



**Faculty of Medicine and Allied Medical Sciences (FM&AMS)**



# **Module 5: Gastrointestinal tract & Metabolism**

**Academic year 2019**

**Phase 2**

**Year 1**

**Term 2**

Designed & Written by Dr Kabir Dherwani

# Introduction to Metabolism and Gastroenterology System

## Purpose of this Study Guide

The purpose of the study guide is to:

- Structure your learning so you can access it in future practice.
- Develop a productive lifelong learning strategy.
- Develop your clinical reasoning skills in preparation for Phase 3 and clinical practice.
- To link your thinking between the systems.

This guide is the result of untiring work of faculty members from all the departments involved in this module. These include Physiology, Anatomy, Biochemistry and Medical Education departments at Isra University.



## Contents

<b>Module details</b> .....	6
<b>Introduction</b> .....	7
<b>Aim</b> .....	9
<b>Structure of the Course</b> .....	9
General objectives: .....	10
Knowledge/cognition.....	10
Psychomotor skills .....	10
Attitude/ Behaviours.....	10
Main Content Areas .....	11
Structure and function of gastrointestinal tract.....	11
Metabolism of Micro and macromolecules.....	11
Pathophysiology of the gastrointestinal tract .....	11
Anatomy practical – students must maintain a journal and will be a part of assessment.....	11
Biochemistry practical – students must maintain a journal and will be a part of assessment .....	11
The Gastrointestinal system & Metabolism module team.....	12
Main Content Area:.....	13
<b>Real life incident 1</b> .....	14
<b>Real life incident 2</b> .....	14
<b>Real Life incident 3</b> .....	14
<b>Real Life incident 4</b> .....	15
Theme: Surface anatomy of the abdomen and abdominal cavity.....	16
<b>Topic: Abdominal Wall – Surface anatomy</b> .....	16
<b>Topic: Abdominal wall – Planes and Regions</b> .....	16
<b>Topic: Anterior Abdominal Wall</b> .....	16
<b>Topic: Anatomical structure of Inguinal Canal</b> .....	16
<b>Topic: Abdominal Cavity</b> .....	17
<b>Topic: Peritoneum</b> .....	17
Theme: Gross anatomy of the gastrointestinal tract.....	18
<b>Topic: Structure of the mouth</b> .....	18
<b>Topic: Structure of the oesophagus</b> .....	18
<b>Topic: Stomach</b> .....	18
<b>Topic: Duodenum</b> .....	19
<b>Topic: Jejunum and Ileum</b> .....	19
<b>Topic: Liver - Structure</b> .....	19



<b>Topic: Gall bladder and Pancreas</b> .....	19
<b>Topic: Portal circulation</b> .....	20
<b>Topic: Large Intestine – Appendix and Caecum</b> .....	20
<b>Topic: Large intestine - Colon</b> .....	20
<b>Topic: Rectum and Anal Canal</b> .....	20
<b>Topic: Arterial supply of the gastrointestinal tract</b> .....	20
<b>Topic: Venous drainage of the gastrointestinal tract</b> .....	21
<b>Topic: lymphatic drainage of the gastrointestinal tract</b> .....	21
<b>Topic: Nerve supply of the gastrointestinal tract</b> .....	21
Theme: Development of the gastrointestinal tract .....	22
<b>Topic: Development of Foregut – Oesophagus &amp; Stomach</b> .....	22
<b>Topic: Embryology of Liver, Gallbladder and Pancreas</b> .....	22
<b>Topic: Development of the mid and hindgut</b> .....	22
Theme: Histology of the gastrointestinal tract .....	23
<b>Topic: Histology – Oesophagus &amp; Stomach</b> .....	23
<b>Topic: Histology of the small and large intestine</b> .....	23
<b>Topic: Histology of the liver and gall bladder</b> .....	23
Theme: Metabolism of Micro and macromolecules.....	24
<b>Topic: Metabolic oxidation of metabolic pathways</b> .....	24
<b>Topic: Digestion &amp; metabolism of carbohydrates</b> .....	24
<b>Topic: Glycolysis: fate of pyruvate &amp; pyruvate kinase deficiency</b> .....	24
<b>Topic: Gluconeogenesis</b> .....	24
<b>Topic: Glycogenolysis &amp; Glycogenesis and Glycogen storage diseases</b> .....	25
<b>Topic: Citric Acid Cycle – Regulation &amp; ATP</b> .....	25
<b>Topic: Hexose Mono Phosphate shunt &amp; G6PD deficiency</b> .....	25
<b>Topic: Lactose, Fructose &amp; Galactose Metabolism &amp; Regulation of Blood Glucose</b> .....	26
<b>Topic: Metabolic role of liver in detoxification</b> .....	26
<b>Topic: Metabolic oxidation of metabolic pathways</b> .....	26
Theme: Organization and function of the gastrointestinal tract.....	27
<b>Topic: Regulation of Gastrointestinal tract and saliva</b> .....	27
<b>Topic: Functions of oesophagus</b> .....	27
<b>Topic: Stomach motility</b> .....	27
<b>Topic: Gastric secretions</b> .....	27
<b>Topic: Liver - functions</b> .....	28
<b>Topic: Exocrine pancreas</b> .....	28



