined** in theory and practical assigned for internal assessment is to be obtained in a particular subject. (average of 3 internal assessments theory and practical separately)
d. Learners must have completed the required certifiable competencies for that phase of training and completed the logbook appropriate for that phase of training to be eligible for appearing at the final university examination of that subject.

9. CRITERIA FOR PASS

For declaration of pass in any subject in the University examination, a candidate shall pass both in Theory and Practical examination components separately as stipulated below:

- The Theory component consists of marks obtained in University Written papers only. For a pass in theory, a candidate must secure at least 40% marks in each of the two papers with minimum 50% of marks in aggregate (both papers together).
- For a pass in practical examination, a candidate shall secure not less than 50% marks in aggregate, i.e., marks obtained in university practical examination and viva voce added together.
- **Internal assessment marks will reflect as a separate head of passing at the university examination.**
- A candidate not securing 50% marks in aggregate in Theory or Practical examination + viva in a subject shall be declared to have failed in that subject and is required to appear for both Theory and Practical again in the subsequent examination in that subject.

10. DECLARATION OF CLASS

a. A candidate having appeared in all the subjects in the same examination and passed that examination in the first attempt and secures 75% of marks or more of **grand total marks (university examination)** prescribed will be declared to have passed the examination with distinction.

b. A candidate having appeared in all the subjects in the same examination and passed that examination in the first attempt and secures 65% of marks or more but less than 75% of **grand total marks (university examination)** prescribed will be declared to have passed the examination in First Class.

c. A candidate having appeared in all the subjects in the same examination and passed that examination in the first attempt and secures 50% of marks or more but less than 65% of **grand total marks (university examination)** prescribed will be declared to have passed the examination in Pass Class.

d. A candidate passing a university examination in more than one attempt shall be placed in Pass class irrespective of the percentage of marks secured by him/her in the examination.

Note: Please note fraction of marks will not be rounded off for clauses (a), (b) and (c)

SECTION III
COURSE CONTENTS

ANATOMY

PREAMBLE

The journey into the fascinating field of medicine begins by trying to understand the **structure** of the **human body.** The subject of **anatomy** deals with the study of the human body from the cellular to the macroscopic level. The marvellous and complex design of the human body will be studied in the context of the competencies that a basic medical doctor needs to achieve by the end of the MBBS course. Thus, the emphasis will be on **clinical, functional** and **applied anatomy** that can be utilized by a clinician, rather than on factual details that may not have relevance to clinical practice.

This draft syllabus has been created from the list of **competencies** mentioned in the **Competency Based Curriculum (CBC)** developed by the **Medical Council of India** for the First MBBS Batch of 2019-20. The subject has been divided into the following broad areas:

A. General anatomy
B. General histology
C. Genetics
D. General embryology
E. Upper limb
F. Thorax
G. Abdomen
H. Pelvis
I. Lower limb
J. Head and neck
K. Neuroanatomy
L. Ethics in anatomy

In each of these broad areas, topics have been specified. The content to be covered under each topic has been mentioned as bulleted points. For each topic, competency numbers have been mentioned as per the competency list mentioned above. The content that is related to non-core competencies **(these competencies need not be assessed in the summative examination) have been marked by an asterisk (*).**

Goals and departmental objectives for the undergraduate (MBBS) Curriculum in Anatomy

Goal

The broad goal of the anatomy curriculum is to provide a comprehensive, scientific knowledge of the structure and development of the human body in order to understand the anatomical basis of disease presentations and patient management.

Objectives

A. Knowledge

At the end of the course student should be able to:

a. Explain the gross structure, normal disposition and integrated functions of organ systems in order to understand the anatomical basis of common disease presentations and clinical procedures.
b. Describe the microscopic structure of various organs and correlate their structure with functions, in order to understand their altered state in various disease processes.
c. Describe the basic principles behind the sequential development of organs systems as a prerequisite to explaining the developmental basis of common variations and congenital anomalies.
d. Describe the normal structure and functions of chromosomes and genes so as to understand the genetic basis of common genetic abnormalities.

B. Skills

At the end of the course the student should be able to:

a. Demonstrate the surface marking of clinically important structures in the cadaver and correlate it with living anatomy.
b. Locate and identify tissues and cells under the light microscope.
c. Identify important structures visualized by imaging techniques, specifically radiographs, computerized tomography (CT) scans, MRI and ultrasonography.
d. Demonstrate the various movements at the important joints in the human body.
e. Accurately palpate the pulsations of arteries at the most appropriate sites.

C. Attitude and communication skills

At the end of the course the student should be able to:

a. Show due respect in handling human body parts and cadavers during dissection.
b. Communicate effectively with peers and teachers in small group teaching-learning activities.
c. Demonstrate the ability to work effectively with peers in a team.
d. Demonstrate professional attributes of punctuality, accountability and respect for teachers and peers.
e. Appreciate the issues of equity and social accountability while undergoing early clinical exposure.

CURRICULUM A. GENERAL ANATOMY

Topic: Anatomical terminology (AN1.1)

- Normal anatomical position
- Planes of the body
- Terms used for relations and comparison
- Terms used for movements of the body

Topic: General features of bones and Joints (AN1.2, AN2.1 to AN2.6)

- Composition of bone and bone marrow
- Parts, blood and nerve supply of a long bone
- Laws of ossification*
- Special features of a sesamoid bone*
- Types of cartilage with its structure and distribution in body
- Joints with subtypes and examples
- Nerve supply of joints and Hilton's law

Topic: General features of Muscle (AN3.1 to AN3.3)

- Classification of muscle tissue according to structure and action
- Parts of skeletal muscle
- Differences between tendons and aponeuroses with examples
- Shunt and spurt muscles*

Topic: General features of skin and fascia (AN4.1 to AN4.5)

- Types of skin and dermatomes in body*
- Structure and function of skin
- Superficial fascia along with fat distribution in body
- Modifications of deep fascia with its functions
- Principles of skin incisions*

Topic: General features of the cardiovascular system (AN5.1 to AN5.8)

- Differences between blood vascular and lymphatic system
- Differences between pulmonary and systemic circulation
- General differences between arteries and veins
- Functional differences between elastic, muscular arteries and arterioles
- Concept of portal system with examples
- Concept of anastomoses and collateral circulation with significance of end-arteries
- Functions of meta-arterioles, precapillary sphincters, arterio-venous anastomoses*
- Definition of thrombosis, infarction and aneurysm*

Topic: General Features of lymphatic system (AN6.1 to AN6.3)

- Components and functions of the lymphatic system*

Structure of lymph capillaries and mechanism of lymph circulation*

- Concept of lymphoedema and spread of tumors via lymphatics and venous system*

Topic: Introduction to the nervous system (AN7.1 to AN7.8)

- General plan of nervous system with components of central, peripheral and autonomic nervous systems
- Components of nervous tissue and their functions
- Parts of a neuron
- Classification of neurons based on structure and function
- Structure of a typical spinal nerve
- Principles of sensory and motor innervation of muscles*
- Concept of loss of innervation of a muscle with its applied anatomy
- Type of synapses*
- Differences between sympathetic and spinal ganglia*

B. GENERAL HISTOLOGY

Topic: Epithelium (AN65.1 to AN65.2)

- Identification of epithelium under the microscope
- Correlation of structure and function of epithelia
- Ultrastructure of epithelium*

Topic: Connective tissue histology (AN66.1 to AN66.2)

- Types of connective tissue with functional correlation
- Ultrastructure of connective tissue*

Topic: Muscle histology (AN67.1 to AN67.3)

- Classification of muscle
- Structure-function correlation of muscle
- Ultrastructure of muscle tissue*

Topic: Nervous tissue histology (AN68.1 to AN68.3)

- Description and identification of unipolar and multipolar neurons, ganglia, peripheral nerve
- Structure-function correlation of neuron
- Ultrastructure of nervous tissue*

Topic: Blood vessels – histology (AN69.1 to AN69.3)

- Identification of elastic and muscular blood vessels, capillaries under the microscope
- Types and structure-function correlation of blood vessels
- Ultrastructure of blood vessels*

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Topic: Glands and Lymphoid tissue (AN70.1 to AN70.2)

- Identification of exocrine glands under the microscope
- Differentiation between serous, mucous and mixed acini
- Identification of lymphoid tissue under the microscope
- Microanatomy of lymph node, spleen, thymus, tonsil and correlation of structure with function

Topic: Bone and Cartilage (AN71.1 to AN71.2)

- Identification of bone under the microscope
- Types and structure-function correlation of bone
- Identification of cartilage under the microscope
- Types and structure function correlation of cartilage

Topic: Integumentary System (AN72.1)

- Identification of skin and its appendages under the microscope
- Correlation of structure and function

C. GENETICS

Topic: Chromosomes (AN73.1 to AN73.3)

- Structure of chromosomes with classification
- Technique of karyotyping with its applications
- Lyon's hypothesis

Topic: Patterns of Inheritance (AN74.1 to AN74.4)

- Various modes of inheritance with examples
- Pedigree charts for the various types of inheritance
- Examples of diseases of each mode of inheritance
- Multifactorial inheritance with examples
- Genetic basis and clinical features of achondroplasia, cystic fibrosis, vitamin D resistant rickets, haemophilia, Duchenne's muscular dystrophy and sickle cell anaemia*

Topic: Principle of Genetics, Chromosomal Aberrations and Clinical Genetics (AN75.1 to AN75.5)

- Structural and numerical chromosomal aberrations
- Mosaics and chimeras with examples
- Genetic basis and clinical features of Prader Willi syndrome, Edward syndrome and Patau syndrome*
- Genetic basis of variation: polymorphism and mutation • Principles of genetic counselling

D. GENERAL EMBRYOLOGY

Topic: Introduction to embryology (AN76.1 TO AN76.2)

Stages of human life

Terms - phylogeny, ontogeny, trimester, viability

Topic: Gametogenesis and fertilization (AN77.1 to AN77.6)

- Uterine changes occurring during the menstrual cycle
- Synchrony between the ovarian and menstrual cycles
- Spermatogenesis and oogenesis
- Stages and consequences of fertilization
- Anatomical principles underlying contraception
- Teratogenic influences; fertility and sterility, surrogate motherhood, social significance of "sex-ratio"*

Topic: Second week of development (AN78.1 to AN78.5)

- Cleavage and formation of blastocyst
- Development of trophoblast
- Process of implantation and common abnormal sites of implantation
- Formation of extra-embryonic mesoderm and coelom, bilaminar disc and prochordal plate
- Abortion, decidual reaction, pregnancy tests

Topic: 3rd to 8th week of development (AN79.1 to AN79.6)

- Formation and fate of the primitive streak
- Formation and fate of notochord
- Process of neurulation
- Development of somites and intra-embryonic coelom
- Embryological basis of congenital malformations, nucleus pulposus, sacrococcygeal teratomas, neural tube defects
- Diagnosis of pregnancy in first trimester*
- Role of teratogens, alpha-fetoprotein*

Topic: Fetal membranes (AN80.1 to AN80.7)

- Formation, functions and fate of chorion, amnion, yolk sac, allantois and decidua
- Formation and structure of umbilical cord
- Formation of placenta, its physiological functions, foeto-maternal circulation and placental barrier
- Embryological basis of twinning in monozygotic and dizygotic twins

- Role of placental hormones in uterine growth and parturition
- Embryological basis of estimation of fetal age*
- Types of umbilical cord attachments*

Topic: Prenatal Diagnosis (AN81.1 to AN81.3)

- Methods of prenatal diagnosis
- Indications, process and disadvantages of amniocentesis
- Indications, process and disadvantages of chorion villus biopsy

E. UPPER LIMB

Topic: Features of individual bones (Upper Limb) (AN8.1 to AN8.6)

- Clavicle, scapula, humerus, radius, ulna - side determination, anatomical position and important features
- Joints formed by the given bone
- Peculiarities of clavicle
- Muscle group attachments on above bones
- Identification and naming of bones in articulated hand
- Parts of metacarpals and phalanges
- Peculiarities of pisiform
- Scaphoid fracture and basis of avascular necrosis*

Topic: Pectoral region (AN9.1 to AN 9.3)

- Pectoralis major, pectoralis minor - attachment, nerve supply and action
- Breast - location, extent, deep relations, structure, age changes, blood supply, lymphatic drainage, microanatomy and applied anatomy
- Development of breast*

Topic: Axilla, Shoulder and Scapular region (AN 10.1 to AN10.13)

- Axilla - boundaries and contents
- Axillary artery and tributaries of vein - origin, extent, course, parts, relations and branches
- Brachial plexus - formation, branches, relations, area of supply of branches, course and relations of terminal branches
- Axillary lymph nodes - anatomical groups and areas of drainage
- Variations in formation of brachial plexus
- Erb's palsy and Klumpke's paralysis - anatomical basis and clinical features*
- Enlarged axillary lymph nodes – anatomical basis*
- Latissmus dorsi and trapezius- location, attachment, nerve supply and actions
- Arterial anastomosis around the scapula*

- Boundaries of triangle of auscultation*
- Deltoid and rotator cuff muscles
- Serratus anterior - attachment and actions
- Shoulder joint - type, articular surfaces, capsule, synovial membrane, ligaments, relations, movements, muscles involved, blood supply, nerve supply and applied anatomy
- Anatomical basis of injury to axillary nerve during intramuscular injections*

Topic: Arm and Cubital fossa (AN11.1 to AN11.6)

- Muscle groups of upper arm
- Biceps and triceps brachii
- Important nerves and vessels in arm - origin, course, relations, branches (or tributaries), termination

  Venepuncture of cubital veins - anatomical basis

  Saturday night paralysis - anatomical basis
- Cubital fossa - boundaries and contents
- Anastomosis around elbow joint*

Topic: Forearm and hand (AN12.1 to AN12.15)

- Ventral forearm - muscle groups with attachments, nerve supply and actions
- Nerves and vessels of forearm - origin, course, relations, branches (or tributaries), termination
- Flexor retinaculum - identification and attachments
- Anatomical basis of carpal tunnel syndrome
- Small muscles of hand
- Movements of thumb and muscles involved
- Blood vessels and nerves in hand - course and branches
- Anatomical basis of claw hand
- Fibrous flexor sheaths, ulnar bursa, radial bursa and digital synovial sheaths
- Infection of fascial spaces of palm*
- Dorsal forearm - muscle groups, attachments, nerve supply and actions
- Origin, course, relations, branches (or tributaries), termination of important nerves and vessels of back of forearm
- Wrist drop - anatomical basis
- Compartments deep to extensor retinaculum
- Extensor expansion – identification and formation

Topic: General Features, joints, radiographs and surface marking (AN13.1 to AN13.8)

- Fascia of upper limb and compartments
- Veins of upper limb
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- Lymphatic drainage of upper limb
- Dermatomes of upper limb*
- Elbow joint, proximal and distal radio-ulnar joints, wrist joint and first carpometacarpal joint - type, articular surfaces, capsule, synovial membrane, ligaments, relations, movements, blood and nerve supply
- Sternoclavicular joint, acromioclavicular joint, carpometacarpal joints and metacarpophalangeal joints*
- Bones and joints of upper limb seen in anteroposterior and lateral view radiographs of shoulder region, arm, elbow, forearm and hand
- 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
- Surface projection of cephalic and basilic vein
- Palpation of brachial artery and radial artery
- Testing of muscles: trapezius, pectoralis major, serratus anterior, latissimus dorsi, deltoid, biceps brachii, brachioradialis
- Development of upper limb*

F. THORAX

Topic: Thoracic cage (AN21.1 to AN21.11)

- Salient features of sternum, typical rib, 1st rib and typical thoracic vertebra
- Features of 2nd, 11th and 12th ribs*
- Features of 1st, 11th and 12th thoracic vertebrae*
- Boundaries of thoracic inlet, cavity and outlet
- Extent, attachments, direction of fibres, nerve supply and actions of intercostal muscles
- Course, relations and branches of a typical intercostal nerve
- Origin, course and branches / tributaries of anterior, posterior intercostal vessels and internal thoracic vessels
- Origin, course, relations and branches of atypical intercostal nerve, superior intercostal artery and subcostal artery*
- Type, articular surfaces and movements of manubriosternal, costovertebral, costotransverse and xiphisternal joints
- Mechanics and types of respiration
- Costochondral and interchondral joints*
- Boundaries and contents of the superior, anterior, middle and posterior mediastinum

Topic: Heart and Pericardium (AN22.1 to AN22.7)

- Pericardium - subdivisions, sinuses, blood supply and nerve supply
- External and internal features of each chamber of the heart

- Origin, course and branches of coronary arteries
- Anatomical basis of ischaemic heart disease
- Formation, course, tributaries and termination of coronary sinus
- Fibrous skeleton of heart
- Position and arterial supply of the conducting system of heart

Topic: Mediastinum (AN23.1 to AN23.7)

- Oesophagus - external appearance, relations, blood supply, nerve supply, lymphatic drainage and applied anatomy
- Thoracic duct - extent, relations, tributaries and applied anatomy
- Origin, course, relations, tributaries and termination of superior venacava, azygos, hemiazygos and accessory hemiazygos veins
- Branches and relations of arch of aorta and descending thoracic aorta
- Location and extent of thoracic sympathetic chain
- Description of splanchnic nerves*
- Right lymphatic duct – extent, relations and applied anatomy

Topic: Lungs and Trachea (AN24.1 to AN24.6, AN25.1 to AN25.6)

- Pleura – extent, recesses with their applied anatomy, blood supply, lymphatic drainage and nerve supply
  Lungs – side determination, external features including root and clinical correlates
  Description of bronchopulmonary segments
- Phrenic nerve - formation and distribution
- Blood supply, lymphatic drainage and nerve supply of lungs
- Extent, length, relations, blood supply, lymphatic drainage and nerve supply of trachea*

Topic: Radiological anatomy of thorax (AN25.7 and AN25.8)

- Identification of structures seen on a plain x-ray chest (PA view)
- Identification of and description in brief of a barium swallow*

Topic: Surface marking of thorax (AN25.9)

- Demonstrate surface marking of lines of pleural reflection, lung borders and fissures, trachea, heart borders, apex beat and surface projection of valves of heart

Topic: Histology of thorax (AN25.1)

- Identification, drawing and labelling of a slide of trachea and lung

Topic: Embryology of thorax (AN25.2 to AN25.6)

- Development of pleura, lung and heart

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- Fetal circulation and changes occurring at birth
- Embryological basis of: 1) atrial septal defect, 2) ventricular septal defect, 3) Fallot's tetralogy and 4) tracheo-oesophageal fistula
- Developmental basis of common cardiac congenital anomalies, transposition of great vessels, dextrocardia, patent ductus arteriosus and coarctation of aorta
- Development of aortic arch arteries, superior vena cava, inferior vena cava and coronary sinus*

G. ABDOMEN AND PELVIS

Topic: Anterior abdominal wall (AN44.1 to AN44.7)

- Planes (transpyloric, transtubercular, subcostal, lateral vertical), regions and quadrants of abdomen
- Anterior abdominal wall – fascia, blood vessels and nerves
- Rectus sheath – formation, contents, linea alba and linea semilunaris
- Inguinal canal - extent, boundaries, contents of inguinal canal, Hesselbach's triangle
- Anatomical basis of inguinal hernia
- Attachments of muscles of anterior abdominal wall
- Common abdominal incisions*
- Umbilicus - position, dermatome and applied aspects*

Topic: Posterior abdominal wall (AN45.1 to AN45.3)

- Thoracolumbar fascia
- Lumbar plexus – root value, formation and branches
- Other nerve plexuses of posterior abdominal wall*

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Major subgroups of back muscles, nerve supply and action*

Topic: Male external genitalia (AN46.1 to AN46.5)

- Testes - coverings, internal structure, side determination, blood supply, nerve supply and lymphatic drainage
- Descent of testis with its applied anatomy
- Parts of epididymis
- Penis - parts, components, blood supply and lymphatic drainage
- Anatomical basis of varicocoele*
- Anatomical basis of phimosis and circumcision*
- Spermatic cord and its contents

Topic: Abdominal cavity (AN47.1 to AN47.14)

- Greater and lesser sac - boundaries and recesses
- Naming and identification of peritoneal folds and pouches
- Anatomical basis of ascites, peritonitis and subphrenic abscess*
- Spleen - anatomical position, external features, peritoneal and visceral relations, blood supply, nerve supply, lymphatic drainage and applied aspects
- Anatomical basis of splenic notch, accessory spleens and Kehr's sign*
- Coeliac trunk- origin, course, important relations and branches
- Abdominal part of oesophagus - anatomical position, blood supply, nerve supply, lymphatic drainage and applied aspects
- Stomach - anatomical position, external features, peritoneal and visceral relations, blood supply, nerve supply, lymphatic drainage and applied anatomy
- Anatomical basis of lymphatic spread in carcinoma stomach and different types of vagotomy*
- Mesentery – extent, borders, contents, relations and applied aspects
- Small Intestine - parts, macroscopic difference between jejunum and ileum, nerve supply and lymphatic drainage
- Superior mesenteric artery - origin, course, termination, important relations and branches
  • Large intestine - features, extent, peritoneal and other relations
- Caecum - anatomical position, external and internal features, important peritoneal and other relations, blood supply, nerve supply, lymphatic drainage and applied aspects
- Vermiform appendix - anatomical position, external and internal features, important peritoneal and other relations, blood supply, nerve supply, lymphatic drainage and applied aspects
- Inferior mesenteric artery - origin, course, important relations and branches
- Duodenum - anatomical position, external and internal features, important peritoneal and other relations, blood supply, nerve supply, lymphatic drainage and applied aspects

- Pancreas - anatomical position, external and internal features, important peritoneal and other relations, blood supply, nerve supply, lymphatic drainage and applied aspects
  Liver and extrahepatic biliary apparatus - anatomical position, external features, important peritoneal relations and visceral relations, blood supply, nerve supply, lymphatic drainage and applied aspects
- Clinical importance of Calot's triangle*
- Anatomical basis of site of needle puncture in liver biopsy, referred pain in cholecystitis and obstructive jaundice*
- Portal vein – formation, course, relations, tributaries and sites of porta-systemic anastomoses
- Anatomical basis of haematemesis and caput medusae in portal hypertension
- Kidneys - anatomical position, side determination, coverings, external features, important visceral relations, blood supply, nerve supply, lymphatic drainage and applied anatomy
- Anatomical basis of radiating pain of kidney to groin*
- Ureter – extent, parts, course, relations, constrictions, blood supply, nerve supply, lymphatic drainage and applied aspects
- Suprarenal gland - anatomical position, coverings, external features, important visceral and other relations, blood supply, nerve supply, lymphatic drainage and applied aspects
- Thoraco-abdominal diaphragm – attachments, major and minor openings, nerve supply and actions
- Thoraco-abdominal diaphragm - abnormal openings and diaphragmatic hernia*
- Abdominal aorta - origin, course, important relations and branches
- Inferior vena cava - formation, course, relations and tributaries

Topic: Pelvic wall and viscera (AN48.1 to AN48.8)

- Muscles of pelvic diaphragm
- Position, features, important peritoneal and other relations, blood supply, nerve supply, lymphatic drainage and clinical aspects of important male and female pelvic viscera
- Origin, course, important relations and branches of internal iliac artery
- Branches of sacral plexus
- Anatomical basis of suprapubic cystostomy, urinary obstruction in benign prostatic hypertrophy, retroverted uterus, prolapse uterus, internal and external haemorrhoids, anal fistula, vasectomy, tubal pregnancy and tubal ligation*
- Neurological basis of automatic bladder*
- Lobes involved in benign prostatic hypertrophy and prostate cancer*
- Structures palpable during vaginal and rectal examination*

Topic: Perineum (AN49.1 to AN49.5)

- Boundaries and contents of superficial and deep perineal pouch

- Perineal body - identification and description
- Perineal membrane in male and female
- Ischiorectal fossa - boundaries, contents and applied anatomy
- Anatomical basis of perineal tear, episiotomy, perianal abscess and anal fissure*

Topic: Vertebral column (AN50.1 to AN50.4)

- Curvatures of the vertebral column
- Type, articular ends, ligaments and movements of intervertebral joints, sacroiliac joints and pubic symphysis
- Site, direction of the needle and structures pierced during lumbar puncture
- Anatomical basis of scoliosis, lordosis, prolapsed disc, spondylolisthesis and spina bifida*

Topic: Sectional Anatomy of Abdomen and Pelvis (AN51.1, AN51.2)

- Cross-sections at T8, T10 and L1 (transpyloric plane) levels
- Midsagittal section of male and female pelvis

Topic: Histology and embryology (AN52.1 to AN52.8)

- Microstructure of oesophagus, cardiooesophageal junction*, fundus of stomach, pylorus of stomach
- Microstructure of duodenum, jejunum, ileum
- Microstructure of colon, appendix
- Microstructure of liver, gallbladder, pancreas
- Microstructure of kidney, ureter, suprarenal gland
- Microstructure of testis, epididymis, vas deferens, penis, prostate gland
- Microstructure of ovary, uterus, uterine tube, cervix*, placenta, umbilical cord, corpus luteum*
- Development of anterior abdominal wall*
- Development and congenital anomalies of diaphragm
- Development and congenital anomalies of foregut
- Development and congenital anomalies of midgut
- Development and congenital anomalies of hindgut
- Development of urinary system
- Development of male reproductive system
- Development of female reproductive system

Topic: Osteology (AN53.1 to AN53.4)

- Lumbar vertebrae - anatomical position, salient features, articulations and attachments of muscle groups

- Sacrum and coccyx - anatomical position, salient features, articulations and attachments of muscle groups
- Bony pelvis - anatomical position, boundaries of pelvic inlet, pelvic cavity and pelvic outlet,
- True and false pelvis with sex differences
- Clinical importance - sacralization of lumbar vertebra, lumbarization of 1st sacral vertebra, types of bony pelvis*

Topic: Radiological anatomy (AN 54.1 to AN54.3)

- Features of plain X ray abdomen
- Contrast X ray - barium swallow, barium meal, barium enema
- Cholecystography
- Intravenous pyelography
- Hysterosalpingography
- ERCP*
- CT abdomen*
- MRI abdomen and pelvis*
- Abdominal arteriography*

Topic: Surface marking (AN 55.1 and AN55.2)

- Regions and planes of abdomen
- Superficial inguinal ring
- Deep inguinal ring
- McBurney's point
- Renal angle
- Murphy's point
- Surface projections of - stomach, liver, fundus of gall bladder, spleen, duodenum, pancreas, ileocaecal junction, kidneys and root of mesentery, abdominal aorta and inferior vena cava

H. LOWER LIMB

Topic: Features of individual bones (lower limb) (AN 14.1 – 14.4)

- Hip bone, femur, patella, tibia, fibula - side determination, anatomical position and important features
- Joints formed by the given bone
- Muscle group attachments on above bones
- Importance of ossification of lower end of femur and upper end of tibia
- Identification and naming of bones in articulated foot with individual muscle attachments*

Topic: Front & Medial Side of Thigh (AN15.1 to AN15.6)

- Origin, course, relations, branches (or tributaries), termination of important nerves and vessels of anterior thigh
- Major muscles with their attachment, nerve supply and actions
- Femoral triangle - boundaries and contents
- Anatomical basis of psoas abscess & femoral hernia*

- Adductor canal – boundaries and contents

Topic: Gluteal region & Back of thigh (AN16.1 to AN16.6)

- Origin, course, relations, branches (or tributaries), termination of important nerves and vessels of gluteal region
- Major muscles with their attachment, nerve supply and actions
- Anatomical basis of sciatic nerve injury during gluteal intramuscular injections
- Anatomical basis of Trendelenburg sign
- Hamstring group of muscles with their attachment, nerve supply and actions
- Origin, course, relations, branches (or tributaries), termination of important nerves and vessels on the back of thigh
- Popliteal fossa - boundaries, roof, floor, contents and relations

Topic: Hip joint (AN17.1 to AN17.3)

- Type, articular surfaces, capsule, synovial membrane, ligaments, relations, movements and muscles involved, blood and nerve supply, bursae around the hip joint
- Anatomical basis of complications of fracture neck of femur*
- Dislocation of hip joint and surgical hip replacement*

Topic: Knee joint, Antero-lateral compartment of leg & Dorsum of foot (AN18.1 to AN18.7)

- Major muscles of anterolateral compartment of leg with their attachment, nerve supply and actions
- Origin, course, relations, branches (or tributaries), termination of important nerves and vessels of anterolateral compartment of leg
- Anatomical basis of foot drop
- Type, articular surfaces, capsule, synovial membrane, ligaments, relations, movements and muscles involved, blood and nerve supply, bursae around the knee joint
- Anatomical basis of locking and unlocking of the knee joint
- Anatomical basis of knee joint injuries*
- Anatomical basis of osteoarthritis*

Topic: Back of leg & Sole (AN19.1 to AN19.7)

- Major muscles of back of leg with their attachment, nerve supply and actions
- Origin, course, relations, branches (or tributaries), termination of important nerves and vessels of back of leg
- Concept of "peripheral heart"
- Sole - layers, muscles, vessels and nerves

- Anatomical basis of rupture of calcaneal tendon*
- Factors maintaining arches of the foot and their importance
- Anatomical basis of flat foot and club foot*
- Anatomical basis of metatarsalgia and plantar fasciitis*

Topic: General features, joints, radiographs & surface marking (AN 20.1 – 20.10)

- Tibiofibular and ankle joints - type, articular surfaces, capsule, synovial membrane, ligaments, relations, movements and muscles involved, blood and nerve supply
- Subtalar and transverse tarsal joints*
- Fascia lata, venous drainage, lymphatic drainage, retinacula and dermatomes of lower limb
- Anatomical basis of enlarged inguinal lymph nodes*
- Anatomical basis of varicose veins and deep vein thrombosis
- Bones and joints of lower limb seen in anteroposterior and lateral view radiographs of various regions of lower limb
- Important bony landmarks of lower limb - vertebral level of highest point on iliac crest, anterior and posterior superior iliac spines, iliac tuberosity, 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 and tuberosity of the navicular
- Palpation of arterial pulses in a simulated environment - femoral, popliteal, anterior tibial, posterior tibial and dorsalis pedis
- Surface marking - mid inguinal point, saphenous opening, great and small saphenous veins, femoral nerve, sciatic, tibial, common peroneal and deep peroneal nerve
- Basic concept of development of lower limb*

I. HEAD AND NECK

Topic: Skull osteology (AN26.1 to AN26.7)

- Anatomical position of skull
- Identification and naming of individual skull bones
- Features of norma frontalis, verticalis, occipitalis, lateralis and basalis
- Cranial cavity - subdivisions, foramina and structures passing through them
- Morphological features of mandible
- Features of typical and atypical cervical vertebrae (atlas and axis)
- Concept of membranous ossification*
- Features of the 7th cervical vertebra*

Topic: Scalp (AN27.1 and AN27.2)

- Scalp - layers, blood supply, nerve supply and surgical importance
- Emissary veins and their role in spread of infection from extracranial route to intracranial venous sinuses

Topic: Face and parotid region (AN28.1 to AN28.10)

- Muscles of facial expression and their nerve supply
- Sensory innervation of face
- Origin / formation, course, branches / tributaries of facial vessels
- Branches of facial nerve with distribution
- Cervical lymph nodes and lymphatic drainage of head, face and neck
  Superficial muscles of face, their nerve supply and actions

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- Anatomical basis of facial nerve palsy
- Surgical importance of deep facial vein
- Parotid gland - parts, borders, surfaces, contents, relations, nerve supply, course of its duct and surgical importance
- Anatomical basis of Frey's syndrome*

Topic: Posterior triangle of neck (AN29.1 to AN29.4)

- Sternocleidomastoid - attachments, nerve supply, relations and actions
- Anatomical basis of Erb's and Klumpke's palsy
- Anatomical basis of wry neck*
- Attachments of inferior belly of omohyoid, scalenus anterior, scalenus medius and levator scapulae*

Topic: Cranial cavity (AN30.1 to AN30.5)

- Cranial fossae and related structures
- Major foramina with structures passing through them
- Identification and description of dural folds and dural venous sinuses
- Clinical importance of dural venous sinuses
- Effect of pituitary tumours on visual pathway*

Topic: Orbit (AN31.1 to AN31.5)

- Extraocular muscles – demonstration and description
- Nerves and vessels in the orbit - demonstration and description
- Anatomical basis of Horner's syndrome*
- Components of lacrimal apparatus
- Anatomical basis of oculomotor, trochlear and abducent nerve palsies along with strabismus

Topic: Anterior triangle of neck (AN32.1 and AN32.2)

- Boundaries and subdivisions of anterior triangle
- Boundaries and contents of muscular, carotid, digastric and submental triangles

Topic: Temporal and infratemporal region (AN33.1 to AN33.5)

- Temporal and infratemporal fossae - extent, boundaries and contents
- Muscles of mastication - attachments, direction of fibres, nerve supply and actions
- Temporomandibular joint - articulating surface, type and movements
- Clinical significance of pterygoid venous plexus
- Features of dislocation of temporomandibular joint*

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Topic: Submandibular region (AN34.1 and AN34.2)

- Submandibular salivary gland - morphology, relations and nerve supply including submandibular ganglion
  Anatomical basis of formation of submandibular stones*

Topic: Deep structures in the neck (AN35.1 to AN35.10)

- Deep cervical fascia - parts, extent, attachments and modifications
- Thyroid gland - location, parts, borders, surfaces, relations and blood supply
- Subclavian artery - origin, parts, course and branches
- Internal jugular and brachiocephalic veins - formation, course, relations, tributaries and termination
- Cervical lymph nodes - extent, drainage and applied anatomy
- Cervical sympathetic chain - extent, formation, relation and branches
- IX, X, XI and XII cranial nerves - course and branches in the neck
- Anatomical basic of clinical features of thyroid swellings*
- Anatomical basis of clinical features of compression of subclavian artery and lower trunk of brachial plexus by cervical rib*
- Fascial spaces of neck*

Topic: Mouth, pharynx and palate (AN36.1 to AN36.5)

- Palatine tonsil - morphology, relations, blood supply and applied anatomy
- Composition of soft palate
- Waldeyer's lymphatic ring - components and functions
- Pyriform fossa - boundaries and clinical significance*
- Anatomical basis of tonsillitis, tonsillectomy, adenoids and peri-tonsillar abscess* • Clinical significance of Killian's dehiscence*

Topic: Cavity of nose (AN37.1 to AN37.3)

- Nasal septum and lateral wall of nose – features, blood supply and nerve supply
- Paranasal sinuses - location and functional anatomy
- Anatomical basis of sinusitis and maxillary sinus tumours*

Topic: Larynx (AN38.1 to AN38.3)

- Larynx - morphology, structure of the walls, nerve supply, blood supply and actions of intrinsic and extrinsic muscles
- Anatomical aspects of laryngitis*
- Anatomical basis of recurrent laryngeal nerve injury*

Topic: Tongue (AN39.1 and AN39.2)

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- Tongue - morphology, nerve supply, embryological basis of nerve supply, blood supply, lymphatic drainage and actions of extrinsic and intrinsic muscles
- Anatomical basis of hypoglossal nerve palsy*

Topic: Organs of hearing and equilibrium (AN40.1 to AN40.5)

- External ear - parts, blood supply and nerve supply
- Middle ear and auditory tube - boundaries, contents, relations and functional anatomy
- Features of internal ear*
  Anatomical basis of otitis externa and otitis media*
- Anatomical basis of myringotomy*

Topic: Eyeball (AN41.1 to AN41.3)

- Eyeball - parts and layers
- Anatomical aspects of cataract, glaucoma and central retinal artery occlusion*
- Intraocular muscles - position, nerve supply and actions*

Topic: Back region (AN42.1 to AN42.3)

- Contents of the vertebral canal
- Suboccipital triangle - boundaries and contents
- Semispinalis capitis and splenius capitis - position, direction of fibres, relations, nerve supply and actions*

Topic: Head and neck joints, histology, development, radiography and surface marking (AN43.1 to AN43.9)

- Atlantooccipital joint and atlantoaxial joint - movements with muscles producing them
- Microanatomy of pituitary gland, thyroid gland, parathyroid gland, tongue, salivary glands, tonsil, epiglottis, cornea and retina
- Microanatomy of olfactory epithelium, eyelid, lip, sclero-corneal junction, optic nerve, cochlea, organ of Corti and pineal gland*
- Development and developmental basis of congenital anomalies of face, palate, tongue, branchial apparatus, pituitary gland, thyroid gland and eye
- Testing of muscles of facial expression, extraocular muscles and muscles of mastication,
- Palpation of arteries - carotid, facial and superficial temporal arteries
- Location of - hyoid bone, thyroid cartilage and cricoid cartilage with their vertebral levels
- Surface marking - thyroid gland, parotid gland and duct, pterion, common carotid artery, internal jugular vein, subclavian vein, external jugular vein, facial artery in the face and accessory nerve
- Identify the anatomical structures in 1) Plain X-ray skull – AP and lateral view; 2) Plain Xray cervical spine - AP and lateral view; 3) Plain X-ray of paranasal sinuses

- Carotid and vertebral angiograms - anatomical route and anatomical structures*

J. NEUROANATOMY

Topic: Meninges and CSF (AN56.1 and AN56.2)

- Meninges - layers with their extent and modifications
- Circulation of CSF with its applied anatomy

Topic: Spinal cord (AN57.1 to AN57.5)

- Spinal cord - external features, extent in child and adult with its clinical implications Transverse section of spinal cord at mid-cervical and mid-thoracic level
- Ascending and descending tracts at mid thoracic level of spinal cord
- Anatomical basis of syringomyelia*

Topic: Medulla oblongata (AN58.1 to AN58.4)

- Medulla oblongata - external features
- Transverse section of medulla oblongata at the level of 1) pyramidal decussation; 2) sensory decussation; 3) inferior olivary nucleus
- Cranial nerve nuclei in medulla oblongata with their functional components • Anatomical basis and effects of medial and lateral medullary syndrome*

Topic: Pons (AN59.1 to AN59.3)

- Pons - external features
- Transverse section of pons at the upper and lower level
- Cranial nerve nuclei in pons with their functional components

Topic: Cerebellum (AN60.1 to AN60.3)

- Cerebellum - external and internal features
- Connections of cerebellar cortex and intracerebellar nuclei
- Anatomical basis of cerebellar dysfunction*

Topic: Midbrain (AN61.1 to AN61.3)

- Midbrain - external and internal features
- Internal features of midbrain at the level of superior and inferior colliculus
- Anatomical basis and effects of Benedikt's and Weber's syndrome*

Topic: Cranial nerve nuclei and cerebral hemispheres (AN62.1 to AN62.6)

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- Cranial nerve nuclei with their functional components
- Cerebral hemispheres – poles, surfaces, sulci, gyri and functional areas
- White matter of cerebrum
- Basal ganglia and limbic lobe - parts and major connections
- Dorsal thalamus, hypothalamus, epithalamus, metathalamus and subthalamus - boundaries, parts, gross relations, major nuclei and connections
- Circle of Willis - formation, branches and major areas of distribution

Topic: Ventricular system (AN63.1 and AN63.2)

- Lateral, 3rd and 4th and ventricles - parts, boundaries and features
- Anatomical basis of congenital hydrocephalus*

Topic: Histology and Embryology (AN64.1 to AN64.3)

- Microanatomical features of spinal cord, cerebellum and cerebrum
- Development of neural tube, spinal cord, medulla oblongata, pons, midbrain, cerebral hemispheres and cerebellum
  Various types of open neural tube defects with their embryological basis*

K. ETHICS IN ANATOMY – AN82.1

- Demonstrate respect and follow the correct procedure when handling cadavers and other biologic tissue.

Summary of time allotted, teaching and learning methods and student assessment

TIME ALLOTTED

Curricular component	Time allotted in hours
Lectures	220
Small group teaching / tutorials / integrated learning /practical	415
Self-directed learning	40
Early clinical exposure (basic science correlation and clinical skills)	30 (18 +12)
Total	**705**
AETCOM module 1.1 and 1.5	12 (8+4)

To be noted:

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- The number of hours mentioned above are **rough guidelines** that can be modified to suit the specific requirements of a medical college.
- It is recommended that **didactic teaching** be restricted to **less than one third of the total time** allotted for that discipline.
- **Greater emphasis** is to be laid on hands-on training, symposia, seminars, small group discussions, **problem-oriented** and problem-based discussions and **self-directed learning.**
- **Students** must be encouraged to take **active part in** and **shared responsibility** for their **learning.**

Suggested guidelines for the teaching and learning methods

Lectures

- All lectures to have **well defined specific learning objectives** which are linked to the relevant competencies. Learning objectives should be observable and assessable. Bloom's taxonomy can be used as a reference in choosing verbs for defining the learning objectives.
- The focus should be on the **must-know component** of the topic.
- As anatomy is a largely visually based subject appropriate pictures and videos can be utilized.
  The anatomical basis of **clinical conditions** pertaining to the topic to be addressed.

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- **Interactivity** needs to be built into the lecture by asking open ended questions, quizzes, incomplete handouts, creation of models, solving problems or a flipped classroom approach, to name a few methods.

Other methods

- **Team based learning** can be used in place of didactic lectures.
- **Case based learning** can be used for tutorials.
- **Seminars** and **assignments** will encourage active learning by the students.

Dissection

- All dissections to have **specific learning objectives** which are linked to the relevant competencies and are clinically relevant.
- The focus should be on **identifying** and how to identify important structures of the region being dissected.
- Students should be encouraged to **perform the dissections** using relevant resources like a good dissection manual and dissection videos, with faculty as facilitators.
- The dissection can be accompanied by relevant surface anatomy exercises, demonstration of suitable radiological images and analysis of joint movements.
- The students should be encouraged to observe the dissection of cadavers in neighboring tables so that they appreciate common anatomical variations.
- Each dissection can be accompanied by suitable **clinical case scenarios** which can be discussed at the end of the dissection to bring out its clinical relevance.
- Each dissection session is a good opportunity to reiterate the concepts of respect for the cadaver and **professionalism.**

Histology practical

- All histology sessions to have **specific learning objectives** which are linked to the relevant competencies and are clinically relevant.
- The focus should be **identifying** and how to identify important structures in the sections being viewed.
- Students should be encouraged to independently identify the salient features of the section with faculty as facilitators.
- Each session can be accompanied by suitable **clinical case scenarios** which can be discussed at the end of the session to bring out its clinical relevance.
- Each session is a good opportunity to reiterate the concept of **professionalism.**

Osteology

- All sessions to have **specific learning objectives** which are linked to the relevant competencies and are clinically relevant.
- The focus should be **identifying** important structures of the bone being studied, the joints formed by the bone and analysis of movements occurring at these joints.

- Students should be encouraged to independently identify the salient features of the bone being studied with faculty as facilitators.
- The session can be accompanied by the demonstration of suitable **radiological images.**
- Each session can be accompanied by suitable **clinical case scenarios** which can be discussed at the end of the session to bring out its clinical relevance.
- Each session is a good opportunity to reiterate the concept of **professionalism.**

INTEGRATION [Kindly refer section II for general guidelines on integration]

Suggested areas for integration

- **Physiology** ○ Structure and functions of a neuron and neuroglia ○ Nerve growth factor and other growth factors/cytokines ○ Different types of muscle fibres and their structure
    - Muscular dystrophy and myopathies ○ Structure and functions of digestive system
    - Functional anatomy of heart including chambers, heart sounds, pacemaker tissue and conducting system
    - Abnormal ECG, arrhythmias, heart block and myocardial infarction ○ Sex determination, sex differentiation and their abnormities, psychiatric and practical implications of sex determination
    - Organization of nervous system
    - Functions and properties of synapses, reflexes and receptors ○ Somatic sensations and sensory tracts
    - Motor tracts, mechanism of maintenance of tone, control of body movements, posture and equilibrium and vestibular apparatus
    - Structure and functions of reticular activating system and autonomic nervous system (ANS),
    - Spinal cord, its functions, lesions and sensory disturbances
    - Functions of cerebral cortex, basal ganglia, thalamus, hypothalamus, cerebellum and limbic system and their abnormalities
    - Correct clinical examination of the nervous system: higher functions, sensory system, motor system, reflexes, cranial nerves in a normal volunteer or simulated environment

- **Biochemistry** ○ Functions of the kidney, liver, thyroid and adrenal glands
    - Tests that are commonly done in clinical practice to assess the functions of kidney, liver, thyroid and adrenal glands
    - Abnormalities of kidney, liver, thyroid and adrenal glands

- **Pathology** ○ Etiology, pathogenesis, pathology, laboratory findings, distinguishing features progression and complications of acute and chronic pyelonephritis and reflux nephropathy
    - Types, etiology, pathogenesis, pathology and hormonal dependency of benign and malignant breast disease
    - Etiology, pathogenesis, pathology and iodine dependency of thyroid swellings ○ Etiology, pathogenesis, manifestations, laboratory and morphologic features of adrenal neoplasms
    - Etiology, pathogenesis, manifestations, radiologic and morphologic features and complications of osteomyelitis

- **Forensic Medicine** ○ Signs of intrauterine death, signs of live birth, viability of foetus, age determination of foetus, ossification centres, hydrostatic test, sudden infant death syndrome and Munchausen's syndrome by proxy
    - Corpus delicti, establishment of identity of living persons including race, sex, religion, complexion, stature, age determination using morphology, teeth eruption, decay, bite marks, bone ossification centres, medico-legal aspects of age

- **Anesthesiology** ○ Anatomy of the airway and its implications for general anaesthesia ○ Correlative anatomy of the brachial plexus, subarachnoid and epidural spaces ○ Principles and steps/ techniques involved in peripheral nerve blocks
    - Anatomical correlates and physiologic principles of pain

- **ENT**
    - Anatomy and physiology of ear, nose, throat, head & neck

- **Ophthalmology** ○ 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
    - Types and causes of corneal ulceration ○ Surgical anatomy and the metabolism of the lens
    - Aetiology, pathology, clinical features and management of vascular occlusions of the retina

- **Dentistry** ○ Parts of the tooth and supporting structures

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General medicine ○ Distinguish between community acquired pneumonia, nosocomial pneumonia and aspiration pneumonia

- ○ Demonstrate in a mannequin the correct technique for performing breast exam, rectal examination, cervical examination and Pap smear
- ○ Classification, presenting features, precipitating and relieving factors of various kinds of headache
- ○ Functional and the vascular anatomy of the brain ○ Functional anatomy of the locomotor system of the brain

Obstetrics and gynaecology ○ Development and anatomy of the female reproductive tract, relationship to other pelvic organs, applied anatomy as related to obstetrics and gynaecology

- ○ Basic embryology of fetus, factors influencing fetal growth and development, anatomy and physiology of placenta and teratogenesis
- ○ Diameters and types of maternal pelvis

General surgery ○ Etiology and classification of cleft lip and palate ○ Principles of reconstruction of cleft lip and palate ○ Applied anatomy and physiology of the thyroid gland ○ Applied anatomy of the parathyroid gland ○ Applied anatomy of the adrenal glands

- ○ Clinical features, principles of investigation, prognosis and management of pancreatitis
- ○ Applied anatomy and appropriate investigations for breast disease
- ○ Clinical features, investigations and principles of management of congenital anomalies of the genitourinary system
- ○ Applied anatomy and physiology of the esophagus ○ Applied anatomy and physiology of the stomach ○ Applied anatomy of the liver
- ○ Clinical features, investigations and principles of management of liver abscess, hydatid disease, injuries and tumors of the liver
- ○ Applied anatomy of the spleen
- ○ Clinical features, investigations, principles of management of splenic injuries and post-splenectomy sepsis prophylaxis
- ○ Applied anatomy of the biliary system
- ○ Clinical features, investigations and principles of management of diseases of the biliary system
- ○ Applied anatomy of the small and large intestines

- ○ Applied anatomy including congenital anomalies of the rectum and anal canal ○ Applied anatomy, clinical features, investigations and principles of management of undescended testis

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- Applied anatomy, clinical features, investigations and principles of management of epidydimo-orchitis
- Applied anatomy, clinical features, investigations and principles of management of varicocele
- Applied anatomy, clinical features, investigations and principles of management of hydrocele

Orthopaedics ○ Mechanism of Injury, clinical features, investigations and management of fracture of clavicle

- Mechanism of Injury, clinical features, investigations and management of fractures of proximal humerus
- Mechanism of Injury, clinical features, investigations and management of supracondylar fracture of humerus
- Mechanism of injury, clinical features, investigations and principles of management of fracture of shaft of humerus and intercondylar fracture of humerus with emphasis on possible neurovascular deficits
- Aetiopathogenesis, clinical features, mechanism of injury, investigations and principles of management of fractures of both bones of the forearm and Galeazzi and Monteggia injury
- Aetiopathogenesis, mechanism of injury, clinical features, investigations and principles of management of fractures of distal radius
- Aetiopathogenesis, mechanism of injury, clinical features, investigations and principles of management of pelvic injuries with emphasis on hemodynamic instability
- Aetiopathogenesis, mechanism of injury, clinical features, investigations and principles of management of spine injuries with emphasis on mobilization of the patient
- Mechanism of injury, clinical features, investigations and principle of management of acetabular fractures
- Aetiopathogenesis, mechanism of injury, clinical features, investigations and principles of management of fractures of proximal femur
- Aetiopathogenesis, mechanism of injury, clinical features, investigations and principles of management of fractures of (a) patella; (b) distal femur; (c) proximal tibia with special focus on neurovascular injury and compartment syndrome
- 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
- Aetiopathogenesis, clinical features, Investigation and principles of management

of fractures of bones of foot (a) both bones leg (b) calcaneus (c) small

- Aetiopathogenesis, clinical features, Investigation and principles of management of ankle fractures

- Investigations to diagnose complications of fractures like malunion, non-union, infection and compartmental syndrome
- Mechanism of injury, clinical features, investigations and principles of management of open fractures with focus on secondary infection prevention and management
- 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
- Clinical features, investigations and principles of management of congenital and acquired malformations and deformities of (a) spine - scoliosis and spinal bifida; (b) hip - congenital dislocation; (c) neck – torticollis; (d) foot - congenital talipes equino varus

- **Physical medicine and rehabilitation** o Causes of disability in patients with a cerebrovascular accident
  - Clinical features, types, evaluation, diagnosis and management of cerebral palsy

- **Paediatrics** o Genetic basis, risk factors, complications, prenatal diagnosis, management and genetic counselling in Down's Syndrome

EARLY CLINICAL EXPOSURE [Kindly refer section II for general guidelines]

SUGGESTED TOPICS AND DEPARTMENTS FOR ECE

General embryology and genetics

- Abnormal implantation - Obstetrics and Gynaecology
- The role of antenatal ultrasound examination - Radiology / Obstetrics and Gynaecology
- The role of teratogens in the causation of congenital anomalies - Pharmacology / Neonatology / Paediatrics
- Foetal diagnosis - Obstetrics and Gynaecology
- Genetic basis of common congenital malformations - Neonatology / Paediatric surgery
- Role of genetics in chronic non-communicable diseases – hypertension, diabetes mellitus, depression and schizophrenia - Medicine / Psychiatry
- Molecular diagnostic techniques - Clinical pathology / Genetics / Haematology / Medical oncology

Upper limb

- Nerve injuries of the median, ulnar and median nerves at different levels – Orthopaedics / Neurology
- Peripheral pulsations and their clinical importance – General surgery / Vascular surgery
- Concept of common fractures and dislocations – Orthopaedics

- Concept of growing end of the upper limb bones and their medicolegal importance – Orthopaedics / Forensic medicine
- Surgical approaches for orthopaedic surgery – Orthopaedics
- Testing muscles for tone, power, range of movement and reflexes – Physiology / Medicine / Neurology
- Basic concepts of skin and muscle flaps and their use in plastic surgery - Plastic surgery

Thorax

- The surgical importance of the mediastinum – General surgery / Chest medicine / Cardiothoracic surgery
- Ischaemic heart disease - Medicine / Cardiology / Cardiothoracic surgery / Physiology
- Congenital anomalies of the heart - Neonatology / Paediatric surgery
- Common radiological abnormalities on chest X rays - Radiology / General medicine
- Pleural effusion, pneumothorax, pleural tapping – General medicine / Chest medicine
- Tracheo-oesophageal fistula / role of surfactant in neonatal breathing - Neonatology / Paediatric surgery / Physiology

Abdomen and pelvis

- Anatomy of abdominal incisions, hydrocoele and inguinal hernia – General surgery
- Cross sectional Anatomy - X- Ray, CT, MRI, Ultrasound – Radiology
- Surgical anatomy of GI tract, liver and EHBA - Physiology / Biochemistry / General surgery / Radiology / Medical gastroenterology
- Surgical anatomy of the urogenital System - Physiology / Biochemistry / General surgery / Radiology / Urology / Nephrology
- Surgical anatomy of the pelvis - Physiology / Obstetrics and Gynaecology
- Applied anatomy of the lumbar spine - Orthopaedics

Lower limb

- Femoral hernia and its anatomical correlates – General surgery
- Nerve injuries and resultant gait abnormalities – Orthopaedics / General medicine / Neurology / Physiology
- Varicose veins and deep vein thrombosis – General surgery
- Elephantiasis – General surgery / Microbiology
- Peripheral pulsations and their clinical importance – General surgery / Vascular surgery
- Common fractures of the lower limb with a focus on fractures of the neck of the femur – Orthopaedics
- Common clinical conditions affecting the joints of the limbs with a focus on the knee joint - Orthopaedics

Head and neck

- Surgical anatomy of the thyroid gland – General surgery / Pathology
- Surgical anatomy of the salivary glands – General surgery / Pathology
- Lymphatic drainage of the head and neck and its applied importance – General surgery / ENT / Pathology
- Endoscopic anatomy of the paranasal air sinuses – ENT
- Surgical anatomy of the middle ear and mastoid cavity – ENT
- Surgical anatomy of the palatine and pharyngeal tonsils – ENT
- Anatomical basis of common eye diseases - Ophthalmology / Physiology
- Column concept for fractures – Orthopaedics

Neuroanatomy

- The blood supply of brain / cerebro-vascular accident – General medicine / Neurology
- Extradural, subdural and subarachnoid haemorrhage – Neurosurgery
- Brain tumours - Neurology / Neurosurgery
- Congenital anomalies of the brain - Neonatology / Paediatrics
- Ascending / descending tracts – Physiology / Neurology
- CSF and its clinical importance - Physiology / Neurology
- Parkinson's disease – Physiology / Neurology

AETCOM (Attitude **Et**hics and **Com**munication Skills)

Module 1.1

Background

It is important for new entrants to get a holistic view of their profession, its ups and downs, its responsibilities and its privileges. It is important to start this discussion early in their careers when their minds are still fresh with the thrill of joining medical school. Such a discussion will help them remember the big picture through the program and remind them why they have chosen to be doctors.

Competencies addressed

1. Enumerate and describe professional qualities and roles of a physician
2. Describe and discuss the commitment to lifelong learning as an important part of physician growth
3. Describe and discuss the role of a physician in health care system
4. Identify and discuss physician's role and responsibility to society and the community that she/ he serves

Hours: 8 (6 hours + 2 hours self-directed learning)

i. Exploratory session- 1 hour ii. Facilitated panel discussion – 2 hours iii. Self-directed

learning - 2 hours iv. Introductory visit to the hospital – 2 hours v. Discussion and closure of case - 1 hour

Contents of the session

1. An exploratory session with the students to find out (a) why they chose to become doctors, (b) what do they think are the privileges and the responsibilities of the profession, (c) what do they expect from society and what do they think society expects from them, and (d) what will they have to do and give up in order to meet their own and society's expectations. This is preferably done in a small group discussion.
2. A facilitated panel discussion involving doctors who are at different stages of their careers (senior, midlevel, young) during which these doctors share their experiences and also answer questions from the students.
3. Self-directed learning where students write a report from reflections based on sessions 1 & 2 and on other reading materials, TV series, movies etc. that they have chosen from the lay press about doctors' experiences.
4. Introductory visit to the hospital / community medical centres
5. A closure session with students to share their reflections based on 1, 2, 3 and 4 that includes their plans for the next 5 years in order to fulfill their professional and personal roles as doctors.
6. A coat ceremony in the Foundation Course may be considered. A white coat ceremony is held in many institutions, as a symbolic transition of the medical student prior to their first day of exposure to clinical teaching, in order to emphasize the importance of their new role as budding doctors.

Assessment

1. Formative: not required

2. Summative: not required

Resources

1. Whitcomb ME. What does it mean to be a physician? Acad Med.2007; 82: 917-8.
2. Eisenberg C. It is still a privilege to be a doctor? N Engl J Med 1986; 314:1113-1114.
3. Ofri D. Neuron overload and the juggling doctor. The Lancet 2010; 376: 1820 – 21. Module 1.5

Module 1.5

Background

Medical students enter college and their first encounter is with the cadaver, the memories of which last for a lifetime. Respect for the cadaver as a teacher translates later into respect for human beings as teachers and a lifelong respect for learning. Throughout the world, the emphasis on "humanizing" the cadaver as the first patient or first teacher has gained momentum.

Competency addressed

Demonstrate respect and follows the correct procedure when handling cadavers and other biologic tissues

Hours: 4 (2+2) hours

i. Opening session- 2 hours
ii. Closing session - 2 hours

Contents of session

1. An initial **introductory session** (large or small group) should be held on the importance of biologic tissues and cadavers in their learning. The discussion should focus on the fact that some of these cadavers were unclaimed, but also that many of them are were donated by families. It must be emphasized that respect for donor families, cadavers and tissues is important. The session should also include safe and clean handling and disposal of biologic tissues (2 hours).
2. A session at the **end of the phase** is a small group or large group discussion with reflective presentations by students on how the cadaver helped them to learn, their experience with dissection etc. These sessions should allow the students to display their creativity and may include prose, poetry, sketches etc. An example of such a project is found in the link below (2 hours).

Assessment

1. **Formative:** The student may be assessed based on their active participation in the sessions. The respect and the manner in which students handle biologic tissues throughout the phase may be part of the overall formative assessment of the student.
2. **Summative:** may not be required.

Resource: http://medicine.yale.edu/education/donation/reflections/ (An example of the project is found here).

SELF-DIRECTED LEARNING [Kindly refer section II for general guidelines]

Forty hours of dedicated time for SDL is provided for anatomy in the first phase.

Suggested guidelines for student assessment

Internal assessment [Kindly refer section II for general guidelines]

TABLE SHOWING SCHEME FOR CALCULATION OF INTERNAL EXAMINATION MARKS

Theory (maximum marks)		**Practical (maximum marks)**	
Theory papers	30 marks*	Gross anatomy, histology (25 marks) viva-voce (5 marks)	30 marks**
Professionalism	5 marks	Histology record	5 marks
Part completion tests	5 marks	Level of participation in early clinical exposure	5 marks
TOTAL	**40 marks**	**TOTAL**	**40 marks**

Please note:

- *Prior to submission to the University, the marks for each of the three internal examination theory assessments must be calculated out of 30 marks, regardless of the maximum marks.
- **Prior to submission to the University, the marks for each of the three internal examination practical assessments must be calculated out of 30 marks, regardless of the maximum marks.
- Only the final marks out of 40 needs to be submitted to the University, separately for theory and practical for each internal assessment.

- Internal assessment should be based on competencies and skills.
- Professionalism (punctuality, respect for teachers and the cadaver, communication with peers, timely completion and submission of record books and level of preparedness for classes) must be assessed and form a component of the marks given for internal assessment as shown in the table above.
- A suggested format for assessing professionalism is shown in ANNEXURE 1.
- A proportion of marks from part completion tests must be added to the internal assessment marks as shown in the table above.
- Histology records must be assessed and contribute to the internal assessment marks as shown in the table above.
- Level of participation in early clinical exposure must be assessed and contribute to the practical component as shown in the table above.

- A suggested format for assessing participation in ECE is shown in ANNEXURE 2 • The scheme for calculation of the internal examination marks is given the table above.
- A clear record of all components that add to the internal assessment marks needs to be maintained by the institution and retained by them for at least 5 years after completion of the examination. Institutions may be asked to provide these details by the University as and when required.
- The internal and formative assessments provide ideal opportunities for students and teachers to identify learning gaps. Teachers should provide high quality feedback to each student to enable them to bridge these learning gaps.
- A suggested format for providing feedback is shown in ANNEXURE 3.

