*KMU Central Curriculum Committee*

*Khyber Medical University, Phase V, Hayatabad | Peshawar*

Gastrointestinal, Hepatobiliary and Metabolism Module

MBBS Year-2 (Academic Year 2019-2020)

Table of Contents

[Duration of Module: Nine Weeks 3](#_Toc28869970)

[Themes 3](#_Toc28869971)

[General learning outcomes 4](#_Toc28869972)

[Theme 1: Painful swallowing 5](#_Toc28869973)

[Gross anatomy 5](#_Toc28869974)

[Embryology 5](#_Toc28869975)

[Histology 5](#_Toc28869976)

[Physiology 6](#_Toc28869977)

[Biochemistry 9](#_Toc28869978)

[Pathology 9](#_Toc28869979)

[ENT 9](#_Toc28869980)

[Theme 2: Pain Epigastrium 10](#_Toc28869981)

[Gross Anatomy 10](#_Toc28869982)

[Histology 11](#_Toc28869983)

[Embryology 11](#_Toc28869984)

[Physiology 12](#_Toc28869985)

[Biochemistry 13](#_Toc28869986)

[Pathology 13](#_Toc28869987)

[Pharmacology 13](#_Toc28869988)

[Forensic Medicine 14](#_Toc28869989)

[Medicine 14](#_Toc28869990)

[Surgery 14](#_Toc28869991)

[Theme 3: Jaundice 15](#_Toc28869992)

[Gross Anatomy 15](#_Toc28869993)

[Embryology 15](#_Toc28869994)

[Histology 16](#_Toc28869995)

[Physiology 16](#_Toc28869996)

[Biochemistry 17](#_Toc28869997)

[Pathology 17](#_Toc28869998)

[Pharmacology 17](#_Toc28869999)

[Forensic Medicine 18](#_Toc28870000)

[Community Medicine 18](#_Toc28870001)

[Medicine 18](#_Toc28870002)

[Surgery 18](#_Toc28870003)

[Theme 4: Diarrhoea and Constipation 19](#_Toc28870004)

[Gross Anatomy 19](#_Toc28870005)

[Embryology 20](#_Toc28870006)

[Histology 20](#_Toc28870007)

[Physiology 20](#_Toc28870008)

[Biochemistry 21](#_Toc28870009)

[Pharmacology 22](#_Toc28870010)

[Community Medicine 23](#_Toc28870011)

[Paediatrics 23](#_Toc28870012)

[Theme 5: Bleeding Per Rectum 24](#_Toc28870013)

[Gross Anatomy 24](#_Toc28870014)

[Embryology 24](#_Toc28870015)

[Histology 24](#_Toc28870016)

[Physiology 24](#_Toc28870017)

[Biochemistry 26](#_Toc28870018)

[Pathology 26](#_Toc28870019)

[Surgery 26](#_Toc28870020)

[Metabolism 27](#_Toc28870021)

[Theme-6: Glucose control (Carbohydrate metabolism) 27](#_Toc28870022)

[Biochemistry 27](#_Toc28870023)

[Theme 7: Obesity (Fat metabolism) 30](#_Toc28870024)

[Biochemistry 30](#_Toc28870025)

[Medicine 33](#_Toc28870026)

[Theme 8: Wasting (Protein metabolism) 33](#_Toc28870027)

[Biochemistry 33](#_Toc28870028)

[List of practical works 36](#_Toc28870029)

[Histology 36](#_Toc28870030)

[Physiology 36](#_Toc28870031)

[Biochemistry 36](#_Toc28870032)

# Duration of Module: Nine Weeks

# Themes

1. Painful swallowing—----------1 week
2. Abdominal pain—--------------2 weeks
3. Jaundice—------------------------1 week
4. Diarrhea and Constipation—1 week
5. Bleeding Per Rectum—-------1 week
6. Hyperglycemia-(Carbohydrate metabolism)- 1 week
7. Obesity (Lipid metabolism)- 4 days
8. Wasting (Protein metabolism)- 8 days

# General learning outcomes

At the end of this 6 weeks` module, the 2nd year students will be able to:

1. Describe the anatomy of oral cavity with respect to GI functions
2. Elaborate the structure and functions of salivary glands
3. Describe the structure and development of esophagus, stomach, small intestine and large intestine
4. Describe the anatomy of peritoneum and mesentery
5. Explain the movements, functions and regulations of gastrointestinal functions
6. Describe the structure, development and functions of hepatobiliary system and pancreas
7. Discuss the mechanisms of digestion and absorptions of carbohydrates, proteins, fats and other nutrients
8. Describe different physiological reflexes occurring upon stimulation of gastrointestinal organs
9. Discuss the chemistry and functions of gastrointestinal hormones
10. Describe common pathological conditions like peptic ulcers, viral hepatitis, obstructive jaundice, carcinoma of esophagus and colorectal cancers
11. Explain the metabolic processes related to carbohydrates, fats and protein metabolism
12. Describe the components of medical ethics
13. Explain research ethics, research misconduct and plagiarism
14. Explain the psychosocial aspects of common psychiatric and functional bowel disorders