Module 5: GIT & Metabolism 2019

MED

<b>Topic: Bile secretion</b> .....	28
<b>Topic: Large intestine - Function</b> .....	28
Theme: Pathophysiology of the gastrointestinal tract disorders .....	30
<b>Topic: Vomiting</b> .....	30
<b>Topic: Diarrhoea</b> .....	30
<b>Topic: GERD &amp; Acid-peptic disease</b> .....	30
<b>Topic: Liver function tests:</b> .....	30
Recommended and additional Reading for the module.....	31
<b>Embryology:</b> .....	31
<b>Histology:</b> .....	31
<b>Anatomy</b> .....	31
<b>Physiology</b> .....	31
<b>Pathology</b> .....	31
<b>Clinical skills</b> .....	32
<b>Community Medicine</b> .....	32
Teaching and Learning opportunities .....	33
About attendance .....	33
Assessment and grading .....	33
Curriculum map .....	33



# **GIT & Metabolism Module Details**

## Module details

Course	<b>MBBS</b>
Phase	<b>Two</b>
Year	<b>One</b>
Term	<b>Two</b>
Commencement date	<b>Monday 16<sup>th</sup>, September 2019</b>
Duration of module	<b>06 weeks</b>
Pre-requisites	<b>Successful completion of Module 1, II, III &amp; IV</b>
Disciplines covered	<b>Physiology, Biochemistry, and Anatomy</b>
Learning outcomes	<b>the competent medical practitioner, the professional</b>
Competencies covered	<b>I (Skilful), and II (Knowledgeable/ problem solver), III (Community Health Promoter)</b>
Module assessment	<b>End-module exam</b>
Assessment methods	<b>One-correct answer (MCQs) &amp; Structured Answer Questions (SAQs), Objective Structured Practical Examination (OSPE)</b>
Year 1 coordinator	<b>Dr Syna Amir</b>



# GIT & Metabolism module

## Introduction

Welcome to the Metabolism and Gastroenterology module. This module in Phase 2 is focused on structure and function of the gastrointestinal tract, metabolism of biomolecules and introduction to the commonly occurring gastrointestinal diseases common in Pakistan.

Teaching and learning during the first two-weeks is focused on the themes of organization of the gastrointestinal tract followed by surface anatomy of the abdominal wall. After which students will study the basic structure, physiological and biochemical aspects of each viscera of the gastrointestinal system in detail. The students will get the opportunity of learning about different types of gastrointestinal secretions and their contribution to digestion and absorption.

Alongside studying the structure and function of the GI tract and viscera of abdomen, students will learn pathophysiology of common GI diseases. Such as learning about mechanisms of gut motility and important disorders of gut motility like vomiting, diseases related to the gastroesophageal junction like Gastro-oesophageal reflux disease (GERD), Acid peptic disease mechanism.

During the mid of module, students will learn about the metabolic disorders, intermediary metabolism and their regulation in health. This module will briefly deal with nutritional needs throughout life and diseases arising as a result. Moreover, relevant aspects related to the hormones will be discussed in the upcoming Endocrinology module.

A sound knowledge of state of nutrition on general metabolism is essential to have a good understanding of the health and diseases in humans. This in turn will help in providing effective treatments for diseases in medical practice. Especially because, Pakistan is a country where malnutrition is highly prevalent.

The goal of the entire gastrointestinal system is to convert the indigestible food to absorbable particles and finally absorption. An important area of this module is to teach how gastrointestinal system is regulated to achieve the above aim.

For your understanding purpose, several real life case scenarios have been mentioned at the beginning of each section where possible. Several of these cases will form the basis of small



group discussion and tutorials. This exposure will help you grasp the principles of gastrointestinal diseases and relate them to clinical conditions in Phase 2 and clinical rotations.

For the purpose of convenience, practicality and feasibility of the Gastrointestinal module is arranged in an anatomical manner starting from the mouth going down to the anus. The liver and pancreas would be discussed in separate sections. The areas that the student should know as essential core knowledge would be designated as (A) and good to know and nice to know is depicted as (B) and (C), respectively.

Our hope is that you at the end of this module could appreciate the importance of gastrointestinal system as a vital part of the human body and understand how its functions relate to the functioning of the human body as a whole. KD!





## Aim

The aim of this module is to identify the key themes and clinical problems for each week and to highlight the more important learning issues and the opportunities for acquiring the essential information related to gastrointestinal system. It is important to point out that the information in this guide is merely a skeleton on which to base your learning from the teaching course and from further reading. At the end of 6 weeks, you should have acquired the core information required to pass the assessment.

## Structure of the Course

There are six themes for the entire module covered over the period of 6 weeks.

- Week 1 Theme:** Organization & function of the gastrointestinal tract
- Week 2 Theme:** Surface and gross anatomy of the abdomen
- Week 3 Theme:** Development of the gastrointestinal tract
- Week 4 Theme:** Metabolism of the micro and macromolecules
- Week 5 Theme:** Hepatobiliary system
- Week 6 Theme:** End-module Assessment



# GIT & Metabolism 2019 module

## General objectives:

At the end of this module, first-year medical student should be able to

### Knowledge/cognition

- Explain the basic anatomy of the gastrointestinal system (*i.e.* oesophagus, stomach, small intestine, colon, liver, gallbladder and pancreas).
- Describe the normal histology of the gastrointestinal system (*i.e.*, oesophagus, stomach, small intestine, colon, liver, gallbladder and pancreas).
- Explain the normal physiological function of the gastrointestinal system, specifically, exocrine and endocrine functions, digestion and absorption, motility and immunology.
- Apply the basic scientific knowledge regarding the metabolism of carbohydrates, proteins, lipids, nucleic acid, and show how defects can lead to disease.
- Describe how metabolic pathways can be integrated differently under varying physiological and pathological circumstances.

