

STUDY GUIDE

2nd YEAR MBBS



Compiled by: Department of Medical Education CMH Kharian Medical College (CKMC), Kharian Cantt.

Learning Outcomes

Knowledge:

- Describe the gross anatomical features of Cerebrum, Midbrain, Pons, Medulla and Spinal cord
- Describe the sensory and motor parts of nervous system
- Describe the major levels of central nervous system along with their functions
- Describe the integrative function of nervous system
- Describe the blood cerebrospinal fluid and blood brain barriers
- Describe the structure of Nerve and explain the myelination of nerve fiber
- Describe the ascending and descending tracts of brain stem
- Describe analgesia system in brain & spinal cord
- Describe the mechanism of consolidation of memory
- Describe the functions of autonomic nervous system
- Explain the Physiology, anatomy and pathogenesis of Head & neck and special sense problems.
- Apply basic sciences to understand the causes of common Head & neck and special sense problems.
- Explain the structural & developmental organization of GIT.
- Explain the composition, functions, mechanism & control of following gastrointestinal secretions: salivary, gastric, pancreatic, biliary, small & large intestines.
- Describe the mechanism of absorption of various nutrients and their role in malabsorption syndrome.
- Explain the physiological anatomy, biochemistry functions and dysfunctions of Liver.
- Explain the GIT hormones (structure, function) & their role in secretion and motility.
- Describe the chemical nature, biosynthesis and the physiological functions of hormones on their target organs.

Skill:

- Draw a labeled diagram of the identified structures with the help of eosin and hematoxylin pencils on the histology notebooks
- Mark the main anatomical land marks on skull
- Dissect various parts of head and neck and special senses, and related structure
- Demonstrate their gross Anatomy and relationship to each other.
- Identify the histological features of all the endocrine glands under microscope.
- To perform all the steps of blood glucose estimation in the lab.
- Dissect various parts of GIT, and related structures including peritoneum, to demonstrate their gross Anatomy and relationship to each other.
- Identify different organs of GIT under microscope and on model.

Attitude:

- Demonstrate the effective attitude towards the colleagues
- Demonstrate a professional attitude, team building spirit and good communication skills
- Observe lab safety rules

1. INTRODUCTION

1.1 BLOCK COMMITTEE

Chief Coordinator Block 1: Dr. Hammad Ahmed Butt M.Phil.
HOD Pharmacology, CKMC

Coordinator: Dr. Noman Sadiq Assistant Professor, Physiology
CKMC

Resource Persons

S No	Name	Designation	Deptt	Contact
1.	Dr. Ahmed Murtaz Khalid	Assistant Prof	Physiology	murtaz_khalid@hotmail.com
2.	Dr. Shaista Noor	Demonstrator	Biochemistry	drsnqureshi@gmail.com

For any information regarding block 1, contact in CKMC:

Faculty members:

Anatomy

Dr. Aneeqa Chughtai

Physiology

Dr. Noman Sadiq

Biochemistry

Dr. Sadaf Saleem Uppal

Surgery

Dr. Ahmed Raza

Medicine

Dr. Aamir Habib

Community Medicine

Dr. Iffat Naiyar

Behavioral Sciences

Dr. Asif Azeem Bajwa

Pharmacology

Dr. Hammad Ahmed Butt

Pathology

Dr. Nasira Shaheen

Radiology

Dr. Humaira Saleem

Gynae/ OB

Dr. Jasia Jabeen

Paediatric Medicine

Dr. Saeed Zaman

Department of Medical Education

Dr. Noman Sadiq

1.2 What is a study guide?

It is an aid to:

- ❖ Inform students how student learning program of the block has been organized.
- ❖ Help students organize and manage their studies throughout the module.
- ❖ Guide students on assessment methods, rules and regulations.

1.3 The study guide:

- Informs about organization and management of the block.
- Defines the objectives which are expected to be achieved at the end of the block.
- Identifies the learning strategies such as lectures, small group teachings, clinical skills, demonstrations, tutorials and case based learning that will be implemented to achieve the block objectives.
- Provides a list of learning resources such as books, computer assisted learning programs, web-links and journals, for students to consult in order to maximize their learning.
- Highlights information on the contribution of continuous assessment and annual examinations on the student's overall performance.
- Includes information on the assessment methods.
- Focuses on information pertaining to examination policy, rules and regulations.

2. Curriculum framework:

Students will experience *integrated curriculum* of the block. The time table is adjusted so that related topics within subjects are scheduled at the same time, with similar topics being taught on the same day or week. In addition to subject based teaching, integrated teaching sessions are introduced in clinical basic science lectures and CBL sessions that brings together clinical and basic sciences. Students will be able to have better understanding of basic sciences when they repeatedly learn in relation to clinical examples.

2.1 Organizing system:

Medical college curriculum shall be organized in blocks of modules. The modules are named after body system for example a module of blood in a block. The key details are as follows:

1. There shall be three blocks in first year MBBS comprising modules.
2. The blocks shall be labeled as 1, 2 and 3.
3. Each module in a block shall have a title. The name of the module shall represent the content taught and learned the majority of time in that module. Module shall be named after body systems.
4. The duration of three blocks shall vary between 8–11 weeks according to syllabus.
5. The syllabus shall be integrated horizontally around systems of the body.
6. There shall be vertical integration to the extent decided by the curriculum coordination committee.
7. Vertical integration shall be in case based learning sessions and in clinical lectures of basic sciences, scheduled in the structured training program.

3. Teaching and Learning methods (MIT):

Following modes of information transfer (MIT) shall be used

- Interactive Lectures
- Clinical lectures of basic sciences
- Case based Learning
- Tutorials
- Laboratory Work

3.1 Interactive lectures:

In large group, the lecturer introduces basic science concepts through common clinical conditions and explains the underlying phenomena through questions, pictures, videos of patients' interviews, exercises, etc. Students are actively involved in the learning process.

3.2 Self-study:

Students' assume responsibilities of their own learning through individual study, sharing and discussing with peers, seeking information from Learning Resource Center, teachers and resource persons within and outside the college. Students can utilize the time within the college scheduled hours of self- study.

3.3 Case based learning (CBL):

3.3.1 What is case based learning?

Case based learning is a form of small group learning that involves the use of learning activities commonly based on patient cases associated with real life situations. A case is used to stimulate learning and acquisition of knowledge, skills and attitudes. It is structured so that students develop the skills of clinical reasoning and critical thinking.

In CBL, the learning objectives for the case are explicitly stated at the beginning of the case, and the learners can focus their learning on attaining the specific outcomes.

The students learning through CBL case is supported by other teaching modalities scheduled during the week (for example lectures, e-modules, videos, seminars, etc.).

All of these learning activities and resources have been designed and organized to allow students to approach their learning as "Discovery Learning" and to create a learning environment that brings together related content from the different domains of medical knowledge.

The Goal of CBL is for student to integrate knowledge and apply it to clinical situations from the start of their medical education.

3.3.2 Self-Assessment and Reflection in CBL

When you are preparing for the case you should reflect and answer the following questions to help you focus your learning.

1. What resources should I use to understand the case?
2. Do I understand how the parts of the case are connected?
3. How has my previous learning experience shaped my approach to this case?
4. What do I know to solve the case and achieve the learning objectives?
5. How do I seek and use feedback from others?
6. How do I seek and use data from other sources?

- External sources (e.g. text books/journal articles/lectures/role models)

It is also important for students to consider their emotional reaction to feedback and how they deal with this.

What steps should I take or resources should I use to respond to my areas in need of improvement?

You may consider various resources including:

- *Role models (tutor, other students who they find particular effective in their approach to learning)*
- *Literature:(journal articles/texts)*

3.3.3The CBL process

1. **Pre- Tutorial:** self-study by students

2. **CBL session:**

a. Introduction and group rules

- **Tutor Introductions:** Tutor introduce herself/himself
- **Student Introductions:** Tutor asks the students introduce themselves to the group.
- **Group Rules:** Every group needs to establish their own accepted rules for group behavior. These would likely include that only one person speaks at once; everyone listens attentively, comes to tutorial prepared and contributes to the discussion. Other ground rules might relate to checking internet, dictionary, notes or taking phone calls during the session.

b. Tutorial Discussions

- The group will determine any roles people will adopt during the session (scribe, time keeper, leader etc.).
- A student will volunteer to verbally read the first component of the case. The reading of the case provides the students an opportunity to formalize themselves with the pronunciation of unfamiliar terms, and provides auditory learning opportunities.
- Discussion might begin with learners identifying any terms or concepts they did not understand.
- The tutor will use active listening skills, and open-ended questions to promote discussion, and probing questions to prompt learners to explore topics more deeply. For Example, can a “normal” Lab value be abnormal? What do we expect it to be in this case? The teacher will not deliver the content. Tutor will only facilitate your learning.

c. Feedback:

Feedback is an interactive process between two or more people that allows the parties to share information with the intention of guiding future performance. Feedback helps an individual to keep their behavior “on target”, thus, it helps a person to better achieve their goals.

- **Feedback is specific rather than general.**

Provide specific information and examples. To make a general statement about another person’s work as a whole does not tell a person which part of his/her performance or actions need changing and which might serve as models.

- **Feedback is descriptive rather than judgmental.**

Respond with observations rather than assumptions. Avoiding judgmental language reduces the other’s need to respond defensively. *Share information – rather than give advice or tell learners what to do:*

- Offer suggestions
- Generate alternatives
- Share insight & experience

- **Feedback is both positive and negative.** A balanced description of a person's behavior or action takes both the strong and weak points into account.
- **Feedback takes into account the needs of both the receiver and the giver of feedback.** What you say to a person about his/her performance not only reflects his/her work or actions, but also how you feel about them at the moment.
- **Feedback is directed at behavior that the receiver can do something about.** When a person is reminded of some shortcoming over which he/she has no control, the major change is in terms of an increased frustration level.
- **Feedback is solicited rather than imposed.** Feedback is most useful when the receiver has formulated the kind of questions he/she most wants an answer to.
- **Feedback is directed primarily at the person's performance or behavior rather than at the person themselves.**
- **Avoid defensiveness.** Use less confrontational language; ask "what, when, where or how" rather than "why".

d. Assessment:

Tutor completes formal assessment for the student in the CBL tutorial at the end of tutorial process. The tutor meets with each student in person to encourage self-assessment, discuss the assessment, and provides additional feedback.

e. At the end of a Session

By the end of each session, the students need to clarify any outstanding questions.

3.3.4 Expectations from the learner in CBL

Case based learning is a student-centered process and it is the responsibility of individual student to participate fully, not only for his or her own learning, but also to aid the learning of others in the group. Although much time is spent alone in the library or at the computer, the full benefits of CBL cannot be realized in isolation.

3.3.5 Role of learner during CBL sessions:

During every CBL session, group chooses a group leader, a scribe and rest of the students become group members. One of the member acts as time keeper.

Role of group leader

- Keep the group on task.
- Ensure deadlines are met.
- Refine for the group the problem statement as the group learns more.
- Ensure that each member of the group understands his or her role and responsibilities.
- Help generate possible solutions.
- Help diffuse group conflict.
- Help ensure that rules are followed not by being dictatorial but by taking everyone along.

Role of scribe

- Summarize the group's discussions/ decisions in the various CBL steps.
- Write everything that is being said on the white board/flip chart.
- Organize information on the white board/flip chart.
- Summarize and clarify.

Role of group members

- Be an active participant in the process of learning.
- Share information.
- Assist in the maintenance of group dynamics.
- Identify gaps in self-knowledge.
- Search for information from various sources.
- Clarify & Summarize.
- Resolve conflicts.
- Reflect on group dynamics.
- Reflect on learning that is taking place individually and in group.
- Provide feedback.
- Assist in the establishment of rules for group dynamics.
- Follow established rules.
- Be regular and punctual.

3.3.6 Guide to professional behavior during CBL session

(Courtesy of McMaster University and CPSP DME)

Respect

- Listens, and indicates so with appropriate verbal or non-verbal behavior.
- Verbal and non-verbal behaviors are neither rude, arrogant nor patronizing.
- Allows others to express opinions and give information without "putting down" anyone.
- Participates in discussion of differences in moral values.
- Differentiates value of information from value of person.
- Acknowledges others' contributions.
- Apologizes when late or gives reason for being so.

Communication Skills

- Speaks directly to group members.
- Presents clearly.
- Uses words that others understand
- Uses open-ended questions appropriately.
- Identifies misunderstanding between self and others or among others.
- Attempts to resolve misunderstanding.
- Tests own assumptions about group members.
- Accepts and discusses emotional issues.
- Able to express own emotional state in appropriate situations.
- Non-verbal behavior indicates that statements have been understood.
- Recognizes and responds to group member's non-verbal communication.

Responsibility

- Punctual completes assigned tasks.
- Presents relevant information.
- Identifies irrelevant or excessive information.
- Takes initiative or otherwise helps to maintain group dynamics.
- Advances discussion by responding to or expanding on relevant issues.
- I own emotional or physical state when relevant to own functioning or group dynamics.
- Describes strengths and weaknesses of group members in a supportive manner.

Self-Awareness/ Self-Evaluation

- Acknowledges own difficulty in understanding
- Acknowledges own lack of appropriate knowledge
- Acknowledges own discomfort in discussing or dealing with a particular issue
- Identifies own strengths
- Identifies own weaknesses
- Identifies means of correcting deficiencies or weaknesses
- Responds to fair negative evaluative comment with reasonable proposals for behavioral change

3.3.7 Using learning resources

In CBL, one of the objectives is self-directed learning. Students search for literature, based on the individual learning goals developed as a result of self-assessment and reflection question provided earlier in the guide.

Bring books and previous notes and use them in tutorial, if necessary, to clarify concepts and terminology. It is helpful to have a good dictionary to check the meaning of terms. We often use words as if we knew what they meant; it may be helpful to challenge your colleagues to define key terms.

To obtain additional information, provided to you, you may be directed to a specific resource or asked how you might find a good resource (journal article, book, expert, etc.). It is important to avoid “guessing games” or wasting time tracking down an obscure reference. But, on the other hand, it is important to develop skill in finding good information.

You are encouraged to discuss matters of interests pertaining to specific case with your peers. Develop a specific list of references for each case considered. Part of the overall learning experience implicit in CBL is the development of skills that will facilitate access to learning resources throughout your future professional career.

4. Examinations:

No student will be allowed to sit in the annual examination if attendance is below 75% in theory and practical separately.

4.1 Assessment types

The assessment will be continuous. The purpose of continuous assessment is formative and summative.

- **Summative Assessment:** The marks of this type of assessment contribute in the final university result through internal assessment. It comprises:
 - CBL/tutorial assessment
 - Scheduled tests
 - Sub-stages
 - End of block exam
 - Pre-annual exam

Scheduled tests and sub-stages will be conducted intermittently throughout the block. Their schedule will be intimated through the time tables.

The end of the block exam will be conducted after 8 weeks of instruction. It will comprise one theory paper and one practical exam for Anatomy, Physiology and Biochemistry. (Table of specifications (TOS) for exam has been provided)

- **Formative Assessment:** Tests may be quizzes, surprise tests/written assignments/self-reflection by students during the teaching time but their marks will not be added to internal evaluation marks. The purpose of formative assessment is to provide feedback to the students, for the purpose of improvement and to teachers to identify areas where students need further guidance.

4.2 Internal Assessment

(Will be submitted to the university before professional exam)

1. The weightage of internal assessment shall be 10 % in theory paper and 10 % in practical, in the annual professional examination (or 10 marks for a 100 marks in theory and practical each)
2. Scheduled tests, sub-stages, CBLs/tutorials, block examinations and pre-annual examinations, conducted by the college shall contribute towards internal assessment for professional examination.

4.3 Annual Professional Examination:

1. The professional examinations schedule will be provided by NUMS.
2. There will be two components of the final result
 - (i) Examination-90 %
 - (ii) Internal Assessment- 10 %
3. There will be one theory paper and one Practical exam for Anatomy, Physiology and Biochemistry each. For practical the class will be divided into batches. Each batch will have practical exam of one subject on the specified day, according to schedule.
4. Theory & Practical assessment shall be of 100 marks each in Anatomy, Physiology and Biochemistry, making a **total of 200 marks for each subject.**
5. The Annual Theory paper shall be of 90 marks. 10 marks of internal assessment of theory papers, conducted throughout the year will be added to it, to make annual theory assessment of 100 marks.
6. Similarly, the annual practical examination will be of 90 marks. 10 marks of internal evaluation of practical exams, conducted throughout the year will be added to it, to make annual practical assessment of 100 marks.
7. The pass score shall be 50 out of 100, in theory and practical separately.

4.4 Schedule of examinations:

a) Continuous assessments schedule

Schedule provided by each department in Time table.

b) Formative tests: Throughout the block

Subject	Contact Hours
Anatomy	250
Physiology	250
Biochemistry	150
Pakistan Studies & Islamiat	50
Pathology*	25
Community Medicine*	25
Medicine & Allied*	15
Surgery & Allied*	15
Behavioural Sciences*	15

***Subject is not assessed in Second Professional examination Educational strategies:**

1. The educational strategies overarching the curriculum shall be:
 - a. Student centered
 - b. Integration
 - c. Problem based
 - d. Structured
 - e. With component of community based and electives

Teaching and Learning methods (MIT)

Multiple learning strategies are used. Interactive lectures are used to provide students entrance to topic needing much effort by the student to understand subject matter. We have used Problem based learning to integrate basic and clinical sciences, and give a learning experience that is contextual, realistic, and relevant. Small group discussions encourage students to social learning bring their concepts and learning to be discussed and schemas corrected and refined. Working in labs provides experiential, hand on learning.

Time table / Structured Training Program

The colleges shall make their own structured training program, taking care of recommended teaching hours in a subject as described by PM&DC.

Internal Assessment.

During the module the students shall be continually formatively assessed. The weightage of internal assessment shall be 10 % in 2nd professional MBBS Examination. There shall be three modular and one pre -annual examination. The scores of tests at the end of each modular assessment and pre-annual examination shall be used for calculation of the internal assessment.

Module and Pre-Annual Examination

1. There will be three module examinations, one at the end of each module.
2. There will be only one Pre-annual examination.
3. The structure of the paper of all the module examinations and pre-annual will be same as that for annual examination though syllabus will be different.
4. The syllabus for modular examination will be announced by the department at least 02 weeks prior to examination.
5. Pre-annual examination will be from whole syllabus.
6. The date sheet for Module and pre-annual examinations will be published by Examination branch of college while the examinations will be conducted by respective department.

The result will be submitted to NUMS examination branch for incorporation in internal assessment before annual examination

Annual Professional Examination.

The University shall take the 2nd professional Examination as per PM&DC guidelines at the end of the academic year. Each subject section has table of specification of Module, Pre- annual and Annual examination. Annual Theory & Practical Examination shall be of 200 marks each in; Anatomy, Physiology and Biochemistry. The pass score shall be 50% in theory and practical separately. The detail marked distribution of 2ND year is as under.

S / N	Subject	MCQs	PBQs SAQs SEQs	Int Assess	Sub Total	Oral & Practical	Int Assess	Sub Total	Grand Total
1	Anatomy	25	65	10	100	90	10	100	200
2	Physiology	25	65	10	100	90	10	100	200
3	Biochemistry	25	65	10	100	90	10	100	200
									600
	Islamiat & Pak Studies	There will be a 100 marks written paper and students need to pass this subject securing minimum 33% marks for the award of bachelor degree later on.							

STRUCTURED SUMMARY OF MODULES- 2nd YEAR

YEAR 2				
Y2M1	1. Abdomen, pelvis and perineum 2. GIT 3. Urinary system	Gross Anatomy Abdomen, pelvis and perineum Embryology Development of <ul style="list-style-type: none"> ○ GIT ○ Urinary system Histology <ul style="list-style-type: none"> ○ GIT ○ Urinary system 	<ul style="list-style-type: none"> ● GIT ● Liver ● Body fluids ● Renal Physiology ● Acid base balance 	<ul style="list-style-type: none"> ● Biochemistry of Digestive Tract ● Metabolism of Carbohydrates ● Biochemistry of Water & Electrolyte Imbalance and Acid base balance
Y2M2	1. Brain and Spinal cord 2. Nervous system	Gross Anatomy <ul style="list-style-type: none"> ○ Brain and Neuro anatomy Embryology Development of <ul style="list-style-type: none"> ○ CNS ○ Skull ○ Development of genital system Histology <ul style="list-style-type: none"> ○ Nervous System ○ Special senses ○ Reproductive System 	<ul style="list-style-type: none"> ● Sensory Physiology ● Motor Physiology ● Higher Mental Functions ● ANS 	<ul style="list-style-type: none"> ● Xenobiotics ● Metabolism of Proteins and Amino Acids ● Nucleotide Metabolism ● Biochemical Genetics
Y2M3	1. Head, Neck and Special Senses 2. Endocrine System 3. Reproductive system	Gross Anatomy <ul style="list-style-type: none"> ○ Head and neck Embryology Development of <ul style="list-style-type: none"> ○ Head and neck ○ Special senses Development of integumentary system Histology <ul style="list-style-type: none"> ○ Endocrine glands ○ Histology of integumentary System 	<ul style="list-style-type: none"> ● Endocrinology ● Reproduction & neonatal physiology ● Special Senses 	<ul style="list-style-type: none"> ● Metabolism of Lipids ● Integration of metabolism ● Bioenergetics ● Biochemistry of Endocrine System

BLOCK-I

Section-I

Anatomy

Summary:

Code	Y2M1
Name	Anatomy
Duration	10 weeks
Broad Themes of Module (Theme: a subject that is being integrated a majority of time of module)	<ul style="list-style-type: none">• Abdomen, pelvis and perineum• GIT• Urinary system
Subject Themes	Gross Anatomy Abdomen, pelvis and perineum Embryology Development of <ul style="list-style-type: none">○ GIT○ Urinary system Histology <ul style="list-style-type: none">○ GIT○ Urinary system
Prerequisite Module	Y1M1 ,M2 &M3

Mode of Information Transfer:

MIT
Lectures
Dissection
Demonstration
CBL
Practical
Dissection movies

GROSS ANATOMY:

Topic	Learning Objectives	MITs
<p>Abdomen</p>	<p>Division of abdomen into regions and quadrants and their contents</p> <ul style="list-style-type: none"> • Describe the Division of abdomen into regions and quadrants • Enlist the contents of abdominal regions <p>Anterior abdominal wall</p> <ul style="list-style-type: none"> • Describe the details of anterior abdominal wall. • Identify the layers of abdominal wall. • Identify the superficial and deep fascia and muscles of abdominal wall. • Describe the formation of rectus sheath and its importance. <p>Nerves of abdomen</p> <ul style="list-style-type: none"> • Describe nerve supply of anterior and posterior abdominal wall. • Identify & create a visual representation of nerves supplying the abdomen. • Sequence and categorize information on the segmental sympathetic supplies and referred pain. • Explain the basic structure of paravertebral plexuses. • Describe somatic nervous supply of abdomen <p>Inguinal Canal</p> <ul style="list-style-type: none"> • Describe Walls of Inguinal Canal • Describe Deep Inguinal Ring & Superficial Inguinal Ring • Identify Structures passing through the inguinal canal • Enlist Coverings of spermatic cord • Explain Mechanics of the inguinal Canal • Define hernia and describe its types • Discuss Direct & indirect Inguinal Hernia • Discuss Surface marking of inguinal canal <p>Peritoneal Cavity & Peritoneal Relationships</p> <ul style="list-style-type: none"> • Define peritoneum • Understand the different folds of peritoneum, i.e., peritoneal ligaments, omenta and mesenteries. • Discuss the pouches, recesses and gutters formed by peritoneal enfoldings • Describe greater and lesser sacs • Enlist the intraperitoneal and retroperitoneal viscera • Discuss vertical tracings of peritoneum 	<p>LGIS/ Demos</p>

	<ul style="list-style-type: none"> • Describe arrangement of peritoneum in transverse section of abdomen • Describe arrangement of peritoneum in transverse section of male pelvis • Describe arrangement of peritoneum in transverse section of female pelvis • Discuss nerve supply of peritoneum • Discuss clinical correlates of peritoneum including peritoneal infection, peritoneal pain. • Discuss the clinical importance of peritoneal cavity as dialyzing chamber <p>Posterior Abdominal Wall</p> <ul style="list-style-type: none"> • Identify structures forming posterior abdominal wall. • Describe muscles of posterior abdominal wall. • Identify attachments of lumbar fascia <p>Lymphatic Drainage of Abdomen</p> <ul style="list-style-type: none"> • Name the lymph nodes draining the abdomen • Enlist the lymphatics draining the abdominal wall & the abdominal viscera. • Identify the terminal group of lymph nodes around abdominal aorta • Describe the lymphatic trunks, cisterna chili & the thoracic duct. • Lumbar Vertebrae • Explain general characteristics of lumbar vertebrae including body and arch of lumbar vertebrae • Describe processes like superior and inferior articular, transverse, spinous, mammillary accessory processes • Describe first lumbar vertebra & fifth lumbar vertebra • Discuss lumbar spinal stenosis <p>Esophagus (abdominal part), stomach</p> <ul style="list-style-type: none"> • Explain gross features of abdominal part of esophagus & stomach. • Name their peritoneal & visceral relations. • Explain their blood supply, lymphatic drainage & nerve supply • Describe achalasia, GERD and esophageal varices. • Discuss gastric ulcer and its perforation, cancer of stomach and its lymphatic spread. <p>Duodenum and pancreas</p> <ul style="list-style-type: none"> • Identify duodenum • Describe four parts of duodenum • Identify the relations of different parts of duodenum • Give their blood supply and venous drainage. 	
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Small Intestine & large intestine (comparison of two)

- Describe the basic anatomy of small & large intestine
- Identify the important gross features of large intestine
- Explain the basic gross features which differentiate large intestine from small intestine
- Identify the appendix on the basis of its distinguished features
- Give relations of small and large intestine.
- Describe the characteristics of ano-rectal regions
- Discuss the blood supply, nerve supply and venous and lymphatic drainage of small and large intestine.
- Discuss clinical correlates of small and large intestines and appendix
- Discuss meckels diverticulum, resection of different parts of gut and its clinical effect
- Discuss clinical problems occurring due to occlusion of GIT blood vessels

Abdominal aorta+ blood supply of abdomen

- Describe the position and the vertebral levels of aorta in the abdomen.
- Enlist the main branches of the aorta and their territories.
- Explain the applied anatomy of the aorta.