UNIVERSITY EXAMINATIONS

TABLE SHOWING SCHEME FOR CALCULATION OF UNIVERSITY EXAMINATION MARKS

Theory (maximum marks)		**Practical (maximum marks)**	
Paper 1	100 marks	**Gross anatomy** i. Spotters (10X2) ii. Window discussion 1 (above diaphragm) iii. Window discussion 2 (below diaphragm) **Total**	 20 marks 15 marks 15 marks **50 marks**
Paper 2	100 marks	**Histology** i. Spotters (10X1) ii. Slide discussion 1 (general histology) iii. Slide discussion 2 (systemic histology) **Total**	 10 marks 10 marks 10 marks **30 marks**
TOTAL	**200 marks**	**Viva-voce** i. Osteology ii. Surface marking iii. Radiological anatomy iv. Embryology **Total**	 05 marks 05 marks 05 marks 05 marks **20 marks**
		TOTAL	**100 marks**

- 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.
- Nature of questions will include different types such as structured essays, modified essays (case based), short essays and short answers questions.

- The objective will be to assess proficiency and skills to identify key structures (on cadavers, dry bones, histology slides and genetics charts, radiographs and embryology models), demonstrate surface marking and movements at joints, with functional and clinical correlations.
- **Viva/oral examination** should assess the student's ability to explain key concepts with functional and clinical correlates related to osteology, embryology, surface marking and radiological anatomy.
- **The marks obtained in the viva examination will be added to the practical 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.**
- The student **must secure a minimum of 50% of marks in aggregate in the viva and practical examination** (both combined) to pass.
- 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.

Theory

Preparation of question papers

- All the question papers to follow the suggested **blueprint (ANNEXURE 4).**
- The marks allotted to a particular topic are to be strictly adhered to.
- **A minimum of 35% marks shall be allocated to assess the higher order thinking skills of the student.**
- All the different types of structures given in the blueprint (eg. arteries, veins, nerves etc) are to be compulsorily covered in each question paper.
- Systemic histology and systemic embryology are **NOT TO BE COVERED** in paper 1.
- The question paper layout give below must be strictly adhered to **(ANNEXURE 5).** Both paper 1 and paper 2 have **TWO POSSIBLE LAYOUTS**, either of which may be followed based on the paper setters' preference.
- Please note that only **core competencie**s (list provided in the MCI document) are to be assessed in the university examinations.
- All questions to contain **appropriate verbs** as shown in the example **(ANNEXURE 6).**
- **One short essay question (5 marks)** and **one short answer question (3 marks)** to be of the **modified variety** containing a clinical case scenario or requiring an **explanation of a concept** or the **drawing** of a diagram **(ANNEXURE 7)**. This question can be **from any component** (general anatomy, histology, embryology, genetics, gross anatomy and neuroanatomy) of the curriculum.
- The questions related to **general** and **systemic histology** must be of a **higher level** than simply drawing and describing a histology slide, as this will anyway be covered in the practical component.

Practical Gross anatomy

- There will be **10 spotters each of two marks** and **two window discussions for 15 marks each**.
- The spotters should be from the **following regions:**
  - Neuroanatomy – 1
  - Head and neck – 2
  - Thorax – 2
  - Upper limb – 1 - Abdomen – 2
  - Lower limb – 1
  - Pelvis – 1
- There will be a **subdivision** of the spotters as follows:
  - Artery - 1 - Vein – 1
  - Nerve – 1
  - Muscle – 1
  - Connective tissue structure - 1
  - Bone – 1
  - Organ – 1
  - Cross section - 1
  - Picture based clinical cases (eg. Erb's palsy, foot drop etc.) - 2
- The **window discussions** will be one from the above diaphragm structures and one from the below diaphragm structures. It is advised that musculo-skeletal **window discussions** be combined with organs. A combination of two musculo-skeletal structures or two organs is to be avoided.
- For the **window discussions**, the students should first be asked to identify key structures, questioned further on these structures and then asked about important clinical applications.
- The **marking scheme** for **window discussions** could be as follows: - Identifies key structures – maximum 6 marks
  - Answers questions related to these structures – maximum 6 marks
  - Clinical applications – maximum 3 marks

Histology

- There will be **10 spotters each of one mark** and **two slide discussions for 10 marks each**.
- Of the **10 spotters**, **four** must be from **general histology**, **five** from **systemic histology** and **one genetics chart**.
- The suggested **list** of **histology slides** is shown in **ANNEXURE 8.**
- For the **slide discussion**, **one slide** must be from **general histology** and **one** from **systemic histology**.
- For the **slide discussion**, the students should first be asked to identify and draw the slide with suitable justification, demonstrate key structures in a section, questioned further on these structures and then asked about important clinical/functional applications.

- If the student does not identify the slide correctly at first, he or she should be given another chance.
- The **marking scheme** for each slide for the slide discussion could be as follows:
  - Draws and identifies the slide correctly with justification – maximum 3 marks
  - Demonstrates key structures – maximum 3 marks
  - Answers questions related to these structures – maximum 3 marks
  - Clinical/functional applications – maximum 1 mark
- The **histology record books** duly signed by the Head of the Department must be submitted during the examination and verified by the external examiner.

Viva voce

- The **four viva-voce stations** will be **radiological anatomy, embryology, osteology and surface marking**, each carrying **05 marks**.
- Though the questions may be different for each student, **the pattern of questioning must be similar**. This could be ensured by utilizing previously prepared **viva cards**.
- In addition to plain and contrast X-rays, cross sectional anatomy (either gross or relevant CT and MRI images) may be assessed in the **radiological anatomy station**.

Students must be assessed using **relevant embryology models and charts** in the **embryology station**.

In the **osteology station**, questions related to bone **articulations with movements** are to be included.

For **surface marking**, the students must perform surface marking and subsequently state the clinical importance of the surface marking. These structures must be restricted to those mentioned in the curriculum. Five marks are allotted for surface marking (maximum of 4 marks for the surface marking plus 1 mark for the clinical importance). This should be conducted in the form of an OSPE (either on a cadaver or volunteer) with a standard checklist to be prepared on the day of the examination by the examiners.

For the other viva topics students should first be asked to identify basic structures, questioned further on these structures and then asked about important clinical applications.

The **marking scheme** could be as follows:

- Identifies the structures (the side and anatomical position if applicable) – maximum 2 marks
- Answers questions related to these structures – maximum 2 marks
- Clinical applications – maximum 1 mark

A **list of suggested topics** for radiological anatomy, surface marking, cross-sectional anatomy and muscle testing is shown in **ANNEXURE 9**.

ANNEXURE 1

Suggested format for assessing professionalism

– 4	Quarter	Overall attendance (5)	Timely submission of record books (5)	Takes the trouble to complete the record book well (5)	Behaves respectfully with peers and teachers (5)	Total (20)	Date	Signature of student	Signature of mentor
	1st								
	2nd								
	3rd								

ıidelines for scoring (to be shown to the student and discussed with them)

tendance – 95-100% - 5; 90-94% - 4; 85-89% - 3; 80-84% - 2;

mely submission of records – Always submits the record on time – 5; Often submits the record on time ; Sometimes submits the record on time – 3; Rarely submits the record on time – 2;

kes the trouble to complete the record well – Diagrams are neatly drawn with complete labelling – 5; agrams are of above average quality with nearly complete labelling – 4; Diagrams are of average quality th partial labelling- 3; Diagrams are of below average quality with inadequate labelling – 2;

haves respectfully with peers and teachers – Always speaks politely and demonstrates the appropriate dy language with peers and teachers – 5; Often speaks politely and demonstrates the appropriate body ıguage with peers and teachers – 4; Sometimes speaks politely and demonstrates the appropriate body ıguage with peers and teachers – 3; Rarely speaks politely and demonstrates the appropriate body ıguage with peers and teachers – 2;

ANNEXURE 2

Suggested format for assessing participation in ECE sessions

Name:……

Date:……

ECE session……

1 = strongly agree. 2 = agree. 3 = no preference. 4 = disagree. 5 = strongly disagree.						
Critical appraisal		**1**	**2**	**3**	**4**	**5**
1	Clarifies, defines and analyses the problem from the scenario / interaction with patient					
2	Identifies learning objectives					

3	Demonstrates initiative and curiosity					
Utilization of learning resources						
4	Utilizes relevant resource materials effectively					
5	Applies knowledge to new situations to solve problems and to reach decisions					
Group work						
6	Organized and prepared for small group sessions					
7	Shares thoughts and opinions with peers actively					
Attitudes and Communication Skills						
8	The oral expression is clear enough to be understood					
9	Provides and accepts constructive feedback					
10	Contributes to group harmony (listens to conflicting opinions and tolerates shortcomings of others)					

Comment:

To describe the strengths and suggested areas for improvement of the reviewed student and to assist him/her to be a more effective learner.

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			
1.	Test 1						
2.	1st Internal Examination						
	Theory						
	Practical						
3.	Overall 1st quarter marks						
4.	Test 2						
5.	2nd Internal Examination						
	Theory						
	Practical						
6.	Overall 2nd quarter marks						
7.	Test 3						
8.	3rd Internal Examination						
	Theory						
	Practical						
9.	Overall 3rd quarter marks						

ANNEXURE 4

Blueprint for the anatomy theory examinations Paper 1

TOPIC	Arteries	Veins	Nerves	Muscles	Space	Bones	Joints	Connective tissue	Organs	Others	Marks
General anatomy											6
General histology											5
General embryology											8
Upper limb											18
Thorax (including diaphragm)											21
Head and neck											29
Neuroanatomy											13
TOTAL											100

Paper 2

	Arteries	Veins	Nerves	Muscles	Space	Bones	Joints	Connective tissue	Organs	Others	Marks
Systemic histology											11
Systemic embryology											11
Genetics											8
Lower limb											18
Abdomen											31

ANNEXURE 5

Pelvis											**21**
TOTAL											**100**

Question paper layouts for theory examinations

PAPER 1

Version 1

Long Essay: **2X 10 = 20**

1	Upper limb
2	Head and neck

Short Essays: **5x 10 = 50**

3	Upper limb
4	Thorax including diaphragm
5	Thorax including diaphragm
6	Thorax including diaphragm
7	Head and neck
8	Head and neck
9	Neuroanatomy
10	Neuroanatomy
11	General embryology
12	General histology

Short Answers: **3X10 = 30**

13	Upper limb
14	Thorax including diaphragm
15	Thorax including diaphragm
16	Head and neck
17	Head and neck
18	Head and neck
19	Neuroanatomy
20	General anatomy
21	General anatomy

22	General embryology

ANNEXURE 5

Question paper layouts for theory examinations

PAPER 1

Version 2

Long Essay: **2X 10 = 20**

1	Thorax including diaphragm
2	Head and neck

Short Essays: **5x 10 = 50**

3	Upper limb
4	Upper limb
5	Upper limb
6	Thorax including diaphragm
7	Head and neck
8	Head and neck
9	Neuroanatomy
10	Neuroanatomy
11	General embryology
12	General histology

Short Answers: **3X10 = 30**

13	Upper limb
14	Thorax including diaphragm
15	Thorax including diaphragm
16	Head and neck
17	Head and neck
18	Head and neck
19	Neuroanatomy
20	General anatomy
21	General anatomy
22	General embryology

ANNEXURE 5

Question paper layouts for theory examinations

PAPER 2

Version 1

Long Essay: **2 X 10 = 20**

1	Lower limb
2	Abdomen

Short Essays: **5 X 10 = 50**

3	Lower limb
4	Abdomen
5	Abdomen
6	Abdomen
7	Pelvis
8	Pelvis
9	Pelvis
10	Genetics
11	Systemic histology
12	Systemic embryology

Short Answers: **3 X 10 = 30**

13	Lower limb
14	Abdomen
15	Abdomen
16	Pelvis
17	Pelvis

ANNEXURE 5

18	Genetics
19	Systemic histology
20	Systemic histology
21	Systemic embryology
22	Systemic embryology

Question paper layouts for theory examinations

PAPER 2

Version 2

Long Essay: **2X 10 = 20**

1	Lower limb
2	Pelvis

Short Essays: **5 X 10 = 50**

3	Lower limb
4	Abdomen
5	Abdomen
6	Abdomen
7	Abdomen
8	Abdomen
9	Pelvis
10	Genetics
11	Systemic histology
12	Systemic embryology

Short Answers: **3 X 10 = 30**

13	Lower limb
14	Abdomen

ANNEXURE 5

15	Abdomen
16	Pelvis
17	Pelvis
18	Genetics
19	Systemic histology
20	Systemic histology
21	Systemic embryology
22	Systemic embryology

ANNEXURE 6

Example of a question paper

Paper 2

Time: 3 hours **Marks: 100**

Your answers should be specific to the questions asked.

Draw neat labelled diagrams (with conventional colours) wherever necessary.

Long essays (2 X 10 = 20 marks)

1) Describe the knee joint under the following headings: a) Bones forming; b) Ligaments; c) Movements with muscles causing them; Nerve supply; d) Applied aspects. (1+3+3+1+2)
2) Describe the stomach under the following headings: a) Location; b) Parts; c) Relations; d) Blood supply; e) Lymphatic drainage; f) Applied aspects. (1+1+3+2+2+1)

Short essays (10 X 5 = 50 marks)

3) Explain the course, relations and distribution of the common peroneal nerve. At which site is the nerve commonly injured and why? Explain the anatomical basis of the clinical features observed as a result of such an injury. (3+1+1)
4) Describe the mechanism, location and applied importance of porta-caval anastomoses. (1+2+2)
5) Describe the gross anatomy and applied importance of the vermiform appendix. (3.5+1.5)
6) Explain the protective mechanisms of the inguinal canal that prevent the occurrence of inguinal hernia.
7) Describe the lobes, relations and applied anatomy of the prostate gland. (2+2+1)
8) Describe the boundaries, contents and applied aspects of the ischiorectal fossa. (2+2+1)
9) Describe the supports of the uterus and their applied importance. (4+1)
10) What is Down syndrome? Explain the genetic mechanism underlying it. (2+3) 11) Correlate the structure and function of the juxta-glomerular apparatus.
12) Explain the mechanism of midgut rotation during development and its consequences.

Short answers (10 X 3 = 30 marks)

13) What is Trendelenburg gait? Explain its anatomical basis. (2+1)
14) A man sustained severe trauma to the lower chest wall on the left side in a road traffic accident. He was taken to the emergency department where he was found to have a fracture of the 9th and 10 ribs and a ruptured spleen. Explain the probable mechanism by which splenic rupture might have occurred.
15) Name the attachments and contents of the lesser omentum. (1.5+1.5)
16) Name the attachments and contents of the broad ligament of the uterus. (1.5+1.5) 17) Describe briefly the gross anatomy of the perineal body and its applied importance. (2+1) 18) Draw a typical pedigree chart showing sex-linked recessive inheritance.
19) Draw a neat, labelled diagram (high-power view) of a haematoxylin and eosin stained section of a pancreatic acinus.
20) Compare and contrast the histology of the duodenum, jejunum and ileum.
21) Enumerate the derivatives of the paramesonephric duct.
22) Enumerate the derivatives of the 2nd pharyngeal arch.

ANNEXURE 7

Examples of questions assessing higher cognitive levels

Short essays (5 marks)

1. Explain the course, relations and distribution of the common peroneal nerve. At which site is the nerve commonly injured and why? Explain the anatomical basis of the clinical features observed as a result of such an injury. (3+1+1)
2. A 50-year-old man suffered a myocardial infarction as a result of thrombosis of the left anterior descending artery and collapsed. Cardiopulmonary resuscitation was performed as an emergency measure. Explain the anatomical basis of the chest compression technique. Describe the structures that can possibly be affected as a result of such a blockage. Where would the pain in this patient be felt and why? (1+2+2)
3. A 30-year-old lady developed right sided pleural effusion secondary to pulmonary tuberculosis. The treating physician decided to do a pleural tap in this patient. Where in the pleural cavity would fluid have initially collected and why? Describe the structures that the needle has to pass through to reach the pleural cavity. What is the ideal location to introduce the needle and why? (1+3+1)

Short answers (3 marks)

1. Compare and contrast the microstructure of a mucous and serous acinus.
2. Explain the mechanism of closure of the foramen ovale of the heart.
3. Explain the mechanism of locking and unlocking of the knee joint.
4. Draw a neat, labelled diagram to show the boundaries and subdivisions of the mediastinum. (1.5+1.5)
5. Explain the role of the soleus muscle in promoting venous return from the lower limb.

ANNEXURE 8

List of histology slides

General histology	Systemic histology

1. Epithelial tissue	1. Breast	38. Eyelid*
2. Connective tissue	2. Lung	39. Eyeball*
3. Serous salivary gland	3. Trachea	40. Cornea
4. Mucous salivary gland	4. Oesophagus	41. Optic nerve*
5. Mixed salivary gland	5. Stomach fundus	42. Retina
6. Hyaline cartilage	6. Stomach pylorus	43. Sclero-corneal junction*
7. White fibrocartilage	7. Duodenum	44. Cochlea*
8. Elastic cartilage	8. Jejunum	45. Organ of Corti*
9. TS of compact bone	9. Ileum	46. Spinal cord
10. LS of compact bone	10. Large intestine	47. Cerebellum
11. TS of skeletal muscle	11. Appendix	48. Cerebrum
12. LS of Skeletal muscle	12. Liver	
13. Cardiac muscle	13. Gall bladder	
14. Large artery	14. Pancreas	
15. Large vein	15. Kidney	
16. Medium sized artery	16. Ureter	
17. Medium sized vein	17. Urinary bladder	
18. Lymph node	18. Testis	
19. Thymus	19. Epididymis	
20. Palatine Tonsil	20. Vas deferens	
21. Spleen	21. Prostate	
22. Peripheral nerve TS	22. Penis	
23. Peripheral nerve LS	23. Ovary	
24. Sensory ganglia	24. Fallopian tube	
25. Autonomic ganglia	25. Uterus	
26. Thick skin	26. Cervix	
27. Thin skin	27. Placenta	
	28. Umbilical cord	
	29. Lip*	
	30. Tongue	
	31. Epiglottis	
	32. Olfactory epithelium*	
	33. Pituitary gland	
	34. Thyroid	
	35. Parathyroid gland	
	36. Adrenal gland	
	37. Pineal gland*	

*** Please note** that the slides marked with an asterisk are **non-core competencies.**

ANNEXURE 9

List of surface marking / muscle testing / radiological anatomy / cross sections

UPPER LIMB					
Arteries (palpation)	**Veins**	**Nerves**	**Connective tissue/other**	**Testing of muscles**	**Radiological anatomy**
1. Axillary artery	1. Basilic vein	1. Axillary Nerve	1. Flexor retinaculum	1. Trapezius	AP and lateral view of radiographs of
2. Brachial Artery	2. Cephalic vein	2. Radial Nerve		2. Pectoralis major	1. Shoulder region
3. Radial Artery	3. Median cubital vein	3. Ulnar Nerve		3. Serratus anterior	2. Arm
4. Ulnar artery		4. Median Nerve		4. Latissimus dorsi	3. Elbow
5. Superficial palmar arch				5. Deltoid	4. Forearm
6. Deep palmar arch				6. Biceps brachii	5. Hand
				7. Brachioradialis	
LOWER LIMB					
1. Femoral artery	1. Great saphenous vein	1. Femoral nerve	1. Saphenous opening	1. Gluteus maximus	AP and lateral view of radiographs of
2. Popliteal artery	2. Small saphenous vein	2. Sciatic nerve	2. Midinguinal point	2. Gluteus medius and minimus	1. Hip
3. Posterior tibial artery		3. Common peroneal nerve		3. Hamstring muscles	2. Knee
4. Dorsalis pedis		4. Deep peroneal nerve		4. Quadriceps femoris	3. Ankle
				5. Dorsiflexors of ankle	4. Foot
				6. Plantar flexors of ankle	
				7. Muscles causing inversion and eversion	

ANNEXURE 9

List of surface marking / muscle testing / radiological anatomy / cross sections

THORAX	
1. Lines of pleural reflections 2. Lung borders and fissures 3. Trachea 4. Heart borders 5. Apex beat 6. Surface projections of valves of heart	1. Plain X ray chest PA view

HEAD AND NECK					
Arteries	**Veins**	**Nerve**	**Gland /other**	**On simulation**	**Radiological anatomy**
1. Common carotid artery	1. Internal jugular vein	1. Accessory nerve	1. Thyroid gland	1. Testing of muscles of facial expression	1. Plain X-ray skull - AP and lateral view
2. Facial artery in the face	2. Subclavian vein		2. Parotid gland and duct	2. Extraocular muscles	2. Plain X-ray cervical spine - AP and lateral view
	3. External jugular vein		3. Pterion	3. Muscles of mastication	3. Plain X-ray paranasal sinuses
				4. Palpation of carotid arteries	
				5. Facial artery	
				6. Superficial temporal artery	
				7. Location of internal and external jugular vein	
				8. Location of hyoid bone, thyroid cartilage, cricoid cartilage with their vertebral level	

ANNEXURE 9

List of surface marking / muscle testing / radiological anatomy / cross sections

ABDOMEN & PELVIS			
Surface marking of	**Surface projection of**	**Sectional Anatomy**	**Radiological anatomy**
1. Regions and planes of abdomen	1. Stomach	1. Cross section at the level of T8, T10, L1 (transpyloric plane)	1. Plain x ray of abdomen
2. Superficial inguinal ring	2. Liver	2. Mid sagittal section of male and female pelvis	2. X ray barium swallow
3. Deep inguinal ring	3. Fundus of gall bladder		3. Barium meal
4. McBurney's point	4. Spleen		4. Barium enema
5. Renal angle	5. Duodenum		5. Cholecystography
6. Murphy's point	6. Pancreas		6. Intravenous pyelography
	7. Ileo-caecal junction		7. Hysterosalpingography
	8. Kidneys		
	9. Root of mesentery		

LIST OF RECOMMENDED BOOKS

General anatomy

- Handbook of General Anatomy, BD Chaurasia / General Anatomy, Vishram Singh

Histology

- diFiore's Atlas of Human Histology with Functional Correlation, Victor P Eroschenko / Wheater's Functional Histology: A Text and Colour Atlas
- Textbook of Human Histology with colour Atlas, Inderbir Singh / Textbook of Histology and Practical Guide, Gunasegaran / Histology: Text and Atlas, Brijesh Kumar

Embryology

- Textbook of Human Embryology, Inderbir Singh / Langman's's textbook of Medical Embryology, TW Sadler

Human genetics

- Human Genetics, SD Gangane / Medical Genetics, GP Pal / Emery's Elements of Human Genetics, Peter Turnpenny and Sian Ellard

Gross anatomy including neuroanatomy

- Cunningham's Manual of Practical Anatomy Volumes I,II and III
- BD Chaurasia's / Dutta's / Vishram Singh's Textbook of Anatomy – all volumes
- Grant's atlas / McMinn's atlas / Netter's atlas
- Clinically Oriented Anatomy, K L Moore / Clinical Anatomy by Regions, Richard Snell / Clinical Anatomy (A Problem Solving Approach) (2 volumes), Neeta Kulkarni
- Gray's Anatomy for Students, South Asia Edition
- Clinical Neuroanatomy, Richard Snell / Textbook of Neuroanatomy, IB Singh / Textbook of Clinical Neuroanatomy, Vishram Singh

Surface and radiological anatomy

- Surface and radiological anatomy, A Halim / Surface and radiological anatomy, Ashwini Appaji and Roopa Kulkarni

Others

- Stedman's Medical Dictionary
- Gray's Anatomy - The Anatomical Basis of Clinical Practice

Please note: It is suggested that students use the latest editions of the above books.

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. Knowledge:

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 wellcoordinated 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**. Skills**

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. Attitude and communication skills:

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.

List of systems included in Physiology:

- General Physiology
- Hematology
- Nerve-Muscle Physiology
- Gastro-Intestinal Physiology
- Cardiovascular physiology
- Respiratory physiology
- Renal Physiology
- Endocrine Physiology
- Reproductive Physiology
- Neurophysiology (Central Nervous System and Special Senses) • Integrated Physiology

Physiology Syllabus

THEORY

General Physiology (PY 1.1-1.9) (8 hrs)

Structure and functions of a mammalian cell**;** Homeostasis, Intercellular communication**;** Apoptosis; Transport mechanisms across cell membranes; Fluid compartments of the body; pH & Buffer systems in the body; Evaluation of functions of the cells and products in clinical care and research.

Hematology: (PY 2.1 - 2.13) (16 hrs)

Components of blood: formation, regulation and functions; plasma proteins – origin, types, variations and functions; Hemoglobin- synthesis, variants, functions and its breakdown & Jaundice; Blood indices; Anemia and its classification; Hemostasis: mechanism, regulation & disorders Anticoagulants; Blood groups, blood banking and transfusion; Immunity: types, mechanism & regulation; ESR; Lymph-composition, circulation and functions

Nerve & Muscle Physiology: (PY 3.1 - 3.18) (10hrs)

Neuron and neuroglia: structures, types, functions; Resting membrane potential; Action potential in nerve, skeletal & smooth muscle; Nerve fibres: classification, functions & properties; nerve injuries, degeneration and regeneration in peripheral nerve; Neuromuscular junction: structure, transmission of impulses, neuro-muscular blocking agents, Myasthenia gravis; Muscle fibres: structure, types & functions; Muscle contraction; molecular basis (skeletal, smooth), Isotonic Vs. Isometric, Energy sources and metabolism, gradation of muscle activity; muscle dystrophy, Myopathies; Strength-duration curve

Gastrointestinal Physiology: (PY 4.1 - 4.10) (10hrs)

Functional anatomy and broad functions of digestive system, enteric nervous system; GI Secretions- composition, mechanism of secretion, functions, and regulation of saliva, gastric, pancreatic, intestinal juices and bile secretion; GI movements- types, regulation, functions, reflexes; role of dietary fibres; Digestion and absorption of nutrients; GI hormones- source, regulation, functions; Gut-brain axis; structure and functions of liver and gall bladder; gastric function tests, pancreatic exocrine function tests & liver function tests, Pathophysiology - Achalasia cardia, peptic ulcer, gastro oesophageal reflux disease, vomiting, diarrhoea, constipation, Adynamic ileus, Hirschsprung's disease.

Cardiovascular Physiology: (PY 5.1 - 5.16) (25hrs)

Functional anatomy of heart; Pacemaker tissue and conducting system-generation, conduction of cardiac impulse; Properties of cardiac muscle; Cardiac cycle; ECG- recording, normal ECG, uses, cardiac axis, Abnormal ECG in common arrhythmias, changes with hypertrophy & MI; Haemodynamics; Heart rate- factors affecting, regulation; Cardiac output- factors, regulation, measurement; Blood pressure- components, determinants, factors, regulation and applied aspect, Regional circulation- autoregulation, microcirculation, lymphatic circulation, coronary, cerebral, capillary, skin, fetal, pulmonary and splanchnic circulation; Pathophysiology- shock, syncope, heart failure & coronary artery disease

Respiratory Physiology: (PY 6.1-6.10) (12hrs)

Functional anatomy of respiratory tract, dead space; Mechanics of respiration; Pressure volume changes during ventilation; Lung volume and capacities; Alveolar surface tension; Compliance; Airway resistance; alveolar ventilation, V/P ratio; Diffusion capacity of lungs; Transport of respiratory gases- Oxygen and Carbon dioxide; Neural and chemical regulation of respiration; Physiology of high altitude and deep sea diving; Principles of artificial respiration, oxygen

therapy; Patho-physiology of dyspnoea, hypoxia, cyanosis, asphyxia, drowning, periodic breathing; Lung function tests & its clinical significance

Renal Physiology: (PY 7.1 - 7.9) (10hrs)

Structure and functions of kidney & juxta glomerular apparatus, role of renin-angiotensin system ; Renal blood flow; Mechanism of urine formation, concentration and diluting mechanism; Concept and significance of 'clearance' tests; Renal regulation of fluid and electrolytes & acidbase balance; Structure and innervation of urinary bladder, physiology of micturition, cystometry, and its abnormalities; Artificial kidney(dialysis) and renal transplantation; Renal Function Tests

Endocrine Physiology: (PY 8.1 - 8.6) (16 hrs)

Mechanism of action of steroid, protein and amine hormones; 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; Physiology of bone and calcium metabolism; Physiology of growth; Physiology of Thymus & Pineal Gland; Hormone function tests ; Obesity & metabolic syndrome; Stress response

Reproductive Physiology: (PY 9.1 - 9.12) (10hrs)

Sex determination; sex differentiation and their abnormalities; Puberty: onset, progression, stages; early and delayed puberty; Male reproductive system: functions of testis, spermatogenesis and its regulation, Cryptorchidism ; Female reproductive system: functions of ovary and its control, menstrual cycle: Hormonal, uterine and ovarian changes; Tests for ovulation; Physiological effects of sex hormones; Contraceptive methods for male and female; Effects of removal of gonads on physiological functions; Physiology of pregnancy, fetoplacental unit, pregnancy tests, parturition & lactation; Semen analysis; Causes and principles of management of infertility; Hormonal changes and their effects during perimenopause and menopause; Psychological and psychiatric disturbances associated with reproductive physiology.

Neurophysiology: (PY 10.1 - 10.20) (37 hrs) Organization of nervous system; Sensory system: types, functions and properties of synapse, receptors, reflex; Somatic sensations & sensory tracts; Physiology of pain; Motor system: organization, motor tracts, mechanism of maintenance of tone, control of voluntary movements ; Posture and equilibrium & vestibular apparatus; Reticular activating system, Autonomic nervous system ; Spinal cord: functional organization and lesions ; Formation, circulation and function of CSF; Blood brain barrier; Neurotransmitters.

Organization, connections and functions of cerebral cortex, basal ganglia, thalamus, hypothalamus, cerebellum and limbic system and their abnormalities; Higher mental functions ; Physiology of sleep, memory, learning and speech and their disorders; EEG.

Special senses- Smell and taste sensation and their abnormalities; Functional anatomy of ear and auditory pathways & physiology of hearing, Deafness, hearing tests; Functional anatomy of eye,

Image formation, Visual pathway and its lesions, Physiology of vision including acuity of vision, colour vision, field of vision, refractive errors, physiology of pupil; light reflex, accommodation reflex, dark and light adaptation; Auditory & visual evoked potentials

Integrated Physiology: (PY 11.1 - 11.14) (6 hrs)

Temperature regulation: mechanism, adaptation to altered temperature (heat and cold environment), mechanism of fever, cold injuries and heat stroke; Exercise- cardio-respiratory and metabolic adjustments during exercise (isotonic and isometric), exercise in heat and cold, physical training effects; Physiological consequences of sedentary lifestyle; Brain death; Physiology of Infancy*; Physiology of aging-free radicals and antioxidants*; Physiology of meditation*.

(* 'Non-core' competencies as per "Competency based Undergraduate Curriculum for the Indian Medical Graduate 2018: Medical Council of India").

PRACTICAL

The following list of practical is minimum and essential. Additional exercises can be included as and when feasible and required. All the practicals have been categorized as '**Procedures to be performed'** and '**Demonstrations'.** The procedures are to be performed by the students during practical classes to acquire skills. These would be included in the practical during University examination. Those categorized as 'Demonstrations' are to be shown to students during practical classes. Questions based on these would be given in the form of data, charts, graphs, problems and case histories for interpretation by students during university examination.

I.<u>Procedures to be performed by the students:</u>

a. **Haematology:**

1. RBC count
2. WBC Count
3. Differential Leucocyte Count
4. Estimation of haemoglobin
5. Blood grouping
6. Bleeding time
7. Clotting time
8. Calculate RBC indices - MCV, MCH, MCHC.

b. **Procedures to be performed on human subjects:**

1. Mosso's ergography.
2. Recording of Blood Pressure, pulse rate at rest and effect of posture.
3. Effect of mild and moderate exercise on blood pressure, pulse rate and respiratory rate using Harvard step test.
4. Record and interpret Lead II ECG. Given a normal ECG, determine cardiac axis.
5. Spirometry – Lung volumes and capacities, MVV, Timed vital capacity.

6. Peak Expiratory Flow Rate
7. Demonstrate Basic Life Support in a simulated environment
8. Visual field by Perimetry

c. **Clinical Examination:**

1. Components of history taking and general physical examination
2. Examination of radial pulse
3. Examination of Cardiovascular system
4. Examination of Respiratory system
5. Examination of abdomen
6. Examination of Higher mental functions
7. Examination of Sensory system
8. Examination of Motor system including reflexes.
9. Examination of Cranial Nerves

II. <u>Demonstrations:</u>

I.Haematology:

1. Erythrocyte sedimentation rate
2. Haematocrit
3. Reticulocyte count
4. Platelet count
5. Osmotic fragility

2. Record Arterial pulse tracing using finger plethysmography*
3. Stethography
4. Tests of cardiovascular autonomic functions*

(* 'Non-core' competencies as per "Competency based Undergraduate Curriculum for the Indian Medical Graduate 2018: Medical Council of India")

III. Interpretation- charts: clinical case histories, graphs, charts, problems

(Suggested topics for preparation of these are given under **ANNEXURE I**. However, many more could be developed which is under discretion of each institution)

Chart also includes - Interpret growth chart*, Interpret anthropometric assessment of infants*: (*these two charts are 'Non-core' competencies as per "Competency based Undergraduate Curriculum for the Indian Medical Graduate 2018: Medical Council of India")

IV. Computer assisted learning:

(i) **Amphibian nerve - muscle experiments and interpretation of graphs** <u>List of graphs on nerve-muscle experiments:</u>

- Simple muscle twitch
- Effect of various strengths of stimuli on Simple muscle twitch

- Effect of changes in temperature on Simple muscle twitch
- Effect of two successive stimuli on muscle contraction
- Effect of multiple successive stimuli (treppe, clonus, tetanus)
- Study of fatigue in skeletal muscle
- Velocity of nerve conduction
- Effect of load on muscle
- Measurement of isometric contractions using nerve muscle preparation

(ii) **Amphibian cardiac experiments and interpretation of graphs** List of graphs on cardiac experiments:

- Normal cardiogram
- Effect of temperature on frog heart
- Effect of Stannius ligatures
- Properties of cardiac muscle – all or none law, staircase effect, refractory period in a beating heart (extrasystole and compensatory pause), refractory period in a quiescent heart
- Effect of vagus on frog's heart
- Action of drugs on vagus (nicotine and atropine)
- Perfusion of isolated heart and effect of ions (NaCl, KCl, $CaCl_2$)
- Perfusion of isolated heart and effect of drugs (adrenaline, acetyl choline, atropine followed by Ach)

SKILL CERTIFICATION:

The list of certifiable skills is given below. The general instructions, blank template, samples of certification checklist suggested for skill certification are provided as **ANNEXURE - IIa, IIb, IIc, IId.**

List and number of sessions for skill certification as prescribed by MCI:

	Topics	Number required to certify as per MCI
PY5.12	Record blood pressure & pulse at rest and in different grades of exercise and postures in a volunteer or simulated environment	1each x 3
PY6.9	Demonstrate the correct clinical examination of the respiratory system in a normal volunteer or simulated environment	1
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 or simulated environment	1 each (total 5)

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	1 each (total 4)

SUGGESTED AREAS FOR INTEGRATION:

As per the "Competency based Undergraduate Curriculum for the Indian Medical Graduate 2018: Medical Council of India"

EARLY CLINICAL EXPOSURE:

- **Clinical visits: 12 hours** (Suggested format for assessing participation in ECE sessions is provided as **ANNEXURE III which could be a part of the practical record book**)
  Suggested hospital visits: (can include more than the below suggestions)
  Anemia, Jaundice, Visit to blood bank, Computerized lung function tests, acid peptic disease, endoscopy procedure, dialysis unit, hemiplegia, etc.
- **Basic science correlations: 18 hours**
  Discussion based on case vignettes, graphs, clinical videos, patient in classroom setting, etc linked to various systems in physiology.

SELF-DIRECTED LEARNING:

Twenty-five hours of dedicated time for self-directed learning is provided for physiology.

AETCOM MODULES TO BE COVERED UNDER PHYSIOLOGY:

AETCOM module number (as per MCI document) *	**Topic**
1.2	**What does it mean to be a patient?**
1.3	**The doctor-patient relationship**

*** https://www.mciindia.org/CMS/wp-content/uploads/2019/01/AETCOM_book.pdf**

Suggested format for reflective writing for the above AETCOM modules is given in ANNEXURE IV. This could be a part of the practical record book.

LOG BOOK:

Suggested Template of logbook is attached as annexure. The minimum elements that needs to be included are mentioned in the template provided **for log book.**

TEACHING HOURS AND METHODS:

Curricular component	Time allotted in hours
Lectures	160
Small group teaching / tutorials / integrated learning /practical	310
Self-directed learning	25
Early clinical exposure (basic science correlation and clinical skills)	30 (18 +12)
Total	**525**
AETCOM module 1.2 and 1.3 ()	15 (8+7)

Note: It is recommended that **didactic teaching** be restricted to **less than one third of the total time** allotted for that discipline.

SCHEME OF EXAMINATION:

INTERNAL ASSESSMENT:

Scheme for calculation of Internal Assessment marks:

Theory (maximum marks)	**Marks**	**Practicals**	**Marks**
Theory written paper	30*	Practical exam (25 marks) and viva- voce (5 marks)	30**
Formative assessment		Formative assessment	
(Part completion tests/ (system-wise reviews)	10	Early clinical exposure + Skill certification	7
		Practical record	3
Total	**40**		**40**

Please note:

- *Prior to submission to the University, the marks for each of the three internal examination theory assessments must be calculated out of 30 marks, regardless of the maximum marks.
- **Prior to submission to the University, the marks for each of the three internal examination practical assessments must be calculated out of 30 marks, regardless of the maximum marks.
- Only the final marks out of 40 needs to be submitted to the University, separately for theory and practical for each internal assessment.

Guidelines: For general guidelines on Internal Assessment refer section II

UNIVERSITY EXAMINATION

SCHEME FOR MARKS DISTRIBUTION FOR UNIVERSITY EXAM:

Theory		Practical	
Paper I	100	Practical exam (Practical I to IV)	80
Paper II	100	Viva voce	20
Total	**200**	**Total**	**100**
Internal assessment	40	Internal assessment	40

A. THEORY: 200 Marks

There shall be two theory papers of 100 marks each and duration of each paper will be of 3 hours.

Type of questions	Number of questions	Marks for each question	Total Marks
Long essay	2	10	20
Short essay	10	5	50
Short answers	10	3	30
Total Marks			100

Blue print for theory question papers:

Paper 1 (Max 100 marks)

Systems	Marks Allocated
General Physiology	05
Hematology	20
Cardiovascular Physiology	25
Respiratory Physiology	20
Gastrointestinal Physiology	15
Renal Physiology	15

Paper 2 (Max 100 marks)

Systems	Marks Allocated
Nerve and muscle Physiology	12
Endocrine physiology	20
Reproductive physiology	15
Central nervous system	35
Special senses	10
Integrated Physiology	08

Note:

- **All the questions should be structured compulsorily. One short essay (5 marks) to be preferably a case vignette in each paper.**
- **The systems assigned to the different papers are generally evaluated under those sections. However, a strict division of the subject may not be possible and some overlapping of systems is inevitable. Students should be prepared to answer overlapping systems.**
- **Example of the structured questions and case vignettes are given in the example question papers in ANNEXURE Va, Vb. This is only a sample paper. The systems under each section of the paper (long essay, short essay and short answer) and the system from which the case vignette may be prepared can vary. However, marks allotted to the various systems as given in the above tables must be adhered to (with a variation of distribution of 1-2 marks between systems).**
- **A minimum of 35% marks shall be allocated to assess the higher order thinking skills of the student.**

B. PRACTICAL: 80 Marks

There shall be four practical sessions, each carrying 20 marks. The distribution of content and marks for the practical would be as follows:

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**
	Clinical examination-II (CVS / RS)	15

Practical – II	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 (note: there should not be duplication of charts between practical – I and IV for a given student)	5
	Total	**20**
	Grand total	**80**

Note: the 'allotted topics' for practical exam under different sections (I to IV) mentioned above needs to be strictly adhered to. The experiments kept under clinical examination should allow for an assessment of the marks allotted (and not be a very small component of the experiment for eg. "elicit a knee jerk" is not a complete experiment).

Viva-Voce Examination: 20 Marks

The viva-voce examination shall carry 20 marks and all examiners will conduct the examination. Viva should focus on application and interpretation. **Charts and graphs** should be prepared on all systems which could be divided amongst 4 examiners (system-wise) and could be used in viva. (viva marks to be added to practical and not theory).

ANNEXURE – I

List of suggested topics for the preparation of charts, clinical cases, graphs, clinical problems

(Note: many other topics from the syllabus can be considered and charts developed which is left to the discretion of individual institution)

i. General Physiology – Blood volume, feedback mechanisms flowchart

ii. Nerve muscle physiology – Myesthenia gravis, picture chart of neuromuscular junction

iii. Hematology – clinical cases of anemia, blood indices, peripheral smear, jaundice (prehepatic, post hepatic and hepatocellular), iv. Cardiovascular system – problems on cardiac output, cardiac index, ejection fraction, clinical cases on hypertension, shock, heart failure; interpretation of ECG and calculation of heart rate from ECG,

v. Respiratory system – spirogram with calculation of lung volumes and capacities, dyspnoeic index, respiratory reserve, charts with FEV1/FVC in obstructive and restrictive conditions

vi. Renal system – Clearance tests, cystometrogram

vii. Gastrointestinal system- clinical cases on peptic ulcer, OGTT, Gastrooesophageal reflux disease

viii. Endocrine system – clinical case histories / pictorial charts for various endocrine disorders

ix. Reproductive system - spinnbarkeit pattern pictorial chart, Fern pattern chart, clinical case history of infertility, hormonal changes during menstrual cycle graph,

x. Central nervous system - pictorial chart of properties of synapses, reflex arc, clinical cases on any of the 12 cranial nerves, Brown Sequard syndrome, cerebellar dysfunction, sensory ataxia, Parkinson's disease, UMN lesion, LMN lesion.

xi. Special senses – visual acuity, perimetry, hearing loss, audiogram

xii. Basal metabolic rate

xiii. Integrated Physiology: Chart also includes - Interpret growth chart*, Interpret anthropometric assessment of infants*: (*these two charts are 'Non-core' competencies as per "Competency based Undergraduate Curriculum for the Indian Medical Graduate 2018: Medical Council of India") xiv.

Others

ANNEXURE- IIa

SUGGESTED FORMAT FOR CERTIFICATION OF SKILLS IN PHYSIOLOGY GENERAL 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 certification is 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?

Grade	Explanation of Grade	Action to be taken
A	Student has performed the assessment **without any error**	Can be certified for skill
B	Student has performed the assessment **with minor errors** that need to be rectified	Re-assessment for parts that have been performed incorrectly
C	Student has performed the assessment **with major errors**	Re-assessment of whole skill
D	Student has **not been able to perform** the assessment	Re-assessment of whole skill

(Note: columns for 'number of attempts' can be added in the template attached below)

ANNEXURE – IIb

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

Satisfactory (√), unsatisfactory (X)

	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)			

Certifiers name and signature with date of certification:

Signature of the student:

ANNEXURE – IIc

Sample Skill certification checklist: Examination of reflexes

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

(Note: columns for 'number of attempts' can be added in the template attached below)
SKILL CHECKLIST (Examination of Reflexes)

Satisfactory (√), unsatisfactory (X)

	Attempt I Date:	**Attempt II Date:**	**Attempt 'n'…… Date:**
Professional conduct and communication			
Step Superficial reflexes: • Explains procedure to subject for each of the following: Plantar reflex: • Asks the subject to lie down with foot wear removed • With the help of a blunt object stroke the sole, from heel along the lateral border of foot and medially along the metatarso-phalangeal joint. • Reports the finding (flexor response/Babinski's sign) • Mentions the level of integration on asking (L5, S1) Abdominal reflex:			

• Asks the subject to lie down with foot wear removed • With the help of a key, strokes parallel to costal margin. Both below and above naval region • Observes and reports the contraction of abdominal muscles • Mentions the level of integration on asking (T8 to T12) Deep reflexes: Biceps jerk: • Places subject's forearm in semi-flexed position supported by his/her forearm in relaxed state. • Places thumb on the tendon of biceps in cubital fossa. • With the help of knee hammer taps on the thumb. • Observes and reports (the contraction of biceps and flexion of forearm) • Mentions the level of integration on asking (C5, C6) Triceps jerk: • Supports the forearm of subject on his/her arm at right angles. • Taps the tendon of triceps just above olecranon. • OR • Asks the subject to place his hand on opposite shoulder and taps triceps tendon. • Observes and reports. (the contraction of triceps and extension of forearm) • Mentions the level of integration on asking (C6, C7) Supinator jerk: • The subject's forearm is held in semi-prone position and asks to rest his hand on the student's hand. • Taps the styloid process of the radius. • Observes and reports (contraction of supinator flexion of elbow and eversion of wrist) • Mentions the level of integration on asking (C5, C6) Knee jerk: (ask to demonstrate either sitting or supine position) Sitting position: • Asks the subject to sit on chair with legs relaxed and not touching the ground / legs crossed. Knee of the examining lower limb is exposed. With knee hammer, taps on the patellar tendon just above tibial tuberosity			

Lying down position: • Asks the subject to liedown supine • Positions the limb at 60◦angle from bed • The student passes the hand underneath the testing limb, rests the hand on the opposite limb and the limb to be tested is slightly raised • The tendon is tapped • Observes and reports (contraction of quadriceps and extension of knee) • Mentions level of integration (L2, L3, L4) Ankle jerk: (ask to demonstrate either sitting or supine position) Standing position: • Asks the subject to place the limb to be examined on the stool with knee flexed at right angles to thigh • Dorsiflexes the ankle • Taps the tendoachillis with knee hammer Lying down position: • Makes the subject lie down. Positions the leg slightly flexed at the knee and foot slightly dorsiflexed. • Holds the big toe gently and taps tendoachillis • Observes and reports (contraction of gastrocnemius muscle with plantar flexion) Mentions level of integration (S1, S2)			
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)			

Certifiers name and signature with date of certification:

Signature of the student:

ANNEXURE IId

Sample Skill certification checklist: Measurement of Blood pressure at rest

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

(Note: columns for 'number of attempts' can be added in the template attached below)

SKILL CHECKLIST (measurement of Blood Pressure)

	Attempt I Date:	**Attempt II Date:**	**Attempt 'n'…… Date:**
Professional conduct and communication			
Steps: ·Positions subject (sitting-with their feet on floor, legs uncrossed and their back supported/ supine-lying down) and rests for 5min approx · Exposes the subjects arm at least 5 inches above the elbow: Sleeve can be rolled up but must be able to fit a finger under it or remove constrictive clothing. · Squeezes all air out of cuff before applying to subject · Arm is supported, at heart level, palm of hand turned up · Place cuff snugly on bare arm.			

·The centre of the bladder is positioned over the line of the artery. ·The lower edge of the bladder is 2-3 cm above the elbow crease ·The palpatory systolic pressure is measured by palpating for the radial artery, closing the valve, and pumping up the cuff. (Deflates cuff slowly and notes the point of reappearance of pulse) · The student reports the Palpatory Systolic Pressure ·Releases the air from the cuff and waits 30 seconds. -Elevates the pressure 20-30mm Hg above the palpatory systolic pressure. · Uses stethoscope properly (direction of ear pieces). Checks the stethoscope amplification for sound. · Position the diaphragm of the stethoscope over the brachial artery. · Deflates slowly at about 2mmHg/ second ·Releases the remaining air in the cuff after recording BP by opening the valve completely and removing the cuff. · If the student needs to recheck, completely deflates, waits 1-2 minutes and then reinflates. ·Documents: pt. position, arm used, cuff size, blood pressure Measurement			
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.			

Certifiers name and signature with date of certification:
Signature of the student:

ANNEXURE III

(Note: questions could be added/modified to this document which is at the discretion of individual institution. This appendix could be a part of practical record/logbook of Physiology)

SUGGESTED FORMAT FOR ASSESSING PARTICIPATION IN EARLY CLINICAL EXPOSURE SESSIONS

Session number: **Date:**

Roll No:

Department visited:

Objectives

1.

2.

3.

1. Briefly describe what you learnt from this session/ clinical visit in relation to the objectives. (in 100-150 words)

2. Apart from the above learning, what did you observe that influenced (Positive/negative) you? (in 100-150 words)

Remarks of teacher: Satisfactory / Not satisfactory

Name and Signature of Teacher with date:

ANNEXURE IV

(Note: questions could be added/modified to this document which is at the discretion of individual institution. This appendix could be a part of practical record/logbook of Physiology)

SUGGESTED FORMAT FOR AETCOM SESSIONS

Name of the Facilitator: Date:

AETCOM module Number: Session number:

AETCOM Topic:

Competencies / Objectives:

1.

2.

3.

1. Briefly describe what you learnt from this AETCOM session in relation to the objectives. (in 100-150 words)

2. Apart from the above learning, what did you observe that influenced (Positive/negative) you during this session? (in 100-150 words)

Remarks by Facilitator:

Signature of Facilitator:

ANNEXURE Va

MODEL question paper - Paper I

Time: 3 hours **Marks: 100**

Your answers should be specific to questions. Draw neat labelled diagrams wherever necessary.

Long essay questions: (10marks x 2 = 20 marks)

1. Describe the mechanics of breathing. Define compliance. Mention two conditions which reduce lung compliance. (7+1+2)
2. With the help of Wigger's diagram discuss the mechanical events of a cardiac cycle with the pressurevolume changes of left ventricle. Correlate the events with ECG and heart sounds. (6+2+2)

Short essays: (5marks x 10 = 50 marks)

3. Discuss the types of transport across cell membrane with one example for each. Explain Secondary active transport (4+1)
4. Draw and label the Juxta glomerular apparatus. Explain briefly Renin-Angiotensin system. (2.5+2.5)
5. Define and classify shock. Discuss physiological basis of tachycardia, pale and clammy extremities in haemorrhagic shock. (1+2+2)
6. A 42-year woman with 3-month history of abdominal pain, diarrhoea and rectal bleeding. She has progressive tiredness and appears pale. Her MCV, MCHC and MCH are low. (a) What is the morphological type of anaemia that you expect in this patient? (1mark) (b) What is the treatment

option for the above-mentioned condition (1 mark) (c) Describe briefly the morphological types of anaemia with an example for each (3marks).

7. Discuss the special features of coronary circulation with functional significance of each feature.
8. Describe the mechanism of HCl production in the stomach. How is it regulated? (3+2)
9. What is Glomerular filtration rate? Describe the various factors that can affect it. How is it measured? (1+3+1)
10. Describe the changes during acclimatization to high altitudes with the physiological basis of each.
11. Discuss the steps involved in micturition reflex. Explain Cystometrogram with a neat labelled diagram. (2.5+2.5)
12. Define jaundice. List the types of Jaundice. Explain the physiological basis of the tests to differentiate the types of jaundice. (1+1+3) **Short answers: (3marks x 10 = 30 marks)**
13. List any six functions of saliva.
14. What is AV nodal delay? Briefly explain its physiological significance (1+2)
15. Name any 3 anticoagulants and briefly explain their mechanism of action (1.5+1.5) 16. Define functional residual capacity. Explain its physiological significance. (1+2) 17. List the enzymes of pancreatic juice.

18. Define and classify hypoxia with an example for each. (1+2) 19.

Discuss the types of movements of small intestines.

20. Define autoimmunity. Name any 2 autoimmune disorders. (1+2)
21. With the help of a neat labelled diagram explain the ionic basis of an action potential in the ventricular muscle. (1.5+1.5)
22. Define Landsteiner's law. List two uses of blood grouping. (1+2)

ANNEXURE Vb

Model question paper - Paper II

Time: 3 hours **Marks: 100**

Your answers should be specific to questions. Draw neat labelled diagrams wherever necessary.

Long essay questions: (10marks x 2 = 20 marks)

1. Describe in detail the biosynthesis of thyroid hormone. Enumerate the functions of the thyroid hormone in different organ systems. List the conditions caused due to the alterations in serum thyroid hormone levels. (3+5+2)
2. Describe the pain pathway from right lower limb. What are the important features of slow and fast pain? Add a note on referred pain. (5+2+3)

Short essays: (5marks x 10 = 50 marks)

3. Define and classify synapse. Discuss any two properties of synapse in detail. (2+ 3)
4. Describe the physiological actions of Insulin. What is diabetic keto-acidosis? (4+1)
5. Describe the steps involved in the transmission of impulses across the neuromuscular junction. Discuss the role of neuromuscular blocking agents. (3+2) 6. Discuss the connections and functions of basal ganglia. (2.5+2.5)
7. Classify sensory receptors with an example for each.
8. Compare and contrast the actions of adrenaline and noradrenaline on CVS.
9. Describe the endometrial changes of menstrual cycle with hormonal basis for the same.

10. A 54-year old male presented with the history of numbness in the tongue and persistent changes in taste perception, after a year-long oral exposure to a commercial cleaning agent. Lingual tactile and two-point discrimination test showed reduced somatic sensation. Taste threshold testing on anterior part of tongue demonstrated severe hypogeusia. (a) Which are the cranial nerves affected here (2marks). (b) Describe the pathway involved in carrying the taste sensation (3marks)
11. List the functions of cerebellum. Add a note on features of cerebellar dysfunctions. (2.5+2.5)
12. List the theories of hearing. Discuss the functions of middle ear. (2+3)

Short answers: (3marks x 10 = 30 marks)

13. Discuss the significance of fetoplacental unit.
14. Define the following terms i) perinatal ii) neonatal iii) infancy (1+1+1)
15. What are the contraceptive methods in females? Briefly explain the mechanism of action of intrauterine contraceptive devices. (1.5+ 1.5)
16. Discuss the steps of spermatogenesis.
17. List the implications of brain death.
18. List the Factors affecting conduction velocity in a nerve fiber. Name the classification system based on it. (2+1)
19. Classify smooth muscle fibers and List the differences between them.
20. Differentiate between REM and NREM sleep.
21. List the acute cardio respiratory responses to whole body isotonic exercise.
22. List any six functions of hypothalamus.

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 of Medical Physiology. South Asian edition. Mario Vaz, Anura Kurpad, Tony Raj.
2. Ganong's Review of Medical Physiology.
3. Vander's Human Physiology.
4. Principles of Medical Physiology. Sabyasachi Sircar
5. Text book of Medical Physiology. Indu Khurana
6. Text book of Medical Physiology. D Venkatesh, H H Sudhakar
7. Text book of medical physiology. G K Pal.
8. Essentials of Medical Physiology. ABS Mahapatra 9. Berne and Levy Physiology. BM Koeppen, BA Stanton 10. Human Physiology. Lauralee Sherwood.

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

BIOCHEMISTRY

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

A. KNOWLEDGE

At the end of the course, the student should be able to:

1. Describe the molecular and functional organization of a cell and its subcellular components;
2. Delineate structure, function and inter-relationships of biomolecules and consequences of deviation from normal;
3. Summarize the fundamental aspects of enzymology and clinical application wherein regulation of enzymatic activity is altered;
4. Describe digestion and assimilation of nutrients and consequences of malnutrition;
5. Integrate the various aspects of metabolism and their regulatory pathways;
6. Explain the biochemical basis of inherited disorders with their associated sequelae;
7. Describe mechanisms involved in maintenance of body fluid and pH homeostasis;
8. Outline the molecular mechanisms of gene expression and regulation, the principles of genetic engineering and their application in medicine;
9. Summarize the molecular concepts of body defence and their application in medicine; 10. Outline the biochemical basis of environmental health hazards, biochemical basis of cancer and carcinogenesis;
11. Familiarize with the principles of various conventional and specialized laboratory investigations and instrumentation analysis and interpretation of a given data;
12. Suggest laboratory investigations to support theoretical concepts and clinical diagnosis.

B. SKILLS:

At the end of the course, the student should be able to:

1. Make use of conventional techniques/instruments to perform biochemical analysis relevant to clinical screening and diagnosis;
2. Analyze and interpret investigative data;
3. Demonstrate the skills of solving scientific and clinical problems and decision making;

C. INTEGRATION

The knowledge acquired in Biochemistry should help the students to integrate molecular events with structure and function of the human body in health and disease.

COURSE CONTENT AND TEACHING HOURS

A. TEACHING HOURS

Curricular component	Time allotted in hours
Lectures	80
Small group teaching / tutorials / integrated learning /practical	150
Self-directed learning	20
Early clinical exposure (basic science correlation and clinical skills)	30 (18 +12)
Total	**280**
AETCOM module 1.4	7

B. Course content

(i) Theory Topics

Syllabus

Teaching hours – 160 hours

Sl Topic (Competency No) No.

1. Relevance of Biochemistry in Medicine Core: 1 hr

Importance of Biochemistry in health and disease - Examples of normal biochemical process - Examples of biochemical derangements involved in disease development (Orientation lecture) - Examples of application of laboratory medicine in screening, diagnosis and prognosis of diseases

2 **Cell and organelles, Cell membrane, Transport across cell membranes** (BI1.1) 2 hrs

Core:

Prerequisite: Concept of prokaryotic and eukaryotic cell

Cell organelles – Structure, Biochemical functions, Marker enzymes Cell Membrane - Fluid mosaic model, composition, Fluidity of membrane

Transport across cell membranes with examples

- Passive transport – Diffusion and facilitated transport (ion channels)
- Active transport – Primary and Secondary
- Endocytosis and Exocytosis

Aquaporins

ABC family of transporters

Non core:

Cytoskeleton –

Structure and functions of microtubules, actin filaments, intermediate filaments

Intercellular communication Separation of cell organelles 9 hrs

3 **Enzymes** (BI2.1, BI2.3, BI2.4, BI2.5, BI2.6, BI2.7) **Core:**

Enzymes- Definition, General properties, IUBMB Classification.

Coenzymes and Cofactors

Mechanism of Enzyme action - Concept of activation energy, transition state, binding energy, active site; Substrate binding to active site - Koshlands Induced fit theory

Factors affecting enzyme activity

Effect of substrate concentration - Michaelis -Menton theory, Km value, Vmax and its significance (derivation not required)

Enzyme specificity

Enzyme inhibition - Competitive and Non-competitive inhibition with examples of clinical importance Suicide inhibition

Enzymes as toxins – Eg. Snake venom phospholipase

Enzyme regulation by- Short term (Covalent modification, Zymogen activation,

Allosteric regulation, Feedback regulation) and long term regulation (Induction and repression)
Clinical Enzymology – Concept of plasma functional and non-functional enzymes
Diagnostic Importance of enzymes – LDH, CK, AST, ALT, ALP, GGT, Amylase, Lipase, G6PD, Cholinesterase, ACP, 5'nucleotidase
Isoenzymes – Definition, Diagnostic Importance of isoenzymes with examples.
Enzymes as Therapeutic agents
Enzymes used in diagnostic assays
Ribozymes **Non core:**
Mechanisms of enzyme catalysis (List) 4

Chemistry of Carbohydrates (BI3.1) 3 hrs

Core:
Definition, Biomedical importance
Classification with examples
Monosaccharide derivatives – Uronic acids, aminosugars, Glycosides, Sorbitol, Mannitol and their Clinical significance.
Disaccharides, oligosaccharides -composition, importance
Polysaccharides –Homopolysaccharides – Composition and Importance of starch, glycogen, Dextran, Cellulose and Inulin.
Heteropolysaccharides – Mucopolysaccharides (Composition and function)
Concept of glycation and glycosylation
Importance of Glycoproteins **Non core:**
Sialic acid – importance
Blood group substances

5 **Carbohydrate metabolism (BI3.2, BI3.3, BI3.4,BI3.5, BI3.6, BI3.7, BI3.9) Core:** 14hrs

Digestion and absorption
Mechanism of absorption
Lactose intolerance
Glucose transporters
Insulin dependent and Insulin independent uptake of glucose by tissues
PATHWAYS – Significance, Site, reactions, key steps, energetics, regulation, inhibitors and associated disorders of -

- Glycolysis, Rapaport Leubering cycle and its significance
- Citric acid cycle, Amphibolic role, Anaplerotic reactions
- Gluconeogenesis, Cori's cycle
- Glycogenesis, Glycogenolysis, Glycogen storage disorders

Significance of HMP shunt pathway and uronic acid pathway Glucose-6-Phosphate dehydrogenase deficiency

Galactosemia, Essential Fructosuria, Hereditary fructose intolerance Regulation of blood glucose levels in well fed condition and fasting/starvation **Non core:**
Galactose and Fructose metabolism
Details of Pyruvate dehydrogenase (PDH) reaction
Essential pentosuria

6 **Chemistry of lipids (BI4.1, BI11.24) Core:** 3 hrs

Definition, Modified Bloor's classification with examples.
Biomedical importance of lipids
Fatty acids - Definition, examples and importance of Essential fatty acids, Mono and Polyunsaturated fatty acids, n3 and n6 fatty acids, Trans-fatty acids.
Triacylglycerol – composition and importance
Phospholipids - Types, functions with clinical importance
Respiratory distress syndrome
Glycolipids – Types and importance
Cholesterol - structure and biological importance
Lipoproteins - Types and functions
Amphipathic lipids - Definition, examples and importance, Liposomes **Non core:**
Fatty acids – nomenclature and different types of classification Synthesis of lung surfactant

7. **Lipid metabolism (BI4.2, BI4.3, BI4.4, BI4.6) Core:** 12 hrs

Digestion and Absorption
Steatorrhea
Biosynthesis and breakdown of triacylglycerol
PATHWAYS – Significance, Site, reactions, key steps, energetics, regulation, and associated disorders of -

- Beta oxidation
- Ketogenesis, ketolysis
- Cholesterol biosynthesis upto mevalonate.