### Psychomotor skills

- Obtain a basic history of patient with gastrointestinal tract problems (Diarrhoea, vomiting, abdominal pain).
- Indicate and interpret biochemical reports such as Liver function test (LFTs) and enzyme studies
- Interpretation of the abdominal x-rays and ultrasound

### Attitude/ Behaviours

- Display personal attributes of compassion, honesty, integrity with standardized patient and medical profession,
- Demonstrate professionalism in all aspects of medical practice specifically, honesty, compassion, integrity, respect for others, professional and social responsibility.



## Main Content Areas

### Structure and function of gastrointestinal tract

- Introduction to the Gastrointestinal system
- Face and mouth
- Oesophagus
- Abdominal wall
- Abdominal cavity
- Stomach
- Duodenum
- Small intestine
- Liver and Gallbladder
- Portal circulation
- Pancreas
- Large intestine
- Rectum and Anal canal.

### Metabolism of Micro and macromolecules

- Introduction to metabolism and concepts related to its regulation
- Carbohydrate metabolism
- Blood glucose regulation

### Pathophysiology of the gastrointestinal tract

- Vomiting
- Gastroesophageal reflux disease (GERD)
- Acid-peptic disease
- Inguinal hernia
- Diarrhoea

### Anatomy practical – students must maintain a journal and will be a part of assessment

- Histology of the oesophagus
- Histology of the stomach
- Histology of the small and large intestine
- Histology of the liver and gall bladder

### Biochemistry practical – students must maintain a journal and will be a part of assessment

- Interpretation of the liver function tests



## The Gastrointestinal system & Metabolism module team

Prof Zaheer Memon	Anatomy
Dr Syna Amir	Anatomy/ Year coordinator
Dr Shaukat Memon	Anatomy
Dr Aftab Abbasi	Anatomy
Prof. Navaid Kazi	Physiology
Dr Abroo Qazi	Physiology
Dr Yaar Mohammad Nizamani	Physiology
Prof. Maria Kazi	Biochemistry
Dr Hina	Biochemistry
Dr. Ruby	Biochemistry
Dr Kabir Dherwani	Medical Education



Main Content Area:

Main Content Area	Lectures	Practical	Clinical Skills	Small Group Discussions	Tutorials	Self-study
<b>Organization and function of GI tract:</b> Introduction of Gastrointestinal tract, Face and mouth, Salivary glands, Pharynx, Oesophagus, Abdominal wall, Abdominal cavity, Stomach, Duodenum and Small intestine						
<b>Development of the Gastrointestinal tract:</b> Development of the foregut, midgut and hindgut						
<b>Metabolism of micro and macromolecules:</b> Introduction to metabolism, Carbohydrate metabolism, Energy extraction,						
<b>Pathophysiology of GI tract:</b> Vomiting, Gastrointestinal reflux disease, Acid-peptic disease, Inguinal hernia, Appendicitis and Diarrhoea						
<b>Total</b>						

Lectures 01 hour (50 minutes approximately)

Practical/ Laboratory 02 hours

Tutorials/ small group discussions (SGD) 02 hours

**A** – Must know,

**L** – Lecture,

**B** – Should know,

**SGD** – Small group discussion,

**C** – Nice to know

**SS** – Self-study



## Real life incident 1

You and your close friends visited Shah Bhattai's shrine and had a lunch in a local hotel. When you came back to the hostel, your friend vomited repeatedly with a large amount of undigested food particles and he looked unwell. Then he had been taken to the nearby Isra emergency department. On the way, you also vomited 4-5 times. Dr Shamsi, the consultant on-call examined your friend and checked the blood pressure and advised him to admit at the Isra Hospital. The doctor examined you and prescribed some drugs.

Next day you noticed full recovery of you and went to hospital to see your friend. You saw that he has been given saline drip.

You are interested to find out

- What is the mechanism of development of vomiting?
- What are the causes of vomiting?
- What is the basis of giving saline drip?

## Real life incident 2

While you were away on holidays from university, your college friend called in the morning and told that his 56-year-old uncle was admitted to the hospital following vomiting dark coloured blood. He also told that his uncle had a swollen abdomen and was bit confused at the time of admission.

Your friend told that his uncle was suffering from hepatitis for the last 25 years. He was doing well 1 month back after he had been advised by the doctor following a similar episode of vomiting.

- What do you think about your friend's condition?

## Real Life incident 3

Your friend in the hostel developed diarrhoea in the evening and you took him to the Isra hospital. Doctor admitted your friend to ward. He was given a normal saline drip.

You are interested in finding the reasons of your friend's diarrhoea and reason for giving a saline. The following day you return to see your friend in the hospital and he was feeling better.

- You are interested in finding out the mechanism of development of diarrhoea. Also the reason for giving a normal saline drip at the onset and Oral Rehydration Solution (ORS).



## Real Life incident 4

You have started your gastrointestinal tract and metabolism module. You hear that your brother has been admitted in the Liaquat National Hospital, Karachi. You take a leave of absence to see him along with your family. He is admitted in the private ward in Gastroenterology department.