# Theme 1: Painful swallowing

|  |  |  |  |
| --- | --- | --- | --- |
| Subject | Topic  | S. No | Learning objectives |
| Gross anatomy | Oral cavity | 1 | Describe the musculature of tongueDescribe the nerve supply of tongue |
|  | Salivary glands | 2 | Describe the gross anatomy of parotid, submandibular and sublingual salivary gland |
|  | Esophagus | 3 | Describe the extent, course, relations and gross structure of esophagus. |
| Embryology | Development of tongue | 4 | Describe the developmental events of tongueEnlist various anomalies of tongue development |
|  | Development of esophagus | 5 | Describe the development of Esophagus |
|  | Development of salivary glands | 6 | Describe the development of salivary glands |
| Histology | Oral cavity | 7 | Describe the microscopic structure of lips |
|  |  | 8 | Describe the histological features of tooth in longitudinal and transverse section |
|  |  | 9 | Explain the histology of tongue. |
|  |  | 10 | Differentiate between the microscopic picture of anterior 2/3rds and posterior 1/3rds of the tongue  |
|  | Esophagus | 11 | Identify the epithelium of esophagus and esophageal glands in mucosa |
|  |  | 12 | Differentiate between musculature in different parts of the esophagus |
| Physiology | General principles of gastrointestinal motility | 13 | Describe electrical activity of gastrointestinal smooth muscle |
|  |  | 14 | Describe the mechanism of excitation of smooth muscle of gastrointestinal |
|  |  | 15 | Differentiate between slow wave and spike potential |
|  | Neural control of GIT function(Enteric Nervous system) | 16 | Differentiate between mesenteric and submucosal plexus. |
|  |  | 17 | Classify the following enteric nervous system neurotransmitters as excitatory or inhibitory: norepinephrine, acetylcholine, CCK, VIP, histamine, and somatostatin |
|  |  | 18 | Describe the role of autonomic nervous system in regulation of GIT’s function |
|  |  | 19 | Differentiate between sympathetic and parasympathetic modulation of the enteric nervous system and the effector organs of the GI tract |
|  |  | 20 |  Describe three types of gastrointestinal reflexes |
|  | Hormonal control ofGastrointestinal motility | 21 | Describe gastrointestinal hormone actions, stimuli for secretion, and site of secretion |
|  | Functional types of movements in the gastrointestinal tract | 22 | Describe the functional types of movements in the gastrointestinal tract |
|  |  | 23 | Describe law of gut. |
|  |  | 24 | Describe blood flow through the villus and its significance |
|  | Gastrointestinal blood flow—Splanchnic circulation | 25 | Describe anatomy of the gastrointestinal blood supply |
|  |  | 26 | Describe the effect of gut activity and metabolic factors on gastrointestinal blood flow |
|  |  | 27 | Describe nervous control of gastrointestinal blood flow |
|  | Ingestion of food | 28 | Describe the mechanics of ingestion of food |
|  |  | 29 | Describe chewing and mastication |
|  |  | 30 | Describe different stages of swallowing. |
|  |  | 31 | Describe the effects of the pharyngeal stage of swallowing on respiration |
|  | General principles of alimentary tract secretion | 32 | Describe basic mechanisms of stimulation of the alimentary tract glands |
|  |  | 33 | Describe dual effect of sympathetic stimulation on alimentary tract glandular secretion |
|  | Role of mucus and saliva | 34 | Describe the secretion of saliva and its nervous regulation |
|  |  | 35 | Describe the plasma and saliva concentrations of Na+, Cl-, and HCO3- at low secretion rates and at high secretion rates and the principal cell types involved in each secretion rate.  |
|  |  | 36 | State the substrates and digestion products of salivary amylase (ptyalin).  |
|  |  | 37 | Identify the stimuli and cell types involved in GI secretion of mucous, and identify the function of salivary mucus.  |
|  |  | 38 | Describe three types of stimuli that increase salivary secretion.  |
|  |  | 39 | State the components of the saliva important in oral hygiene, and identify the role of salivary secretions in eliminating heavy metals |
|  | Disorders of swallowing and esophagus | 40 | Describe the clinical abnormalities of swallowing mechanism |
|  |  | 41 | Describe Achalasia and Megaesophagus |
| Biochemistry | Saliva | 42 | Describe the composition of salivary secretions |
|  |  | 43 | Describe the formation and characteristics of salivary secretions |