Inferior vena cava + venous drainage of abdomen

- Describe the formation of inferior vena cava
- Enlist the tributaries of inferior vena cava
- Explain abdominal and thoracic relations of this vein
- Discuss clinical importance of inferior vena cava.

Liver

- Describe the anatomical structure of liver.
- Identify lobes, surfaces and ligaments of liver.
- Discuss its relations
- Identify bare area of liver on a model of liver.
- Give its blood supply lymph drainage and nerve supply
- Discuss its clinical correlations

Gall bladder and biliary tract

- Describe the location, size, relation and blood supply of gallbladder
- Explain differences between Intra & Extra Hepatic Biliary Systems
- List different components of Extra-hepatic biliary System

	<ul style="list-style-type: none"> • Identify the right & left hepatic ducts, common hepatic duct, cystic ducts, bile duct • Describe clinical conditions related to gallbladder <p>Hepatic portal system</p> <ul style="list-style-type: none"> • Describe the hepatic portal circulation. • Explain the anatomy of hepatic vein. • Describe the Portal -Caval anastomosis. • Explain the clinical correlation of hepatic portal system. <p>Kidney</p> <ul style="list-style-type: none"> • Describe the gross features of kidney and its coverings • Differentiate the anterior and posterior surfaces and relations of kidney. • Identify the internal structure of kidney • Describe the blood Supply of Kidney • Describe the Lymph nodes draining the kidney • Explain the Nerve supply of Kidney • Identify ureter, urinary bladder and urethra • Describe the course constrictions and relations of ureter • Discuss the blood supply and venous drainage of ureter. • Give location and description of suprarenal glands • Discuss their gross features and relations • Discuss their blood supply lymph drainage and nerve supply • Give clinical correlations of kidney ureter and suprarenal glands 	
<p>Pelvis Bones and joints</p>	<ul style="list-style-type: none"> • Identify surface marking of stomach, spleen, liver, gall bladder, kidney & appendicular orifice. • Identify the surface anatomy of <ul style="list-style-type: none"> ➤ Kidney, ➤ Ureter and ➤ Urinary bladder • Perform the Surface anatomy of the kidney on human bony landmarks 	<p>LGIS/ Demos</p>
	<ul style="list-style-type: none"> • Define bony pelvis, true and false pelvis • Describe surfaces of sacrum. • Explain articulation. • Identify muscles associated with sacrum. • Differentiate between male and female sacrum. • Enlist various types of joints of pelvis. • Explain type, articulations, ligaments and relations of joints. • Enlist factors providing stability to joint. • Describe blood supply , nerve supply & movements of joint • Differentiate the greater & lesser pelvis. • Describe the superior & inferior circumference and 	

	<p>their boundaries.</p> <ul style="list-style-type: none"> • Describe the anatomical position of pelvis. • Differentiate the shapes of female pelvis regarding childbirth. • Differentiate between male & female pelvis. 	
<p>Pelvic diaphragm</p> <p>Vessels and nerve supply of pelvis</p>	<ul style="list-style-type: none"> • Describe the anatomy of the pelvic walls. • Discuss the muscles of pelvic floor and formation of pelvic diaphragm • Develop an understanding of blood supply, nerve supply, and lymphatic drainage of muscles. • Describe actions of pelvic diaphragm • Identify pelvic nerves. • Describe Sacral plexus. • Identify coccygeal plexus. • Describe pelvic hypogastric plexus. • Discuss main arteries of pelvis common iliac artery external iliac artery internal iliac artery arteries of true pelvis. • Describe main veins of the pelvis and their tributaries. • Identify area of drainage of these veins. • Describe different groups of lymph nodes. • Explain the role of lymphatics and common route and spread of malignancies of pelvis. 	LGIS/ Demos
<p>Sigmoid colon and rectum</p>	<ul style="list-style-type: none"> • Describe sigmoid colon. • Describe rectum. • Explain relations, blood supply and innervation of these pelvic organs • Discuss their important clinical correlations 	LGIS/ Demos
<p>Urinary bladder</p>	<ul style="list-style-type: none"> • Discuss urinary bladder, its peritoneal covering and internal structure • Discuss blood supply venous drainage and lymph drainage of urinary bladder • Describe nerve supply and mechanism of micturition • Discuss clinical correlates of urinary bladder including urinary retention, difficulty with micturition after spinal cord injury, bladder injuries 	LGIS/ Demos
<p>Male genital organs</p>	<ul style="list-style-type: none"> • Explain male genital organs, their structure, position, function and important relations • Discuss vas deferens, seminal vesicle, and ejaculatory ducts • Give their blood supply and lymphatic drainage • Discuss prostate, its lobes and its relations • Describe its blood supply and lymphatic drainage • Discuss its clinical correlates including benign prostatic hyperplasia and CA prostate. 	LGIS/ Demos
<p>Ovaries fallopian tubes and uterus</p>	<ul style="list-style-type: none"> • Identify ovaries and fallopian tubes. • Describe the parts of ovaries and fallopian tubes. • Identify the ligaments of ovaries 	LGIS/ Demos

	<ul style="list-style-type: none"> Enumerate the clinical correlates of ovaries and uterine tubes. Explain the details of uterus, cervix and vagina. Enumerate the parts of uterus, ligaments, relations and support of uterus. Discuss the role of uterus in labour Identify the clinical correlates of uterus, cervix and vagina 	
PERINIUM	<ul style="list-style-type: none"> Identify borders and relations of the perineum. Describe divisions of the perineum. Explain superficial and deep perineal pouch and their contents Explain cutaneous nerves of the perineum. Define perineal body. 	LGIS/ Demos
Anal canal	<ul style="list-style-type: none"> Explain the gross anatomy of Anal Canal Identify the relations of the anal canal with the surrounding structures. Describe the blood supply, venous and lymphatic drainage of anal canal. Explain innervations of anal canal. Discuss clinical conditions of anal canal. Describe hemorrhoids and their types Discuss perianal hematoma, fissure, abscess and fistula Discuss incontinence after trauma and spinal cord injury 	
Ischiorectal fossa	<ul style="list-style-type: none"> Identify the boundaries and recesses of ischiorectal fossa Describe the contents of ischiorectal fossa Describe ischiorectal fossa infection 	
Testis	<ul style="list-style-type: none"> Describe the coverings of testis. Recognize the internal features of testis. Explain the significance of pampiniform plexus. Justify the location of testis outside the body Integrate the knowledge of descent of testis to its vessels, lymphatics and nerves. Recall the different clinical conditions associated with testis. 	
Male Urogenital Triangle	<ul style="list-style-type: none"> Describe gross anatomy of male external genitalia. Describe the gross structure of penis Explain its arterial, venous drainage & nerve supply. Describe scrotum and its walls Discuss its blood supply and lymphatic drainage Describe the nerve supply of anterior and posterior walls of scrotum. Explain anatomy of male urethra, its arterial, venous drainage & nerve supply. Discuss injury to different parts of male urethra and extravasation of urine. 	LGIS/ Demos
Female Urogenital Triangle	<ul style="list-style-type: none"> Enlist the names and anatomical location of female external genitalia. 	LGIS/ Demos

	<ul style="list-style-type: none"> • Explain function, arterial supply, venous drainage and nerve supply of female external genitalia. • Discuss clinical importance of female external genitalia. • Explain course & relations of female urethra. • Describe arterial supply, venous drainage and nerve supply of female urethra. • Discuss clinical importance of female urethra. 	
EMBROYOLOGY		
GIT	<ul style="list-style-type: none"> • Describe the divisions of primitive gut. • Describe the derivatives of foregut. • Describe the development of the derivatives of foregut. • Describe the applied anatomy of derivatives of foregut • Describe the derivatives of midgut. • Explain physiological herniation of midgut • Explain the rotation of midgut. • Describe derivatives of hindgut. • Discuss the formation of dorsal and ventral mesentery and structures taking origin from them • Describe the clinical correlation of mid and hind gut. • Describe the congenital anomalies of gut • Enlist the special features associated with common anomalies related to gut including: <ul style="list-style-type: none"> ➤ Cleft lip or cleft palate ➤ Hernias • Esophageal atresia • Describe the congenital anomalies of gut • Enlist the special features associated with common anomalies related to gut including: <ul style="list-style-type: none"> ➤ Mal-rotation of gut ➤ Anorectal malformations • Explain the hepatic and cystic buds • Discuss the site and source of parenchymal and stromal tissue of liver and gall bladder. • Explain the origin of pancreatic buds and their derivatives in adult pancreas • Explain congenital anomalies of liver, gall bladder and pancreas. 	LGIS
Urinary System	<ul style="list-style-type: none"> • Describe the development of kidneys, their collecting system and excretory system • Discuss the congenital anomalies of kidneys, renal agenesis, horse shoe kidney, and wilms tumor • Describe the development of urinary bladder. • Explain the development of urethra. • Describe the congenital anomalies related to them. 	LGIS
HISTOLOGY		
GIT	<ul style="list-style-type: none"> • Give overview of digestive system • Describe structure of the gastrointestinal tract, GIT • Explain histological features of layers of GIT 	LGIS / Lab

	<ul style="list-style-type: none"> • Describe histological features of structure of each layer of esophagus • Describe different regions of stomach, grossly and histologically • Explain various layers of the wall of stomach • Describe different glands and the various kind of cells present in them • Identify the parts of small intestine. • Describe the histological features of different parts of small intestine. • Briefly review the gross anatomy of pancreas • Discuss the histological components of pancreas • Discuss the histological details of Parenchyma and Lobules (acini) of Pancreas • Discuss the Duct System of Pancreas • Describe the endocrine component of pancreas • Describe the basic anatomy of large intestine • Identify the important histological features of large intestine • Explain the basic histological features which differentiate large intestine from small intestine • Identify the appendix on the basis of its distinguished features • Describe the characteristics of anorectal regions • Identify histology of liver • Explain common liver disorders • Explain clinical manifestations of liver disorders. • Describe Gall bladder histology • Describe the histological architecture of liver • Identify the structural details of hepatocytes, portal triad, hepatic sinus & hepatic lobule • Describe the different components of biliary tract • Identify the histological appearance of gall bladder 	
<p>Urinary System</p>	<ul style="list-style-type: none"> • Describe the detailed microscopic features of nephron and collecting ducts • Describe the location of the ureter & urinary bladder • Explain the histology of <ul style="list-style-type: none"> ➤ Ureter, ➤ Urinary bladder and Urethra 	<p>LGIS / Lab</p>

List of Histology Practical's- 1st Year MBBS Class first module

Histology Practical's Y2 M1

- a. Esophagus
- b. Gastro-esophageal junction, Stomach, Pyloric-duodenal junction
- c. Small intestine
- d. Large intestine
- e. Appendix
- f. Pancreas
- g. Liver & gall bladder
- h. Kidney
- i. Ureter
- j. Urinary bladder

Case Base Learning Scenarios:

CBL 1 - Anatomy

A case of abdominal wall hernia

Learning objectives:

1. Revise the structure of the anterior abdominal wall, its muscles, nerve supply, blood supply and lymphatic drainage.
2. What are the different abdominal planes and regions? What is the significance of dividing the abdomen into regions?
3. Define and learn to mark the inguinal rings.
4. Learn the walls, function and mechanics of inguinal canal.
5. What is hernia? What are the parts of hernia and various types of abdominal wall hernias?
6. Which type of hernia is present in this patient? And how did you make your diagnosis?
7. Learn to differentiate between the direct and indirect inguinal hernia.
8. What is processus vaginalis? And how is it related to inguinal hernia?
9. Why is it necessary to repair a hernia?
10. Which nerve is susceptible to injury during the surgical repair of inguinal hernia? And what are its effects?

Reading References:

1. Snell's Clinical Anatomy, 8th Edition.
2. Clinically Oriented Anatomy, Keith L. Moore, 6th Edition.
3. www.med.umich.edu/lrc/coursepages/.../anatomy/.../clinical_index.ht...

CBL 2 - Anatomy

A case of gastric ulcer

Learning objectives:

1. Learn the parts of stomach, its relations, stomach bed, blood supply, nerve supply and lymphatic drainage.
2. To learn the histological structure of stomach and know the factors which protect the gastric mucosa from acid and enzymes.
3. Define peritoneum and learn its functions.
4. To understand the terms intraperitoneal and retroperitoneal.
5. Understand and locate the peritoneal ligaments, omenta, mesenteries, pouches, recesses and spaces.
6. What are the greater and lesser sacs of peritoneum?

7. How does the greater peritoneal sac communicate with the omental bursa?
8. Account for the chronic ulcer pain (heart burn, diffuse pain epigastrium) that the patient complained of in his history from the acute, sharp, stabbing pain after the perforation has taken place.
9. What is the cause of the rigidity of the abdominal wall and costal character of the patient's respiration?
10. Which major branch of the celiac trunk would be subject to erosion and possible fatal hemorrhage if an ulcer on the posterior wall of the stomach perforates through the gastric mucosa?

Reading References:

1. Snell's Clinical Anatomy, 8th Edition.
2. Clinically Oriented Anatomy, Keith L.Moore, 6th Edition.
3. www.med.umich.edu/lrc/coursepages/.../anatomy/.../clinical_index.ht...

CBL 3 - Anatomy
A case of cirrhosis liver

Learning objectives:

1. To learn the gross anatomy of liver, its lobes (anatomical and physiological), peritoneal reflections, blood supply and relations.
2. Revise the functions of liver.
3. What are the bile ducts of liver?
4. What is the microanatomy and circulation of the liver?
5. What is the hepatic portal system?
6. To learn the location and tributaries of portal vein.
7. What are the connections between the portal circulation and the systemic circulation?
Recall the sites of portal - systemic anastomoses.
8. What goes wrong in cirrhosis of the liver?
9. Why was this patient jaundiced?
10. What is portal hypertension? Why does portal hypertension occur in cirrhosis?
11. Which signs in this patient indicate the portal hypertension?

Reading References:

1. Snell's Clinical Anatomy, 8th Edition.
2. Clinically Oriented Anatomy, Keith L.Moore, 6th Edition.
3. www.med.umich.edu/lrc/coursepages/.../anatomy/.../clinical_index.ht...

CBL 4 - Anatomy

A case of prolapse of uterus

Learning objectives:

1. To know the meaning of uterine, prolapse, stress incontinence and cystocele.
2. To learn the gross features of the uterus and vagina, along with the relations, blood supply, nerve supply and the lymphatic drainage.
3. To revise the peritoneal reflections of the pelvis and the uterus.
4. What are the supports of uterus?
5. What are ligaments of the uterus?
6. Describe the anatomy of the pelvic diaphragm? What muscles make it up?
7. To learn the significance of pelvic diaphragm.
8. The cystocele caused a bulge in the anterior wall of the vagina. What structures could prolapse and cause a bulge in the posterior wall of the vagina?

Reading References:

1. Snell's Clinical Anatomy, 8th Edition.
2. Clinically Oriented Anatomy, Keith L.Moore, 6th Edition.
3. www.med.umich.edu/lrc/coursepages/.../anatomy/.../clinical_index.ht...

CBL 5- Anatomy

Patient with bleeding per rectum

Learning Objectives:

1. Recognize the features of the rectum that differentiate it from the colon.
2. Describe the development of Rectum and Anal canal
3. Describe the development of cloacae and urogenital sinus
4. Describe ano-rectal anomalies
5. Describe the blood supply, venous and lymphatic drainage of anal canal
6. Enlist causes of bleeding per rectum
7. Describe the boundaries of ischio-rectal fossa
8. Demonstrate History taking on a SP with lower GIT bleed
9. Demonstrate examination of a SP with lower GIT bleed.

Reading References:

1. Snell's Clinical Anatomy, 8th Edition.
2. Clinically Oriented Anatomy, Keith L.Moore, 6th Edition.
3. www.med.umich.edu/lrc/coursepages/.../anatomy/.../clinical_index.ht...

Learning Resources:

Anatomy

1. Clinical Anatomy for Medical Students by Richard Snell (8th edition).
2. Basic Histology Text and Atlas by Luiz Carlos and Junqueira (12th latest edition).
3. Medical Embryology by Langman (11th edition).
4. Essential Clinical Anatomy by Keith Moore (6th edition).
5. The Developing Human (clinical oriented embryology) by Keith Moore (8th edition).

BLOCK-I

Section-II

Physiology

Summary:

Code	Y2M1
Name	Physiology
Duration	10 weeks
Broad Themes of Module (Theme: a subject that is being integrated a majority of time of module)	<ul style="list-style-type: none"> • Abdomen, pelvis and perineum • GIT • Urinary system
Subject Themes	<ul style="list-style-type: none"> • GIT • Liver • Body fluids • Renal Physiology • Acid base balance
Prerequisite Module	Y1M1 ,M2 &M3

Mode of Information Transfer:

MIT
Lectures
Tutorials (PTT)
CBL
Practicals
Class tests

Physiology learning outcomes and MITs:

S.No.	Topic	Learning objectives
GIT Physiology		
1.	GIT physiology (LGIS, SGD/tutorial, Practical)	<ul style="list-style-type: none"> • To know the physiologic anatomy of gastrointestinal wall • To understand the role of intestinal cells of cajal in the electrical activity of G.I smooth muscle • To know the enteric nervous system and its role in control of G.I function • To be able to differentiate between myenteric and submucosal plexuses • To be able to explain the autonomic control of G.I tract
2.	Chewing/swallowing reflex (LGIS)	<ul style="list-style-type: none"> • To be able to explain importance of chewing • To know the mechanism of chewing reflex • To be able to describe the process of swallowing • To understand different phases of swallowing reflex • To understand different steps occurring in the involuntary phase of swallowing

		<ul style="list-style-type: none"> • To know the effects of pharyngeal phase of swallowing on respiration • To know how different types of peristalsis in esophagus are taking place • To understand the importance of esophageal sphincter
3.	Functions of stomach & gastric emptying (LGIS)	<ul style="list-style-type: none"> • To be able to categorize different functions of stomach • To know the role of basic electrical rhythm in regulation of G.I motility • To understand the process of stomach emptying • To be able to explain the different factors regulating stomach emptying • To know secretion of different hormones taking place in stomach • To be able to explain different steps taking place in the secretion of hydrochloric acid in stomach
4.	Functions of small intestine (LGIS)	<ul style="list-style-type: none"> • To be able to categorize different types of movements taking place in small intestine • To understand role of ileocecal valve • To understand secretory functions of small intestine
5.	Functions of large intestine (LGIS)	<ul style="list-style-type: none"> • To be able to categorize different functions of large intestine • To be able to explain different types of movements taking place in colon • To understand the role of gastrocolic and duodenocolic reflexes in regulation of mass movements • To know the secretory functions of large intestine and its nervous control
7.	Defecation reflex (LGIS)	<ul style="list-style-type: none"> • To be able to explain the process of defecation • To understand the pathway of defecation reflex • To know different types of defecation reflex • To know the pathophysiological basis of megacolon
8.	Vomiting reflex (LGIS)	<ul style="list-style-type: none"> • To understand the factors leading to the process of vomiting • To be able to explain the location of vomiting center in the brain • To be able to explain the vomiting reflex • To understand the role of chemoreceptor trigger zone for initiating vomiting
9.	Hormones of GIT (LGIS)	<ul style="list-style-type: none"> • To be able to categorize the different types of G.I hormones • To understand the secretion of different hormones from G.I.T and their regulation
10.	Functions of liver	<ul style="list-style-type: none"> • To be able to categorize different functions of liver

		<ul style="list-style-type: none"> To understand the role of liver in the metabolism of bilirubin To know the synthetic functions of liver
Body fluids		
1.	Body fluid compartments (LGIS)	<ul style="list-style-type: none"> To be able to explain total body water content and its distribution in different body compartments To be able to quantify daily intake and output of water from body To understand the fluid present in the potential spaces and mechanism of their collection in these spaces To know the ionic composition of ECF and ICF
2.	Water balance (LGIS)	<ul style="list-style-type: none"> To understand the basic principles of osmosis and osmotic pressure To know the mechanism of maintenance of osmotic equilibrium between ICF and ECF To be able to explain what would be the effect on ICF and ECF compartments when isotonic, hypotonic and hypertonic solution are added to ECF
3.	Edema (LGIS)	<ul style="list-style-type: none"> To understand the role of Starling forces in the development/ prevention of edema To describe role of lymphatics in prevention of edema To be able to understand safety factor and its role in the prevention of edema To be able to describe the causes of intracellular edema To be able to describe the causes of extracellular edema <p>□</p>
Renal Physiology		
1.	Renal physiology (LGIS, SGD/tutorial)	<ul style="list-style-type: none"> To know the functional anatomy of urinary system To understand the multiple functions of kidneys To know the physiology of micturition To understand the processes involved in urine formation resulting from glomerular filtration, tubular reabsorption, and tubular secretion
2.	GFR and its regulation (LGIS, SGD/tutorial)	<ul style="list-style-type: none"> To know the composition of the glomerular filtrate and glomerular capillary membrane To understand the determinants of the GFR To understand the physiological control of glomerular filtration and renal blood flow To know the autoregulation of GFR and renal blood flow
3.	Processing of glomerular filtrate (LGIS, SGD/tutorial)	<ul style="list-style-type: none"> To be able to describe reabsorption and secretion by the renal tubules To understand the passive and active mechanisms involved in tubular reabsorption

		<ul style="list-style-type: none"> • To understand the reabsorption and secretion along different parts of the nephron • To learn about the regulation of tubular reabsorption • To know use of clearance methods to quantify kidney function
4.	Regulation of Potassium (LGIS)	<ul style="list-style-type: none"> • To know about the regulation of internal potassium distribution • To understand the potassium secretion by principal cells of late distal and cortical collecting tubules • To be able to explain different factors that regulate potassium secretion: plasma potassium concentration, aldosterone, tubular flow rate, and hydrogen ion concentration
5.	Regulation of B.P (LGIS)	<ul style="list-style-type: none"> • To know about the role of kidneys in pressure natriuresis and diuresis • To understand the renal regulation of body fluid volumes and arterial pressure • To understand role of nervous and hormonal factors in renal-body fluid feedback control
6.	Renal regulation of osmolarity (LGIS)	<ul style="list-style-type: none"> • To know the control of extracellular fluid osmolarity and sodium concentration by kidneys • To know the osmoreceptor-ADH feedback system • To understand the role of thirst in controlling extracellular fluid osmolarity and sodium concentration • To understand the role of angiotensin II and aldosterone in controlling extracellular fluid osmolarity and sodium concentration
7.	Micturition reflex (LGIS, SGD/tutorial)	<ul style="list-style-type: none"> • To learn the physiologic anatomy and nervous connections of the bladder • To understand the filling of the bladder and bladder wall tone; the cystometrogram • To be able to explain the micturition reflex and facilitation or inhibition of micturition by the brain • To know about the abnormalities of micturition
8.	Formation of concentrated urine (LGIS, SGD/tutorial)	<ul style="list-style-type: none"> • To understand the obligatory urine volume • To know about the requirements for excreting a concentrated urine—high ADH levels and hyperosmotic renal medulla • To understand the countercurrent mechanism producing a hyperosmotic renal medullary interstitium • To know the role of distal tubule and collecting ducts in excreting a concentrated urine • To understand the role of urea in hyperosmotic renal medullary interstitium and formation of concentrated urine

		<ul style="list-style-type: none"> • To understand the countercurrent exchange in the vasa recta in preservation of hyperosmolarity of the renal medulla • To be able to explain the concentrating mechanism and changes in osmolarity in different segments of the tubule • To be able to quantify renal urine concentration and dilution: “Free Water” and osmolar clearances • To know about the disorders of urinary concentrating ability
9.	Plasma clearance (LGIS, SGD/tutorial)	<ul style="list-style-type: none"> • To know the use of clearance methods to quantify kidney function • To know about estimation of GFR by inulin clearance, and plasma creatinine clearance • To understand PAH clearance for estimation of renal plasma flow • To understand the calculation of filtration fraction, tubular reabsorption and secretion from renal clearance
10.	Acidbase balance (LGIS, SGD/tutorial)	<ul style="list-style-type: none"> • To know the defenses against changes in hydrogen ion concentration: buffers, lungs, and kidneys • To know the buffering of hydrogen ions in the body fluids • To understand the bicarbonate buffer system and quantitative dynamics of the bicarbonate buffer system • To understand the phosphate buffer system, proteins: important intracellular buffers • To be able to explain the respiratory regulation of acid- base balance • To understand renal control of acid-base balance and secretion of hydrogen ions and reabsorption of bicarbonate ions by the renal tubules • To understand the combination of excess hydrogen ions with phosphate and ammonia buffers in the tubule—A mechanism for generating new bicarbonate ions
11.	Acid base Disorders (LGIS, SGD/tutorial)	<ul style="list-style-type: none"> • To know the Renal Correction of acidosis—increased excretion of hydrogen ions and addition of bicarbonate ions to the extracellular fluid • To know the renal correction of alkalosis—decreased tubular secretion of hydrogen ions and increased excretion of bicarbonate ions • To understand causes of acid base disorders • To understand concept of anion gap

Approved List of Practical	
Module 1	
1.	Consultation of research paper at under graduate level
2.	Examination of Vital Signs
3.	Blood glucose estimation
4.	Determination of urine specific gravity
5.	Examination of body Temperature
6.	Examination of Body Mass Index (BMI)
7.	Any other practical relevant to that Module

List of Case Based Learning (CBL)

CBLs Y2M1

1. Gastrointestinal physiology (4)
2. Renal physiology (4)

Total number of CBLs = 8

Gastrointestinal physiology

CBL 1

A 49 yrs old man presented in OPD with complaints of digestive problems. He had difficulty in swallowing both solids and liquids and occasionally regurgitates. The problem is more noticeable when he is under stress or when he eats too fast. He had the feeling that food is stuck in his esophagus and is not going down. He lost 10 lb in last 2 months.

After physical examination the physician advised barium swallow. The reports suggested that he has achalasia. He was advised procedure to physically dilate LES.

Learning objectives

1. To know about enteric nervous system.
2. To know about peristalsis, law of gut and its significance.
3. Role of esophageal peristalsis in normal swallowing.
4. What events occur at LES and at what timing.
5. To know about innervations of lower esophageal sphincter.