You discover him catching sleep in the bed otherwise looking all right and there is normal saline drip hanging by his bedside. Both of you catch up about each other. He tells you that he had not been feeling all too well over the last week or so after he had luncheon at street hawker with his friends by the Ocean mall. After the night out, he gradually over the days started to feel lazy and feverish at night. At work, he felt weak in doing regular chores, which he would normally do on day-to-day basis.

Over the last two days, he had been scratching all over his body. He sought to self-medicate using over the counter drugs to relieve fever and headache. However, that did not go well. Then he started vomiting since yesterday and decided to seek the help of the doctor where he works.

The doctor straightway advised him for hospital admission and suggested him to inform close family members. The doctor told him that there is something wrong with his liver and asked for biochemical tests to check liver function.

You are curious to know,

- What do these signs and symptoms indicate? – Pathophysiology
- How do these signs and symptoms develop over the course of the day and what is their significance?
- Why some signs appear early and others late?
- What is the cause behind scratching all over the body?
- How the doctor knew there was something wrong with the liver straight away?
- Why the doctor prescribed for liver function tests and what is its significance?



## **Instructional Objectives of the module**

Theme: Surface anatomy of the abdomen and abdominal cavity

### Topic: Abdominal Wall – Surface anatomy

#### **Content area**

1. Anterior superior iliac spine and pubic tubercle. (A)
2. Surface markings of inguinal ligament, mid inguinal point and McBurney's point. (A)
3. Lateral border of rectus abdominis (A)
4. Dermatomes of anterior abdominal wall (A)

#### **Instructional Objective**

- Describe the surface anatomy bones & landmarks of abdomen.

### Topic: Abdominal wall – Planes and Regions

#### **Content area**

1. Planes (subcostal, inter tubercular etc.) (A)
2. Regions (9 regions) (A)
3. Trans pyloric plane (A)
4. Describe the surgical incisions of the abdominal wall. (A)

#### **Instructional Objective**

- Describe the planes and regions of the abdomen.

### Topic: Anterior Abdominal Wall

#### **Content area:**

1. Layers (skin to parietal peritoneum) (A)
2. Superficial fascia, Muscles, (A)
3. Rectus sheath: layers, contents, linea alba (A)
4. Fascia Transversalis. (A)
5. Umbilicus: Ligaments: ligamentum teres, medial umbilical ligaments, median umbilical ligament. (A)
6. Nerves: Lower 5 intercostal, subcostal, ilioinguinal, iliohypogastric. (A)
7. Arteries: superior and inferior epigastric (anastomosis between subclavian and external iliac) & others (intercostal, branches of external iliac & femoral)
8. Veins: lateral thoracic, tributaries of great saphenous (communication between superior and inferior vena cava) (A)
9. Lymphatics: superficial (umbilicus as watershed area) (A)
10. Different types of hernias (incisional and umbilical) (A)

#### **Instructional objectives:**

- Describe the anterior abdominal wall.

### Topic: Anatomical structure of Inguinal Canal

#### **Content area:**

1. Surface marking of superficial inguinal ring and deep inguinal ring. (A)





2. Walls of inguinal canal. (A)
3. Coverings and contents of spermatic cord. (A)
4. Different types of hernias (direct or indirect). (A)

**Instructional objectives:**

- Describe the anatomical structure of the inguinal region

**Topic: Abdominal Cavity**

**Content area:**

1. Peritoneal cavity (A)
2. Arrangement of abdominal viscera in three layers. (A)
3. Posterior abdominal wall (A)
4. Relevant clinical applications. (A)

**Instructional objectives:**

- Describe the general structure of the abdominal cavity and arrangement of the abdominal viscera.
- Identification of the general structure of the abdominal cavity and arrangement of the abdominal viscera.

**Topic: Peritoneum**

**Content area:**

1. Peritoneum (parietal and visceral, folds of peritoneum: greater and lesser omentum, mesentery, mesoappendix, Transverse mesocolon, sigmoid mesocolon) (A)
2. Functions of peritoneum (A)
3. Peritoneal cavity (A)

**Instructional objectives:**

- Describe the extent of peritoneum horizontally.
- Explain the attachment of the peritoneum on the liver and its reflection.
- Describe boundaries of the lesser sac.



## Theme: Gross anatomy of the gastrointestinal tract

### Topic: Structure of the mouth

#### **Content area**

1. Vestibule, lips, cheeks, gum, teeth, mouth.
2. Palate (roof) – hard palate, soft palate and muscles.
3. Vessels and nerves
4. Floor of the mouth
5. Boundaries
6. Contents (Submandibular gland and duct & sublingual gland, Hypoglossal and lingual nerves)

#### **Instructional Objective**

- Describe the structure of the mouth and its functions
- Identify the structures of the mouth and discuss its functions.

### Topic: Structure of the oesophagus

#### **Content area**

1. Gross anatomy of the oesophagus (**A**) – curvatures, constrictions, relations, blood supply, venous drainage, lymphatic drainage, nerve supply.
2. Microscopy of the oesophagus (**B**)

#### **Instructional Objective**

- Describe the macroscopic and microscopic anatomy and relations of oesophagus & development.