Other types of Oxidation of fatty acids and associated disorders
Lipoprotein metabolism Structure, Composition, Types, Functions, metabolism of Chylomicrons, VLDL, LDL, HDL
Formation and functions of bile acids and bile salts
Fatty liver and lipotropic factors
Hyperlipoproteinemias
Biochemical basis of use of hypolipidemic drugs
Prostaglandins – types and biomedical importance **Non core:**

Fatty acid synthase multienzyme complex
Outline of Fatty acid biosynthesis
Lipid Storage Disorders

3 hrs

8 **Chemistry of amino acids and Proteins (BI5.1, BI5.2) Core:**

Prerequisite: Amino acids – Classification based on side chain properties, nutritional requirement

Classification of Amino acids based on metabolic fate
Standard and non-standard amino acids
Biologically important peptides
Proteins – Definition, Classification based on chemical nature and solubility, functions, nutritional value
Structural organisation of proteins (primary, secondary, super secondary structures/ motifs, domains, tertiary and quaternary structures)
Bonds stabilizing protein structure
Structure function relationship of proteins - haemoglobin, myoglobin, collagen and Insulin
Denaturation - definition, causes, properties of a denatured protein, significance.

Non core:

Isoelectric pH
Non-protein amino acids, Non-alpha amino acids, D-amino acids 9

Protein and amino acid metabolism (BI5.3, BI5.4, BI5.5, BI11.17)

13 hrs

Core:

Digestion and absorption and associated disorders
Amino acid pool
General reactions – Transamination, Transmethylation, Transdeamination, Deamination - Oxidative and nonoxidative and their significance.
Biogenic amines
Sources and fate of ammonia **-** Trapping, Transport and Disposal of ammonia, ammonia toxicity
Urea cycle and its disorders

Amino acid metabolism

Glycine – specialised products and their importance
Phenylalanine, Tyrosine – metabolic pathway, synthesis of catecholamines. Pheochromocytoma
Other specialised products formed from tyrosine and their importance
Tryptophan- synthesis of serotonin and melatonin and their importance
Carcinoid syndrome
Sulphur containing amino acids – functions of cysteine, methionine synthesis of SAM, SAH, Homocysteine
Formation of Nitric oxide and its importance

Inborn errors of metabolism – enzyme defects, clinical features, laboratory diagnosis and biochemical basis of management of – PKU, Tyrosinosis, Alkaptonuria, Albinism, Homocystinuria, Maple syrup urine disease (MSUD) Important functions/products from histidine, serine, Aspartate, Asparagine,
glutamate, glutamine, serine, branched chain amino acids
Polyamines - Examples and importance **Non core:**
Techniques to separate and identify amino acids.

10 **Plasma proteins (BI5.2)** 3 hrs

Core:
Functions and clinical significance of plasma proteins - Albumin, α, β and γ globulins.
Acute phase reactants - Positive and Negative (clinical significance)
Biological Reference range of serum total protein, albumin, total globulin, C reactive protein
Multiple Myeloma **Non**
core:
Separation and identification of plasma proteins by electrophoresis and precipitation reactions

11 **Metabolism and homeostasis (BI6.1, BI3.8, BI4.5, BI4.7, BI3.10, BI11.17)** 6 hrs **Core:**
Metabolic processes taking place in specific organs in the body in fed, fasting and exercise states.
Metabolic changes during starvation
Adipose tissue – Hormones secreted from adipose tissue (adipokines – leptin, adiponectin) their functions and role in hunger and satiety.
Diabetes mellitus – types, metabolic changes, complications.
Guidelines for diagnosis of Diabetes mellitus
Artificial sweeteners- list, use, metabolic effects(briefly) and concerns (to be discussed with in context of their use in Diabetes Mellitus).
Lipid profile, Dyslipidemia
Atherosclerosis – definition, role of lipids in atherogenesis (LDL, Oxidised LDL, Lp(a), Small dense LDL, HDL)
Lab tests in Myocardial infarction **Non**
core:
Advanced Glycation End (AGEs) products

12 **Biological Oxidation (BI6.6)** 3 hrs

Core:
Prerequisite: Bioenergetics – Laws of thermodynamics, Free energy, Exergonic and endergonic reactions, Chemical Coupling Redox pair, Redox potential.
High Energy Compounds – Definition, Classification, biological significance.
Transport of reducing equivalents across mitochondria

Electron Transport Chain – Organization, components, flow of electrons.
Oxidative Phosphorylation – Sites, mechanism (Chemiosmotic theory).
Binding change mechanism of ATP synthesis by ATP synthase.
Inhibitors of Electron Transport Chain and oxidative phosphorylation. Uncouplers and their significance.
Brown adipose tissue metabolism.
Non core:
ATP-ADP cycle.
Structure and organization of ATP synthase complex.
Mitochondrial myopathies

13 **Heme metabolism (BI6.11, BI6.12, BI5.2, BI11.17)** 7 hrs

Core:
Heme –Outline of Synthesis, porphyrias
Degradation of Heme, Bilirubin metabolism – synthesis, transport, conjugation, excretion
Jaundice – definition, types, causes, lab diagnosis
Congenital hyperbilirubinemias
Hemoglobin – Adult, fetal and embryonic types Abnormal hemoglobins– carboxy, sulph, metHb.
Hemoglobinopathies – molecular defects, pathophysiological changes in thalassemias and sickle cell anemia **Non core:**
p50 of hemoglobins

14. **Extracellular matrix (BI9.1, BI9.2)** 4 hrs

Core:
Composition of ECM – Proteins (Composition and functions of Collagen, elastin, fibrillin, fibronectin, laminin) and Proteoglycans.
Involvement of ECM components in health and disease**.** Eg. Osteogenesis Imperfecta, Ehler-Danlos syndrome etc **Non core:**
Bone tissue– Concept of Bone turnover, factors affecting bone turnover, Peak bone mass, List of markers of bone formation and bone resorption.

15. **Vitamins (BI6.5)** 12 hrs

Core:
Prerequisite: Definition, difference between water and fat soluble vitamins
RDA, Sources, Metabolism, Biochemical functions, Deficiency manifestations, Hypervitaminoses of Fat soluble vitamins (A,D,E,K), Water soluble vitamins - Vitamin C, Folic acid, Vitamin B12, Thiamine, riboflavin, Niacin, Pyridoxine, Biotin, Pantothenic acid
Antivitamins **Non core:**
Vitamers

8 hrs

Lipoic acid

16 **Minerals (BI6.9, BI6.10) Core:**
Major elements and trace elements
Sources, RDA, absorption and transport, Homeostasis, Functions, Biological reference range, disorders associated with – Calcium, phosphorus, Iron
Functions and disorders associated with - Copper, Zinc, Selenium, Fluoride, Iodine, Magnesium, Molybdenum. 17 **Chemistry of Nucleic acids (BI7.1) Core:**
Prerequisite: Nitrogenous bases: Purines and Pyrimidines (Major, Minor, Free Bases); Nucleosides and Nucleotides – Structure, examples, Importance
Nucleoside derivatives: NMP, NDP, NTP cAMP, SAM, PAPS, UDP sugars etc
Synthetic Nucleotide Analogues and their application
Structure and function of DNA (B-DNA)
Structural organization of DNA to form chromatin (Primary and Secondary) Types of RNA (hnRNA, mRNA, rRNA, tRNA, snRNA) with structure and functions microRNA (miRNA) and small interfering RNA (siRNA) and their applications in medicine **Non core:**
Different types of DNA

2 hrs

18 **Nucleotide metabolism (BI6.2, BI6.3, BI6.4) Core:**
Prerequisite: Sources of atoms of Purine and pyrimidine ring
Salvage pathways of Purine and pyrimidine synthesis
Catabolism of Purines, Uric acid and its importance
Etiology, manifestations and biochemical basis of clinical manifestations of – Gout, LeschNyhan syndrome, **Non core:**
SCID, Oroticaciduria
Diagnostic importance of Adenosine deaminase 19 **Molecular Biology (BI7.1, BI7.2, BI7.3, BI9.3) Core:**
Concept of Genomics, proteomics and metabolomics
DNA Metabolism
Cell cycle
DNA replication - prokaryotic and eukaryotic replication, requirements, process, inhibitors
Telomere, Telomerase and its importance DNA
repair mechanisms

4 hrs

11 hrs

Diseases associated with DNA repair – Eg. Xeroderma Pigmentosum
Mutations, causes, types of mutation, Consequences with examples

RNA Metabolism

Transcription process
Transcriptional units, promoter regions, RNA polymerases in prokaryotes and eukaryotes
Differences between prokaryotic and Eukaryotic transcription
Inhibitors of transcription process
Post transcriptional modifications of all types of RNA

Protein Biosynthesis

Genetic Code and its characteristics
Requirements and activation of amino acids
Translation in Eukaryotes
Inhibitors of Translation
Post translational modifications

Regulation of Gene expression

Gene, introns, exons, cistron
Regulation of gene expression in prokaryotes with illustration of Lac Operon
Regulation of gene expression in eukaryotes – Role of enhancers, repressors, DNA regulatory elements, gene amplification, gene rearrangement, RNA processing, RNA editing, mRNA stability.

Non core:

Role of transcriptional activators and coregulators
Protein folding – Role of Chaperones and Heat shock proteins, Alzheimers disease, Prion diseases
Protein targeting and sorting with associated disorders Eg, I cell disease
Protein motifs in DNA regulatory proteins
Chromatin remodeling in regulation
Epigenetics

20. **Molecular biology techniques and Gene therapy (BI7.4) Core:** 4 hrs

Recombinant DNA technology, DNA cloning - process and application
PCR technique and its application
Blotting techniques
Concept, types and application of gene therapy.
DNA Polymorphism, SNP, VNTR, RFLP
DNA genomic and cDNA libraries
DNA Probes
DNA Microarrays
Overview of Human Genome Project HGP 21

Biochemistry of Cancer (BI10.1, BI10.2)

Core: 5 hrs

Cell cycle, regulation, abnormal cell growth, programmed cell death (apoptosis) Cell signaling (action of hormones and growth factors) – Cell surface receptors - G protein coupled signaling, catalytic receptor signaling, steroid receptor signaling.
Mutagens and carcinogens: Definitions, examples and their actions in carcinogenesis
Protooncogenes and their activation, oncogenes, tumour suppressor genes and their role in development of cancer
Oncogenic viruses (HPV and cervical cancer)
Growth factors and their receptors
Tumour markers and their importance in diagnosis and prognosis of cancer Biochemical basis of cancer therapy – alkylating agents, antimetabolites,
topoisomerase inhibitors, antibiotics, hormones, receptor blockers, radiotherapy etc
Monoclonal antibodies and their application **Non core:**
Hybridoma technology
Estrogen and progesterone receptors and their clinical importance in breast cancer

22 **Immunology (BI10.3, BI10.4, BI10.5)** 1 hr

Core:
Cellular and humoral components of immune system
Immunoglobulins – Classes, structure function relationship
Innate and adaptive immune responses, self/non-self-recognition
Role of T-helper cells in immune responses
Ig class switching
Concept of Immune tolerance and Autoimmunity
Antigens and concepts in vaccine development – types of vaccines, immunological basis of vaccine development, recombinant DNA technology in vaccine development.
Non core: Hypersensitivity reactions
Concept of graft rejection Phases
of vaccine development.

23. **Nutrition and dietetics (BI8.1, BI8.2, BI8.3, BI8.4, BI8.5, BI11.17, BI11.23, BI11.24)** 7 hrs **Core:**
Energy content of food items
BMR – Definition, Normal values, Factors affecting and biomedical importance
SDA – Definition and significance (Thermogenic effect of food)
Nitrogen balance
Balanced diet – definition, composition
Dietary fibers – definition, examples, importance
Glycemic index – definition, calculation, importance
Nutritional importance of Carbohydrates, Lipids, Proteins, Vitamins and minerals, commonly used food items including fruits and vegetables.
Nutritional indices
Calculation of calorie requirement
Dietary advice for optimal health in childhood and adults, special conditions like diabetes mellitus , coronary artery disease, pregnancy.

Types, causes and effects of Protein energy malnutrition

Obesity – Definition, BMI, types, causes, role of GI peptides and adipokines in obesity, associated health risks (eg., metabolic syndrome)

24 **Organ function tests (BI6.13, BI6.14, BI6.15, BI11.17)** 11 hrs

Core:

Functions of Liver, Kidney, Thyroid and adrenals.

Liver Function Tests: Tests based on Synthetic, Excretory, and Role of enzymes in hepatic dysfunction

Renal Function tests – Tests to assess glomerular and tubular functions

Mechanism of action of Group I and Group II hormones

Thyroid function tests

Adrenal function tests

Non core:

Lab tests for evaluation of Infertility.

25 **Acid base balance (BI6.7, BI6.8, BI11.17)** 4 hrs

Core:

Prerequisite: Concept of Acids, Bases and buffers, HH Equation and its application

Regulation of pH of blood by buffers, respiratory and renal mechanisms

Anion gap and its significance

Acidosis and alkalosis (metabolic and respiratory) – causes, compensatory mechanisms and lab findings

26 **Water and electrolyte balance (BI6.7)** 3 hrs

Core:

Distribution of water and electrolytes in ICF and ECF

Osmolality of ECF

Regulation of water and electrolyte balance

Disorders of electrolyte imbalance – causes and clinical features of Hyperkalemia,

Hypokalemia, Hypernatremia, Hyponatremia

Dehydration

27 **Free Radicals and Antioxidants (BI7.6, BI7.7)** 3 hrs

Core:

Free radicals, Reactive oxygen species (ROS), Reactive nitrogen species (RNS)

Damaging effects of ROS on biomolecules, lipid peroxidation

Anti-oxidant defence system of our body – enzymes, vitamins, metabolites as antioxidants

Role of oxidative stress in atherosclerosis, diabetes mellitus and cancer **Non core:**

Fenton and Haber Weiss reactions

28 **Xenobiotics and Detoxification (BI7.5)** 1 hr

Core:

Xenobiotics and disease caused. Biotransformation

Phase –I reactions

Oxidation

Hydroxylation

Cytochrome P450

Phase-II reactions

Conjugation reactions-Glucuronic acid, Glutathione, Glycine **Non core:**

Other detoxification reactions reduction, hydrolysis, Acetylation, Methylation and reduction

29 **Clinical chemistry (BI11.16)** 2 hrs

Core:

Basic concepts of clinical chemistry laboratory

Automation - advantages

Quality control concepts (Internal and external quality control, precision, accuracy)

Specimen collection and Common Preanalytical errors

Biological reference intervals

Critical alerts

Ethics in Laboratory Medicine

Note:

1. Students are expected to familiarize by themselves the contents mentioned as prerequisite (in italics)

SUGGESTED DISTRIBUTION OF THEORY TEACHING HOURS						
Sl No	**Topic**	**Suggested TL methods (hours)**				
		Lecture (80)	**SGT (40)**	**CBL (40)**	**Total (160)**	**Integration (20) Shared extra hours**
1	Relevance of Biochemistry in Medicine			1 Orientation lecture		
2	Cell and organelles, Cell membrane, Transport across cell membranes	2	-	-	**2**	2
3	Enzymes	5	2	2	**9**	-

4	Chemistry of Carbohydrates	3	-	-	**3**	-
5	Carbohydrate metabolism	8	2	4	**14**	-
6	Chemistry of lipids	3	-	-	**3**	-
7	Lipid metabolism	8	2	2	**12**	-
8	Chemistry of amino acids and Proteins	3	-	-	**3**	-
9	Protein and amino acid metabolism	7	2	4	**13**	-
10	Plasma proteins	1	-	2	**3**	1
11	Metabolism and homeostasis	2	4	-	**6**	2
12	Biological Oxidation	3	-	-	**3**	-
13	Heme metabolism	3	-	4	**7**	2
14	Extracellular matrix	2	2	-	**4**	-
15	Vitamins	2	4	6	**12**	-
16	Minerals	2	4	2	**8**	2
17	Chemistry of Nucleic acids	2	-	-	**2**	-
18	Nucleotide metabolism	2	-	2	**4**	-
19	Molecular Biology	7	4	-	**11**	-
20	Molecular biology Techniques and Gene therapy	2	2	-	**4**	1
21	Biochemistry of Cancer	3	-	2	**5**	2
22	Immunology	1	-	-	**1**	2
23	Nutrition and dietetics	3	2	2	**7**	2
24	Organ function tests	1	4	6	**11**	2
25	Acid base balance	2	-	2	**4**	1
26	Water and electrolyte balance	1	2	-	**3**	1
27	Free Radicals and Antioxidants	1	2	-	**3**	-
28	Xenobiotics and Detoxification	1	-	-	**1**	-
29	Clinical chemistry	-	2	-	**2**	-

Note: The above table containing teaching hours assigned to different topics under large and small group teaching may be used as a guide by the Institutes.

i. Assessment methods for Theory (Formative and Summative):

- **Written (Structured Long essay Questions/Short essay questions /short answer questions/ clinical vignette based questions) Viva Voce**
- **Case based learning Sessions with lab data interpretation - 20 X2=40 hrs**

Sl. No	Topic	Suggested Cases for discussion	No. of sessions (2 hrs each)	Domain / Level	Assessment Tool
1	Diagnostic enzymology BI2.7, BI11.17	Myocardial infarction Acute pancreatitis	1	K/KH	Case chart discussion /OSPE
2	Carbohydrate metabolism BI3.8, BI3.10, BI11.17	Diabetes Mellitus GTT charts/GST Galactosemia Von Gierke disease	2	K/KH	Case chart discussion /OSPE
3	Lipid metabolism BI3.10, BI4.7, BI11.17	Dyslipidemia Ketoacidosis Familial hypercholesterolemia	1	K/KH	Case chart discussion /OSPE
4	Protein metabolism Inborn errors of metabolism BI5.5, BI11.17	PKU Alkaptonuria Homocystinuria MSUD Albinism	2	K/KH	Case chart discussion /OSPE
5	Plasma proteins BI5.5, BI11.16, BI11.17	Multiple myeloma	1	K/KH	Case chart discussion /OSPE
6	Nucleotide metabolism BI6.4, BI11.17	Gout	1	K/KH	Case chart discussion /OSPE
7	Liver Function tests and Hemoglobinopathies BI6.2, BI6.14, BI11.17	Hemolytic Jaundice Hepatic jaundice Obstructive jaundice Neonatal jaundice Alcoholic cirrhosis Non alcoholic steatohepatitis Sickle cell anaemia Thalassemia	2	K/KH	Case chart discussion /OSPE
8	Renal function tests BI6.14, BI11.17	Normal renal function Renal failure Nephrotic syndrome Acute glomerulonephritis	2	K/KH	Case chart discussion /OSPE

9	Thyroid function tests BI6.14, BI11.17	Hypothyroidism Hyperthyroidism	1	K/KH	Case chart discussion /OSPE
10	Vitamin deficiency disorders BI6.5	Vitamin A deficiency Rickets/Osteomala cia Scurvy Beri Beri Pellagra Megaloblastic anemia	3	K/KH	Case chart discussion /OSPE
11	Minerals BI6.10	Iron deficiency anaemia Tetany Wilson's disease Goitre Fluorosis	1	K/KH	Case chart discussion /OSPE
12	Nutritional disorders BI8.2	Kwashiorkor Marasmus Metabolic syndrome	1	K/KH	Case chart discussion /OSPE
13	Cancer BI10.2	Prostate carcinoma Breast carcinoma	1	K/KH	Case chart discussion /OSPE
14	Disturbances in acid-base balance BI6.8, BI11.17	Metabolic acidosis Metabolic alkalosis Respiratory acidosis Respiratory alkalosis	1	K/KH	Case chart discussion /OSPE

ii. PRACTICAL: 35X2 = 70 hours

Part 1: Qualitative Experiments – 9X2=18hrs
Part 2: Quantitative Experiments – 14X2=28hrs
Part 3: Demonstration Experiments – 12X2=24hrs

Sl. No	Type of Experiment	Suggested Teaching learning method - Practical tests to be performed	No. of practical classes	Domain/ Level	Assessment method

Part 1: Qualitative Experiments - 9 Classes					
1	Analysis of Normal constituents of urine BI11.3, BI11.4	DOAP sessions – Examine Physical properties, Inorganic constituents (Calcium, Phosphorus and Ammonia) and Organic constituents (Urobilinogen, Urea, Uric acid and Creatinine)	3	S/P	Qualitative analysis
2	Analysis of Pathological Constituents of Urine BI11.4, BI11.20	DOAP sessions - Physical examination, chemical tests for Glucose, Ketone Bodies, Blood, Proteins, Bile salts and Bile Pigments Demonstration by using Dip sticks	4	S/P	Qualitative analysis
3	Urine screening tests for Inborn errors of metabolism BI11.5, BI5.5	Newborn screening tests- Interpretation of laboratory reports	1	K/KH	OSPE/ Viva
4	Calculate the energy content of food items 11.23	Small group discussion – Calculate	1	K/KH	OSPE/ Viva
Part 2: Quantitative Experiments - 14 Classes					
1	Estimation of plasma glucose by Enzymatic method and Glucometer as point of care testing BI11.21, BI3.10	DOAP sessions - Perform and Interpret	2	S/P	Quantitative analysis/ OSPE/Case chart interpretation

2	Estimation of serum and urine creatinine by Jaffe's method, Creatinine clearance BI11.7, BI11.21	DOAP sessions - Perform and Interpret	2	S/P	Quantitative analysis/ OSPE/Case chart interpretation
3	Estimation of blood urea by end point method BI11.21	DOAP sessions - Perform and Interpret	2	S/P	Quantitative analysis/ OSPE/Case chart interpretation
4	Estimation of Total Protein and Albumin in serum by Biuret and BCG method, A:G ratio BI11.8, BI11.21	DOAP sessions - Perform and Interpret	2	S/P	Quantitative analysis/ OSPE/Case chart interpretation
5	Estimation of Total cholesterol and High density lipoprotein(HDL) cholesterol BI11.9	Practical - Perform and Interpret	1	S/P	Quantitative analysis/ OSPE/Case chart interpretation
6	Estimation of Triacylglycerols BI11.10	Practical - Perform and Interpret	1	S/P	Quantitative analysis/ OSPE/Case chart interpretation
7	Estimation of Calcium and Phosphorous BI11.11	Practical - Perform and Interpret	1	S/P	Quantitative analysis/ OSPE/Case chart interpretation

8	Estimation of Serum Bilirubin BI11.12	Practical - Perform and Interpret	1	S/P	Quantitative analysis/ OSPE/Case chart interpretation
9	Estimation of AST, ALT activity BI11.13	Practical - Perform and Interpret	1	S/P	Quantitative analysis/ OSPE/Case chart interpretation
10	Estimation of ALP activity BI11.14	Practical - Perform and Interpret	1	S/P	Quantitative analysis/ OSPE/Case chart interpretation
Part 3: Demonstrations -12 Classes					
1	Lab safety and Biomedical waste disposal, Commonly used lab equipment, glassware and reagents BI11.1	Small group discussion, lab visit	1	K/KH	Viva
2	Preparation of buffers and estimation of pH using pH meter BI11.2, 11.16, 11.19	Demonstration - Observe	1	K/KH	Viva
3	Colorimetry, Spectrophotometry BI11.6, BI11.18,	Demonstration - Observe	1	K/KH	Viva
4	Clinical chemistry autoanalyser and quality control (Internal and External quality control, Precision, Accuracy, QC rules), Biological reference intervals BI11.16, BI11.19	Demonstration - Observe and interpret	1	K/KH	OSPE/ Viva
5	Specimen collection and preanalytical errors in clinical Biochemistry lab	Collection centre and lab visit	1	K/KH	Viva
6	Serum protein electrophoresis, types and applications BI11.16, BI11.19	Demonstration - Observe and interpret	1	K/KH	OSPE/ Viva

7	Paper chromatography/TLC of amino acids/sugars, types and applications BI11.5, BI5.5, BI11.16, BI11.19	Demonstration - Observe and Interpret	1	K/KH	OSPE/ Viva
8	Analysis of CSF BI11.15	Small group discussion - Interpret	1	K/KH	OSPE/ Viva
9	Estimation of serum electrolytes by ISE BI11.16, BI11.19	Demonstration - Observe and Interpret	1	K/KH	OSPE/ Viva
10	Blood gas analysis using ABG analyser BI11.16, BI11.19	Demonstration- Observe and Interpret	1	K/KH	OSPE/ Viva
11	Principle, procedure and applications of ELISA, protein extraction, Blotting techniques, PAGE BI11.16, BI11.19	Demonstration- Observe	1	K/KH	Viva
12	Principle, procedure and applications of PCR, DNA isolation BI11.16, BI11.19	Demonstration- Observe	1	K/KH	Viva

CERTIFICATION OF SKILL ACQUISITION:

To be certified using checklists

Suggested Checklist format for Certification of Skills (refer logbook)

Sl No	Competency to be certified with Competency number	No. required to
1	Perform urine analysis to estimate and determine normal constituents (BI11.4)	1
2	Perform urine analysis to estimate and determine abnormal constituents (BI11.4)	1
3	Identify abnormal constituents in urine, interpret the findings and correlate these with pathological states (BI11.20)	1
4	Demonstrate estimation of glucose in serum (BI11.21)	1
5	Demonstrate the estimation of serum Creatinine and Creatinine clearance (BI11.7, BI11.21)	1
6	Demonstrate estimation of urea in serum (BI11.21)	1
7	Demonstrate estimation of serum protein, albumin and A:G ratio (BI11.7, BI11.21)	1

Note: In Theory, Practicals and Certification of Skill sections, topics with corresponding competency numbers as mentioned in Volume 1 of Competency based Undergraduate Curriculum for Indian Medical graduate (2018), prescribed by Medical Council of India , have been mentioned.

iii. SUGGESTED AREAS FOR INTEGRATION:

As per the "Competency based Undergraduate Curriculum for the Indian Medical Graduate 2018: Medical Council of India"

iv. EARLY CLINCAL EXPOSURE (ECE): Needs to be entered in Log book CLINICAL SKILLS - 12 hours Suggested cases for hospital visit

- Anemia
- Jaundice
- Renal failure
- Diabetes Mellitus

BASIC SCIENCE CORRELATION - 18 hours Suggested topics -

- Biochemical basis of myocardial infarction (dyslipidemia, atherosclerosis, diagnostic tests)
- Biochemical basis of acute complications of diabetes mellitus
- Biochemical alterations in diarrhea (acid base and electrolyte and ORS management
- Biochemical basis of Metabolic syndrome
- Critical alerts in Biochemistry lab test results.
- Evidence based laboratory medicine

v. SELF DIRECTED LEARNING (SDL):

Suggested topics for log book entry in the form of concept mapping

- RBC membrane composition and Biochemical basis of Hereditary spherocytosis
- Respiratory distress syndrome
- Advanced glycation end products and complications of Diabetes Mellitus
- Hormonal basis of osteoporosis
- Cardiovascular risk assessment score
- Biochemical basis of Alzheimer disease

AETCOM MODULES TO BE COVERED UNDER BIOCHEMISTRY:

AETCOM module number (as per MCI document)	**Topic**
1.4	**The foundations of communication - 1**

Suggested format for reflective writing for the above AETCOM modules is given in ANNEXURE III. This could be a part of the practical record book.

SCHEME OF EXAMINATION

INTERNAL ASSESSMENT

[Kindly refer section II for general guidelines**]**

Sche me for calculation of Internal assessment marks:

Theory (maximum marks)	Marks	Practicals	Marks
Theory written paper	30*	Practical exam (25 marks) and viva-voce (5 marks)	30**
Formative assessment		Formative assessment	
MCQs/unit test/seminars/assignments/ Case based learning tests	10	Early clinical exposure + Skill certification	5
		Practical record	5
Total	40		40

Please note:

*Prior to submission to the University, the marks for each of the three internal examination theory assessments must be calculated out of 30 marks, regardless of the maximum marks.

**Prior to submission to the University, the marks for each of the three internal examination practical assessments must be calculated out of 30 marks, regardless of the maximum marks.

Only the final marks out of 40 needs to be submitted to the University, separately for theory and practical for each internal assessment.

UNIVERSITY EXAMINATIONS [Kindly refer section II for general guidelines]

TABLE SHOWING SCHEME FOR CALCULATION OF UNIVERSITY EXAMINATION MARKS

Theory (maximum marks)		Practical (maximum marks)	
Paper 1	100	Practical exam (Practical Exercise 1 to 4)	80
Paper 2	100	Viva-voce	20
TOTAL	200	TOTAL	100

A. THEORY: 200 Marks

There shall be two theory papers of 100 marks each and duration of each paper shall be 3 hours. The pattern of questions in each paper shall be as mentioned below

Type of Question	**Number of Questions**	**Maximum Marks for each question**	**Total**
Structured Long essay questions (SLEQ) [Includes one case vignette-based question (CVBQ)]	2	10	**20**
Short ESSAY questions (SEQ) [includes two case vignette-based questions (CVBQ)]	10	05	**50**
Short answer questions (SAQ)	10	03	**30**
Total marks			**100**

Note:

1. A suggested format for blueprint of question paper is shown in Annexure I
2. Please refer Annexure II for suggested model question paper

B. 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.

C. 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)

Distribution of topics for Paper 1 and Paper 2 for University examination Topic wise weightage

Sl No	Paper 1 Topics	Weightage Up to (in marks)
1	Cell, cellular organelles and membrane transport	5
2	Extra cellular matrix	3
3	Enzymes	13
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

Sl No	Paper 2 Topics	Weightage Upto (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.
- **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.**

ANNEXURE I

BLUE PRINT FOR QUESTION PAPER
(to be filled by the question paper setter)

- Total marks under each type of question from each topic needs to be entered by QP Setter. • It should be in accordance with RGUHS guideline
-

BIOCHEMISTRY PAPER 1

A	B	C	D	E	G	H	I	
Sl No	**Topic**	**Total max as per RGUHS guideline**	**SLEQ 10 marks (including one CVBQ of 10 marks)**	**SEQ 5 marks each (including two CVBQ of 5 marks)**	**SAQ 3 marks each**	**Total marks from each topic (total of columns from D to G)**	**Higher order thinking skills questions (including CVBQs)**	
							Question number	**Marks**
1	Cell, cellular organelles and membrane transport	5						
2	Extra cellular matrix	3						
3	Enzymes	13						
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						

SLEQ- Structured Long Essay Question; SEQ- Short Essay Question; SAQ- Short Answer Question ; CVBQ- Case Vignette Based Question

Marks allocated to questions that assess higher order thinking skills (%) =

BIOCHEMISTRY PAPER 2

A	B	C	D	E	G	H	I	
Sl No	**Topic**	**Total max as per RGUHS guideline**	**SLEQ 10 marks (including one CVBQ of 10 marks)**	**SEQ 5 marks each (including two CVBQ of 5 marks)**	**SAQ 3 marks each**	**Total marks from each topic (total of columns from D to G)**	**Higher order thinking skills questions (including CVBQs)**	
							Question number	**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						

SLEQ- Structured Long Essay Question; SEQ- Short Essay Question; SAQ- Short Answer

Question; CVBQ- Case Vignette Based Question

Marks allocated to questions that assess higher order thinking skills (%) =

Note:

1. Question paper may be framed using "Blue print "table as guideline
2. A minimum of 35% marks in each paper shall be allocated to questions that assess the higher order thinking skills of the student. This includes Case Vignette based questions.
3. Column 'I' has been provided for calculating percentage of marks allotted for questions assessing higher order thinking skills.

ANNEXURE II

Rajiv Gandhi University of Health Sciences, Karnataka

First Phase MBBS Degree examination

Model Question paper

Biochemistry (RS-4) Draw

a neat labelled diagram wherever necessary

Time= Three hours **Paper I** **Maximum marks= 100**

Long essays 2X10= 20 marks

1. A 30-year-old male came to the Physician with complaints of excessive hunger, weight loss and increased thirst since few months. Following results were obtained on testing-
   i. Blood: Random Blood Sugar- 400 mg/dL ii.
   Urine: Benedict's Test – Orange precipitate
   a. What is the probable diagnosis?
   b. What is the biochemical basis of symptoms?
   c. Name the lab tests used to monitor the patient after confirmation of diagnosis?
   d. Discuss the mechanism of regulation of blood glucose levels?

(1+3+1+5=10 marks) 2. Discuss iron with respect to the following aspects-

   a. Dietary sources
   b. Absorption and transport
   c. Deficiency manifestations
   d. Laboratory findings in deficiency (1+5+2+2=10 marks)

Short essays (10X5= 50 marks)

3. A 50-year-old male presented to emergency medicine department with complaints of severe chest pain and sweating since 6 hours. After further examination and testing, he was diagnosed as having Myocardial infarction.
   a. What would be the best marker for diagnosing Myocardial infarction in this patient (1 mark)
   b. What is the biochemical basis of using such a marker (3 marks)

c. List other markers that have been used to diagnose myocardial infarction (1 mark)

4. A 60-year-old female presented with tingling and numbness in fingers, and muscle cramps in hands. On examination, Chvostek's and Trousseau's signs were observed. She had previously undergone Thyroidectomy for Grave's disease. Following results were obtained on testing-
   i. Serum Calcium- 6 mg/dL
   ii. Serum Phosphrous – 7 mg/dL

   a. What is your diagnosis? (1 mark)
   b. What is the biochemical basis for symptoms and laboratory findings? (3 marks)
   c. Name another mineral deficiency which has similar manifestations as the above (1 mark)
5. Discuss the metabolic changes in starvation.
6. Describe the mechanism of Oxidative phosphorylation
7. What are mucopolysaccharides. Mention the composition and biological importance of any 4 mucopolysaccharides. (1+4 marks)
8. Discuss the functions and clinical significance of lysosomes
9. Prescribe a balanced diet for a 70 kg male with moderate physical activity
10. Discuss the β-oxidation of fatty acids under following headings-
    a. Biological significance (0.5 marks)
    b. Steps (4 marks)
    c. Energy released by oxidation of one molecule of palmitic acid (0.5 marks)
11. Give biochemical reasons for the following
    a. Neurological and dermatological manifestations in Vitamin B6 deficiency (2 marks)
    b. A patient on Anti-tuberculous treatment may develop Vitamin B6 deficiency (1 mark)
    c. Neurological manifestations in Vitamin B12 deficiency (2 marks)
12. Explain the biochemical basis for the following-
    a. LDL is called the 'bad' cholesterol and HDL is called the "good' cholesterol (2 marks)
    b. Fasting hypoglycemia and hyperuricemia in Von Gierke disease (2 marks)
    c. Lung surfactant prevents Respiratory distress syndrome (1 mark)

Short answers (10X3= 30 marks)

13. Explain the renal regulation of pH with diagram.
14. Mechanism of Renin angiotensin system in maintaining fluid balance
15. Discuss briefly Vitamin B1 with respect to deficiency manifestations and laboratory findings in deficiency (2+1 marks)
16. a. List two functions of collagen. (1 mark)
    b. Mention the nature of collagen abnormality in (2 marks)
       i. Osteogenesis Imperfecta
       ii. Ehlers- Danlos Syndrome
17. Briefly explain Kohsland's induce fit theory
18. Name essential fatty acids. Mention their biological significance (1+2 marks).
19. Differentiate between high and normal anion gap metabolic acidosis with an example.

20. Give biochemical reasons for the following-
    a. Selenium has a sparing action on Vitamin E (1 mark)
    b. Fluoride is used as preservative for blood glucose (2 marks)
21. Explain the metabolic changes leading to production of ketone bodies.
22. Give biochemical reasons for the following
    a. Urine is acidic in metabolic alkalosis (1 mark)
    b. Hyperkalemia is generally associated with metabolic acidosis (1 mark)
    c. Hyperkalemia is a critical alert in laboratory (1 mark)

1. A guide to preparation of Case based question for Practical Examination

Q. An elderly man was brought to the emergency ward with chief complaints of nausea, vomiting, decreased urine output, bilateral swelling of feet and increased thirst. On examination he was lethargic, and disoriented with pedal oedema, tachycardia, BP – 100/60 mmHg, dry tongue and decreased skin turgor.

- Interpret the history and mention the possible diagnosis.
- Write the principle and estimate the concentration of given quantitative parameter in the sample provided and write your interpretation.
- What other biochemical investigations can be carried out to arrive at a final diagnosis?

ANNEXURE III

(Note: questions could be added/modified to this document which is at the discretion of individual institution. This appendix could be a part of practical record/logbook of Biochemistry)

SUGGESTED FORMAT FOR AETCOM SESSIONS

Name of the Facilitator: Date:

AETCOM module Number: Session number:

AETCOM Topic:

Competencies / Objectives:

1.

2.

3.

1. Briefly describe what you learnt from this AETCOM session in relation to the objectives. (in 100-150 words)

2. Apart from the above learning, what did you observe that influenced (Positive/negative) you during this session? (in 100-150 words)

Remarks by Facilitator:

Signature of Facilitator:

5. 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. Bhagavan and Ha. Essentials of Medical Biochemistry with clinical cases
5. Stryer. Biochemistry
6. James Watson. Molecular biology of gene

RAJIV GANDHI UNIVERSITY OF HEALTH SCIENCES

BANGALORE, KARNATAKA

MBBS PHASE 1

LOG BOOK FORMAT

FOR PRE-CLINICAL SUBJECTS

NAME OF THE CANDIDATE :

NAME OF THE COLLEGE :

ACADMEIC YEAR :

INDEX

BONAFIDE CERTIFICATE

This is to certify that this log book is the bonafide record of Mr./Ms…….....whose particulars along is given above. His/ Her log of competencies acquired, are as noted in the entries in this log book as per the Competency Based Undergraduate Medical Education Curriculum, Graduate Medical Regulation 2018, during the period …….. to……..

Signature with date

Head, Department of Anatomy :

Head, Department of Physiology :

Head, Department of Biochemistry :

Principal/Dean :

BASIC PROFORMA OF THE STUDENT

PARTICULARS OF THE STUDENT:

Name of the student :

Date of Birth :

Father's name :

Mother's name :

Address :

Contact no : Email id :

Signature: .....

Photo

SUGGESTED GUIDELINES FOR LOG BOOK:
GENERAL INFORMATION:

1. The log book is a record of the academic / non-academic activities of the student.
2. Each medical student is responsible for maintaining their logbook.
3. Entries in the log book will be in accordance with activities done in the pre-clinical departments.
4. Some sections of the logbook are subject specific and have to be scrutinized by the head of the concerned department
5. It is the responsibility of the student to enter their activity in respective pages and get them duly signed by the supervising faculty.
6. The log book shall be kept as record work of the candidate for that department /specialty and be submitted to department as a Bonafide record of the candidate before appearing for the university examination.

NOTE: The contents in the log book are suggested guidelines. The institutions can make necessary changes as per the needs.

ANATOMY

Suggested format for assessing professionalism

Quarter	Overall attendance (5)	Timely submission of record books (5)	Takes the trouble to complete the record book well (5)	Behaves respectfully with peers and teachers (5)	Total (20)	Date	Signature of student	Signature of mentor
1st								
2nd								
3rd								

Guidelines for scoring (to be shown to the student and discussed with them)

Attendance – 95-100% - 5; 90-94% - 4; 85-89% - 3; 80-84% - 2

Timely submission of records – Always submits the record on time – 5; Often submits the record on time – 4; Sometimes submits the record on time – 3; Rarely submits the record on time – 2

Takes the trouble to complete the record well – Diagrams are neatly drawn with complete labelling – 5; Diagrams are of above average quality with nearly complete labelling – 4; Diagrams are of average quality with partial labelling- 3; Diagrams are of below average quality with inadequate labelling – 2

Behaves respectfully with peers and teachers – Always speaks politely and demonstrates the appropriate body language with peers and teachers – 5; Often speaks politely and demonstrates the appropriate body language with peers and teachers – 4; Sometimes speaks politely and demonstrates the appropriate body language with peers and teachers – 3; Rarely speaks politely and demonstrates the appropriate body language with peers and teachers – 2;

Suggested format for assessing participation in ECE sessions

Name:……

Date:…….

ECE session…….

1 = strongly agree. 2 = agree. 3 = no preference. 4 = disagree. 5 = strongly disagree.						
Critical appraisal		**1**	**2**	**3**	**4**	**5**
1	Clarifies, defines and analyses the problem from the scenario / interaction with patient					
2	Identifies learning objectives					
3	Demonstrates initiative and curiosity					
Utilization of learning resources						
4	Utilises relevant resource materials effectively					
5	Applies knowledge to new situations to solve problems and to reach decisions					
Group work						
6	Organised and prepared for small group sessions					
7	Shares thoughts and opinions with peers actively					
Attitudes and Communication Skills						
8	The oral expression is clear enough to be understood					
9	Provides and accepts constructive feedback					
10	Contributes to group harmony (listens to conflicting opinions and tolerates shortcomings of others)					

Comment:

To describe the strengths and suggested areas for improvement of the reviewed student and to assist him/her to be a more effective learner.

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			
1.	Test 1						
2.	1st Internal Examination						
	Theory						
	Practical						
3.	Overall 1st quarter marks						
4.	Test 2						
5.	2nd Internal Examination						
	Theory						
	Practical						
6.	Overall 2nd quarter marks						
7.	Test 3						
8.	3rd Internal Examination						
	Theory						
	Practical						

9.	**Overall 3rd quarter marks**						

Suggested format for monitoring performance in student seminars

SEMINARS

Sl no	Date	Topic	Level of participation [attended/presented]	Remarks if any	Signature of faculty/mentor
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					
16.					
17.					
18.					

Practical completion certificate

This is to certify that the prescribed Anatomy practicals for the I MBBS have been performed by the student satisfactorily

Date Signature of Faculty/Mentor

PHYSIOLOGY

Suggested format for assessing professionalism

Quarter	Overall attendance (5)	Timely submission of record books (5)	Takes the trouble to complete the record book well (5)	Behaves respectfully with peers and teachers (5)	Total (20)	Date	Signature of student	Signature of mentor
1st								
2nd								
3rd								

Guidelines for scoring (to be shown to the student and discussed with them)

Attendance – 95-100% - 5; 90-94% - 4; 85-89% - 3; 80-84% - 2

Timely submission of records – Always submits the record on time – 5; Often submits the record on time – 4; Sometimes submits the record on time – 3; Rarely submits the record on time – 2

Takes the trouble to complete the record well – Diagrams are neatly drawn with complete labelling – 5; Diagrams are of above average quality with nearly complete labelling – 4; Diagrams are of average quality with partial labelling- 3; Diagrams are of below average quality with inadequate labelling – 2

Behaves respectfully with peers and teachers – Always speaks politely and demonstrates the appropriate body language with peers and teachers – 5; Often speaks politely and demonstrates the appropriate body language with peers and teachers – 4; Sometimes speaks politely and demonstrates the appropriate body language with peers and teachers – 3; Rarely speaks politely and demonstrates the appropriate body language with peers and teachers – 2;

Suggested format for monitoring academic performance and providing feedback – Internal assessments and formative assessments

Assessment	Marks	Feedback of faculty/mentor		Date	Signature of student	Signature of mentor
		Positive points	Points that could be improved			
I Internal assessment						
Theory paper **Practical + viva**						
Formative assessment part I						
Theory: (System reviews) **Practical:** • **Practical record completion** • **Early clinical exposure** • **Skill certification**						
II Internal assessment						
Theory paper **Practicals + viva**						
Formative assessment part II						

eory: (System iews) **ıcticals:** **Practical record completion** **Early clinical exposure** **Skill certification**						
						141

Third Internal assessment						
eory paper **ıcticals + viva**						
Formative assessment part III						
eory: (System iews) **ıcticals:** **Practical record completion** **Early clinical exposure** **Skill certification**						

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Suggested format for monitoring performance in student seminars

SEMINARS

Sl no	Date	Topic	Level of participation [attended/presented]	Remarks if any	Signature of faculty/mentor

175

Suggested format for Certification of skills

(Note: the skill checklists are to be used as a guide for evaluation could be a part of the practical record book and a documentation of the same could be kept in the department. The following is for logbook entry of confirming the completion of skill certifications)

Sl No	Date	Skill	Date of certification	Signature of Observer
1		Record blood pressure & pulse at rest		
2		Effect of posture on blood pressure and pulse rate (supine to standing posture)		
3		Effect of different grades of exercise on blood pressure and pulse rate		
4		Demonstrate the correct clinical examination of the respiratory system		
5		Demonstrate the correct clinical examination of the Higher mental functions		
6		Demonstrate the correct clinical examination of sensory system		
7		Demonstrate the correct clinical examination of motor system		
8		Demonstrate the correct clinical examination of reflexes		
9		Demonstrate the correct clinical examination of cranial nerves		
10		Demonstrate clinical examination of Testing of visual acuity, colour and field of vision		
11		Demonstrate the correct clinical examination of hearing		
12		Demonstrate the correct clinical examination of Testing for smell		

13		Demonstrate the correct clinical examination of taste sensation		

Suggested format for Early clinical exposures and related activities

Sl No	Date of visit	Title of the visit	Signature of the mentor

Suggested format for AETCOM

Date	Topic	Signature of the mentor

Suggested format documentation and feedback for self-directed learning

Sl no	Date	Topic	Feedback	Signature of faculty/mentor

Practical completion certificate

This is to certify that the prescribed physiology practicals for the I MBBS have been performed by the student satisfactorily

Date Signature of Faculty/Mentor

BIOCHEMISTRY

a. 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			
1.	Test 1						
2.	1st Internal Examination						
	Theory						
	Practical						
3.	Overall 1st quarter marks						
4.	Test 2						
5.	2nd Internal Examination						
	Theory						
	Practical						
6.	Overall 2nd quarter marks						
7.	Test 3						
8.	3rd Internal Examination						
	Theory						
	Practical						
9.	Overall 3rd quarter marks						

b. Suggested format for assessing professionalism

Quarter	Overall attendance (5)	Timely submission of record books (5)	Takes the trouble to complete the record book well (5)	Behaves respectfully with peers and teachers (5)	Total (20)	Date	Signature of student	Signature of mentor
1st								
2nd								
3rd								

Guidelines for scoring (to be shown to the student and discussed with them)

Attendance – 95-100% - 5; 90-94% - 4; 85-89% - 3; 80-84% - 2

Timely submission of records – Always submits the record on time – 5; Often submits the record on time – 4; Sometimes submits the record on time – 3; Rarely submits the record on time – 2

Takes the trouble to complete the record well – Excellent: Presentation of content above expectations – 5; Good: Presentation of content meets expectations – 3; Needs Improvement: Presentation of content below expectations -1.
Content: Includes Tables, Charts, Diagrams, Calculations etc.

Behaves respectfully with peers and teachers – Always speaks politely and demonstrates the appropriate body language with peers and teachers – 5; Often speaks politely and demonstrates the appropriate body language with peers and teachers – 4; Sometimes speaks politely and demonstrates the appropriate body language with peers and teachers – 3; Rarely speaks politely and demonstrates the appropriate body language with peers and teachers – 2;

Suggested format for student seminars participation

SEMINARS

Sl no	Date	Topic	Level of participation [attended/presented]	Remarks if any	Signature of faculty/mentor
1.					
2.					
3.					
4.					
5.					

c. 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.

1. Briefly describe what you learnt from this clinical visit in relation to the objectives. (in 100-150 words)

2. Apart from the above learning, what did you observe that influenced (Positive/negative) you? (in 100-150 words)

Signature of Facilitator

**Scoring pattern can be decided by individual colleges*

d. Suggested format for SELF DIRECTED LEARNING Topics

(Minimum one entry per term)

Name of the Facilitator:

SDL Topic:

SUMMARY OF CONCEPTS LEARNT (Concept map):

Signature of Facilitator

**Scoring pattern can be decided by individual colleges*

e. CERTIFICATION 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 glucose		
4.	BI11.21	Demonstrate estimation of 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		

Certification of Competencies - Skill Acquisition

Suggested format for checklist General Guidelines

(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 appropriate interpretations independently and can be certified
- **Does not meet expectations (DME)** -
  Student needs further training to perform and report the test results with appropriate interpretations independently and a re evaluation to certify the same.
  B: > than 50% of criteria meets expectation, reevaluation needed only for criteria which have not met 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 to students regards the areas for improvement/reassessment

Checklist 1:
Description of competency: Perform urine analysis to estimate and determine normal constituents (BI 11.4)

Sl No	Assessment criteria	Date of evaluation		
1	Student is able to list all physical characteristics of normal urine			

2	Student is able to perform the physical examination of urine sample for Volume, appearance, colour, odour, pH and specific gravity			
3	Student is able to interpret the results of all the above physical examination of urine sample			
4	Student is able to list common organic constituents (Urea, Uric acid, Creatinine, Urobilinogen) of normal urine and the tests to be performed			
5	Student is able to explain the principles of all organic tests performed for normal constituents of urine			
6	Student is able to perform relevant tests for organic constituents of urine according to the procedure given			
7	Student is able to interpret the results of all the tests for organic constituents of normal urine along with normal levels in urine			
8	Student is able to list common inorganic constituents (Calcium, Phosphate, Ammonia) of normal urine and the tests to be performed			
9	Student is able to explain the principles of all organic tests performed for normal constituents of urine			
10	Student is able to perform relevant tests for inorganic constituents of urine according to the procedure given			
11	Student is able to interpret the results of all the tests performed for inorganic constituents of normal urine along with normal levels in urine			
12	Student is able to interpret the physiological and pathological variations in organic and inorganic constituents of urine			
	Overall performance (A/B/C)			
	Appropriate feedback given to student (yes/No)			
	Name of Evaluator			
	Signature of evaluator			
	Signature of student			

It is hereby certified that the student is competent to perform the above mentioned skill

Date of certification:

Name and Signature of Evaluator:

Checklist 2

Description of competency: Perform urine analysis to determine Abnormal constituents, interpret the findings and correlate with pathological states (BI 11.4 and BI 11.20)

Sl	Assessment criteria	Date of evaluation

No				
1	Student is able to list the common abnormal constituents of urine (reducing substance, ketone bodies, proteins, blood, bile salts, bile pigments)			
2	Student is able to perform the physical examination of abnormal urine sample for Volume, appearance, colour, odour, pH and specific gravity			
3	Student is able to interpret the results of all the above physical examination of urine sample in different pathological conditions			
4	Student is able to list the relevant chemical tests to be performed to detect abnormal constituents of urine			
5	Student is able to explain the principles of all the chemical tests correctly			
6	Student is able to perform all the chemical tests correctly according to the procedure given			
7	Student is able to interpret the observations of all the tests as positive or negative correctly			
8	Student is able to explain the biochemical basis of combination of positive findings on physical examination and chemical analysis of given abnormal urine sample			
9	Student is able to interpret and associate various abnormal physical findings with different pathological conditions			
10	Student is able to interpret and associate various abnormal constituents with different pathological conditions			
	Overall performance (A/B/C)			
	Appropriate feedback given to student (yes/No)			
	Name of Evaluator			
	Signature of evaluator			
	Signature of student			

It is hereby certified that the student is competent to perform the above-mentioned skill

Date of certification:

Name and Signature of Evaluator:

Checklist 3

Description of competency: Demonstrate estimation of Glucose in serum (BI 11.21)

Sl No	Assessment criteria	Date of evaluation		
1	Student is able to explain the Principle of the given method of estimation of Glucose			
2	Student is able to mention other methods for estimation with advantages and disadvantages			
3	Student is able to perform the estimation of Serum glucose in given sample according to the given procedure correctly			
4	Student is able to calculate the concentration of the given analyte using the appropriate formula.			
5	Student is able to write the report of the given test requested correctly with appropriate units and reference intervals			
6	Student is able to mention the preanalytical errors that could affect the test result			
7	Student is able to mention the right collection tube and right time for collecting fasting and post prandial samples			
8	Student is able to interpret the report of the given sample according to current standard guidelines using biological reference intervals of fasting, postprandial and random glucose.			
9	Student is able to relate the findings of estimation performed with clinical condition appropriately			
10	Student is able to extrapolate the results of serum glucose in different clinical conditions appropriately			
	Overall performance (A/B/C)			
	Appropriate feedback given to student (yes/No)			
	Name of Evaluator			
	Signature of evaluator			
	Signature of student			

It is hereby certified that the student is competent to perform the above-mentioned skill

Date of certification:

Name and Signature of Evaluator:

Checklist 4 Description of competency: Demonstrate estimation of serum creatinine and creatinine clearance (BI 11.7, BI 11.21)

Sl No	Assessment criteria	Date of evaluation		
1	Student is able to explain the Principle of the given method of estimation of Serum Creatinine			
2	Student is able to mention other methods for estimation with advantages and disadvantages			
3	Student is able to perform the estimation of Serum Creatinine in given sample according to the given procedure correctly			
4	Student is able to calculate the concentration of the given analyte using the appropriate formula.			
5	Student is able to write the report of the given test requested correctly with appropriate units, reference intervals and interpret the result correctly.			
6	Student is able to mention the non-Creatinine interferences that could affect the test result			
7	Student is able to calculate Creatinine clearance using appropriate formula correctly and interpret the results			
8	Student is able to mention the indications for Creatinine clearance and its advantages.			
9	Student is able to calculate estimated Creatinine clearance using different formulae, different urine Creatinine ratios with their advantages.			
10	Student is able to explain the biochemical basis of altered levels of Creatinine in serum and urine in different pathological conditions			
	Overall performance (A/B/C)			
	Appropriate feedback given to student (yes/No)			
	Name of Evaluator			
	Signature of evaluator			
	Signature of student			

It is hereby certified that the student is competent to perform the above-mentioned skill

Date of certification:

Name and Signature of Evaluator:

Checklist 5

Description of competency: Demonstrate estimation of urea in serum (BI 11.21)

Sl No	Assessment criteria	Date of evaluation		
1	Student is able to explain the Principle of the given method of estimation of Serum Urea			
2	Student is able to mention other methods for estimation with advantages and disadvantages			
3	Student is able to perform the estimation of Serum Urea in given sample according to the given procedure correctly			
4	Student is able to calculate the concentration of the given analyte using the appropriate formula.			
5	Student is able to write the report of the given test requested correctly with appropriate units and reference intervals			
6	Student is able to mention the preanalytical errors/ interferences that could affect the test result			
7	Student is able to calculate Blood urea nitrogen and explain its importance			
8	Student is able to enumerate various pre renal, renal and post renal causes for Uremia			
9	Student is able to relate the findings of estimation performed with clinical condition appropriately			
10	Student is able to extrapolate the results of serum urea in different clinical conditions appropriately			
	Overall performance (A/B/C)			
	Appropriate feedback given to student (yes/No)			
	Name of Evaluator			
	Signature of evaluator			
	Signature of student			

It is hereby certified that the student is competent to perform the above mentioned skill

Date of certification:

Name and Signature of Evaluator:

Checklist 6

Description of competency: Demonstrate estimation of serum protein , albumin and A:G ratio(BI 11.8, BI 11.21)

Sl No	Assessment criteria	Date of evaluation		
1	Student is able to explain the Principle of the given method of estimation of Serum Total Protein and Serum Albumin			
2	Student is able to perform the estimation of Serum Total Protein and Serum Albumin in given sample according to the given procedure correctly			
3	Student is able to calculate the concentration of the given analyte using the appropriate formula.			
4	Student is able to calculate Total globulin level and A:G ratio correctly			
5	Student is able to write the report of the given test requested correctly with appropriate units and reference intervals			
6	Student is able to enumerate and explain the causes for Hypoproteinemia/ Hypoalbuminemia correctly			
7	Student is able to enumerate and explain the causes of Hyperproteinemia correctly			
8	Student is able to enumerate and explain the causes of reversed A:G ratio correctly			
9	Student is able to relate the findings of estimation performed with clinical condition appropriately			
10	Student is able to extrapolate the results of serum total protein and serum albumin in different clinical conditions appropriately			
	Overall performance (A/B/C)			
	Appropriate feedback given to student (yes/No)			
	Name of Evaluator			
	Signature of evaluator			
	Signature of student			

It is hereby certified that the student is competent to perform the above mentioned skill

Date of certification:

Name and Signature of Evaluator:

Practical completion certificate

This is to certify that the prescribed Biochemistry practicals for the I MBBS have been performed by the student satisfactorily

Date Signature of Faculty/Mentor

Other academic/non-academic activities

CONFERENCE/CME/WORKSHOP ATTENDED

SL NO	DATE	PARTICULARS	REMARKS IF ANY	SIGNATURE OF STAFF

SCIENTIFIC PROJECT PRESENTATIONS/REPORTS/ OUTREACH ACTIVITIES

SL NO	DATE	PARTICULARS	SIGNATURE OF STAFF

ACHIEVEMENTS/ AWARDS /ANY OTHER ACTIVITIES

SL NO	DATE	PARTICULARS	SIGNATURE OF FACULTY

EXTRACURRICULAR ACTIVITIES

SL NO	DATE	PARTICULARS	SIGNATURE OF FACULTY

Handbook of competencies and specific learning objectives

COMPETENCY BASED UNDERGRADUATE CURRICULUM FOR

THE INDIAN MEDICAL GRADUATE

MBBS Phase I

RAJIV GANDHI UNIVERSITY OF HEALTH SCIENCES, KARNATAKA

4th T Block, Jayanagar, Bengaluru- 560041

RAJIV GANDHI UNIVERSITY OF HEALTH SCIENCES, KARNATAKA 4th T Block, Jayanagara, Bangalore -560041

MBBS PHASE I

HUMAN ANATOMY

[CODE: AN]

Handbook of competencies and specific learning objectives

COMPETENCY BASED UNDERGRADUATE CURRICULUM FOR THE INDIAN MEDICAL GRADUATE

PREFACE

A competency refers to the *"observable knowledge, skills or attitudes defined in terms of behaviours needed for successful job performance"*. The Medical Council of India (MCI) has listed four hundred and nine competencies under eighty-two topics in the competency-based curriculum (CBC) for the subject of Anatomy for the Phase I MBBS students. In order for these competencies to be achieved, specific learning objectives (SLOs') need to be framed for individual teaching-learning (TL) sessions and for assessment. This handbook lists the competencies and SLOs' for the entire course and provides guidelines about the TL and assessment methods along with the time requirements. The handbook follows the template of the CBC document and mentions the code number, learning domain/s addressed, level of competency required based on Miller's pyramid and whether or not the competency is core or non-core. It is hoped that this document will be useful for faculty to design TL activities and develop assessment strategies to ensure that the students achieve the learning outcomes envisaged in the CBC document.