CBL 2

An 18 years old boy came to OPD of a hospital with complaints of vomiting and diarrhea since last night. He gave history of taking lunch at a local restaurant a day before yesterday. About a day after that lunch, he developed nausea followed by profuse vomiting and watery diarrhea. On general physical examination, moderate dehydration was noticed. Laboratory investigations revealed presence of E. coli in stool, TLC 12,000/ μ l with neutrophils 75% and serum levels of Na^+ (138 meq/l) and Cl^- (105 meq/l). Patient was given anti emetic drug along with oral rehydration salt (ORS) and appropriate antibiotics. He was advised to observe hygienic eating habits to avoid such incidence in future.

Learning objectives:

1. To know the role of enteric and autonomic nervous system in GI functions.
2. To know the functions of stomach and factors affecting gastric emptying.
3. To know the functions of small & large intestines.
4. To learn about defecation and vomiting reflexes.
5. To learn pathophysiology of diarrhea.

CBL 3

A 67 years old man reported to the emergency department with the complaints of acute onset abdominal pain that aggravated over the past 7 hours. He also complained of uncontrollable stool voiding, which were mucoid and blood stained. He had smoked more than 30 cigarettes a day, for the last 40 years and gave a 3 yrs history of claudication.

Plain abdominal radiograph did not show any abnormality, however, a diagnosis of acute mesenteric ischemia, consequent to thromboembolism of mesenteric vessels was established on the result of contrast enhanced CT scan. The patient was prepared for total colectomy and the surgery went uneventful.

The surgeon advised the ward staff to ensure IV hydration therapy of the patient and daily blood sampling for blood CP and electrolytes along with regular monitoring of his vital signs and 6 hourly ECG recording. His vitamin K levels were also advised to be checked on every third day.

Learning objectives:

1. Know the functions of large intestine.
2. Understand the mechanisms of electrolyte homeostasis related to colon.
3. Co-relate the effects of electrolyte disturbances consequent to colectomy on ECG.
4. Describe the relation of vitamin K absorption and large intestine.
5. Elaborate the significance of colectomy with probable development of _____ anemia in this patient.

CBL 4

A 12-year-old boy brought to the hospital by his parents with complains of large amounts of watery diarrhea and vomiting for 1 day. Diarrhea was sudden in onset and painless. The stool passed having characteristic "rice-water" appearance with few flecks of mucus in it. He vomited large amount of clear fluid 4-6 times in one day and having continuous feeling of nausea. He was thirsty and has complains of intense cramps in his calf muscles. His vitals include: BP 90/70 mm Hg, Pulse 110 beats/min, RR 18 breaths/min & Temp 99 °F. On general physical examination he was looking restless and irritable with dry tongue, decreased skin turgor and sunken eyes. Lab investigations revealed severe electrolyte imbalance with particularly decreased plasma concentrations of Na^+ , Cl^- & HCO_3^- . Microscopic examination of stool revealed teeming of diarrheal fluid with motile comma-shaped bacteria. On the basis of history and clinical findings he was diagnosed as a case of **cholera**.

Learning objectives:

1. Discuss mechanism of development of diarrhea in cholera infection.
2. What should be your treatment plan for this patient?
3. Define diarrhea and classify it.
4. Understand various levels of dehydration and their associated signs & symptoms.
5. What are possible complications of severe dehydration?
6. Discuss pathway of vomiting reflex.
7. Elucidate steps of act of vomiting.
8. Differentiate between vomiting center and chemoreceptor trigger zone.
9. Discuss basic movements of small intestine.
10. Discuss regulation of peristaltic activity in the small intestine.
11. Discuss defecation reflexes.
12. Discuss important functions of normal flora (colonic bacteria) of colon.

Renal Physiology

CBL 5

A 5-year-old boy presents to the urgent care clinic because his mother noticed that the child is not going to the bathroom and his feet are swollen. Two weeks earlier the child was treated for streptococcal throat infection with penicillin. The mother admits to ceasing administering the medication to the child after a couple of days because she thought the child felt better. **PHYSICAL EXAMINATION**

Vital Signs: Temp 37°C, Pulse 78/min, Resp rate 15/min, BP 120/90 mm Hg

Physical Examination: The patient is oliguric and has a slight fluid accumulation in the lower extremities and peri-orbital region. There is palpable peripheral edema in both feet.

LABORATORY STUDIES

Urinalysis: Very dark urine, presence of red blood cells, red blood cell casts, and protein (>3 g/day)

Serum complement C3, C4, CH50 levels: Low

ASO titer: 250 units/mL (normal: <160 units/mL) Anti D

Nase-B level: > 60 units

BUN: 32 mg/dL (normal: 7-18 mg/dL)

Creatinine: 2.0 mg/dL (normal: 0.6-1.2 mg/dL)

DIAGNOSIS Post streptococcal glomerulonephritis

Learning objectives:

1. After discussion you should be able to:
2. Describe the morphology of a typical nephron and its blood supply.
3. Define autoregulation and list the major theories advanced to explain autoregulation in the kidneys.
4. Define glomerular filtration rate, describe how it can be measured, and list the major factors affecting it.
5. Outline tubular handling of Na⁺ and water.
6. Discuss tubular reabsorption and secretion of glucose and K⁺.
7. Describe how the countercurrent mechanism in the kidney operates to produce hypertonic or hypotonic urine.
8. List the major classes of diuretics; understand how each operates to increase urine flow.
9. Describe the voiding reflex and draw a cystometrogram.

CBL 6

Salar, a 20 years old teenager is fond of fast food and insists on drinking soft drinks whenever he feels thirsty. On a recent trip to a fast food outlet he suspected eating stale burger and returned home feeling nausea, light headedness and lassitude. During the night he had two episodes of vomiting and had to go to washroom thrice for passing stools which were watery in consistency. He insisted on drinking soft drinks when he felt thirsty and weak after vomiting with little relief to symptoms. On next day medical examination, he was diagnosed with mild gastroenteritis and prescribed appropriate medication and fluids. He recovered within 24 hours.

Learning objectives:

1. To understand the concept of ECF osmolarity and Na^+ concentration.
2. To elaborate mechanism of excreting concentrated urine.
3. To know definitions of osmolar clearance and free water clearance.
4. To understand thirst mechanism and describe thirst centre and osmo-receptor ADH feedback mechanism.
5. To elaborate regulation of blood volume.
6. To elaborate regulation of ECF volume.

CBL 7

A 16-year-old high school student is brought to the emergency department by the emergency medical service after being found lying in the front yard of a neighbor's house, where he was mowing the lawn. The patient has a regular yard service and has been mowing for several months without problems. The patient was finishing his sixth yard for the day during a summer month with temperatures exceeding 37.8°C . His mowing partner noticed that the patient had been complaining of fatigue, light-headedness, nausea, and profuse sweating in the previous yard. While mowing the last yard, he became very confused and behaved oddly before finally losing consciousness. In the emergency department, he is tachycardic, with a temperature of 40.6°C . He is lethargic, and his skin is dry. He is diagnosed with heat stroke, and therapy is begun immediately.

Learning objectives:

1. To understand concept of fluid osmolarity.
2. To understand systemic effects of ECF osmolarity.
3. To develop knowledge of renal regulation of fluid osmolarity.
4. To develop an understanding of fluid regimens available for hydration.
5. To gain insight into fluid overload and edema formation in body.

CBL 8

A 21-year-old man with insulin-dependent diabetes presents to the emergency center with mental status changes, nausea, vomiting, abdominal pain, and rapid respirations. On examination, the patient is noted to be hypotensive, breathing rapidly (tachypneic), and febrile. A fruity odor is detected on his breath. A random blood sugar is significantly elevated at 600 mg/dL. The patient also has hyperkalemia, hypomagnesemia, and elevated serum ketones. An arterial blood gas reveals a metabolic acidosis. The patient is diagnosed with diabetic ketoacidosis (DKA) and is admitted to the intensive care unit for intravenous (IV) hydration, glucose control, and correction of metabolic abnormalities.

Learning objectives:

1. To understand basis of acid base regulation in human body.
2. To list various renal and respiratory mechanisms for acid base regulation.
3. To develop an understanding of electrolyte buffer systems.
4. To develop and understanding of acid base disorders.
5. To interpret laboratory findings of various acid base disorders.
6. To gain insight into concept of anion gap.
7. To develop an understanding of treatment options available for acid base disorders.

BLOCK -I

Section-III

Biochemistry

Summary:

Code	Y2M1
Name	Biochemistry
Duration	10 weeks
Broad Themes of Module (Theme: a subject that is being integrated a majority of time of module)	<ul style="list-style-type: none"> • Abdomen, pelvis and perineum • GIT • Urinary system
Subject Themes	<ul style="list-style-type: none"> • Biochemistry of Digestive Tract • Metabolism of Carbohydrates • Biochemistry of Water & Electrolyte Imbalance and • Acid base balance
Prerequisite Module	Y1M1, M2 & M3

Mode of Information Transfer:

MIT
Lectures
Tutorials (PTT)
CBL
Practicals
Class tests

Biochemistry learning outcomes and MITs:**Subject Name: Biochemistry**

S.No	Topic	Learning Outcome
1	Biochemistry of Digestive Tract (LGIS, SGD/tutorial)	a. Introduction of digestion and absorption b. Introduction, composition, functions, daily secretion, stimulants and depressants of <ul style="list-style-type: none"> - Saliva - Gastric Juice & HCL - Pancreatic Juice - Bile Juice - Succus Entericus c. Digestion and absorption of carbohydrates, proteins, nucleic acid and lipids d. Biochemical disorders of GIT, e.g. achlorhydria, peptic ulcers, lactose intolerance, cholelithiasis and related disorders
2	Metabolism of Carbohydrates (LGIS, SGD/tutorial)	a. Glycolysis - Phases and reactions of Glycolysis - Energetics of Aerobic and Anaerobic glycolysis

		<p>and their importance - Regulation of Glycolysis</p> <p>-</p> <p>Cori's cycle - The fate of Pyruvate</p> <p>b. The Citric Acid Cycle</p> <p>c. Reactions, energetics and regulation and importance of Citric acid cycle - Amphibolic nature of citric acid cycle. The anaplerotic reactions and regulations of TCA cycle</p> <p>d. Gluconeogenesis - Important three bypass reaction of gluconeogenesis - Entrance of amino acids and intermediates of TCA cycle and other nutrients as gluconeogenic substrates - Significance of gluconeogenesis</p> <p>e. Glycogen Metabolism - Reactions of Glycogenesis and glycogenolysis - Importance of UDP-Glucose - Regulation of Glycogen Synthase and Glycogen Phosphorylase - Glycogen phosphorylase 'a' and the blood glucose sensor - Disorders of Glycogen metabolism (Glycogen Storage Diseases)</p> <p>f. Secondary pathways of carbohydrate (Hexose) metabolism - Hexose Mono Phosphate Shunt, its reactions and importance - Glucuronic acid pathway, its reactions and importance</p> <p>g. Metabolism of Fructose, Galactose and Lactose</p> <p>h. Regulation of Blood Glucose Level - Hyperglycemia, hypoglycemia and their regulating factors - Biochemistry of Diabetes Mellitus, its Laboratory findings and Diagnosis</p>
3	Biochemistry of water & Electrolyte imbalance and Acid Base Balance (LGIS, SGD/tutorial)	<p>a. Distribution of body water</p> <p>b. Functions of water in human body</p> <p>c. Regulation of water balance</p> <p>d. Role of kidneys in water and electrolyte balance</p> <p>e. Hyper and hypo natremia, kalemia and magnesnia</p> <p>f. Acid base balance</p> <p>g. Mechanisms of acid base regulation</p> <p>h. Disorders of acid base balance</p>

List of Practical:

a.	Serum Creatinine	Estimation and clinical interpretation
b. .	Serum Creatinine Kinase	Estimation and clinical interpretation
c.	The Techniques and Instrumentation of pH Meter	<ul style="list-style-type: none"> • Identify the following • Principle • Enlist its uses
d.	Techniques and Instrumentation of spectrophotometer	<ul style="list-style-type: none"> • List the differences between spectrophotometer and UV-spectrophotometer • Identify different parts of spectrophotometer • Enlist the functions of different parts of spectrophotometer • Perform spectrophotometry by applying its working principle (Beer's Lambert's law) to quantify the analytes in a given solution, for determination of different diseases e.g. MI, Liver diseases.
e.	Estimation and clinical interpretation of Electrolytes in blood	<ul style="list-style-type: none"> • Principle of Flame Photometer • Important Electrolytes • Reference range of <ul style="list-style-type: none"> ▪ Sodium ▪ Potassium ▪ Chloride • Causes of: <ul style="list-style-type: none"> ▪ Hyperkalemia ▪ Hypokalemia ▪ Hyponatremia ▪ Hyponatremia
f.	Estimation and Clinical Interpretation of Serum Glucose	<ul style="list-style-type: none"> • Using semi automatic chemistry analyser, microlab 300 machine student must learn how to estimate exact concentration of glucose in a given sample i.e. plasma • Causes of hypo and hyperglycemia • To know the principle of the test i.e. chemical reaction involved • Random blood sugar • Fasting blood sugar

g.	Oral Glucose Tolerance Test and its Clinical Interpretation	<ul style="list-style-type: none"> • To learn the method, principle and significance of the test • To learn its interpretation • To know its indications
h.	Estimation and Clinical Interpretation of plasma enzyme ALP	<ul style="list-style-type: none"> • Using semi-automatic chemistry analyzer, micro lab 300 machine student must learn how to estimate exact concentration of ALP in a given sample i.e. plasma • To know the principle of the test i.e. chemical reaction involved • Use of the test in clinical setting • Reference range

List of Case Based Learning (CBL):

Topic: Biochemistry of Digestive Tract (Lactose Intolerance) CBL Session – 1, 2nd Year

A 30 year old white man from British embassy reported with bloating, abdominal pain and diarrhea for 3 hours. He was a known patient of IBD and a careful history revealed ingestion of ice cream just before the onset of symptoms. Attending physician suspected lactose intolerance (not adult hypolactasia) and advised the patient lactose free diet after symptomatic management.

Related Lab Investigations:

Test Name	Result	Normal Values
Hydrogen breath test	Hydrogen 30ppm after 1.5 hrs of ingestion of 50 g lactose	Less than 20 ppm
Stool RE	Normal study	Normal study

Lactase is an intestinal brush border enzyme which hydrolyzes disaccharide lactose to glucose and galactose. Its expression is maximum in infants and gradually decreases with advancing life in most people of non- European ancestry. More than 70-90 percent people of Caucasians, Africans and American ancestry exhibit a decline in lactase expression also called adult hypolactasia. More over some GIT diseases which affect mucosa like, IBD (Crohn's disease), short bowel syndrome, malnutrition, sprue etc may also lead to lactase deficiency. Ingested lactose is neither thus digested nor absorbed and passes to colon where bacterial fermentation of lactose produces gas and organic acids. Organic acids osmotically draw water and cause increased peristalsis, cramps and diarrhea. The treatment and prevention rely on lactose free diet.

Learning Objectives:

1. Digestion and absorption of carbohydrates
2. Lactose intolerance
3. Other diseases related to digestion and absorption of carbohydrates

CBL Session – 2, 2nd Year

Topic: Biotechnology Techniques-PCR Etc. (HCV & Lymphoma)

A 54-year-old male presented with fever, night sweats and weight loss. He also complained of a non-tender, non-inflammatory mass on left lateral side of his neck. The mass has grown to the size of a hazelnut since it was first noticed 6 weeks ago. On examination submandibular

and supraclavicular nodes were palpable. Blood complete picture was normal but patient was diagnosed as a case of B Cell Non Hodgkin lymphoma with the help of tissue histology and bone marrow aspiration cytology. During the laboratory investigation phase he was incidentally found to be a patient of HCV infection as well.

In addition to commitment about the treatment and prognosis of the lymphoma, attending physician was also concerned about the status of his HCV infection. He ordered abdominal ultrasound to check for liver cirrhosis and Quantitative PCR to check for HCV viral load.

Related Lab Investigations:

Test Name	Result	Normal Values
Hemoglobin	14 g/dL	Adult Male 13-18 g/dL Adult Female 12-16 g/dL
WBC Count	11.5 x 10 ⁹ / L	4.0x11.0x10 ⁹ /L
(Tumor/mass)Lymph Node Biopsy	B Cell lymphoma cells seen	Normal cytology
Lymphoma cells in peripheral blood smear	Not seen	Not seen
Bone marrow biopsy for histological examination	Monoclonal lymphoid aggregates seen	No such aggregates
LDH	630 U/L	225-450 U/L
Anti HCV Antibody test	Positive	Negative
USG Abdomen	Nodular and shrunken appearance of liver but mild changes	Normal echo-texture

Test Name	Result	Normal Values
Quantitative PCR (for viral RNA)	700,000 IU/MI	Normally it is negative Viral Load is expressed as copies/mL: Low: less than 2 M/mL • High: more than 2 M/mL Or Expressed as International Units(IU/mL): • Low: less than 800,000 IU/mL • High: more than 800,000 IU/mL
Cytogenetic testing in culture sample (2 -3 weeks)	No abnormal chromosomal pairing or less or	Normal chromosomal pairing and normal number

	more chromosomes found	
Fluorescent in situ hybridization (FISH) for t(14;18) of c-myc	No translocation found on microscopy	No translocation
PCR for Immunoglobulin light chain gene rearrangements	This test was carried out as there was a research center nearby and outcome had a research benefit as well. For patient it was helpful in determining whether it was reactive or malignant	

Though HCV and lymphoma is not a common combination in patients encountered in clinics but it has been selected to emphasize role of biotechnology techniques in diagnosis, management and prognosis of both the diseases. PCR is a very basic technique of DNA selected portion amplification in vitro from even minute quantities of DNA. It makes DNA ample to carry out any genetic analysis. In HCV patients quantitative PCR is routinely advised to see viral load. While in lymphoma certain related immunoglobulin gene rearrangement can be checked to understand etiology of the disease better.

Learning Objectives:

1. Molecular Biology Techniques and their applications
2. Procedure, principle and uses of PCR
3. Types of PCR

CBL Session – 3, / 2nd year

Topic: CO poisoning and Metabolic Acidosis (DKA)

A 50-year-old chowkidar of boy's high school was brought to emergency in semi-comatose state at 6 am. He was a known diabetic for last 10 years and had similar episode two months back but that time he was conscious and walked in himself. His capillary sugar level was high, blood pressure was 100/70mmHg, pulse 100/min and respiratory rate was 30/min. He was moderately dehydrated, no other significant finding was there and laboratory investigations revealed following.

Related Lab Investigations:

Test Name	Result	Normal Values
Plasma Glucose levels	16mmol/L	Max 11.1 random
pH	7.30	7.35 to 7.45
HCO ₃	16	24 mEq/L
pCO ₂	35	40 mmHg
Ketone bodies in urine	Positive	Negative

As the compensation of the primary acidosis was not appropriate so he was diagnosed as a case of mixed acid base disorder (Metabolic acidosis and respiratory acidosis). A careful history revealed that he used a stove for heating in the room which used wood fire. This lead the physician to suspect CO poisoning as well. CO inhibits ETC and hampers ATP synthesis moreover it reduces the availability of active Hb for normal tissue oxygenation and CO₂ removal. The treatment included oxygen support, HCO₃ administration slow iv, scinsulin for hyperglycemia and iv fluids.

Learning Objectives:

1. How to diagnose acid base disorders
2. ETC and oxidative phosphorylation
3. Inhibitors of ETC and Oxidative phosphorylation including CO

Primary Disorder	Change	Compensation
Metabolic acidosis	↓ HCO ₃ 1	↓ 1.3 CO ₂
Metabolic alkalosis	↑ HCO ₃ 1	↑ 0.7 CO ₂
Respiratory acidosis		
Acute	↑ pCO ₂ 10	↑ 1 HCO ₃
Chronic	↑ pCO ₂ 10	↑ 3.5 HCO ₃
Respiratory alkalosis		
Acute	↓ pCO ₂ 10	↓ 2 HCO ₃
Chronic	↓ pCO ₂ 10	↓ 5 HCO ₃

**CBL Session – 4, / 2nd year
Topic: Cholera(Water & Electrolytes)**

A 21-years-old female law student working in a developing country suddenly began to pass profuse watery stools almost continuously. She soon started to vomit. Her general condition declined abruptly, and she was rushed to the local village hospital. On admission, she was cyanotic, skin turgor was poor, blood pressure was 70/50 mmHg (normal 120/80 mm Hg), and her pulse was rapid and weak. The doctor on duty diagnosed cholera, took a stool sample, and started treatment immediately. Patient was isolated and given normal saline with 20mmol/L K⁺ added (ringers lactate was not administered). Doxycycline 500mg every 6 hours was started and plenty of ORS was advised after initial IV fluids. The relatives were called for

counseling. As cholera can become epidemic or pandemic, relatives were given following advice to follow and teach others.

1. Drink only boiled or treated water.
2. Cook well and eat hot.
3. Avoid shellfish.
4. Peel all vegetables and fruits.

Related Lab Investigations:

Test Name	Result	Normal Values
Stool Microscopy	Vibrio cholera seen	Nil
Stool culture	Yielded growth of Vibrio cholera	Nil/ normalflora
Serum electrolytes	Low Na ⁺ ,K ⁺ , Cl ⁻ and HCO ₃ ⁻	Normal

Vibrio Cholera is a gram negative rod, comma shaped bacterium transmitted through faecal- oral route. Its incubation period is few hours to 5 days and it causes profuse watery stools, fever, vomiting and rapid dehydration which may cause death. One may lose up to 1L/hour water in stools. Heat killed vaccine is not that effective and is not required for international travel. Prevention of epidemic spread is important. The key to effective treatment and prevention of death is meticulous and timely water and electrolyte replacement.

Learning Objectives:

1. Mechanisms of water regulation
2. Mechanisms of electrolyte regulation
3. Disturbances in water and electrolyte regulation and their correction
4. Role of ORS in rehydration

CBL Session – 5, / 2nd year:

Topic: Carbohydrate Metabolism (G6PD deficiency)

A 23 year old boy was prescribed Septran (**sulphamethoxazole** and trimethoprim) and **paracetamol** for urinary tract **infection** and **fever** (10 hrs. history of symptoms). After two days the boy presented again with subsiding initial symptoms but **lethargy fatigue, dyspnea**

and slight pallor. His lab investigations are given in the table below. Doctor suspected **G6PD deficiency** which was confirmed by genetic analysis later.

Related Lab Investigations:

Test Name	Result	Normal Values
Hemoglobin	9 g/dl	12 – 17 g/dL
RBCs	3.2×10^6	$4.1 – 5.6 \times 10^6/\mu\text{L}$
PCV (hematocrit)	28	35-50 %
MCV	84	80-98 fL
MCH	28	27-34pg
MCHC	30	32-36g/dL
WBCs	$13 \times 10^3/\mu\text{L}$	$4-11 \times 10^3/\mu\text{L}$
Fluorescent spot test (Butler test)	Positive	Negative

Glucose 6-phosphate dehydrogenase (G6PD) deficiency is an inherited disease characterized by **hemolytic anemia** caused by the inability to detoxify oxidizing agents. G6PD deficiency is the most common disease-producing enzyme abnormality in humans. Diminished G6PD activity impairs the ability of the cell to form the **NADPH** that is essential for the maintenance of the **reduced glutathione pool**. These results in a decrease in the cellular **detoxification of free radicals and peroxides** formed within the cell. Glutathione also helps maintain the reduced states of sulfhydryl groups in proteins, including hemoglobin. Oxidation of those sulfhydryl groups leads to the formation of denatured proteins that form insoluble masses (called **Heinz bodies**) that attach to the red cell membranes.

Learning Objectives:

1. HMP shunt and its importance
2. Sources of NADPH
3. Uses of NADPH in body

CBL Session-6 / 2nd year

Topic: Pyruvate Kinase Deficiency

A two year old girl was referred to hematologist after her pediatrician found her to be severely anemic with splenomegaly and jaundice. Her mother gave a possible history of “blood problem” in her family but did not know for sure. Her complete blood count revealed normal hemoglobin with normocytic anemia. The platelet and white cell count was normal. On the

peripheral smear there were many bizarre erythrocytes including speculated cells. A diagnosis of Pyruvate Kinase deficiency was made.

Explanation

The normal erythrocyte lacks mitochondria and is completely dependent on glycolysis for production of ATP. ATP is required to meet the metabolic needs of the RBCs and to fuel the pumps necessary for the maintenance of the biconcave, flexible shape of the cell, which allows it to squeeze through narrow capillaries. The anemia observed in glycolytic enzyme deficiencies is a consequence of the reduced rate of glycolysis, leading to decreased ATP production. The resulting alterations in the red blood cell membrane lead to changes in the shape of the cell and, ultimately, to phagocytosis by the cells of the reticuloendothelial system, particularly macrophages of the spleen. The premature death and lysis of red blood cells results in hemolytic anemia.

Learning Objectives:

1. Reactions of Glycolysis
2. Reduction of Pyruvate to Lactate
3. Fates of pyruvate and hormonal regulation of glycolysis
4. Glucose Transporters

CBL Session –7, /2nd year

Topic: Obesity

A 40 year old house wife presented with chronic pain in both knees and back. Her weight was 93 kg and height was 5'3". Her waist to hip ratio was measured to be 1.1. She also complained of inguinal hernia. She was diagnosed as a case of android obesity with BMI almost 36. Her doctor advised her to change dietary and life style habits and gave some symptomatic relief medicines after seeing the report of tests ordered empty stomach.

Related Lab Investigations:

Test Name	Result	Normal Values
TC	6.2 mmol/L	Less than 5.6 mmol/L
TGs	1.8 mmol/L	Less than 1.6 mmol/L
LDL	3.6 mmol/L	Less than 2.6 mmol/L
HDL	90 mmol/L	More than 1.04 mmol/L
BSF	120 mg/dL	Less than 110 mg/dL

Obesity is a disorder of body weight regulatory systems characterized by an accumulation of excess body fat. The BMI (weight in kg)/(height in meters)² provides a measure of relative weight, adjusted for height. This allows comparisons both within and between populations. The healthy range for the BMI is between 18.5 and 24.9. Individuals with a BMI between 25 and 29.9 are considered overweight, those with a BMI equal to or greater than 30 are defined as obese, and a BMI over 40 is considered extremely obese. Anyone more than 100 pounds overweight is considered severely obese. These cutoffs are based on the studies examining the relationship of BMI to premature death, and are similar in men and women.