### Topic: Stomach

#### **Content area:**

1. Position, shape and size (**A**)
2. External features and subdivisions (**A**)
3. Key relations (**A**)
4. Peritoneal attachments (**A**)
5. Arrangement of abdominal viscera in 3 layers (**A**)
6. Posterior abdominal wall (**A**)
7. Relevant clinical applications (**A**)
8. Histology anatomy of stomach (**A**)
9. Development of stomach (**B**)

#### **Instructional objectives:**

- Demarcate the functionally distinct regions of the gastric mucosa.
- Describe the function of gastric mucosal cell.
- Discussion on the gross anatomy and development of the stomach.
- Identify the different cells of gastric mucosa under the microscope and discuss their functions.



Topic: Duodenum

**Content area:**

1. Describe the position, parts, key relations, peritoneal attachments (A)
2. Development (B)
3. Relevant clinical application (B)
4. Describe the mucosa of the duodenum (A)
5. Microscopy (A)

**Instructional objectives:**

- Describe the macroscopic and microscopic anatomy of the duodenum and its development.
- Identification and discussion about different parts of duodenum and small intestine.

Topic: Jejunum and Ileum

**Content area:**

1. Jejunum and Ileum, Duodenal flexure, mesentery, mucosal features, Meckel's diverticulum (B)
2. Vessels and nerves (A)
3. Development (B)

**Instructional objectives:**

- Describe the macroscopic anatomy of small intestine.

Topic: Liver - Structure

**Content area:**

1. Liver – position, parts, fissures, surfaces and lobes, porta hepatic, common hepatic ducts, key relations of diaphragmatic and visceral surfaces, peritoneal attachments, bare area, vessels, physiological lobes. (A)
2. Collateral circulation of the liver and the mechanism of development of portal hypertension. (A)

**Instructional objectives:**

- Describe the macroscopic anatomy of the Liver.
- Describe the pathophysiological basis of portal hypertension.

Topic: Gall bladder and Pancreas

**Content area:**

1. Gall bladder – Position and parts, key relations, cystic duct and artery, variations, veins and lymphatics, nerves and gallstones. (A)
2. Bile duct – origin, course, termination, sphincter (A)
3. Blood supply of the liver. (A)

**Instructional objectives:**

- Describe the macroscopic anatomy of the biliary system and pancreas.



Topic: Portal circulation

**Content area:**

1. Explain the organization of liver tissue in relation to its microcirculation, making correct use of the terms: portal triads, central vein, sinusoidal capillary, hepatocytes, lobule, periportal region and centrilobular region. (A)
2. Relationship of hepatocytes to bile canaliculi and sinusoidal capillaries. (A)

**Instructional objectives:**

- Structure and function relationship of the hepatocytes.
- Schematic description of the relationship between hepatocyte and bile canaliculi.

Topic: Large Intestine – Appendix and Caecum

**Content area:**

1. Describe the anatomical structure of the caecum and vermiform appendix (position & variation, key relations, taenia coli, ileocecal valve, meso appendix, vessels and nerves) (A)
2. Relevant clinical applications (Appendicitis) (A)

**Instructional objectives:**

- Describe the gross anatomy of the large intestine with relation to structure and microscopic anatomy.

Topic: Large intestine - Colon

**Content area:**

1. Outline the gross anatomy of the colon and its function. (A)
2. Parts, colic flexures, transverse mesocolon, hastura, appendices, epiploicae, vessels, nerves. (A)

**Instructional objectives:**

- Describe the gross anatomy of the large intestine with relation to structure and microscopic anatomy.

Topic: Rectum and Anal Canal

**Content area:**

1. Relations, peritoneal attachments, sphincters, mucosa (A)
2. Development (B)
3. Ischioanal fossa – Relations and contents (A)
4. Haemorrhoids (B)

**Instructional objectives:**

- Describe the macroscopic and microscopic anatomy of the rectum and anal canal.
- Ischioanal fossa

Topic: Arterial supply of the gastrointestinal tract

**Content area:**



1. Abdominal aorta: relations, level of bifurcation, branches in the abdomen.
2. Blood supply of the abdomen

**Instructional objectives:**

- Describe the course of the abdominal aorta
- Enumerate the paired and unpaired branches of the abdominal aorta
- Discuss the arterial supply of the abdominal wall.
- Discuss the applied anatomy related to the abdominal aorta.

**Topic: Venous drainage of the gastrointestinal tract**

**Content area:**

1. Inferior vena cava: relations, level of bifurcation, branches in the abdomen.
2. Venous drainage of the abdomen.

**Instructional objectives:**

- Describe the formation of the inferior vena cava
- List the tributaries of the inferior vena cava
- Explain the relation of the inferior vena cava with adjacent organs
- Discuss the applied anatomy related to the inferior vena cava

**Topic: lymphatic drainage of the gastrointestinal tract**

**Content area:**

1. Lymphatic drainage of the abdomen.

**Instructional objectives:**

- List and explain the group of lymph nodes draining the abdomen.
- Describe the structures related to the abdominal lymph drainage: lymphatic trunks, cistern chili, thoracic duct

**Topic: Nerve supply of the gastrointestinal tract**

**Content area:**

1. Nerves of the abdomen.

**Instructional objectives:**

- Describe the nerve supply of the abdomen.



## Theme: Development of the gastrointestinal tract

### Topic: Development of Foregut – Oesophagus & Stomach

#### **Content area**

1. Development of foregut – oesophagus & stomach

#### **Instructional Objective**

- Describe the development of the foregut (the stages of development of oesophagus, stomach, duodenum, liver & pancreas).
- Describe the congenital anomalies of different parts of the foregut based on its embryology.