INDEX

Understanding the competencies table

A	B	C	D	E	F	G	H	I	J
No.	Competencies	Domain	K/KH/SH/P	Core	Suggested Teaching Learning Method	Suggested Assessment method	No. required to certify (P)	Vertical Integration	Horizontal Integration
Physiology									
Summary Name of Topic: General Physiology Number of Competencies: (08)									
PY1.1	Describe the structure and functions of a	K	KH	Y	Lectures, Small group discussion	Written/Viva			Biochemistry
IM25.4	Elict *document* and present a medical history that helps delineate the	S	SH	Y	Bed Side clinic, DOAP	Skill assessment		Community Medicine	

Description of competency

Unique number of the competency. First two alphabets represent the subject (see list); number following alphabet reflects topic number, following period is a running number.

Identifies the domain or domains addressed
K - Knowledge
S - Skill
A - Attitude
C - Communication

Identifies the level of competency required based on the Miller's pyramid
K - Knows
KH - Knows How
S - Skill
SH - Show How
P - Perform independently

Identifies if the competency is core or desirable.
Y indicates Core; N-non-core

Identifies the suggested learning method.
DOAP - Demonstrate (by Student) Observe, Assist Perform)

Identifies the suggested assessment method
Skill assessment - Clinics, Skills lab, Practicals etc.

no of times a skill needs to be done independently to be certified for independent performance; Rarely used in UG

Subject (s) in other phases with which the competency can be vertically integrated to increase relevance or improve basic understanding

Subject (s) in the same phase with which the competency can be horizontally integrated or aligned to allow a more wholesome understanding

***Numbers given are for illustrative purposes only and should not be compared with the same in curriculum documents**

**From the CBC document*

Deriving learning objectives from competencies

K	Knows	A knowledge attribute – Usually enumerates or describes
KH	Knows how	A higher level of knowledge – is able to discuss or analyse
S	Shows	A skill attribute: is able to identify or demonstrate the steps
SH	Shows how	A skill attribute: is able to interpret / demonstrate a complex procedure requiring thought, knowledge and behaviour
P	Performs (under supervision or independently)	Mastery for the level of competence - When done independently under supervision a pre-specified number of times - certification or capacity to perform independently results

Competency: An **observable** ability of a health professional, **integrating multiple components** such as knowledge, skills, values and attitudes.

PA42.3*	**Identify the etiology of meningitis based on given CSF parameters**	K/S	SH	Y

PA42.1*	At the end of the session the **phase II student** must be able to enumerate the most common causes of meningitis correctly
PA42.2*	At the end of the session the **phase II student** must be able to enumerate the components of CSF analysis correctly
PA42.3*	At the end of the session the **phase II student** must be able to **describe** the CSF features for a given etiology of meningitis **accurately**
PA42.4*	At the end of the session the **phase II student** must be able to identify the aetiology of meningitis correctly from a **given set of CSF parameters**

Audience - who will do the behavior

Behavior - What should the learner be able to do?

Condition - Under what conditions should the learner be able to do it?

Degree – How well must it be done

Objective: Statement of what a learner should be able to do at the end of a specific learning experience
***Numbers given are for illustrative purposes only and should not be compared with the same in curriculum documents**

**From the CBC document*

Deriving learning methods from competencies

Competency: An **observable** ability of a health professional, **integrating multiple components** such as knowledge, skills, values and attitudes.

PA42.3*	**Identify** the etiology of meningitis based on given CSF parameters	K/S	SH	Y

Objective: Statement of what a learner should be able to do at the end of a specific learning experience

PA42.1*	At the end of the session the **Phase II student** must be able to enumerate the most common causes of meningitis **correctly**	Lecture or small group discussion
PA42.2*	At the end of the session the **Phase II student** must be able to enumerate the components of a CSF analysis correctly	Related objectives can be combined into one teaching session
PA42.3*	At the end of the session the **Phase II student** must be able to **describe** the CSF features for a given etiologic of meningitis **accurately**	
PA42.4*	At the end of the session the **Phase II student** must the able to identify the aetiology of meningitis correctly from a **given set of CSF parameters**	small group discussion, practical session

*Numbers given are for illustrative purposes only and should not be compared with the same in curriculum documents

**From the CBC document*

Deriving assessment methods from competencies

Competency: An observable ability of a health professional, integrating multiple components such as knowledge, skills, values and attitudes.

PA42.3*	**Identify** the etiology of meningitis based on given CSF parameters	K/S	SH	Y

Objective: Statement of what a learner should be able to do at the end of a specific learning experience

PA42.1*	At the end of the session the Phase II student must be able to enumerate the most common causes of meningitis correctly	Short note or part of structured essay: Enumerate 5 causes of meningitis based on their prevalence in India
PA42.2*	At the end of the session the **Phase II student** must be able to enumerate the components of a CSF analysis correctly	Short note or part of structured essay: Enumerate the components tested in a CSF analysis
PA42.3*	At the end of the session the **Phase II student** must be able to **describe** the CSF features for a given aetiology of meningitis **accurately**	Short note or part of structured essay: Describe the CSF findings that are characteristic of tuberculous meningitis
PA42.4*	At the end of the session the **Phase II student** must the able to identify the aetiology of meningitis correctly from a **given set of CSF parameters**	Short note / part of the structured essay/ Skill station/ Viva voce Review the CSF findings in the following patient and identify (write or vocalise) the most likely etiology

*** Numbers given are for illustrative purposes only and should not be compared with numbers in the curriculum document**

**From the CBC document*

Deriving assessment methods from competencies

Competency: An **observable** ability of a health professional, **integrating multiple components** such as knowledge, skills, values and attitudes.

MI2.4*	List the common microbial agents causing anemia. Describe the morphology, mode of infection and discuss the pathogenesis, clinical course, diagnosis and prevention and treatment of the common microbial agents causing Anemia.	K	KH	Y	Didactic Small group discussion	Written/ Viva voce	Medicine	Pathology

Objective: Statement of what a learner should be able to do at the end of a specific learning experience

MI2.1*	Enumerate the common microbial agents causing anaemia
MI2.2*	Describe the morphology of agent (1,2 etc)
MI2.3*	Describe the mode of infection of agent in humans
MI2.4*	Discuss the pathogenesis of anemia caused by agent
MI2.5*	Describe the clinical course of infection by agent
MI2.6*	Enumerate the diagnostic tests to identify the aetiology of agent as a cause of anemia
MI2.7*	Discuss the methods to prevent infection by agent
MI2.8*	Describe the treatment of infection by agent

Integrate concept - not necessarily teachers
Plan session with teachers of both subjects -teachers from both subjects usually not needed. Ensure redundancy and duplication by reviewing both subjects

Horizontally aligned and integrated with pathology

Vertically integrated with General Medicine

Integrate concept - not necessarily teachers Plan session with teachers from both phases. Make a decision on how much of the information needs to be brought down to this phase to make it relevant. Consider how a competency can ascend over phases: for eg. - can be at a KH -(know how) in phase II but becomes SH in phase III. For vertical integration with clinical subjects, use of a case to link the concept (a well written paper, case is sufficient). Using teachers from both phases is rarely required

**From the CBC document*

Explanation of terms used in this manual

Lecture	Any instructional large group method including traditional lecture and interactive lecture
Small group discussion	Any instructional method involving small groups of students in an appropriate learning context
DOAP (Demonstration-Observation - Assistance - Performance)	A practical session that allows the student to observe a demonstration, assist the performer, perform in a simulated environment, perform under supervision or perform independently
Skill assessment	A session that assesses the skill of the student including those in the practical laboratory, skills lab, skills station that uses mannequins/ paper case/simulated patients/real patients as the context demands
Core	A competency that is necessary in order to complete the requirements of the subject (traditional must know)
Non-Core	A competency that is optional in order to complete the requirements of the subject (traditional nice (good) to know/ desirable to know)

**From the CBC document*

Please note: The term DOAP is not used in this document. Instead the phrase *"dissection with small group discussion"* has been used.

Domains of learning

K	Knowledge
S	Skill
A	Attitude
C	Communication

Levels of competency

K	Knows	A knowledge attribute - Usually enumerates or describes
KH	Knows how	A higher level of knowledge - is able to discuss or analyze
S	Shows	A skill attribute: is able to identify or demonstrate the steps
SH	Shows how	A skill attribute: is able to interpret/ demonstrate a complex procedure requiring thought, knowledge and behavior
P	Performs (under supervision or independently)	Mastery for the level of competence - When done independently under supervision a pre-specified number of times - certification or capacity to perform independently results

**From the CBC document*

GENERAL ANATOMY

Topic: Anatomical terminology
Number of competencies: 1
Number of procedures for certification: Nil
Total number of hours required: 2 [1 hour (theory) and 1 hour (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN1.1	Demonstrate normal anatomical position, various planes, relation, comparison, laterality & movement in our body	K/S	SH	Y	**Theory**	**Practical**
					1	1

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe the anatomical position of the body and its importance
b. Demonstrate the anatomical position of the body
c. Define the anatomical planes
d. Define the anatomical terms related to the following with examples: - direction
   - relation
   - comparison
   - laterality
   - movement
e. Demonstrate the types of movements possible at synovial joints

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture	Small group discussion	Short answer	• Viva-voce • OSPE

Topic: General features of bones and joints
Number of competencies: 6
Number of procedures for certification: Nil
Total number of hours required: 1 [1 hour (theory)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN1.2	Describe composition of bone and bone marrow	K	KH	Y	**Theory**	**Practical**
AN2.1	Describe parts, blood and nerve supply of a long bone	K	KH	Y	1	-
AN2.2	Enumerate laws of ossification	K	KH	N		
AN2.3	Enumerate special features of a sesamoid bone	K	KH	N		
AN2.4	Describe various types of cartilage with its structure & distribution in body	K	KH	Y		
SPECIFIC LEARNING OBJECTIVES (SLOs')						

GENERAL ANATOMY

At the end of the teaching and learning session the 1st phase MBBS student should be able to: a.

Describe the general features of a bone

b. Describe the composition of bone and bone marrow
c. Name the sites where red bone marrow is present in adults
d. Classify the bones of the body according to their shape
e. Name the parts of a developing/growing long bone with a neat labelled diagram
f. Classify bones according to their structure
g. Explain the difference between compact and cancellous bones
h. Describe the arterial supply of long bone with a neat labelled diagram
i. Describe the nerve supply of a long bone
j. Define ossification and explain the primary and secondary ossification centers
k. Explain the difference between intramembranous and endochondral ossification with neat labelled diagram
l. Enumerate laws of ossification, including direction of nutrient foramen and the growing end of the bone
m. Describe the different types of epiphysis with suitable examples
n. Enumerate special features of a sesamoid bone and its functions with examples
o. Describe types of cartilage with its structure & distribution in body with examples

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture Small group discussion	-	• Short answer • Short essay	• Viva-voce • OSPE

Topic: General features of bones and joints
Number of competencies: 6
Number of procedures for certification: Nil
Total number of hours required: 1 [1 hour (theory)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN2.5	Describe various joints with subtypes and examples	K	KH	Y	**Theory**	**Practical**
AN2.6	Explain the concept of nerve supply of joints & Hilton's law	K	KH	Y	1	-
SPECIFIC LEARNING OBJECTIVES (SLOs')						

GENERAL ANATOMY

At the end of the teaching and learning session the 1st phase MBBS student should be able to: a.
Define a joint

b. Classify joints according to structure and function with suitable examples
c. Describe the types of fibrous joints with examples
d. Define a synovial joint and describe the salient features of a typical synovial joint with diagram
e. Explain the difference between atypical, complex and compound joints with examples
f. Classify the types of synovial joints with examples
g. Explain the factors maintaining the stability of the joints
h. Compare and contrast the primary and secondary cartilaginous joints
i. Describe the nerve supply of a joint
j. Explain the concept of Hilton's law with examples
k. Describe the types of movements that occur in the synovial joints

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
• Lecture • Small group discussion	-	• Long essay • Short answer	• Spotter • Viva-voce • OSPE

Topic: General features of muscular system
Number of competencies: 3
Number of procedures for certification: Nil
Total number of hours required: 1 [1 hour (theory)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN3.1	Classify muscle tissue according to structure & action	K	KH	Y	**Theory**	**Practical**

AN3.2	Enumerate the parts of skeletal muscle and differentiate between tendons and aponeurosis with examples	K	KH	Y	1	-
AN3.3	Explain Shunt and spurt muscles	K	KH	Y		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Define a muscle and describe the characteristics of muscles
b. Classify muscles according to structure with suitable examples
c. Classify muscles according to their action and describe agonists, antagonists, synergists, fixators with suitable examples d. Enumerate the parts of a skeletal muscle
e. Define terms origin and insertion of a skeletal muscle
f. Explain the difference between tendons, aponeuroses and ligaments with suitable examples *g.* Explain Shunt and spurt muscles

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
• Lecture • Small group discussion	-	• Short answer • Short essay • Case based short essay	• Spotter • Viva-voce • OSPE

Topic: General features skin and fascia
Number of competencies: 5
Number of procedures for certification: Nil
Total number of hours required: 1 [1 hour (theory)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN4.1	Describe different types of skin & dermatomes in body	K	KH	N	**Theory**	**Practical**

AN4.2	Describe structure & function of skin with its appendages	K	KH	Y	1	-
AN4.3	Describe superficial fascia along with fat distribution in body	K	KH	Y		
AN4.4	Describe modifications of deep fascia with its functions	K	KH	Y		
AN4.5	Explain principles of skin incisions	K	KH	Y		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Name the different types of skin with examples
b. Describe the structure and function of skin with neat labelled diagram
c. Describe the difference between thin and thick skin
d. Name the appendages of skin
e. Describe briefly the sweat gland, sebaceous gland, hair & nail
f. Define a dermatome and explain its clinical importance
g. Describe the arrangements of dermatomes in the body
h. Define superficial fascia and name the contents of superficial fascia
i. Describe regional variations in fat distribution and the functions of superficial fascia
j. Define the deep fascia and describe modifications of deep fascia with its functions
k. Define the Langer's line and explain the principles of skin incisions based on Langer's lines

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture Small group discussion	-	• Short answer • Short essay	Viva-voce Spotter

Topic: General features of the cardiovascular system
Number of competencies: 8
Number of procedures for certification: Nil
Total number of hours required: 1 [1 hour (theory)]

GENERAL ANATOMY

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN5.1	Differentiate between blood vascular and lymphatic system	K	KH	N	**Theory**	**Practical**
					1	-
AN5.2	Differentiate between pulmonary and systemic circulation	K	KH	Y		
AN5.3	List general differences between arteries & veins	K	KH	Y		
AN5.4	Explain functional difference between elastic, muscular arteries and arterioles	K	KH	Y		
AN5.5	Describe portal system giving examples	K	KH	Y		
AN5.6	Describe the concept of anastomoses and collateral circulation with significance of end-arteries	K	KH	Y		
AN5.7	Explain function of meta-arterioles, precapillary sphincters, arterio-venous anastomoses	K	KH	N		
AN5.8A	Define thrombosis, infarction & aneurysm	K	KH	N		
SPECIFIC LEARNING OBJECTIVES (SLOs')						

GENERAL ANATOMY

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe the types and functions of blood vessels
b. Describe the layers of blood vessel
c. Compare and contrast the structure and functions of arteries and veins
d. Explain the functional difference between elastic, muscular arteries and arterioles
e. Compare and contrast the blood vascular system and lymphatic system
f. Compare and contrast the pulmonary and systemic circulations

a. Define microvasculature with types of capillaries and their functional significance
b. Describe the portal circulation with examples
c. Define anastomoses and describe the different types of anastomosis with functions giving suitable examples d. Explain the concept of collateral circulation
e. Describe the end-arteries with suitable examples
f. Explain briefly the functions of meta arterioles, precapillary sphincter and arteriovenous anastomosis g. Define thrombosis, infarction & aneurysm

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
• Lecture • Small group discussion	-	□ Short answer	□ Viva-voce

GENERAL ANATOMY

Topic: General features of lymphatic system
Number of competencies: 3
Number of procedures for certification: Nil
Total number of hours required: 1 [1 hour (theory)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN6.1	List the components and functions of the lymphatic system	K	KH	N	**Theory**	**Practical**
AN6.2	Describe structure of lymph capillaries & mechanism of lymph circulation	K	KH	N	1	-
AN6.3	Explain the concept of lymphoedema and spread of tumors via lymphatics and venous system	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. List the components of lymphatic system and describe the functions of lymphatic system
b. Explain the concept of primary and secondary lymphatic organs
c. Describe the structure of lymph capillaries and explain the difference between lymph capillaries and blood capillaries
d. Explain the mechanism of lymph flow from its formation to its absorption into the venous system e. Define lymphedema
f. Explain the anatomical basis of lymphedema and the spread of tumors via lymphatics and venous system

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**

• Lecture • Small group discussion	-	□ Short answer	• Viva-voce • OSPE

Topic: Introduction to the nervous system **Number of competencies:** 8

Number of procedures for certification: Nil

Total number of hours required: 1 [1 hour (theory)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN7.1	Describe general plan of nervous system with components of central, peripheral & autonomic nervous systems	K	KH	Y	1	-
AN7.2	List components of nervous tissue and their functions	K	KH	Y		
AN7.3	Describe parts of a neuron and classify them based on number of neurites, size & function	K	KH	Y		
AN7.4	Describe structure of a typical spinal nerve	K	KH	Y		
AN7.5	Describe principles of sensory and motor innervation of muscles	K	KH	N		
AN7.6	Describe concept of loss of innervation of a muscle with its applied anatomy	K	KH	Y		
AN7.7	Describe various type of synapse	K	KH	N		
AN7.8	Describe differences between sympathetic and spinal ganglia	K	KH	N		

GENERAL ANATOMY

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe the general plan of nervous system with its components
b. Describe the structural and functional classification of the nervous system
c. List components of nervous tissue and their functions
d. Describe the parts of a neuron with neat labelled diagram
e. Classify the neurons based on number of neurites, size, and function with suitable examples
f. Describe the structure of a typical spinal nerve with neat labelled diagram
g. Describe principles of sensory and motor innervation of muscles
h. Describe concept of loss of innervation of a muscle
i. Define a synapse and describe type of synapse
j. Define ganglia and describe the difference between sympathetic and spinal ganglia

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
• Lecture • Small group discussion	-	□ Short answer	• Viva-voce • OSPE

GENERAL HISTOLOGY

Topic:

Epithelium histology

Number of competencies: 2

Number of procedures for certification: 1

Total number of hours required: 3 [1 hour (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN65.1	Identify epithelium under the microscope & describe the various types that correlate to its function	K/S	P	Y	**Theory**	**Practical**
					1	2
AN65.2	Describe the ultrastructure of epithelium*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Classify epithelial tissue based on the shape of cells, number of layers and surface modifications with suitable examples

b. Identify, differentiate and draw the microstructure of the different types of epithelia - Simple squamous epithelium

- Simple cuboidal epithelium
- Simple columnar epithelium
- Stratified squamous non-keratinized epithelium
- Stratified squamous keratinized epithelium
- Stratified cuboidal epithelium
- Stratified columnar epithelium
- Pseudo-stratified ciliated columnar epithelium
- Transitional epithelium

c. Correlate the characteristics of particular epithelia to their function and their essential features including junctions, apical modifications, and polarity

d. Describe the ultrastructure of epithelium

TEACHING AND LEARNING METHODS	ASSESSMENT METHODS

GENERAL HISTOLOGY

Topic:

Theory	Practical	Theory	Practical / Viva-voce
☐ Lecture	☐ Small group discussion	☐ Short answer	• Spotter • Slide discussion

Connective tissue histology

Number of competencies: 2

Number of procedures for certification: Nil

Total number of hours required: 3 [1 hour (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN66.1	Describe & identify various types of connective tissue with functional correlation	K/S	SH	Y	1	2
AN66.2	Describe the ultrastructure of connective tissue*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe the components of connective tissue
b. Classify connective tissue based on the density of fibre content and characteristics with suitable examples
c. Identify, describe and draw the microstructure of the different types of connective tissue with suitable examples
d. Correlate the structure and functions of different types of connective tissue
e. Describe the ultrastructure of connective tissue

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
☐ Lecture	☐ Small group discussion	☐ Short answer	• Spotter • Slide discussion

GENERAL HISTOLOGY

Topic:

Muscle histology

Number of competencies: 3

Number of procedures for certification: Nil

Total number of hours required: 3 [1 hour (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN67.1	Describe & identify various types of muscle under the microscope	K/S	SH	Y	**Theory**	**Practical**
AN67.2	Classify muscle and describe the structure-function correlation of the same	K	KH	Y	1	2
AN67.3	Describe the ultrastructure of muscular tissue*	K	KH	N		
SPECIFIC LEARNING OBJECTIVES (SLOs')						

GENERAL HISTOLOGY

Topic:

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Classify muscle tissue based on its microscopic features and functions with suitable examples
b. Correlate the structure and function of the different types of muscle tissue
c. Compare and contrast the microstructure of the three types of muscle tissue
d. Identify, and draw the microstructure of the following slides: TS of skeletal muscle, LS of skeletal muscle (HP), Cardiac muscle
e. Demonstrate and describe the following structures: Epimysium, Fascicles, Perimysium, Muscle fibres, Endomysium, Nuclei of muscle fibres in the slide of TS of skeletal muscle (LP)
f. Demonstrate and describe the following structures: Epimysium Fascicles, Perimysium, Muscle fibers, Endomysium, Nuclei of muscle fibres , Cross striations in the slide of LS of skeletal muscle (HP)
g. Demonstrate and describe the following structures: Muscle fibres, Nuclei of muscle fibres, Cross striations, Intercalated discs in the slide of Cardiac muscle in the slide of cardiac muscle
h. Compare and contrast the ultrastructure of the three different types of muscle tissue

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture	Small group discussion	Short answer	• Spotter • Slide discussion

Nervous tissue histology

Number of competencies: 3

Number of procedures for certification: Nil

Total number of hours required: 3 [1 hour (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN68.1		K/S	SH	Y	**Theory**	**Practical**

GENERAL HISTOLOGY

Topic:

AN68.2	Describe & Identify multipolar & unipolar neuron, ganglia, peripheral nerve	K	KH	Y	1	2
AN68.3	Describe the structure-function correlation of neuron Describe the ultrastructure of nervous tissue*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Classify neurons based on their structure and functions with suitable examples
b. Identify and draw the microstructure of the transverse and longitudinal section of a peripheral nerve, spinal ganglion and autonomic ganglion
c. Demonstrate and describe the following structures: Epineurium with epineural blood vessels, Interfascicular connective tissue, Perineurium, Nerve fascicles, Endoneurium with neurilemma, Myelin sheath, Axon, Schwann cell nuclei in the slide of peripheral nerve (TS**)**
d. Demonstrate and describe the following structures: Epineurium with epineurial blood vessels, Perineurium Endoneurium with neurilemma, Myelin sheath, Axon, Schwan cell and fibroblast nuclei in the slide of peripheral nerve (LS)
e. Demonstrate and describe the following structures**:** Capsule, Epineurium, Clusters of unipolar cell bodies with nucleus and nucleolus, Nuclei of satellite cells, LS of nerve fibre in the slide of sensory ganglion
f. Demonstrate and describe the following structures: Multipolar neuron with process, Eccentric nucleus, Unmyelinated nerve fibres, Satellite cells in the slide of autonomic ganglia
a. Compare and contrast the microscopic features of spinal and autonomic ganglia
b. Describe the ultrastructure of nervous tissue

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**

GENERAL HISTOLOGY

☐ Lecture	☐ Small group discussion	☐ Short answer	☐ Spotter ☐ Slide discussion

GENERAL HISTOLOGY

Topic:

Nil

Blood Vessels

Number of competencies: 3

Number of procedures for certification:

Total number of hours required: 3 [1 hour (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN69.1	Identify elastic & muscular blood vessels, capillaries under the microscope	K/S	SH	Y	**Theory**	**Practical**
					1	2
AN69.2	Describe the various types and structure-function correlation of blood vessel	K	KH	Y		
AN69.3	Describe the ultrastructure of blood vessel	K	KH	N		
SPECIFIC LEARNING OBJECTIVES (SLOs')						

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Classify blood vessels based on their structure and functions with suitable examples

b. Identify and draw the microstructure of cross sections of a large artery, medium sized artery, medium sized vein and a large vein and capillaries

c. Correlate the structure and function of the different types of blood vessels

d. Demonstrate and describe the following structures: tunica intima-endothelium, subendothelium tunica media-elastic fibres, smooth muscle nuclei tunica adventitia- vasa vasorum in the slide of large artery/ elastic artery

e. Demonstrate and describe the following structures: tunica intima - endothelium, subendothelium, tunica media - smooth muscle nuclei, connective tissue, tunica adventitia - longitudinal sections of smooth muscle fibres, vasa vasorum in the slide of large vein

f. Demonstrate and describe the following structures: tunica intima - endothelium, subendothelium, internal elastic lamina, tunica media -external elastic lamina, tunica adventitia - vasa vasorum

g. Describe and demonstrate the following structures: tunica intima - endothelium, subendothelium, tunica media - smooth muscle nuclei, collagen fibres, tunica adventitia - vasa vasorum in the slide of medium sized vein

h. Compare and contrast the microscopic features of the different types of blood vessels

i. Describe the ultrastructure of the different types of blood vessels

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**

GENERAL HISTOLOGY

☐ Lecture	☐ Small group discussion	☐ Short answer	☐ Spotter ☐ Slide discussion

GENERAL HISTOLOGY

Topic:

Nil

Glands & Lymphoid tissue

Number of competencies: 2

Number of procedures for certification:

Total number of hours required: 6 [2 hours (theory) and 4 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN70.1		K/S	SH	Y	**Theory**	**Practical**

	Identify exocrine gland under the microscope & distinguish between serous, mucous and mixed acini				1	2

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Classify exocrine glands based on their structure and secretions with suitable examples
b. Identify and draw the microstructure of serous, mucous and mixed glands
c. Correlate the structure and function of the different types of exocrine glands
d. Compare and contrast the microscopic features of serous, mucous and mixed glands
e. Demonstrate and describe the following structures Stroma, Parenchyma, Capsule, Septa, Lobules, Mucous acini, Intralobular ducts Interlobular ducts in the slide of the mucous salivary gland
f. Demonstrate and describe the following structures: Stroma Parenchyma, Capsule, Septa, Lobules, Serous acini, Intralobular ducts, Interlobular ducts in the slide of serous salivary gland
g. Demonstrate and describe the following structures: Stroma, Parenchyma, Capsule Septa, Lobules, Mucous acini, Serous acini, Mucous acini with serous demilunes, Intralobular ducts, Interlobular ducts in the slide of the mixed salivary gland

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture	Small group discussion	Short answer	• Spotter • Slide discussion

GENERAL HISTOLOGY

Topic:

Glands & Lymphoid tissue continued

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN70.2	Identify the lymphoid tissue under the microscope & describe microanatomy of lymph node, spleen, thymus, tonsil and correlate the structure with function	K/S	SH	Y	**Theory**	**Practical**
					1	2

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Classify lymphatic tissue based on its origin and degree of capsulation with suitable examples
b. Correlate the structure and function of the different types of lymphatic tissue
c. Compare and contrast the microstructure of the different types of lymphatic tissue
d. Identify and draw the microstructure of the lymph node, thymus, spleen and palatine tonsil
e. Demonstrate and describe the following structures: Capsule, Cortex, Medulla, Trabeculae, Sub-capsular sinus, Lymphatic nodules, Germinal centres, Paracortex, Trabecular sinuses, Medullary sinuses, Medullary cords in the slide of the lymph node
f. Demonstrate and describe the following structures: Capsule, Cortex, Medulla, Trabeculae, Lobules, Hassal's corpuscles in the slide of thymus
g. Demonstrate and describe the following structures: Capsule, Red pulp, White pulp, Trabeculae, Central artery in the slide of the spleen
h. Demonstrate and describe the following structures: Hemi-capsule, Crypts, Stratified squamous non-keratinized epithelium, Lymphatic nodules in the slide of the palatine tonsil

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture	Small group discussion	Short answer	• Spotter • Slide discussion

GENERAL HISTOLOGY

Bone & Cartilage

Number of competencies: 2

Number of procedures for certification:

Total number of hours required: 3 [1 hour (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN71.1	Identify bone under the microscope; classify various types and describe the structure-function correlation of the same	K/S	SH	Y	**Theory**	**Practical**
					1	2
AN71.2	Identify cartilage under the microscope & describe various types and structure- function correlation of the same	K/S	SH	Y		
SPECIFIC LEARNING OBJECTIVES (SLOs')						

GENERAL HISTOLOGY

Topic:

Nil

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Classify the bone tissue based on its structure with suitable examples
b. Identify and draw the microstructure of compact (LS and TS) and spongy bone
c. Correlate the structure and function of the different types of bone
d. Compare and contrast the microscopic features of cartilage and bone
e. Compare and contrast the microscopic features of compact and spongy bone
f. Demonstrate and describe the following structures: Periosteum, Outer circumferential lamellae, Concentric lamellae, Interstitial lamellae, Haversian canals, Lacunae with canaliculi, Haversian systems, Volkmann's canals, Inner circumferential lamellae, Endosteum in the slide of TS of compact bone
g. Demonstrate and describe the following structures: Periosteum, Parallel lamellae, Haversian canals, Lacunae with canaliculi, Volkmann's canals in the slide of the LS of compact bone
h. Classify cartilages based on their structure with suitable examples
i. Identify and draw the light microscopic features of hyaline, elastic and white fibrous cartilage
j. Correlate the structure and function of the different types of cartilage
k. Compare and contrast the microscopic features of hyaline, elastic and white fibrous cartilage
l. Demonstrate and describe the following structures: Perichondrium, Chondroblasts, Chondrocytes, Lacunae, Cell nests, Glassy, basophilic matrix, Territorial matrix, Inter-territorial matrix in the slide of the hyaline cartilage

m. Demonstrate and describe the following structures: Perichondrium, Chondroblasts, Chondrocytes, Lacunae, Matrix with elastic fibres in the slide of the elastic cartilage
n. Demonstrate and describe the following structures: Bundles of collagen fibres, Chondrocytes arranged in rows, Lacunae, Fibroblast nuclei in the slide of the white fibrocartilage

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture	Small group discussion	Short answer	• Spotter • Slide discussion

Integumentary System

Number of competencies: 1

Number of procedures for certification:

Total number of hours required: 3 [1 hour (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN72.1	Identify the skin and its appendages under the microscope and correlate the structure with function	K/S	SH	Y	**Theory**	**Practical**
					1	2
SPECIFIC LEARNING OBJECTIVES (SLOs')						

GENERAL HISTOLOGY

Topic:

Nil

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Classify skin based on the structure of the epidermis with suitable examples
b. Identify and draw the microstructure of thick and thin skin
c. Correlate the structure with function of thick and thin skin
d. Compare and contrast the microscopic features of thick and thin skin
e. Demonstrate and describe the following structures: Epidermis – 5 layers stratified squamous keratinized epithelium -Stratum Basale, Stratum spinosum, Stratum granulosum, Stratum lucidum, Stratum corneum Dermis - Papillary layer, Dermal papillae, Reticular layer, Sweat glands in the slide of the thick skin
f. Demonstrate and describe the following structures: epidermis - 4 layers Stratum Basale, Stratum spinosum, Stratum granulosum, Stratum corneum dermis Papillary layer, dermal papillae, ducts of sweat glands, Reticular layer, cut section of hair follicle, Arrector pili muscle, Sebaceous glands, sweat glands, Blood vessels in the slide of the thin skin

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture	Small group discussion	Short answer	• Spotter • Slide discussion

GENETICS

Topic:

Chromosomes

Number of competencies: 3

Number of procedures for certification: Nil

Total number of hours required: 1 [1 hour (theory)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN73.1	Describe the structure of chromosomes with classification	K	KH	Y	1 hour	-
AN73.2	Describe technique of karyotyping with its applications	K	KH	Y		
AN73.3	Describe the Lyon's hypothesis	K	KH	Y		

SPECIFIC LEARNING OBJECTIVES (SLOs)

At the end of the teaching and learning session the 1st phase MBBS student should be able to: a. Describe the structure of chromosomes

b. Classify the chromosomes based on the length of their arms and the position of the centromere

c. Describe the technique of karyotyping and its applications

d. Differentiate between normal (male and female) and abnormal karyotypes

e. Apply Lyon hypothesis to explain the formation and clinical significance of Barr bodies

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical**
Lecture	-	• Short Essay • Short answer	-

GENETICS

Topic:

Patterns of inheritance

Number of competencies: 4

Number of procedures for certification: Nil

Total number of hours required: 3 [1 hour (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN74.1	Describe the various modes of inheritance with examples	K	KH	Y	**Theory**	**Practical**
AN74.2	Draw pedigree charts for the various types of inheritance & give examples of diseases of each mode of inheritance	K	KH	Y	1 hour	2 hours
AN74.3	Describe multifactorial inheritance with examples	K	KH	Y		
AN74.4	Describe the genetic basis & clinical features of Achondroplasia, Cystic Fibrosis, Vitamin D resistant rickets, Haemophilia, Duchenne muscular dystrophy & Sickle cell anaemia	K	KH	Y		

SPECIFIC LEARNING OBJECTIVES (SLOs)

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Classify the various patterns of inheritance with examples
b. Explain the characteristics of the different types of single gene disorders
c. Interpret different pedigree symbols
d. Interpret and draw pedigree charts for the various types of single gene disorders
e. Explain the concept of multifactorial inheritance with examples
f. Interpret the different pattern of inheritance
g. Describe the genetic basis & clinical features of Achondroplasia, Cystic Fibrosis, Vitamin D resistant rickets, Haemophilia, Duchenne muscular dystrophy & Sickle cell anaemia

TEACHING AND LEARNING METHODS	ASSESSMENT METHODS

GENETICS

Topic:

Theory	Practical	Theory	Practical
□ Lecture	• Small group teaching • Visit to the Genetic lab	• Short Essay • Short answer	• Spotter • Viva-voce

Principles of genetics, Chromosomal Aberrations & Clinical genetics

Number of competencies: 5

Number of procedures for certification: Nil

Total number of hours required: 4 [2 hour (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN75.1	Describe the structural and numerical chromosomal aberrations	K	KH	Y	2 hour	2 hours
AN75.2	Explain the terms mosaics and chimeras with example*	K	KH	N		
AN75.3	Describe the genetic basis & clinical features of Prader Willi syndrome, Edward syndrome & Patau syndrome*	K	KH	N		
AN75.4	Describe genetic basis of variation: polymorphism and mutation	K	KH	Y		
AN75.5	Describe the principles of genetic counselling	K	KH	Y		
SPECIFIC LEARNING OBJECTIVES (SLOs)						

GENETICS

Topic:

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe the different types of structural chromosomal aberrations with suitable examples
b. Describe the autosomal aberrations with suitable examples
c. Describe the sex chromosomal aberrations with suitable examples
d. Explain the genetic basis of numerical and structural chromosomal aberrations
e. Describe the karyotype and salient clinical features of Down syndrome, Turner syndrome and Klinefelter syndrome f. Differentiate between true and pseudohermaphroditism
g. Define mosaics and chimeras
h. Describe the genetic basis and salient clinical features of Prader Willi syndrome, Edward syndrome and Patau syndrome i. Define mutation and describe the different types mutation
j. Define polymorphism with examples
k. Describe the principles of genetic counseling

TEACHING AND LEARNING METHODS	ASSESSMENT METHODS

GENETICS

Theory	Practical	Theory	Practical
Lecture	Small group teaching Visit to the Genetic lab	• Short Essay • Short answer	• Spotter • Viva-voce

Topic: Prenatal Diagnosis
Number of competencies: 3
Number of procedures for certification: Nil
Total number of hours required: 1 [1 hour (theory)]

TOPIC:

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN81.1	Describe various methods of prenatal diagnosis	K	KH	Y	**Theory**	**Practical**
AN81.2	Describe indications, process and disadvantages of amniocentesis	K	KH	Y	1 hour	-
AN81.3	Describe indications, process and disadvantages of chorion villus biopsy	K	KH	Y		

SPECIFIC LEARNING OBJECTIVES (SLOs)

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe the various methods of prenatal diagnosis,
b. Describe the common indications for prenatal diagnosis
c. Describe a few of the common ethical issues involved in prenatal diagnosis
d. Describe indications, process and disadvantages of amniocentesis
e. Describe indications, process and disadvantages of chorion villus biopsy
f. Compare and contrast amniocentesis and chorionic villus biopsy for prenatal diagnosis

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical**
Lecture	-	• Short Essay • Short answer	-

[**Please Note:** The topic prenatal diagnosis could be taught either as part of General embryology or Genetics]

Introduction to embryology and gametogenesis

Number of competencies: 2 + 3

Number of procedures for certification: Nil

Total number of hours required: 2 [2 hours (theory)]

GENETICS

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN76.1	Describe the stages of human life	K	KH	Y	**Theory**	**Practical**
AN76.2	Explain the terms- phylogeny, ontogeny, trimester, Viability	K	KH	Y	2 hours	-
AN77.1	Describe the uterine changes occurring during the menstrual cycle	K	KH	Y		
AN77.2	Describe the synchrony between the ovarian and menstrual cycles	K	KH	Y		
AN77.3	Describe spermatogenesis and oogenesis along with diagrams	K	KH	Y		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Explain the developmental periods / stages of human life
b. Explain growth and differentiation
c. Explain the terms - phylogeny, ontogeny, trimester, viability
d. Describe the menstrual cycle with reference to phases and changes occurring in the endometrium
e. Describe the relation between ovarian cycle and menstrual cycle
f. Describe spermatogenesis with reference to spermatocytosis, meiosis and spermiogenesis with diagrams g. Describe oogenesis and the ovarian cycle with diagrams
h. Compare and contrast between spermatogenesis and oogenesis
i. Describe the structure of male and female gametes with neat labelled diagram
j. Describe in brief abnormalities in the formation of gametes

TEACHING AND LEARNING METHODS	ASSESSMENT METHODS

GENERAL EMBRYOLOGY

TOPIC:

Theory	Practical	Theory	Practical / Viva-voce
● Lecture	□ Small group teaching □ Self-directed learning (Model demonstration)	• Short answer • Short essay • Case based short essay	□ Viva-voce

Fertilization (First week of development)

Number of competencies: 3 + 3

Number of procedures for certification: Nil

Total number of hours required: 2 [2 hours (theory)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN77.4	Describe the stages and consequences of fertilization	K	KH	Y	**Theory**	**Practical**
AN77.5	Enumerate and describe the anatomical principles underlying contraception	K	KH	Y	2 hours	-
AN77.6	Describe teratogenic influences; fertility and sterility, surrogate motherhood, social significance of “sex-ratio” *	K	KH	N		
AN78.1	Describe cleavage and formation of blastocyst	K	KH	Y		
AN78.2	Describe the development of trophoblast	K	KH	Y		
AN78.3	Describe the process of implantation and common abnormal sites of implantation	K	KH	Y		
SPECIFIC LEARNING OBJECTIVES (SLOs’)						

TOPIC:

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe the process of fertilization with special reference to the site, phases and results
b. Describe the process of cleavage of the zygote to form the morula
c. Describe the stages in the transformation of the zygote into the blastocyst
d. Describe the development of the trophoblast
e. Describe the process of implantation in pregnancy with special reference to the site, type and mechanism
f. Enumerate the types of contraception's and describe the anatomical principles underlying contraception g. Enumerate the abnormal sites of implantation
h. Explain the embryological basis of ectopic pregnancy
i. Define teratogens and explain the characteristics of teratogen
j. Explain the influence of teratogens on fertility and sterility with suitable examples k. Explain the surrogate motherhood
l. Define the sex ratio and explain the social significance of gender imbalance

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture Video assisted Lecture Team based learning	• Small group teaching • Self-directed learning (Model demonstration)	• Short essay • Modified short essay • Short answer • Case based short essay	• Spotter • Viva-voce • OSPE

Second week of development

Number of competencies: 3

Number of procedures for certification: Nil

Total number of hours required: 1 [1 hour (theory)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN78.2	Describe the development of trophoblast	K	KH	Y	**Theory**	**Practical**
AN78.4	Describe the formation of extra-embryonic mesoderm and coelom, bilaminar disc and prochordal plate	K	KH	Y	1 hour	-
AN78.5	Describe in brief abortion; decidual reaction, pregnancy test	K	KH	Y		
SPECIFIC LEARNING OBJECTIVES (SLOs')						

TOPIC:

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe the formation and functions of the Cytotrophoblast and syncytiotrophoblast
b. Describe in brief the Utero-placental circulation
c. Describe the changes in the embryoblast
d. Describe the development of embryonic bilaminar germ disc
e. Define the prochordal plate and explain its importance
f. Describe the development and functions of the amnion
g. Describe in brief amniotic fluid formation, functions and embryological basis for oligohydramnios, polyhydramnios
h. Describe the stages of development and fate of primary yolk sac, secondary yolk sac
i. Describe the development of the extraembryonic coelom
j. Describe the formation and fate of the chorion
k. Define abortion
l. Define the decidua and explain the decidual reaction, parts and fate of the decidua
m. Explain the embryological basis of pregnancy test

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
• Lecture • Video assisted Lecture		• Short essay • Modified short essay	• Spotter • Viva-voce

Team based learning		• Short answer • Case based short essay	OSPE

GENERAL EMBRYOLOGY

TOPIC:

3rd and 4th week of development **Number of competencies:** 3 + 3

Number of procedures for certification: Nil

Total number of hours required: 2 [2 hours (theory)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN79.1	Describe the formation & fate of the primitive streak	K	KH	Y	**Theory**	**Practical**
AN79.2	Describe formation & fate of notochord	K	KH	Y	2 hours	-
AN79.3	Describe the process of neurulation					
AN79.4	Describe the development of somites and intraembryonic coelom	K	KH	Y		
AN79.5	Explain embryological basis of congenital malformations, nucleus pulposus, sacrococcygeal teratomas, neural tube defects*	K	KH	N		
AN79.6	Describe the diagnosis of pregnancy in first trimester and role of teratogens, alpha-fetoprotein*	K	KH	N		
SPECIFIC LEARNING OBJECTIVES (SLOs')						

GENERAL EMBRYOLOGY

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Define and describe the process of gastrulation
b. Describe the formation, importance & fate of the primitive streak in the formation of the three germ layers
c. Explain the embryological basis for the development of sacrococcygeal teratomas
d. Describe the trilaminar germ disc of the developing embryo
e. Enumerate the derivatives of the ectodermal germ layer
f. Define Neurulation and describe the stages and results of neurulation
g. Describe the formation and derivatives of Neural crest
h. Enumerate the derivatives of the mesodermal germ layer
i. Describe the formation, subdivisions and derivatives of paraxial mesoderm
j. Describe the formation and derivatives of intermediate mesoderm
k. Describe the formation, subdivisions, derivatives of lateral plate mesoderm
l. Explain the formation of blood and blood vessels
m. Enumerate the derivatives of the endodermal germ layer
n. Describe the folding of the embryo and its role in the formation of the gut tube and umbilical cord o. Explain the development of the chorionic villi
p. Describe the diagnosis of pregnancy in first trimester
q. Explain the embryological basis of maternal serum alfa protein screening test
r. Explain the embryological basis for triple & quadruple test for birth defects

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
• Lecture • Video assisted teaching • Team based learning	-	• Short essay • Short answer • Modified short essay • Case based short essay	• Spotters • Viva-voce

TOPIC:

Fetal membranes

Number of competencies: 7

Number of procedures for certification: Nil

Total number of hours required: 1 [1 hour (theory)]

NUMBER		DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Time required in hours	
	Describe formation, functions & fate of-chorion:	K	KH	Y	**Theory**	**Practical**

GENERAL EMBRYOLOGY

AN80.1	amnion; yolk sac; allantois & decidua				1 hour	-
AN80.2	Describe formation & structure of umbilical cord	K	KH	Y		
AN80.3	Describe formation of placenta, its physiological functions, foeto-maternal circulation & placental barrier	K	KH	Y		
AN80.4	Describe embryological basis of twinning in monozygotic & dizygotic twins	K	KH	Y		
AN80.5	Describe role of placental hormones in uterine growth & parturition	K	KH	Y		
AN80.6	Explain embryological basis of estimation of fetal age*	K	KH	N		
AN80.7	Describe various types of umbilical cord attachments*	K	KH	N		
SPECIFIC LEARNING OBJECTIVES (SLO's)						

GENERAL EMBRYOLOGY

TOPIC:

At the end of the teaching and learning session the 1st phase MBBS student should be able to: a. Name the fetal membranes

b. Describe the formation, functions and fate of the Chorion
c. Describe the formation, functions of the amnion
d. Describe the formation and fate of the Yolk sac
e. Describe the allantois and its derivatives
f. Describe formation, contents, structure and functions of the umbilical cord
g. Describe various types of umbilical cord attachments
h. Describe formation of the placenta
i. Correlate the structure and functions of the placenta
j. Describe the foeto-maternal circulation & placental barrier in detail
k. Briefly describe the anomalies of placenta
l. Describe role of placental hormones in uterine growth & parturition
m. Explain the mutual relation of amniotic cavity, extraembryonic coelom and uterine cavity
n. Describe embryological basis of twinning in monozygotic & dizygotic twins
o. Define foetal period and describe the monthly changes of developing fetus briefly
p. Explain embryological basis of estimation of fetal age

TEACHING AND LEARNING		**ASSESSMENT METHODS**	
Teaching methods		**Assessment methods**	
Theory	**Practical**	**Theory**	**Practical**
• Lecture • Team based lecture • Video assisted learning	-	• Short essay • Short answer • Modified short essay • Case based short essay	• Spotters • Viva-voce

Prenatal diagnosis

Number of competencies: 3

Number of procedures for certification: Nil

Total number of hours required: 1 [1 hour (theory)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN81.1	Describe various methods of prenatal diagnosis	K	KH	Y	1 hour	-
AN81.2	Describe indications, process and disadvantages of amniocentesis	K	KH	Y		
AN81.3	Describe indications, process and disadvantages of chorion villus biopsy	K	KH	Y		
SPECIFIC LEARNING OBJECTIVES (SLOs')						
At the end of the teaching and learning session the 1st phase MBBS student should be able to: a. Describe the various methods of prenatal diagnosis b. Describe the common indications for prenatal diagnosis c. Describe a few of the common ethical issues involved in prenatal diagnosis d. Describe indications, process and disadvantages of amniocentesis e. Describe indications, process and disadvantages of chorion villus biopsy f. Compare and contrast amniocentesis and chorionic villus biopsy for prenatal diagnosis						
TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**				

GENERAL EMBRYOLOGY

TOPIC:

Theory	Practical	Theory	Practical / Viva-voce
• Lecture • Team based lecture • Video assisted lectures	-	• Short essay • Short answer • Case based short essay	• Spotters • Viva-voce

[**Please Note**: The topic prenatal diagnosis could be taught either as part of General embryology or Genetics] ****Embryology Model class could be considered as an independent practical class of 2 hours duration.**

UPPER LIMB

Topic:

Features of individual bones **Number of competencies:** 6

Number of procedures for certification: Nil

Total number of hours required: 6 [6 hours (theory)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN8.1	Identify the given bone, its side, important features and keep it in anatomical position	K/S	SH	Y	5	-
AN8.2	Identify and describe joints formed by the given bone	K/S	SH	Y		
AN8.3	Enumerate peculiarities of clavicle	K	KH	Y		
AN8.4	Demonstrate important muscle attachment on the given bone	K/S	SH	Y		

SPECIFIC LEARNING OBJECTIVES (SLOs')

Bones – 1. Clavicle; 2. Scapula; 3. Humerus; 4. Ulna; 5. Radius

At the end of the teaching and learning session the 1st phase MBBS student should be able to: a. Identify the bone and determine its side

b. Hold the bone in anatomical position
c. Describe the type to which the bone belongs
d. Identify the main parts and their features
e. Identify the parts of the bone in direct contact with important neurovascular structures
f. Demonstrate the attachments of functional groups of muscles
g. Describe and demonstrate the articulating surfaces and joints formed by the bone h. Describe the peculiarities of the clavicle

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**

Topic:

	□ Dissection with small group discussion	• Short essay • Short answer	• Spotters • Viva-voce

Features of individual bones continued

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN8.5	Identify and name the various bones in the articulated hand, Specify the parts of the metacarpals and phalanges and enumerate the peculiarities of pisiform	K/S	SH	Y	1	-
AN8.6	Describe scaphoid fracture and explain the anatomical basis of avascular necrosis*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Identify and name all the bones of the articulated hand
b. Identify the tubercle of scaphoid, crest of trapezium and hook of hamate
c. Identify the parts of the metacarpals and phalanges
d. Describe the peculiarities of pisiform
e. Identify and name the joints formed between the carpals, metacarpals and phalanges
f. Describe scaphoid fracture and explain the anatomical basis of avascular necrosis

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
-	□ Dissection with small group discussion	□ Short answer	• Spotters • Viva-voce

Topic:

Pectoral region

Number of competencies: 3

Number of procedures for certification: Nil

Total number of hours required: 5 [1 hour (theory) and 4 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN9.1	Describe attachment, nerve supply & action of pectoralis major and pectoralis minor	K	KH	Y	**Theory**	**Practical**
					1	4
AN9.2	Describe the location, extent, deep relations, structure, age changes, blood supply, lymphatic drainage, microanatomy and applied anatomy of breast	K	KH	Y		
AN9.3	Describe development of breast*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe and demonstrate the location, attachments, nerve supply and actions of the pectoralis major
b. Describe and demonstrate the location, attachments, nerve supply and actions of the pectoralis minor
c. Describe the gross anatomy (location, extent, gross structure, deep relations, blood supply, lymphatic drainage) of the breast d. Describe the type of gland, microscopic structure and age changes of the breast
e. Describe the development and common congenital anomalies of the breast f. Explain the anatomical basis for
- incisions made to drain breast abscesses
- the clinical signs seen in breast cancer

TEACHING AND LEARNING METHODS	ASSESSMENT METHODS

UPPER LIMB

Topic:

Theory	Practical	Theory	Practical / Viva-voce
□ Lecture	□ Dissection with small group discussion	• Long essay • Short essay • Short answer	• Spotters • Window discussion • Viva-voce

Axilla, Shoulder and Scapular region

Number of competencies: 13

Number of procedures for certification: Nil

Total number of hours required: 13 [3 hours (theory) and 10 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN10.1	Identify & describe boundaries and contents of axilla	K/S	SH	Y	**Theory**	**Practical**

Topic:

					2	4
AN10.2	Identify, describe and demonstrate the origin, extent, course, parts, relations and branches of axillary artery & tributaries of vein	K/S	SH	Y		
AN10.3	Describe, identify and demonstrate formation, branches, relations, area of supply of branches, course and relations of terminal branches of brachial plexus	K/S	SH	Y		
AN10.4	Describe the anatomical groups of axillary lymph nodes and specify their areas of drainage	K	KH	Y		
AN10.5	Explain variations in formation of brachial plexus	K	KH	Y		
AN10.6	Explain the anatomical basis of clinical features of Erb's palsy and Klumpke's paralysis*	K	KH	N		
AN10.7	Explain anatomical basis of enlarged axillary lymph nodes*	K	KH	N		
SPECIFIC LEARNING OBJECTIVES (SLOs')						

UPPER LIMB

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe and demonstrate the boundaries and contents of the axilla
b. Describe and demonstrate the origin, extent, course, parts, relations and branches of the axillary artery
c. Describe and demonstrate the formation, extent, course, relations and tributaries of axillary vein
d. Describe and demonstrate the formation of the brachial plexus
e. Describe the common variations in the formation of the brachial plexus
f. Name the infraclavicular branches of the brachial plexus
g. Describe and demonstrate the course, relations and branches of the median, radial, axillary, ulnar and musculocutaneous nerves in the axilla
h. Describe the anatomical groups of axillary lymph nodes and specify their areas of drainage
i. Explain the anatomical basis of the clinical features of Erb's and Klumpke's paralysis
j. Explain the anatomical basis of axillary lymphadenopathy

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
□ Lecture	□ Dissection with small group discussion	• Long essay • Short essay • Short answer	• Spotters • Window discussion • Viva-voce

Axilla, Shoulder and Scapular region continued

Topic:

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN10.8	Describe, identify and demonstrate the position, attachment, nerve supply and actions of trapezius and latissimus dorsi	K/S	SH	Y	-	4
AN10.9	Describe the arterial anastomosis around the scapula and mention the boundaries of triangle of auscultation*	K	KH	N		
AN10.11	Describe & demonstrate attachment of serratus anterior with its action	K/S	SH	Y		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe and demonstrate the layers of the muscles of the back
b. Describe and demonstrate the position, attachments, nerve supply and actions of the trapezius, latissimus dorsi and serratus anterior
c. Explain the anatomical basis of clinical manifestations of injury to the spinal accessory nerve and the long thoracic nerve
d. Explain the movements of the scapula and the muscles causing these movements
e. Describe and demonstrate the boundaries and contents of the triangle of auscultation
f. Describe the arterial anastomosis around the scapula and its clinical significance

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
-	Dissection with small group discussion	• Short essay • Short answer	• Spotters • Viva-voce

Axilla, Shoulder and Scapular region continued

Topic:

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN10.10	Describe and identify the deltoid and rotator cuff muscles	K/S	SH	Y	**Theory**	**Practical**
AN10.12	Describe and demonstrate shoulder joint for– type, articular surfaces, capsule, synovial membrane, ligaments, relations, movements, muscles involved, blood supply, nerve supply and applied anatomy	K/S	SH	Y	1	2
AN10.13	Explain anatomical basis of Injury to axillary nerve during intramuscular injections*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe and demonstrate the position, attachments, nerve supply and actions of the deltoid b.