|  |  | 44 | Elaborate the functions of saliva |
| Pathology | Carcinoma of Esophagus  | 45 | Describe the histological types and presentation of esophageal carcinoma |
| ENT | Oral ulceration | 46 | Enlist the causes of oral ulcerations |
|  |  | 47 | Describe Aphthous ulcers and its treatment |
|  |  | 48 | Describe the clinical features and drugs used to treat esophageal candidiasis |
| Theme 2: Pain Epigastrium |
| Gross Anatomy | Anterior abdominal wall | 49 | Describe the origin, insertion, nerve supply and actions of anterolateral abdominal wall muscles  |
|  |  | 50 | Describe the formation of rectus sheath |
|  |  | 51 | Describe the contents of rectus sheath |
|  |  | 52 | Describe the surface anatomy of anterior abdominal wallDescribe the structures related to transpyloric plane |
|  |  | 53 | Enlist various types of abdominal hernias |
|  | Inguinal canal | 54 | Describe the boundaries of inguinal canal |
|  |  | 55 | Enlist the contents of inguinal canal in males and females |
|  |  | 56 | Differentiate between direct and indirect inguinal hernia |
|  | Peritoneum | 57 | Describe greater and lesser omentum  |
|  |  | 58 | Describe the nerve supply of peritoneum |
|  |  | 59 | Describe the anatomy of lesser sac. |
|  |  | 60 | Describe the boundaries of epiploiec foramen |
|  |  | 61 | Describe the various peritoneal pouches, recesses and ligaments |
|  | Stomach | 62 | Describe the gross structure of stomach |
|  |  | 63 | Describe the blood supply and lymphatic drainage of stomach |
|  |  | 64 | Describe the anatomy of stomach bed |
|  | Duodenum | 65 | Describe the gross structure and blood supply of duodenum |
|  |  | 66 | Write the relations of various parts of duodenum |
|  | Pancreas | 67 | Describe the gross structure of pancreas and its ductal system |
| Histology | Stomach | 68 | Enumerate the different layers of the stomach wall |
|  |  | 69 | Write a note on gastric glands. |
|  |  | 70 | Differentiate between fundic and pyloric mucosa |
|  | Duodenum | 71 | Discuss histological features of duodenum and describe duodenal glands. |
|  | Pancreas | 72 | Describe the histology of pancreas |
|  |  | 73 | Differentiate histologically between exocrine and endocrine portions of pancreas |
| Embryology | Development of foregut | 74 | Describe the development of stomach |
|  |  | 75 | Describe the development of duodenum |
|  |  | 76 | Enlist various developmental anomalies of stomach |
|  |  | 77 | Enlist various developmental anomalies of duodenum |
|  | Pancreas | 78 | Describe the development of pancreas |
|  |  | 79 | Enlist various anomalies of pancreas |
| Physiology | Motor function ofStomach | 80 | Describe the motor function of stomach. |
|  |  | 81 | Describe basic electrical rhythm of the stomach wall |
|  |  | 82 |  Describe Pyloric pump |
|  |  | 83 | Describe role of the pylorus in controlling stomach emptying |
|  |  | 84 | Describe the regulation of gastric emptying |
|  | Gastric secretion | 85 | Describe characteristics of the gastric secretions |
|  |  | 86 | Describe the mechanism of secretion of different gastric glands |
|  |  | 87 | Describe the phases and regulation of gastric secretion.  |
|  |  | 88 | Enlist the hormones that inhibit and increase gastric secretions.  |
|  |  | 89 | Enumerate the reflexes that inhibit and increase gastric secretions |
| Biochemistry | Gastric secretions | 90 | Describe the chemical composition of gastric secretions |
|  |  | 91 | Describe the functions of HCl and other constituents of gastric secretions |
|  |  | 92 | Discuss the mechanism of synthesis and secretion of HCl from gastric mucosa |
|  |  | 93 | Discuss the mechanism of secretion and role of Intrinsic factor from gastric parietal cells |
| Pathology | Peptic ulcer disease | 94 | Describe the mechanism of formation of peptic ulcers, its stages and complications |
|  |  | 95 | Describe the etiology, pathology and clinical presentation of gastric cancer |
|  |  | 96 | Describe the mechanism of development, presentation and complications of acute pancreatitis |
| Pharmacology | Drugs used in Peptic ulcer | 97 | Classify the drugs used in Peptic ulcer disease |
|  |  | 98 | Describe the mechanism of action of drugs used in Peptic ulcer |
| Forensic Medicine | Poisons identification through gastric lavage | 99 | Enlist indications and contraindications for gastric lavageDescribe the sampling technique of gastric lavage fluid  |