Learning Objectives:

1. Assessment of Obesity
2. Metabolic Changes in Obesity
3. Molecules that influence Obesity
4. Body weight regulation
5. Weight reduction
6. Fast & Feed Cycle

CBL Session – 8, / 2nd year

Topic: Nutrition (Kwashiorkor)

An 11 months old infant was brought to children OPD with retardation in growth, apathy and lethargy. On examination his face was edematous and moonlike, brittle and thin hair, pitting edema and hepatomegaly. Physician diagnosed him as a case of kwashiorkor and advised changes in diet in addition to vitamin supplements.

Explanation

Kwashiorkor occurs when protein deprivation is relatively greater than the reduction in total calories. Protein deprivation is associated with severely decreased synthesis of visceral protein. Kwashiorkor is frequently seen in children after weaning at about one year of age, when their diet consists predominantly of carbohydrates. Typical symptoms include stunted growth, edema, skin lesions, depigmented hair, anorexia, enlarged fatty liver, and decreased plasma albumin concentration. Edema results from the lack of adequate plasma proteins to maintain the distribution of water between blood and tissues. Edema may mask muscle loss.

Learning Objectives:

1. Dietary reference intakes
2. Energy requirement in humans
3. Balanced diet
4. Diet in pregnancy & lactation
5. Protein Energy Malnutrition

Reference Books:

1. Lippincott's illustrated reviews and Harper's text book of Biochemistry
2. Davidson's Practice of Medicine
3. Internet sources

BLOCK-II

Section-I

Anatomy

Summary:

Code	Y2M2
Name	Anatomy
Duration	10 weeks
Broad Themes of Module (Theme: a subject that is being integrated a majority of time of module)	1. Brain and Spinal cord 2. Nervous system
Subject Themes	Gross Anatomy <ul style="list-style-type: none">○ Brain and Neuro anatomy Embryology Development of <ul style="list-style-type: none">○ CNS○ Skull○ Development of genital system Histology <ul style="list-style-type: none">○ Nervous System○ Special senses○ Reproductive System
Prerequisite Module	Y2M1

Mode of Information Transfer:

MIT
Lectures
Dissection
Demonstration
CBL
Practicals
Dissection movies

Anatomy Learning Outcomes

GROSS ANATOMY

Topic	Learning Objectives	MITs
Nervous System	<ul style="list-style-type: none"> • Describe the divisions of the nervous system and their components and briefly describe how they function. • Enumerate structures within spinal and cranial cavities • Define ventricles and CSF. Define coverings of brain and spinal cord. 	LGIS/ demos
Meninges of brain	<ul style="list-style-type: none"> • Identify meninges of brain on the given model • Describe the dural reflections with special emphasis on tentorium cerebelli and falx cerebri. • Explain the features of spaces within meninges • Define Meningitis • Explain the structures encountered during lumbar puncture • Enumerate the nerves and blood vessels supplying the meninges. 	
Venous Sinuses of Brain	<ul style="list-style-type: none"> • Describe the attachments of meninges with the help of dissection • Demonstrate the supratentorial and infratentorial compartments of tentorium cerebelli with the help of dissection. • Describe the extradural and subdural hematoma. 	
Structure of Spinal Cord	<ul style="list-style-type: none"> • Explain the attachments of dural venous sinuses of brain with the help of diagrams • Describe the important relations with the help of diagrams • Discuss the importance of facial vein connection with dural venous sinuses. 	
Ascending Tracts of Spinal Cord	<ul style="list-style-type: none"> • Describe the structure of spinal cord • Describe the structure of gray matter and white matter in spinal cord. • Enumerate the major ascending and descending tracts of spinal cords 	
Descending Tracts of Spinal Cord	<ul style="list-style-type: none"> • Describe the pathways for superficial and deep sensations. • Describe the effects of lesions of section of spinal cord. 	LGIS/ demos
Structure of Medulla	<ul style="list-style-type: none"> • Outline the pathways of voluntary movements • Describe the location of first, second and third order neurons 	LGIS/ demos
Structure of Medulla	<ul style="list-style-type: none"> • Identify the gross features of medulla on a given model. • Describe gross features of medulla on a given model • Describe the internal structure of medulla with the help of different cross sections • Correlate the significance of raised pressure in posterior cranial fossa to its effects on medulla oblongata 	LGIS/ demos

	<ul style="list-style-type: none"> • Discuss nuclei of cranial nerves present in medulla. • Describe clinical correlations of medulla 	
Structure of Pons	<ul style="list-style-type: none"> • Identify the gross features of Pons on a given model. • Explain the internal structure of Pons with cross sections at different levels • Discuss nuclei of cranial nerves lying in pons • Discuss the anatomical structures involved in Pontine hemorrhage 	LGIS/ demos
Gross Anatomy of Midbrain	<ul style="list-style-type: none"> • Identify the gross structure of midbrain on a given model. • Describe the internal structure of midbrain with cross sections at different levels • Discuss nuclei of cranial nerves lying in midbrain. • Enumerate the clinical consequences of trauma to midbrain 	LGIS/ demos
Cerebellum	<ul style="list-style-type: none"> • Describe the gross features of cerebellum on the given model • Explain the cerebellar nuclei and their connection with other parts of brain. afferent fibers and efferent fibers • Discuss the effect of lesions of cerebellum on voluntary movements 	LGIS/ demos
Gross anatomy of Interior cerebrum	<ul style="list-style-type: none"> • Describe the features of parts of following on a given model <ul style="list-style-type: none"> ➤ Cerebrum ➤ Diencephalon ➤ Telencephalon • Identify gross features of parts of diencephalon. <ul style="list-style-type: none"> ➤ Thalamus ➤ hypothalamus • Correlate the anatomical lesions of nuclei of thalamus and hypothalamus with the clinical conditions like diabetes insipidus and obesity 	LGIS/ demos
Reticular formation and limbic system	<ul style="list-style-type: none"> • Discuss reticular formation and its afferent and efferent projections • Describe functions of reticular formation • Discuss components of limbic system • Discuss connecting pathways of the limbic system • Discuss afferent and efferent pathways of hippocampus • Discuss clinical correlations of reticular formation and limbic system 	

The basal nuclei	<ul style="list-style-type: none"> • Discuss corpus striatum and its nuclei • Discuss their connections, direct and indirect pathway • Discuss clinical correlations of basal nuclei • Discuss parkinsonism in detail 	
Gross Features Of Cerebral Hemispheres	<ul style="list-style-type: none"> • Identify the main sulci and gyri of cerebral hemispheres on the given model • Describe the gross features of the lobes of cerebrum. • Explain the phenomenon of cerebral dominance • Discuss clinical correlations of cerebral cortex • Discuss the effects of lesions in the Motor cortex on voluntary movements and speech. • Discuss the effect of lesion in the Frontal eye field in relation to personality change. 	LGIS/ demos
Dissection Of Cerebrum	<ul style="list-style-type: none"> • Identify the location of major sensory and motor areas within specific lobes with the help of dissection • Describe the major sensory and motor areas of cortex with the help of dissection 	LGIS/ demos
Gross Anatomy Of White Matter Of Cerebrum	<ul style="list-style-type: none"> • Classify the cerebral fibers of according to their connections. • Describe the fibers present in the brain. <ul style="list-style-type: none"> ➤ Commissural fibers ➤ Association fibers ➤ Projection fiber • Explain the effects of lesions of different parts of internal capsule 	LGIS/ demos
Blood supply of brain stem and spinal cord	<ul style="list-style-type: none"> • Describe the blood supply of different parts of brain • Explain the formation and importance of circle of Willis with diagram 	LGIS/ demos
Blood supply of cerebrum	<ul style="list-style-type: none"> • Describe the blood supply of different parts of cerebrum 	LGIS/ demos
Dural venous sinuses	<ul style="list-style-type: none"> • Explain the formation and importance of veins draining cerebrum 	LGIS/ demos
Base and Interior of skull	<ul style="list-style-type: none"> • Identify the important features of bones forming inferior view of skull on the given bone. • Mark the foramina at the base of skull and enumerate the contents of clinically relevant foramina. 	LGIS/ demos
Imaging Of CNS	<ul style="list-style-type: none"> • Describe the appearance of different parts of brain in <ul style="list-style-type: none"> ➤ Normal radiographs ➤ MRI ➤ CT scan 	LGIS/ demos
Ventricles Of Brain	<ul style="list-style-type: none"> • Enumerate ventricles of brain • Describe the relations and boundaries of each ventricle • Describe the formation of choroid plexus • Explain the process of production and absorption of CSF by arachnoid villi • Explain the causes of overproduction and blockage of CSF • Enumerate the varieties of hydrocephalus 	LGIS/ demos

	EMBRYOLOGY	
Development of Spinal cord	<ul style="list-style-type: none"> • Describe the development of neural tube. • Describe the differentiation of neural tube into different parts of brain. • Describe the development of spinal cord. • Describe the positional changes of the cord 	LGIS
Developmental Anomalies Of Spinal Cord	<ul style="list-style-type: none"> • Explain the causes of neural tube defects • Explain the process of development of spin bifida • Describe the clinical conditions relevant to the development of neural tube defects Like Spina bifida spina bifida with meningocele. 	LGIS / Lab
Development Of Cerebrum	<ul style="list-style-type: none"> • Describe the development of cerebral hemispheres and ventricles. • Explain the relation of congenital aqueduct stenosis and hydrocephalus. • Enumerate and briefly describe the congenital anomalies associated with development of cerebrum. 	LGIS / Lab
Development of Brainstem	<ul style="list-style-type: none"> • Describe the development of medulla, Pons, midbrain and cerebellum • Describe the developmental changes in alar and basal plates in brainstem 	LGIS / Lab
	□	LGIS / Lab
Development Of Skull	<ul style="list-style-type: none"> • Describe the stages of development of neurocranium • Describe the stages of development of viscerocranium • Describe the stages of differentiation of neurocranium into Membranous Neurocranium and chondrocranium • Describe the importance of fontanelle of skull in relation to <ul style="list-style-type: none"> ➤ normal ossification of the skull ➤ changes in intracranial pressure • Describe the features of Newborn Cranium 	LGIS / Lab
Development of external genital organs	<ul style="list-style-type: none"> • Describe the development of cloacal folds • Describe the development of genital swellings • Describe the differentiation of male and female external genitalia from genital swellings • Enlist common anomalies 	LGIS / Lab
Development of uterus and ovary	<ul style="list-style-type: none"> • Describe development of • ovary • Enlist common anomalies 	LGIS / Lab
Development of fallopian tubes and vagina	<ul style="list-style-type: none"> • Describe development of • Uterus • fallopian tubes • vagina • Enlist common anomalies 	LGIS / Lab
Development of male reproductive system	<ul style="list-style-type: none"> • Describe the formation of indifferent gonad • Describe the development of testis from indifferent gonad • Enumerate the developmental anomalies of male genital organ 	LGIS / Lab

HISTOLOGY		
Histology Of Nerve Tissue	<ul style="list-style-type: none"> • Describe the histological features of nerve tissue with the help of drawings on board in the skill lab • Identify the type of nerve tissue on given slides under microscope. • Draw a labeled diagram of the identified structures with the help of eosin and hematoxylin pencils on the histology notebooks • Describe the histological changes in nerve in injury, neuroma and regeneration 	LGIS / Lab
Histology Of Spinal Cord	<ul style="list-style-type: none"> • Identify the microscopic features of spinal cord on a given slide. • Draw a labeled diagram of the identified tissue on the histology note book with the help of H&E pencils. 	LGIS / Lab
Structure of nerve and Concept of myelinated and unmyelinated Fibres	<ul style="list-style-type: none"> • Describe the structure of Nerve • Explain the Myelination of nerve fiber • Describe the importance of Myelination • Define SLE 	LGIS/ lab
Neurons and Neuroglia	<ul style="list-style-type: none"> • Describe the structure of neuron • Classify the supporting cells and • Enumerate their functions 	LGIS/ lab
Joint Receptors	<ul style="list-style-type: none"> • Describe the anatomical structure of neuromuscular spindles • Differentiate between the anatomical structure of annulospiral and flowerspray endings 	LGIS/ lab
Histology Of Cerebrum and cerebellum	<ul style="list-style-type: none"> • Identify the histological features of cerebrum and cerebellum under microscope. • Draw a labeled diagram of cerebrum and cerebellum in practical notebook. 	LGIS/ lab
Histology of female reproductive system	<ul style="list-style-type: none"> • Describe the histology of female reproductive tract with the help of microscopic images • Describe the changes in epithelium in each part • Describe the histological changes in menstruation 	LGIS/ lab
Histology of ovary and uterine tubes	<ul style="list-style-type: none"> • Identify the slides under the microscope and enumerate the characteristics of each <ul style="list-style-type: none"> ➤ Ovary ➤ Uterine tube ➤ Uterus – 3 stage ➤ vagina ➤ Give two points of identification for each slide • Draw a labeled diagram of identified tissue in note books 	LGIS/ lab
Histology male reproductive system	<ul style="list-style-type: none"> • Describe the histological features of following on the given slide <ul style="list-style-type: none"> ➤ Testis ➤ Seminal vesicles ➤ Ductus deferens ➤ Ductus epididymis 	LGIS/ lab

	<ul style="list-style-type: none"> • Draw a labeled diagram of identified tissue in practical note book 	
Histology Of Eye	<ul style="list-style-type: none"> • Identify these structures under microscope • Draw a labeled diagram of the identified structure on histology notebook • Describe the histological features of lens, cornea & retina 	LGIS/ lab
Organ Of Corti	<ul style="list-style-type: none"> • Identify the histological features of organ of corti under microscope • Identify the cells and spaces present in the cochlea on the given slide • Draw a labeled diagram of identified tissue in histo note books 	LGIS/ lab
Taste buds	Describe the structure of the taste buds and their cells	LGIS/ lab
Olfactory epithelium	<ul style="list-style-type: none"> • Describe the structure of the olfactory receptors and other cells involved in olfaction 	LGIS/ lab

List of Practical:

Histology Practical's

1. Testis & Epididymis
2. Vas deferens, Seminal vesicle
3. Prostate
4. Ovary
5. Fallopian tube, Uterus
6. Cervix, Vagina
7. Histology of Nervous Tissue, Neurons, Neuroglia , Structure of nerve and ganglia
8. Histology of Spinal cord
9. Histology of cerebellum
10. Histology of cerebral cortex
11. Histology of retina, cornea .lens, inner ear, Olfactory epithelium and taste buds

ANATOMY CBL

A PATIENT WITH COMMUNED FRONTAL COMPLEX SKULL FRACTURE

CBL 1:

Learning objectives

1. To learn the osteology of exterior & interior of skull.
2. To learn the development of neurocranium & viscerocranium
3. To learn the complications associated with skull fractures.
4. To learn the various clinical modalities used to investigate a case of fracture skull.

CBL 2: Case of spinal shock

Learning objectives:

1. Correlate the structure of components of nervous tissue to their function.
2. Compare topographic anatomy of spinal cord in adult and newborn.
3. Localize grey and white matter in spinal cord.
4. Interpret neurological presentation of spinal cord injuries at different levels.
5. Describe neurulation and transformation of neural tube into central nervous system.
6. State embryological basis and presentation of neural tube defects.
7. Correlate the development of vertebral column to structure and function.
8. What is the basis of correlation between spinal cord segment and vertebrae?

PATIENT WITH INTENTION TREMOR AND TENDENCY TO FALL ON ONE SIDE

CBL 3 (Spinocerebellar Ataxia)

Learning objectives

1. Correlate structure of cerebellum on specimen and model to imaging (CT/MRI).
Correlate microstructure of cerebellum to function.
2. Correlate functional anatomy of cerebellum to various clinical presentations in cerebellar diseases.
3. Perform clinical examination of cerebellar functions.
4. How do you anatomical divisions of cerebellum correlate with functional division?
5. How does cerebellum receive its input and from where?
6. How does cerebellum affect motor activities?
7. What is the basis of signs seen in cerebellar disorders?
8. Why this patient falls on one side of the body?
9. How is balance maintained? How cerebellum performs inhibitory functions?

CBL 4 :Case of parkinsonism

Learning objectives:

1. Localize the various Anatomical & clinical basal ganglia.
2. Correlate the connections of basal nuclei to their functions.
3. Describe extra-pyramidal pathways.
4. Relate basis of disorders associated with basal nuclei.
5. Describe the synthesis, functions and degradation of various neurotransmitters involved in functioning of basal nuclei.
6. Identify drugs modulating the functions of neurotransmitters in basal nuclei.

CBL 5

Patient with Stroke

Learning objectives:

1. Describe the topographic anatomy of cerebrum and associate sulci and gyri with cortical functions. Identify various sulci, gyri and cortical areas on the specimen/model/imaging modalities.
2. Identify various fiber bundles in the cerebrum.
3. State the functional losses associated with the lesions of fiber bundles in cerebrum.
4. Correlate the effects of cerebral vascular occlusion to clinical presentations.
5. What functions are performed by frontal lobe?
6. Which areas of cerebral cortex are affected by occlusion of middle cerebral artery?
7. How is cerebral dominance determined?
8. How does the cerebral hemisphere coordinate in production of meaningful speech?
9. Where do collaterals from corticospinal tract go? What is their significance?
10. Which visual field is affected by the stroke?

BLOCK-II

Section-II

Physiology

Summary:

Code	Y1M2
Name	Physiology
Duration	10 weeks
Broad Themes of Module (Theme: a subject that is being integrated a majority of time of module)	1. Brain and Spinal cord 2. Nervous system
Subject Themes	<ul style="list-style-type: none"> • Sensory Physiology • Motor Physiology • Higher Mental Functions • ANS
Prerequisite Module	Y1M1

Mode of Information Transfer:

MIT
Lectures
Tutorials (PTT)
CBL
Practicals
Class tests

Physiology learning outcomes and MITs:

CNS		
1.	Processing of information in neuronal pool (LGIS, SGD/tutorial)	<ul style="list-style-type: none"> • To be able to explain types of synapses— chemical and electrical and physiologic anatomy of the synapse and chemical substances that function as synaptic transmitters • To know the electrical events during neuronal excitation and electrical events during neuronal inhibition • To know about the transmission and processing of signals in neuronal pools ,relaying of signals through neuronal pools prolongation of a signal by a neuronal pool, after discharge, synaptic fatigue
2.	Sensory receptors & receptor Potential (LGIS, SGD/tutorial)	<ul style="list-style-type: none"> • To understand types of sensory receptors and the sensory stimuli and differential sensitivity of receptors • To understand the transduction of sensory stimuli into nerve impulses • To know the local electrical currents at nerve endings— receptor potentials, adaptation of

		<p>receptors</p> <ul style="list-style-type: none"> • To know the nerve fibers that transmit different types of signals, and their physiologic classification • To understand the transmission of signals of different intensity in nerve tracts—spatial and temporal • summation
3.	Sensory tracts (LGIS, SGD/tutorial, Practical)	<ul style="list-style-type: none"> • To know the functional anatomy of dorsal column medial lemniscal system and anterolateral pathway • To understand the sensations carried by different sensory tracts • To differentiate between different sensory tracts
4.	Sensory cortex (LGIS, SGD/tutorial, Practical)	<ul style="list-style-type: none"> • To know about the somatosensory cortex and somatosensory association areas
5.	Physiology of pain (LGIS, SGD/tutorial, Practical)	<ul style="list-style-type: none"> • To understand the types of pain and their qualities— fast pain and slow pain • To know about the pain receptors and their stimulation • To understand the dual pathways for transmission of pain signals into the central nervous system • To understand the referred pain and visceral pain
6.	Brain analgesia system (LGIS)	<ul style="list-style-type: none"> • To know the pain suppression system in the brain and spinal cord • To understand the brain's opiate system— endorphins and enkephalins
7.	Clinical abnormalities/ thermal sensations (LGIS)	<ul style="list-style-type: none"> • To know the clinical abnormalities of pain and other somatic sensations • To know the thermal sensations, thermal receptors and their excitation and transmission of thermal signals in the nervous system

8.	Inner ear / auditory pathways (LGIS, SGD/tutorial, Practical)	<ul style="list-style-type: none"> • To be able to explain central auditory mechanisms and auditory nervous pathways • To understand the function of the cerebral cortex in hearing and determination of the direction from which sound comes • To understand the hearing abnormalities and types of deafness
9.	Motor system / Spindle / stretch reflex (LGIS, SGD/tutorial, Practical)	<ul style="list-style-type: none"> • To be able to explain organization of the spinal cord for motor functions • To understand the muscle sensory receptors—muscle spindles and golgi tendon organs—and their roles in muscle control • To understand the receptor function of the muscle spindle and muscle stretch reflex • To understand the role of the muscle spindle in voluntary motor activity • To know the clinical applications of the stretch reflex and golgi tendon reflex • To know the function of the muscle spindles and golgi tendon organs in conjunction with motor control from higher levels of the brain
10.	Motor functions of spinal cord (LGIS, SGD/tutorial, Practical)	<ul style="list-style-type: none"> • To understand the flexor reflex and the withdrawal reflexes and crossed extensor reflex • To be able to explain the reciprocal inhibition and reciprocal innervation • To understand the reflexes of posture and locomotion and postural and locomotive reflexes of the cord • To know the spinal cord reflexes that cause muscle spasm
11.	Spinal shock (LGIS)	<ul style="list-style-type: none"> • To be able to explain spinal cord transection and spinal shock
12.	Pyramidal tract/ extra pyramidal tract (LGIS)	<ul style="list-style-type: none"> • To be able to understand primary motor cortex premotor area, supplementary motor area • To understand the transmission of signals from the motor cortex to the muscles • To understand extrapyramidal system and excitation of the spinal cord motor control areas by the primary motor cortex and red nucleus <p>To know the role of the brain stem in controlling motor function and support of the body against gravity</p>

13.	Cerebellum (LGIS, SGD/tutorial, Practical)	<ul style="list-style-type: none"> • To be able to explain the contributions of the cerebellum and its motor functions • To know anatomical functional areas of the cerebellum • To understand neuronal circuit of the cerebellum • To know the clinical abnormalities of the cerebellum in these spaces
14.	Basal ganglia (LGIS)	<ul style="list-style-type: none"> • To understand function of the basal ganglia in executing patterns of motor activity • To know the role of the basal ganglia for cognitive control of sequences of motor patterns • To understand function of the basal ganglia to change the timing and to scale the intensity of movements • To be able to explain the functions of specific neurotransmitter substances in the basal ganglia
15.	Vestibular system (LGIS, SGD/tutorial, Practical)	<ul style="list-style-type: none"> • To understand the vestibular apparatus and function of the utricle and saccule in the maintenance of static equilibrium • To understand the detection of head rotation by the semicircular ducts • To be able to explain the vestibular mechanisms for stabilizing the eyes • To understand other factors concerned with equilibrium
16.	Speech (LGIS, SGD/tutorial, Practical)	<p>To know the functions of specific cortical areas and association areas</p> <ul style="list-style-type: none"> • To understand the comprehensive interpretative function of the posterior superior temporal lobe- Wernicke's Area • To understand the functions of the parieto- occipitotemporal cortex in the nondominant hemisphere • To understand higher intellectual functions of the prefrontal Association areas
17.	Memory (LGIS, SGD/tutorial, Practical)	<ul style="list-style-type: none"> • To know the memory—roles of synaptic facilitation and synaptic inhibition • To know about the short-term memory, intermediate long-term memory and consolidation of memory

18.	Sleep (LGIS, Tutorial)	<ul style="list-style-type: none"> • To be able to describe slow-wave sleep and REM Sleep (paradoxical sleep, desynchronized sleep) • To know the basic theories of sleep and physiologic effects of sleep • To understand the origin of brain waves
19.	EEG/epilepsy (LGIS)	<ul style="list-style-type: none"> • To know about the effect of varying levels of cerebral activity on the frequency of the EEG • To understand the changes in the EEG at different stages of wakefulness and sleep • To understand epilepsy, grand mal epilepsy petit mal epilepsy, focal epilepsy
20.	Functions of hypothalamus / temperature regulation (LGIS)	<ul style="list-style-type: none"> • To know about the normal body temperatures • To understand mechanisms of heat production and heat loss • To be able to explain the regulation of body temperature—role of the hypothalamus • To understand the neuronal effector mechanisms that decrease or increase body temperature • To know the concept of a “set-point” for temperature control • To understand the behavioral control of body temperature • To know the abnormalities of body temperature regulation and fever

List of Practicals:

Module 2	
1.	Examination of cranial Nerves
2.	Examination Sensory System
3.	Examination of Motor System
4.	Examination of Deep Tendon Reflexes
5.	Examination of Superficial Reflexes
6.	Examination of Cerebellar Functions
7.	Any other practical relevant to that Module

List of Case Based Learning Scenerios: **CNS Physiology Including Autonomic Nervous System**

CBL 1

A 35 year old female was brought to hospital after a gunshot wound in her abdomen. Her laparotomy was performed with the midline incision, bullet was removed and organs involved were repaired. She was discharged after 7 days on wound healing. After 3 days of removal of stitches, the patient observed numbness and lack of thermal sensation in the area of her scar. The doctor reassured her for complete recovery in few days. After one month she reported back with hyperaesthesia in the same area. On examination the doctor observed the loss of pressure; two points discrimination and vibration sensations in the same area. She was reassured that her sensations will very likely come back after sometime. After 6 months she had partially recovered from most of the lost sensations.

Learning objectives:

The learning objectives for the students are to:

1. Know the outline of sensory component of nervous system and levels of sensory processing.
2. Comprehend the functional unit of nervous system (the neuron), its types, functions and properties.
3. Classify the various receptors and list their functions.
4. Differentiate between afferent and efferent, myelinated and unmyelinated never fibers.

5. Outline General and sensory classifications of nerve fibers, their functional significance and association with the effects of anesthetics.
6. Explain the processes of nerve degeneration and regeneration.
7. Understand the morphology and types of synapses, their role in processing of information by the nervous system.
8. Conceive electrical events involved in excitation and inhibition of synapse including pre and postsynaptic inhibition.
9. Comprehend the process of synaptic delay, fatigue and summation of inputs.
10. Evolve the concept of receptor adaptation, process of spatial and temporal summation.
11. Comprehend the concept of sensory receptors, their types, characteristics distribution in the body. To understand as to how sensory receptors, detect different modalities of stimuli or sensations.
12. Describe the mechanism of generation of receptor potential and transduction of sensory stimuli into nerve impulses.
13. Understand coding of intensity, location and quality of stimuli.