### Topic: Embryology of Liver, Gallbladder and Pancreas

#### **Content area:**

1. Development of liver (**B**)
2. Development of Pancreas and Gallbladder (**B**)

#### **Instructional objectives:**

- Describe the development of liver.
- Outline the embryological origin of the gallbladder and pancreas.

### Topic: Development of the mid and hindgut

#### **Content area:**

1. Development of midgut and hindgut (stages)
2. Congenital anomalies of the midgut and hindgut

#### **Instructional objectives:**

- Describe the development of midgut and hindgut,
- Explain the congenital anomalies on the embryological basis.



## Theme: Histology of the gastrointestinal tract

### Topic: Histology – Oesophagus & Stomach

#### **Content area**

1. Histology – oesophagus & stomach (**A**)
  - a. Layers
  - b. Glands
  - c. Cells
  - d. Secretions

#### **Instructional Objective**

- Identify the tissue – oesophagus and stomach, under the microscope,
- Describe the general histological features of the gastrointestinal tract and particularly of the oesophagus.
- Describe the functions of the layers, components and cells in the wall of the different parts of stomach.
- Explain how they differ in different organ system,
- Describe the microscopic features of glands in the stomach, their cells and secretions they secrete.

### Topic: Histology of the small and large intestine

#### **Content area:**

1. Histology – small and large intestine (**B**)
  - a. Layers,
  - b. Cells
  - c. Glands
  - d. Lymphoid tissue

#### **Instructional objectives:**

- List and explain the different layers of small intestine & large intestine,
- Discuss the cells and glands present in the small intestine & large intestine
- Define and explain the pycers patches
- Differentiate between small and large intestine based on their histological features.

### Topic: Histology of the liver and gall bladder

#### **Content area:**

1. Histology of the liver – parenchyma, hepatic lobule, portal lobule and acinus,
2. Histology of the gall bladder

#### **Instructional objectives:**

- Identify the hepatic tissue under the microscope,
- Explain the arrangement of the liver parenchyma.
- Demonstrate their understanding of the general concepts behind classical hepatic lobule, portal lobule and hepatic acinus
- Describe the histological structure of the gall bladder.



## Theme: Metabolism of Micro and macromolecules

### Topic: Metabolic oxidation of metabolic pathways

#### **Content area:**

1. NADH<sub>2</sub>, Adenosine Triphosphate and High-energy compounds. (A)
2. General scheme for flow of a biochemical pathway (B)
3. Anabolism, Catabolism (A)
4. Points of control – Significance (B)

#### **Instructional Objectives:**

- Outline energy aspects of metabolism
- Outline metabolic pathways
- State principles of regulation of pathways

### Topic: Digestion & metabolism of carbohydrates

#### **Content area**

1. Dietary carbohydrates (A)
2. Glycaemic index (A)
3. Digestive enzymes (A)
4. Absorption (B)

#### **Instructional Objective**

- Describe dietary carbohydrates and their action.
- Explain the biochemical significance of the glycaemic index.
- Describe the biomedical importance of dietary fibres.
- Recall the main digestive enzymes and describe their action on carbohydrates,
- Discuss the metabolic abnormalities due to the digestive enzyme deficiency,
- Explain the absorption of different carbohydrates by the intestinal mucosal cells.

### Topic: Glycolysis: fate of pyruvate & pyruvate kinase deficiency

#### **Content area:**

1. Biochemical pathways with control points (A)
2. Reversible and irreversible reactions (B)
3. Points of control and principle functions (B)

#### **Instructional objective:**

- Differentiate between aerobic and anaerobic glycolysis,
- List the reactions of the two stages of glycolysis – (investment & generation)
- Explain the regulation of the glycolysis cycle via hormones
- Discuss the fate of pyruvate

### Topic: Gluconeogenesis

#### **Content area:**

1. Biochemical pathways with control points (A)
2. Reversible and irreversible reactions (B)





3. Points of control and principle functions (B)

**Instructional Objective:**

- Describe the mechanism of gluconeogenesis,
- Describe the reactions that are discrete to the gluconeogenesis,
- Explain the mechanism of transport of oxaloacetic acid to the cytosol
- Explain the Cori cycle,
- Discuss the enzymes that regulate gluconeogenesis.

Topic: Glycogenolysis & Glycogenesis and Glycogen storage diseases

**Content area:**

1. Significant points of entry of fructose, glucose, galactose and glycogen (A)
2. Biochemical reactions (A)
3. Reciprocal control (A)
4. Functions and significance (A)
5. Glycogen storage diseases (C)

**Instructional Objective:**

- Explain the structure and function of the glycogen,
- Describe the mechanism of glycogen synthesis and its regulation,
- Describe the mechanism of glycogenolysis and its regulation,
- Explain the various form of glycogen storage diseases.

Topic: Citric Acid Cycle – Regulation & ATP

**Content area:**

1. Biochemical pathway. (A)
2. Control points (B)
3. Functions (A)

**Instructional Objective:**

- Discuss the significance of the TCA cycle as an amphibolic pathways,
- Discuss the reactions of the TCA cycle and its regulatory steps,
- Describe the energy produced from the TCA cycle.