Describe and identify the rotator cuff muscles

c. Describe and demonstrate the spaces around the scapula and the structures passing through them
d. Describe and demonstrate the type, articulating surfaces, capsule, ligaments, important relations, movements and muscles causing them, and nerve supply of the shoulder joint.
e. Explain the anatomical basis of dislocation of the shoulder joint
f. Explain the anatomical basis of the clinical manifestations due to injury to the axillary nerve during intramuscular injections

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
□ Lecture	□ Dissection with small group discussion	• Long essay • Short essay • Short answer	• Spotters • Window discussion • Viva-voce

Topic:

Arm and cubital fossa **Number of competencies:** 6

Number of procedures for certification: Nil

Total number of hours required: 6 [6 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN11.1	Describe and demonstrate muscle groups of upper arm with emphasis on biceps and triceps brachii	K/S	SH	Y	-	4
AN11.2	Identify & describe origin, course, relations, branches (or tributaries), termination of important nerves and vessels in arm	K/S	SH	Y		
AN11.4	Describe the anatomical basis of Saturday night paralysis	K	KH	Y		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe and demonstrate the muscles of the flexor compartment of the arm with emphasis on the biceps brachii
b. Describe and demonstrate the muscles of the extensor compartment of the arm with emphasis on the triceps brachii
c. Describe and demonstrate the origin, course, relations, branches, distribution and termination of the musculocutaneous nerve
d. Describe and demonstrate the origin, course, relations, branches, distribution and termination of the brachial artery e. Describe the anatomical basis of Saturday night paralysis

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
-	Dissection with small group discussion	• Long essay • Short essay • Short answer	• Spotters • Window discussion • Viva-voce

Topic:

Arm and cubital fossa continued

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN11.5	Identify & describe boundaries and contents of cubital fossa	K/S	SH	Y	-	2
AN11.3	Describe the anatomical basis of venipuncture of cubital veins	K	KH	Y		
AN11.6	Describe the anastomosis around the elbow joint*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe and demonstrate the boundaries of the cubital fossa
b. Describe and demonstrate the important contents (median neve, brachial artery, radial artery, ulnar artery and tendon of biceps) of the cubital fossa and their relations
c. Describe the anatomical basis of venipuncture of the median cubital vein
d. Describe the arterial anastomosis around the elbow joint and its functional importance

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
-	Dissection with small group discussion	• Short essay • Short answer	• Spotters • Window discussion • Viva-voce

UPPER LIMB

Topic:

Forearm and hand

Number of competencies: 15

Number of procedures for certification: Nil

Total number of hours required: 10 [2 hours (theory) and 8 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN12.1		K/S	SH	Y	**Theory**	**Practical**

Topic:

	Describe and demonstrate important muscle groups of ventral forearm with attachments, nerve supply and actions				1	4
AN12.2	Identify & describe origin, course, relations, branches (or tributaries), termination of important nerves and vessels of forearm	K/S	SH	Y		
AN12.3	Identify & describe flexor retinaculum with its attachments*	K/S	SH	N		
AN12.4	Explain anatomical basis of carpal tunnel syndrome	K	KH	Y		
AN12.5	Identify & describe small muscles of hand. Also describe movements of thumb and muscles involved	K/S	SH	Y		
AN12.6	Describe & demonstrate movements of thumb and muscles involved	K/S	SH	Y		
AN12.7	Identify & describe course and branches of important blood vessels and nerves in hand	K/S	SH	Y		
AN12.8	Describe anatomical basis of Claw hand	K	KH	Y		
AN12.9	Identify & describe fibrous flexor sheaths, ulnar bursa, radial bursa and digital synovial sheaths	K /S	SH	Y		

AN12.10	Explain infection of fascial spaces of palm*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe and demonstrate the muscle groups (superficial and deep set) of the ventral forearm with their attachments, nerve supply and actions
b. Describe and demonstrate the origin, course, relations, branches, distribution and termination of the radial artery
c. Describe and demonstrate the origin, course, relations, branches, distribution and termination of the ulnar artery
d. Describe and demonstrate the origin, course, relations, branches, distribution of the median nerve
e. Describe and demonstrate the origin, course, relations, branches, distribution of the ulnar nerve
f. Describe and demonstrate the origin, course, relations, branches, distribution of radial nerve
g. Describe and demonstrate the attachments of flexor retinaculum of the hand
h. Describe and demonstrate the structures passing superficial and deep to the flexor retinaculum of the hand i. Explain the anatomical basis of carpal tunnel syndrome
j. Describe and demonstrate the small muscles/intrinsic muscles of the hand (thenar, hypothenar, lumbricals and interossei)
k. Describe the origin, insertion, nerve supply and actions of lumbrical muscles of the hand
l. Describe the origin, insertion, nerve supply and actions of interossei muscles of the hand
m. Describe and demonstrate the movements of the thumb
n. Describe the muscles producing movements of thumb
o. Describe and demonstrate the formation, termination and supply of the superficial palmar arch of the hand
p. Describe and demonstrate the course and relations of the ulnar nerve in the hand
q. Describe the anatomical basis of the claw hand
r. Describe and demonstrate the fibrous flexor sheaths of the hand
s. Describe and demonstrate the fascial spaces of the palm
t. Describe and demonstrate the ulnar and radial bursae of the hand
u. Explain infection of fascial spaces of palm

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**

UPPER LIMB

Topic:

□ Lecture	□ Dissection with small group discussion	• Long essay • Modified long essay • Short essay • Short answer	• Spotters • Window discussion • Viva-voce

Forearm and hand continued

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN12.11	Identify, describe and demonstrate important muscle groups of dorsal forearm with attachments, nerve supply and actions	K/S	SH	Y	1	4
AN12.12	Identify & describe origin, course, relations, branches (or tributaries), termination of important nerves and vessels of back of forearm	K/S	SH	Y		
AN12.13	Describe the anatomical basis of Wrist drop	K	KH	Y		
AN12.14	Identify & describe compartments deep to extensor retinaculum	K/S	SH	Y		
AN12.15	Identify & describe extensor expansion formation	K/S	SH	Y		
SPECIFIC LEARNING OBJECTIVES (SLOs')						

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe and demonstrate the attachments, nerve supply and actions of superficial and deep group of muscles of the dorsal forearm
b. Describe and demonstrate the origin, course, relations, branches, termination of the posterior interosseous nerve
c. Describe and demonstrate the origin, course, relations, branches, termination of posterior interosseous artery
d. Describe and demonstrate the cutaneous innervation of the palmar and dorsal aspect of the hand e. Describe the anatomical basis of Wrist drop
f. Describe and demonstrate the attachments of extensor retinaculum of the hand
g. Describe and demonstrate the compartments deep to extensor retinaculum of the hand
h. Describe and demonstrate the extensor digital expansion of the hand

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**

UPPER LIMB

☐ Lecture	☐ Dissection with small group discussion	• Short essay • Short answer	☐ Spotters ☐ Window discussion ☐ Viva-voce

UPPER LIMB

Topic:

General features, joints, radiographs & surface marking

Number of competencies: 8

Number of procedures for certification: Nil

Total number of hours required: 11 [3 hours (theory) and 8 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN13.1	Describe and explain Fascia of upper limb and compartments, veins of upper limb and its lymphatic drainage	K	KH	Y	1	2
AN13.2	Describe dermatomes of upper limb	K	KH	Y		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe and demonstrate the superficial fascia, deep fascia and its modifications in the upper limb
b. Explain the compartments formed by the intermuscular septa of the upper limb
c. Define and describe the dermatomes of the upper limb
d. Describe the arrangements of veins of the upper limb
e. Describe and demonstrate formation, course and relations, tributaries, termination and clinical importance of the veins of the upper limb (dorsal venous arch, cephalic, basilic, median cubital vein, axillary vein)
f. Describe the lymphatic drainage of the upper limb and its functional importance

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture	Dissection with small group discussion	• Short essay • Short answer	• Spotters • Window discussion

Topic: General features, joints, radiographs & surface marking continued

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
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	K/S	SH	Y	1	2
AN13.4	Describe Sternoclavicular joint, Acromioclavicular joint, Carpometacarpal joints & Metacarpophalangeal joint*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe and demonstrate the type, articular surfaces, capsule, synovial membrane, ligaments, relations, movements, blood supply and nerve supply of elbow joint
b. Describe and demonstrate the type, articular surfaces, capsule, ligaments of the proximal and distal radioulnar joint
c. Define and explain the movements, supination and pronation of the radioulnar joint
d. Describe and demonstrate the type, articular surfaces, capsule, synovial membrane, ligaments, relations, movements, blood supply and nerve supply of the wrist joint
e. Describe and demonstrate the type, articular surfaces, capsule, synovial membrane, ligaments, relations, movements, blood supply and nerve supply of first carpometacarpal joint
f. Describe the type, articular surfaces, capsule, ligaments of the sternoclavicular joint, Acromioclavicular joint, carpometacarpal joints and metacarpophalangeal joint*

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**

Topic: General features, joints, radiographs & surface marking continued

Lecture	Dissection with small group discussion	• Short essay • Short answer	• Spotters • Window discussion

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	Practical
AN13.5	Identify the bones and joints of upper limb seen in anteroposterior and lateral view radiographs of shoulder region, arm, elbow, forearm and hand	K/S	SH	Y	1	2

SPECIFIC LEARNING OBJECTIVES (SLOs')

Radiographs: 1. Shoulder region; 2. Arm; 3. Elbow; 4. Forearm; 5. Hand

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Identify and name the region of the radiograph
b. Differentiate and identify the X ray as either plain or contrast radiograph
c. Identify and describe the view as either AP, Lateral in the radiograph
d. Describe and demonstrate the different tissues from most to least opaque on the X-ray as: bone, soft tissue, air, fat on the radiograph
e. Identify and name the normal anatomic structures on X-ray of the upper limb (clavicles and scapulae, Humerus, radius, ulna, carpal bones, metacarpals and phalanges on the respective radiographs)
f. Describe and demonstrate the articulations/joints of the upper limb on the X-ray (shoulder joint, elbow joint, superior and inferior radioulnar joint, wrist joint and carpometacarpal joint on the respective radiograph)
g. Identify and explain - fracture, dislocation on the radiographs

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**

UPPER LIMB

Topic: General features, joints, radiographs & surface marking continued

□ Lecture	□ Dissection with small group discussion	• Short essay • Short answer	• Spotters • Window discussion

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN13.6	Identify & demonstrate important bony land marks of upper limb: Jugular notch, sternal angle, acromial angle, spine of the scapula, vertebral level of the medial end, inferior angle of the scapula	K/S	SH	Y	-	2
AN13.7	Identify & demonstrate surface projection of: Cephalic and C Palpation of Brachial artery, Radial artery, Testing of muscles: Trapezius, pectoralis major, serratus anterior, latissimus dorsi, deltoid, biceps brachii, Brachioradialis	K/S	SH	Y		
AN13.8	Describe the development of the upper limb* (*This competency to be covered in one of the embryology classes*)	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Identify & demonstrate important bony land marks of upper limb on the dissecting cadaver and /or living subjects (Jugular notch, sternal angle, acromial angle, spine of the scapula, vertebral level of the medial end, inferior angle of the scapula)
b. Draw and describe the surface marking of cephalic and basilic vein
c. Describe and demonstrate the Palpation of Brachial artery, Radial artery and explain its functional importance
d. Describe and demonstrate the testing of muscles trapezius, pectoralis major, serratus anterior, latissimus dorsi, deltoid, biceps brachii, Brachioradialis with its clinical importance

UPPER LIMB

Topic: General features, joints, radiographs & surface marking continued

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
-	Dissection with small group discussion	• Short essay • Short answer	• Spotters • Window discussion

THORAX

Topic:

Thoracic cage

Number of competencies: 11

Number of procedures for certification: Nil

Total number of hours required: 3 [3 hours (theory)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Time required	
					Theory	**Practical**
AN 21.1	Identify and describe the salient features of sternum, typical rib and typical thoracic vertebra	K/S	SH	Y	**3**	**-**
AN21.2	Identify and describe the features 2nd, 11th and 12th ribs. 1st, 11th and 12th thoracic vertebrae*	K/S	SH	N		
AN21.8	Describe & demonstrate type, articular surfaces & movements of manubriosternal, costovertebral, costotransverse and xiphisternal joints	K/S	SH	Y		
AN21.9	Describe & demonstrate mechanics and types of respiration	K/S	SH	Y		
AN21.10	Describe costochondral and interchondral joints*	K	KH	N		
SPECIFIC LEARNING OBJECTIVES (SLO)						

THORAX

Bones: 1. Sternum; 2. Ribs; 3. Thoracic vertebra

At the end of the teaching and learning session the 1st phase MBBS student should be able to a.

Identify the bone

b. Hold the bone in anatomical position
c. Describe the type to which the bone belongs
d. Identify the main parts and the general features of the bone
e. Demonstrate the attachments of muscles
f. Describe and demonstrate the articulating surfaces and joints formed by the bone
g. Describe & demonstrate type, articular surfaces & movements of manubriosternal,
h. Describe & demonstrate type, articular surfaces & movements of costovertebral joint
i. Describe & demonstrate type, articular surfaces & movements of costotransverse joint
j. Describe & demonstrate type, articular surfaces & movements of xiphisternal joints
k. Define the sternal angle and explain its clinical importance

l. Explain the anatomical basis of sternal puncture
m. Identify the typical and atypical ribs
n. Identify and describe the features 2nd, 11th and 12th ribs *
o. Compare and contrast the typical and atypical rib features with examples
p. Identify and describe the typical thoracic vertebra
q. Identify and demonstrate the features of 1st, 11th and 12th thoracic vertebrae*
r. Compare and contrast the thoracic vertebrae with other vertebrae (cervical, Lumbar)
s. Describe & demonstrate mechanics and types of respiration

TEACHING AND LEARNING /ASSESSMENT METHODS

Teaching methods		**Assessment methods**	
Theory	**Practical**	**Theory**	**Practical**
Small group discussion	-	Short answer	• Spotters • Viva-voce

Topic: Thoracic cage continued

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Time required	
AN21.3	Describe & demonstrate the boundaries of thoracic inlet, cavity and outlet	K/S	SH	Y	**Theory**	**Practical**
					1	4
AN21.4	Describe & demonstrate extent, attachments, direction of fibres, nerve supply and actions of intercostal muscles	K/S	SH	Y		
AN21.5	Describe & demonstrate origin, course, relations and branches of a typical intercostal nerve	K/S	SH	Y		
AN21.6	Mention origin, course and branches/ tributaries of: 1) anterior & posterior intercostal vessels 2) internal thoracic vessels	K	KH	Y		
AN21.7	Mention the origin, course, relations and branches of 1) atypical intercostal nerve 2) superior intercostal artery, subcostal artery*	K	KH	N		
SPECIFIC LEARNING OBJECTIVES (SLO)						

At the end of the session, the 1st phase MBBS student should be able to:

a. Describe and demonstrate the boundaries of thoracic inlet
b. Enumerate the structures passing through the thoracic inlet
c. Explain the anatomical basis of the thoracic inlet syndrome*
d. Describe and demonstrate the thoracic outlet
e. Define the typical intercostal space. Enumerate the number of intercostal spaces on each side of the chest wall
f. Describe and demonstrate the boundaries of a typical intercostal space
g. Describe and demonstrate the contents of the typical intercostal space
h. Describe and demonstrate the attachments, direction of fibres, nerve supply of the intercostal muscles
i. Describe the actions of the intercostal muscles and correlate with the movements of respiration
j. Describe & demonstrate the origin, course, relations and branches of a typical intercostal nerve k. Enumerate the arteries supplying the thoracic wall
l. Describe the origin, course and branches/tributaries of anterior & posterior intercostal vessels
m. Describe the origin, course and branches/tributaries of internal thoracic vessels.
n. Describe the origin, course and branches and distribution of atypical intercostal nerve
o. Describe the origin, course and branches and distribution of superior intercostal artery*
p. Describe the origin, course and branches and distribution of subcostal artery*

TEACHING AND LEARNING /ASSESSMENT METHODS

Teaching methods		**Assessment methods**	
Theory	**Practical**	**Theory**	**Practical**
Lecture Small group discussion	Dissection – small group discussion	Short answer	• Spotters • Window discussion

THORAX

Topic: Thoracic cage and Mediastinum
Number of competencies: 1 and 7
Number of procedures for certification: Nil
Total number of hours required: 5 [1 hour (theory) & 4 hours (Practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Time required	
AN21.11		K	KH	Y	**Theory**	**Practical**

	Mention boundaries and contents of the superior, anterior, middle and posterior mediastinum				1	4
AN23.1	Describe & demonstrate the external appearance, relations, blood supply, nerve supply, lymphatic drainage and applied anatomy of oesophagus	K/S	SH	Y		
AN23.2	Describe & demonstrate the extent, relations tributaries of thoracic duct and enumerate its applied anatomy	K/S	SH	Y		
AN23.3	Describe & demonstrate origin, course, relations, tributaries and termination of superior venacava, azygos, hemiazygos and accessory hemiazygos veins	K/S	SH	Y		
AN23.4	Mention the extent, branches and relations of arch of aorta & descending thoracic aorta	K	KH	Y		
AN23.5	Identify & Mention the location and extent of thoracic sympathetic chain	K/S	SH	Y		
AN23.6	Describe the splanchnic nerves*	K	KH	N		
AN23.7	Mention the extent, relations and applied anatomy of lymphatic duct	K	KH	Y		

SPECIFIC LEARNING OBJECTIVES (SL)

At the end of the session, the 1st phase MBBS student should be able to:

a. Define the mediastinum

b. Describe the subdivisions of the mediastinum
c. Describe and demonstrate the boundaries of superior mediastinum
d. Describe and demonstrate the contents of superior mediastinum
e. Describe and demonstrate the boundaries and contents of middle mediastinum
f. Describe and demonstrate the boundaries of posterior mediastinum
g. Describe and demonstrate the contents of posterior mediastinum
h. Describe & demonstrate the extent, relations, constrictions, blood supply, nerve supply, lymphatic drainage and applied anatomy of oesophagus
i. Describe and demonstrate extent, relations, tributaries and applied anatomy of thoracic duct
j. Describe & demonstrate the origin, course, relations, tributaries and termination of superior venacava
k. Describe & demonstrate the origin, course, relations, tributaries and termination of azygos, hemiazygos and accessory hemiazygos veins
l. Describe and demonstrate the extent, branches and relations of arch of aorta
m. Describe and demonstrate the extent, branches and relations of descending thoracic aorta
n. Describe and demonstrate the location and extent of thoracic sympathetic chain
o. Describe and demonstrate the formation, relations, area of distribution of splanchnic nerves*
p. Describe and demonstrate the extent, relations and applied anatomy of Right lymphatic duct

TEACHING AND LEARNING /ASSESSMENT METHODS

Teaching methods		**Assessment methods**	
Theory	**Practical**	**Theory**	**Practical**
Lecture Small group discussion	Dissection – small group discussion	• Short essay • Short answer	• Spotters • Window discussion

Topic: Heart and pericardium
Number of competencies: 7
Number of procedures for certification: Nil
Total number of hours required: 6 [2 hour (theory) & 4 hours (Practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Time required	
					Theory	**Practical**
AN22.1	Describe & demonstrate subdivisions, sinuses in pericardium, blood supply and nerve supply of pericardium	K/S	SH	Y	2	4
AN22.2	Describe & demonstrate external and internal features of each chamber of heart	K/S	SH	Y		
AN22.3	Describe & demonstrate origin, course and branches of coronary arteries	K/S	SH	Y		
AN22.4	Describe anatomical basis of ischaemic heart disease	K	KH	Y		
AN22.5	Describe & demonstrate the formation, course, tributaries and termination of coronary sinus	K/S	SH	Y		
AN22.6	Describe the fibrous skeleton of heart	K	KH	Y		
AN22.7	Mention the parts, position and arterial supply of the conducting system of heart	K	KH	Y		
SPECIFIC LEARNING OBJECTIVES (SLO)						

At the end of the session, the 1st phase MBBS student should be able to:

a. Define pericardium and name the layers of the pericardium
b. Describe and demonstrate the attachments and structures related to the fibrous pericardium
c. Describe the attachments and functions of serous pericardium
d. Describe the blood supply and nerve supply of pericardium
e. Name the sinuses of the heart
f. Describe and demonstrate the boundaries of transverse sinus of the pericardium
g. Describe and demonstrate the boundaries of oblique sinus of the pericardium

h. Identify and describe the external features of the heart:
   - apex
   - base
   - three surfaces – sterno-costal, diaphragmatic and left surface
   - three borders – right, inferior and left borders
   - Grooves and sulci along with its contents
i. Describe and demonstrate the internal features of right atrium
j. Describe and demonstrate the internal features of left atrium
k. Describe and demonstrate the internal features of right ventricle
l. Describe and demonstrate the internal features of left ventricle
m. Describe the fibrous skeleton of heart
n. Describe the parts, position and arterial supply of the conducting system of heart
o. Name the coronary arteries and their important branches
p. Describe and demonstrate the origin, course and branches and area of distribution of right and left coronary arteries a. Describe the anatomical basis of ischemic heart
b. Explain the anatomical basis of coronary dominance
c. Describe & demonstrate the formation, course, tributaries and termination of coronary sinus
d. Describe and demonstrate the venous drainage of the heart

TEACHING AND LEARNING /ASSESSMENT METHODS

Teaching methods		**Assessment methods**	
Theory	**Practical**	**Theory**	**Practical**
Lecture Small group discussion	Dissection - small group discussion	• Short essay • Short answer	• Spotters • Window Discussion

THORAX

Lungs & Trachea

Number of competencies: 6

Number of procedures for certification: NIL

Total number of hours required: 6 [2 hour (theory) & 4 hours (Practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Time required	
					Theory	**Practical**
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	K	KH	Y	2	4
AN24.2	Identify side, external features and relations of structures which form root of lung & bronchial tree and their clinical correlate	K/S	SH	Y		
AN24.3	Describe a bronchopulmonary segment	K	KH	Y		
AN24.4	Identify phrenic nerve & describe its formation & distribution	K/S	SH	Y		
AN24.5	Mention the blood supply, lymphatic drainage and nerve supply of lungs	K	KH	Y		
AN24.6	Describe the extent, length, relations, blood supply, lymphatic drainage and nerve supply of trachea	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLO)

At the end of the session, the 1st phase MBBS student should be able to:

a. Define pleura and name the layers of the pleura
b. Describe the difference between parietal and visceral pleura
c. Describe the subdivisions of the parietal pleura
d. Describe the blood supply, lymphatic drainage and nerve supply of pleura
e. Describe the pulmonary ligament and explain its functional significance
f. Describe the attachments of the suprapleural membrane

Topic:

g. Name the pleural recesses
h. Describe the pleural recesses and explain their applied anatomy i. Identify and describe the external features, fissures, lobes and relations of the right lung j. Identify and describe the external features, fissures, lobes and relations of the left lung k. Compare and contrast the anatomical features of the right and left lungs l. Differentiate between the root of lung and the hilum of lung m. Enumerate the structures forming the root of lung and their relations n. Define bronchopulmonary segment o. Describe the bronchopulmonary segments of each lung p. Describe the characteristic anatomical features of bronchopulmonary segments and their clinical importance q. Describe the functional relations of arteries and veins to the bronchopulmonary segments r. Identify and describe the formation, course, relations and area of distribution of phrenic nerve s. Describe the blood supply, lymphatic drainage and nerve supply of lungs t. Describe and demonstrate the extent, length, relations, blood supply, lymphatic drainage and nerve supply of trachea*

TEACHING AND LEARNING /ASSESSMENT METHODS

Teaching methods		**Assessment methods**	
Theory	**Practical**	**Theory**	**Practical**
Lecture Small group discussion	Dissection – small group discussion	• Long essay • Short essay • Short answer	• Spotters • Window discussion

Lungs & Trachea (Histology)

Number of competencies: 1

Number of procedures for certification: 1

Total number of hours required: 3 [1 hour (theory) & 2 hours (Practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Time required	
					Theory	**Practical**
AN25.1	Identify, draw and label a slide of trachea and lung	K/S	SH	**Y**	1	2

SPECIFIC LEARNING OBJECTIVES (SLO)

At the end of the session, the 1st phase MBBS student should be able to:

a. Identify and draw the H & E slide of Trachea

b. Demonstrate and describe the layers of the trachea in H & E slide – mucosa with lining epithelium, submucosa – seromucous glands, fibro-musculo cartilaginous layer – hyaline cartilage, trachealis muscle, adventitia with blood vessels c. Identify and draw the H & E slide of the lung

d. Demonstrate and describe the following structures in the slide of Lung: Intrapulmonary bronchus, terminal bronchiole, respiratory bronchiole, alveolar duct, alveolar sac, alveoli, alveolar capillaries

TEACHING AND LEARNING /ASSESSMENT METHODS

Teaching methods		**Assessment methods**	
Theory	**Practical**	**Theory**	**Practical**

Topic:

• Lecture • Small group discussion	Histology - small group discussion	• Short essay • Short answer	• Spotters • Slide Discussion

Topic:

Nil

Radiological anatomy (thorax) **Number of competencies**: 2

Number of procedures for certification:

Total number of hours required: 3 [1 hour (theory) & 2 hours (Practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Time required	
					Theory	**Practical**
AN25.7	Identify structures seen on a plain x-ray chest (PA view)	K/S	SH	Y	1	2
AN 25.8	Identify and describe in brief a barium swallow*	K/S	SH	N		

SPECIFIC LEARNING OBJECTIVES (SLO)

At the end of the session, the 1st phase MBBS student should be able to:

a. Identify and name the region of the radiograph
b. Identify and differentiate between plain and contrast radiographs of chest
c. Describe the differences between PA and AP views of chest radiograph
d. Describe and demonstrate the different tissues from most to least opaque on the X-ray as: bone, soft tissue, air, fat on the radiograph
e. Identify the anatomical structures on plain radiograph of chest (PA view)
f. Describe the basis of contrast radiography
g. Identify structures on a barium swallow*
h. Describe the structures seen on a barium swallow*

TEACHING AND LEARNING /ASSESSMENT METHODS

Teaching methods		Assessment methods	
Theory	**Practical**	**Theory**	**Practical**
• Lecture • Small group discussion	Small group discussion	-	• Spotters • Viva voce

Topic:

Nil

Surface marking of thorax **Number of competencies**: 1 **Number of procedures for certification:**
Total number of hours required: 2 [2 hours (Practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Time required	
					Theory	**Practical**
AN25.9	Demonstrate the surface marking of lines of pleural reflection, lung borders, and fissures, trachea, heart borders, apex beat and surface projection of valves of heart	K/S	SH	Y	-	2

SPECIFIC LEARNING OBJECTIVES (SLO)

At the end of the session, the 1st phase MBBS student should be able to:

a. Demonstrate the surface marking of lines of pleural reflection on the cadaver /simulator and explain one relevant clinical importance
b. Demonstrate the surface marking of borders of the lung (right / left) on the cadaver/simulator and explain one relevant clinical importance
c. Demonstrate the surface marking of fissures of the lung (right/left) on the cadaver/ simulator and explain one relevant clinical importance
d. Demonstrate the surface marking of trachea on the cadaver/simulator and explain one relevant clinical importance
e. Demonstrate the surface marking of borders of the heart on the cadaver/simulator and explain one relevant clinical importance
f. Demonstrate the surface marking of apex beat on the cadaver /simulator and explain one relevant clinical importance
g. Demonstrate the surface marking of valves of the heart on the cadaver/simulator and explain one relevant clinical importance

TEACHING AND LEARNING /ASSESSMENT METHODS

Teaching methods		Assessment methods	
Theory	**Practical**	**Theory**	**Practical**

Topic:

Nil

-	Small group discussion	-	• Viva voce • OSPE

Embryology of thorax

Number of competencies: 5

Number of procedures for certification:

Total number of hours required: 6 [4 hours of theory & 2 hours (Practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Time required	
AN25.2					**Theory**	**Practical**

Topic:

	Nil					
	Describe the development of pleura, lungs and heart	K	KH	Y	4	2
AN25.3	Describe the fetal circulation and changes occurring at birth	K	KH	Y		
AN25.4	Describe the embryological basis of: 1) atrial septal defect 2) ventricular septal defect, 3) Fallot's tetralogy & 4) trachea-esophageal fistula	K	KH	Y		
AN25.5	Describe the developmental basis of congenital anomalies, transposition of great vessels, dextrocardia, patent ductus arteriosus and coarctation of aorta	K	KH	Y		
AN25.6	Mention the development of aortic arches arteries, SVC, IVC and coronary sinus*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLO)

At the end of the session, the 1st phase MBBS student should be able to:

a. Describe the formation of the respiratory diverticulum
b. Describe the parts of the respiratory diverticulum that develop into the larynx, trachea, bronchi, bronchioles and alveoli c. Describe the stages in the maturation of the lungs
d. Give examples of some congenital abnormalities of the respiratory system
e. Explain the embryological basis of trachea-esophageal fistula
f. Describe the cardiogenic area and its relation to the pericardial cavity
g. Describe the formation of the heart tube, its parts and looping
h. Describe the changes in the sinus venosus

i. Describe the formation the interatrial septum
j. Describe the formation of the right and left atria
k. Describe the formation of the atrioventricular valves
l. Give examples of congenital malformations with special reference to atrial septal defects
m. Describe the formation of septa in the truncus, conus and ventricle
n. Describe the formation of the two ventricles
o. Describe the formation of the semilunar valves
p. Describe the formation of the conducting system of the heart
q. Describe the formation of transverse and oblique sinuses of the pericardium
r. Give examples of congenital malformations with special emphasis on ventricular septal defects and Fallot's tetralogy s. Describe the pharyngeal arch arteries and their derivatives
t. Describe the branches of the dorsal aorta
u. Describe the derivatives of the vitelline, umbilical and cardinal veins
v. Describe the fetal circulation and the changes occurring in it after birth
w. Describe the formation of the lymphatic system
x. Give examples of congenital malformations of the arterial and venous systems

TEACHING AND LEARNING /ASSESSMENT METHODS			
Teaching methods		**Assessment methods**	
Theory	**Practical**	**Theory**	**Practical**
Lecture Team based learning	Small group discussion - Model	• Short essay • Short answers	• Viva voce • OSPE

ABDOMEN AND PELVIS

Anterior abdominal wall

Number of competencies: 3

Number of procedures for certification: Nil

Total number of hours required: 4 [2 hours (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN44.1	Describe & demonstrate the planes (transpyloric, transtubercular, subcostal, lateral vertical, linea alba, linea semilunaris), regions & quadrants of abdomen	K/S	SH	Y	2	2
AN44.2	Describe & identify the fascia, nerves & blood vessels of anterior abdominal wall	K/S	SH	Y		
AN44.6	Describe & demonstrate attachments of muscles of anterior abdominal wall.	K/S	SH	Y		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Demonstrate location of planes (transpyloric, transtubercular, subcostal, lateral vertical) of abdomen b. Deduce clinical relevance of planes of abdomen

c. Classify regions of abdomen into quadrants
d. Assess location of viscera in appropriate quadrants of abdomen
e. Relate position of umbilicus with clinical relevance,
f. Explain referred pain around umbilicus, dermatome, applied aspects*
g. Explain distribution of fascia of anterior abdominal wall
h. Explain attachments of muscles of anterior abdominal wall
i. Explain course, relations, branches and applied aspects of nerves of anterior abdominal wall
j. Explain course, relations, branches and applied aspects of blood vessels of anterior abdominal wall
k. Give anatomical basis for extravasation urine in perineum, caput medusae

TEACHING AND LEARNING METHODS	ASSESSMENT METHODS

ABDOMEN AND PELVIS

Topic:

Theory	Practical	Theory	Practical
Lecture Case based learning Team based learning	Demonstration with small group discussion	• Structured Long essay • Modified Long essay • Short essay • Short answer	• Spotters • Group discussion

Rectus Sheath

Number of competencies: 2

Number of procedures for certification: Nil

Total number of hours required: 3 [1 hour (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN44.2	Describe the formation of rectus sheath and its contents	K/S	SH	Y	1	2
AN44.7	Enumerate common abdominal incisions*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to: a. Explain formation of rectus sheath

b. Describe formation of Linea alba, linea semilunaris
c. List contents of rectus sheath
d. Explain attachments of muscles of rectus sheath
e. Trace course and branches of nerves of rectus sheath
f. Trace course and branches of blood vessels of rectus sheath
g. Apply concept of anatomical basis of common abdominal incisions*

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical**
• Lecture • Case based learning	□ Demonstration with small group discussion	• Structured Long essay • Short essay • Short answer	• Spotters • Group discussion

ABDOMEN AND PELVIS

Topic:

ABDOMEN AND PELVIS

Topic:

Inguinal canal

Number of competencies: 2

Number of procedures for certification: Nil

Total number of hours required: 3 [1 hour (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN44.4	Describe & demonstrate extent, boundaries, contents of inguinal canal including Hesselbach's triangle	K/S	SH	Y	**Theory**	**Practical**
					1	2
AN44.5	Explain the anatomical basis of inguinal hernia.	K	KH	Y		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to: a. Identify extent of Inguinal canal

b. Explain boundaries of Inguinal canal
c. Name contents of inguinal canal in male and female individuals
d. Outline acquisition of coverings of spermatic cord in inguinal canal
e. Explain boundaries of Hesselbach's triangle.
f. Compare and contrast anatomical aspects of types of inguinal hernia
g. Give anatomical basis for cremasteric reflex
h. Explain importance of conjoint tendon

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical**

ABDOMEN AND PELVIS

Topic:

□ Lecture	□ Demonstration with small group discussion	• Structured Long essa ' • Short essay • Short answer	• Spotters • Group discussion

Posterior abdominal wall

Number of competencies: 2

Number of procedures for certification: Nil

Total number of hours required: 3 [1 hour (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN45.1	Describe thoracolumbar fascia	K	KH	Y	**Theory**	**Practical**
AN45.2	Describe & demonstrate lumbar plexus for its root value, formation & branches	K/S	SH	Y	1	2
AN45.3	Mention the major subgroups of back muscles, nerve supply and action*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Explain layers, extent, attachments of thoracolumbar fascia
b. Describe major subgroups of back muscles, nerve supply and action*
c. Demonstrate approach to exposure of kidney from back

TEACHING AND LEARNING METHODS	ASSESSMENT METHODS

ABDOMEN AND PELVIS

Topic:

Theory	Practical	Theory	Practical
□ Lecture	□ Demonstration with small group discussion	• Structured Long essay • Short essay • Short answer	• Spotters • Group discussion

Male external genitalia

Number of competencies: 5

Number of procedures for certification: Nil

Total number of hours required: 3 [1 hour (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN46.1	Describe & demonstrate coverings, internal structure, side determination, blood supply, nerve supply, lymphatic drainage & descent of testis with its applied anatomy	K/S	SH	Y	1	2
AN46.2	Describe parts of epididymis	K	KH	Y		
AN46.3	Describe penis under following headings: (parts, components, blood supply and lymphatic drainage)	K	KH	Y		
AN46.4	Explain the anatomical basis of varicocele*	K	KH	N		
AN46.5	Explain the anatomical basis of phimosis & circumcision*	K	KH	N		
SPECIFIC LEARNING OBJECTIVES (SLOs')						

ABDOMEN AND PELVIS

Topic:

At the end of the teaching and learning session the 1st phase MBBS student should be able to: a. Discuss coverings of testis

b. Point out macroscopic structure of testis
c. Determine the side of testis
d. Explain blood supply, nerve supply, lymphatic drainage of testis
e. Deduce anatomical basis of varicocoele, hydrocoele*
f. List parts of epididymis
g. Explain parts, components, blood supply and lymphatic drainage of penis
h. Apply anatomical basis of phimosis & circumcision*
i. Explain spermatic cord and its contents
j. Correlate embryological basis for descent of testis, cryptorchidism, ectopic testis

ABDOMEN AND PELVIS

Topic:

EACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical**
Lecture Case based learning	Demonstration with small group discussion	• Structured Long essay • Modified Long eassay • Short essay • Short answer	• Spotters • Group discussion

ABDOMEN AND PELVIS

Peritoneum

Number of competencies: 4

Number of procedures for certification: Nil

Total number of hours required: 4 [2 hours (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN47.1	Describe & identify boundaries and recesses of lesser & greater sac	K/S	SH	Y	2	2
AN47.2	Name & identify various peritoneal folds & pouches with its explanation	K/S	SH	Y		
AN47.3	Explain anatomical basis of ascites & peritonitis*	K	KH	N		
AN47.4	Explain anatomical basis of subphrenic abscess*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to: a. Outline peritoneal reflection,

b. Define peritoneal folds and ligaments
c. Draw neat labeled diagram of vertical and horizontal disposition of peritoneum d. Explain peritoneal pouches
e. Define attachments of greater omentum, mesentery, sigmoid mesocolon
f. Explain boundaries and recesses of greater sac
g. Explain boundaries and recesses of lesser sac
h. Explain boundaries and clinical relevance of epiploic foramen and hepatorenal pouch of morrison i. Relate anatomical basis of ascites & peritonitis*
j. Discuss anatomical basis of subphrenic abscess*
k. Categorise abdominal cavity into compartments and recesses

TEACHING AND LEARNING METHODS	ASSESSMENT METHODS

ABDOMEN AND PELVIS

Topic:

Theory	Practical	Theory	Practical
Lecture	Demonstration with small group discussion	• Structured Long essay • Short essay • Short answer	• Spotters • Group discussion

Spleen and Coeliac trunk

Number of competencies: 3

Number of procedures for certification: Nil

Total number of hours required: 3 [1 hour (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN47.5		K/S	SH	Y	**Theory**	**Practical**

	Describe & demonstrate major viscera of abdomen under following headings (anatomical position, external and internal features, important peritoneal and other relations, blood supply, nerve supply, lymphatic drainage and applied aspects)				1	2
AN47.6	Explain the anatomical basis of Splenic notch, Accessory spleens, Kehr's Sign*	K	KH	N		
AN47.9	Describe & identify the origin, course, important relations and branches of Coeliac trunk	K/S	SH	Y		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to: a. Hold spleen in anatomical position

b. Identify external features of spleen
c. Define Hilton's law
d. Trace peritoneal relations of spleen
e. Identify visceral relations of spleen
f. Explain blood supply, nerve supply, lymphatic drainage of spleen
g. Correlate anatomical basis of splenic notch, accessory spleens, Kehr's sign
h. Trace origin, course, important relations and branches of coeliac trunk

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical**
Lecture Case based learning Team based learning	Demonstration with small group discussion	• Structured Long essay • Modified Long essay • Short essay • Short answer	• Spotters • Group discussion

ABDOMEN AND PELVIS

Topic:

Abdominal part of Esophagus and Stomach **Number of competencies:** 2

Number of procedures for certification: Nil

Total number of hours required: 3 [1 hour (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN47.5		K/S	SH	Y	**Theory**	**Practical**

AN47.6	Describe & demonstrate major viscera of abdomen under following headings (anatomical position, external and internal features, important peritoneal and other relations, blood supply, nerve supply, lymphatic drainage and applied aspects) Explain the anatomical basis of Different types of vagotomy, & Lymphatic spread in carcinoma stomach*	K	KH	N	1	2

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Explain blood supply, nerve supply, lymphatic drainage and applied aspects of abdominal part of esophagus b. Interpret clinical basis for esophageal varices

c. Hold stomach in anatomical position
d. Identify external features of stomach
e. Trace peritoneal relations of stomach
f. Explain structures forming stomach bed and their clinical relevance
g. Explain visceral relations of stomach
h. Explain blood supply, nerve supply, lymphatic drainage of stomach
i. Justify anatomical basis of lymphatic spread in carcinoma stomach*
j. Correlate normal anatomy of stomach with its applied aspects
k. Infer different types of vagotomy*

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical**
• Lecture • Case based learning	□ Demonstration with small group discussion	• Structured Long essay • Modified long essay	• Spotters • Group discussion
□ Team based learning		• Short essay • Case based short essay • Short answer	

ABDOMEN AND PELVIS

Topic:

Mesentery and Small Intestine **Number of competencies:** 2

Number of procedures for certification: Nil

Number of teaching hours: 3 [1 hour (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN47.5	Describe & demonstrate major viscera of abdomen under following headings (anatomical position, external and internal features, important peritoneal and other relations, blood supply, nerve supply, lymphatic drainage and applied aspects)	K/S	SH	Y	1	2
AN 47.9	Describe & identify the origin, course, important relations and branches of superior mesenteric artery	K/S	SH	Y		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Explain extent, borders, contents, relations, applied aspects of mesentery b. Explain parts of small intestine

c. Differentiate between jejunum and ileum macroscopically

d. Explain nerve supply, lymphatic drainage of jejunum and ileum

e. Explain origin, course, important relations and branches of superior mesenteric artery

f. Infer clinical relevance of Meckel's diverticulum

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical**
□ Lecture	□ Demonstration with small group discussion	• Structured Long essay • Short essay • Short answer	• Spotters • Group discussion

ABDOMEN AND PELVIS

Topic:

Large Intestine

Number of competencies: 2

Number of procedures for certification: Nil

Number of teaching hours: 2 [1 hour (theory) and 1 hour (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN47.5	Describe & demonstrate major viscera of abdomen under following headings (anatomical position, external and internal features, important peritoneal and other relations, blood supply, nerve supply, lymphatic drainage and applied aspects)	K/S	SH	Y	1	1
AN 47.9	Describe & identify the origin, course, important relations and branches of inferior mesenteric artery	K/S	SH	Y		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. State features, extent, peritoneal and other relations of large intestine
b. Explain anatomical position, external and internal features, important peritoneal and other relations, blood supply, nerve supply, lymphatic drainage and applied aspects of caecum
c. Explain anatomical position, external and internal features, important peritoneal and other relations, blood supply, nerve supply, lymphatic drainage and applied aspects of vermiform appendix
d. List positions of vermiform appendix
e. Trace origin, course, important relations and branches of inferior mesenteric artery f. Explain marginal artery of Drummond

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical**

ABDOMEN AND PELVIS

Topic:

• Lecture • Case based learning • Team based learning	□ Demonstration with small group discussion	• Structured Long essay • Modified Long essay • Short essay • Case based short essay □ Short answer	• Spotters • Group discussion

Duodenum

Number of competencies: 1

Number of procedures for certification: Nil

Number of teaching hours: 2 [1 hour (theory) and 1 hour (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN47.5	Describe & demonstrate major viscera of abdomen under following headings (anatomical position, external and internal features, important peritoneal and other relations, blood supply, nerve supply, lymphatic drainage and applied aspects)	K/S	SH	Y	1	1

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to: a. Hold duodenum in anatomical position

b. Identify external and internal features of duodenum
c. Identify important peritoneal and other relations of duodenum
d. Explain blood supply, nerve supply, lymphatic drainage of duodenum
e. Correlate applied aspects of duodenum

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical**

ABDOMEN AND PELVIS

Topic:

• Lecture • Case based discussion • Team based learning	□ Demonstration with small group discussion	• Structured Long essay • Modified long essay • Short essay • Case based short essay □ Short answer	• Spotters • Group discussion

Pancreas

Number of competencies: 1

Number of procedures for certification: Nil

Number of teaching hours: 2 [1 hour (theory) and 1 hour (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN47.5	Describe & demonstrate major viscera of abdomen under following headings (anatomical position, external and internal features, important peritoneal and other relations, blood supply, nerve supply, lymphatic drainage and applied aspects)	K/S	SH	Y	**Theory**	**Practical**
					1	1
SPECIFIC LEARNING OBJECTIVES (SLOs')						
At the end of the teaching and learning session the 1st phase MBBS student should be able to: a. Identify Anatomical position, external and internal features of pancreas b. Explain Important peritoneal and other relations, blood supply, nerve supply, lymphatic drainage of pancreas c. Correlate clinical aspects of pancreas						
TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**				

ABDOMEN AND PELVIS

Topic:

Theory	Practical	Theory	Practical
• Lecture • Case based learning • Team based learning	Demonstration with small group discussion	• Structured Long essay • Modified long essay • Short essay • Case based short essay Short answer	• Spotters • Group discussion

Topic: Portal vein
Number of competencies: 2
Number of procedures for certification: Nil
Number of teaching hours: 2 [1 hour (theory) and 1 hour (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN47.8	Describe & identify the formation, course relations and tributaries of portal vein	K/S	SH	Y	**Theory**	**Practical**
					1	1
AN47.10	Enumerate the sites of porta-systemic anastomosis	K	KH	Y		

SPECIFIC LEARNING OBJECTIVES (SLOs')
At the end of the teaching and learning session the 1st phase MBBS student should be able to: a. Explain formation, course, relations of portal vein b. Trace tributaries of portal vein c. Enumerate sites of porta-systemic anastomosis d. Deduce anatomic basis of hematemesis & caput medusae in portal hypertension

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical**
• Lecture • Case based learning	□ Demonstration with small group discussion	• Structured Long essay • Modified long essay • Short essay • Short answer	• Spotters • Group discussion

Topic: Liver and Extrahepatic biliary apparatus
Number of competencies: 3
Number of procedures for certification: Nil

ABDOMEN AND PELVIS

Number of teaching hours: 3 [1 hour (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN47.5	Describe & demonstrate major viscera of abdomen under following headings (anatomical position, external and internal features, important peritoneal and other relations, blood supply, nerve supply, lymphatic drainage and applied aspects)	K/S	SH	Y	1	2
AN47.6	Explain the anatomical basis of liver biopsy (site of needle puncture), referred pain in cholecystitis, obstructive jaundice*	K	KH	N		
AN47.7	Mention the clinical importance of Calot's triangle*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to: a. Hold liver in anatomical position

b. List factors maintaining stability of liver
c. Identify external features and important visceral relations of liver
d. Explain important peritoneal relations, blood supply, nerve supply, lymphatic drainage of liver
e. Classify liver into anatomical and physiological lobes and vascular segments f. Identify bare areas of liver
g. Interpret clinical relevance of bare area of liver
h. Explain features of porta hepatis
i. Describe external features of extra hepatic biliary apparatus
j. Correlate clinical aspects of liver and extra hepatic biliary apparatus
k. Deduce clinical importance of Calot's triangle*
l. Outline sites of liver biopsy (site of needle puncture) *
m. Deduce referred pain in cholecystitis*
n. Correlate clinical aspects of obstructive jaundice*

TEACHING AND LEARNING METHODS	ASSESSMENT METHODS

ABDOMEN AND PELVIS

Theory	Practical	Theory	Practical
Lecture Case based discussion Team based earning	Demonstration with small group discussion	• Structured Long essay • Modified long essay • Short essay • Case based short essay • Short answer	• Spotters • Group discussion

ABDOMEN AND PELVIS

Topic: Kidney and Ureter
Number of competencies: 2
Number of procedures for certification: Nil
Number of teaching hours: 4 [2 hours (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN47.5	Describe & demonstrate major viscera of abdomen under following headings (anatomical position, external and internal features, important peritoneal and other relations, blood supply, nerve supply, lymphatic drainage and applied aspects)	K/S	SH	Y	**Theory**	**Practical**
					2	2
AN47.6	Explain the anatomical basis of radiating pain of kidney to groin*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Hold kidney in anatomical position and determine its side
b. List factors for stability of kidney
c. Identify external features of kidney
d. Explain coverings, important visceral relations, blood supply, nerve supply, lymphatic drainage of kidney e. Deduce reason for movement of kidney with respiration
f. Identify macroscopic structure of kidney
g. Outline borders of kidney in Morris parallelogram
h. Deduce radiating pain of kidney to groin*
i. Correlate applied aspects of kidney
j. Explain extent, parts, course, relations, constrictions, blood supply, nerve supply, lymphatic drainage of ureter

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical**

ABDOMEN AND PELVIS

□ Lecture	□ Demonstration with small group discussion	• Structured Long essay • Short essay • Short answer	• Spotters • Group discussion

Topic: Thoraco-abdominal diaphragm
Number of competencies: 2
Number of procedures for certification: Nil
Number of teaching hours: 2 [1 hour (theory) and 1 hour (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN47.13	Describe & demonstrate the attachments, openings, nerve supply & action of the thoracoabdominal diaphragm	K/S	SH	Y	1	1
AN47.14	Describe the abnormal openings of thoracoabdominal diaphragm and diaphragmatic hernia*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Explain attachments of thoracoabdominal diaphragm
b. Identify major and minor openings of thoracoabdominal diaphragm
c. Enumerate structures passing through major and minor openings of thoracoabdominal diaphragm
d. Interpret changes in shape of major openings of diaphragm with respiration
e. Explain nerve supply & action of diaphragm
f. Correlate reasons for abnormal openings of diaphragm
g. Interpret congenital aspects of diaphragmatic hernia*

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical**

□ Lecture	□ Demonstration with small group discussion	• Structured Long essay • Short essay • Short answer	• Spotters • Group discussion

Please note: *The thoraco-abdominal diaphragm is to be assessed along with thorax in paper I in the university examination*

Topic: Suprarenal gland
Number of competencies: 1
Number of procedures for certification: Nil
Number of teaching hours: 2 [1 hour (theory) and 1 hour (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN47.5	Anatomical position, external features coverings important visceral and other relations blood supply, nerve supply, lymphatic drainage applied aspects	K/S	SH	Y	1	1

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Identify anatomical position of suprarenal gland
b. Explain external features, coverings, important visceral and other relations of suprarenal gland
c. Explain blood supply, nerve supply, lymphatic drainage of suprarenal gland
d. Explain applied aspects of suprarenal gland

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical**
□ Lecture	□ Demonstration with small group discussion	• Short essay • Short answer	□ Spotters

ABDOMEN AND PELVIS

Topic: Posterior abdominal wall
Number of competencies: 3
Number of procedures for certification: Nil
Number of teaching hours: 3[1 hour (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN 45.2	Describe & demonstrate lumbar plexus for its root value, formation & branches	K/S	SH	Y	**Theory**	**Practical**
					1	2
AN 47.8	Describe & identify the formation, course relations and tributaries of inferior vena cava & renal vein	K/S	SH	Y		
AN 47.9	Describe & identify the origin, course, important relations and branches of abdominal aorta & common iliac artery	K/S	SH	Y		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Explain origin, course, important relations and branches of abdominal aorta
b. Explain formation, course relations and tributaries of inferior venacava
c. Explain root value, formation & branches* of lumbar plexus
d. Explain attachments, nerve supply, action of psoas major
e. Define boundaries of lumbosacral triangle of Marcille
f. Name contents of lumbosacral triangle of Marcille
g. Explain situation, relations, tributaries of cysterna chyli
h. Enumerate branches of lumbar sympathetic chain
i. Interpret clinical significance of coeliac ganglia

ABDOMEN AND PELVIS

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical**
□ Lecture	□ Demonstration with small group discussion	• Short essay • Short answer	□ Spotters

ABDOMEN AND PELVIS

Topic: Pelvic wall and viscera

Number of competencies: 8
Number of procedures for certification: NIL
Total number of hours required: 22 [9 hours (theory) and 13 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN48.1	Describe & identify the muscles of pelvic diaphragm	K/S	SH	Y	Theory	Practical
					1	2

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Demonstrate and describe the location, attachments, nerve supply, relations and functions/clinical importance of the following muscles:
   i. Levator ani (pelvic diaphragm)
   ii. Obturator internus iii. Piriformis

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
□ Lecture	□ Dissection with small group discussion	• Short essay • Short answer	□ Spotters

Topic: Pelvic wall and viscera continued

COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
& demonstrate the (position, features, eritoneal and other relations, blood supply, y, lymphatic drainage and clinical aspects of) ale & female pelvic viscera	K/S	SH	Y	Theory	Practical
				6	8

SPECIFIC LEARNING OBJECTIVES (SLOs')

g and learning session the 1st phase MBBS student should be able to:

describe the position, features, important peritoneal and other relations, blood supply, nerve supply, lymphatic ical aspects of the following structures:

t of ureter
adder
ethra iv. Male urethra

tube
its supports)

ix. Vas deferens

y ducts
esicles
age changes)

xiv. Anal canal

CHING AND LEARNING METHODS	ASSESSMENT METHODS

Topic: Pelvic wall and viscera continued

	Practical	Theory	Practical
	Dissection with small group discussion	• Long essay • Short essay • Short answer	• Spotters • Window discussion

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	Practical
AN48.3	Describe & demonstrate the origin, course, important relations and branches of internal iliac artery	K/S	SH	Y	2	3
AN48.4	Describe the branches of sacral plexus	K/S	SH	Y		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Demonstrate and describe the origin, course, important relations, branches / tributaries and distribution and applied anatomy of the internal iliac vessels.
b. Describe the formation, branches and distribution of the sacral plexus.

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture	Dissection with small group discussion	• Short essay • Short answer	• Spotters • Window discussion

Topic: Pelvic wall and viscera continued

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN48.5	Explain the anatomical basis of suprapubic cystostomy, urinary obstruction in benign prostatic hypertrophy, retroverted uterus, prolapse uterus, internal and external hemorrhoids, anal fistula, vasectomy, tubal pregnancy & tubal ligation*	K/S	SH	N	Theory	Practical
					-	-
SPECIFIC LEARNING OBJECTIVES (SLOs)						
At the end of the teaching and learning session the 1st phase MBBS student should be able to: a. Explain the anatomical basis of the following: i. Catheterization in males and females ii. Suprapubic cystostomy iii. Urinary obstruction in benign prostatic hypertrophy iv. Retroverted uterus v. Prolapse uterus vi. Internal and external haemorrhoids vii. Anal fistula viii. Vasectomy ix. Tubal pregnancy x. Tubal ligation						

ABDOMEN AND PELVIS

Topic: Pelvic wall and viscera continued

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
-	-	-	-

Please note: *No separate time is allotted for these topics, as they will be done as part of the relevant lecture / practical classes*

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN48.6	Describe the neurological basis of automatic bladder	K/S	SH	N	Theory	Practical
AN48.7	Mention the lobes involved in benign prostatic hypertrophy & prostatic cancer	K/S	SH	N	-	-
AN48.8	Mention the structures palpable during vaginal & rectal examination	K/S	SH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs)

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Explain the anatomical basis of automatic bladder

b. Compare and contrast the anatomical basis of benign prostatic hypertrophy and prostatic cancer c. Mention the structures palpable during

i. Vaginal examination

ii. Rectal examination

ABDOMEN AND PELVIS

Topic: Pelvic wall and viscera continued

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
-	-	-	-

Please note: *No separate time is allotted for these topics, as they will be done as part of the relevant lecture / practical classes*

ABDOMEN AND PELVIS

Topic:

Perineum

Number of competencies: 5

Number of procedures for certification: NIL

Total number of hours required: 8 [2 hours (theory) and 6 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN49.1	Describe & demonstrate the superficial & deep perineal pouch (boundaries and contents)	K/S	SH	Y	**Theory**	**Practical**
					1	4
AN49.2	Describe & identify perineal body	K/S	SH	Y		
AN49.3	Describe & demonstrate perineal membrane in male & female	K/S	SH	Y		

SPECIFIC LEARNING OBJECTIVES (SLOs)

At the end of the teaching and learning session the 1st phase MBBS student should be able to: a.

Demonstrate and describe the

i. Boundaries and subdivisions of the perineum
ii. Superficial perineal pouch (boundaries and contents, sex differences)
iii. Deep perineal pouch (boundaries and contents, sex differences

b. Describe formation, function and clinical importance of the perineal body
c. Describe & demonstrate location and attachments of the perineal membrane in male and female
d. Name the structures piercing the perineal membrane in males and females

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**

Topic:

☐ Lecture	☐ Dissection with small group dissection	• Short essay • Short answer	-

Perineum continued

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN49.4	Describe & demonstrate boundaries, content & applied anatomy of ischiorectal fossa	K/S	SH	Y	1	2

SPECIFIC LEARNING OBJECTIVES (SLOs)

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Demonstrate & describe boundaries, contents and applied anatomy of the ischiorectal fossa
b. Demonstrate & describe boundaries and contents of the pudendal canal
c. Demonstrate & describe the origin, course and distribution of the pudendal nerve
d. Demonstrate & describe the origin, course and distribution of the internal pudendal vessels e. Explain the anatomical basis of perianal abscess

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
☐ Lecture	☐ Dissection with small group discussion	• Long essay • Short essay • Short answer	

Perineum continued

ABDOMEN AND PELVIS

Topic:

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN49.5	Explain the anatomical basis of perineal tear, episiotomy, perianal abscess and anal fissure*	K/S	SH	N	**Theory**	**Practical**
					-	-

SPECIFIC LEARNING OBJECTIVES (SLOs)

At the end of the teaching and learning session the 1st phase MBBS student should be able to: a.

Explain the anatomical basis of

i. Perineal tears
ii. Episiotomy
iii. Perianal abscess iv. Pudendal nerve block
v. Rupture of membranous urethra vi.
Anal fissure

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
-	-	-	-

Please note: *No separate time is allotted for these topics, as they will be done as part of the relevant lecture / practical classes*

ABDOMEN AND PELVIS

Topic:

Vertebral Column

Number of competencies: 4

Number of procedures for certification: Nil

Number of teaching hours: 3 [1 hour (theory) and 2 hour (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN 50.1	Describe the curvatures of the vertebral column	K	KH	Y	1	2
AN50.2	Describe & demonstrate the type, articular ends, ligaments and movements of intervertebral joints, sacroiliac joints & pubic symphysis	K/S	SH	Y		
AN50.3	Describe lumbar puncture (site, direction of the needle, structures pierced during the lumbar puncture)	K	KH	Y		
AN50.4	Explain the anatomical basis of scoliosis, lordosis, prolapsed disc, spondylolisthesis & spina bifida*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to: a.