CBL 2

A 30 years old motor cyclist met a road side accident. He was brought to the hospital in fully conscious state with immobile legs. On examination; right leg was found paralyzed with exaggerated deep reflexes and hypertonia, while left leg was found normal. The tactile discrimination, position and vibration senses of right leg were lost, whereas crude touch, pain & temperature sensations were intact on right side. The examination of left leg revealed loss of pain, temperature & crude touch. Patient's bladder was catheterized. The diagnosis of Brown-Sequard syndrome due to injury to the lumbar spine was made.

Learning objectives:

1. To know functional anatomy of spinal cord.
2. To learn ascending and descending spinal tracts.
3. To differentiate between various sensations.
4. To understand regulation of muscle tone.
5. To learn physiology of deep tendon reflexes.
6. To understand pathology of spinal shock & Brown- Sequard syndrome.

CBL 3

A 30-year-old female has had several episodes, each separated by several months, in which she experiences brief periods of physical weakness, clumsiness of the legs and hands, visual disturbances, and mood swings. Her weakness is most prominent in her lower extremities. CT scans show evidence of multiple lesions in the white matter of the brain and spinal cord. During her last episode, there were increasing neurological deficits due to an increasing number of disseminated lesions. The attending physician made a diagnosis of multiple sclerosis based on history and investigations. Tab. prednisone (60 mg/day for five to seven days) was prescribed to help her return to as normal and active a life as possible.

Learning objectives:

1. To understand conceptual basis of cortical and brainstem control of motor function.
2. To identify specialized areas of motor control in cerebral cortex.
3. To distinguish between pyramidal and extra-pyramidal motor tracts.
4. To critically reflect on the integrative motor control of spinal cord, cerebellum, basal ganglia and cerebral cortex.
5. To elaborate spinal cord reflexes underpinning motor control of spinal cord.
6. To gain insight into pathophysiology and clinical manifestations of demyelinating nerve diseases.

CBL 4

An elderly woman of 56 yrs of age reported to the emergency dept of hospital with severe chest pain which was radiating to left arm and left side of neck & face. Her past history revealed that she was known hypertensive for past 20 yrs for which she was taking medicine. She also gave history of occasional chest pain. Her G.P.E revealed that she was well oriented, afebrile, pulse = 90 min, B.P 150/110mm Hg, E.C.G = T wave inversion in lead II, III, AVF. She was given one tab of nitroglycerine (vasodilator) sublingually. She was diagnosed as case of ANGINA and was treated accordingly.

Learning objectives:

To develop a detailed working knowledge of:

1. Different types of pain.
2. Pathway of different pains.
3. Centers of pain in brain.
4. Brain analgesia system.

CBL 5

A 60 year old male, known case of hypertension was brought into emergency dept with H/O sudden onset of unconscious and urinary incontinence. On examination patient had spastic paralysis of right half of the body; hyper-reflexia and presence of Babinski's sign. On regaining consciousness, patient was also found to have motor dysphasia & facial nerve palsy (upper motor neuron type). He was diagnosed to be suffering from cerebrovascular accident/cerebral stroke (CVA) of left side. Supportive treatment & physiotherapy was advised.

Learning objectives:

1. To know about the functions of motor cortex and descending tracts.
2. To know about physiology of speech.
3. To know about upper & lower motor neuronal lesions in cranial nerve palsies.
4. To know about physiological basis of Babinski's sign.
5. To know about physiology and pathology of deep tendon reflexes.
6. To learn the pathophysiology of cerebrovascular accident.

CBL 6

A 58 years old female presented in emergency department with h/o sudden loss of consciousness which was persistent. There was hypertonia on Rt half of body & reflexes were exaggerated. Urgent CT scan brain showed hemorrhage in the area of Lt internal capsule of brain. There was h/o uncontrolled hypertension for the last 15 years. She was given supportive treatment and after regaining consciences after 10 days, she had difficulty in speech. She was able to understand written and spoken words but was unable to utter even simple words. There was spastic paralysis of Rt half of the body; ankle clonus was demonstrable and Babinski's sign was present. Sensory system was intact. A diagnosis of haemorrhagic CVA (Lt) was made.

Learning objectives:

1. To know the functional anatomy of motor cortex.
2. To know the pathophysiology of cerebrovascular accident.
3. To comprehend the physiological significance of internal capsule.
4. To understand the pathophysiological basis of signs & symptoms of the patient.
5. To appreciate the different speech areas and physiological role of each.

6. To compare the upper motor & lower motor neuron lesions.
7. To understand different types of aphasia & compare these with dysarthria.

CBL 7

Zahid, a 53 yrs old businessman was brought to Neurology OPD by his younger brother with complaints of his inability to speak since last morning. He is a known hypertensive for last 20 yrs, but not using his medicines regularly. On physical examination his blood pressure was 190/130 mm of Hg. There was no motor deficit except for inability to speak but he was unable to understand the spoken words as well as the written words. His antihypertensive therapy was readjusted and blood pressure was brought to 140/90 mm of Hg. CT scan of brain revealed infarcted Wernicke's area of brain involving angular gyrus, lower parts of temporal lobe and superior borders of Sylvian fissure. Diagnosis of Global aphasia was made and management plan was handed over by the physician and family was counseled about the prognosis.

Learning objectives:

1. To learn the physiology of language input and output in brain.
2. To learn the role of Wernicke's area and Broca's area in speech.
3. To learn the role of cerebellum, basal ganglia and sensory cortex in speech.
4. To learn the role of auditory and visual association areas in speech.
5. To learn the physiology of articulation.
6. To know various types of abnormalities of speech.
7. To know definition of aphasias.
8. To know various types of aphasias.
9. To know evaluation, treatment and prognosis of aphasia.

CBL 8

Zeeshan, a 6 yrs child, was brought to an ophthalmologist because his parents observed that his eyes are not properly aligned and he is using only left eye to look at various objects. His external ocular examination revealed healthy eye lids, palpebral fissures, conjunctiva and cornea. Pupils were equal in size and light and accommodation response was normal on both sides. Ocular motility was tested and unpairing of conjugate movements in the horizontal plane along with saccadic dysfunction was observed. Visual acuity was 6/6 in left eye and 6/24 in right eye. Intra ocular pressure was 12mm of Hg on both sides. Ophthalmoscopy and slit lamp examination revealed no abnormality. The ophthalmologist covered the normal eye

with eyepatch. He also counseled the parents about the conservative management plan and available surgical options and advised review after 01 month.

Learning objectives:

1. To know the normal physiology of vision and visual pathways.
2. To learn the physiological basis of image formation on retina.
3. To know the optics of vision.
4. To learn the basis of ocular reflexes.
5. To learn the types of eye movements and their role in vision (locking-unlocking movements, vestibular movements, saccadic movements, pursuit movements).
6. To learn the basis of interference excitation and fusion of visual images.

BLOCK-II

Section-III

Biochemistry

Summary:

Code	Y2M2
Name	<i>Biochemistry</i>
Duration	10 weeks
Broad Themes of Module (Theme: a subject that is being integrated a majority of time of module)	1. Brain and Spinal cord 2. Nervous system
Subject Themes	<ul style="list-style-type: none"> • <i>Xenobiotics</i> • <i>Metabolism of Proteins and Amino Acids</i> • <i>Nucleotide Metabolism</i> • <i>Biochemical Genetics</i>
Prerequisite Module	Y2M1

Mode of Information Transfer:

MIT
Lectures
Tutorials (PTT)
CBL
Practicals
Class tests

Biochemistry learning outcomes and MITs:

S/N	Topic	Los
	Xenobiotic (LGIS)	<ul style="list-style-type: none"> • Cytochrome P450 • Xenobiotic metabolism
1	Metabolism of Proteins and Amino Acids (LGIS, SGD/tutorial, Practical)	<ul style="list-style-type: none"> • Amino acid oxidation, metabolic fates of amino acid, transamination, deamination decarboxylation, deamidation and transamination • Transport of amino group, role of Pyridoxal phosphate, Glutamate, Glutamine, Alanine • Ammonia intoxication, Nitrogen excretion and Urea formation, Urea cycle and its regulation, genetic defects of Urea cycle • Functions, pathways of amino acid degradation and genetic disorders of individual amino acids • Integration and regulation of Metabolic Pathways in Different Tissues
2	Nucleotide Metabolism	<ul style="list-style-type: none"> • Chemistry of nucleotides • Typical and atypical nucleotides

		<ul style="list-style-type: none"> • Synthesis of nucleotides • Salvage pathway of nucleotides • Degradation of purines and related diseases • Degradation of pyrimidines and related diseases
3	Biochemical Genetics (LGIS)	<ul style="list-style-type: none"> • DNA Structure • Organization of Eukaryotic DNA • Replication of prokaryotic DNA • Replication of Eukaryotic DNA • Structure of three types of RNA • Prokaryotic transcription • Eukaryotic transcription • Post transcriptional modifications • Translation of genetic code • Regulation of gene expression
4	Cancer biology (LGIS)	<ul style="list-style-type: none"> • DNA repair mechanisms • Xeroderma Pigmentosum • Retroviruses and cancer
5	Genetic disorders (LGIS)	<ul style="list-style-type: none"> • Thalassemia • Sickle cell anemia • Defects of metabolism
6	Molecular biology technology (LGIS)	<ul style="list-style-type: none"> • PCR • DNA Cloning • Southern blotting • Probes • Restriction fragment length polymorphism • Prenatal Diagnosis • Analysis of gene expression • Gene therapy
7	Neurotransmitters (Synaptic transmission) (LGIS)	<ul style="list-style-type: none"> • Catecholamines chemistry synthesis and degradation • Serotonin • Histamine

List of Practicals:

1. DNA Extraction
2. PCR
3. Estimation and clinical interpretation of Uric Acid in blood
4. Determination of Amino acids in Urine by Paper Chromatography
5. Estimation and clinical interpretation of plasma enzyme Amylase
6. Estimation and clinical interpretation of Bilirubin in blood
7. Estimation and clinical interpretation of plasma enzyme LDH
8. Estimation and clinical interpretation of plasma enzyme ALT

List of Case Based Learning Scenerios:

CBL-1

Topic: Metabolism of Nucleic acids (Acute Gout)

A moderately obese 54-year-old male appeared at the emergency department complaining of severe pain of 10 hours duration in his left big toe. He stated that he was a regular consumer of meat and soda (alcohol and sea food consumption are also risk factors). He had no other significant medical history. On examination, his left big toe was found to be red and markedly swollen around the metacarpophalangeal joint, and exquisitely sensitive. There was no evidence of arthritis elsewhere. Because of the history and location of the affected joint, the attending physician suspected that the patient was having an attack of acute gout. She ordered a number of lab tests, including a white cell count, determination of serum uric acid, and x-ray examination of the affected joint. The x-ray findings were non-specific; no indication of chronic arthritis was evident. Findings of other tests are tabulated below. Under local anesthesia, arthrocentesis was performed on the affected joint and a small amount of synovial fluid withdrawn and sent to the laboratory for detection of cells and crystals. Typical needle-shaped crystals of MSU showing negative birefringence were detected in the synovial fluid.

LAB INVESTIGATIONS:

Test Name	Result	Normal Values
Serum Uric acid	680 $\mu\text{mol/L}$	Children 120-330 $\mu\text{mol/L}$ Adult Male 210-430 $\mu\text{mol/L}$ Adult Female 150-360 $\mu\text{mol/L}$
ESR	60 mm	1 – 10 mm in 1 st hour
WBC Count	11.0 x 10 ⁹ / L	4.0 x 11.0 x 10 ⁹ / L
RA Factor	Negative	Negative

Gout is a disease caused by hyperuricemia mostly due to genetic factors while diet and lifestyle play a minor role in its causation. Uric acid is an end product of purine metabolism and as it is already near its saturation limit in plasma, minor increase due to mostly under- excretion from kidney or overproduction leads to its deposition in crystal form mostly where the solvent is stagnant like synovial fluid of relatively immobile joints. This crystallization appears first at the most immobile and coldest fluid body, typically big toe joint space and typically at night because temperature is further lower at night time and due to sleep and

mobility is also further decreased. Crystals in a smooth lubricated environment play havoc and cause acute inflammatory response leading to severe pain, redness, warmth and loss of function locally. Moreover, uric acid deposition in other soft tissues leads to formation of tophi.

LEARNING OBJECTIVES:

1. Structure and chemistry of nucleosides and nucleotides.
2. Functions of nucleotides.
3. The biochemical basis of various clinical features

REFERENCE BOOKS:

1. Harper's text book of Biochemistry.
2. Davidson's Practice of Medicine.
3. Lippincott's textbook of Biochemistry

CBL-2

Nucleic Acids (ADA Deficiency)

A little girl aged 11 months was brought by her parents to a children's hospital. She had a number of attacks of pneumonia and thrush (oral infection usually due to a fungus *Candida albicans*) since birth. The major findings of a thorough workup were very low levels of circulating lymphocytes (i.e. **severe lymphopenia**) and low levels of circulating **immunoglobulins**. The attending pediatrician suspected **SCID**. Analysis of a sample of red blood Cells revealed a low activity of **ADA** and very high level (about 50 times normal) of **dATP**. This confirmed the diagnosis of SCID due to deficiency of ADA, the enzyme that converts **adenosine to inosine**.

The deficiency of ADA is inherited as autosomal recessive and accounts for almost 15% cases of SCID. T lymphocytes express high activity of enzyme normally. Lack of ADA activity leads to accumulation of adenosine and dATP which is toxic to T cells. Secondly B lymphocytes are also affected and lead to impaired **humoral immunity**. Defective immune system allows different **opportunistic infection** to occur and recur. An example of acquired immunodeficiency is AIDS. Such conditions can be treated by, antibiotics, fortifying immune system by immunoglobulins and treating the root cause.

LEARNING OBJECTIVES:

1. Ingestion and fate of nucleotides in human body
2. Role of Nucleotides in DNA synthesis
3. The biochemical basis of various clinical features

REFERENCE BOOKS:

1. Harper's text book of Biochemistry. (Page 616)
2. Davidson's Practice of Medicine.
3. Lippincott's textbook of Biochemistry

CBL-3

Topic: DNA Damage and Repair (Xeroderma Pigmentosum)

An 8-year-old boy, an only child, presented at a dermatology clinic with a skin tumor on his right cheek. He had always avoided exposure to sunlight because it made his skin blister. His skin had scattered areas of hyperpigmentation and other areas where it looked mildly atrophied. There was no family history of a similar disorder. Because of the presence of a skin tumor at such a young age, the history of avoidance of sunlight, and the other milder skin lesions, the dermatologist made a provisional diagnosis of XP.

The patient's fibroblasts and control fibroblasts were exposed to UV light, and cell samples were taken at 8 hour intervals for a total of 32 h post irradiation. Extracts of DNA were prepared and the numbers of dimers remaining at each time point indicated were determined. Only 24% of the dimers formed persisted in DNA extracted from the normal cells at 32 h, whereas approximately 95% were found in the extract from the patient's cells at 32

h. This showed that the UV-induced lesions had not been repaired, and thus confirmed the diagnosis of XP.

Exposure to unfiltered UV light causes formation of pyrimidine dimers in both prokaryotic and eukaryotic cells. This adduct formation prevents replication of DNA beyond this point. If these persist, it can lead to abnormal replication product and numerous mutations and multiple skin cancers. There are specific proteins in humans called XP proteins (uvr ABC in prokaryotes) which are continuously correcting such adduct formations by excision repair of damaged DNA. If there is a defect in one of these proteins (genetic), it leads to abnormal repair mechanism and disease resulting is called Xeroderma pigmentosum. It must be differentiated from porphyrias.

LEARNING OBJECTIVES:

1. Structure of DNA and its replication.
2. Causes of DNA damage and repair mechanism.
3. Xeroderma pigmentosum and other related disorders

REFERENCE BOOKS:

1. Harper's text book of Biochemistry.
2. Davidson's Practice of Medicine.
3. Lippincott's textbook of Biochemistry

CBL-4

Topic: Transcription (Tuberculosis and rifampin)

A 24-year-old girl presented with a 9-week history of cough, malaise and breathlessness. She had lost 5Kg weight in last two months but no history of night sweats or hemoptysis. She along with her 4 siblings and parents, lives in a house of only two rooms. On examination, she was mildly pyrexial (38°C) but had no anemia or clubbing. Crepitation was audible over the lung apex on right side. There were no other notable physical signs. Her hemoglobin and WBC count were normal but the CRP (C reactive protein) was raised. The chest X-ray showed unilateral upper- and middle-lobe shadowing but no hilar enlargement. Sputum was found to contain acid-fast bacilli and Mycobacterium tuberculosis was subsequently cultured. Mantoux test was strongly positive. A diagnosis of pulmonary tuberculosis was made. The patient was treated with isoniazid and rifampin for 6 months, together with pyrazinamide and ethambutol for the first 2 months. She was allowed home on medication when her sputum became negative on direct smear. After three months, the chest X-ray is now much improved. **RELATED LAB**

INVESTIGATIONS:

Test Name	Result	Normal Values
Hemoglobin	12.4 g/dL	Adult Male 13-18 g/dL Adult Female 12-16 g/dL
WBC Count	$9.8 \times 10^9 / L$	$4.0 \times 11.0 \times 10^9 / L$
CRP	23mg/dL	5-10 mg/dL

Mantoux test (tuberculin skin test) (NOT SIGNIFICANT) "QuantIFERON-TB Gold" is a newer test which measures the response of immune system of body to MTB antigen in vitro	12mm induration	Less than 10mm in vaccinated individuals
Sputum for culture sensitivity	No growth	No growth
Sputum for AFB (smear test)	Positive only third time	Negative
Culture of MTBC (mycobacterium tuberculosis complex) 2-3 weeks Traditional solid media shows growth in 4-8 weeks	Positive	Negative
Nucleic Acid Amplification Tests (NAAT)	Detects genetic material of MTB	Not detected
LAM (lipoarabinomannan) antigen test in urine (mycobacterial cell wall component shed in plasma) 30 Min	Positive	Negative
Adenosine Deaminase Test ADA	Increased	-
HIV test	Negative	Negative

Pulmonary tuberculosis is an infection of lungs by a special bacterium called mycobacterium tuberculosis. Vaccine against TB is a part of EPI (extended program of immunization) by WHO which imparts roughly 20% additional protection against the infection. BCG vaccine (Bacillus Calmette–Guérin) is the only vaccine available and given to all the children round the world (90%) against tuberculosis. Though the disease is not common in developed countries, but in developing countries including Pakistan and especially African countries TB is quite prevalent and a major public health problem. Multidrug therapy with good compliance for 6 months at least is usually the treatment of choice. One of the antibiotic drugs is rifampin. Rifampin inhibits bacterial cell growth by inhibiting RNA synthesis. It binds to beta subunit of bacterial (prokaryotic) RNA polymerase and interferes with the formation of first phosphodiester bond.

This prevents initiation of transcription in Acid fast bacilli (AFB). This slows growth and replication of the bacteria which are washed away in secretions. If there is resistance to this drug, the infection is called MDR-TB (multi-drug resistant TB). MDR-TB and XDR-TB (extensive drug resistant TB) are serious public health problems and over 13 million die every year with TB worldwide. Dactinomycin (also called Actinomycin D) is an antibiotic and anticancer agent which binds DNA template and hinders the movement of RNA polymerase on it, blocking the transcription.

LEARNING OBJECTIVES:

1. Structure and types of RNA
2. Pro and Eukaryotic gene transcription
3. Post transcriptional modification of RNA including splicing

REFERENCE BOOKS:

1. Lippincott's textbook of Biochemistry
2. Harper's text book of Biochemistry
3. Davidson's Practice of Medicine

CBL-5

Topic: Biotechnology Techniques-PCR etc (HCV & Lymphoma)

A 54-year-old male presented with fever, night sweats and weight loss. He also complained of a non-tender, non-inflammatory mass on left lateral side of his neck. The mass has grown to the size of a hazelnut since it was first noticed 6 weeks ago. On examination submandibular and supraclavicular nodes were palpable. Blood complete picture was normal but patient was diagnosed as a case of B Cell Non Hodgkin lymphoma with the help of tissue histology and bone marrow aspiration cytology. During the laboratory investigation phase he was incidentally found to be a patient of HCV infection as well.

In addition to commitment about the treatment and prognosis of the lymphoma, attending physician was also concerned about the status of his HCV infection. He ordered abdominal ultrasound to check for liver cirrhosis and Quantitative PCR to check for HCV viral load.

RELATED LAB INVESTIGATIONS:

Test Name	Result	Normal Values
Hemoglobin	14 g/dL	Adult Male 13-18 g/dL Adult Female 12-16 g/dL
WBC Count	$11.5 \times 10^9 / L$	$4.0 \times 11.0 \times 10^9 / L$
(Tumor/mass)Lymph Node Biopsy	B Cell lymphoma cells seen	Normal cytology
Lymphoma cells in peripheral blood smear	Not seen	Not seen
Bone marrow biopsy for histological examination	Monoclonal lymphoid aggregates seen	No such aggregates
LDH	630 U/L	225-450 U/L
Anti HCV Antibody test	Positive	Negative
USG Abdomen	Nodular and shrunken appearance of liver but mild changes	Normal echo-texture
Quantitative PCR (for viral RNA)	700,000 IU/mL	Normally it is negative Viral Load is expressed as copies/mL: Low: less than 2 M/mL • High: more than 2 M/mL Or Expressed as International Units (IU/mL): • Low: less than 800,000 IU/mL • High: more than 800,000 IU/mL
Cytogenetic testing in culture sample (2 -3 weeks)	No abnormal chromosomal pairing or less or more chromosomes found	Normal chromosomal pairing and normal number
Fluorescent in situ hybridization (FISH) for t(14;18) of c-myc	No translocation found on microscopy	No translocation
PCR for Immunoglobulin light chain gene rearrangements	This test was carried out as there was a research center nearby and outcome had a research benefit as well. For patient it was helpful in determining whether it was reactive or malignant	

Though HCV and lymphoma is not a common combination in patients encountered in clinics but it has been selected to emphasize role of biotechnology techniques in diagnosis, management and prognosis of both the diseases. PCR is a very basic technique of DNA selected portion amplification in vitro from even minute quantities of DNA. It makes DNA

ample to carry out any genetic analysis. In HCV patients quantitative PCR is routinely advised to see viral load. While in lymphoma certain related immunoglobulin gene rearrangement can be checked to understand etiology of the disease better.

LEARNING OBJECTIVES:

1. Molecular Biology Techniques and their applications
2. Procedure, principle and uses of PCR
3. Types of PCR

REFERENCE BOOKS:

1. Lippincott’s textbook of Biochemistry
2. Harper’s text book of Biochemistry
3. CMDT 2013, (Current Medical Diagnosis and Treatment)

CBL-6

Topic: Cholera (G protein coupled receptor)

A 21-year-old female law student working in a developing country suddenly began to pass profuse watery stools almost continuously. She soon started to vomit. Her general condition declined abruptly, and she was rushed to the local village hospital. On admission, she was cyanotic, skin turgor was poor, blood pressure was 70/50 mmHg (normal 120/80 mm Hg), and her pulse was rapid and weak. The doctor on duty diagnosed cholera, took a stool sample, and started treatment immediately. Patient was isolated and given normal saline with 20mmol/L K⁺ added (ringers lactate was not administered). Doxycycline 500mg every 6 hr was started and plenty of ORS was advised after initial IV fluids. The relatives were called for counseling. As cholera can become epidemic or pandemic, relatives were given following advice to follow and teach others. 1. Drink only boiled or treated water, 2. Cook well and eat hot, 3. Avoid shellfish, 4. Peel all vegetables and fruits.

RELATED LAB INVESTIGATIONS:

Test Name	Result	Normal Values
Stool Microscopy	Vibrio cholera seen	Nil
Stool culture	Yielded growth of Vibrio cholera	Nil/ normal flora
Serum electrolytes	Low Na ⁺ ,K ⁺ , Cl ⁻ and HCO ₃ ⁻	Normal

Vibrio Cholera is a gram negative rod, comma shaped bacterium transmitted through faecal- oral route. Its incubation period is few hours to 5 days and it causes profuse watery stools, fever, vomiting and rapid dehydration which may cause death. One may lose upto 1L/hour water in stools. Heat killed vaccine is not that effective and is not required for international travel. Prevention of epidemic spread is important. The key to effective treatment and prevention of death is meticulous and timely water and electrolyte replacement.

LEARNING OBJECTIVES:

1. Mechanisms of cell receptors
2. Mechanisms of cellular second messenger

REFERENCE BOOKS:

1. Lippincott’s textbook of Biochemistry
2. Harper’s text book of Biochemistry
3. Davidson’s Practice of Medicine

CBL-7

Topic: INTEGRATION OF METABOLISM (DM)

A 47 year old lady presented with polyuria, polydipsia and weight loss for few months. She also complained for recurrent burning micturition/ genital thrush for some time. Her plasma glucose levels were checked and she was diagnosed as a case of DM.

RELATED LAB INVESTIGATIONS:

Test Name	Result	Reference
Plasma Glucose levels random	15mmol/L	Upto 11.1mmol/L
Plasma glucose levels fasting (next day) (DM if more than 7mmol/L)	9 mmol/L	5.6 mmol/L
HbA1c	60mmol/L	Upto 48mmol/L (6.5%)

Explanation Diabetes mellitus is a serious pandemic metabolic derangement syndrome in which decreased endogenous insulin or its decreased effectiveness is the hallmark. Insulin and glucagon are major regulatory hormones of metabolism. Insulin is the hormone of fed state and it’s the hormone of storage (causes deposition of carbohydrate and fat stores). Decreased synthesis or release of insulin from beta cells of pancreas leads to hyperglycemia in addition to other metabolic derangements and the condition is called type 1 DM. On the other hand, despite normal release of insulin from pancreas there may be resistance to its

action in peripheral tissue (adipose and skeletal muscle) mostly secondary to obesity and this condition is called type 2 DM.

LEARNING OBJECTIVES:

1. Mechanism of action and effects of Insulin and Glucagon
2. Biochemical Basis of sign and symptoms of DM
3. Biochemical Diagnosis of DM

REFERENCE BOOKS:

1. Harpers text book of Biochemistry
2. Guyton text book of physiology
3. Internet sources

CBL-8

INTEGRATION OF METABOLISM -Obesity (obesity)

A 40 year old house wife presented with chronic pain in both knees and back. Her weight was 93 kg and height was 5'3". Her waist to hip ratio was measured to be 1.1. She also complained of inguinal hernia. She was diagnosed as a case of android obesity with BMI almost 36. Her doctor advised her to change dietary and life style habits and gave some symptomatic relief medicines after seeing the report of tests ordered empty stomach.