Topic: Hexose Mono Phosphate shunt & G6PD deficiency

**Content area**

1. Function of G6P dehydrogenase pathway (A)
2. Important intermediates from the pathways (A)

**Instructional Objective**

- Describe the biomedical significance of the HMP shunt,
- Describe the oxidative and non-oxidative stages of the HMP shunt,
- Describe the enzymes responsible for the HMP shunt regulation,
- Explain the abnormalities of the HMP shunt with regards of G6PD,
- Discuss the functions of the NADPH and Glutathione,



Topic: Lactose, Fructose & Galactose Metabolism & Regulation of Blood Glucose

**Content area**

1. Factors regulating blood glucose (A)
2. Diabetes Mellitus (C).

**Instructional Objective**

- List the sources of fructose
- Discuss the alternative mechanism of the monosaccharide metabolism.
- Explain the metabolic pathway of the fructose.
- Explain the disorders that occur due to deficiency of enzyme that metabolize fructose.
- Discuss the important enzymes involved in galactose metabolism.
- Explain the metabolic pathway of galactose metabolism.
- Describe the mechanism of regulation of blood glucose during regular and fasting periods

Topic: Metabolic role of liver in detoxification

**Content area**

1. Metabolic role of the liver (A)
2. **Detoxification (A)**

**Instructional Objective**

- List the liver function tests based on the functions of the liver.
- Discuss the metabolic, synthetic, excretory, detoxification and storage functions of the liver.
- Identify the type of jaundice based on the levels of serum bilirubin (conjugated and unconjugated), urinary bilirubin, faecal stercobilinogen
- Discuss the importance of albumin, total protein and prothrombin time in diagnosing liver disease.

Topic: Metabolic oxidation of metabolic pathways

**Content area**

1. Bioenergetics (A)
2. Biological oxidation (B)
3. Multi-enzyme complexes (A)

**Instructional Objective**

- List high and low energy phosphate
- List the oxido-reductase enzyme
- Define bioenergetics and explain the general laws of thermodynamics
- Define free energy and equilibrium constant.
- Describe the role of ATPs as a energy carrier,
- Describe biologic oxidation and redox potential.



## Theme: Organization and function of the gastrointestinal tract

### Topic: Regulation of Gastrointestinal tract and saliva

#### **Content area**

1. Gastrointestinal hormones (**A**)
2. Neural regulation (**B**)
3. Hormonal regulation (**B**)
4. Composition and pH of saliva (**B**)
5. Functions of the saliva (**A**)

#### **Instructional Objective:**

- Describe the mechanism of regulation of the gastrointestinal system (Hormonal, Neural & Enteric).
- List the constituents of saliva and its function.
- Describe the composition of the saliva, function and its mechanism of secretions,
- Describe the nervous regulation of salivary secretions.

### Topic: Functions of oesophagus

#### **Content area:**

1. Functions of muscles of mastication & functions (**A**)
2. Mechanism of Deglutition and protective mechanisms. (**A**)
3. Three phases: Oral phase (**A**), Pharyngeal phase (**A**), Oesophageal phase (**A**)
4. Nervous regulation – conditional and unconditional reflexes (**A**)

#### **Instructional Objective:**

- Explain the mechanism of mastication and its clinical significance,
- Describe the phases of deglutition and mechanism for each phase.

### Topic: Stomach motility

#### **Content area:**

1. The events that occur following entry of the food bolus into the stomach: receptive relaxation and peristalsis (**A**)
2. The mechanism of gastric emptying (**A**)

#### **Instructional objectives:**

- Describe the gastric motility its regulation.
- Explain the regulation of stomach emptying.

### Topic: Gastric secretions

#### **Content area:**

1. Constituents of gastric juice (HCl, Pepsin, Intrinsic factor, Mucus) (**A**)
2. Cell type, the mechanism, regulation of gastric acid secretion, factors that affect gastric acid secretion (**A**)
3. Factors that maintain the barrier and disrupt the barrier leading to peptic ulcer. (**A**)



4. The role of *Helicobacter pylori* and Non-Steroidal Anti-inflammatory drugs in disrupting the behaviour. (A)
5. Gastrinoma (B)

**Instructional objectives:**

- List the constituents of gastric juice and function.
- Describe the mechanism of secretion of HCl.
- Describe the regulation of gastric secretion.
- Describe gastric mucosal barrier and its functions.
- List the factors that disrupt the gastric mucosal barrier.

Topic: Liver - functions

**Content area:**

1. Synthetic function-plasma protein, clotting factors (vitamin B12, storage, detoxification, metabolism of carbohydrates fats and proteins – previously done in section 1) (A)

**Instructional objectives:**

- List the main function of the liver.
- Outline the consequences of derangement of liver diseases.

Topic: Exocrine pancreas

**Content area:**

1. Composition of pancreatic secretions (A)
2. Function and regulation of pancreatic secretions (A)

**Instructional objectives:**

- Describe the composition and secretion of pancreatic juice,
- Explain the phases of pancreatic sections,
- Describe the regulation of pancreatic secretion

Topic: Bile secretion

**Content area:**

1. Composition of bile (A)
2. Function and regulation of bile secretions (A)

**Instructional objectives:**

- List the composition of bile and factors for its release,
- Explain the mechanism of conjugation and secretion of bile salts,
- Describe the enterohepatic circulation of bile salts.