Explain curvatures of the vertebral column

b. Identify type, articular ends of vertebral column
c. Identify attachments of ligaments of vertebral column
d. Demonstrate movements of intervertebral joints, sacroiliac joints & pubic symphysis
e. Remove spinal cord form vertebral canal as team work
f. Observe procedure of lumbar puncture (site, direction of the needle, structures pierced during the lumbar puncture)
g. Interpret anatomical basis of scoliosis, lordosis, prolapsed disc, spondylolisthesis & spina bifida*

TEACHING AND LEARNING METHODS	ASSESSMENT METHODS

ABDOMEN AND PELVIS

Topic:

Theory	Practical	Theory	Practical
Lecture	Demonstration with small group discussion	• Short essay • Short answer	• Spotters • Viva voce

Sectional Anatomy

Number of competencies: 2

Number of procedures for certification: Nil

Number of teaching hours: 4 [4 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN51.1	Describe & identify the cross-section at the level of T8, T10 and L1 (transpyloric plane)	K/S	SH	Y	-	4
AN51.2	Describe & identify the midsagittal section of male and female pelvis	K	SH	Y		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to interpret features of: a. Cross-section at the level of T8

b. Cross-section at the level of T10

c. Cross-section at the level of L1 (transpyloric plane)

d. Midsagittal section of male pelvis

e. Midsagittal section of female pelvis

TEACHING AND LEARNING METHODS	ASSESSMENT METHODS

ABDOMEN AND PELVIS

Topic:

Theory	Practical	Theory	Practical
-	□ Demonstration with small group discussion	• Short essay • Case based short essay □ Short answer	• Spotters • Viva voce

Systemic Histology of Abdomen and Pelvis

Number of competencies: 3

Number of procedures for certification: Nil

Number of teaching hours: 12 [4 hours of theory & 8 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN52.1	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	K/S	SH	Y	4	8
AN52.3	Describe & identify the microanatomical features of cardio-oesophageal junction	K/S	SH	Y		
SPECIFIC LEARNING OBJECTIVES (SLOs')						

ABDOMEN AND PELVIS

Topic:

At the end of the teaching and learning session the 1st phase MBBS student should be able to: **a.**

Oesophagus

i. Correlate general plan of GIT with functions
ii. Name the layers of wall of GIT
iii. Correlate lining epithelium of esophagus with functions iv. Explain importance of esophageal glands
v. Interpret relevance of enteric nerve plexus with role of esophagus in peristalsis

b. Cardiooesophageal junction*

i. Identify a slide of cardioesophageal junction
ii. Identify transition of its lining epithelium
iii. Define Barett's esophagus iv. Interpret clinical aspects of gastroesophageal junction
v. Correlate histology of muscularis externa at gastroesophageal junction with its microscopic structure

c. Fundus of stomach

i. Classify parts of stomach based on microscopic structure ii. Explain microscopic structure of layers of stomach

ABDOMEN AND PELVIS

iii. Explain microscopic structure of fundus of stomach iv.
Draw a neat labeled diagram of gastric gland
v. Correlate functions of cells lining gastric gland with structure

d. Pylorus of stomach

i. Explain microscopic structure of pylorus of stomach
ii. Differentiate between gastric glands of fundic and pyloric parts of stomach

e. Duodenum, Jejunum, Ileum

i. Compare and contrast between microscopic structures of duodenum, jejunum and Ileum
ii. Differentiate between villi and microvilli
iii. Explain location and importance of Brunner's glands iv. Correlate histology of mucosa and submucosa of small intestine with function
v. Interpret features of intestinal glands of Leiberkuhn with functional relevance
vi. Infer clinical relevance of Paneth cells
vii. Explain features of Peyer's patch
viii. Define M (Microfold) cells

f. Large intestine, Appendix

i. Differentiate between microscopic structure of large and small intestine
ii. Correlate structure of mucosa of large intestine with function
iii. Explain special features of muscularis externa of large intestine iv. Describe layers of wall of appendix
v. Compare lymphatic nodules of Ileum and appendix
vi. Interpret the reason for naming appendix as abdominal tonsil
vii. Define hiatus muscularis

g. Liver, Gallbladder

i. Draw a neat labeled diagram of hepatic lobule
ii. Enumerate functions of hepatocytes
iii. Explain microscopic structure of portal triad iv. Trace flow of bile and blood in hepatic lobule of liver
v. Define hepatic lobule, portal lobule and hepatic acinus of Rappaport

vi. Define space of Disse and space of Mall and their clinical relevance
vii. Define Von Kupfer cell and enumerate its functions
viii. Explain distribution of stroma, hepatic sinusoids, bile canaliculi in liver
ix. Correlate functions of mucosa of gall bladder with its histology
x. Enumerate special features of microscopic structure of gall bladder

h. Pancreas, Suprarenal gland

i. Explain distribution of stroma and parenchyma in pancreas
ii. Draw a neat labeled diagram of pancreatic acinus
iii. Differentiate between a pancreatic acinus and serous acinus iv. Define centroacinar cell
v. Explain microscopic structure of islet of Langerhans
vi. Correlate functions of islet of Langerhans
vii. Name the layers of cortex of suprarenal gland
viii. Explain distribution of cells in layers of cortex of suprarenal gland and correlate with their functions
ix. Explain histological features of chromaffin cells of adrenal medulla
x. Explain functional relevance of vasculature in suprarenal gland

TEACHING AND LEARNING METHODS		**ASSESS ıENT METHODS**	
Theory	**Practical**	**Theory**	**Practical**
Lecture	Demonstration with small group discussion	• Short essay • Short answer	• Spotters • Slide discussion

ABDOMEN AND PELVIS

Topic: Histology of Urinary system & Male & Female reproductive system
Number of competencies: 2
Number of procedures for certification: NIL

Total number of teaching hours: 9 [3 hours of theory & 6 hours of practical]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN52.2	Describe & identify the microanatomical features of: Urinary system: kidney, ureter & urinary bladder; Male reproductive system: testis, epididymis, vas deferens, prostate & penis; Female reproductive system: ovary, uterus, uterine tube, cervix, placenta & umbilical cord	K/S	SH	Y	3	6
AN52.3	Describe & identify the microanatomical features of corpus luteum*	K/S	SH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs)

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Identify, draw and describe a labelled diagram of the specific microscopic features of kidney - cortex, medulla, glomerulus, PCT, DCT, collecting tubule, loop of Henle, collecting duct, juxta-glomerular apparatus and explain / correlate their contribution to normal function b. Differentiate between the PCT, DCT, collecting tubule, loop of Henle, collecting duct

c. Identify, draw and describe a labelled diagram of the specific microscopic features of ureter - layers and features of the layers and explain / correlate their contribution to normal function

d. Identify, draw and describe a labelled diagram of the specific microscopic features of urinary bladder- layers, and explain / correlate their contribution to normal function

e. Identify, draw & describe a labelled diagram of the microscopic features of testis - coverings, seminiferous tubules and it's contents, interstitial cells of Leydig, blood testis barrier and explain / correlate their contribution to normal function

f. Identify, draw and describe a labelled diagram of the specific microscopic features of epididymis- organization of duct of the epididymis and it's contents, connective tissue and explain / correlate their contribution to normal function

g. Compare and contrast microscopic features of testis & epididymis

h. Identify, draw and describe a labelled diagram of the specific microscopic features of vas deferens – layers and it's composition and explain / correlate their contribution to normal function

ABDOMEN AND PELVIS

i. Identify, draw and describe a labelled diagram of the specific microscopic features of prostate – prostatic urethra, glandular structure, stroma, age changes and explain / correlate their contribution to normal function

j. Identify, draw and describe a labelled diagram of the specific microscopic features of penis- coverings, corpora, penile urethra and explain / correlate their contribution to normal function

k. Identify, draw and describe a labelled diagram of the specific microscopic features of ovary and explain/ correlate their contribution to normal function

l. Identify, draw and describe a labelled diagram of the specific microscopic features of proliferative and secretory phases of Uterine cycle and explain/ correlate their contribution to normal function

m. Identify, draw and describe a labelled diagram of the specific microscopic features of layers of uterine tube and explain/ correlate their contribution to normal function

n. Identify, draw and describe a labelled diagram of the specific microscopic features of layers of cervix - layers and explain/ correlate their contribution to normal function

o. Identify, draw and describe a labelled diagram of the specific microscopic features of placenta - decidua basalis, chorion, primary, secondary and tertiary villi, intervillous spaces, placental barrier and explain/ correlate their contribution to normal function

p. Identify, draw and describe a labelled diagram of the specific microscopic features of umbilical cord - covering, stroma, contents and explain/ correlate their contribution to normal function

q. Identify, draw and describe a labelled diagram of the specific microscopic features of corpus luteum and explain/ correlate their contribution to normal function*

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
□ Lecture	□ Small group discussion	• Short essay • Short answer	• Spotter • Slide discussion

***Please note:** The slide of mammary gland could be covered with the female reproductive system*

Topic: Development of Diaphragm
Number of competencies: 4
Number of procedures for certification: NIL
Total number of teaching hours: 1 [1 hour of theory]

<table>
<tr><th>NUMBER</th><th>COMPETENCY</th><th>DOMAIN K/S/A/C</th><th>LEVEL K/KH/SH/P</th><th>CORE Y/N</th><th colspan="2">Teaching time required in hours</th></tr>
<tr><td>AN52.4</td><td>Describe the development of anterior abdominal wall*</td><td>K</td><td>KH</td><td>N</td><td>Theory</td><td>Practical</td></tr>
<tr><td>AN52.5</td><td>Describe the development and congenital anomalies of diaphragm</td><td>K</td><td>KH</td><td>Y</td><td>1</td><td>-</td></tr>
<tr><td colspan="7">SPECIFIC LEARNING OBJECTIVES (SLOs)</td></tr>
<tr><td colspan="7">At the end of the teaching and learning session the 1st phase MBBS student should be able to:
a. Name the different sources and discuss the development of the anterior abdominal wall*
b. Name the different sources, discuss the development and associated congenital anomalies of diaphragm
c. Explain the embryological basis of congenital diaphragmatic hernia</td></tr>
<tr><td colspan="3">TEACHING AND LEARNING METHODS</td><td colspan="4">ASSESSMENT METHODS</td></tr>
<tr><td colspan="2">Theory</td><td>Practical</td><td colspan="2">Theory</td><td colspan="2">Practical / Viva-voce</td></tr>
<tr><td colspan="2">□ Lecture</td><td></td><td colspan="2">• Short essay
• Short answer</td><td colspan="2">□ Viva-voce</td></tr>
</table>

Please note: *The thoraco-abdominal diaphragm is to be assessed along with thorax in paper I in the university examination*

ABDOMEN AND PELVIS

ABDOMEN AND PELVIS

Development of GIT

Number of competencies: 1

Number of procedures for certification: NIL

Total number of teaching hours: 5 [3 hours (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN52.6	Describe the development and congenital anomalies of: foregut, midgut & hindgut	K	KH	Y	3	2 (models)
SPECIFIC LEARNING OBJECTIVES (SLOs)						

ABDOMEN AND PELVIS

Topic:

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Name the parts of the primitive gut and state the extent of each part
b. Describe the formation of the oesophagus and the reasons for its elongation
c. Describe the formation of the stomach, the rotations that it undergoes and name the peritoneal folds attached to it
d. Describe the formation of the duodenum, the mechanism of it becoming retroperitoneal and the reason for its dual blood supply
e. Describe the formation of the liver and extrahepatic biliary apparatus and name the peritoneal folds attached to the liver
f. Describe the formation of the pancreas from the pancreatic buds, its duct system and the mechanism of it becoming retroperitoneal g. Describe the formation of the spleen and the peritoneal folds attached to it
h. Name some of the congenital anomalies of the foregut achalasia cardia, congenital hypertrophic pyloric stenosis, annular pancreas i. State the extent of the midgut
j. Describe the formation of the primary intestinal loop, its pre and post-arterial segments, the vitelline duct and the caecal bud
k. Describe the physiological umbilical hernia, its time of occurrence and reasons for its occurrence l. Describe the rotations of the gut
m. Describe the return of the intestinal loops into the abdominal cavity
n. Describe the formation of the mesenteries of the midgut and fixation of the gut
o. Describe the derivatives of the midgut
p. Name some congenital abnormalities of the midgut with special reference to Meckel's diverticulum, Omphalocele or exomphalos, Congenital umbilical hernia, omphalocele, and gastroschisis
q. Describe the formation of the peritoneal cavity and the lesser sac
r. Explain the embryological basis of the following congenital anomalies:
s. Describe the extent of the hindgut

t. Name the derivatives of the hindgut
u. Describe the division of the hindgut by the allantois
v. Name the derivatives of the pre-allantoic part of the hindgut
w. Describe the division of the cloaca by the urorectal septum
x. Describe the formation of the proctodeum and anal canal
y. Name the derivatives of the post-allantoic part of the hindgut
z. Name some congenital malformations of the hindgut structures: imperforate anus, Hirchsprung disease aa. Explain the embryological basis of the following congenital anomalies: errors of rotation of the gut; errors of fixation of the gut; duodenal atresia

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture	Models	• Short essay • Short answer	Viva-voce

ABDOMEN AND PELVIS

Topic:

Development of Urinary system

Number of competencies: 1

Number of procedures for certification: NIL

Total number of teaching hours: 4 [2 hours (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN52.7	Describe the development of urinary system	K	KH	Y	2	2 (models)

SPECIFIC LEARNING OBJECTIVES (SLOs)

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe the location and components of the intermediate mesoderm
b. Describe the subdivisions of the primitive urogenital sinus
c. Describe the formation of the excretory tubules and its fate in males and females
d. Describe the formation of the mesonephric duct and its fate in males and females
e. Describe the formation of the kidney from the ureteric bud and metanephric blastema
f. Describe the ascent and rotation of the kidneys
g. Describe the formation of the ureters
h. Describe the formation of the urinary bladder with special reference to the trigone
i. Describe the formation of the male and female urethra
j. Name some congenital malformations with special reference to congenital polycystic kidney, urachal fistula and ectopia vesicae

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture	Models	• Short essay • Short answer	Viva-voce

ABDOMEN AND PELVIS

ABDOMEN AND PELVIS

Topic:

Development of reproductive system

Number of competencies: 1

Number of procedures for certification: NIL

Total number of teaching hours: 4 [2 hours (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN52.8	Describe the development of male & female reproductive system	K	KH	Y	2	2 (models)

SPECIFIC LEARNING OBJECTIVES (SLOs)

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Explain the role of the Y chromosome in the formation of the genital system
b. Describe the formation of the gonadal ridge and the formation and migration of the primordial germ cells
c. Describe the formation of the indifferent gonad from the above
d. Describe the formation of the various cells and structures within testes
e. Describe the formation of the duct system of the testes from the mesonephric ducts and tubules
f. Describe the descent of the testes and the various factors responsible for it
g. Name some congenital anomalies of the testes with special reference to cryptorchidism
h. Describe the formation of the prostate gland, the seminal vesicle and the bulbourethral gland
i. Describe the formation of the male external genitalia and penile urethra
j. Describe the formation of the ovary from the indifferent gonad
k. Describe the descent of the ovary and the formation and remnants of the gubernaculum
l. Describe the formation and parts of the paramesonephric ducts
m. Describe the formation of the uterine tubes, uterus, and the broad ligament
n. Describe the formation of the vagina from the vaginal plate and sinovaginal bulbs
o. Describe the derivatives of the mesonephric tubules and ducts in the female
p. Describe the formation of the female external genitalia
q. Name some congenital malformations of the female genital tract - septate uterus, unicornuate uterus, uterus didelphys, ambiguous genitalia, rectovaginal fistula

TEACHING AND LEARNING METHODS	ASSESSMENT METHODS

ABDOMEN AND PELVIS

Theory	Practical	Theory	Practical / Viva-voce
□ Lecture		• Short essay • Short answer	□ Viva voce

Osteology- Lumbar vertebra, Sacrum and Pelvis **Number of competencies:** 2

Number of procedures for certification: Nil

Number of teaching hours: 6 [6 hours (theory)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN53.1	Identify & hold the bone (lumbar vertebra) in anatomical position, describe the salient features, articulations & demonstrate the attachments of muscle groups	K/S	SH	Y	**Theory** 6	**Practical** -
AN53.2	Demonstrate the anatomical position of bony pelvis & show boundaries of pelvic inlet, pelvic cavity, pelvic outlet	K/S	SH	Y		
AN53.3	Define true pelvis and false pelvis and demonstrate sex determination in male & female bony pelvis	K/S	SH	Y		
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) *	K/S	SH	N		
SPECIFIC LEARNING OBJECTIVES (SLOs')						

ABDOMEN AND PELVIS

Topic:

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Determine anatomical position of lumbar vertebra
b. Demonstrate salient features of lumbar vertebra
c. Demonstrate articulations of lumbar vertebra
d. Identify attachments of muscle groups of lumbar vertebrae
e. Enumerate atypical features of fifth lumbar vertebra
f. Relate clinical importance of lumbar vertebra (sacralization of lumbar vertebra, lumbarization of 1st sacral vertebra) * g. Define Fawcett's rule*, coccydynia*
h. Determine anatomical position of sacrum
i. Identify salient features of sacrum
j. Demonstrate articulations of sacrum

k. Enumerate structures passing through sacral canal, structures passing anterior to ala of sacrum l. List the contents of sacral canal
m. Name the structures related to pelvic surface of sacrum
n. Determine anatomical position of bony pelvis,
o. Show boundaries of pelvic inlet, pelvic cavity, pelvic outlet
p. Explain types of bony pelvis & coccyx
q. Define true pelvis and false pelvis
r. Determine sex of bony pelvis

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical**
	Demonstration with small group discussion	• Short essay • Short answer	• Spotters • Viva voce

ABDOMEN AND PELVIS

Radiological anatomy of Abdomen and Pelvis **Number of competencies:** 3

Number of procedures for certification: Nil

Number of teaching hours: 2 [2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN54.1	Describe & identify features of plain X ray abdomen	K/S	SH	Y	**Theory**	**Practical**
AN54.2	Describe & identify the special radiographs of abdominopelvic region (contrast X ray barium swallow, barium meal, barium enema, cholecystography, intravenous pyelography & hysterosalpingography)	K/S	SH	Y	-	2
AN54.3	Describe role of ERCP, CT abdomen, MRI, arteriography in radiodiagnosis of abdomen*	K	KH	N		
SPECIFIC LEARNING OBJECTIVES (SLOs')						

ABDOMEN AND PELVIS

Topic:

At the end of the teaching and learning session the 1st phase MBBS student should be able to: a.
Identify features of plain X ray abdomen
b. Interpret findings in contrast X ray - barium swallow, barium meal, barium enema c.
Interpret findings in cholecystography
d. Interpret findings in intravenous pyelography
e. Interpret findings in hysterosalpingography
f. Interpret findings in ERCP*
g. Interpret findings in CT abdomen*
h. Interpret findings in MRI abdomen and pelvis*
i. Interpret findings in abdominal arteriography*

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical**
	□ Demonstration with small group discussion	• Short essay • Short answer	□ Viva voce

Topic: Surface marking
Number of competencies: 3
Number of procedures for certification: Nil
Number of teaching hours: 2 [2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN55.1		K/S	SH	Y	**Theory**	**Practical**

AN55.2	Demonstrate the surface marking of; regions and planes of abdomen, superficial inguinal ring, deep inguinal ring, Mcburney's point, renal angle & Murphy's point Demonstrate the surface projections of: stomach, liver, fundus of gall bladder, spleen, duodenum, pancreas, ileocecal junction, kidneys & root of mesentery	K/S	SH	Y	-	2

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Mark regions and planes of abdomen on surface of the cadaver
b. Mark superficial inguinal ring
c. Mark deep inguinal ring
d. Mark Mcburney's point
e. Mark renal angle
f. Mark Murphy's point
g. Mark surface projections of: stomach, liver, fundus of gall bladder, spleen, duodenum, pancreas, ileocaecal junction, kidneys & root of mesentery

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical**
	□ Demonstration with small group discussion	□ Short answer	□ OSPE/ Viva voce

LOWER LIMB

Topic: Features of individual bones of lower limb **Number of competencies:** 4
Number of procedures for certification: Nil
Total number of hours required: 6 [6 hours (theory)]

<table>
<tr><th>NUMBER</th><th>COMPETENCY</th><th>DOMAIN K/S/A/C</th><th>LEVEL K/KH/SH/P</th><th>CORE Y/N</th><th colspan="2">Teaching time required in hours</th></tr>
<tr><td>AN14.1</td><td>Identify the given bone, its side, important features & keep it in anatomical position</td><td>K/S</td><td>SH</td><td>Y</td><td>Theory</td><td>Practical</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>6</td><td>-</td></tr>
<tr><td>AN14.2</td><td>Identify & describe joints formed by the given bone</td><td>K</td><td>SH</td><td>N</td><td></td><td></td></tr>
<tr><td>AN14.3</td><td>Describe the importance of ossification of lower end of femur & upper end of tibia</td><td>K</td><td>KH</td><td>Y</td><td></td><td></td></tr>
<tr><td>AN14.4</td><td>Identify and name various bones in the articulated foot with individual muscle attachment</td><td>K/S</td><td>SH</td><td>N</td><td></td><td></td></tr>
<tr><td colspan="7">SPECIFIC LEARNING OBJECTIVES (SLOs’)</td></tr>
<tr><td colspan="7">Bones – 1. Hip bone; 2. Femur; 3. Tibia; 4. Fibula; 5. Patella; 6. Articulated foot
At the end of the teaching and learning session the 1st phase MBBS student should be able to: a. Identify the bone and determine its side
b. Hold the bone in anatomical position
c. Describe the type to which the bone belongs
d. Identify the main parts and their features
e. Identify the parts of the bone in direct contact with important neurovascular structures
f. Demonstrate the attachments of functional groups of muscles
g. Describe and demonstrate the articulating surfaces and joints formed by the bone
h. Describe the importance of ossification of lower end of femur
i. Describe the importance of ossification of upper end of tibia</td></tr>
<tr><td colspan="3">TEACHING AND LEARNING METHODS</td><td colspan="4">ASSESSMENT METHODS</td></tr>
<tr><td colspan="2">Theory</td><td>Practical</td><td colspan="2">Theory</td><td colspan="2">Practical / Viva-voce</td></tr>
</table>

□ Small group discussion	-	□ Short answer	• Spotters • Viva-voce

Topic: Front & Medial side of thigh

Number of competencies: 5

Number of procedures for certification: Nil

Total number of hours required: 7 [1 hour (theory) and 6 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN15.1	Describe and demonstrate origin, course, relations, branches (or tributaries), termination of important nerves and vessels of anterior thigh	K/S	SH	Y	1	6
AN15.2	Describe and demonstrate major muscles with their attachment, nerve supply and actions	K/S	SH	Y		
AN15.3	Describe and demonstrate boundaries, floor, roof and contents of femoral triangle	K/S	SH	Y		
AN15.4	Explain anatomical basis of psoas abscess & femoral hernia*	K	KH	N		
AN15.5	Describe and demonstrate adductor canal with its content	K/S	SH	Y		
SPECIFIC LEARNING OBJECTIVES (SLOs')						

LOWER LIMB

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe and demonstrate attachments, nerve supply and actions of the muscles of front of thigh
b. Describe and demonstrate formation, course, tributaries, area of drainage of the great saphenous vein
c. Describe and demonstrate the positions of the perforator veins of the lower limb
d. Describe and demonstrate the origin, course, tributaries and area of drainage of femoral vein
e. Describe and demonstrate the origin, course, branches and distribution of femoral artery
f. Describe and demonstrate the origin, course, branches and distribution of profunda femoris artery
g. Describe and demonstrate the origin, course, relations and distribution of femoral nerve
h. Describe and demonstrate the origin, course, relations and distribution of saphenous nerve
i. Describe and demonstrate boundaries, floor, roof and contents of femoral triangle
j. Describe and demonstrate the femoral sheath
k. Describe and demonstrate the boundaries and contents of femoral canal
l. Explain the anatomical basis of femoral hernia*
m. Explain the anatomical basis of psoas abscess*
n. Describe and demonstrate the boundaries and contents of adductor canal
o. Describe and demonstrate the attachments, nerve supply and actions of adductor group of muscles
p. Describe and demonstrate the formation, course, branches and area of distribution of obturator nerve

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture	Dissection with small group discussion	• Long essay • Short essay • Short answer	• Spotters • Window discussion

Topic: Gluteal region & back of thigh
Number of competencies: 6
Number of procedures for certification: Nil
Total number of hours required: 9 [1 hour (theory) & 8 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN16.1		K/S	SH	Y	**Theory**	**Practical**

	Describe and demonstrate origin, course, relations, branches (or tributaries), termination of important nerves and vessels of gluteal region				1	8
AN16.2	Describe anatomical basis of sciatic nerve injury during gluteal intramuscular injections	K	KH	Y		
AN16.3	Explain the anatomical basis of Trendelenburg sign	K	KH	Y		
AN16.4	Describe and demonstrate the hamstrings group of muscles with their attachment, nerve supply and actions	K/S	SH	Y		
AN16.5	Describe and demonstrate the origin, course, relations, branches (or tributaries), termination of important nerves and vessels on the back of thigh	K/S	SH	Y		
AN16.6	Describe and demonstrate the boundaries, roof, floor, contents and relations of popliteal fossa	K/S	SH	Y		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe and demonstrate the boundaries and communications of the gluteal region
b. Describe and demonstrate attachments, nerve supply and actions of the Gluteus maximus muscle
c. Describe and demonstrate the structures under cover of gluteus maximus muscle
d. Describe and demonstrate attachments, nerve supply and actions of the gluteus medius, gluteus minimus and tensor faciae lata

e. Explain the anatomical basis of Trendelenburg sign
f. Describe and demonstrate the relations of structures to piriformis muscle and ischial spine
g. Describe and demonstrate the origin, course, relations, distribution and termination of pudendal nerve
h. Describe and demonstrate the origin, course, distribution and termination of Sciatic nerve
i. Describe and demonstrate the origin, course, distribution and termination superior gluteal nerve
j. Describe and demonstrate the origin, course, distribution and termination inferior gluteal nerve
k. Describe anatomical basis of sciatic nerve injury during gluteal intramuscular injections
l. Describe and demonstrate the origin, course, branches and the distribution of profunda femoris artery
m. Describe and demonstrate the anastomosis formed by the perforators of the profunda femoris artery n. Describe and demonstrate the cruciate anastomosis
o. Describe and demonstrate trochanteric anastomosis
p. Enumerate the characteristic features of the hamstring muscles
q. Describe and demonstrate the attachment, nerve supply and actions of hamstrings group of muscles
r. Describe and demonstrate the boundaries and contents of popliteal fossa
s. Describe and demonstrate the formation, course, tributaries and area of drainage of small saphenous vein
t. Describe and demonstrate the formation, course, branches and distribution of popliteal artery
u. Describe and demonstrate the relationship of popliteal artery, vein and tibial nerve in upper, middle and lower third of the popliteal fossa

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture	Dissection with small group discussion	• Long essay • Short essay • Short answer	• Spotters • Window discussion

Topic: Hip Joint
Number of competencies: 3
Number of procedures for certification: Nil
Total number of hours required: 2 [1 hour (theory) & 1 hour (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN17.1	Describe and demonstrate the type, articular surfaces, capsule, synovial membrane, ligaments, relations, movements and muscles involved, blood and nerve supply, bursae around the hip joint	K/S	SH	Y	1	1
AN17.2	Describe anatomical basis of complications of fracture neck of femur*	K	KH	N		
AN17.3	Describe dislocation of hip joint and surgical hip replacement	K	KH	Y		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe and demonstrate the type, articulating surfaces, capsule, ligaments, important relations, movements and muscles causing them, blood supply and nerve supply of the hip joint
b. Describe the bursae around the hip joint
c. Describe anatomical basis of complications of fracture neck of femur
d. Describe the anatomical basis for dislocation of hip joint
e. Explain the anatomical basis of surgical hip replacement

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**

☐ Lecture	☐ Dissection with small group discussion	• Short essay • Short answer	• Spotters • Window discussion

Topic: Knee joint, Anterior compartment of leg & dorsum of foot
Number of competencies: 7
Number of procedures for certification: Nil
Total number of hours required: 5 [1 hour (theory) & 4 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN18.1		K/S	SH	Y	**Theory**	**Practical**

	Describe and demonstrate major muscles of anterior compartment of leg with their attachment, nerve supply and actions				1	4
AN18.2	Describe and demonstrate origin, course, relations, branches (or tributaries), termination of important nerves and vessels of anterior compartment of leg	K/S	SH	Y		
AN18.3	Explain the anatomical basis of foot drop	K	KH	Y		
AN18.4	Describe and demonstrate the type, articular surfaces, capsule, synovial membrane, ligaments, relations, movements and muscles involved, blood and nerve supply, bursae around the knee joint	K/S	SH	Y		
AN18.5	Explain the anatomical basis of locking and unlocking of the knee joint	K	KH	Y		
AN18.6	Describe knee joint injuries with its applied anatomy*	K	KH	N		
AN18.7	Explain anatomical basis of osteoarthritis*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe and demonstrate major muscles of anterior compartment of leg with their attachment, nerve supply and actions
b. Describe and demonstrate the origin, course, relations, branches, termination of anterior tibial artery
c. Describe and demonstrate the origin, course, relations, branches, termination of dorsalis pedis artery

d. Describe and demonstrate the origin, course, relations, branches, termination of deep peroneal nerve e.
Explain the anatomical basis of foot drop

f. Describe and demonstrate the type, articular surfaces, capsule, synovial membrane, ligaments, relations, movements and muscles involved, blood and nerve supply, bursae around the knee joint
g. Explain the anatomical basis of locking and unlocking of the knee joint
h. Describe knee joint injuries with its applied anatomy
   - Prepatellar bursitis
   - Clergyman's knee
   - Soft tissue injuries: anterior and posterior cruciate injury, meniscal tear
   - Dislocation of the knee joint
   - Replacement of knee joint
i. Explain anatomical basis of osteoarthritis
j. Describe and demonstrate the attachments, nerve supply and actions of muscles of the lateral compartment of the leg
k. Describe and demonstrate the origin, course, branches of the common peroneal nerve
l. Describe and demonstrate the origin, course, relations, branches, termination of superficial peroneal nerve
m. Describe and demonstrate the attachments of sartorius, gracilis and semitendinosus on the medial compartment of leg n. Describe and demonstrate the retinacula around the ankle
o. Describe and demonstrate the structures related to the extensor retinaculum of the foot
p. Describe and demonstrate the nerve supply of the dorsum of the foot

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture	Dissection with small group discussion	• Long essay • Modified long essay • Short essay • Short answer	• Spotters • Window discussion

***Please note:** Medial side of the leg and lateral side of the leg were found to be missed out in the CBME document and have been included in this section*

Topic: Back of Leg & Sole
Number of competencies: 7
Number of procedures for certification: Nil
Total number of hours required: 5 [1 hour (theory) & 4 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN19.1	Describe and demonstrate the major muscles of back of leg with their attachment, nerve supply and actions	K/S	SH	Y	1	4
AN19.2	Describe and demonstrate the origin, course, relations, branches (or tributaries), termination of important nerves and vessels of back of leg	K/S	SH	Y		
AN19.3	Explain the concept of "peripheral heart"	K	KH	Y		
AN19.4	Explain the anatomical basis of rupture of calcaneal tendon*	K	KH	N		
AN19.5	Describe factors maintaining importance arches of the foot with its importance	K	KH	Y		
AN19.6	Explain the anatomical basis of flat foot & club foot*	K	KH	N		
AN19.7	Explain the anatomical basis of metatarsalgia & plantar fasciitis*	K	KH	N		
SPECIFIC LEARNING OBJECTIVES (SLOs')						

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe and demonstrate the superficial, intermediate and deep group of muscles of back of leg with their attachment, nerve supply and actions
b. Describe and demonstrate origin, course, branches and distribution of tibial nerve
c. Describe and demonstrate origin, course, branches (or tributaries) and distribution of posterior tibial vessels d. Explain the concept of "peripheral heart"
e. Explain the anatomical basis of rupture of calcaneal tendon
f. Enumerate the types of arches of the foot
g. Explain the structure and functions of the arches of the foot
h. Compare and contrast the medial and lateral longitudinal arches of the foot
i. Describe factors maintaining arches of the foot with its functional importance
j. Explain the anatomical basis of flat foot
k. Explain the anatomical basis of the club foot*
l. Explain the anatomical basis of metatarsalgia*
m. Explain the anatomical basis of plantar fasciitis

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture	Dissection with small group discussion	• Short essay • Short answer	• Spotters • Window discussion

Please note: *This competency is not included in the CBME document but needs to be taught and assessed:*
***Describe the layers of the sole along with the major nerves and vessels supplying it. (Not to be assessed in practical examination)*

Topic

: General Features, Joints, radiographs & surface marking

Number of competencies: 10

Number of procedures for certification: Nil

Total number of hours required: 16 [6 hours (theory) & 10 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN20.1	Describe and demonstrate the type, articular surfaces, capsule, synovial membrane, ligaments, relations, movements and muscles involved, blood and nerve supply of tibiofibular and ankle joint	K/S	SH	Y	1	2
AN20.2	Describe the subtalar and transverse tarsal joints*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe and demonstrate the type, articular surfaces, capsule, synovial membrane, ligaments, relations, movements and muscles involved, blood and nerve supply of proximal and distal tibiofibular joints

b. Describe and demonstrate the type, articular surfaces, capsule, synovial membrane, ligaments, relations, movements and muscles involved, blood and nerve supply of ankle joint

c. Describe and demonstrate the type, articulating surfaces, ligaments and movements and muscles producing the movements of the subtalar joints

d. Define inversion and eversion of the foot and explain the functional importance and the muscles producing these movements e. Describe the transverse tarsal joints

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture	Dissection with small group discussion	• Short essay • Short answer	• Spotters • Window discussion

Topic

: General Features, Joints, radiographs & surface marking continued

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN20.3	Describe and demonstrate fascia lata, venous drainage, lymphatic drainage, retinacula & dermatomes of lower limb	K/S	SH	Y	2	2
AN20.4	Explain anatomical basis of enlarged inguinal lymph nodes	K	KH	N		
AN20.5	Explain anatomical basis of varicose veins and deep vein thrombosis	K	KH	Y		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe and demonstrate the superficial and deep fascia of the thigh
b. Describe and demonstrate the attachments and salient features of the fascia lata of the thigh
c. Describe and demonstrate the attachment and functional importance of iliotibial tract
d. Describe the modifications of the deep fascia – retinacula of the lower limb
e. Describe the dermatomes of the lower limb and its functional importance
f. Describe the superficial and deep set of lymphatics of the lower limb
g. Explain anatomical basis of enlarged inguinal lymph nodes
h. Describe the venous drainage of the lower limb along with its functional importance
i. Explain the factors facilitating venous return of the lower limb
j. Explain anatomical basis of varicose veins
k. Explain the anatomical basis of deep vein thrombosis

TEACHING AND LEARNING METHODS	ASSESSMENT METHODS

Topic

Theory	Practical	Theory	Practical / Viva-voce
Lecture	Dissection with small group discussion	• Long essay • Modified long essay • Short essay • Short answer	• Spotters • Window discussion

: General Features, Joints, radiographs & surface marking continued

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN20.6	Identify the bones and joints of lower limb seen in anteroposterior and lateral view radiographs of various regions of lower limb	K/S	SH	Y	**Theory**	**Practical**
					1	2

SPECIFIC LEARNING OBJECTIVES (SLOs')

Radiographs: 1. Hip joint Ap and lateral view; 2. Knee joint: AP and lateral view; 3. Ankle joint: AP and lateral view; 4. Foot AP and lateral view
At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Identify and name the region of the radiograph
b. Differentiate and identify the X ray as either plain or contrast radiograph
c. Identify and describe the view as either AP, Lateral in the radiograph
d. Describe and demonstrate the different tissues from most to least opaque on the X-ray as: bone, soft tissue, air, fat on the radiograph
e. Identify and name the normal anatomic structures on X-ray of the lower limb (Hip bone, femur, tibia, fibula, patella, articulated foot with names of the individual bones on the respective radiographs)
f. Describe and demonstrate the articulations/joints of the lower limb on the X-ray (Hip joint, knee joint, ankle joint, foot – subtalar joint on the respective radiograph)
g. Identify and explain - fracture, dislocation on the radiographs
h. ** CT, MRI, ultrasound of the lower limb can be utilized for teaching and learning along with the plain radiographs*

TEACHING AND LEARNING METHODS	ASSESSMENT METHODS

LOWER LIMB

Topic

Theory	Practical	Theory	Practical / Viva-voce
Lecture E - learning	Dissection with small group discussion	-	• Spotters • OSPE • Viva voce

Topic: General Features, Joints, radiographs & surface marking continued

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN20.7	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	K/S	SH	Y	1	4
AN20.8	Identify & demonstrate palpation of femoral, popliteal, post tibial, anterior tibial & dorsalis pedis blood vessels in a simulated environment	K/S	SH	Y		
AN20.9	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	K/S	SH	Y		
SPECIFIC LEARNING OBJECTIVES (SLOs')						

LOWER LIMB

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Identify & demonstrate important bony land marks of lower limb on the dissecting room cadaver/ living subjects/simulators: 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
b. Identify & demonstrate palpation of femoral and its clinical importance
c. Identify and demonstrate palpation of popliteal artery and its clinical importance
d. Identify and demonstrate palpation of post tibial artery and its clinical importance
e. Identify and demonstrate palpation of anterior tibial artery and its clinical importance
f. Identify and demonstrate palpation of dorsalis pedis artery and its clinical importance
g. Identify and demonstrate surface projection of femoral nerve
h. Identify and demonstrate surface projection of saphenous opening
i. Identify and demonstrate surface projection sciatic nerve and its clinical importance
j. Identify and demonstrate surface projection tibial nerve and its clinical importance
k. Identify and demonstrate surface projection common peroneal nerve and its clinical importance
l. Identify and demonstrate surface projection of deep peroneal nerve and its clinical importance
m. Identify and demonstrate surface projection of great saphenous vein with clinical importance
n. Identify and demonstrate surface projection of small saphenous vein and its clinical importance

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
□ Lecture □ E - learning	□ Dissection with small group discussion	-	• Spotters • OSPE • Viva voce

Please note: *This competency is not included in the CBME document but needs to be taught and assessed:*

***Describe and demonstrate the testing of muscles of the following muscles in the lower limb: quadriceps femoris, gluteus maximus, gluteus medius and maximus, hamstring group of muscles, gastrocnemius and soleus*

Topic: General Features, Joints, radiographs & surface marking continued

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN20.10	Describe basic concept of development of lower limb*	K	KH	N	**Theory**	**Practical**
					1	-

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe the development of the lower limb
b. Explain the concept of the axis artery of the lower limb
c. Explain the embryological basis of the congenital anomalies of the lower limb

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**

□ Lecture □ E - learning	-	-	-

HEAD AND NECK

Topic: Skull osteology
Number of competencies: 7
Number of procedures for certification: Nil
Total number of hours required: 6 [6 hours (theory)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN26.1	Demonstrate anatomical position of skull, identify and locate individual skull bones in skull	K/S	SH	Y	6	-
AN26.2	Describe the features of norma frontalis, verticalis, occipitalis, lateralis and basalis	K/S	SH	Y		
AN26.3	Describe cranial cavity, its subdivisions, foramina and structures passing through them	K/S	KH	Y		
AN26.4	Describe morphological features of mandible	K/S	SH	Y		
AN26.5	Describe features of typical and atypical cervical vertebrae (atlas and axis)	K/S	SH	Y		
AN26.6	Explain the concept of bones that ossify in membrane*	K	K/H	N		
AN26.7	Describe the features of the 7th cervical vertebra*	K/S	S/H	N		
SPECIFIC LEARNING OBJECTIVES (SLOs')						

HEAD AND NECK

Bones – 1. Articulated skull; 2. Mandible; 3. Cervical vertebrae- atlas vertebra, axis vertebra and typical cervical vertebrae;

At the end of the teaching and learning session the 1st phase MBBS student should be able to: a. Hold the skull in anatomical position

b. Identify and locate individual skull bones in an articulated skull
c. Identify and describe the salient features of norma frontalis, verticalis, occipitalis, lateralis and basalis
d. Identify and describe the cranial cavity, its salient features and subdivisions, major foramina and structures passing through them
e. Identify and describe the following in relation to the mandible: parts, area of attachments of the muscles of mastication, major foramina with structures passing through them and large blood vessels and nerves related it
f. Identify and describe the salient features of typical and atypical cervical vertebrae (atlas axis and vertebra prominens)

g. Describe with examples bones which undergo membranous ossification

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Small group discussion	-	Short answer	• Spotters • Viva-voce

Topic: Scalp
Number of competencies: 2
Number of procedures for certification: Nil
Total number of hours required: 3 [1 hour (theory) + 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN27.1	Describe the layers of scalp, its blood supply, its nerve supply and surgical importance	K	KH	Y	**Theory**	**Practical**
					1	2
AN27.2	Describe emissary veins with its role in spread of infection from extracranial route to intracranial venous sinuses	K	KH	Y		
SPECIFIC LEARNING OBJECTIVES (SLOs')						
At the end of the teaching and learning session the 1st phase MBBS student should be able to: a. Identify and describe the layers of scalp, its blood supply, nerve supply and lymphatic drainage b. Describe the surgical importance of each layer of the scalp c. Define emissary veins and describe their applied importance						
TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**				

HEAD AND NECK

Theory	Practical	Theory	Practical / Viva-voce
□ Lecture	□ Dissection with small group discussion	• Long essay • Short essay • Short answer	• Spotters • Window discussion

Topic: Face & parotid region
Number of competencies: 10
Number of procedures for certification: Nil
Total number of hours required: 10 [2 hours (theory) & 8 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN28.1	Describe & demonstrate muscles of facial expression and their nerve supply	K/S	SH	Y	**Theory**	**Practical**

					2	8
AN28.2	Describe sensory innervation of face	K	KH	Y		
AN28.3	Describe & demonstrate origin/formation, course, branches/tributaries of vessels	K/S	SH	Y		
AN28.4	Describe & demonstrate branches of facial nerve with distribution	K/S	SH	Y		
AN28.5	Describe cervical lymph nodes and lymphatic drainage of head, face and neck	K	KH	Y		
AN28.6	Identify superficial muscles of face, their nerve supply and actions	K/S	SH	Y		
AN28.7	Explain the anatomical basis of facial nerve palsy	K	KH	Y		
AN28.8	Explain surgical importance of deep facial vein	K	KH	Y		
AN28.9	Describe & demonstrate the parts, borders, surfaces, contents, relations and nerve supply of parotid gland with course of its duct and surgical importance	K/S	SH	Y		
AN28.10	Explain the anatomical basis of Frey's syndrome*	K	KH	N		
SPECIFIC LEARNING OBJECTIVES (SLOs')						

HEAD AND NECK

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Explain the special features of the muscles of facial expression
b. Specify the names of the superficial muscles of face, their nerve supply and actions
c. Identify and describe the attachments, nerve supply and actions of the orbicularis oculi, orbicularis oris and buccinator d. Describe the muscle groups acting on the oral and palpebral fissures
e. Describe the sensory innervation of the face
f. Explain the anatomical basis of facial palsy and trigeminal neuralgia
g. Describe the origin, termination, course and branches of the facial artery
h. Identify and describe the formation, course, tributaries and areas drained by the facial vein
i. explain the surgical importance of deep facial vein
j. Describe the lymphatic drainage of the face
k. Demonstrate and describe the coverings, parts, borders, surfaces, contents, relations and nerve supply of the parotid gland and course of parotid duct.
l. Identify and name the structures within the parotid gland
m. Demonstrate and describe the course and relations of the parotid duct
n. Explain the anatomical basis of Frey's syndrome

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
□ Lecture	□ Dissection with small group discussion	• Long essay • Modified long essay • Short essay • Short answer	• Spotters • Window discussion

Topic: Posterior triangle of neck
Number of competencies: 4
Number of procedures for certification: Nil
Total number of hours required: 7 [1 (theory) & 6 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN29.1	Describe & demonstrate attachments, nerve supply, relations and actions of sternocleidomastoid	K/S	SH	Y	1	6
AN29.2	Explain anatomical basis of Erb's & Klumpke's palsy	K	KH	Y		
AN29.3	Explain anatomical basis of wry neck*	K	KH	N		
AN29.4	Describe & demonstrate attachments of 1) inferior belly of omohyoid, 2) scalenus anterior, 3) scalenus medius & 4) levator scapulae*	K/S	SH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Demonstrate and describe the boundaries, subdivisions and contents of the posterior triangle of the neck
b. Demonstrate and describe the attachments, nerve supply, relations and actions of the sternocleidomastoid c. Explain the anatomical basis of Erb's palsy
d. Explain the anatomical basis of Klumpke's palsy
e. Demonstrate and describe the attachments, nerve supply, relations and actions of the inferior belly of omohyoid, scalenus anterior, scalenus medius and levator scapulae
f. Explain the anatomical basis of Erb's palsy

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**

☐ Lecture	☐ Dissection with small group discussion	• Long essay • Modified long essay • Short essay • Short answer	• Spotters • Window discussion

HEAD AND NECK

Topic

: Cranial cavity

Number of competencies: 5

Number of procedures for certification: Nil

Total number of hours required: 5 [1 hour (theory) & 4 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN30.1	Describe the cranial fossae & identify related structures	K/S	SH	Y	1	4
AN30.2	Describe & identify major foramina with structures passing through them	K/S	SH	Y		
AN30.3	Describe & identify dural folds & dural venous sinuses	K/S	SH	Y		
AN30.4	Describe clinical importance of dural venous sinuses	K	KH	Y		
AN30.5	Explain effect of pituitary tumours on visual pathway*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Identify the boundaries, contents and structures passing through the foramina of the cranial fossae b. Demonstrate and describe the three meningeal layers

c. Demonstrate and describe the dural folds and dural venous sinuses

d. Describe the location, boundaries, relations and communications of the cavernous sinus

e. Explain the anatomical basis of cavernous sinus thrombosis

f. Explain the clinical importance of dural venous sinuses

g. Explain the effect of pituitary tumours on the visual pathway

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**

Topic

Lecture	Dissection with small group discussion	• Long essay • Modified long essay • Short essay • Short answer	• Spotters • Window discussion

: Orbit

Number of competencies: 5

Number of procedures for certification: Nil

Total number of hours required: 6 [2 hours (theory) & 4 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN31.1	Describe & identify extra ocular muscles of eyeball	K/S	SH	Y	**Theory**	**Practical**
AN31.2	Describe & demonstrate nerves and vessels in the orbit	K/S	SH	Y	2	4
AN31.3	Describe anatomical basis of Horner's syndrome*	K	KH	N		
AN 31.4	Enumerate components of lacrimal apparatus	K	KH	Y		
AN 31.5	Explain the anatomical basis of oculomotor, trochlear and abducent nerve palsies along with strabismus	K	KH	Y		
SPECIFIC LEARNING OBJECTIVES (SLOs')						

HEAD AND NECK

Topic

At the end of the teaching and learning session the 1st phase MBBS student should be able to: a. Demonstrate and describe the boundaries of the orbit along with its foramina and fissures b. Demonstrate and describe the nerve supply and actions of extraocular muscles c. Describe the course and distribution of the frontal, nasociliary, oculomotor, trochlear, abducent and optic nerves d. Describe the course and distribution of the ophthalmic artery e. Describe the connections of the ciliary ganglion f. Describe the anatomical basis of Horner's syndrome g. Specify the components of lacrimal apparatus h. Explain the anatomical basis of features of oculomotor, trochlear and abducent nerve palsies and strabismus

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture	Dissection with small group discussion	• Long essay • Modified long essay • Short essay • Short answer	• Spotters • Window discussion

: Anterior triangle

Number of competencies: 2

Number of procedures for certification: Nil

Total number of hours required: 10 [2 hours (theory) & 8 hours (practical)]

NUMBER	**COMPETENCY**	**DOMAIN K/S/A/C**	**LEVEL K/KH/SH/P**	**CORE Y/N**	**Teaching time required in hours**	
					Theory	**Practical**
AN32.1	Describe boundaries and subdivisions of anterior triangle	K/S	SH	Y	2	8
AN32.2	Describe & demonstrate boundaries and contents of muscular, carotid, digastric and submental triangles	K/S	SH	Y		
SPECIFIC LEARNING OBJECTIVES (SLOs')						

HEAD AND NECK

Topic

At the end of the teaching and learning session the 1st phase MBBS student should be able to: a. Demonstrate and describe the disposition and features of the fascial layers of the neck b. Demonstrate the midline structures of the neck and describe their clinical relevance c. Demonstrate and describe the boundaries and subdivisions of the anterior triangle d. Demonstrate and describe the boundaries and contents of the muscular, carotid, digastric and submental triangle e. Demonstrate and describe the gross anatomy of the common carotid, internal carotid and external carotid arteries, internal jugular vein and the vagus nerve

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
□ Lecture	□ Dissection with small group discussion	• Long essay • Short essay • Short answer	• Spotters • Window discussion

: Temporal and Infratemporal regions

Number of competencies: 5

Number of procedures for certification: Nil

Total number of hours required: 11 [3 hours (theory) & 8 hours (practical)]

NUMBER	**COMPETENCY**	**DOMAIN K/S/A/C**	**LEVEL K/KH/SH/P**	**CORE Y/N**	**Teaching time required in hours**	
AN33.1		K/S	SH	Y	**Theory**	**Practical**

Topic

AN33.2	Describe & demonstrate extent, boundaries and contents of temporal and infratemporal fossae Describe & demonstrate attachments, direction of fibres, nerve supply and actions of muscles of mastication	K/S	SH	Y	3	8
AN33.3	Describe & demonstrate articulating surface, type & movements of temporomandibular joint	K/S	SH	Y		
AN 33.4	Explain the clinical significance of pterygoid venous plexus	K	KH	Y		
AN 33.5	Describe the features of dislocation of temporomandibular joint*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Demonstrate and describe the extent, boundaries and contents (maxillary artery, middle meningeal artery, mandibular nerve, otic ganglion and its connections, lingual nerve and inferior alveolar nerve) of the temporal and infratemporal fossae
b. Demonstrate and describe the attachments, direction of fibres, nerve supply and actions of muscles of mastication
c. Describe the type, articular surfaces, movements and muscles responsible for the movements of the temporomandibular joint d. Explain the clinical significance of the pterygoid venous plexus
e. Describe the anatomical basis of dislocation of the temporomandibular joint

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture	Dissection with small group discussion	• Long essay • Modified long essay • Short essay • Short answer	• Spotters • Window discussion

: Submandibular region

Number of competencies: 2

Topic

Number of procedures for certification: Nil
Total number of hours required: 5 [1 hour (theory) & 4 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN34.1	Describe & demonstrate the morphology, relations and nerve supply of submandibular salivary gland & submandibular ganglion	K/S	SH	Y	1	4
AN34.2	Describe the basis of formation of submandibular stones*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe the location, lobes, relations and nerve supply of the submandibular salivary gland
b. Demonstrate and describe the relations of the hyoglossus muscle
c. Demonstrate and describe the location, relations and connections of the submandibular ganglion
d. Demonstrate the origin, course, termination and relations of the submandibular duct
e. Describe the anatomical basis of the formation of submandibular stones

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture	Dissection with small group discussion	• Short essay • Short answer	• Spotters • Window discussion

: Deep structures of the neck
Number of competencies: 10
Number of procedures for certification: Nil

HEAD AND NECK

Topic

Total number of hours required: 11 [3 hours (theory) & 8 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN35.1	Describe the parts, extent, attachments, modifications of deep cervical fascia	K	KH	Y	**Theory**	**Practical**
					3	8
AN35.2	Describe & demonstrate location, parts, borders, surfaces, relations & blood supply of thyroid gland	K/S	SH	Y		
AN35.3	Demonstrate & describe the origin, parts, course & branches subclavian artery	K/S	SH	Y		
AN 35.4	Describe & demonstrate origin, course, relations, tributaries and termination of internal jugular & brachiocephalic veins	K/S	SH	Y		
AN 35.5	Describe and demonstrate extent, drainage & applied anatomy of cervical lymph nodes	K/S	KH	Y		
AN 35.6	Describe the anatomically relevant clinical features of Thyroid swellings*	K/S	SH	Y		
AN 35.7	Describe the clinical features of compression of subclavian artery and lower trunk of brachial plexus by cervical rib*	K	KH	Y		
AN 35.8	Describe and demonstrate the extent, formation, relation & branches of cervical sympathetic chain	K	KH	N		

AN 35.9	Describe the course and branches of IX, X, XI & XII nerve in the neck	K	KH	N		
AN 35.10	Describe the fascial spaces of neck	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Demonstrate and describe the parts, extent, attachments and modifications of deep cervical fascia
b. Demonstrate and describe the thyroid gland under the following headings: location, parts, borders, surfaces, relations, blood supply and lymphatic drainage
c. Explain the anatomical basis of the liability of injury to the external and recurrent laryngeal nerves during thyroidectomy
d. Demonstrate and describe the origin, parts, course, branches and distribution of the subclavian artery
e. Demonstrate and describe the course, branches and distribution of the vagus nerve in the neck
f. Demonstrate and describe the course and distribution of the glossopharyngeal nerve in the neck
g. Demonstrate and describe the course and distribution of spinal accessory nerve in the neck
h. Demonstrate and describe the course and distribution of hypoglossal nerve in the neck
i. Describe the structures encountered during tracheostomy
j. Describe the anatomical basis of the clinical features of thyroid swellings
k. Describe the anatomical basis of the clinical features of compression of the subclavian artery and lower trunk of brachial plexus by a cervical rib
l. Describe the clinical importance of the fascial spaces of the neck

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture	Dissection with small group discussion	• Long essay • Modified long essay • Short essay • Short answer	• Spotters • Window discussion

Topic

: Mouth, pharynx and palate

Number of competencies: 5

Number of procedures for certification: Nil

Total number of hours required: 6 [2 hours (theory) & 4 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN36.1	Describe the 1) morphology, relations, blood supply and applied anatomy of palatine tonsil 2) composition of soft palate *(please note that gross anatomy of pharynx needs to be included here)*	K	KH	Y	2	4
AN36.2	Describe the components and functions of Waldeyer's lymphatic ring	K	KH	Y		
AN36.3	Describe the boundaries and clinical significance of pyriform fossa*	K	KH	N		
AN 36.4	Describe the anatomical basis of tonsillitis, tonsillectomy, adenoids and peri-tonsillar abscess*	K	KH	N		
AN 36.5	Describe the clinical significance of Killian's dehiscence*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Demonstrate and describe the subdivisions and boundaries, layers of wall, muscles, their nerve supply, blood supply and lymphatic drainage of the pharynx
b. Demonstrate and describe the structure, muscles, nerve supply and functional anatomy of the soft palate
c. Demonstrate and describe the morphology, relations, blood supply and applied anatomy of the palatine tonsil
d. Describe the components and functions of Waldeyer's lymphatic ring
e. Demonstrate and describe the boundaries and clinical significance of the pyriform fossa
f. Describe the anatomical basis of Killian's dehiscence

HEAD AND NECK

Topic

Number of competencies:

Number of procedures for certification:

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture	Dissection with small group discussion	• Long essay • Short essay • Short answer	• Spotters • Window discussion

: Cavity of nose

3

Nil

Total number of hours required: 4 [2 hours (theory) & 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN37.1	Describe & demonstrate features of nasal septum, lateral wall of nose, their blood supply and nerve supply	K/S	SH	Y	2	2
AN37.2	Describe location and functional anatomy of paranasal sinuses	K	KH	Y		
AN37.3	Describe anatomical basis of sinusitis & maxillary sinus tumours*	K	KH	N		
SPECIFIC LEARNING OBJECTIVES (SLOs')						

HEAD AND NECK

Topic

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Demonstrate and describe the parts of the nose
b. Demonstrate and describe the components and features of the nasal septum, lateral wall of nose, their blood supply and nerve supply
c. Explain the clinical importance of Little's area
d. Describe the location and functional anatomy of the paranasal sinuses
e. Describe the anatomical aspects of sinusitis and maxillary sinus tumors
f. Explain the dangerous areas of the nasal cavity and their clinical relevance

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture	Dissection with small group discussion	• Long essay • Short essay • Short answer	• Spotters • Window discussion

HEAD AND NECK

Topic
Number of competencies:
Number of procedures for certification:

: Larynx

3

Nil

Total number of hours required: 3 [1 hour (theory) & 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN38.1	Describe the morphology, identify structure of the wall, nerve supply, blood supply and actions of intrinsic and extrinsic muscles of the larynx	K/S	SH	Y	1	2
AN38.2	Describe the anatomical aspects of laryngitis*	K	KH	N		
AN38.3	Describe anatomical basis of recurrent laryngeal nerve injury*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Demonstrate and describe the boundaries of the laryngeal inlet
b. Demonstrate and describe the morphology, structure of the wall, nerve supply, blood supply and actions of the intrinsic and extrinsic muscles of the larynx
c. Describe the anatomical basis of recurrent laryngeal nerve injury

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture	Dissection with small group discussion	• Long essay • Short essay • Short answer	• Spotters • Window discussion

Topic

: Tongue

2

Nil

Total number of hours required: 3 [1 hour (theory) & 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
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	K/S	SH	Y	1	2
AN39.2	Explain the anatomical basis of hypoglossal nerve palsy*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe the morphology, nerve supply, blood supply, lymphatic drainage and actions of the extrinsic and intrinsic muscles of tongue

b. Describe the origin, insertion, nerve supply and actions of the extrinsic and intrinsic muscles of tongue c. Describe the embryological basis of nerve supply.

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture	Dissection with small group discussion	• Long essay • Short essay • Short answer	• Spotters • Window discussion

Topic
Number of competencies:
Number of procedures for certification:

: Organs of hearing and equilibrium
Number of competencies: 2
Number of procedures for certification: Nil
Total number of hours required: 3 [1 hour (theory) & 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN40.1	Describe & identify the parts, blood supply and nerve supply of external ear	K/S	SH	Y	1	2
AN40.2	Describe & demonstrate the boundaries, contents, relations and functional anatomy of middle ear and auditory tube	K/S	SH	Y		
AN40.3	Describe the features of internal ear*	K	KH	N		
AN 40.4	Explain anatomical basis of otitis externa and otitis media*	K	KH	N		
AN 40.5	Explain anatomical basis of myringotomy*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Identify and describe the parts, blood supply and nerve supply of the external ear
b. Describe the boundaries, contents, relations and functional anatomy of the middle ear and auditory tube c. Name the parts of the inner ear and describe their functions
d. Describe the relations and blood supply of the inner ear
e. Explain the relation between the mastoid antrum and middle ear
f. Explain the anatomical aspects of otitis externa and otitis media

Topic

g. Explain the anatomical basis of myringotomy

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture	Dissection with small group discussion	• Short essay • Short answer	• Spotters • Window discussion

HEAD AND NECK

Topic

: Eyeball

Number of competencies: 3

Number of procedures for certification: Nil

Total number of hours required: 3 [1 hour (theory) & 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN41.1	Describe & demonstrate parts and layers of eyeball	K/S	SH	Y	1	2
AN41.2	Describe the anatomical aspects of cataract, glaucoma & central retinal artery occlusion*	K	KH	N		
AN41.3	Describe the position, nerve supply and actions of intraocular muscles*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Demonstrate and describe the parts, layers and functions of the eyeball
b. Demonstrate and describe the position, nerve supply and actions of the extraocular muscles

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture	Dissection with small group discussion	• Long essay • Short essay • Short answer	• Spotters • Window discussion

Topic

: Back

Number of competencies: 3

Number of procedures for certification: Nil

Total number of hours required: 3 [1 hour (theory) & 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN42.1	Describe the contents of the vertebral canal	K/S	SH	Y	1	2
AN42.2	Describe & demonstrate the boundaries and contents of suboccipital triangle	K/s	SH	Y		
AN42.3	Describe the position, direction of fibres, relations, nerve supply, actions of semispinalis capitis and splenius capitis*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs')

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Demonstrate and describe the contents of the vertebral canal
b. Demonstrate and describe the boundaries and contents of the suboccipital triangle
c. Demonstrate and describe the course of the third part of the vertebral artery in the suboccipital triangle
d. Describe the position, direction of fibres, relations, nerve supply, actions of semispinalis capitis and splenius capitis*

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**

HEAD AND NECK

Topic

Lecture	Dissection with small group discussion	• Long essay • Short essay • Short answer	• Spotters • Window discussion

: Head & neck Joints, Histology, Development, Radiography & Surface marking

Number of competencies: 9

Number of procedures for certification: Nil

Total number of hours required: 19 [9 (theory) & 10 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN43.1		K/S	SH	Y	**Theory**	**Practical**

Topic

	Describe & demonstrate the movements with muscles producing the movements of atlantooccipital joint & atlantoaxial joint	'			9	16
AN43.2	Identify, describe and draw the microanatomy of pituitary gland, thyroid, parathyroid gland, tongue, salivary glands, tonsil, epiglottis, cornea, retina	K/S	SH	Y		
AN43.3	Identify, describe and draw microanatomy of olfactory epithelium, eyelid, lip, sclero-corneal junction, optic nerve, cochlea- organ of Corti, pineal gland*	K/S	SH	N		
AN 43.4	Describe the development and developmental basis of congenital anomalies of face, palate, tongue, branchial apparatus, pituitary gland, thyroid gland & eye	K	KH	Y		
AN 43.5	Demonstrate- 1) testing of muscles of facial expression, extraocular muscles, muscles of mastication, 2) 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	K/S	SH	Y		
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	K/S	SH	Y		

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	K/S	SH	Y		
AN 43.8	Describe the anatomical route used for carotid angiogram and vertebral angiogram*	K/S	SH	N		
AN 43.9	Identify anatomical structures in carotid angiogram and vertebral angiogram*	K/S	KH	N		
SPECIFIC LEARNING OBJECTIVES (SLOs')						

NEUROANATOMY

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Demonstrate the testing of muscles of facial expression, extraocular muscles, muscles of mastication, sternocleidomastoid and trapezius

b. Identify the slides of pituitary gland, thyroid, parathyroid gland, tongue, salivary glands, tonsil, epiglottis, cornea, retina.

c. Describe the microscopic anatomy and draw a neat labelled diagram of microstructure of pituitary gland, thyroid, parathyroid gland, tongue, salivary glands, tonsil, epiglottis, cornea, retina

d. Describe the microscopic anatomy and draw a neat labelled diagram of microstructure of olfactory epithelium, eyelid, lip, sclerocorneal junction, optic nerve, cochlea- organ of Corti, pineal gland*

e. Demonstrate the palpation of carotid arteries, facial artery, and superficial temporal artery

f. Demonstrate the location of hyoid bone, thyroid cartilage and cricoid cartilage and describe their vertebral levels g. Demonstrate the surface projection of

- thyroid gland
- parotid gland and duct
- pterion
- carotid arteries
- jugular veins
- subclavian artery
- subclavian vein
- facial artery in the face
- accessory nerve
- apex of lung and cervical pleura

h. Identify the major radiological anatomical features in:

- plain X ray skull - AP and lateral view plain X ray cervical spine - AP and lateral view
- plain X ray of paranasal sinuses

i. Describe the anatomical basis for carotid and vertebral angiograms*

j. Identify the anatomical structures in carotid and vertebral angiograms*

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical / Viva-voce**
Lecture	Demonstration with small group discussion	• Short essay (only histology) • Short answer (only histology)	• Spotters • Slide discussion • Surface marking • Viva-voce

NEUROANATOMY

Topic: Meninges and CSF & Ventricular System
Number of competencies: 4
Number of procedures for certification: Nil
Total number of hours required: 6 [2 hours (theory) and 4 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN56.1	Describe & identify various layers of meninges with its extent & modifications	K/S	SH	Y	**Theory**	**Practical**
					2 hours	4 hours
AN56.2	Describe circulation of CSF with its applied anatomy	K	KH	Y		
AN63.1	Describe & demonstrate parts, boundaries & features of IIIrd, IVth & lateral ventricle	K/S	SH	Y		
AN63.2	Describe anatomical basis of congenital hydrocephalus*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs)

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Identify the layers of the meninges
b. Describe the modifications of the meninges
c. Explain the formation, flow and functions of the CSF
d. Describe the tela choroidea and choroid plexus
e. Describe the parts of the lateral ventricle
f. Demonstrate the relations of the parts of the lateral ventricle
g. Describe the location and boundaries of 3rd ventricle
h. Describe the location and boundaries of 4th ventricle
i. Demonstrate the salient features of the floor of the 4th ventricle
j. Draw a neat labeled diagram of the floor of the 4th ventricle
k. Explain the anatomical basis for hydrocephalus and its clinical manifestations

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical**

☐ Lecture	☐ Dissection with small group discussion	• Short Essay • Short answer	☐ Spotter

Spinal Cord (including histology)

Number of competencies: 6 **Number of procedures for certification:**

Total number of hours required: 7 [1 hour (theory) and 6 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN57.1	Identify external features of spinal cord	K/S	SH	Y	**Theory**	**Practical**
AN57.2	Describe extent of spinal cord in child & adult with its clinical implication	K	KH	Y	1 hour	4 hours (Dissection) 2 hours (Histology)
AN57.3	Draw & label transverse section of spinal cord at midcervical & mid- thoracic level	K	KH	Y		
AN57.4	Enumerate ascending & descending tracts at mid thoracic level of spinal cord	K	KH	Y		
AN57.5	Describe anatomical basis of syringomyelia*	K	KH	N		
AN64.1	Describe & identify the microanatomical features of **spinal cord**, cerebellum & cerebrum	K/S	SH	Y		
SPECIFIC LEARNING OBJECTIVES (SLOs)						

NEUROANATOMY

Topic:

Nil

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Demonstrate and explains the external and internal features of the spinal cord
b. Describe the spinal meninges and modifications
c. Describe the blood supply of the spinal cord
d. Compare and contrast between transverse sections taken at the level of cervical, thoracic, lumbar and sacral segments of the spinal cord with reference to the ratio of grey matter to white matter
e. Describe the major ascending and descending pathways of the spinal cord.
f. Draw a neat labeled cross- sectional diagram of the spinal cord depicting the ascending and descending tracts g. Explain the anatomical basis of lumbar puncture
h. Explain the anatomical basis of spinal / epidural anesthesia

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical**
Lecture	• Dissection with small group discussion • Histology: small group teaching	• Short Essay • Short answer	• Spotter • Window discussion

Medulla Oblongata

Number of competencies: 4 **Number of procedures for certification:**

Total number of hours required: 3 [1 hour (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN58.1	Identify external features of medulla oblongata	K/S	SH	Y	**Theory**	**Practical**
AN58.2	Describe transverse section of medulla oblongata at the level of 1) pyramidal decussation, 2) sensory decussation 3) ION	K	KH	Y	1 hour	2 hours
AN58.3	Enumerate cranial nerve nuclei in medulla oblongata with their functional group	K	KH	Y		
AN58.4	Describe anatomical basis & effects of medial & lateral medullary syndrome*	K	KH	N		
SPECIFIC LEARNING OBJECTIVES (SLOs)						

NEUROANATOMY

Topic:

Nil

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe the external features of medulla oblongata
b. Demonstrate the external features of the medulla oblongata
c. Identify the salient cross-sectional features of medulla oblongata at the following levels: motor decussation, sensory decussation & inf. olivary nucleus
d. Draw a neat labeled diagram of medulla oblongata indicating the salient cross-sectional features at all the 3 levels mentioned above e. Enumerate the cranial nerve nuclei at each level
f. Describe the functional components of the cranial nerve nuclei present in the medulla oblongata g. Describe the blood supply of the medulla
h. Describe in brief the result of trauma (injury/hemorrhage/blockage of blood supply) to the medulla and its major clinical manifestations

TEACHING AND LEARNING METHODS		**ASSESSMENT METHODS**	
Theory	**Practical**	**Theory**	**Practical**
Lecture	Dissection with small group discussion	• Short essay • Short answer	Spotter

NEUROANATOMY

Topic:

Nil

Pons

Number of competencies: 3 **Number of procedures for certification:**

Total number of hours required: 3 [1 hour (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN59.1	Identify external features of pons	K/S	SH	Y	**Theory**	**Practical**
AN59.2	Describe transverse section of pons at the upper and lower level	K	KH	Y	1 hour	2 hours
AN59.3	Enumerate cranial nerve nuclei in pons with their functional group	K	KH	Y		

SPECIFIC LEARNING OBJECTIVES (SLOs)

At the end of the teaching and learning session the 1st phase MBBS student should be able to: a. Describe the external features of pons

b. Demonstrate the external features of the pons

c. Identify the salient cross sectional features of pons at the following levels: upper and lower levels

d. Draw a neat labeled diagram of pons indicating the salient cross sectional features at the 2 levels mentioned above e. Enumerate the cranial nerve nuclei at each level

f. Describe the functional components of the cranial nerve nuclei present in the pons g. Describe the blood supply of the pons

h. Describe in brief the result of trauma (injury/hemorrhage/blockage of blood supply) to the pons and its major clinical manifestations

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical**

NEUROANATOMY

Topic:

Nil

☐ Lecture	☐ Dissection with small group discussion	• Short essay • Short answer	☐ Spotter

Cerebellum (including histology)

Number of competencies: 4 **Number of procedures for certification:**

Total number of hours required: 4 [1 hour (theory) and 3 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN60.1	Describe & demonstrate external & internal features of cerebellum	K/S	SH	Y	**Theory**	**Practical**
AN60.2	Describe connections of cerebellar cortex and intracerebellar nuclei	K	KH	Y	1 hour	2 hours (Dissection) 1 hour (Histology)
AN60.3	Describe anatomical basis of cerebellar dysfunction*	K	KH	N		
AN64.1	Describe & identify the microanatomical features of spinal cord, **cerebellum** & cerebrum	K/S	SH	Y		
SPECIFIC LEARNING OBJECTIVES (SLOs)						

NEUROANATOMY

Topic:

Nil

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe the external/gross features of cerebellum
b. Demonstrate the external /gross features of the cerebellum
c. Identify the salient internal features of cerebellum on sagittal and horizontal sections d. Identify the nuclei in the cerebellum
e. Describe connections of cerebellar cortex and intracerebellar nuclei
f. Describe the microstructure of the cerebellum
g. Draw a neat labeled diagram of the micro-circuitry (cytoarchitecture) of the cerebellum
h. Describe the blood supply of the cerebellum
i. Describe in brief the result of trauma (injury/haemorrhage/blockage of blood supply) to the cerebellum and its major clinical manifestations

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical**
Lecture	• Dissection with small group discussion • Histology: Small group teaching	• Short essay • Short answer	• Spotter • Window dissection

Midbrain

Number of competencies: 3 **Number of procedures for certification:**

Total number of hours required: 3 [1 hour (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN61.1	Identify external features of midbrain	K/S	SH	Y	**Theory**	**Practical**

Topic:

Nil

AN61.2	Describe internal features of midbrain at the level of superior & inferior colliculus	K	KH	Y	1 hour	2 hours
AN61.3	Describe anatomical basis & effects of Benedikt's and Weber's syndrome*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs)

At the end of the teaching and learning session the 1st phase MBBS student should be able to: a.
Describe the external features of midbrain

b. Demonstrate the external features of the midbrain

c. Identify the salient cross sectional features of mid-brain at the following levels: superior colliculus and inferior colliculus

d. Draw a neat labeled diagram of midbrain indicating the salient cross sectional features at the 2 levels mentioned above e. Enumerate the cranial nerve nuclei at each of the levels

f. Describe the functional components of the cranial nerve nuclei present in the midbrain g.
Describe the blood supply of the midbrain

h. Describe in brief the result of trauma (injury/haemorrhage/blockage of blood supply) to the midbrain and its clinical manifestations i.
Describe the anatomical basis of Parkinson disease

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical**
□ Lecture	• Dissection with small group discussion • Histology: Small group teaching	• Short essay • Short answer	□ Spotter

Cranial nerve nuclei **Number of competencies:** 1

Number of procedures for certification:

Total number of hours required: 2 [2 hours (theory)]

Topic:

Nil

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN62.2	Enumerate cranial nerve nuclei with its functional component	K	KH	Y	**Theory**	**Practical**
					2 hours	-

SPECIFIC LEARNING OBJECTIVES (SLOs)

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe the functional components of each of the 12 cranial nerves
b. Demonstrate the origins of the 12 cranial nerves in a given specimen of brain
c. Describe in brief the course of each cranial nerve
d. Describe in brief the functions of each cranial nerve
e. Describe in brief the effects of injury to each of the cranial nerve

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical**
Lecture		• Short essay • Short answer	

Cerebral Hemispheres

NEUROANATOMY

Topic:

Nil

Number of competencies: 6 **Number of procedures for certification:**

Total number of hours required: 7 [2 hours (theory) and 5 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
AN62.2	Describe & demonstrate surfaces, sulci, gyri, poles, & functional areas of cerebral hemisphere	K/S	SH	Y	**Theory**	**Practical**
AN62.3	Describe the white matter of cerebrum	K	KH	Y	2 hours	4 hours (Dissection) 1 hours (Histology)
AN62.4	Enumerate parts & major connections of basal ganglia & limbic lobe	K	KH	Y		
AN62.5	Describe boundaries, parts, gross relations, major nuclei and connections of dorsal thalamus, hypothalamus, epithalamus, metathalamus and subthalamus	K	KH	Y		
AN62.6	Describe & identify formation, branches & major areas of distribution of circle of Willis	K/S	SH	Y		
AN64.1	Describe & identify the microanatomical features of spinal cord, cerebellum & cerebrum	K/S	SH	Y		
SPECIFIC LEARNING OBJECTIVES (SLOs)						

NEUROANATOMY

Topic:

Nil

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe the gross anatomy features on the medial, superolateral and the inferior surfaces of the cerebral hemisphere
b. Demonstrate the gross anatomy features on the medial, superolateral and the inferior surfaces of the cerebral hemisphere
c. Describe the white matter under the headings of association, projection and commissural fibers with examples for each d. Describe the internal capsule in detail along with its blood supply
e. Describe in brief the corpus callosum
f. Enumerate parts & major connections of basal ganglia

g. Describe in brief the result of lesions in the basal ganglia
h. Enumerate parts & major connections of limbic lobe
i. Describe boundaries, parts, gross relations, major nuclei and connections of thalamus
j. Describe the blood supply to the cerebral hemisphere with special attention to the Circle of Willis k. Describe the microstructure of the cerebrum

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical**
Lecture	• Dissection with small group discussion • Histology: Small group teaching	• Short essay • Short answer	• Spotter • Window dissection

NEUROANATOMY

Topic: Embryology
Number of competencies: 2
Number of procedures for certification: Nil
Total number of hours required: 3 [1 hour (theory) and 2 hours (practical)]

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours	
					Theory	**Practical**
AN64.2	Describe the development of neural tube, spinal cord, medulla oblongata, pons, midbrain, cerebral hemisphere & cerebellum	K	KH	Y	1 hour	2 hours (Embryology models)
AN64.3	Describe various types of open neural tube defects with its embryological basis*	K	KH	N		

SPECIFIC LEARNING OBJECTIVES (SLOs)

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Describe the formation of the neural tube
b. Enumerate the structures developing from the neural crest cells
c. Name the parts of the neural tube and their derivatives
d. Enumerate the different types of neural tube defects leading to abnormalities at birth
e. Enumerate the avoidable causes of neural tube defects

TEACHING AND LEARNING METHODS		ASSESSMENT METHODS	
Theory	**Practical**	**Theory**	**Practical**
□ Lecture	• Small group teaching • Self-directed learning (Embryology models)	• Short Essay • Short answer	□ Viva-voce

Topic: Ethics in anatomy
Number of competencies: 1
Number of procedures for certification: Nil
Total number of hours required: 4

NUMBER	COMPETENCY	DOMAIN K/S/A/C	LEVEL K/KH/SH/P	CORE Y/N	Teaching time required in hours
AN82.1	Demonstrate respect and follow the correct procedure when handling cadavers and other biologic tissue	S	SH	Y	4

SPECIFIC LEARNING OBJECTIVES (SLOs)

At the end of the teaching and learning session the 1st phase MBBS student should be able to:

a. Appreciate the contribution made by body donors to her/his learning.
b. Demonstrate appropriate professional behavior while participating in dissection sessions.
c. Demonstrate the correct method of handling the instruments used for dissection.
d. Use the recommended safety precautions while handling the cadavers.
e. Appropriately discard the waste generated during dissection.
f. Reflect on how the experience of dissection of cadavers has impacted her/him.