RELATED LAB INVESTIGATIONS:

Test Name	Result	Normal Values
TC	6.2 mmol/L	Less than 5.6 mmol/L
TGs	1.8 mmol/L	Less than 1.6 mmol/L
LDL	3.6 mmol/L	Less than 2.6 mmol/L
HDL	90 mmol/L	More than 1.04 mmol/L
BSF	120 mg/dL	Less than 110 mg/dL

Obesity is a disorder of body weight regulatory systems characterized by an accumulation of excess body fat. The BMI (weight in kg)/(height in meters)² provides a measure of relative weight, adjusted for height. This allows comparisons both within and between populations. The healthy range for the BMI is between 18.5 and 24.9. Individuals with a BMI between 25 and 29.9 are considered overweight, those with a BMI equal to or greater than 30 are defined as obese, and a BMI over 40 is considered extremely obese. Anyone more than 100 pounds overweight is considered severely obese. These cutoffs are based on the studies examining the relationship of BMI to premature death, and are similar in men and women.

LEARNING OBJECTIVES:

1. Obesity and how to measure
2. Body weight regulation
3. Weight reduction

REFERENCE BOOKS:

1. Lippincott's illustrated reviews and Harper's text book of Biochemistry
2. Davidson's Practice of Medicine
3. Internet sources

BLOCK-III

Section-I

Anatomy

Summary:

Code	Y2M3
Name	Anatomy
Duration	10 weeks
Broad Themes of Module (Theme: a subject that is being integrated a majority of time of module)	Head, Neck and Special Senses Endocrine System Reproductive system
Subject Themes	Gross Anatomy <ul style="list-style-type: none">○ Head and neck Embryology Development of <ul style="list-style-type: none">○ Head and neck○ Special senses Development of integumentary system
	Histology <ul style="list-style-type: none">○ Endocrine glands○ Histology of integumentary System
Prerequisite Module	Y2M1 & Y2M2

Mode of Information Transfer:

MIT
Lectures
Dissection
Demonstration
CBL
Practical's
Dissection movies

Anatomy learning outcomes:

List of Learning objectives &MIT, of Anatomy Y2M3

Gross Anatomy

Topic	Learning outcomes	MIT
Skull Anterior And Posterior View	<ul style="list-style-type: none">• Describe the bones forming the anterior view of skull on the given bone.• Identify the bones forming the boundaries of orbit, nasal cavity and oral cavity and mark their boundaries.• Describe the bones forming posterior view of skull on the given bone• Mark the main anatomical landmarks on normaoccipitalis	SGD (small group discussion) and dissection
Lateral View of Skull	<ul style="list-style-type: none">• Describe the bones forming the lateral view of skull on the given bone• Identify the boundaries of temporal, infratemporal fossa and pterygopalatine fossa on the given bone.• Mark the bones forming pterion and explain the clinical importance of pterion with the help the diagram	SGD and dissection
Gross anatomy of scalp	<ul style="list-style-type: none">• Enumerate layers of scalp• Describe gross features of each layer• Describe the course of arteries, veins and nerves supplying the scalp with the help of model• Describe the danger area of the scalp• Describe the role of occipitofrontalis in preventing spread of scalp infections towards neck	SGD and dissection
Gross anatomy of face	<ul style="list-style-type: none">• Describe the muscles of face along with their nerve supply with the help of models• Describe the actions of muscles of face.• Describe the course of arteries, veins and nerves supplying the face with the help of model• Describe the features of facial infections and cavernous sinus thrombosis	SGD and dissection

Gross anatomy of trigeminal nerve	<ul style="list-style-type: none"> Trace the pathway of trigeminal nerve from nucleus to target organs Enumerate the divisions of trigeminal nerve Describe the features of trigeminal neuralgia 	SGD and dissection
Branches of trigeminal, nerve, mandibular, maxillary	<ul style="list-style-type: none"> Describe the pathway of mandibular nerve from nucleus to target organs Describe the pathway of maxillary nerve from nucleus to target organs Describe the lesions of nerves with special reference to infections of molar teeth 	SGD and dissection
Gross anatomy of facial nerve	<ul style="list-style-type: none"> Describe the course of facial nerve in face Enumerate its branches Discuss the involvement of nuclei of facial nerve in bell palsy Differentiate between upper and lower motor neuron lesions 	SGD and dissection
Salivary glands	<ul style="list-style-type: none"> Enumerate salivary glands Describe the locations of major salivary glands Trace the secretomotor nerve supply of major salivary glands Describe the structures involved in parotid infections 	SGD and dissection
Temporomandibular joint	<ul style="list-style-type: none"> Identify the type of TMJ. Identify the articular surfaces of TMJ on a given model or dry bones. Name the ligaments of TMJ. Describe the movements of jaw at TMJ with special reference to axis and muscles producing them. Describe the clinical signs of anterior dislocation of TMJ and explain the steps of its reduction. 	SGD and dissection
Infratemporal region	<ul style="list-style-type: none"> Identify the location of infratemporal fossa on a given model and skull. Enlist the structures forming various boundaries of infratemporal fossa. Enlist the communications of infratemporal fossa and the structures traversing each. Enumerate the contents of infratemporal fossa. 	SGD and dissection

	<ul style="list-style-type: none"> • Discuss the relationships of various contents of infratemporal fossa. • Discuss the attachments, actions and nerve supply of muscles of mastication. 	
Deep cervical fascia – I	<ul style="list-style-type: none"> • Enumerate the layers of deep cervical fascia • Describe the attachments of investing, pretracheal, and prevertebral layers of fascia • Describe the modification of prevertebral layer into axillary sheath • Describe the formation of carotid sheath and its contents 	SGD and dissection
Deep cervical fascia – II	<ul style="list-style-type: none"> • Describe the spaces within fascia • Describe the clinical significance of retropharyngeal space • Describe the relation of layers of fascia and spread of infection • Describe the significance of merging of carotid sheath with pretracheal layer of fascia to prevent spread of infections 	SGD and dissection
Muscles of neck	<ul style="list-style-type: none"> • Describe the muscles of neck along with their nerve supply with the help of models • Describe the features of torticollis 	SGD and dissection
Triangles of neck	<ul style="list-style-type: none"> • Enumerate triangles of neck • Describe the muscles forming the boundaries of triangles • Describe the contents of triangles and their importance • Describe the lesions of the spinal accessory nerve in posterior triangle 	SGD and dissection
Vessels of neck	<ul style="list-style-type: none"> • Enumerate the main vessels in neck • Describe the course and branches of: <ul style="list-style-type: none"> ➤ Common carotid artery ➤ External carotid artery ➤ Internal carotid artery ➤ subclavian artery ➤ External jugular vein ➤ Internal jugular vein • Describe the importance of monitoring jugular venous pulse in heart diseases • Enumerate causes of prominence of external jugular vein 	SGD and dissection

	<ul style="list-style-type: none"> • Discuss subclavian vein thrombosis 	
Oral Cavity	<ul style="list-style-type: none"> • Identify structures forming the boundaries of oral cavity • Identify structures in the floor of oral cavity with the help of models • Identify the structures forming the boundaries of oral vestibule • Enumerate the vessels and nerves supplying the oral cavity • Discuss clinical correlations of oral cavity 	SGD and dissection
Gross anatomy of palate	<ul style="list-style-type: none"> • Identify the main features of hard palate and soft palate. • Enumerate muscles of soft palate on the model • Enumerate blood supply and nerve supply of soft palate • Identify the main muscles forming the palatoglossal and palatopharyngeal arches 	SGD and dissection
Tongue	<ul style="list-style-type: none"> • Describe the gross features of parts of tongue • Describe the blood supply, nerve supply, lymphatic drainage of tongue • Describe the movements of tongue 	SGD and dissection
Pharynx	<ul style="list-style-type: none"> • Describe the following parts of pharynx on the given model • Oropharynx • Nasopharynx • Laryngopharynx • Describe muscles of pharynx • Describe lymphoid tissue in the pharynx • Describe the importance of structures passing through the spaces between muscles of pharynx while performing tonsillectomy • Describe spread of infections from nasopharynx to middle ear 	SGD and dissection
Viscera of neck	<ul style="list-style-type: none"> • Describe the relations of trachea and esophagus in neck region with the help of dissection • Describe the structures involved in cricothyroidotomy and tracheostomy with the help of dissection 	SGD and dissection

	<ul style="list-style-type: none"> • Demonstrate the gross features of thyroid and parathyroid glands on models • Describe blood supply and nerve supply of thyroid and parathyroid gland through models • Describe the relations of vessels and nerves supplying the thyroid gland and their significance while performing thyroidectomy 	
Joints of neck	<ul style="list-style-type: none"> • Name the typical and atypical intervertebral joints of neck. • Identify the types of atlanto-occipital and atlanto-axial joints. • Describe the movements of these joints with muscles producing them. 	SGD and dissection
Prevertebral region and root of neck	<ul style="list-style-type: none"> • Name the prevertebral muscles. Give their origin, insertion, action and nerve supply of prevertebral muscles • Describe the relations of key muscle of root of neck (scalenus anterior) • Describe the parts and branches of subclavian artery. 	SGD and dissection
Back of neck	<ul style="list-style-type: none"> • Name the muscles of back of neck. • Identify the boundaries and contents of suboccipital triangle. • Describe the course and relations of 3rd and 4th parts of vertebral arteries. 	SGD and dissection
Submandibular region	<ul style="list-style-type: none"> • Describe the muscles present in the submandibular region and sublingual region with the help of model and prosection. • Enumerate the nerves vessels and ganglion in submandibular and sublingual region 	SGD and dissection
Nerves of neck	<ul style="list-style-type: none"> • Enumerate the main nerves in neck • Trace the course of glossopharyngeal nerve, vagus nerve, accessory nerve and hypoglossal nerve on the given model, from nucleus to target organs. • Enumerate branches of each of the above nerve 	SGD and dissection
Lymphatic drainage of head and neck	<ul style="list-style-type: none"> • Enumerate the groups of lymph of nodes draining the neck 	SGD and dissection

	<ul style="list-style-type: none"> • Describe their location and areas of drainage • Describe the formation of jugular lymph trunk • Describe the clinical importance of lymphatic drainage of head and neck 	
Gross anatomy of larynx	<ul style="list-style-type: none"> • Explain the gross features of inlet of larynx, piriform fossa, laryngeal folds, cavity of larynx • Correlate the laryngeal anatomy to foreign bodies aspiration • Explain the gross features of intrinsic muscles of larynx, extrinsic muscles of larynx, movements of vocal folds • Describe the cartilage involvement in fractures of the laryngeal skeleton 	SGD and dissection
Gross anatomy of larynx	<ul style="list-style-type: none"> • Identify the gross features of <ul style="list-style-type: none"> ➤ cartilages of larynx ➤ membranes of larynx • Trace the course of following nerves of larynx <ul style="list-style-type: none"> ➤ Internal laryngeal nerve ➤ External laryngeal nerve ➤ Inferior laryngeal nerve • Discuss clinical correlations of larynx including recurrent laryngeal nerve and external laryngeal nerve damage 	SGD and dissection
Gross Anatomy External Ear	<ul style="list-style-type: none"> • Describe the gross anatomical features of external ear Auricle External auditory meatus • Describe the blood supply, nerve supply and lymphatic drainage of external ear. • Correlate the significance of straightening the auditory canal during clinical examination with the anatomical structure of canal. 	SGD and dissection
Functions of external and middle ear	<ul style="list-style-type: none"> • Describe the following three functions of the external ear: <ul style="list-style-type: none"> ➤ Transmission of sound to tympanic membrane ➤ Amplification of sound ➤ Prevention of dust and dirt from reaching ear drum • Describe the function of ossicles of the middle ear in conduction of sound from tympanic membrane to cochlea 	SGD and dissection

Functions of external and middle ear	<ul style="list-style-type: none"> • Describe the phenomenon of impedance matching provided by the tympanic membrane and Ossicular system of the ear • Describe attenuation reflex along with its two functions of: <ul style="list-style-type: none"> ➤ Protecting cochlea ➤ Masking low frequency sound waves 	SGD and dissection
Gross anatomy middle ear-I	<ul style="list-style-type: none"> • Describe the gross anatomical features of middle ear • Describe the structures forming the walls of middle ear cavity on the given model • Describe the contents of middle ear cavity 	SGD and dissection
Gross anatomy middle ear-II	<ul style="list-style-type: none"> • Identify the parts of ear ossicles on the given model • Describe the muscles present in middle ear cavity • Describe the gross features of auditory tube • Describe the nerve supply of auditory tube • Describe the anatomical structures involved in paralysis of the stapedius • Blockage of pharyngotympanic tube 	SGD and dissection
Conduction of sound	<ul style="list-style-type: none"> • Describe the role of the following in conduction of sound vibrations: <ul style="list-style-type: none"> ➤ Scala vestibule ➤ Scala media ➤ Scala tympani 	SGD and dissection
Gross anatomy inner ear-I	<ul style="list-style-type: none"> • Identify the parts of bony labyrinth on the given model • Identify the parts of membranous labyrinth on the given model • Identify the parts of cochlea of semi-circular canal on the given model. 	SGD and dissection
Gross anatomy inner ear-II	<ul style="list-style-type: none"> • Describe the gross features of bony labyrinth • Describe the gross features of membranous labyrinth • Describe the orientation of semicircular canals and ducts within the inner ear • Describe the gross features of internal acoustic meatus • Describe anatomical structures involved in perforation of tympanic membrane 	SGD and dissection

	<ul style="list-style-type: none"> • Describe mastoiditis • Discuss the role of membranous labyrinth in motion sickness • Discuss the role of spiral organ of Corti in high-tone deafness • Define otic barotraumas 	
Vestibulocochlear nerve	<ul style="list-style-type: none"> • Trace the course of vestibulocochlear nerve in the inner ear on the given model • Identify the area of supply of vestibular nerve on the given model • Identify the area of supply of cochlear nerve • Identify the gross features of vestibulocochlear ganglion on model • Discuss the consequences of damage to vestibulocochlear nerve 	SGD and dissection
Gross Anatomy of Orbital Region	<ul style="list-style-type: none"> • Describe the bony orbit • Enlist the structures present in the orbit • Describe gross features of eye lids • Describe the attachment of muscles of eyelid • Describe the attachment of orbital septum • Describe the distribution of Blood Vessels and Lymph Vessels of the Orbit • Describe the anatomical structures involved in Inflammation of the Palpebral Glands 	SGD and dissection
Extraocular muscles	<ul style="list-style-type: none"> • Describe the extraocular muscles of eye • Describe the movements of eyeball • Correlate the anatomical lesions in nuclei of nerve supplying the extraocular muscles with the loss of function in muscles. 	SGD and dissection
Oculomotor Nerve	<ul style="list-style-type: none"> • Trace the pathway of Oculomotor nerve from nucleus to target organs • Correlate the anatomical lesions in nuclei of oculomotor nerve with clinical conditions like <ul style="list-style-type: none"> ➤ External Strabismus ➤ Ptosis and Diplopia 	SGD and dissection

Trochlear Nerve	<ul style="list-style-type: none"> Trace the pathway of Trochlear nerve from nucleus to target organs. Discuss the effect of lesion of trochlear nerve 	SGD and dissection
Gross anatomy of lacrimal apparatus	<ul style="list-style-type: none"> Enumerate the structures forming lacrimal apparatus Describe the gross features of each part of lacrimal apparatus Describe the nerve supply of lacrimal apparatus Co relate the anatomical structures of lacrimal apparatus with the features of blocked Lacrimal duct 	SGD and dissection
Gross anatomy of eyeball	<ul style="list-style-type: none"> Describe the coats and parts of eye ball on a given model. <ul style="list-style-type: none"> ➤ Fibrous coat ➤ Vascular pigmented coat ➤ Nervous coat Describe the blood supply and verve supply of eyeball Describe the actions of muscles of pupil Describe the appearance of optic disc and macula lutea on ophthalmoscope 	SGD and dissection
Optic Nerve	<ul style="list-style-type: none"> Trace the pathway of optic nerve from nucleus to target organs Describe the formation of olfactory bulb and optic tract. Correlate the anatomical lesions in visual pathway with clinical conditions like hemianopia, homonymous hemianopia Bitemporal hemianopia. 	SGD and dissection
Gross anatomy nose	<ul style="list-style-type: none"> Describe the structure of external nose and nasal cavity Describe the concha and meatus in the lateral wall Enumerate the sinuses opening in them Discuss anatomical structures involved in nasal fractures Correlate the anatomical structure of nasal mucosa with clinical manifestations of rhinitis 	SGD and dissection
Olfactory Nerve	<ul style="list-style-type: none"> Trace the pathway of Olfactory nerve form nucleus to target organs on a model Describe the formation of olfactory bulb and olfactory tract. 	SGD and dissection

	<ul style="list-style-type: none"> • Correlate the effects of lesion of olfactory nerve with special reference to clinical conditions causing anosmia 	
Paranasal Sinuses	<ul style="list-style-type: none"> • Describe the gross features of paranasal sinuses • Describe infections of sinuses • Describe the Drainage of mucus in relation to sinusitis • Describe the Function of Paranasal Sinuses • Discuss the anatomical structures involved in sinusitis with special reference to clinical consequences of infections of the ethmoidal cells of the ethmoidal sinuses 	SGD and dissection
Cranial nerves	<ul style="list-style-type: none"> • Discuss the intracranial and extra cranial course of all cranial nerves • Discuss clinical correlations and examination of all cranial nerves. 	
Imaging of Head	<ul style="list-style-type: none"> • Identify the bones forming skeleton of head on radiograph • Identify boundaries of orbit & paranasal sinuses on radiograph 	SGD and dissection
Imaging of neck	<ul style="list-style-type: none"> • Describe the appearance of structures of neck and face in: <ul style="list-style-type: none"> ➤ Radiograph ➤ CT scan ➤ MRI 	SGD and dissection
Surface marking of Head & neck	<ul style="list-style-type: none"> • Mark the main vessels of head & neck on the given subject <ul style="list-style-type: none"> ➤ Superficial temporal artery ➤ Supra orbital and supra trochlear ➤ Facial Artery ➤ External Carotid artery ➤ External Jugular vein ➤ Subclavian artery • Palpate the following muscles <ul style="list-style-type: none"> ➤ Trapezius ➤ Sternocleidomastoid 	SGD and dissection

Embryology

Integumentary System (LGIS)	<ul style="list-style-type: none"> • Describe the development of skin, hair, glands, nail, mammary glands and tooth • Enlist common anomalies
Development of Pharyngeal Arches (LGIS)	<ul style="list-style-type: none"> • Describe the development of pharyngeal arches • Describe the components of pharyngeal arches • Enumerate the components developing from all three layers of each arch • Describe the anomalies associated with them.
Development of pharyngeal pouches (LGIS)	<ul style="list-style-type: none"> • Describe the development of pharyngeal pouches and membranes • Describe the components of pharyngeal pouches and membranes • Describe the features of anomalies associated with the development of pouches and membranes
Development of face (LGIS)	<ul style="list-style-type: none"> • Describe the role of frontonasal prominences, maxillary prominences and mandibular prominences in development of face • Describe the formation of oblique facial clefts • Describe the features of Congenital microstomia
Development of palate (LGIS)	<ul style="list-style-type: none"> • Describe the stages of development of primary palate • Describe the stages of development of secondary palate • Describe the process of development of Cleft Lip and Cleft palate
Tongue (LGIS)	<ul style="list-style-type: none"> • Describe the development of tongue • Describe the anomalies associated with development
Development of nose (LGIS)	<ul style="list-style-type: none"> • Describe the development of nose • Describe the development of paranasal sinuses & nasal conchae
Development of Thyroid and parathyroid glands (LGIS)	<ul style="list-style-type: none"> • Enumerate the arches from which thyroid and parathyroid glands develop. • Describe the mechanism of descent of thyroid and parathyroid glands during development. • Describe the features of congenital hypothyroidism • Enumerate congenital anomalies of thyroid gland • Describe thyroglossal cyst. • Describe clinical features of thyroglossal cyst
Development of adrenal glands (LGIS)	<ul style="list-style-type: none"> • Describe the development of adrenal glands • Describe the process of differentiation of fetal cortex into adult cortex • Enlist congenital anomalies of adrenal gland
Development of Eye-I (LGIS)	<ul style="list-style-type: none"> • Describe the development of optic cup • Relate the differentiation of wall of optic cup with the formation of sclera and cornea • Enlist developmental anomalies of sclera and cornea
Development of Eye-II (LGIS)	<ul style="list-style-type: none"> • Describe the development of ciliary body, ciliary muscles and retina • Describe the differentiation of mesenchyme into chambers of eye. • Describe the transformation of optic stalk into optic nerve

	<ul style="list-style-type: none"> • Enlist related common anomalies • Describe the anatomical structures involved in congenital retinal detachment
Development of external ear (LGIS)	<ul style="list-style-type: none"> • Describe the embryological development of external & middle ear • Describe the associated developmental anomalies
Development of inner ear (LGIS)	<ul style="list-style-type: none"> • Describe the embryological development of inner ear. • Describe the differentiation of otic vesicle into different parts of inner ear • Describe the anomalies related to the development of inner ear

Histology

Skin (LGIS, SGD/tutorial, Practical)	<ul style="list-style-type: none"> • Describe components of skin,nail,hair. • Explain histological difference between thick and thin skin • Describe the various appendages of skin • Draw labeled diagram of thick and thin skins on sketch book
Lip & Tongue (LGIS, SGD/tutorial, Practical)	<ul style="list-style-type: none"> • Describe the histological features of lip & tongue with the help of microscopic images. • Identify the microscopic features on given slides <ul style="list-style-type: none"> ➤ Lip ➤ Tongue • Draw labeled diagrams of identified tissue
Histology salivary glands (LGIS, SGD/tutorial, Practical)	<ul style="list-style-type: none"> • Describe components of salivary glands • Identify the following on given slides: <ul style="list-style-type: none"> ➤ Parotid gland ➤ Submandibular gland ➤ Sublingual glands • Draw labeled diagrams of identified tissue
Histology of pituitary gland (LGIS, SGD/tutorial, Practical)	<ul style="list-style-type: none"> • Describe the various parts of pituitary gland. • Identify the gland under the microscope and write two points of identification for the gland • Identify the various hormonal disorders of pituitary gland
Thyroid Gland & Parathyroid Gland (LGIS, SGD/tutorial, Practical)	<ul style="list-style-type: none"> • Describe histological features of thyroid and parathyroid gland • Describe the role of thyroid follicular cells in thyroid disorders • Identify the microscopic features of thyroid and parathyroid gland under microscope on the given slide. • Draw labeled diagram of the identified tissue on the histology note book
Adrenal Gland (LGIS, SGD/tutorial, Practical)	<ul style="list-style-type: none"> • Describe the histological features of adrenal gland • Describe the cell types present in zones of adrenal gland and enumerate the hormones produced by each zone • Identify the histological features of adrenal gland under microscope. • Draw labeled diagrams of the identified tissues on the histology notebooks
Pancreas (LGIS, SGD/tutorial, Practical)	<ul style="list-style-type: none"> • Describe the histological features of islets of Langerhan's • Describe the cell types present in islets of Langerhan's • Draw labeled diagrams of the identified tissues on the histology notebooks

Larynx (LGIS, SGD/tutorial, Practical)	<ul style="list-style-type: none"> • Different layers of larynx • Histological characteristics of each layer of larynx • Histological classification of laryngeal cartilage
Nose (LGIS, SGD/tutorial, Practical)	<ul style="list-style-type: none"> • Describe the different types of mucosa of the different parts of the nose • Histology of nasal cartilage

List of Practical work:

1. Thyroid gland
2. Pituitary gland
3. Pancreas (islets) and adrenal gland
4. Lip
5. Tongue
6. Salivary glands
7. Nose and larynx
8. Skin and appendages

CBL 1:**A case of facial trauma****LEARNING OBJECTIVES:**

1. Describe the topographic anatomy of facial skeleton.
2. Describe muscles responsible for various facial expressions.
3. Describe and identify nerve supply, blood supply and lymphatic drainage of face and scalp.
4. Identify muscles of facial expressions on anatomical specimens.
5. Facial nerve examination.
6. Surface marking of facial artery.
7. Demonstrate facial planes in the head & neck on cadaver.
8. Demonstrate ABC of facial trauma (Air way, Breathing and Circulation) on manikins. Identify nerve supply, arterial supply and venous drainage of face and scalp.

CBL 2:**A case of infection of facial spaces of neck****LEARNING OBJECTIVES**

1. Describe deep cervical fascia and division of neck into various compartments, muscles of neck.
2. Describe the contents of these compartments. Correlate facial spaces with spread of infection from neck to mediastinum.
3. Examine Accessory nerve and mark its surface anatomy Examine lymph nodes of neck

CBL-3**A case of ludwig's angina****LEARNING OBJECTIVES:**

1. What nerve(s) would need to be anesthetized in order to prevent pain during a lower third molar extraction?
2. Some patients occasionally experience temporary paralysis of the muscles of facial expression or of mastication following a dental procedure. Why do you think this might happen?
3. When dental work is performed on the lower teeth, anesthetic injected at a single point is often adequate to produce complete local anesthetization of all the teeth on a given side. The same is not true for the upper teeth. Why not? How do they have to be anesthetized?
4. What are the anatomical structures that prevent joint dislocation?
5. Identify the masticatory muscles and give their functions.
6. Define the boundaries and contents of the infratemporal fossa.
7. Identify the branches of the trigeminal nerve and their functions related to mastication and sensation from the face.
8. Identify the chorda tympani nerve and give its function.
9. Describe the structure and function of the temporomandibular joint

10. Identify the muscles bordering the submandibular and paralingual spaces.
11. List and identify the major nerves and vessels of these spaces.
12. Describe the submandibular and sublingual salivary glands and give their innervations.
13. List the muscles of the tongue and describe their origins.
14. Describe the oral cavity, its oral vestibule and dental arches (including temporary and permanent dentitions), and the hard and soft palate.

CBL-4

A case of otitis media

LEARNING OBJECTIVES:

1. A major factor in the pathogenesis of otitis media is dysfunction of the auditory (Eustachian) tubes. What is the function of the auditory tubes?
2. Which muscle opens the auditory (Eustachian) tube?
3. What surgical procedures may be used to treat the fluid build-up in the middle ear?
4. What are possible complications to otitis media?
5. What would an infection of the outer ear be called? What anatomical features/structures protect the ear from injury?
6. Define the three parts of the ear and the function of each part.
7. Describe each of the four walls of the middle ear cavity and identify deeper structures responsible for certain of their features.
8. Describe the structure and actions of the tympanic membrane, the auditory ossicles, and the muscles of the middle ear.