Topic: Large intestine - Function

**Content area:**

1. Storage absorption of water and electrolytes, motility (A)
2. Nerve supply of internal and external anal sphincters, (A)
3. Physiological basis of colicky pain (A)



Module 5: GIT & Metabolism 2019

MED

**Instructional objectives:**

- Describe the function of the large intestine.
- Describe the mechanism of defecation.



## Theme: Pathophysiology of the gastrointestinal tract disorders

### Topic: Vomiting

#### **Content area:**

1. The causes of vomiting: Neural, chemical and psychic factors. (A)
2. Mechanisms and consequences of vomiting. (A)
3. Fluid and electrolyte (A)

#### **Instructional objectives:**

- Define vomiting.
- List the causes and explain the mechanism and consequences of vomiting.

### Topic: Diarrhoea

#### **Content area:**

1. Secretory, osmotic, electrolyte abnormalities, beneficial effects of Oral Rehydration Solution. (A)

#### **Instructional objectives:**

- Describe the physiological and biochemical basis of different types of diarrhoea.

### Topic: GERD & Acid-peptic disease

#### **Content area:**

1. Gastroesophageal Reflux disease (A)
2. Acute and chronic gastritis (B)
3. Gastric ulcer (A)

#### **Instructional objectives:**

- Define acute gastritis and its different types,
- Define gastric ulcer and its type,
- Explain the pathophysiological mechanism of gastric ulcer.

### Topic: Liver function tests:

#### **Content area:**

1. Liver enzymes: names and significance in clinical diagnosis – (A)

#### **Instructional objectives:**

- List the enzymes used in the assessment of hepatobiliary disease,
- Interpret the biochemical report of patients with altered hepatic functions.



## Recommended and additional Reading for the module

### Embryology:

#### Recommended reading

- Webster S & De Wreede R. (2012). **Embryology at a Glance**. John Wiley & Sons.

#### Additional reading

- Moore, Keith L., *et al.* **The developing human: clinically oriented embryology**. Philadelphia: *Saunders/Elsevier*, 2013 9<sup>th</sup> edition.
- **Snell's Clinical Embryology for medical students** (Latest Edition)
- Sadler, Thomas W. **Langman's medical embryology**. Wolters Kluwer Health, 2014. 13<sup>th</sup> edition

### Histology:

#### Recommended reading

- Peckham, M. (2011). **Histology at a Glance (Vol. 50)**. John Wiley & Sons.

#### Additional reading:

- Fawcett, D. W., and R. P. Jensch. "**Bloom and Fawcett's Concise Histology 2nd.**" *Arnold-Hodder Headline Group*. London (2002): 1-360.
- Junqueira, C. L., J. Carneiro, and R. O. Kelley. "**Basic histology.**" *Basic histology* (2013) 13<sup>th</sup> edition.
- Young, Barbara, ed. **Wheater's functional histology: a text and colour atlas**. Elsevier Health Sciences, 2014. 6<sup>th</sup> edition

### Anatomy

#### Recommended reading

- Faiz O, Blackburn S & Moffat D. (2011). **Anatomy at a Glance** (Vol. 66). John Wiley & Sons.
- Drake, Richard, A. Wayne Vogl, and Adam WM Mitchell. **Gray's anatomy for students**. Elsevier Health Sciences, 2015. 3<sup>rd</sup> edition.

### Physiology

#### Recommended reading

- Ward, J. P., & Linden, R. W. (2013). **Physiology at a Glance**. John Wiley & Sons.
- Sherwood L, **Human Physiology: From cells to systems** *West Publishing Company*, New York. 7<sup>th</sup> edition.

#### Additional reading

- Ganong's **Review of Medical Physiology**. *Lange Medical Publications* McGraw Hill
- Guyton, A.C., **Textbook of Medical Physiology**, Saunders, Philadelphia

### Pathology

#### Recommended reading



- Finlayson, C. J., & Newell, B. A. (2009). **Pathology at a Glance**. Wiley-Blackwell.
- Kumar, Vinay, Abul K. Abbas, and Jon C. Aster, eds. **Robbins basic pathology**. Elsevier Health Sciences, 2012.

### Clinical skills

#### Recommended reading

- **Macleod's Clinical Examination**. Edited by Douglas *et al.* 2009, 12<sup>th</sup> edition. Published by Churchill Livingstone, Elsevier. **The Cardiovascular system, pages: 106-151**

### Community Medicine

#### Recommended reading

- Somerville, M., Kumaran, K., & Anderson, R. (2012). **Public health and epidemiology at a glance** (Vol. 72). John Wiley & Sons.
- Iliyas M *et al*, eds. **Public Health and Community Medicine**. Time publishers, 2007 7<sup>th</sup> edition.
- Park, K (2005) **Park's textbook of Preventive and Social Medicine**, 2007. Bhanot Publication 29<sup>th</sup> edition.
- Community Medicine for all, by Brigadier Iqbal Ahmed.
- Epidemiology by Hennekins.

**Male and female students should refer to the main university library (or ask librarian) for interactive materials available in the form of Compact Discs (CDs).**

**Note: You are requested to read the latest edition available.**

**All students are informed to come prepared for the lectures after reading the “at a glance” series mentioned in the recommended books. After the lectures, students are suggested to read the recommended textbook. The faculty members will provide the page numbers for the topics covered at the end of the lecture or an activity.**





Teaching and Learning opportunities

About attendance

Assessment and grading

Curriculum map