TEACHING AND LEARNING METHODS	ASSESSMENT METHODS	
• Ceremony to felicitate body donors • Cadaveric oath administration • Lecture cum demonstration on handling cadavers and other biological tissues	**Theory**	**Practical**
	□ Reflective writing (formative)	□ Professionalism log (formative)

PHYSIOLOGY

Handbook of competencies and specific learning objectives **Specific learning objectives:**

Physiology - Theory

The SLOs are broad guidelines for teachers to aid in teaching and in no means a complete list for assessment of the students. This document is not to be meant to be circulated among students.

General Physiology

PY1.1 Describe the structure and functions 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 in intra cellular transport

PY1.2 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

PY1.3 Describe intercellular communication

- List the types of Intercellular junctions and describe their functions
- Describe the various functional types of intercellular signaling (autocrine, paracrine, synapse, neuroendocrine and endocrine)

PY1.4 Describe apoptosis – programmed cell death

Define apoptosis

Describe the function of apoptosis

- Briefly describe the pathways involved in apoptosis

PY1.5 Describe and discuss transport mechanisms across cell membranes

- List the types of transports across cell membrane (passive, active, vesicular)

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- Distinguish between active and passive transport mechanisms
- 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

PY1.7 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 and discuss the molecular basis of resting membrane potential and action potential in excitable tissue

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- 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-Katz equation
- 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

PY1.9 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

Hematology:

PY2.1 Describe the composition and functions of blood components

- 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

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PY2.2 Discuss the origin, forms, variations and functions of plasma proteins

- 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 Describe and discuss the synthesis and functions of Hemoglobin and explain its breakdown. Describe 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 Describe RBC formation (erythropoiesis & 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

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PY2.5 Describe different types of anemias & Jaundice

Define anemia and classify based on i) Morphology ii) Etiology

Explain the physiological basis of symptoms/signs of anemia

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 Describe 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

PY2.7 Describe the 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

PY2.8 Describe the physiological basis of hemostasis and, anticoagulants. Describe bleeding & clotting disorders (Hemophilia, purpura)

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- 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 Vit 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 Describe different blood groups and discuss the 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
- Describe the complications of mismatched blood transfusion
- Describe how blood is stored and discuss the changes that occur in stored blood

PY2.10 Define and classify different types of immunity. Describe the development of immunity and its regulation

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- 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 in immunity

  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

Nerve muscle Physiology:

PY3.1 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

PY3.2 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

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- Explain with the help of a diagram, the concept of 'local currents' in a nerve
- 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

PY3.3 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

PY3.4 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

PY3.5 Discuss the action of neuro-muscular blocking agents

- Identify, with examples potential sites where neuromuscular transmission can be affected (pre-synaptic, synaptic and post-synaptic)
- Explain the mechanism of action of the drugs acting at the neuromuscular junction.

PY3.6 Describe the pathophysiology of Myasthenia gravis

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- 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

PY3.7 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

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Explain the basis for the phenomenon of Quantal summation

PY3.8 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

PY3.9 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

PY3.10 Describe the mode of muscle contraction (isometric and isotonic) Differences between isometric and isotonic exercises with examples

- Distinguish between isometric and isotonic muscle contraction
- List examples of isometric and isotonic muscle contraction

PY3.11 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

PY3.12 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.

PY3.13 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

PY3.17 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

Gastrointestinal Physiology:

PY4.1 Describe the 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.

PY4.2 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 HCl secretion.
- 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

PY4.3 Describe GIT 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

PY4.4 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

PY4.5 Describe the source of GIT hormones, their regulation and functions List the principal GI hormones and explain physiological functions of each of these hormones.

- List the GI hormones and their sites of production • Describe the actions and regulation of the GI hormones.

PY4.6 Describe the Gut-brain axis and factors influencing it

- 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 microbiota and its management (role of drugs, probiotics etc)
- Describe action of GI hormones/ peptides on the CNS

PY4.7 Describe & 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

PY4.8 Describe & discuss gastric function tests, pancreatic exocrine function tests & 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

PY4.9 Discuss the physiology aspects of: peptic ulcer, gastro oesophageal reflux disease, vomiting, diarrhoea, constipation, Adynamic ileus, Hirschsprung's disease

- Discuss dysphagia and its causes.
- Discuss the pathophysiology and effects of achalasia cardia
- Describe the cause and features of ○ GERD

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    - 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 ○ Vomiting ○ Diarrhoea ○ Constipation
- Discuss the pathophysiology and presentation of Hirchsprung's disease, adynamic ileus

Cardiovascular Physiology:

PY5.1 Describe the functional anatomy of heart including chambers, sounds; 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.

PY5.2 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

PY5.3 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.

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Mention the clinical significance of JVP.

List the different heart sounds & explain their basis

PY5.4 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

PY5.5 Describe the physiology of electrocardiogram (E.C.G), its applications 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 and Einthoven'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 ECG waves
- 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.

PY5.6 Describe abnormal ECG, arrythmias, heart block and myocardial Infarction

- Classify and describe arrhythmias based on its origin.

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- 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

PY5.7 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:
  - Laplace law ○ Bernoulli's principle
  - Fahraeus Lindqvist effect

PY5.8 Describe and discuss local and systemic cardiovascular regulatory mechanisms

Included under competency number: PY5.9 and PY5.10

PY5.9 Describe the factors affecting heart rate, regulation of cardiac output & 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.

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- 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, Pulse pressure & Mean arterial pressure

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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.
- 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 & ReninAngiotensin mechanism in intermediate term regulation of BP.
- Define the terms – Hypertension, Hypotension

PY5.10 Describe & discuss regional circulation including microcirculation, lymphatic circulation, coronary, cerebral, capillary, skin, fetal, 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.

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- 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
- Define 'triple response' & explain the basis for the same
- Mention the circulatory readjustments which occur at birth

PY5.11 Describe the pathophysiology of 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

Respiratory system

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PY6.1 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 breathing cycle
- Define pulmonary compliance and list the factors altering the 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 distress syndrome
- 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 pressures in the alveolus

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- 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.

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  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 regulation of 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.
- Briefly describe the mechanism of cough reflex, sneezing reflex & deglutition apnoea.

PY6.4 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. (repeated PY 6.5)
- 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. List the various parameters of respiratory function assessed in pulmonary function testing.

- 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 the normal 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

Renal Physiology

PY7.1 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

PY7.2 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

PY7.3 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

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- 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
- 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

PY7.4 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

PY7.5 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

PY7.6 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

PY7.7 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 PY7.8 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

PY7.9 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

Endocrine Physiology:

PY8.1 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) PY8.2 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 Introduction:
- 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)

Hypothalamus:

- List the hormones secreted by the hypothalamus and discuss the functions of each.
- Discuss the Hypothalamus-pituitary-organ axis in detail with examples.

Pituitary gland:

- Describe the functional anatomy of pituitary gland
- List the hormones secreted by anterior pituitary and posterior pituitary
- Describe the actions and regulation of growth hormone
- List the clinical features with physiological basis for each: a) gigantism, b) acromegaly, c) dwarfism
- List the actions and factors controlling the secretions of oxytocin and vasopressin

Thyroid gland:

- Describe the functional anatomy of thyroid gland.
- Describe the structure, biosynthesis and transport and metabolism of thyroid hormones.
- Describe the physiological actions and regulation of thyroid hormones.

- Discuss the clinical features with pathophysiological basis for each: a) cretinism, b) myxoedema, c) hyperthyroidism
- List Antithyroid drugs and the sites of their action
- Describe the Thyroid function tests

Calcium homeostasis:

- Describe the distribution, absorption and fate of calcium and phosphorus.
- Describe the plasma concentration, regulations and functions of calcium and phosphorus.
- List the components of the organic matrix of bone
- List the important dietary sources of calcium and phosphate
- Describe the physiological actions and regulation of parathyroid hormones.
- Describe the physiological actions of Vit D
- Describe the physiological actions of Calcitonin
- Mention the normal serum calcium levels. Describe the hormonal regulation of calcium homeostasis (parathyroid, Calcitonin, Vitamin D).
- Define tetany.
- List of clinical features of decreased serum calcium level
- Define osteoporosis

Adrenal cortex and medulla:

- Name the catecholamines secreted by adrenal medulla
- Describe the types of adrenergic receptors, physiological actions and regulations of catecholamines.

- Discuss the clinical features of Pheochromocytoma
- Describe the structure, biosynthesis and transport of adrenocortical hormones.
- Describe the metabolism, regulation and actions of adrenocortical hormones.
- Discuss the clinical features with pathophysiological basis for each: a) Addison's disease, b) Cushing's syndrome, c) Conn's syndrome, d) Adrenogenital syndrome
- List the features of Congenital adrenal hyperplasia

Pancreas:

- Name the hormones secreted by each cell of endocrine pancreas. List their functions.
- Name hormones that affect plasma glucose concentration and describe the action of each hormone
- Describe the structure and biosynthesis of insulin.
- Describe the mechanism of actions and regulation of insulin • Describe the physiological response to hypoglycemia
- List the types of glucose transporters found in human body.
- Define and give the normal values of fasting blood sugar, post prandial blood sugar with clinical significance.
- Discuss glucose tolerance test with clinical significance
- Discuss physiological basis of clinical features of diabetes mellitus.

PY8.3 Describe the physiology of Thymus & Pineal Gland

- Discuss the functions of the thymus.
- Describe the physiological actions of melatonin.
- List functions of Pineal gland
- Discuss the effects of thymectomy

PY8.4 Describe function tests: Thyroid gland, Adrenal cortex, Adrenal medulla and pancreas •

Included under PY8.3

PY8.5 Describe the metabolic and endocrine consequences of obesity & 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.)

PY8.6 Describe & 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.

Reproductive Physiology

PY9.1 Describe and discuss sex determination; sex differentiation and their abnormities 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
Pseudohermaphrodite

PY9.2 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

PY9.3 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

PY9.4 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:
  - List the ovarian hormones and describe the physiological actions of each
  - 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
- 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

PY9.5 Describe and discuss the 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

PY9.6 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

PY9.7 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

PY9.8 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

PY9.9 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

PY9.10 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

PY9.11 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 occur in different systems
- Discuss the uses and side effects of hormone replacement therapy (HRT)

PY9.12 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

Neurophysiology

Sensory system:

PY10.1 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

PY10.2 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
- Classify reflexes and discuss the properties of reflexes PY10.3 Describe and discuss somatic sensations & 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

Motor system:

PY10.4 Describe and discuss motor tracts, mechanism of maintenance of tone, control of body movements, posture and equilibrium & vestibular apparatus

- List the descending tracts

- Describe the cortico bulbar and cortico spinal tract (pyramidal tract) from its origin to termination with a diagram and list its functions
- Describe the extrapyramidal tracts (vestibulospinal, rubrospinal, reticulospinal, olivospinal, tectospinal) and their functions
- 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 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

PY10.5 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

PY10.6 Describe and discuss Spinal cord, its functions, lesion & 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

Higher mental functions, special senses

PY10.7 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

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- 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 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
- Cerebellum – covered under 10.4

PY10.8 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

PY10.9 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.

PY10.10 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

PY10.12 Identify normal EEG forms

- Given the EEG recording, Identify the various waves of the EEG (alpha block, sleep spindles)

PY10.13 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

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PY10.14 Describe and discuss Patho-physiology of altered smell and taste sensation List and describe disorders of taste and smell

Describe the clinical tests for taste and smell

PY10.15 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

PY10.16 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

PY10.17 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
- 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

PY10.18 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

PY10.19 Describe and discuss auditory & visual evoke potentials

- Explain evoked potential
- Discuss the physiological and clinical uses of auditory and visually evoked potentials

Integrated Physiology:

PY11.1 Describe and discuss mechanism of temperature regulation

- Define the normal range of body temperature

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- 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

PY11.2 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

PY11.3 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

PY11.4 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 training
- Describe the whole body and skeletal muscle effects of sustained endurance / resistance training
- Define exercise, grading, type, oxygen debt

PY11.5 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

PY11.6 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:
    - growth and weight gain ○ developmental milestones ○ nervous system changes ○ cardiovascular system

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- respiratory system ○ gastrointestinal system ○ endocrine system ○ renal and urinary system
- hematological and immune function

PY11.7 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

PY11.8 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 chronic heat and cold conditions.
- Highlight the differences in cardiorespiratory responses to exercise in heat and cold from those in thermoneutral conditions

PY11.9 Interpret growth charts

- Define growth chart
- List the types of growth chart
- Define: stunting, wasting, failure to thrive

- Interpret the WHO / IAP weight-for-age growth chart for the given data (case history)

PY11.10 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

PY11.11 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)

PY11.12 Discuss the physiological effects of meditation

- Describe the physiological changes seen with meditation with regards to:
    - Neuroendocrine (cognitive, autonomic function, EEG, sleep, HPA axis) ○ cardiorespiratory function ○ metabolic activity

BIOCHEMISTRY

Handbook of competencies and specific learning objectives

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Specific Learning Objectives (SLO)

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/ SH/P	Suggested Teaching Learning method	Suggested Assessment method	Vertical integration	Horizontal Integration
Topic: Basic Biochemistry		**Number of competencies: (01) Number of procedures that require certification: (NIL)**					
Topic: Cell and organelles, Cell membrane, Transport across cell membranes							
BI1.1	**Describe the molecular and functional organisation of a cell and its subcellular components.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**		**Physiology**
Specific Learning Objectives							
	Explain the differences between prokaryotic and eukaryotic cell	K	KH				
	Describe structure and enumerate functions of sub-cellular organelles with suitable diagrams	K	KH				
	List the Marker enzymes of cell membrane and subcellular organelles	K	K				
	Describe process used to separate cell organelles						
	Describe structure and enumerate functions of cell membrane with suitable diagram (Fluid mosaic model)	K	KH				
	Explain components of cell membrane contributing to membrane asymmetry and membrane fluidity and their importance	K	KH				
	List different types of transport mechanism across cell membranes for small and large molecules	K	K				
	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	K	KH				
	Enumerate the disorders related to cell membrane and subcellular organelles	K	K				

Specific Learning Objectives (SLO)

	List the components of cytoskeleton including microtubules, actin filaments, intermediate filaments and explain their structure and function	K	K				
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Explain the types of intercellular junctions and different ways of intercellular signalling	K	KH				
	List the types and functions of Aquaporins	K	K				
	Explain the types and functions of ABC family of transporters	K	KH				
Topic: Enzymes		**Number of competencies: (07) Number of procedures that require certification: (NIL)**					
BI2.1	**Explain fundamental concepts of enzyme, isoenzyme, alloenzyme, Coenzyme & co-factors. Enumerate the main classes of IUBMB nomenclature.**	**K**	**KH**	**Lecture, case discussion**	**Written/ Viva voce**		
Specific Learning Objectives							
	Define Enzymes, Coenzymes and Cofactors, Isoenzyme, Alloenzyme, Proenzymes, Ribozymes with suitable examples	K	K				
	Classify enzymes(IUBMB) with suitable examples	K	KH				
	Explain the role of Coenzymes and Cofactors in enzyme catalysed reaction with examples	K	KH				
BI2.2	**Observe the estimation of SGOT & SGPT**	**K**	**K**	**Demonstrate**	**Viva voce**		
Specific Learning Objectives							
	Observe the estimation of SGOT, SGPT and ALP and interpret the results in given sample accurately	K	K				
BI2.3	**Describe and explain the basic principles of enzyme activity**	**K**	**KH**	**Lecture, case discussion**	**Written/Viva voce**		

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Specific Learning Objectives (SLO)

Specific Learning Objectives							
	Describe the features of active site of enzyme and its relevance in enzyme action	K	KH				

Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Explain the mechanism of Enzyme action related to substrate binding (lock and key mode and Koschland's induced fit theory) including concepts of activation energy, transition state and binding energy	K	KH				
	List different mechanisms of enzyme catalysis	K	K				
	Explain different factors affecting enzyme activity	K	KH				
	Explain the effect of substrate concentration on enzyme activity	K	KH				
	Define Km and Vmax and explain their significance	K	KH				
	Describe different types of Enzyme specificity with suitable examples	K	KH				
	Explain various mechanisms of short term regulation of enzyme activity with e.g. including Covalent modification, Zymogen activation, Allosteric regulation, Feedback regulation	K	KH				
	Explain various mechanisms of long term regulation of enzyme activity with examples including induction and repression	K	KH				
BI2.4	**Describe and discuss enzyme inhibitors as poisons and drugs and as therapeutic enzymes**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**Pathology, General Medicine**	
Specific Learning Objectives							
	Explain Competitive and Non-competitive inhibition with examples of clinical importance	K	KH				
	Explain Suicide inhibition with example	K	KH				
	Describe the role of enzymes as Therapeutic agents	K	KH				

Specific Learning Objectives (SLO)

	Explain the role of enzymes as toxins with example	K	KH				
BI2.5	**Describe and discuss the clinical utility of various serum enzymes as markers of pathological conditions.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**Pathology, General Medicine**	
Specific Learning Objectives							
	Discuss the diagnostic importance of enzymes in cardiac, liver, pancreatic, bone and prostate disorders	K	KH				
Number	**COMPETENCY The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Discuss the diagnostic importance of enzymes and isoenzymes in myocardial infarction	K	KH				
	Discuss the therapeutic importance of isoenzymes with examples.	K	KH				
	Enumerate the difference between functional and non functional plasma enzymes with suitable examples	K	K				
	Explain the possible mechanisms of alteration in enzyme and isoenzyme levels in circulation in different pathological conditions of heart, liver, pancreas, bone and prostate	K	KH				
	Describe the role of enzymes as tumor markers	K	KH				
BI2.6	**Discuss use of enzymes in laboratory investigations (Enzyme-based assays)**	**K**	**KH**	**Lecture, Small group discussion**	**Written/Viva voce**	**Pathology, General Medicine**	
Specific Learning Objectives							
	Describe the use of enzymes in diagnostic assays	K	KH				
	Describe the use of enzymes in techniques like recombinant DNA technology, PCR etc	K	KH				
	Describe the use of enzymes as labels in techniques like ELISA, RIA	K	KH				

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Specific Learning Objectives (SLO)

BI2.7	**Interpret laboratory results of enzyme activities & describe the clinical utility of various enzymes as markers of pathological conditions.**	**K**	**KH**	**Lecture, Small group discussion, DOAP sessions**	**Written/Viva voce**	**Pathology, General Medicine**	
Specific Learning Objectives							
	Interpret the lab test reports of enzymes and isoenzymes in cardiac disorders	K	KH				
	Interpret the lab test reports of enzymes and isoenzymes in liver disorders	K	KH				

Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Interpret the lab test reports of enzymes and isoenzymes in of pancreatic disorders	K	KH				
	Interpret the lab test reports of enzymes and isoenzymes in bone disorders	K	KH				
	Interpret the lab test reports of enzymes and isoenzymes in prostate disorders	K	KH				

Topic: Chemistry and Metabolism of Carbohydrates	**Number of competencies: (10)**	**Number of procedures that require certification: (NIL)**					
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**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**		
Specific Learning Objectives							
	Define carbohydrates accurately	K	K				

	Explain the biomedical importance of carbohydrates as energy source, storage and structural element.	K	KH				
	Classify carbohydrates with examples	K	KH				
	List the Monosaccharide derivatives	K	K				
	Explain the clinical significance of Uronic acids, amino sugars, Glycosides, Sorbitol, Mannitol	K	KH				
	Describe the biologically important disaccharides and oligosaccharides	K	KH				
	Define Polysaccharides, Homopolysaccharides, Heteropolysaccharides	K	K				
	Explain the composition and importance of starch, glycogen, Dextran, Cellulose and Inulin.	K	KH				
	Explain the composition and importance of mucopolysaccharides	K	KH				
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Differentiate between glycation and glycosylation	K	KH				
	Explain the biological importance of Glycolipids	K	KH				
	Explain the biological importance of Glycoproteins	K	KH				
	Explain the biological importance of Sialic acid	K	KH				
	Explain the role of carbohydrates as Blood group substances	**K**	**KH**				
BI3.2	**Describe the processes involved in digestion and assimilation of Carbohydrates and storage.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**		
Specific Learning Objectives							
	Explain the process of digestion of carbohydrates	K	KH				
	Explain different types of Glucose transporters	K	KH				

	Explain Insulin dependent and Insulin independent uptake of glucose by tissues	K	KH				
	Explain the process of utilization of carbohydrates for energy generation	K	KH				
	Explain the process of conversion of carbohydrates into their storage form glycogen	K	KH				
BI3.3	**Describe and discuss the digestion and assimilation of carbohydrates from food.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**General Medicine**	
Specific Learning Objectives							
	List the digestible and non digestible dietary carbohydrates with their biological importance	K	K				
	Explain the process of digestion of dietary carbohydrates	K	KH				

Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Explain the mechanism of absorption of digested end products of dietary carbohydrates	K	KH				
	Explain the causes, biochemical basis of clinical features and management of lactose intolerance	K	KH				
BI3.4	**Define and differentiate the pathways of carbohydrate metabolism, (Glycolysis, gluconeogenesis, glycogen metabolism, HMP shunt).**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**General Medicine**	
Specific Learning Objectives							

	Describe the process of Glycolysis (aerobic and anaerobic) highlighting the significance, site, reactions, key steps, energetics, regulation and inhibitors	K	KH				
	Explain the substrate level phosphorylation reactions in glycolysis.	K	KH				
	Differentiate between aerobic and anaerobic glycolysis	K	KH				
	Explain Rapaport Leubering cycle and its significance	K	KH				
	List the cofactors required for Pyruvate dehydrogenase (PDH) reaction	K	K				
	Explain the significance, Site, reactions, key steps, energetics, regulation of Gluconeogenesis	K	KH				
	Explain the mechanism of transport of Lactate and Alanine from skeletal muscle to liver for gluconeogenesis	K	KH				
	Explain the role of adipose tissue in gluconeogenesis in prolonged fasting	K	KH				
	Explain the significance, Site, reactions, key steps, energetics, regulation of Glycogenesis	K	KH				
	Explain the significance, Site, reactions, key steps, energetics, regulation of Glycogenolysis	K	KH				
	Describe Glycogen storage disorders with enzyme defects and features	K	KH				
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Explain the significance of HMP shunt pathway	K	KH				
	Explain the significance of Uronic acid pathway	K	KH				
BI3.5	**Describe and discuss the regulation, functions and integration of carbohydrate along with associated diseases/disorders.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**General Medicine**	

BIOCHEMISTRY

Specific Learning Objectives (SLO)

Specific Learning Objectives							
	Discuss the regulation of glycolysis, gluconeogenesis in well fed and fasting conditions	K	KH				
	Discuss the regulation of glycogen metabolism in well fed and fasting conditions	K	KH				
	Describe the features of Glucose-6-Phosphate dehydrogenate deficiency	K	KH				
	Name the enzyme defect in Galactosemia and describe the clinical features	K	K				
	Name the enzyme defect and features of Essential Fructosuria, Hereditary fructose intolerance, Essential pentosuria	K	K				
BI3.6	**Describe and discuss the concept of TCA cycle as amphibolic pathway and its regulation.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**		
Specific Learning Objectives							
	Describe the sequential steps of Citric acid cycle with significance, site, key steps, energetics, regulation and inhibitors	K	KH				
	Explain the Amphibolic role of Citric acid cycle	K	KH				
	Explain the Anaplerotic reactions of Citric acid cycle	K	KH				

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/ SH/P	Suggested Teaching Learning method	Suggested Assessment method	Vertical integration	Horizontal Integration
BI3.7	**Describe the common poisons that inhibit crucial enzymes of carbohydrate metabolism(eg. fluoride, arsenate)**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**		**Physiology**

BIOCHEMISTRY

Specific Learning Objectives (SLO)

Specific Learning Objectives							
	Explain the action of inhibitors on glycolytic enzymes and their importance	K	KH				
	Explain the action of inhibitors on enzymes of citric acid cycle and their importance	K	KH				
BI3.8	**Discuss and interpret laboratory results of analytes associated with metabolism of carbohydrates.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**Pathology, General Medicine**	
Specific Learning Objectives							
	List the lab investigations done in Glycogen storage disorders, Galactosemia, Glucose-6-Phosphate dehydrogenase deficiency, Essential Fructosuria, Hereditary fructose intolerance	K	K				
	Interpret the lab investigations done in Glycogen storage disorders, Galactosemia, Glucose-6-Phosphate dehydrogenase deficiency, Essential Fructosuria, Hereditary fructose intolerance	K	KH				
BI3.9	**Discuss the mechanism and significance of blood glucose regulation in health and disease.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**General Medicine**	
Specific Learning Objectives							
	State the normal plasma glucose levels in fasting, post prandial and random samples and interpret the given reports	K	K				
	Explain the mechanism of regulation of blood glucose levels in well fed condition and fasting/starvation	K	KH				
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**

	Explain the importance of blood glucose regulation in normal healthy individual in well fed, overnight fasting and during exercise states	K	KH				
	Explain the derangements in blood glucose regulations in abnormal conditions of diabetes mellitus and starvation	K	KH				
	Explain various metabolic changes taking place in diabetes mellitus	K	KH				
	Describe the biochemical basis of acute complications of diabetes mellitus	K	KH				
	Describe the biochemical basis of chronic complications of diabetes mellitus	K	KH				
	Differentiate the hormonal regulation of blood glucose among obese and non obese individuals	K	KH				
BI3.10	**Interpret the results of blood glucose levels and other laboratory investigations related to disorders of carbohydrate metabolism.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**General Medicine**	
Specific Learning Objectives							
	State the normal plasma levels of glucose in fasting, postprandial and random conditions	K	K				
	Interpret the plasma glucose levels as hyperglycemia or hypoglycemia against normal biological reference intervals	K	KH				
	Explain diagnostic criteria of diabetes mellitus including WHO and ADA guidelines	K	KH				
	List the complications of diabetes mellitus including acute metabolic, microvascular and macrovascular complications	K	K				
	List the lab investigations done in diabetes mellitus and its relevance	K	K				

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Specific Learning Objectives (SLO)

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/ SH/P	Suggested Teaching Learning method	Suggested Assessment method	Vertical integration	Horizontal Integration
	Define oral glucose tolerance test and list the indications, contraindications and different types of GTT including classical, oral, intravenous, mini, clinical/physiological GTT	K	K				
	Explain the precautions advised to patients before GTT	K	KH				
	Interpret the oral GTT report against the recent recommendations of normal, impaired glucose tolerance (IGT), impaired fasting glucose (IFG) and diabetic levels	K	KH				
	Explain the rationale behind glycosylated haemoglobin as an indicator of control status of diabetes mellitus	K	KH				
	Mention the normal glycated Hb levels and interpret the given reports	K	K				
	Describe the importance of measuring serum insulin and c peptide in diabetic individuals	K	KH				
	Describe the importance of glycosuria among diabetic individuals	K	KH				
	Explain the importance of microalbuminuria among diabetic individuals	K	KH				
	Explain the derangement in lipid status among diabetes individuals	K	KH				
Topic: Chemistry and Metabolism of Lipids		**Number of competencies: (07)**			**Number of procedures that require certification: (NIL)**		
BI4.1	**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**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**General medicine**	
Specific Learning Objectives							

	Define lipids and explain the biomedical importance of lipids in the body	K	K				
	Classify lipids with examples	K	KH				
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Classify fatty acids with examples	K	KH				
	Mention the essential fatty acids and their significance in the body.	K	K				
	Explain the biological importance of MUFA and PUFA	K	KH				
	Describe the composition and importance of triacyglycerol	K	KH				
	Classify phospholipids, mention their composition and biological significance of the various phospholipids	K	KH				
	Explain the biochemical defect, clinical features and diagnosis of respiratory distress syndrome.	K	KH				
	Mention the Composition and importance of glycolipids	K	KH				
	Describe the Composition the biologically important products derived from cholesterol	K	KH				
BI4.2	**Describe the processes involved in digestion and absorption of Lipids and also the key features of their metabolism**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**General Medicine**	
Specific Learning Objectives							
	List the various dietary lipids	K	K				
	Mention the sites and describe the role of various enzymes, hormones and bile salts in lipid digestion	K	K				

	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 lymphatics and blood vessels	K	K				
	Define steatorrhea and explain the causes and biochemical diagnosis of steatorrhea						
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Mention the sites and outline the synthesis of triacylglycerol in the body	K	K				
	List the various lipases and explain their physiological and pathological importance	K	K				
	Describe the mobilisation of depot fat from adipose tissue and the factors regulating it.	K	KH				
	Describe the role of carnitine in fatty acid oxidation and explain why small and medium chain fatty acids can be oxidised in carnitine deficiency	K	KH				
	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 fatty acid oxidations	K	KH				
	Mention the metabolic defect and clinical effects associated with propionyl CoA carboxylase deficiency and methylmalonic aciduria , acyl CoA dehydrogenase, Translocase and Carnitine deficiency, Refsums' disease, Zellweger syndrome and organic acidurias	K	K				
	Outline the synthesis of palmitic acid in the body	K	KH				

	Mention the advantages of the fatty acid synthase complex in the body. Mention other multienzyme complexes.	K	K				
	Describe the desaturase and chain elongation system involved in fatty acid synthesis and explain why essential fatty acids cannot be synthesised by the body	K	KH				
	Differentiate between beta oxidation and synthesis of fatty acid	K	KH				
	Name the different ketone bodies and their importance.	K	K				
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Mention the organ/tissue and subcellular location of synthesis of ketone bodies; describe the synthesis of the 3 ketone bodies.	K	KH				
	Mention the organs that utilise ketone bodies and explain the steps involved in its utilisation and the key enzyme required.	K	K				
	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.	K	KH				
	Mention the biological importance of cholesterol in the body	K	K				
	Mention the organ/tissue and subcellur location and describe the step, enzymes involved in the synthesis of cholesterol (up to mevalonate in detail)	K	KH				
	Explain the significance of HMG CoA reductase in cholesterol synthesis and the effect of lipid lowering drugs.	K	KH				
	Differentiate between HMG CoA synthase, HMG CoA reductase and HMG CoA lyase enzymes	K	KH				

	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.	K	KH				
	Describe the formation vitamin D and steroid hormones from cholesterol	K	KH				
	Explain the formation bile acids (primary and secondary) and bile salts as the end product of cholesterol metabolism and its enterohepatic circulation.	K	KH				
	Describe the formation of pulmonary surfactant	K	KH				
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Mention the lipid storage disorders and the biochemical defect associated with it	K	KH				
	Define and describe Fatty liver and its pathological effects	K	K				
	Explain the effect of alcohol in development of fatty liver	K	KH				
	Differentiate between alcoholic fatty liver and non alcoholic steatohepatitis (NASH)	K	KH				
	Mention the lipoptropic factors and their role in fatty liver	K	K				
	Explain the significance, Site, reactions, key steps, energetics, regulation of Glycogenolysis	K	KH				
BI4.3	**Explain the regulation of lipoprotein metabolism and associated disorders**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**General Medicine**	

Specific Learning Objectives (SLO)

B14.4	**Describe the structure and functions of lipoproteins, their functions, interrelations and relations with atherosclerosis.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**General Medicine**	
Specific Learning Objectives							
	Describe the structure , composition and function of various Lipoproteins	K	KH				
	Classify the lipoproteins based on separation technique	K	KH				
	Describe the Formation and cellular uptake and the fate of Chylomicrons, VLDL, LDL and HDL.	K	KH				
	Explain the role of various apoliporoteins, CETP, LCAT, ACAT in the metabolism of lipoproteins	K	KH				
	Explain the role of lipoprotein lipase and the effect of Km on its tissue specific activity.	K	KH				
Number	**COMPETENCY The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Classify hyper and hypolipoproteinemias based on Frederickson's criteria, mention the biochemical defects associated and the laboratory findings	K	KH				
	Define Atherosclerosis – and explain the role of lipids in atherogenesis (OxLDL, Lpa, Small dense LDL, HDL)	K	KH				
	Mention the important markers of atherosclerosis	K	K				
BI4.5 BI 4.7	**Interpret the laboratory results of analytes associated with metabolism of lipids**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**General Medicine**	
Specific Learning Objectives							

	Explain the various components of a Lipid profile	K	KH				
	Mention the biological reference intervals of total cholesterol, HDL, VLDL and Triglycerides as per current applicable (NCEP) guidelines	K	K				
	Interpret the lipid profile and apolipoprotein analysis and arrive at the type of lipoprotein disorder.	K	KH				
	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)	K	K				

Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
BI4.6	**Describe the therapeutic uses of prostaglandins and inhibitors of eicosanoid synthesis**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**General Medicine**	
Specific Learning Objectives							
	Define Eicosanoids and differentiate prostaglandins, prostacyclins, thomboxanes and leukotrienes.	K	K				
	List the important Prostaglandins and their source in the body	K	K				
	Compare and contrast the biological actions of various prostaglandins	K	KH				
	Describe the therapeutic uses of prostaglandins in various conditions (Gastric ulcers, Bronchial asthma, hypertension, Induction of labour, PDA)	K	KH				

	Describe the of action of anti-inflammatory drugs on PG synthesis	K	KH				
	Mention the biological importance of thromboxanes and leukotrienes	K	KH				

Topic: Chemistry and Metabolism of Proteins		**Number of competencies: (05)**			**Number of procedures that require certification: (NIL)**		
BI5.1	**Describe and discuss structural organization of proteins.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**		
Specific Learning Objectives							
	Define amino acid	K	K				
	Classify amino acid based on structure with examples	K	KH				
	Classify amino acid based on special groups and metabolic fate with examples	K	KH				

Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Classify amino acid based on Nutritional with examples and List essential , semi essential amino acid	K	KH				
	Describe the relevance of Selenocysteine –the 21st amino acid	K	KH				
	Describe Isoelectric pH and its application	K	KH				
	List nonstandard amino acid with examples	K	K				
	Describe peptide bond and its role in protein formation	K	KH				
	Describe Structural organization of proteins	K	KH				

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Specific Learning Objectives (SLO)

	Describe primary, secondary, super secondary structures/ motifs, domains, tertiary and quaternary structures with appropriate examples. Describe Bonds stabilizing protein structure	K	KH				
	Describe process of denaturation and its application	K	KH				
	List method to determine primary, secondary, tertiary and quaternary structure` of protein	K	K				
BI5.2	**Describe and discuss functions of proteins and structure-function relationships in relevant areas e.g. hemoglobin and selected hemoglobinopathies**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**Pathology, General Medicine**	**Physiology**
Specific Learning Objectives							
	Classify the proteins based on functions (Structural, Hormonal, Catalytic, Transport with suitable examples)	K	KH				
	Classify plasma proteins and enumerate their function	K	KH				
	Describe specific functions and clinical significance of plasma proteins including Albumin,□, β and γ globulins.	K	KH				

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/ SH/P	Suggested Teaching Learning method	Suggested Assessment method	Vertical integration	Horizontal Integration
	Define an Acute phase reactant including positive and Negative function and enumerate their clinical significance.	K	KH				
	Describe primary structure of insulin and how it influences the function of a protein.	K	KH				
	Describe α helix and beta -Pleated sheet and how it influences the secondary organization of protein.	K	KH				

	Describe structure of myoglobin and how it influences the function al (three dimensional) organization of protein.	K	KH				
	Describe structure of hemoglobin and how it influences the quaternary organization of protein.	K	KH				
	Classify abnormal hemoglobin with respect to their alteration in structure and functions with examples.	K	KH				
	Describe hemoglobinopathies.	K	KH				
	Describe biochemical basis and genetics of sickle cell anaemia and explain the basis of its clinical features, investigations and principles of management.	K	KH				
	Describe biochemical basis and genetics of thalassemia and explain the basis of its clinical features investigations and principles of management.	K	KH				
	Differentiate between adult and fetal haemoglobin and Analyze the results of haemoglobin composition studies and use them to differentiate between the major hemoglobinopathies.	K	KH				

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/ SH/P	Suggested Teaching Learning method	Suggested Assessment method	Vertical integration	Horizontal Integration
BI5.3	**Describe the digestion and absorption of dietary proteins.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**Pediatrics**	
Specific Learning Objectives							
	List foodstuffs containing complete proteins.	K	K				

	Describe process of digestion that occurs in different part of human gastrointestinal tract.	K	KH				
	Enumerate the various proteolytic enzymes involved in the digestion of proteins.	K	KH				
	Describe the absorption of digested amino acids in to the cells.	K	KH				
	Describe the dynamics of the free amino acid pool.	K	KH				
	Discuss how the absorbed amino acids get transported in the circulatory system.	K	KH				
	Discuss how to treat diseases associated with protein digestion and absorption.	K	KH				
BI5.4	**Describe common disorders associated with protein metabolism.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**Pediatrics**	
Specific Learning Objectives							
	Describe the metabolic processes including Transamination, Deamination (Oxidative and nonoxidative) and their significance in degradation of proteins and amino acids.	K	KH				
	Describe Sources and fate of ammonia including Trapping, Transport and Disposal of ammonia.	K	KH				
	Explain the basis of ammonia toxicity with clinical significance.	K	KH				
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Describe Significance, Site, reactions, key steps, energetics, regulation, and associated disorders of Urea cycle.	K	KH				
	Discuss disorders of urea cycle with respect to defective enzyme, clinical features, and treatment.	K	KH				

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Specific Learning Objectives (SLO)

	Enumerate specialized products formed from Glycine and their importance.	K	K				
	Discuss biochemical basis of Metabolic disorders of Glycine, Glycinuria and Primary hyperoxaluria.	K	KH				
	Outline the metabolic (Catabolic and anabolic) pathway of Phenylalanine and Tyrosine and discuss the synthesis of catecholamines and other specialised products formed and their importance	K	KH				
	Explain metabolic enzyme defect, clinical features, laboratory investigations and basis of treatment in Phenylketonuria, Tyrosinemia and Alkaptonuria.	K	KH				
	Outline the metabolism (Catabolic and anabolic) of Tryptophan and discuss the synthesis of serotonin, melatonin and other specialised products formed and their importance	K	KH				
	Explain biochemical basis, clinical features and basis of treatment in Carcinoid syndrome and Hartnup's disease.	K	KH				
	Outline the metabolism of Sulphur containing amino acids cysteine and methionine including their functions, synthesis of SAM, SAH, and Homocysteine and enumerate importance of trans methylation.	K	KH				
	Discuss biochemical basis of Cystinuria, Homocystinuria, their clinical features and treatment.	K	KH				
	Outline the metabolism of branch chain amino acid and its importance	K	KH				
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Discuss Metabolic defects of branched chain amino acids their clinical features and treatment including Maple syrup urine disease (MSUD)	K	KH				

	Describe Formation of Nitric oxide and its therapeutic importance.	K	KH				
	Define Polyamines and enumerate their clinical importance with examples.	K	K				
	List important functions of and products formed from Histidine, Serine, Aspartate, Asparagine, glutamate, glutamine, serine, branched chain amino acids.	K	K				
	Outline one carbon metabolism and describe its significance.	K	KH				
BI5.5	**Interpret laboratory results of analytes associated with Metabolism of proteins**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**General Medicine**	
Specific Learning Objectives							
	Describe Inborn errors of metabolism of protein.	K	KH				
	Enumerate normal reference interval of blood urea and its importance in interpretation of kidney disease.	K	KH				
	Enumerate normal reference interval of ammonia and its importance in interpretation of urea cycle disorders and hepatic coma.	K	KH				
	Enumerate normal reference interval of phenyl alanine in blood and urine, its importance in laboratory diagnosis of PKU.	K	KH				
	Enumerate screening tests for PKU and Explain their significance including Guthrie test and ferric chloride test.	K	KH				
	Describe role of Paper and thin layer chromatographic in identification of Phenyl alanine, Tyrosine, Tryptophan, Glycine to detect inborn errors of aminoacids.	K	KH				
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**

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Specific Learning Objectives (SLO)

	Enumerate normal reference interval of Homocysteine and its importance in Homocystinuria, myocardial infarction, stroke and pulmonary embolism.	K	KH				
	Enumerate normal reference interval of dopamine, norepinephrine (noradrenaline), epinephrine (adrenaline) and significance of VMA in interpretation of Pheochromocytoma.	K	KH				
	Discuss excretion of 5-hydroxy indole acetate in urine in carcinoid syndrome and its interpretation in laboratory diagnosis.	K	KH				
	Enumerate normal reference interval of branch chain amino acids and its role in diagnosis of maple syrup urine disease.	K	KH				
	Enumerate techniques used to separate and identify amino acids and proteins including their principle including chromatography and electrophoresis.	K	KH				
	List Biological Reference range of serum total protein, albumin, total globulin, C reactive protein and enumerate the causes of their increased and decreased levels.	K	KH				
	Discuss approach to the Laboratory investigation of Multiple Myeloma.	K	KH				

Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**

Topic: Metabolism and homeostasis	**Number of competencies: (15)**	**Number of procedures that require certification: (NIL)**

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Specific Learning Objectives (SLO)

BI6.1	**Discuss the metabolic processes that take place in specific organs in the body in the fed and fasting states.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**General Medicine**	
Specific Learning Objectives							
	Describe metabolic adaptations/stages under well fed state, fasting and starvation	K	KH				
	Describe metabolic adaptations during re feeding after prolonged starvation	K	KH				
	Describe metabolic profile of brain, adipose tissue, skeletal muscle, cardiac muscle and liver during well fed state and fasting	K	KH				
	Explain relative changes of important parameters during starvation	K	KH				
	Describe effect of exercise on metabolic profile	K	KH				
	Explain feed fast cycle/starve feed cycle	K	KH				

Topic: Chemistry of Nucleic acids and Nucleotide metabolism							
BI6.2	**Describe and discuss the metabolic processes in which nucleotides are involved**	**K**	**KH**	**Lecture, Small group**	**Written/ Viva voce**		
Specific Learning Objectives							
	Name the Purines and Pyrimidines	K	K				
	Distinguish the chemical structure of the various Purines and Pyrimidines	K	KH				
	Explain the structure of nucleosides and Nucleotides	K	KH				
	List the properties of nitrogenous bases/ nucleosides /Nucleotides	K	K				
	Enumerate the functions of Nucleotides.	K	K				
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**

	Explain the importance of cAMP, cGMP, SAM, PAPS	K	KH				
	Enumerate the guanosine, uridine and cytidine derivatives and their function	K	K				
	Enumerate the synthetic nucleotide analogues and their therapeutic importance	K	K				
	Name the carbon and nitrogen sources in purine and pyrimidine ring	K	K				
	Explain purine Salvage pathways and its importance	K	KH				
	Explain pyrimidine Salvage pathways and its importance	K	KH				
	Describe the degradation pathway of Purine nucleotides	K	KH				
	State the reference range of serum and urinary uric acid	K	K				
	Enumerate the end products of pyrimidine catabolism and their significance	K	K				
BI6.3	**Describe the common disorders associated with nucleotide metabolism.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**		**Physiology**
Specific Learning Objectives							
	Discuss the, manifestation and biochemical basis of Lesch Nyhan syndrome.	K	KH				
	Classify Gout and enumerate the causes of Gout	K	KH				
	Discuss the biochemical basis for severe combined immunodeficiency disorder	K	KH				
BI6.4	**Discuss the laboratory results of analytes associated with gout & Lesch Nyhan syndrome**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**General Medicine**	
Specific Learning Objectives							
	State the reference range of serum and urinary uric acid in male and female	K	K				

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Specific Learning Objectives (SLO)

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/ SH/P	Suggested Teaching Learning method	Suggested Assessment method	Vertical integration	Horizontal Integration
	State the normal urate pool and its daily turnover	K	K				
	Define Hyperuricemia and enumerate its causes	K	K				
	Interpret the laboratory results of a patient suspected with gouty arthritis	K	KH				
Topic: Vitamins							
BI6.5	**Describe the biochemical role of vitamins in the body and explain the manifestations of their deficiency**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**General Medicine**	
Specific Learning Objectives							
	Define the role of vitamins in health and disease	K	K				
	Classify vitamins and enumerate all the vitamins in each class	K	KH				
	Differentiate the characteristics of water soluble and fat soluble vitamins	K	KH				
	Describe the structure and chemistry of vitamers of vitamin A and provitamin A	K	KH				
	List the sources of Vitamin A and beta carotene and RDA of vitamin A in adults and children	K	K				
	Discuss the digestion, transport and storage of vitamin A	K	KH				
	Enumerate the functions of different vitamers of vitamin A	K	K				
	Describe the events of Wald's visual cycle with the help of a neat labeled diagram	K	KH				
	Discuss the different stages of deficiency manifestations of vitamin A	K	KH				
	State the common manifestations of hypervitaminosis A	K	K				

	Enumerate the therapeutic uses of vitamin A	K	K				
	State the provitamin forms of vitamin D	K	K				
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	List the sources of Vitamin D and RDA of vitamin D in adults and children	K	K				
	Discuss the synthesis of vitamin D and its conversion to its active form Calcitriol accurately	K	KH				
	Enumerate the reasons to justify Vitamin D is a hormone	K	K				
	Discuss the role of Calcitriol on calcium and phosphorus metabolism with reference to mineralization of bones	K	KH				
	Name the deficiency disorder of Vitamin D in children and adults	K	K				
	Discuss the causes and deficiency manifestation of Rickets	K	KH				
	Define renal rickets, vitamin D dependent rickets and Hypophosphatemic rickets	K	KH				
	Enumerate the extra skeletal functions of calcitriol	K	K				
	Name the structure and different forms of vitamin E	K	K				
	Discuss the role of alpha tocopherol as an antioxidant with special reference to its role as chain breaking antioxidant in lipid peroxidation	K	KH				
	Describe the biochemical functions of Vitamin E	K	KH				
	List the rich and moderate sources and RDA of Vitamin E	K	K				
	Describe the deficiency manifestation of Vitamin E	K	KH				
	Name the structure and different forms vitamin K	K	K				
	List the rich and moderate sources and RDA of vitamin K	K	K				
	Describe the biochemical functions of vitamin K	K	KH				

	Describe the deficiency manifestation of vitamin K	K	KH				
	Enumerate the common manifestations of Hypervitaminosis K	K	K				
	Name the ring structure and coenzymes Thiamine	K	K				
	List the rich and moderate sources and RDA of Thiamine	K	K				
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Describe the major biochemical functions of Thiamine	K	KH				
	Relate the function of TPP with carbohydrate metabolism	K	KH				
	Describe the deficiency manifestation of Thiamine	K	KH				
	Classify and distinguish the different types of Berberi accurately	K	KH				
	Enumerate the antagonists of Thiamine	K	K				
	Name the ring structure and coenzymes of Riboflavin	K	K				
	Illustrate the formation of FMN and FAD	K	KH				
	List the common sources and RDA of Riboflavin	K	K				
	Describe the major biochemical functions of Riboflavin giving examples of different metabolic reactions in which FMN and FAD participate	K	KH				
	Describe the deficiency manifestation of Riboflavin	K	KH				
	Enumerate the antagonists of Riboflavin	K	K				
	Name the ring structure and coenzymes of Niacin	K	K				
	Illustrate the formation of NAD^+ and $NADP^+$	K	KH				
	List the common sources and RDA of Niacin	K	K				
	Describe the biochemical functions of Niacin coenzyme NAD^+/NADH giving an example each in carbohydrate, lipid and amino acid metabolism	K	KH				

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Specific Learning Objectives (SLO)

	State at least two reactions each of generation and utilization of $NADP^+$ and NADPH respectively	K	K				
	Enumerate the causes of Niacin deficiency	K	K				
	Describe the deficiency manifestation of Niacin	K	KH				
	Enumerate the Therapeutic uses and toxicity of Niacin	K	K				
	Name the components of Pantothenic acid structure	K	K				
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Enumerate the Coenzyme derivatives of pantothenic acid	K	K				
	Discuss the importance of acetyl CoA and Succinyl CoA pool	K	KH				
	State the sources, RDA and deficiency manifestations of pantothenic acid	K	K				
	Name the ring structure and different forms and coenzyme of Pyridoxine	K	K				
	List the common sources and RDA of Pyridoxine	K	K				
	Describe the biochemical functions of Pyridoxine with special reference to role of PLP in amino acid metabolism	K	KH				
	Describe the deficiency manifestation, therapeutic uses and toxicity manifestations of Pyridoxine	K	KH				
	Name the components in structure of Biotin	K	K				
	List the common sources and RDA of Biotin	K	K				
	Describe the biochemical functions of Biotin	K	KH				
	Mention the biotin independent reactions	K	KH				
	State the deficiency manifestations of Biotin	K	K				
	State the role of Avidin - Biotin in clinical assays	K	K				

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Specific Learning Objectives (SLO)

	Mention the components in structure of Folic acid	K	K				
	Illustrate the formation of THF	K	KH				
	List the common sources and RDA of Folic acid	K	K				
	Discuss the role of folic acid in one carbon metabolism	K	KH				
	Describe the deficiency manifestation of Folic acid	K	KH				
	List the tests to assess the Folic acid deficiency status	K	K				
	Enumerate the antifolate drugs and their therapeutic uses	K	K				

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/ SH/P	Suggested Teaching Learning method	Suggested Assessment method	Vertical integration	Horizontal Integration
	Name the ring structure with its components and co enzyme form of vitamin B12	K	K				
	List the common sources and RDA of Vitamin B12	K	K				
	Discuss the digestion and absorption of Vitamin B12 emphasizing the role of intrinsic factor of castle	K	KH				
	Describe the functions of Vitamin B12 stating the reaction in which methyl and adenosyl cobalamin participate	K	KH				
	Describe the biochemical basis and deficiency manifestation of Vitamin B12 and tests to assess the Vitamin B12 deficiency status	K	KH				
	Discuss the chemistry of vitamin C	K	KH				
	List the common sources and RDA of vitamin C	K	KH				
	Enumerate the biochemical functions of vitamin C	K	K				
	Describe the deficiency manifestation of vitamin C	K	KH				
	Enumerate the therapeutic uses of vitamin C	K	K				

	Enumerate the vitamin like substances and mention their structure and function	K	K				

Topic: Biological oxidation							
BI6.6	**Describe the biochemical processes involved in generation of energy in cells.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**		
Specific Learning Objectives							
	Define primary, secondary/intermediary and tertiary metabolism/internal respiration/cellular respiration	K	K				
	Define substrate level and oxidative phosphorylation and enumerate its sites and examples.	K	K				
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Define high energy compounds and enumerate its examples	K	K				
	Describe the organization, components and flow of electrons in electron transport chain	K	KH				
	Explain the chemiosmotic theory	K	KH				
	Describe the Binding change mechanism of ATP synthesis by ATP synthase	K	KH				
	Explain the regulation of ATP synthesis by oxidative phosphorylation	K	KH				
	Enumerate the inhibitors of electron transport chain and oxidative phosphorylation	K	K				
	Define uncouplers and enumerate its examples	K	K				
	Describe the role of brown adipose tissue in thermogenesis	K	KH				

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Specific Learning Objectives (SLO)

Topic: Acid base balance, Water and electrolyte balance							
BI6.7	**Describe the processes involved in maintenance of normal pH, water &electrolyte balance of body fluids and the derangements associated with these.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**General Medicine**	**Physiology**
Specific Learning Objectives							
	Enumerate the functions of water	K	K				
	Outline the distribution of water in various body compartments	K	KH				
	Explain the principles of water balance by considering water input sources and water output process	K	KH				
	Explain the various regulatory mechanisms by which water balance is maintained	K	KH				
	Illustrate the distribution of electrolytes in various body compartments	K	KH				

Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	State the serum reference range for measured electrolytes; sodium, potassium, chloride and bicarbonate	K	K				
	Describe the concepts of osmolality, plasma osmolality and effective osmolality	K	KH				
	Describe the hormonal regulation of water and electrolyte balance	K	KH				
	Discuss the role of Renin – Angiotensin system in regulation of water and electrolyte balance	K	KH				
	Discuss the causes, pathophysiology and biochemical alterations in conditions of dehydration and over hydration	K	KH				
	Explain the composition and basis of dehydration management with ORS	K	KH				