CBL 5:

A case of injury to orbit

LEARNING OBJECTIVES:

1. How would you explain the right ptosis and pupillary constriction in this case?
2. Identify the prominent bony features of the orbit with included foramina and fissures.
3. Describe the components of the eyelids with associated muscles, tarsal glands, connective tissue fascia and conjunctiva.
4. Identify the extra ocular muscles, their function and innervation.
5. Identify all sensory, motor and autonomic nerves of the orbit and trace their routes to and within the orbit.
6. Identify branches of ophthalmic arteries and veins

BLOCK-III

Section-II

Physiology

Summary:

Code	Y1M3
Name	<i>Physiology</i>
Duration	10 weeks
Broad Themes of Module (Theme: a subject that is being integrated a majority of time of module)	4. Head, Neck and Special Senses 5. Endocrine System 6. Reproductive system
Subject Themes	<ul style="list-style-type: none"> • Endocrinology • Reproduction & neonatal physiology • Special Senses
Prerequisite Module	Y1M1&Y1M2

Mode of Information Transfer:

MIT
Lectures
Tutorials (PTT)
CBL
Practicals
Class tests

Physiology learning outcomes:

Subject Name: Physiology Y&M Number: Y2M3

S No	Topic	Learning objectives
Endocrinology		
1.	Basics of endocrinology (LGIS)	<ul style="list-style-type: none"> • To understand the coordination of body functions by chemical messengers • To know the chemical structure and synthesis of hormones • To understand the hormone secretion, transport, and clearance from the blood • To know the feedback control of hormone secretion • To understand the transport of hormones in the blood And "clearance" of hormones from the blood
2.	Mechanism of action of hormones (LGIS, SGD/Tutorial)	<ul style="list-style-type: none"> • To learn the hormone receptors and Their activation • To understand the intracellular signaling After hormone receptor activation

		<ul style="list-style-type: none"> • To understand the second messenger mechanisms for mediating intracellular hormonal functions • To know the hormones that act mainly on the genetic machinery of the cell
3.	Hormones of hypothalamus (LGIS, SGD/Tutorial)	<ul style="list-style-type: none"> • To understand the pituitary gland and its relation to the hypothalamus • To understand the hypothalamic-hypophysial portal blood vessels of the anterior pituitary gland
4.	Hormones of pituitary gland (LGIS, SGD/Tutorial)	<ul style="list-style-type: none"> • To know the physiological functions of growth hormone • To understand the regulation of growth hormone secretion • To know the hypopituitarism and hypopituitarism • To be able to explain the posterior pituitary gland and its relation to the hypothalamus • To understand the physiological functions of ADH and oxytocin Hormone
5.	Thyroid gland (LGIS, SGD/Tutorial)	<ul style="list-style-type: none"> • To understand the synthesis and secretion of the thyroid metabolic hormones • To understand the physiologic functions of the thyroid hormones • To understand the regulation of thyroid hormone secretion • To understand the Diseases of the Thyroid gland
6.	Calcium regulating hormones (LGIS, SGD/Tutorial)	<ul style="list-style-type: none"> • To know the regulation of calcium and phosphate in the extracellular fluid and plasma • To know about actions of vitamin D • To understand the effect of parathyroid hormone on calcium and phosphate concentrations in the extracellular fluid • To understand the control of parathyroid secretion by calcium ion concentration • To understand actions of calcitonin • To know the pathophysiology of parathyroid hormone, vitamin D, and bone disease
7.	Hormones of adrenal cortex (LGIS, SGD/Tutorial)	<ul style="list-style-type: none"> • To be able to explain synthesis and secretion of adrenocortical hormones • To understand the functions of the mineralocorticoids-aldosterone • To know the functions of the glucocorticoids

		<ul style="list-style-type: none"> To know the abnormalities of adrenocortical secretion
8.	Hormones of pancreas (LGIS, SGD/Tutorial)	<ul style="list-style-type: none"> To understand metabolic effects of insulin To understand the mechanisms of insulin secretion To understand the control of insulin secretion To understand glucagon and its functions To understand regulation of glucagon secretion To know the pathophysiology of diabetes mellitus
Reproductive system		
1.	Male reproductive physiology (LGIS, SGD/Tutorial)	<ul style="list-style-type: none"> To understand the physiologic anatomy of the male sexual organs To understand the process of spermatogenesis Function of the seminal vesicles and prostate gland To understand the abnormal spermatogenesis and male fertility To understand the testosterone and other male sex hormones
2.	Female reproductive system (LGIS, SGD/Tutorial)	<ul style="list-style-type: none"> To know the physiologic anatomy of the female sexual organs To understand the monthly ovarian cycle; function of the gonadotropic hormones To know the gonadotropic hormones and their effects on ovarian follicle growth—the “follicular” phase of the ovarian cycle corpus luteum—“luteal” phase of the To understand ovarian cycle To know about functions of the ovarian hormones—estradiol and progesterone
3.	Menstrual cycle (LGIS, SGD/Tutorial)	<ul style="list-style-type: none"> To know the regulation of the female monthly rhythm—interplay between the ovarian and hypothalamic-pituitary hormones and feedback oscillation of the hypothalamic- To understand the pituitary-ovarian system To be able to explain puberty and menarche and menopause
4.	Pregnancy (LGIS, SGD/Tutorial, Practical)	<ul style="list-style-type: none"> To be able to describe maturation and fertilization of the ovum Transport of the fertilized ovum in the fallopian tube To understand the implantation of the blastocyst in the uterus and early nutrition of

		<p>the embryo</p> <ul style="list-style-type: none"> To know about the response of the mother's body to pregnancy To be able to explain changes in the maternal circulatory system during pregnancy
5.	Placenta (LGIS, SGD/Tutorial)	<ul style="list-style-type: none"> To know about hormonal factors in pregnancy To understand human chorionic gonadotropin and its effect to cause persistence of the corpus luteum and to prevent menstruation To know the placental hormones
6.	Parturition (LGIS, SGD/Tutorial)	<ul style="list-style-type: none"> To know about the mechanism of parturition and onset of labor—a positive feedback To know about the mechanics of parturition
Neonatal physiology		
1.	Neonatal physiology (LGIS)	<ul style="list-style-type: none"> To understand growth and functional development of the fetus development of the organ systems To understand adjustments of the infant to extrauterine life To understand the circulatory readjustments at birth To know the special problems of prematurity

List of practical

Module 3	
1.	Testing the Visual Acuity
2.	Determination of the Field of Vision
3.	Testing the Color vision
4.	Demonstration of Sensation of Taste (Gustation)
5.	Determination of sense of olfaction
6.	Demonstration / Performance of Hearing Tests
7.	Demonstration of pure Tone Audiometry
8.	Pregnancy Test
9.	Any other practical relevant to that Module

List of Case Based Learning Scenarios:

Physiology CBLs Year 2ndModule 3rd Endocrinology

CBL-1

29 years old Farzana presented to gynaecological OPD with difficulty to feed her first born baby. On detailed history she revealed failure of milk ejection, difficulty in conceiving her first baby and prolonged labour during birth process. Detailed gynaecological screening could not identify any gynaecological abnormality and she was referred to Medical OPD as a diagnostic dilemma. Detailed imaging revealed a benign tumor of hypothalamus involving paraventricular nucleus and failed secretion of oxytocin hormone. She was maintained on synthetic oxytocin for a trial period with relief of symptoms.

Learning objectives:

1. To define, classify and understand mechanism of action of hormones.
2. To learn sites of secretion of various hormones of body.
3. To understand storage, release and feedback control of various hormones.
4. To understand the mechanism of hormone action.

CBL-2

Bakhtawar is a 20 year old college student. Lately she has noticed increased facial hair growth and roughness of facial skin. There are also stain marks on her limbs and she complains of chronic back ache. She has tried sun block creams with little relief from her complaints. On seeking medical advice, she was referred to an Endocrinologist who told her that she might have a hormonal imbalance and various hormone assays may be required.

Learning objectives:

1. To learn definition, classification and functions of hormones.
2. To learn feedback control to hormonal secretion.
3. To understand the concept of “clearance” of hormones from blood.
4. To learn the mechanisms of action of hormones.
5. To elaborate the second messenger system of hormone action.
6. To understand concept of radio immune assay and ELISA.

CBL-3

A 44 years old man presented in OPD with complaints of gradual deterioration of vision, progressive increase in body weight and increased frequency of micturition. He also told the doctor that his shoe size had increased and he had facing problems in finding extra large shoes for the last 2 years. His physical examination revealed Height = 1.73m (5 ft 8 inches), Weight = 114 kg (250 lbs), B.P=140/80mmHg, thickened fingers and a large jaw and tongue. **Biochemical tests revealed**

IGF-1 = 1144 ng/ml (normal: 109 – 284 ng/ml)

Basal GH = 24 ng/ml (normal: 5 ng/ml)

TSH = 1.46 μ U/ml (normal: 0.49 – 4.67 μ U/ml)

Random blood glucose = 280 mg/dl (normal: 70 – 140 mg/dl)

Chest radiograph showed gross cardiomegaly. A pituitary MRI revealed a 4.5 cm macroadenoma which was compressing the optic chiasma significantly. A diagnosis of acromegaly was made.

Learning objectives:

1. Relate the symptoms and lab tests to the affected endocrine gland and the hormones.
2. Identify the manifestations of acromegaly which are normal or abnormal in this patient.
3. Understand the neuronal and vascular connections between hypothalamus and pituitary gland.
4. Elucidate the action of growth hormone and role of somatomedins in bone growth.
5. Comprehend feedback control of growth hormone secretion.
6. Differentiate between Gigantism, acromegaly and dwarfism.
7. Hormones secreted by pituitary gland, their mechanism of action and their regulation.

CBL-4

A 28 years old woman presented in medical OPD of Military Hospital with complaints of restlessness, palpitation, disturbed sleep and difficulty in concentrating on her job for the past one month. During history taking, she revealed that she had lost 5 kg body weight during last one month, despite good eating habits.

On general physical examination she was looking nervous and restless. Her body temperature was 37.5 °C, pulse rate; 101 / min, respiratory rate; 18 / min and blood pressure was 145 / 80 mm Hg. She also had fine tremors and her knee jerk was brisk.

Learning objectives:

Students should know:

1. The possible underlying derangement in this patient and its pathophysiology.
2. Factors and hormones affecting body metabolism.
3. Effect of thyroid hormones on metabolic functions of body.
4. Effect of thyroid hormone on CVS.
5. Mechanism of action of thyroid hormone.
6. Effect of decreased and increased secretion of thyroid hormone.
7. Causes of hypothyroidism and hyperthyroidism.
8. Physiological basis of various signs and symptoms in the patient.

CBL-5

A 30 year old female referred by psychiatrist presents with tremor, weight loss, emotional lability, frequent bowel movements, swollen neck, bulging eyes, double vision, heat intolerance, fatigue, scanty periods, filthy nails. On examination enlarged thyroid gland (4 times normal) was found. Thyroid scan also showed greatly enlarged thyroid compared with normal. Further testing confirmed hyperthyroidism. The patient was treated with propylthiouracil for 6 months. Symptoms decreased over time and patient was maintained on follow up therapy.

Learning objectives:

1. To clinically correlate signs and symptoms of thyroid disease.
2. To learn synthesis, storage and release of thyroid hormones.
3. To understand modes of transport and clearance of thyroid hormones.
4. To understand the mechanism of action of thyroid hormones.
5. To learn regulation of thyroid hormone secretion.
6. To describe pathophysiology of thyroid hormone secretion abnormalities and interpret the diagnosis of thyroid disease.
7. To differentiate between Grave's disease, goiter and cretinism.
8. To know pathophysiology of thyrotoxicosis and consequent laboratory findings.

CBL-6

A 35-year-old woman comes to her physician's office with the complaint of recent rapid weight gain and excessive sweating. What initiated her visit was a recent panic attack that frightened her. Her face looks swollen compared with the rest of her body. She complains of recent weakness, backaches, and headaches, and her periods have lately been irregular. Over the past month, she has noticed frequent bruising with slow healing. She is not on any birth control or using any medication except for acetaminophen for the headaches.

PHYSICAL EXAMINATION

Vital Signs: Temp: 37°C, Pulse 68/min, Resp rate 14/min, BP 130/86 mm Hg, BMI 33
Physical Examination: The patient's face is round and her trunk is swollen, but her arms and legs are thin. She sounds depressed. She has supraclavicular fat pads.

LABORATORY STUDIES

Pregnancy test (HCG): Negative

Glucose tolerance: Abnormal, consistent with insulin resistance.

Plasma cortisol levels: 4pm: 25 µg/dL (normal: 3-15 µg/dL). Dexamethasone is given orally at 11 pm. At around 8 am the next morning, cortisol levels are 35 µg/dL (normal: < 5 µg/dL).

24-Hour urine collection for free cortisol: Abnormally high Plasma

ACTH: 7 pg/mL (normal: > 20 pg/mL)

MRI of the pituitary: Normal

CT of abdomen and chest: Adrenal tumor

DIAGNOSIS: Cushing's syndrome (primary hypercortisolism from adrenal tumor)

Learning objectives:

1. After discussion you should be able to:
2. Describe hormones and their contribution to whole body homeostatic mechanisms.
3. Understand the chemical nature of different classes of hormones and how this determines their mechanism of action on target cells.
4. Define how hormones are synthesized and secreted by cells of endocrine glands, including how peptide hormones are cleaved from longer precursors.
5. Explain the relevance of protein carriers in the blood for hydrophobic hormones, and the mechanisms that determine the level of free circulating hormones.

6. Understand the principles of feedback control for hormone release and its relevance for homeostasis.
7. Understand the principles governing disease states that result from over- or under- production of key hormones.

CBL-7

A 10 yrs old boy presented in pediatric OPD. He had complaints of significant weight loss in last six months despite having voracious appetite. He was constantly thirsty and was urinating every 30-40 min. He also had episodes of bed wetting. On physical examination his height was 5 ft 1 inch. His weight was 95 lb which was 100 lb 2 months back. BP was found to be 90/55 mm Hg in supine and 75/45 mm Hg in standing position. Laboratory findings revealed the following

Fasting plasma glucose-----320mg/dl (70-110) Plasma

ketones-----1+ (none)

Urinary glucose-----4+ (none)

Urinary ketones-----2+ (none)

On the basis of these findings diagnosis of type 1 diabetes was made. He was immediately started injectable insulin and counseled on how to monitor blood glucose with finger stick. He was advised regular check up for monitoring of renal function.

Learning objectives:

1. To know about hormones of pancreas and their functions.
2. Effects of insulin on carbohydrate, protein and fat metabolism.
3. Mechanism of action of insulin.
4. Role of insulin in controlling blood sugar level in postprandial and fasting state.
5. Discuss appearance of ketones in blood and urine.
6. To know the importance of monitoring blood sugar level.
7. To know the importance of monitoring renal function.

Reproductive Physiology CBLs

CBL-1

A couple presents to clinic for work up of infertility after 6 years of unprotected intercourse. The wife declines any medical problems and notes regular menstrual cycles. The husband states that he has had chronic sinusitis and lower respiratory tract infections. Physical examination of the woman is unremarkable. Physical examination of the man is remarkable for dextrocardia. Further testing of the man revealed immotile sperms on semen analysis. The man was labeled infertile due to autosomal recessive Kartagener's syndrome and counseled accordingly.

Learning objectives:

1. To know the physiologic anatomy of male reproductive organs.
2. To elaborate steps of spermatogenesis.
3. To elucidate hormonal influences on spermatogenesis.
4. To understand the function of prostate gland and seminal vesicle.
5. To learn the concept of "acrosome reaction".
6. To understand regulation, effects and pathophysiology of testosterone.
7. To understand the abnormalities of male sexual physiology.

CBL-2

A 26 yrs old female presented in gynae OPD with complaint of amenorrhea for the last 6 months. On inquiring it was revealed that she had normal vaginal delivery 7 months back and currently she is breast feeding the baby. There was no history of use of contraceptives. On examination vitals were found to be normal. The gynecologist advised urine pregnancy test which was found to be negative. A diagnosis of lactational amenorrhea was made and the patient was counseled.

Learning objectives:

1. What are the phases of normal menstrual cycle?
2. What are the phases of normal ovarian cycle?
3. To know about the levels of FSH, LH, estrogen and progesterone throughout the cycle.
4. Discuss prolactin, its site of secretion, mechanism of action and its functions.
5. Discuss different types of amenorrhea.
6. To know about oxytocin and its functions.

CBL-3

A 50 yrs old woman presented to gynae OPD with complaints of hyperpigmentation, hot flashes, night sweats, fatigue, irritability, decreased vaginal secretions and history of osteoporosis. Her investigations revealed decreased estrogen & decreased progesterone levels. The gynecologist diagnosed her as a case of menopause.

Learning objectives:

1. To know about the monthly ovarian cycle.
2. To understand the functions of female hormones.
3. Explain the phases of menstrual cycle.
4. To know the regulation of female monthly rhythm.

BLOCK-III

Section-III

Biochemistry

Summary:

Code	Y1M3
Name	Biochemistry
Duration	10 weeks
Broad Themes of Module (Theme: a subject that is being integrated a majority of time of module)	<ul style="list-style-type: none"> • Head, Neck and Special Senses • Endocrine System • Reproductive system
Subject Themes	<ul style="list-style-type: none"> • Metabolism of Lipids • Integration of metabolism • Bioenergetics • Biochemistry of Endocrine System
Prerequisite Module	Y1M1&Y1M2

Mode of Information Transfer:

MIT
Lectures
Tutorials (PTT)
CBL
Practicals
Class tests

Biochemistry learning outcomes and MITs:**Subject Name: Biochemistry**

SNo	Topic	Learning objectives
	Endocrinology – I (Receptors) (LGIS, SGD/Tutorial)	<ul style="list-style-type: none"> • Cell surface receptors • G protein coupled receptors • Intracellular second messenger signaling cascade • Intracellular ligand receptors
1	Endocrinology (LGIS, SGD/Tutorial)	<ul style="list-style-type: none"> • Chemistry, Secretion, Mechanism of action, regulation and effect on Carbohydrates, Lipids, Proteins, Mineral and water metabolism and disorders of various endocrine glands • Mechanism of action of hormones • Functions of growth hormone • Functions of thyroid hormone • Functions of adrenal hormone

		<ul style="list-style-type: none"> • Functions of pancreatic hormone • Functions of parathyroid hormone
2	Reproduction (LGIS, SGD/Tutorial)	<ul style="list-style-type: none"> • Androgens synthesis and functions • Estrogens synthesis and functions
3	Metabolism of Lipids (LGIS, SGD/Tutorial)	<ul style="list-style-type: none"> • Mobilization and transport of fatty acids, triacylglycerol, and sterols • Oxidation of fatty acids - Activation and transport of fatty acid in the mitochondria - β-oxidation, fate of Acetyl CoA, regulation of β-oxidation - Other types of oxidation, i.e. α-oxidation, ω-oxidation, peroxisome oxidation, oxidation of odd number carbon containing fatty acids and Unsaturated fatty acids etc. • Ketogenesis - Mechanism and utilization of Ketone bodies and significance - Ketosis and its mechanism • Biosynthesis of fatty acids • Eicosanoids, synthesis from Arachidonic acid, their mechanism and biochemical functions • Triacylglycerol synthesis and regulation • Synthesis and degradation of phospholipids and their metabolic disorders • Cholesterol synthesis, regulation, functions, fate of intermediates of Cholesterol synthesis, Hypercholesterolemia, Atherosclerosis • Plasma Lipoproteins, VLDL, LDL, HDL, and Chylomicrons, their transport, functions and importance in health and disease • Glycolipid metabolism and abnormalities
4	<ul style="list-style-type: none"> • Bioenergetics (LGIS, SGD/Tutorial) 	<ul style="list-style-type: none"> • For the current 2nd Year MBBS (inducted in 2016 and have appeared in 1st Prof) Topic of "Nutrition" to be taught in place of Bioenergetics
5	Integration and regulation of Metabolic Pathways in Different Tissues (LGIS, SGD/Tutorial)	<ul style="list-style-type: none"> • Chemistry and Metabolic effects of insulin and glucagon on metabolism • Feed fast cycle • Liver, brain, skeletal muscle and kidney in fasting state • Liver, brain, skeletal muscle and kidney in fed state • Adipose tissue in fed and fasting state • Diabetes mellitus • Obesity

List of Practicals:

S. No	Topic	Learning Outcome
1.	Estimation and Clinical Interpretation of serum Cholesterol	<ul style="list-style-type: none">• Using semi-automatic chemistry analyzer, micro lab 300 machine student must learn how to estimate exact concentration of proteins in a given sample i.e. plasma• To know the principle of the test i.e. chemical reaction involved• Use of the test in clinical setting• Reference range
2.	Estimation and Clinical Interpretation of Urea in blood	<ul style="list-style-type: none">• Using semi-automatic chemistry analyzer, micro lab 300 machine student must learn how to estimate exact concentration of Urea in a given sample i.e. plasma• To know the principle of the test i.e. chemical reaction involved• Use of the test in clinical setting• Reference range
3.	Estimation and Clinical Interpretation of Serum Proteins	<ul style="list-style-type: none">• Using semi-automatic chemistry analyzer, micro lab 300 machine student must learn how to estimate exact concentration of glucose in a given sample i.e. plasma• Causes of hypo and hyper proteinemia• To know the principle of the test i.e. chemical reaction involved• Use of the test in clinical setting• Reference Range
4.	Determination of amino acids in urine by Paper Chromatography	<ul style="list-style-type: none">• To detect the presence of a specific amino acid in a given solution/urine using paper chromatography technique• To compare Rf values of amino acids• To learn the significance of appearance of certain amino acids in urine
5.	Estimation and Clinical Interpretation of plasma enzyme ALT	<ul style="list-style-type: none">• Using semi-automatic chemistry analyzer, micro lab 300 machine student must learn how to estimate exact concentration of ALT in a given sample i.e. plasma• To know the principle of the test i.e. chemical reaction involved• Uses of the test in clinical setting• Reference range
6.	Estimation and Clinical Interpretation of enzyme AST in blood	<ul style="list-style-type: none">• Using semi-automatic chemistry analyzer, micro lab 300 machine student must learn how to estimate exact concentration of AST in a given sample i.e. plasma

		<ul style="list-style-type: none"> • To know the principle of the test i.e. chemical reaction involved • Use of the test in clinical setting • Reference range
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List of Case Based Learning Scenerios:

List of Biochemistry CBLs Year 2nd Module 3rd

CBL-1

Ethanol Intoxication (Water, electrolyte and acid base balance)

A 28 year old man was brought to emergency when found unresponsive by his family. Due to social stigma (worldwide), the family members were hesitant to tell that he consumed almost half a liter of ethanol in the last evening on marriage ceremony of his cousin. His peers reported that he was a known drinker for last five years. His vitals were normal but gag reflex and response to pain were absent. Pupils were miotic and pinpoint but reactive to light. His respiration was inadequate (oxygen saturation 70 percent) and he was intubated. There was no history of use of sleeping pills (barbiturates etc) or painkillers (NSAIDS).

RELATED LAB INVESTIGATIONS:

Test Name	Result	Normal Values
Serum ethanol levels	410mg/dL	Nil
GGT	270 U/L	30 U/L in males
Na⁺	133mEq/L	142mEq/L
pH	7.34	7.35 to 7.45
HCO₃	18 (26 at some other time)*	24 mEq/L
Cl⁻	103	103 mEq/L
pO₂	70	80-100mmHg
pCO₂	58	40 mmHg
Ketone bodies in urine	Present	Absent (present in fasting)

Orally ingested alcohol is absorbed quickly without chemical change from GIT, reaching maximum plasma concentration in almost an hour. It crosses capillary membrane through simple diffusion and affects almost every organ of the body. Though pathophysiology of alcohol related metabolic derangements is not completely understood, its main effects are through its metabolic products, acetaldehyde and acetate. Malnutrition is common in chronic alcoholics and it further worsens the scenario. Acetaldehyde is the main injurious metabolic product of alcohol produced in

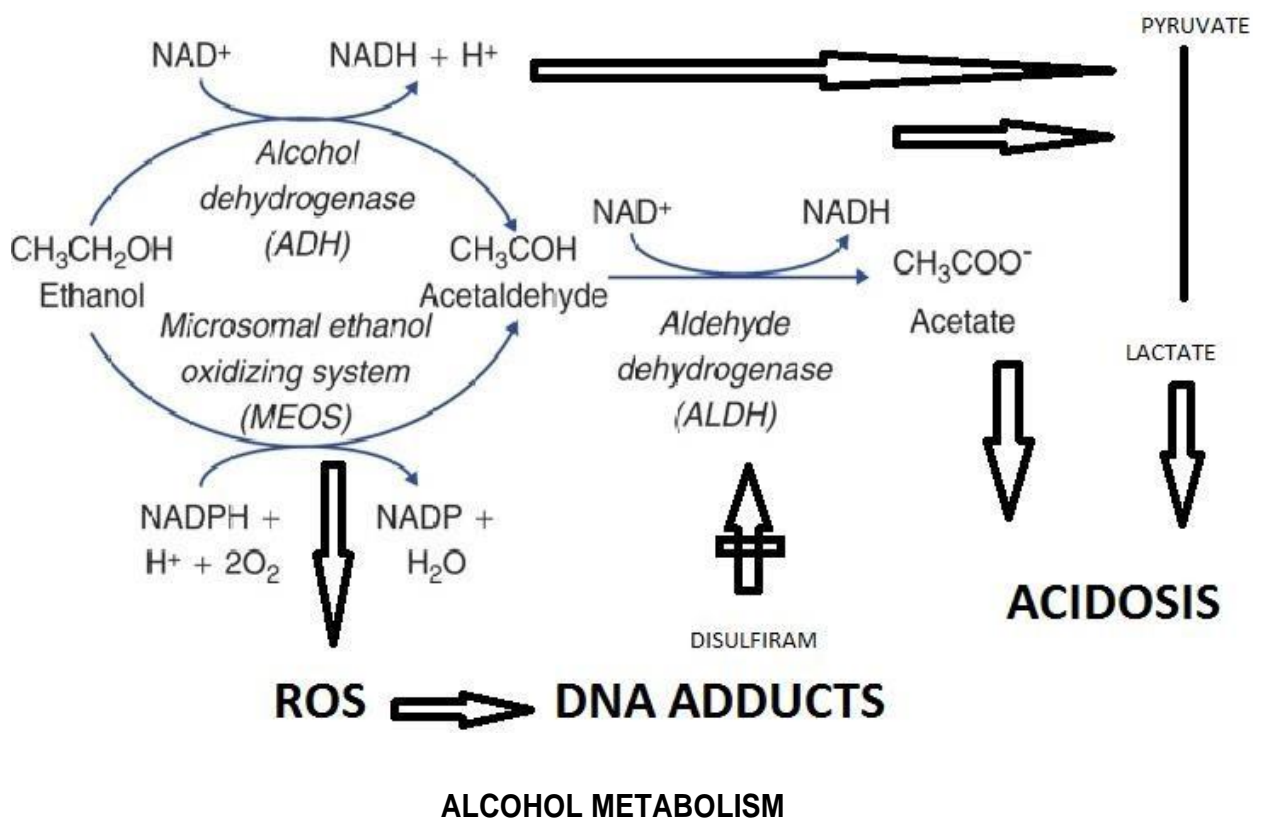
cytosolic as well as microsomal ethanol metabolism. Compared to non-alcoholic subjects, chronic alcoholic patients have lower serum concentrations of potassium, magnesium, bicarbonate, calcium and phosphate as well as a lower arterial pH value.