	Discuss briefly the causes, pathophysiology and manifestations of dehydration	K	KH				
	Define acids and bases	K	K				
	Derive Henderson Hasselbalch's equation and discuss its importance	K	KH				
	Define buffer, buffering capacity and its significance	K	K				
	Classify buffers in the body and plasma	K	KH				
	Explain role and mechanism of bicarbonate buffer system in maintenance of pH	K	KH				
	Explain the role of phosphate buffer system and protein buffer system in maintenance of pH	K	KH				
	Explain the role of respiratory system in maintaining acid balance	K	KH				
	Explain the isohydric transport of CO2 in blood	K	KH				
	Highlight the importance of renal system in maintaining acid balance	K	KH				

Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Discuss the key mechanisms by which kidneys help in maintaining acid base balance	K	KH				
	Define titrable acidity	K	K				
	Highlight the importance of glutaminase and ammonia in buffering acid base balance.	K	KH				
	Classify acid base disorders based on the metabolic/ respiratory component and pH	K	KH				
	Describe the causes, pathophysiology and compensatory mechanisms in metabolic acidosis	K	KH				

	Define Anion gap and write its reference range	K	K				
	Classify metabolic acidosis based on anion gap giving at least three causes in each type	K	KH				
	Describe the causes, pathophysiology and compensatory mechanisms in metabolic Alkalosis	K	KH				
	Classify metabolic alkalosis based on urinary chloride levels	K	KH				
	Recognize the relationship between serum potassium and metabolic Alkalosis	K	KH				
	Describe the causes, pathophysiology and compensatory mechanisms in Respiratory acidosis	K	KH				
	Describe the causes, pathophysiology and compensatory mechanisms in Respiratory alkalosis	K	KH				
	Define acids and bases	K	K				
	Derive Henderson Hasselbalch's equation and discuss its importance	K	KH				

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/ SH/P	Suggested Teaching Learning method	Suggested Assessment method	Vertical integration	Horizontal Integration
BI6.8	**Discuss and interpret results of Arterial Blood Gas (ABG) analysis in various disorders**	**K**	**KH**	**Lecture, Small group discussion,**	**Written/ Viva voce**	**General Medicine**	
Specific Learning Objectives							
	Discuss the role of Arterial Blood Gas (ABG) analysis in diagnosing various acid base disorders / Explain the application of ABG analysis in clinical practice	K	KH				
	Interpret results of Arterial Blood Gas (ABG) analysis data in the given cases	K	KH				

Topic: Minerals							
BI6.9	**Describe the functions of various minerals in the body, their metabolism and homeostasis**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**General Medicine**	**Physiology**
Specific Learning Objectives							
	Define major minerals and micro minerals	K	K				
	Enumerate RDA, dietary sources, functions, biological reference interval of calcium and phosphorus	K	K				
	Explain distribution in the body, transport across cells, absorption and regulation of metabolism of calcium and phosphorus	K	KH				
	Enumerate RDA, dietary sources, functions, proteins containing iron in the body, transport and storage forms of iron	K	K				
	Explain distribution in the body, transport across cells, absorption, mucosal block theory of iron absorption and regulation of metabolism of iron	K	KH				
	Enumerate functions, proteins containing and dietary sources of Copper, Zinc, Selenium, Magnesium and other trace elements like,	K	K				
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	iodine, nickel, molybdenum and chromium.						
	Enumerate functions, dietary sources, RDA and biological reference interval of sodium, potassium and chloride.	K	K				
BI6.10	**Enumerate and describe the disorders associated with mineral metabolism**	**K**	**KH**	**Lecture, case discussion**	**Written/ Viva voce**	**General Medicine**	
Specific Learning Objectives							

	Enumerate the signs and symptoms, laboratory investigations and disorders associated with metabolism of calcium, phosphorus, iron, sodium and chloride	K	K				
	Describe the biochemical basis of signs and symptoms of disorders associated with metabolism of calcium, phosphorus, ,iron, sodium and chloride	K	KH				
	Interpret the mineral status of calcium, phosphorus, ,iron, sodium and chloride in normal people and in associated disorders using laboratory investigations	K	KH				
	Enumerate the disorders associated with Copper, Zinc, Selenium, Magnesium & other trace elements like, iodine, nickel, molybdenum and chromium	K	K				

Topic: Haem metabolism							
BI6.11	**Describe the functions of haem in the body and describe the processes involved in its metabolism and describe porphyrin metabolism**	**K**	**KH**	**Lecture, case discussion**	**Written/Viva voce**	**Pathology, General Medicine**	**Physiology**
Specific Learning Objectives							
	List the function of haem and haem containing compounds.	K	K				
	Describe the biosynthesis and regulation of haem synthesis	K	KH				
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Enumerate and classify disorders of haem metabolism, associated porphyrias and the respective enzyme defects	K	K				
	Describe the associated features and diagnosis of porphyria(Hereditary porphyria and acquired porphyria)	K	KH				

Specific Learning Objectives (SLO)

	Describe catabolism of heam including generation of bilirubin, transport to liver, and conjugation in liver, excretion of bilirubin in bile and enterohepatic circulation.	K	KH				
BI6.12	**Describe the major types of haemoglobin and its derivatives found in the body and their physiological/ pathological relevance.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/Viva voce**	**Pathology, General Medicine**	**Physiology**
Specific Learning Objectives							
	Describe the structure of hemoglobin including assembly of Polypeptide chain and explain the structure function relation ships	K	KH				
	List the Function of hemoglobin	K	K				
	Explain Transport of oxygen, carbon dioxide and protons by haemoglobin, Bohr effect and Role of 2, 3 BPG.	K	KH				
	Enumerate major types of haemoglobin and their normal levels in blood of adults, neonates and children including Hb A, HbA_2,HbF and others	K	K				
	Describe the difference in polypeptide composition of Hb A, HbA_2 and HbF	K	KH				
	Enumerate Normal & Abnormal hemoglobin derivatives	K	K				
	Explain what are carboxyhaemoglobin, methemoglobin, sulfhaemoglobin and glycated haemoglobin and their clinical relevance	K	KH				
	Describe the genesis and molecular pathology of hemoglobinopathies and thalassemias.	K	KH				

Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Enumerate the sickle cell anemia, thalassemia and other hemoglobin variants	K	K				

	Explain the pathohysiology and laboratory diagnosis of thalassemia and hemoglobinopathies	K	KH				
	Define and classify anemia	K	K				
	Enumerate the functions of myoglobin	K	K				

Topic: Organ function tests							
BI6.13	**Describe the function of the kidney, liver, thyroid and adrenal glands**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**Pathology, General Medicine**	**Physiology, Human Anatomy**
Specific Learning Objectives							
	Enumerate functions of kidney, liver, thyroid and adrenal glands	K	K				
	Describe the role of kidney in excretion of metabolic wastes, maintaining water and electrolyte balance, activation of Vitamin D and synthesis of erythropoietin	K	KH				
	Define GFR- Glomerular filtration rate	K	K				
	Explain the role of glomerular filtration barrier in urine formation	K	KH				
	Describe role of liver in biochemical functions, including synthesis of plasma proteins, cholesterol, triacyl glycerol and lipoprotein synthesis	K	KH				
	Describe role of liver in metabolism involving carbohydrates, ketogenesis, protein catabolism and TCA cycle, storage of fat soluble vitamins.	K	KH				
	Describe role of liver in detoxification including ammonia, bilirubin, cholesterol, and drug metabolites	K	KH				

Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**

	Explain synthesis, regulation and secretion of thyroid hormones using hypothalamo-hypophysial-thyroid axis.	K	KH				
	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	K	KH				
	Explain synthesis, secretion, transport and metabolism of adrenal cortical hormones and adrenal medullary hormones	K	KH				
	Describe Biological effects of Adrenal hormones including glucocorticoids, gonadal hormones and catecholamines as neurotransmitters	K	KH				
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)**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**General Medicine Pathology**	**Physiology Human Anatomy**
Specific Learning Objectives							
	Classify renal function tests, liver function tests, thyroid function tests and adrenal function tests	K	KH				
	Enumerate the physical properties, normal and abnormal constituents of urine	K	K				
	Enumerate the tests performed to assess the physical properties, normal and abnormal constituents of urine	K	K				
	Define clearance and renal threshold	K	K				
	Classify clearance tests	K	KH				
	Explain the relationship of GFR with clearance	K	KH				

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Specific Learning Objectives (SLO)

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/ SH/P	Suggested Teaching Learning method	Suggested Assessment method	Vertical integration	Horizontal Integration
	Describe the procedure of clearance test and formulae to calculate clearance (endogenous creatinine/urea clearance test, inulin clearance test)	K	KH				
	Enumerate the advantages and disadvantages of clearance tests (endogenous creatinine/urea clearance test, inulin clearance test)	K	K				
	Explain the role of cystatin C as glomerular filtration marker	K	KH				
	Enumerate the markers of glomerular permeability	K	K				
	Enumerate tubular function tests and describe their procedure (specific gravity, measurement of osmolality, concentration test, dilution test, urinary acidification test)	K	KH				
	Enumerate the immunological tests in renal disease	K	K				
	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, alpha1antitrypsin in diagnosis of liver diseases.	K	KH				
	Enumerate the markers of excretory function, liver injury, cholestasis, chronic liver disease.	K	KH				
	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.	K	KH				

	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.	K	KH				

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/ SH/P	Suggested Teaching Learning method	Suggested Assessment method	Vertical integration	Horizontal Integration
BI6.15	**Describe the abnormalities of kidney, liver, thyroid and adrenal glands**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**General Medicine Pathology**	**Physiology Human Anatomy**
Specific Learning Objectives							
	Define and enumerate the causes of uremia, azotemia, polyuria, oliguria, anuria, isosthenuria, hematuria, hemoglobinuria, proteinuria, microalbuminuria, glycosuria and explain their clinical relevance	K	K				
	Define acute renal failure and chronic renal failure	K	K				
	Explain the grading of chronic kidney disease based on GFR	K	KH				
	Describe the salient clinical features of nephritic syndrome and nephritic syndrome	K	KH				
	Enumerate different types of renal stones and their cause	K	K				
	Define, classify and enumerate salient features and laboratory investigations of jaundice	K	K				
	Differentiate prehepatic, hepatic and post hepatic jaundice using salient features and laboratory investigations	K	KH				
	Enumerate the causes of congenital and acquired hyperbilirubinemia	K	K				

	Enumerate the salient features of hepatitis, cholestasis, cirrhosis of liver, alcoholic liver disease, non alcoholic fatty liver disease, Reye syndrome.	K	K				
	Enumerate the causes and explain the salient features of primary and secondary causes of hyperthyroidism, hypothyroidism	K	KH				
	Enumerate the causes and explain the salient features of Adrenal gland-dysfunction including Cushing's disease, Addison's disease, Conn's syndrome, pheochromocytoma.	K	KH				

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/ SH/P	Suggested Teaching Learning method	Suggested Assessment method	Vertical integration	Horizontal Integration
Topic: Molecular biology		**Number of competencies: (07)**			**Number of procedures that require certification: (NIL)**		
BI7.1	**Describe the structure and functions of DNA and RNA and outline the cell cycle.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**		
Specific Learning Objectives							
	Enumerate the functions of DNA	K	K				
	Describe the structure of Watson and Crick model of DNA with the help of a neat labelled diagram	K	KH				
	Enumerate different forms of DNA and their differences	K	K				
	Define Tm or melting temperature of DNA	K	K				
	Enumerate the difference between DNA and RNA	K	K				
	Illustrate cell cycle with the help of a neat labelled diagram	K	KH				
	Recognize the phase where replication occurs in cell cycle	K	KH				
	Describe the structure and function of mRNA	K	KH				

	Describe the function structure of tRNA with the help of a neat labelled diagram	K	KH				
	Compare and Contrast the difference between prokaryotic and eukaryotic ribosomes	K	KH				
BI7.2	**Describe the processes involved in replication & repair of DNA and the transcription & translation mechanisms**	**K**	**KH**	**Lecture, Small group**	**Lecture, Small group**		
Specific Learning Objectives							
	Define Replication	K	K				
	Enumerate at least four salient features of Replication	K	K				
	Discuss the role of various proteins in DNA replication process	K	KH				
	Describe the replication process in prokaryotes with the help of a neat	K	KH				

Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	labelled diagram						
	Illustrate the Okazaki fragment formation with the help of a neat labelled diagram	K	KH				
	Enumerate the different types and functions of eukaryotic DNA Polymerases	K	K				
	Discuss replication Process in Eukaryotes with the help of a neat labelled diagram	K	KH				
	Enumerate at least three inhibitors in each of prokaryotic and eukaryotic replication process	K	K				
	Highlight the importance of Telomerase in health and disease condition	K	KH				
	List the DNA repair mechanisms	K	K				
	Discuss Mismatch repair mechanism with the help of a neat labelled diagram and its significance	K	KH				

	Discuss base excision repair mechanism with the help of a neat labelled diagram and its significance	K	KH				
	Discuss Nucleotide repair mechanism with the help of a neat labelled diagram and its significance	K	KH				
	Define Transcription	K	K				
	Enumerate the similarities and differences between Replication and Transcription	K	K				
	Discuss the DNA templates and prokaryotic enzyme for Transcription process	K	KH				
	Discuss the importance of Promoter region in initiation and regulation of transcription process	K	KH				

Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Describe transcription in Prokaryotes with the help of a neat labelled diagram.	K	KH				
	Enumerate the differences between prokaryotic and eukaryotic Transcription	K	K				
	Discuss Transcription process in Eukaryotes with the help of a neat labelled diagram.	K	KH				
	Discuss the posttranscriptional modifications in hnRNA with the help of a neat labelled diagram.	K	KH				
	Discuss the post transcriptional modifications in, tRNA with the help of a neat labelled diagram.	K	KH				
	Discuss the post transcriptional modifications in rRNA	K	KH				
	State the role of Ribozymes giving at least two examples	K	K				

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Specific Learning Objectives (SLO)

	Discuss the role of reverse transcriptase in synthesis of cDNA.	K	KH				
	Enumerate the inhibitors of transcription process in prokaryotes and eukaryotes and state their significance	K	K				
	Define codon	K	K				
	Discuss the organization of genetic code	K	KH				
	Name the initiator and terminator codons	K	K				
	Discuss the characteristic features of Genetic Code	K	KH				
	Define translation process	K	K				
	Enumerate all the requirements of protein biosynthesis	K	K				
	Illustrate the formation of charged tRNA	K	KH				
	Discuss the initiation of protein biosynthesis with the help of a neat labelled diagram.	K	KH				

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/ SH/P	Suggested Teaching Learning method	Suggested Assessment method	Vertical integration	Horizontal Integration
	Describe the elongation step of protein biosynthesis with the help of a neat labelled diagram.	K	KH				
	Describe the termination step of protein biosynthesis with the help of a neat labelled diagram.	K	KH				
	Discuss the mechanism of inhibitors of protein biosynthesis in both prokaryotes and eukaryotes	K	KH				
	Define and state the importance of polysomes	K	K				
	Discuss the common mechanisms of protein targeting to various destination and associated disorder with example of I cell disease and others.	K	KH				

	Discuss the co and post translational modifications in protein biosynthesis process	K	KH				
	Describe briefly Protein folding mechanism and role of Chaperones and Heat shock proteins and associated disorders Alzheimer's disease, Prion diseases	K	KH				
	Discuss briefly mitochondrial DNA, genes and related disorders	K	KH				
BI7.3	**Describe gene mutations and basic mechanism of regulation of gene expression**	**K**	**KH**	**Lecture, Small group**	**Lecture, Small group**	**Pediatrics**	
Specific Learning Objectives							
	Observe the estimation of SGOT, SGPT and ALP and interpret the results in given sample accurately	K	KH				
	Define Mutation	K	K				
	Classify point mutations based on the type of nucleotide altered	K	KH				
	Categorize point mutations based on consequence citing examples	K	KH				
	Explain the frameshift mutations and its consequences in protein biosynthesis	K	KH				
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	State the importance of regulation of gene expression	K	K				
	Discuss the types of gene regulation in prokaryotes	K	KH				
	Explain the gene expression in Prokaryotes giving example of Lac Operon	K	KH				
	Explain the concept of intron, exon, cistron and Gene	K	KH				
	Enumerate at least four types of gene regulation in Eukaryotes	K	KH				
	Explain briefly the role of transcriptional activators and coregulators.	K	KH				

	Explain the gene amplification mechanism in regulation of gene expression in Eukaryotes	K	KH				
	Illustrate gene rearrangement mechanism in Antibody synthesis	K	KH				
	Discuss briefly gene regulation at RNA level	K	KH				
	Explain gene silencing by RNA interference (RNAi) in regulation of gene expression	K	KH				
	Highlight the concepts of epigenetics in regulation of gene expression	K	KH				
	Briefly explain the concepts of Concept of Genomics, proteomics and metabolomics	K	KH				

Topic: 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.**	**K**	**KH**	**Lecture, case discussion**	**Written/Viva voce**	**Pediatrics, General Medicine**	
Specific Learning Objectives							
	Define Recombinant DNA technology	K	K				
	Define Hybrid / chimeric/ Recombinant DNA	K	K				
	Discuss on Restriction Endonucleases and their role in recombinant DNA technology	K	KH				
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	List and Explain the role of vectors in recombinant DNA technology	K	KH				
	Explain plasmids and their role in recombinant DNA technology	K	KH				
	Enumerate the host cells and process of DNA transfer into host cells in recombinant DNA technology	K	KH				

	Explain the process of recombinant DNA technology using plasmid as vector	K	KH				
	Discuss the construction of Genomic Library and its clinical significance	K	KH				
	Explain the formation of cDNA and construction of cDNA library	K	KH				
	Define and illustrate the role of DNA Probes	K	K				
	Enumerate the applications of Recombinant DNA technology emphasizing on its application in field of Medicine	K	KH				
	Define and discuss the process of Polymerase Chain Reaction	K	K				
	Enumerate the applications of Polymerase Chain Reaction	K	K				
	Explain Southern Blot technique and state its applications	K	KH				
	State the importance of Northern blot technique	K	K				
	State the importance of Western blot technique	K	K				
	Explain briefly DNA microarray technique and its applications	K	KH				
	Enumerate the DNA markers; SNP, VNTRs, RFLP and state their importance	K	K				
	State the importance of RFLP and write any two of its applications	K	K				
	Explain the basis of DNA fingerprinting/DNA Profiling with the help of neat labelled diagram.	K	KH				
	Define and classify gene therapy	K	K				
	Explain the vectors used in gene therapy	K	KH				

Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Discuss the process of gene therapy giving example of gene therapy in SCID	K	KH				

	Discuss role of gene therapy in cancer treatment	K	KH				
	Discuss the therapeutic role of RNAi (RNA interference) / Antigene and Antisense therapy in cancer treatment	K	KH				
	Give an overview of Human Genome Project (HGP)	K	KH				

Topic: Xenobiotics and Detoxification							
BI 7.5	**Describe the role of xenobiotics in disease**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**		
Specific Learning Objectives							
	Define xenobiotics and biotransformation	K	K				
	List the common xenobiotics	K	K				
	Mention the biological damage caused by xenobiotics (e.g.: mutagenic, carcinogenic, allergenic)and the disease associated (Ex Cancer, teratogenic condition due to exposure to pesticides)	K	K				
	Describe the phase 1 and phase 2 reactions involved in the metabolism of xenobiotics	K	KH				
	Explain other detoxification reactions such as reduction, hydrolysis, acetylation, methylation and reduction other detoxification reactions	K	KH				
	Explain the significance of cytochromes in detoxification	K	KH				
	Describe the metabolic consequences of alcoholism	K	KH				

Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
Topic: Free Radicals and Antioxidants							

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Specific Learning Objectives (SLO)

BI7.6	**Describe the anti-oxidant defence systems in the body.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**		
Specific Learning Objectives							
	Define Antioxidants	K	K				
	Classify antioxidants	K	KH				
	Explain enzymatic antioxidants and their significance	K	KH				
	Explain the role of Vitamin E as an antioxidant	K	KH				
	Explain the importance of Nutrient and Metabolic antioxidants	K	KH				
BI7.7	**Describe the role of oxidative stress in the pathogenesis of conditions such as cancer, complications of diabetes mellitus and atherosclerosis**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**General Medicine, Pathology**	
Specific Learning Objectives							
	Define Free Radicals and Reactive Oxygen Species (ROS) and list the different types of free radicals	K	K				
	Explain the different reactions and mechanisms involved in production of free radicals	K	KH				
	Explain the free radical damage to various biomolecules with special reference to lipid peroxidation	K	KH				
	Discuss the role of oxidative stress in pathogenesis of inflammatory disorders , respiratory disorders and cataract	K	KH				
	Describe the role of oxidative stress in the pathogenesis of cancer	K	KH				
	Describe the role of oxidative stress in the pathogenesis of complications of diabetes mellitus	K	KH				
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**

	Describe the role of oxidative stress in the pathogenesis of atherosclerosis	K	KH				
	Mention the test to measure oxidative stress in serum	K	K				

Topic: Nutrition	**Number of competencies: (05)**			**Number of procedures that require certification: (NIL)**			
BI8.1	**Discuss the importance of various dietary components and explain importance of dietary fibre.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**General Medicine, Pediatrics, Pathology**	
Specific Learning Objectives							
	List the important dietary components of food	K	K				
	Define calorific value of food and list the calorific value of carbohydrate , protein and fat	K	K				
	List the sources, recommended daily intake and types of dietary carbohydrates	K	K				
	Discuss about the major dietary polysaccharide and cane sugar with their clinical importance	K	KH				
	Define dietary fibre and their requirement per day and list the dietary fibres with examples	K	K				
	Enumerate the physiological effect of dietary fibre and their clinical importance	K	K				
	List the sources, different types of dietary fat and recommended daily intake	K	K				

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Specific Learning Objectives (SLO)

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/ SH/P	Suggested Teaching Learning method	Suggested Assessment method	Vertical integration	Horizontal Integration
	List the different sources of cholesterol and the clinical importance of cholesterol	K	K				
	Discuss about polyunsaturated fatty acids, essential fatty acids	K	KH				
	List the sources of dietary protein and recommended daily intake of protein	K	K				
	Discuss about essential amino acids	K	KH				
	Define nitrogen balance and enumerate their types	K	K				
	Enumerate the factors affecting nitrogen balance	K	K				
	List the indices used to assess the nutritional value of protein and add a note on amino acid score	K	K				
	Discuss about limiting amino acid and mutual supplementation	K	KH				
BI8.2	**Describe the types and causes of protein energy malnutrition and its effects**	**K**	**KH**	**Lecture, case discussion**	**Written/ Viva voce**	**General Medicine, Pediatrics, Pathology**	
Specific Learning Objectives							
	Classify protein energy malnutrition	K	K				
	Enumerate the causes for protein energy malnutrition	K	K				
	Describe aetiology, clinical features, investigation and treatment of kwashiorkor and add a note on biochemical mechanism underlying the disease	K	KH				

	Describe aetiology, clinical features, investigation and treatment of marasmus and add a note on biochemical mechanism underlying the disease	K	KH				
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Differentiate between kwashiorkor and marasmus	K	KH				
	Discuss marasmic kwashiorkor and its sequelae	K	KH				
	Discuss about treatment of protein energy malnutrition	K	KH				
	Define and list the causes of cachexia due to diseases	K	K				
BI8.3	**Provide dietary advice for optimal health in childhood and adult, in disease conditions like diabetes mellitus, coronary artery disease and in pregnancy**	**K**	**KH**	**Lecture, case discussion**	**Written/ Viva voce**	**General Medicine**	
Specific Learning Objectives							
	Define respiratory quotient and list the RQ of carbohydrate, fat, protein and mixed diet.	K	K				
	Define Basal Metabolic Rate , list the factors affecting BMR, different types of measurements of BMR and normal value of BMR	K	K				
	Describe Specific Dynamic Action (SDA)	K	KH				
	List the different types of physical activity and add a note on energy requirement of different physical activity	K	K				
	List the components of balanced diet	K	K				
	Discuss about food guide pyramid	K	KH				
	Discuss the general principles of prescribing a diet based on body weight, protein requirement, calorie requirement and SDA and importance of prescribing a diet	K	KH				

	Describe the different steps of prescribing the diet for a 60kg sedentary man	K	KH				
	Describe glycemic index with reference meal as 50gram of glucose and list the glycemic index of common foods	K	KH				
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	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	K	KH				
	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	K	KH				
	Describe the different steps of prescribing the diet for pregnant	K	KH				
	Discuss about total parenteral nutrition	K	KH				
BI8.4	**Describe the causes (including dietary habits), effects and health risks associated with being overweight/ obesity**	**K**	**KH**	**Lecture, case discussion**	**Written/ Viva voce**	**General Medicine, Pathology**	
Specific Learning Objectives							
	Define obesity with respect to body mass index (BMI)	K	K				
	List the causes for overweight and obesity including genetic causes for obesity	K	K				
	Discuss about regulators of appetite	K	KH				
	Describe the different steps of prescribing the diet for overweight and obese individual and add a note on Atkin's diet	K	KH				

	Enumerate the ill effects associated with overweight and obese	K	K				
	Discuss the steps to be followed for prevention and treatment of overweight and obese	K	KH				

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/ SH/P	Suggested Teaching Learning method	Suggested Assessment method	Vertical integration	Horizontal Integration
BI8.5	**Summarize the nutritional importance of commonly used items of food including fruits and vegetables.(macro-molecules & its importance**	**K**	**KH**	**Lecture, Small group discussion**	**Written/Viva voce**	**Community medicine, General Medicine, Pediatrics**	
Specific Learning Objectives							
	List the common food items of Indian population and their ratio in diet	K	K				
	Discuss cereals and millets are the major sources of energy and their nutritional value	K	KH				
	Discuss about mutual supplementation of cereals and pulses	K	KH				
	Discuss, milk is a complete protein	K	KH				
	Discuss, egg is the reference protein	K	KH				
	Discuss the nutritional importance of fruits and vegetables	K	KH				
	Discuss, water is the essential nutrient of life	K	KH				

Topic: Extracellular Matrix	**Number of competencies: (03)**			**Number of procedures that require certification: (NIL)**			
BI9.1	**List the functions and components of the extracellular matrix (ECM).**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**		

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Specific Learning Objectives (SLO)

Specific Learning Objectives							
	List the functions of extracellular matrix	K	K				
	Enumerate the different components of ECM	K	K				
	Describe the structure of collagen	K	KH				
	Describe the structure and functions of mucopolysaccharides	K	KH				

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/ SH/P	Suggested Teaching Learning method	Suggested Assessment method	Vertical integration	Horizontal Integration
	Explain the role of mucopolysaccharides in formation of extracellular matrix	K	KH				
	Enumerate the functions of Proteoglycans in extracellular matrix	K	K				
	Explain briefly the role of non-collagen proteins in extracellular matrix formation	K	KH				
	Explain the role of Laminin, Elastin and Fibronectin	K	KH				
BI9.2	**Discuss the involvement of ECM components in health and disease.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**General Medicine**	
Specific Learning Objectives							
	Enumerate the various genetic disorders from abnormalities in the synthesis of collagen	K	K				
	Discuss briefly the pathophysiology of Ehler Danlos syndrome, Marfan syndrome Alport syndrome	K	KH				
	Explain the alterations of ECM components in osteoarthritis or rheumatoid arthritis	K	KH				
BI9.3	**Describe protein targeting & sorting along with its associated disorders.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**		

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Specific Learning Objectives (SLO)

Specific Learning Objectives							
	Discuss briefly the co-translational and post translational modification of proteins in endoplasmic reticulum resulting in sorting of proteins	K	KH				
	Discuss the mechanism involving signal sequences by which proteins are targeted to a specific destination	K	KH				
	Explain the role of Golgi apparatus in protein glycosylation and protein sorting	K	KH				
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Discuss the role of Chaperones and chaperonin system in protein folding	K	KH				
	State the disorders associated with defective protein targeting	K	KH				
	Discuss briefly the pathophysiology of Zellweger syndrome, Refsum's disease and I-cell disease	K	KH				
Topic: Oncogenesis and Immunity	**Number of competencies: (05)**			**Number of procedures that require certification: (NIL)**			
Topic: Biochemistry of cancer							
BI10.1	**Describe the cancer initiation, promotion, oncogenes & oncogene activation. Also focus on p53 & apoptosis**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**Obstetrics &Gynaecology, General Surgery, Pathology**	
Specific Learning Objectives							
	Define cancer and enumerate the causes of cancer including physical, chemical, genetic, biological	K	K				

	Explain different types of cell signaling including G protein coupled signaling, catalytic receptor signaling, steroid receptor signaling with suitable examples of hormones and growth factors	K	KH				
	Elaborate the role of mutagens and antimutagens in etiology of cancer	K	KH				
	Explain the action of oncogens and anti oncogens.	K	KH				
	Describe the role of Oncogenic viruses and associated cancer.	K	KH				
	Explain biochemical functions of oncogenes, proto-oncogenes and oncosuppressor genes	K	KH				
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Compare characteristic features of tumor cells with normal cell	K	KH				
	Elaborate the role of cell cycle, abnormal cell growth and programmed cell death (apoptosis) in causing cancer	K	KH				
	Describe activation of oncogenes including point mutation of protooncogene and insertional mutagenesis	K	KH				
	Describe protective action of oncosuppressor gene including p53, RB gene and effects of loss of its action.	K	KH				
	Explain apoptosis including requirement for apoptosis, apoptosis mediating gene, apoptosis protecting gene and mechanism of apoptosis	K	KH				
BI10.2	**Describe various biochemical tumor markers and the biochemical basis of cancer therapy.**	**K**	**KH**	**Lecture, case discussion**	**Written/ Viva voce**	**Obstetrics &Gynecology, General Surgery, Pathology**	
Specific Learning Objectives							
	Define and classify tumor markers with suitable examples	K	K				

	Enumerate diagnostic and prognostic application of tumor markers including their elevation in benign and malignant condition	K	K				
	Explain 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 antibody and their application	K	KH				

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/ SH/P	Suggested Teaching Learning method	Suggested Assessment method	Vertical integration	Horizontal Integration
Topic: Immunology							
BI10.3	**Describe the cellular and humoral components of the immune system & describe the types and structure of antibody**	**K**	**KH**	**Lecture, case discussion**	**Written/ Viva voce**	**Obstetrics &Gynecology, General Surgery, Pathology**	
Specific Learning Objectives							
	Describe the central and peripheral lymphoid organs	K	KH				
	Describe briefly the cells of the lymphoreticular system and their role in cell mediated immune response.	K	KH				
	Describe the role of T-helper cells in immune responses	K	KH				
	Describe the structure and functions of different types of antibody	K	KH				
	Describe immunoglobulin class switching	K	KH				
BI 10.4	**Describe and discuss innate and adaptive immune response, self/nonself recognition and the central role of T helper cells in immune response**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**General Medicine Pathology**	**Physiology**
Specific Learning Objectives							
	Describe innate and adaptive immune response	K	KH				

	Describe the role of T-helper cells in immune responses	K	KH				
	Define an antigen and discuss the various determinants of antigenicity	K	K				
	Describe the concept of self/non-self antigens	K	KH				
	Describe the concepts of immune tolerance and autoimmunity	K	KH				
	Mention the basis for graft versus host rejection	K	K				

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/ SH/P	Suggested Teaching Learning method	Suggested Assessment method	Vertical integration	Horizontal Integration
BI 10.5	**Describe antigens and concepts involved in vaccine development**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**Pathology Pediatrics Microbiology**	
Specific Learning Objectives							
	Define and describe the different types of vaccines	K	K				
	Describe the immunological basis of vaccine development	K	KH				
	Compare active and passive immunization	K	KH				
	Mention the various phases in vaccine development	K	K				

Topic: Biochemical Laboratory Tests	**Number of competencies: (24)**				**Number of procedures that require certification: (05)**		
BI11.1	**Describe commonly used laboratory apparatus and equipments, good safe laboratory practice and waste disposal.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**		
Specific Learning Objectives							
	List commonly used laboratory glassware and equipments	K	K	Demonstrate			

	Indicate commonly used laboratory glassware and equipments	K	K	Small group discussion	MCQs/Viva voce		
	Describe Good and safe laboratory practices	K	KH	Small group discussion			
	Explain the current guidelines for Biomedical waste disposal	K	KH	Demonstrate			

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/ SH/P	Suggested Teaching Learning method	Suggested Assessment method	Vertical integration	Horizontal Integration
BI11.2	**Describe the preparation of buffers and estimation of pH.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**		
Specific Learning Objectives							
	Define buffers, molarity, normality, molar solution, normal solution, percentage solution	K	K	Small group discussion	MCQ/ Viva voce/ SEQ/		
	Identify the uses of at least 4 buffers in biochemistry laboratory	K	K	Small group discussion			
	Describe the method to prepare at least two commonly used buffers in biochemistry laboratory	K	KH	Small group discussion			
	Describe the importance of HH equation in determination of pH	K	KH	Lecture			
	Describe the principle, parts and uses of pH meter	K	KH	Demonstrate			
	Explain the procedure to estimate pH using pH meter	K	KH	Demonstrate			
	Observe the estimation of pH of different buffers using pH meter	S	KH	Demonstrate			
BI11.3	**Describe the chemical components of normal urine.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/Viva voce**		
Specific Learning Objectives							

Specific Learning Objectives (SLO)

	List the chemical components of normal urine categorising under organic and inorganic constituents	K	K	Small group discussion	MCQ/ viva voce		
	List the chemical tests to be performed to detect organic and inorganic components of normal urine	K	K	Small group discussion			
	Explain the principles of all the chemical tests listed to detect organic and inorganic components of normal urine	K	KH	Small group discussion			
	Describe the clinical significance of organic constituents of normal urine.	K	KH	Small group discussion			
	Describe the clinical significance inorganic constituents of normal urine.	K	KH	Small group discussion			
	Interpret the physiological and pathological variations in organic and inorganic constituents of urine	K	KH	Small group discussion			
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
BI11.4	**Perform urine analysis to estimate and determine normal and abnormal constituents**	**S**	**P**	**DOAP session**	**Skill assessment**	**General Medicine**	**Physiology**
Specific Learning Objectives							
	Describe the ways of urine sample collection and the preservatives used	K	KH	Small group discussion	Qualitative analysis/ OSPE/ Interpret Case chart/ Viva Voce		
	Describe the physical properties of urine for volume, colour, odour, appearance, pH, Specific gravity under normal physiological conditions	K	KH	Small group discussion			**Physiology**
	Describe the physical properties of urine for colour, odour, appearance, pH, Specific gravity in abnormal/diseased conditions	K	KH	Small group discussion		**General Medicine**	
	Describe the abnormal constituents of urine in different diseases conditions	K	KH	Small group discussion		**General Medicine**	
	Perform the physical analysis of normal urine for colour odour and appearance by observation	S	P	DOAP Session			

	Estimate the pH of given urine sample using pH paper correctly by comparison of colour change by visual analysis	S	P	DOAP Session			
	Estimate the specific gravity of given urine sample using urinometer correctly with temperature correction	S	P	DOAP Session			
	Perform urine analysis to determine at least 3 organic and 3 inorganic constituents of normal urine by chemical tests according to the given procedure	S	P	DOAP Session			
	List the common abnormal constituents of urine	K	KH	Small group discussion			
	List the chemical tests to be performed to detect abnormal constituents of urine	K	KH	Small group discussion			
	Describe the principles of all the chemical tests listed to be performed to detect abnormal constituents of urine	K	KH	Small group discussion			
	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	S	P	DOAP Session			
	Perform the dipstick analysis of given urine sample for chemical constituents according to the given procedure and observe the findings	S	P	DOAP Session			
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
BI11.5	**Describe screening of urine for inborn errors & describe the use of paper chromatography**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**General Medicine**	
Specific Learning Objectives							
	Enumerate the urine screening tests for inborn errors of metabolism	K	KH	Lecture		**General Medicine**	
	Identify the urine screening tests for inborn errors of metabolism as positive or negative and interpret the findings	K	KH	Demonstrate			

Specific Learning Objectives (SLO)

	Describe the principle and uses of paper chromatography	K	KH	Demonstrate			
	Interpret the given paper/TLC chromatogram of amino acids accurately	S	SH	Lab report interpreting			
	Interpret the given lab reports of screening tests for inborn errors of metabolism	S	SH	Lab report interpreting			
BI11.6	**Describe the principles of colorimetry**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**		
Specific Learning Objectives							
	Describe the principle of photoelectric colorimeter/spectrophotometer and the application of beer lamberts law	K	KH	Small group discussion			
	Describe the parts of photoelectric colorimeter using a labelled diagram	K	KH	Demonstrate			
	Explain the differences between colorimeter and spectrophotometer	K	KH	Demonstrate			

Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**

BI11.7	**Demonstrate the estimation of serum Creatinine and Creatinine clearance**	**S**	**P**	**Practical**	**Skills assessment**		
Specific Learning Objectives							
	Explain the principle of Jaffe's method and modified Jaffe's method for estimation of serum Creatinine	K	KH	Small group discussion	Quantitative analysis/ OSPE/ Interpret Case chart/ Viva Voce		
	Describe the principle of Jaffe's method for estimation of urine creatinine	K	KH	Small group discussion			
	Perform the estimation of serum creatinine by Jaffe's method using colorimeter as per the standard test protocol	S	P	Practical			
	Perform the estimation of urine creatinine by Jaffe's method using colorimeter as per the standard test protocol	S	P	Practical			

	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	S	SH	Practical			
	Interpret the given serum creatinine, urine creatinine and creatinine clearance values against biological reference intervals	S	SH	Practical			
	Interpret the given serum creatinine, urine creatinine and creatinine clearance values in pathological conditions	S	SH	Practical			
	Explain the difference between measured and calculated eGFR and its clinical significance	K	KH	Small group discussion			
	Explain the use of urine Creatinine in expressing the excretion of other compounds as ratios	K	KH	Small group discussion			

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/ SH/P	Suggested Teaching Learning method	Suggested Assessment method	Vertical integration	Horizontal Integration
BI11.8	**Demonstrate estimation of serum proteins, albumin and A:Gratio**	**S**	**P**	**Practical**	**Skills assessment**		
Specific Learning Objectives							
	Describe the principle of Biuret method for estimation of serum Total protein	K	KH	Small group discussion	Quantitative analysis/ OSPE/ Interpret Case chart/ Viva Voce		
	Describe the principle of Dye binding method (BCG) for estimation of serum Albumin	K	KH	Small group discussion			
	Perform the estimation of serum Total protein by Biuret method using colorimeter as per the standard test protocol	S	P	Practical			
	Perform the estimation of serum Albumin by Dye binding (BCG) method using colorimeter as per the standard test protocol	S	P	Practical			
	Calculate A:G ratio using serum total protein and serum albumin values obtained in previous experiment	S	SH	Practical			

	Interpret the given serum protein, albumin and A:G ratio values against biological reference intervals	S	SH	Small group discussion			
BI11.9	**Demonstrate the estimation of serum total cholesterol and HDL-cholesterol**	**S**	**P**	**Practical**	**Skills assessment**		
Specific Learning Objectives							
	Describe the principle of chemical/enzymatic method for estimation of serum Total Cholesterol	K	KH	Small group discussion	Quantitative analysis/ OSPE/ Interpret Case chart/ Viva Voce		
	Describe the principle of given method for estimation of serum HDL Cholesterol	K	KH	Small group discussion			
	Perform the estimation of serum Total cholesterol by chemical method using Colorimeter/Semi automated analyser as per the standard test protocol	S	P	Practical			
	Perform the estimation of serum HDL cholesterol by chemical method using Colorimeter/Semi automated analyser as per the standard test protocol	S	P	Practical			
	Interpret the given serum Total cholesterol and serum HDL Cholesterol values against biological reference intervals	S	SH	Small group discussion			

Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**

BI11.10	**Demonstrate the estimation of triglycerides**	**S**	**P**	**Practical**	**Skills assessment**		
Specific Learning Objectives							
	Describe the principle of given method for estimation of serum triglycerides	K	KH	Small group discussion	Quantitative analysis/ OSPE/ Interpret		
	Perform the estimation of serum triglycerides by given method using Colorimeter/Semi automated analyser as per standard test protocol	S	P	Demonstrate			

	Interpret the given serum triglycerides values against biological reference intervals	S	SH	Small group discussion	Case chart/ Viva Voce		
BI11.11	**Demonstrate estimation of calcium and phosphorous**	**S**	**P**	**Practical**	**Skills assessment**		
Specific Learning Objectives							
	Describe the principle of OCPC/Dye binding method for estimation of serum Total calcium	K	KH	Small group discussion	Quantitative analysis/ OSPE/ Interpret Case chart/ Viva Voce		
	Describe the principle of given method for estimation of serum phosphorous	K	KH	Small group discussion			
	Perform the estimation of serum Total calcium by given method using Semi automated analyser as per standard test protocol	S	P	Practical			
	Perform the estimation of serum phosphorous by chemical method using colorimeter as per the standard test protocol	S	P	Practical			
	Interpret the given serum Total calcium and serum phosphorous values against biological reference intervals	S	SH	Practical			
BI11.12	**Demonstrate the estimation of serum bilirubin**	**S**	**P**	**Practical**	**Skills assessment**		
Specific Learning Objectives							
	Describe the principle of given method for estimation of serum Total Bilirubin	K	KH	Small group discussion	Quantitative analysis/ OSPE/ Interpret Case chart/ Viva Voce		
	Perform the estimation of serum Total bilirubin by given method using Colorimeter as per the standard test protocol	S	P	Practical			
	Interpret the given serum Total bilirubin values against biological reference intervals	S	S H	Small group discussion			
Number	**COMPETENCY The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
BI11.13	**Demonstrate the estimation of SGOT/SGPT**	**S**	**P**	**Practical**	**Skills assessment**		

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Specific Learning Objectives (SLO)

Specific Learning Objectives							
	Describe the principle of given method for estimation of serum SGOT	K	KH	Small group discussion	Quantitative analysis/ OSPE/ Interpret Case chart/ Viva Voce		
	Describe the principle of given method for estimation of serum SGPT	K	KH	Small group discussion			
	Perform the estimation of serum SGOT by given method using Semi automated/autoanalyser as per the standard test protocol	S	P	Practical			
	Perform the estimation of serum SGPT by given method using Semi automated/autoanalyser as per the standard test protocol	S	P	Practical			
	Interpret the given serum SGOT and serum SGPT values against biological reference intervals	S	SH	Small group discussion			
BI11.14	**Demonstrate the estimation of alkaline phosphatase**	**S**	**P**	**Practical**	**Skills assessment**		
Specific Learning Objectives							
	Describe the principle of given method for estimation of serum Alkaline phosphatase	K	KH	Small group discussion	Quantitative analysis/ OSPE/ Interpret Case chart/ Viva Voce		
	Perform the estimation of serum Alkaline phosphatase by given method using Colorimeter/Semi automated analyser as per the standard test protocol	S	P	Practical			
	Interpret the given serum alkaline phosphatase values against biological reference intervals	S	SH	Small group discussion			
BI11.15	**Describe & discuss the composition of CSF**	**K**	**KH**	**Lecture, Small group discussion**	**Written/Viva voce**		
Specific Learning Objectives							
	Describe the normal physical properties of CSF	K	KH	Small group discussion	Viva voce/ SAQ		
	Describe the physical properties of CSF in abnormal conditions	K	KH	Small group discussion			

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Specific Learning Objectives (SLO)

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/ SH/P	Suggested Teaching Learning method	Suggested Assessment method	Vertical integration	Horizontal Integration
	Describe the normal chemical composition of CSF	K	KH	Small group discussion	Viva voce/ SAQ		
	Discuss the alterations in chemical composition of CSF in abnormal conditions	K	KH	Small group discussion			
	Tabulate the physical and chemical lab CSF findings in different pathological conditions	K	KH	Small group discussion			
BI11.16	**Observe use of commonly used equipments/techniques in biochemistry Laboratory including:** **•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**	**S**	**KH**	**Demonstrate**	**Skill assessment**		
Specific Learning Objectives							
	Observe the estimation of pH of any two buffers using pH meter and their applications	S	KH	Demonstrate	Written/Viva voce/OSPE		
	Observe the paper chromatography of aminoacids using standard aminoacid mixtures and urine sample and their applications	S	KH	Demonstrate			
	Observe the Thin layer chromatography of aminoacids using standard aminoacid mixtures and urine sample and their applications	S	KH	Demonstrate			

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Specific Learning Objectives (SLO)

	Observe the agarose gel serum protein electrophoresis of normal and abnormal serum samples and their applications	S	KH	Demonstrate			
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Observe the agarose gel hemoglobin electrophoresis of normal and abnormal blood samples and their applications	S	KH	Demonstrate	Written/Viva voce/OSPE		
	Observe the PAGE for separation of proteins and their applications	S	KH	Demonstrate			
	Observe the serum electrolyte analysis by ISE and their applications	S	KH	Demonstrate			
	Observe the blood gas analysis on ABG analyser and their applications	S	KH	Demonstrate			
	Observe the ELISA procedure with quantitation using plate reader and their applications	S	KH	Demonstrate	Written/Viva voce/OSPE		
	Observe the immunodiffusion technique and their applications	S	KH	Demonstrate			
	Observe the functioning of autoanalysers and describe the principles and advantages of autoanalysers in clinical biochemistry laboratory	S	KH	Demonstrate			
	Explain quality control process in clinical biochemistry laboratory and their use	K	KH	Demonstrate			
	Observe the isolation of DNA from blood/tissues and describe the application	S	KH	Demonstrate			

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Specific Learning Objectives (SLO)

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.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**	**General Medicine, Pathology**	
Specific Learning Objectives							
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	List the lab tests used to diagnose diabetes mellitus	K	K	Lecture	MCQ/SEQ/ Viva voce/ Interpret Case chart		
	List the tests used to monitor diabetes mellitus status	K	K	Lecture			
	Explain the basis and rationale of glycated haemoglobin to monitor diabetic status	K	KH	Lecture			
	Explain the basis and rationale of lipid profile in evaluation of cardiovascular risk assessment	K	KH	Lecture			
	Explain the basis and rationale of dyslipidemia in diabetes mellitus	K	KH	**ECE**			
	Enumerate the tests used to evaluate cardiac function	K	KH	Lecture			
	Explain the basis and rationale of the tests used in diagnosis of Myocardial infarction	K	KH	**ECE**			
	Explain the basis and rationale of the lab tests done to assess the functioning of kidney	K	KH	Small group Discussion			

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Specific Learning Objectives (SLO)

	Discuss the commonly done renal function tests in renal failure	K	KH	ECE			
	Explain the basis and rationale of serum uric acid in gout	K	KH	Case based learning			
	Explain an algorithm for evaluation of proteinuria	K	KH	Chart based discussion		Pathology	
	Explain the basis and rationale of tests used in diagnosis of Nephrotic syndrome	K	KH	Small group Discussion			
	Explain an algorithm for laboratory evaluation of edema	K	KH	Chart based discussion		Pathology	
	Explain the lab evaluation for different types of Jaundice	K	KH	Small group Discussion		Pathology	
	Describe the lab tests done to assess the functioning of Liver	K	KH	Small group Discussion			
	Explain the basis and rationale of lab tests done in Liver disorders	K	KH	Case based learning discussion			
	Explain the basis and rationale of lab tests done to assess the functioning of pancreas	K	KH	Small group discussion			
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Discuss the lab tests done in pancreatic disorders	K	KH	Case based learning discussion			
	Explain the basis and rationale of lab tests done to assess the functioning of thyroid	K	KH	Small group discussion Lecture	MCQ/SEQ/ Viva voce/ Interpret Case chart	Pathology	
	Discuss the lab tests done in thyroid disorders	K	KH	Small group Discussion			

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Specific Learning Objectives (SLO)

	Discuss the lab tests done in acid base disorders	K	KH	Small group Discussion			
	Interpret the given lab report of patient with jaundice	S	SH	**ECE** Case based learning		**Medicine**	
	Interpret the given lab report of patient with renal dysfunction	S	SH	**ECE** Case based learning		**Medicine**	
	Interpret the given lab report of pancreatic function tests	S	SH	**ECE** Case based learning			
	Interpret the given lab report of thyroid function tests	S	SH	**ECE** Case based learning		**Medicine**	
	Interpret the given lab report of cardiac function tests	S	SH	**ECE** Case based learning			
	Interpret the given lab report of patient with type 2 diabetes mellitus	S	SH	**ECE** Case based learning		**Medicine**	
	Interpret the given lab report of patient with acute chest pain presenting to emergency department	S	SH	**ECE** Case based learning		**Medicine**	
Number	**COMPETENCY** **The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**
	Justify the given lab findings in patient presenting with arthritis	S	SH	**ECE** Case based			

				learning			
BI11.18	**Discuss the principles of spectrophotometry.**	**K**	**KH**	**Lecture, Small group discussion**	**Written/ Viva voce**		
Specific Learning Objectives							
	Describe the principle of spectrophotometry	K	KH	Small group discussion	Viva voce		
	Describe the parts of spectrophotometer	K	KH	Demonstrate			
BI11.19	**Outline the basic principles involved in the functioning of instruments commonly used in a biochemistry laboratory and their applications.**	**K**	**KH**	**Lecture, Small group Discussion**	**Written/ Viva voce**		
Specific Learning Objectives							
	Describe the principle and uses of colorimeter	K	KH	Demonstrate	SAQ/ Viva voce		
	Describe the principle and uses of spectrophotometer	K	KH	Demonstrate			
	Describe the principle and uses of urinometer	K	KH	Demonstrate			
	Describe the principle and uses of pH meter	K	KH	Demonstrate			
	Describe the principle and uses of semiautomated analyser	K	KH	Demonstrate			
	Describe the principle and uses of fully automated chemistry analyser	K	KH	Demonstrate			
	Describe the principle and uses of fully automated immunoanalyser	K	KH	Demonstrate			
	Describe the principle and uses of centrifuge	K	KH	Demonstrate			
	Describe the principle and uses of electrophoresis apparatus	K	KH	Demonstrate			
	Describe the principle and uses of glucometer	K	KH	Demonstrate			
	Describe the principle and uses of ABG analyser	K	KH	Demonstrate			
	Describe the principle and uses of electrolyte analyser by ISE	K	KH	Demonstrate			

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Specific Learning Objectives (SLO)

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/ SH/P	Suggested Teaching Learning method	Suggested Assessment method	Vertical integration	Horizontal Integration
BI11.20	**Identify abnormal constituents in urine, interpret the findings and correlate these with pathological states.**	**S**	**SH**	**DOAP sessions**	**Skill assessment**		
Specific Learning Objectives							
	Identify the abnormal constituents of urine from the given chemical tests	S	SH	DOAP sessions	Qualitative analysis/ OSPE/ Interpret Case chart/ Viva Voce		
	Interpret the abnormal physical and chemical test findings of the given urine sample	S	SH	DOAP sessions			
	Correlate the abnormal urine findings in given urine sample with pathological states	S	SH	Case based discussions			
BI11.21	**Demonstrate estimation of glucose, creatinine, urea and total protein in serum.**	**S**	**SH**	**DOAP sessions**	**Skill assessment**		
Specific Learning Objectives							
	Describe the principle of enzymatic method for estimation of serum glucose	K	KH	Small group discussion	Quantitative analysis/ OSPE/ Interpret Case chart/ Viva Voce		
	Perform the estimation of serum Glucose by enzymatic method using colorimeter	S	P	DOAP sessions			
	Interpret the given serum glucose levels against biological reference intervals	S	SH	Small group discussion			
	Describe the principle of Jaffe's method for estimation of serum creatinine	K	KH	Small group discussion			
	Perform the estimation of serum creatinine by Jaffe's method using colorimeter	S	P	DOAP sessions			
	Interpret the given serum creatinine levels against biological reference intervals	S	SH	Small group discussion			

Specific Learning Objectives (SLO)

	Describe the principle of for estimation of serum urea by an end-point method	K	KH	Small group discussion			
	Perform the estimation of serum urea by an end-point method using colorimeter	S	P	DOAP sessions			
	Interpret the given serum glucose levels against biological reference intervals	S	SH	Small group discussion			
	Describe the principle of Biuret method for estimation of serum total protein	K	KH	Small group discussion			
	Perform the estimation of serum Total protein by Biuret method using colorimeter	S	P	DOAP sessions	Quantitative analysis/ OSPE/ Interpret Case chart/ Viva Voce		
	Interpret the given serum Total protein levels against biological reference intervals	S	SH	Small group discussion			
BI11.22	**Calculate albumin: globulin(AG) Ratio and Creatinine clearance**	**K**	**KH**	**Lecture, Small group Discussion**	**Written/ Viva voce**	**General Medicine**	
Specific Learning Objectives							
	Calculate A: G ratio using given serum total protein and serum albumin values and interpret the results.	S	SH	Practical	Quantitative analysis/ OSPE/ Interpret Case chart/ Viva Voce		
	Calculate the creatinine clearance using the formula UV/P with given volume of urine output and interpret the results.	S	SH	Practical			
BI11.23	**Calculate energy content of different food Items, identify food items with high and low glycemic index and explain the importance of these in the diet**	**K**	**KH**	**Lecture, Small group Discussion**	**Written/ Viva voce**	**General Medicine**	

Number	**COMPETENCY The student should be able to**	**Domain K/S/A/C**	**Level K/KH/ SH/P**	**Suggested Teaching Learning method**	**Suggested Assessment method**	**Vertical integration**	**Horizontal Integration**

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Specific Learning Objectives (SLO)

Specific Learning Objectives							
	Calculate the energy content of different food items correctly based on their carbohydrate, protein and lipid content	K	KH				
	Identify food items with high and low glycemic index	K	KH				
	Explain the importance of low and high glycemic index food items in diet in normal and diseased conditions	K	KH				

Number	COMPETENCY The student should be able to	Domain K/S/A/C	Level K/KH/ SH/P	Suggested Teaching Learning method	Suggested Assessment method	Vertical integration	Horizontal Integration
BI11.24	**Enumerate advantages and/or disadvantages of use of unsaturated, saturated and trans fats in food.**	**K**	**KH**	**Lecture, Small group Discussion**	**Written/ Viva voce**	**General Medicine**	
Specific Learning Objectives							
	Explain the advantages and/or disadvantages of use of unsaturated fats in food.	K	KH				
	Explain the advantages and/or disadvantages of use of saturated fats in food.	K	KH				
	Explain the advantages and/or disadvantages of use of trans fats in food.	K	KH				

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Topic	Competency Number	Number of Teaching hours
Relevance of Biochemistry in Medicine		1 hr (Orientation lecture)
Cell and organelles, Cell membrane, Transport across cell membranes	BI1.1	2 hrs
Enzymes	BI2.1, BI2.3, BI2.4, BI2.5, BI2.6, BI2.7	9 hrs
Chemistry of Carbohydrates	BI3.1	3 hrs
Carbohydrate metabolism	BI3.2, BI3.3, BI3.4,BI3.5, BI3.6, BI3.7, BI3.9	14 hrs
Chemistry of lipids	BI4.1, BI11.24	3 hrs
Lipid metabolism	BI4.2, BI4.3, BI4.4, BI4.6	12 hrs
Chemistry of amino acids and Proteins	BI5.1, BI5.2	3 hrs
Protein and amino acid metabolism	BI5.3, BI5.4, BI5.5, BI11.17	13 hrs
Plasma proteins	BI5.2	3 hrs
Metabolism and homeostasis	BI6.1, BI3.8, BI4.5, BI4.7, BI3.10, BI11.17	6 hrs
Biological Oxidation	BI6.6	3 hrs
Heme metabolism	BI6.11, BI6.12, BI5.2, BI11.17	7 hrs
Extracellular matrix	BI9.1, BI9.2	4 hrs
Vitamins	BI6.5	12 hrs
Minerals	BI6.9, BI6.10	8 hrs
Chemistry of Nucleic acids	BI17.1	2 hrs
Nucleotide metabolism	BI6.2, BI6.3, BI6.4	4 hrs
Molecular Biology	BI7.1, BI7.2, BI7.3, BI9.3	11 hrs
Molecular biology techniques and Gene therapy	BI7.4	4 hrs
Biochemistry of Cancer	BI10.1, BI10.2	5 hrs

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Immunology	BI10.3, BI10.4, BI10.5	1 hr
Nutrition and dietetics	BI8.1, BI8.2, BI8.3, BI8.4, BI8.5, BI11.17, BI11.23, BI11.24	7 hrs
Organ function tests	BI6.13, BI6.14, BI6.15, BI11.17	11 hrs

Acid base balance	BI6.7, BI6.8, BI11.17	4 hrs
Water and electrolyte balance	BI6.7	3 hrs
Free Radicals and Antioxidants	BI7.6, BI7.7	3 hrs
Xenobiotics and Detoxification	BI7.5	1 hr
Clinical chemistry	BI11.16	2 hrs
	Total	**160 hrs**
Analysis of Normal constituents of urine	BI11.3, BI11.4	3x2=6 hrs
Analysis of Pathological Constituents of Urine	BI11.4, BI11.20	4x2=8 hrs
Urine screening tests for Inborn errors of metabolism	BI11.5, BI5.5	1x2= 2 hrs
Calculate the energy content of food items	BI11.23	1x2= 2 hrs
Estimation of plasma glucose by Enzymatic method and Glucometer as point of care testing	BI11.21, BI3.10	2x2= 4 hrs
Estimation of serum and urine creatinine by Jaffe's method, Creatinine cleara nce	BI11.7, BI11.21	2x2= 4 hrs
Estimation of blood urea by an end-point method	BI11.21	2x2= 4 hrs
Estimation of Total Protein and Albumin in serum by Biuret and BCG method, A:G ratio	BI11.8, BI11.21	2x2= 4 hrs
Estimation of Total cholesterol and High density lipoprotein(HDL) cholesterol	BI11.9	1x2= 2 hrs
Estimation of Triacylglycerols	BI11.10	1x2= 2 hrs
Estimation of Calcium and Phosphorous	BI11.11	1x2= 2 hrs
Estimation of Serum Bilirubin	BI11.12	1x2=2 hrs

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Estimation of AST, ALT activity	BI11.13	1x2=2 hrs
Estimation of ALP activity	BI11.14	1x2=2 hrs
Lab safety and Biomedical waste disposal, Commonly used lab equipment, gl assware and reagents	BI11.1	1x2= 2 hrs
Preparation of buffers and estimation of pH using pH meter	BI11.2, BI11.6, BI11.9	1x2=2 hrs
Colorimetry, Spectrophotometry	BI11.6, BI11.18	1x2=2 hrs
Clinical chemistry autoanalyser and quality control (Internal and External quality control, Precision, Accuracy, QC rules), Biological reference intervals	BI11.16, BI11.19	1x2=2 hrs
Specimen collection and preanalytical errors in clinical Biochemistry lab		1x2= 2 hrs
Serum protein electrophoresis, types and applications	BI11.16, BI11.19	1x2=2 hrs
Paper chromatography/TLC of amino acids/sugars, types and applications	BI11.5, BI5.5, BI11.16, BI11.19	1x2=2 hrs
Analysis of CSF	BI11.15	1x2=2 hrs
Estimation of serum electrolytes by ISE	BI11.16, BI11.19	1x2= 2 hrs
Blood gas analysis using ABG analyser	BI11.16, BI11.19	1x2=2 hrs
Principle, procedure and applications of ELISA, protein extraction, Blotting tec hniques, PAGE	BI11.16, BI11.19	1x2=2 hrs
Principle, procedure and applications of PCR, DNA isolation	BI11.16, BI11.19	1x2=2 hrs
		Total 70 hrs
Note: BI11.4, BI11.7, BI11.8, BI11.20, BI11.21 are required to certify. All competencies are core competencies. BI9.3 is a non core competency. There is overlapping of competencies between topics. Number of teaching hours is in reference to syllabus.		