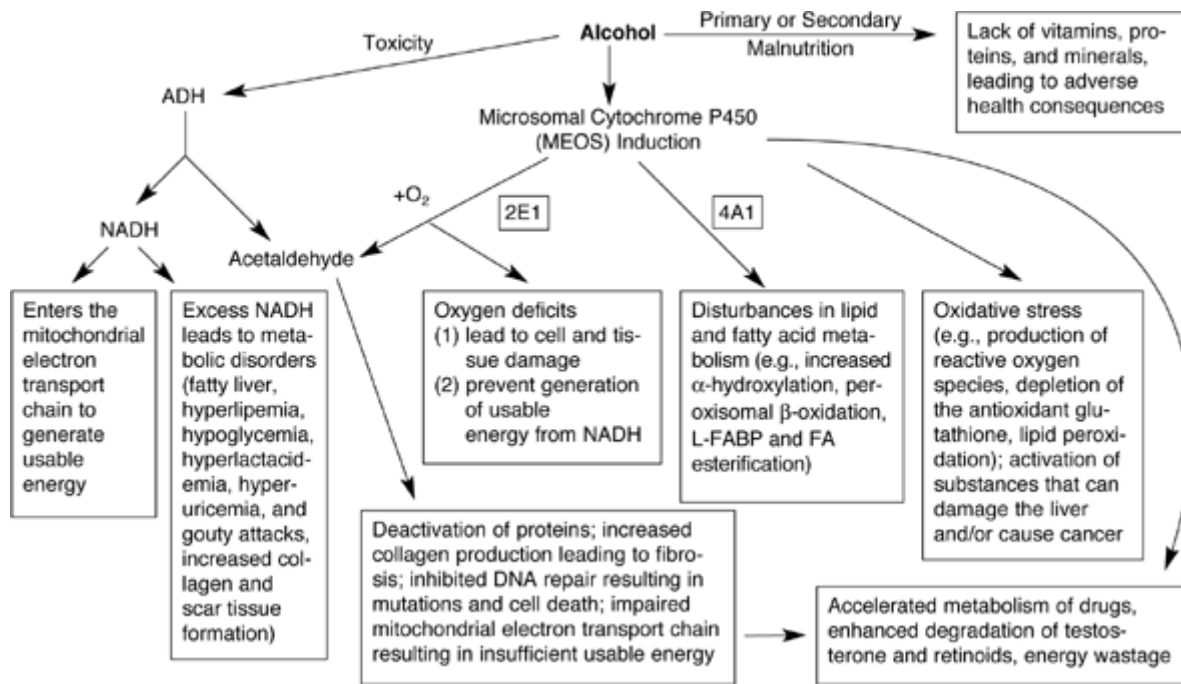
LEARNING OBJECTIVES:

1. How to diagnose acid base disorders
2. Alcohol metabolism in human body
3. Effects of alcohol on electrolyte and acid base balance

REFERENCE BOOKS:

1. Harper's text book of Biochemistry
2. Davidson's Practice of Medicine
3. Internet sources





CBL-2

Protein Metabolism (Urea Cycle- Cirrhosis of Liver)

A 47 year old truck driver was brought in hospital with **hematemesis, confusion, delirium** and inappropriate behaviour. He was a diagnosed case of Hep B virus infection for last ten years and was treated with entecavir (nucleoside analog) 0.5mg orally daily for one year, but response was not good. He was not vaccinated for Hep B previously. He has been visiting medical OPD off and on for general **weakness, tiredness, itchy and yellow skin, swelling on lower legs and abdominal distension**. He was advised operation for **esophageal varices** few months back which he could not plan. He was having **fever** for last three days and was taking Panadol two tablets when required. He was admitted and transfused with blood and saline. His hands and feet had to be tied on bed to prevent self- harm and misbehavior in **stuporous state**. He was advised endoscopic variceal ligation, restriction in protein intake, **neomycin and laxatives**.

RELATED LAB INVESTIGATIONS:

Test Name	Result	Normal Values
Serum albumin	28 g/L	35-50 g/L
ALT	74 U/L	Upto 42 U/L in males
USG Abdomen	Shrunken, nodular, coarse liver & splenomegaly	Normal study
Clotting time	8 mins	2-6 mins
Hb	11 g/dL	14-16g/dLin males
HBsAg	Repeatedly Positive	Negative

Hepatitis B is a viral infection of liver caused by hepatitis B virus and transmitted through blood or body secretions. A three dose vaccine is recommended for general population. Only 5-30 percent infections can become chronic and can cause severe liver damage. As it causes continuous slow damage to hepatocytes, ALT is mildly or moderately increased. Over the span of 5-8 years a significant harm to liver is done and **liver appears shrunken, fibrosed and nodular**. When intrahepatic blood pressure increases the **portal flow is shunted to systemic circulation** at lower end of esophagus and in superior and middle rectal veins of rectum. Here the blood vessels dilate and can be torn with physical trauma (friction by bolus in esophagus and fecal matter in rectum) leading to frank bleeding. Ammonia made by breakdown of urea by microorganisms in the gut is reabsorbed into the portal circulation (being lipid soluble gas) which is again detoxified by liver in normal individuals. But as portal blood is shunted to systemic circulation, **ammonia** can cause **toxicity to CNS** and results in altered consciousness and behavior called **hepatic encephalopathy**. This **hyperammonemia is secondary** to liver disease and is much more common as compared to primary hyperammonemia. Decrease in albumin production by liver will cause fluid to escape to peritoneum causing **ascities**.

LEARNING OBJECTIVES:

1. Disposal of amino groups of amino acids and Urea Cycle
2. The role of liver and portal circulation in entero-hepatic circulation of free ammonia
3. Hyperammonemia and fate of ammonia

REFERENCE BOOKS:

1. Harper's text book of Biochemistry
2. Davidson's Practice of Medicine
3. Internet sources

CBL-3

Lipid Metabolism (cholesterol – Ischemic Heart Disease IHD)

A 46 years old businessman, known hypertensive, was brought in cardiology emergency in a semi-unconscious state after a bout of severe chest pain 40 mins ago. He was immediately put on oxygen and given injection pethidine. His ECG and trop I was done in emergency and findings of both were consistent with myocardial infarction (showing more than two hours passed since MI). He was given nitrates and injection streptokinase immediately.

He had mild chest pain few days back and underwent complete investigation for cardiac disease. At that time his ECG and echocardiography were unremarkable, his BP was 160/90mmHg and his lipid profile including other tests is given in table below. On the basis of these investigations, he was advised low fat (strict prohibition of saturated fat), **low salt** and **low calorie diet**, regular **exercise** after clearance by cardiologist, low dose **aspirin** and **statins**.

RELATED LAB INVESTIGATIONS:

Test Name	Result	Normal Values (mmol/L)
Triglycerides (TG)	2.4mmol/L	Desirable <1.60 Borderline 1.60-2.20 HighRisk 2.30 -5.60
Total cholesterol (TC)	6.4mmol/L	Desirable < 5.20 Moderate Risk 5.20 -6.20 HighRisk > 6.20
LDL-c	4.30mmol/L	Optimal < 2.50 Desirable 2.60 -3.30 Moderate risk 3.40 -4.10 High risk > 4.10
HDL-c	0.93mmol/L	Desirable > 1.04
Plasma Glucosefasting	5.9mmol/L	Normal 3.3 – 5.6mmol/L Impaired GT 5.6-7.0 mmol/L Diabetes mellitus >7.0
CK-MB	24 U/L	Upto 25 U/L

Intake of energy dense foods, lack of physical activity, sedentary life style, smoking and aberranteating and work hours are all risk factors for CAD. Type of fat consumed is also very important in determining the risk. It is established that circulating cholesterol (LDL-c) is a bad indicator of coronary health. Dietary cholesterol is poorly absorbed from the intestine thus it does not significantly affect plasma LDL levels. Cholesterol is synthesized in almost all nucleated cells of human body and its endogenous production is inhibited by statin drugs which are widely used in

clinics. Limitation on dietary cholesterol has been lifted recently and it is now allowed for healthy individuals. On the other hand taking saturated fat in diet significantly increases plasma cholesterol (LDL-c) levels and make one prone to atherosclerosis and cardiac event. Plasma glucose surge after intake of refined sugars has also been found to be associated with cardiac morbidity.

LEARNING OBJECTIVES:

1. Metabolism of lipoproteins
2. Hyperlipidemias especially hypercholesterolemia type II
3. Cholesterol synthesis and statin drugs

REFERENCE BOOKS:

1. Lippincott’s illustrated reviews and Harper’s text book of Biochemistry
2. Davidson’s Practice of Medicine
3. Internet sources

CBL-4

Lipid Metabolism (FA oxidation – MCAD Deficiency)

A 10 month old infant was admitted in pediatric ward for pneumonia. He was being given appropriate antibiotics but suddenly went into syncope after an episode of vomiting. He was found to have severe hypoglycemia while his BP was normal. Ketonemia and ketonuria were absent. On examination there was hepatomegaly (examination was done after patient was stable). He was normal at birth and no newborn screening was done for inborn errors of metabolism. The measurement of MCAD enzyme activity in leukocytes confirmed the diagnosis of MCAD deficiency. Mother was advised to never let the baby empty stomach and ensure feeding at regular small intervals especially of carbohydrate rich meals. In infants 2 g/kg of uncooked cornstarch at bedtime ensures sufficient glucose overnight.

RELATED LAB INVESTIGATIONS:

Test Name	Result	Normal Values
Plasma Glucose random	2.0 mmol/L	3.3-11.1 mmol/L
Plasma ketones	0.04 mmol/L	0.05-3.0 mmol/L
Urinary ketone bodies	Present	Absent (may be present during fasting)
Plasma acylcarnitines tandem mass spectrometry	Increased	-

In mitochondria, there are four fatty acyl CoA dehydrogenase species, each with a specificity for either short-, medium-, long-, or very-long-chain fatty acids. MCAD deficiency, an autosomal recessive disorder, is one of the most common inborn errors of metabolism, and the most common inborn error of fatty acid oxidation, being found in 1:14,000 births worldwide, with a higher incidence in Northern Europeans. It results in decreased ability to oxidize fatty acids with six to ten carbons (these accumulate and can be measured in urine), and severe hypoglycemia (because the tissues must increase their reliance on glucose). Treatment includes avoidance of fasting. MCAD deficiency has been identified as the cause of some cases originally reported as sudden infant death syndrome (SIDS) or Reye syndrome.

LEARNING OBJECTIVES:

1. Fatty Acid synthesis
2. Beta oxidation
3. Ketogenesis, ketonemia and ketonuria

REFERENCE BOOKS:

1. Lippincott's illustrated reviews and
2. Harper's textbook of Biochemistry
3. Internet sources

CBL-5

Protein Metabolism (PKU)

A-20-month-old boy born to consanguineous parents was evaluated for marked delay in achievement of milestones, blond hair and irritability. Large amount of phenyl-ketones in urine, and raised plasma phenylalanine led to the diagnosis of phenylketonuria. He was placed on a low phenylalanine diet formulated from locally available foods and the clinical and biochemical response was monitored with the aid of urinary ferric chloride test. On this diet he showed a mild clinical and biochemical improvement.

RELATED LAB INVESTIGATIONS:

Test Name	Result	Normal Values
Plasma Phenylalanine	24mg/dL	1-2 mg/dL
Urinary Phenyl lactate	Present	Absent
Urinary Phenyl acetate	Present	Absent
Urinary Phenyl pyruvate	Present	Absent

Phenylketonuria (PKU) is a rare genetic disorder with an incidence of 1 in 15,000 births. It is characterized by a deficiency of a hepatic enzyme (phenylalanine hydroxylase, or PAH) responsible for the conversion of the amino acid phenylalanine (Phe) into tyrosine. An absence of (or deficiency in) PAH results in increased blood concentrations of Phe and toxic accumulation in the brain. If PKU is left untreated, it may lead to deficit in cognitive functions, intellectual impairment, seizures, various behavioral problems, and psychiatric symptoms.

Most individuals with phenylketonuria (PKU) appear normal at birth. If newborn screening fails, progressive developmental delay is the most common presentation. Other findings in untreated children in later infancy and childhood may include vomiting, mousy odor, eczema, seizures, self-mutilation, and severe behavioral disorders.

LEARNING OBJECTIVES:

1. Metabolism of amino acids and role of folic acid
2. Inborn errors of metabolism
3. Phenylketonuria

REFERENCE BOOKS:

1. Lippincott's illustrated reviews and
2. Harper's textbook of Biochemistry
3. Internet sources

CBL-6

Obesity (obesity)

A 40 years old house wife presented with chronic pain in both knees and back. Her weight was 93 kg and height was 5'3". Her waist to hip ratio was measured to be 1.1. She also complained of inguinal hernia. She was diagnosed as a case of android obesity with BMI almost 36. Her doctor advised her to change dietary and life style habits and gave some symptomatic relief medicines after seeing the report of tests ordered empty stomach.

RELATED LAB INVESTIGATIONS:

Test Name	Result	Normal Values
TC	6.2 mmol/L	Less than 5.6 mmol/L
TGs	1.8 mmol/L	Less than 1.6 mmol/L
LDL	3.6 mmol/L	Less than 2.6 mmol/L
HDL	90 mmol/L	More than 1.04 mmol/L
BSF	120 mg/dL	Less than 110 mg/dL

Obesity is a disorder of body weight regulatory systems characterized by an accumulation of excess body fat. The BMI (weight in kg) (height in meters) ² provides a measure of relative weight, adjusted for height. This allows comparisons both within and between populations. The healthy range for the BMI is between 18.5 and 24.9. Individuals with a BMI between 25 and 29.9 are considered overweight, those with a BMI equal to or greater than 30 are defined as obese, and a BMI over 40 is considered extremely obese. Anyone more than 100 pounds overweight is considered severely obese. These cutoffs are based on the studies examining the relationship of BMI to premature death, and are similar in men and women.

LEARNING OBJECTIVES:

1. Obesity and how to measure
2. Body weight regulation
3. Weight reduction

REFERENCE BOOKS:

1. Lippincott's illustrated reviews and Harper's text book of Biochemistry
2. Davidson's Practice of Medicine
3. Internet sources

CBL-7

Endocrinology (Hyperthyroidism)

A 50 years old anxious & over-active lady presented with weight loss and occasional diarrhea for few months. Her appetite was moderately increased and she thought she had become more heat intolerant. She was also experiencing palpitations, tremors and irritability for few months. After physical examination and lab investigations, physician diagnosed her a case of hyperthyroidism and advised her Carbimazole 20mg daily and propranolol 40mg thrice daily for four weeks.

RELATED LAB INVESTIGATIONS:

Test Name	Result
T3	Raised
T4	Raised
TSH	Low
IgG anti thyroidAb	Present

There are two major systems in human body for inter organ coordination. One is wired and called Nervous system while other is wireless type and called endocrine system. The hormones of endocrine gland are produced by specialized cells/ tissues located distant to the site of action. They produce minute quantities of hormones which always travel in blood, get access to almost all tissues but produce transient effects only on the cells which have receptors for specific hormone. Thyroid hormones control metabolic rate or in other words if we consider human body as an automobile and its engine represents the metabolism the thyroid is the accelerator.

LEARNING OBJECTIVES:

1. Endocrine hormones – introduction and classification
2. Pituitary Hormones
3. Thyroid & parathyroid hormones

REFERENCE BOOKS:

1. Guyton text book of physiology
2. Davidson’s Practice of Medicine
3. Internet sources

CBL-8

Endocrinology (Cushing Syndrome)

A 40 year old lady presented with weight gain, lethargy, depression, general weakness and irregularity in menses. On examination she was found to have BP 145/90 mmHg and her face appeared moonlike while buffalo neck hump and supraclavicular fat distribution were evident. She was a known patient of rheumatoid arthritis and has been on steroids for last two years. Doctor diagnosed her as a case of iatrogenic Cushing syndrome.

RELATED LAB INVESTIGATIONS:

Test Name	Result	Reference
Plasma Glucose levels random	12mmol/L	Upto 11.1mmol/L
Cortisol levels	Raised	
ACTH	Normal	

Adrenal cortex produces 1) glucocorticoids e.g. cortisol which affect carbohydrate, protein and fat metabolism 2) mineralocorticoids i.e. aldosterone which regulates Na and water balance 3) androgens which are weak until converted to potent compounds in the periphery. A chronic excess of glucocorticoid with loss of feedback mechanism of hypothalamo-pituitary adrenal axis and loss

of circadian rhythm of cortisol secretion is called Cushing's syndrome and its chief causes are chronic exogenous steroid use and pituitary adenoma.

LEARNING OBJECTIVES:

1. Hormones of adrenal cortex
2. Mechanism of action and effects of adrenal cortical hormones
3. Biochemical Basis of sign and symptoms of Cushing syndrome and disease
4. Biochemical Diagnosis of Cushing syndrome

REFERENCE BOOKS:

1. Harpers text book of Biochemistry
2. Guyton text book of physiology
3. Internet sources

CBL-9

Endocrinology (DM)

A 47 years old lady presented with polyuria, polydipsia and weight loss for few months. She also complained for recurrent burning micturition/ genital thrush for some time. Her plasma glucose levels were checked and she was diagnosed as a case of DM.

RELATED LAB INVESTIGATIONS:

Test Name	Result	Reference
Plasma Glucose levels random	15mmol/L	Upto 11.1mmol/L
Plasma glucose levels fasting (next day) (DM if more than 7mmol/L)	9 mmol/L	5.6 mmol/L
HbA1c	60mmol/L	Upto 48mmol/L (6.5%)

Diabetes mellitus is a serious pandemic metabolic derangement syndrome in which decreased endogenous insulin or its decreased effectiveness is the hallmark. Insulin and glucagon are major regulatory hormones of metabolism. Insulin is the hormone of fed state and it's the hormone of storage (causes deposition of carbohydrate and fat stores). Decreased synthesis or release of insulin from beta cells of pancreas leads to hyperglycemia in addition to other metabolic derangements and the condition is called type 1 DM. On the other hand, despite normal release of insulin from pancreas there may be resistance to its action in peripheral tissue (adipose and Skeletal muscle) mostly secondary to obesity and this condition is called type 2 DM.

LEARNING OBJECTIVES:

1. Hormones of endocrine pancreas
2. Mechanism of action and effects of Insulin and Glucagon
3. Biochemical Basis of sign and symptoms of DM
4. Biochemical Diagnosis of DM

REFERENCE BOOKS:

1. Harpers text book of Biochemistry
2. Guyton text book of physiology
3. Internet sources

Second Professional MBBS Examination ANATOMY

Table of Specifications for Annual Second Professional Examination: Theory

Time Allowed	=03 hrs (<i>Including MCQs</i>)	
Marks of theory paper	=90	
Internal assessment	=10	
Total marks	=100	
Pass Marks	=50	
25 x MCQs (on separate sheet)	(25 Marks)	Time =30 min
Q. No. 1,2,3,4,5,6,7,8,9		
(7x SAQs/SEQs (C1 & C2) = 07 marks each		
2 x SAQs/SEQs (C3) = 08 marks each)	(65 Marks)	Time = 2 hours 30 minutes

S.No	Topic	NUMBER OF MCQs (25) (C1=10, C2=10, C3=5) 1 mark each	NUMBER OF SAQs/SEQs (09) • 7x SAQs/SEQs (C1 & C2) = 07 marks each • 2 x SAQs/SEQs (C3) = 08 marks each
1.	Special Embryology	05	01
2.	Special Histology	05	01
3.	Abdomen Pelvis & Perineum	05	03
4.	Head and neck	05	02
5.	Brain & Neuro Anatomy	05	02
Total		25 (25 Marks)	09 (65 Marks)

Theory: Internal Assessment (IA) Calculation

A	B	C	D
Roll No.	Name	All Modules/ Pre annual Exams or any other exam	Total Marks of internal assessment Out Of 10
Total Marks		Sum of Marks obtained x10/ sum of total marks in all exams	

Table of Specifications for Annual Professional Exam: Practical

VIVA 50 marks		Practical 40 marks				Total
		Non Observed OSPE		Observed station OSPE	Histology Manual	
Internal Examiner	External Examiner	Gross embryology, & X – rays	Histology	Long Slides 05 marks. Surface marking 02 marks.		
25 Marks	25 Marks	20* Marks	10 Marks	07 Marks	03 marks	90 marks

* 10 stations (2 Abdomen and Pelvis, 2 Head & Neck, 2 Brain, 2 embryology, 2 radiology)

Practical: Internal Assessment Calculation

A	B	C	D
Roll No.	Name	OSPE /Practical Class tests throughout the year /Pre annual Practical Exams or any other exam	Total Marks of internal assessment Out Of 10
Total Marks		Sum of Marks obtained x10/ sum of total marks in all exams	

Second Professional MBBS Examination

PHYSIOLOGY

Table of Specifications for Annual Second Professional Examination: Theory

Time Allowed =03hrs (Including MCQs)

Marks of theory paper =90

Internal assessment =10

Total marks =100

Pass Marks =50

25 x MCQs (on separate sheet) (25 Marks) Time =30 min

Q. No. 1,2,3,4,5,6,7,8,9

(7x SAQs/SEQs (C1 & C2) = 07 marks each

2 x SAQs/SEQs (C3) = 08 marks each) (65 Marks) Time = 2 hours 30 minutes

S No	Topic	NUMBER OF MCQs(25) (C1=10, C2=10, C3=5) 1 mark each	NUMBER OF SAQs/SEQs (09)	
			7x SAQs/SEQs (C1 & C2) =07 marks each	2 x SAQs/SEQs(C3) = 08 marks each
1.	GIT	06	01	Whole Course
2.	Renal	06	02	
3.	CNS + Special Senses	07	02	
4.	Endo, Repro, Neonatal	06	02	
Total		25	07	02
Grand Total		25 (25 Marks)	09 (65 Marks)	

Theory: Internal Assessment (IA) Calculation

A	B	C	D
Roll No.	Name	All Modules/ Pre annual Exams or any other exam	Total Marks of internal assessment Out Of 10
Total Marks		Sum of Marks obtained x10/ sum of total marks in all exams	

Table of Specifications for Annual Professional Exam: Practical

Viva (Theory) 50 marks		Practical 40 marks					Total
Internal Examiner	External Examiner	OSPE (20)		Experimental Physiology + Table Viva	Practical Procedure	Practical Journal	
		Observed	Unobserved				
25	25	10	10	12	5	3	90

Practical: Internal Assessment Calculation

A	B	C	D
Roll No.	Name	OSPE /PTT/ Class tests throughout the year /Pre annual Exams or any other exam	Total Marks of internal assessment Out Of 10
Total Marks		Sum of Marks obtained x10/ sum of total marks in all exams	

Second Professional MBBS Examination

BIOCHEMISTRY

Table of Specifications for Annual Second Professional Examination: Theory

Time Allowed	=03 hrs	<i>(Including MCQs)</i>
Marks of theory paper	=90	
Internal assessment	=10	
Total marks	=100	
Pass Marks	=50	
25 x MCQs (on separate sheet)	(25 Marks)	Time =30 min
Q. No. 1,2,3,4,5,6,7,8,9		
(7x SAQs/SEQs (C1 & C2) = 07 marks each		
2 x SAQs/SEQs (C3) = 08 marks each)	(65 Marks)	Time = 2 hours 30 minutes

Topic	NUMBER OF MCQs (25) (C1=10, C2=10, C3=5) 1 mark each	NUMBER OF SAQs/SEQs (09)	
		7x SAQs/SEQs (C1 & C2) = 07 marks each	2 x SAQs/SEQs (C3) = 08 marks each
Biochemical Genetics + Molecular Biology Techniques	02	01	Any 2 from whole courses
Biochemistry of Endocrine System + Water & Electrolyte, Acid base balance	03	01	
Integration of metabolism + Nucleotide Metabolism	03	01	
Metabolism of Lipids	03	01	
Biochemistry of Digestive Tract+ Bioenergetics	04	01	
Metabolism of Carbohydrates	05	01	
Metabolism of Proteins and Amino Acids+ Xenobiotic	05	01	
Total	25 (25 marks)	07 (49 Marks)	02 (16 Marks)
Grand Total	25 (25 marks)	09 (65 Marks)	

Theory: Internal Assessment (IA) Calculation

A	B	C	D
Roll No.	Name	All Modules/ Pre annual Exams or any other exam	Total Marks of internal assessment Out Of 10
Total Marks		Sum of Marks obtained x10/ sum of total marks in all exams	

Table of Specifications for Annual Professional Exam –Practical

Viva (Theory) 50 marks		Practical 40 marks				Total
Internal Examiner	External Examiner	OSPE (20)		Viva + Performance	journal	
		Observed (2 Station)	Unobserved (10 Station)			
25	25	10	10	15	5	90

Practical: Internal Assessment Calculation

A	B	C	D
Roll No.	Name	OSPE /PTT/ Class tests throughout the year /Pre annual Exams or any other exam	Total Marks of internal assessment Out Of 10
Total Marks		Sum of Marks obtained x10/ sum of total marks in all exams	