| Medicine | GERD and Peptic ulcer | 100 | Describe the etiology, clinical features, complications and drug treatment of GERD and peptic ulcer disease |
| Surgery | Peptic ulcer | 101 | Describe the complications of long-term peptic ulcer disease and its surgical management |
|  | Lump in the abdomen | 102 | Describe common causes of lump in abdomen and enlist the common surgical procedures for treatment of hernia.  |
|  | Acute pancreatitis | 103 | Describe the etiology, clinical features, complications and management of acute pancreatitis |
| Theme 3: Jaundice |
| Gross Anatomy | Liver | 104 | Describe the borders and surfaces of liver |
|  |  | 105 | Describe the visceral surface of liver |
|  |  | 106 | Describe the peritoneal reflections and associated ligaments of liver |
|  |  | 107 | Describe the lobes and segments of liver |
|  |  | 108 | Describe the blood supply of liver |
|  |  | 109 | Describe the hepato renal pouch of morrison and its clinical significance |
|  | Extra hepatic billiary apparatus | 110 | Describe the gross anatomy of gall bladder |
|  |  | 111 | Describe calot’s triangle  |
|  |  | 112 | Describe the gross anatomy of extra hepatic billiary tree |
|  | Spleen | 113 | Describe the gross anatomy of spleen and blood supply of spleen |
|  | Hepatic portal venous system | 114 | Describe the formation and tributaries / branches of hepatic portal venous system |
|  |  | 115 | Explain the clinical significance of hepatic portal system |
| Embryology | Development of distal fore gut | 116 | Describe the development of liver |
|  |  | 117 | Describe the development of gall bladder and billiary tree |
|  |  | 118 | Describe the developmental anomalies of liver and biliary tree |
| Histology | Liver | 119 | Discuss the histological features of liver |
|  |  | 120 | Describe liver parenchyma and general structural plan of the liver |
|  |  | 121 | Describe the histological features of the structures present in the portal triad |
|  | Spleen | 122 | Discuss the histological features of spleen |
|  |  | 123 | Differentiate between red pulp and white pulp |
| Physiology | Pancreatic secretion | 124 | Describe the role of pancreatic secretions in digestion.  |
|  |  | 125 | Describe the phases and regulation of pancreatic secretion |
|  | Physiology of liver | 126 | Describe Physiological Anatomy of the Liver |
|  |  | 127 | Describe blood flow through the liver |
|  |  | 128 | Describe metabolic functions of liver |
|  |  | 129 | Describe Regulation of Liver Mass—Regeneration |
|  |  | 130 | Describe Bilirubin formation and excretion |
|  | Secretion of bile by liver | 131 | Describe the mechanism of secretion of bile by the liver |
|  |  | 132 | Describe the function of bile salts in fat digestion and absorption |
|  |  | 133 | Describe functions of the biliary tree in digestion |
| Biochemistry | Bile | 134 | Describe the constituents of bile |
|  |  | 135 | Describe the functions of bile |
|  |  | 136 | Describe the mechanism of gall stone formation |
| Pathology | Acute/ chronic viral hepatitis | 137 | Describe the different viruses causing acute and chronic hepatitis |
|  |  | 138 | Describe the pathogenesis, stages and clinical presentation of liver cirrhosis |
| Pharmacology | First pass hepatic metabolism of drugs | 139 | Describe the mechanism of drugs detoxification and metabolism in the liver |
|  | Hepatotoxic drugs | 140 | Enlist some of the commonly used hepatotoxic drugs and their toxicities |
| Forensic Medicine | Hepatotoxic poisons | 141 | Enlist the poisons which cause hepatotoxicityDiagnose poisoning through routine toxicological sampling |
| Community Medicine | Hepatitis B and C virus infection | 142 | Describe the epidemiology of hepatitis B and C virus infection and its control measures |
|  |  | 143 | Describe water borne hepatitis (Hepatitis A and E) viruses and its control measures |
| Medicine | Liver cirrhosis | 144 | Describe the etiology, clinical features, complications and treatment options of liver cirrhosis |
| Surgery | Obstructive jaundice | 145 | Describe the etiology, clinical features, biochemical investigations and treatment options of obstructive jaundice |

# Theme 4: Diarrhoea and Constipation

|  |  |  |  |
| --- | --- | --- | --- |
| Gross Anatomy | Jejunum and ileum | 146 | Describe the gross features of jejunum and ileum |
|  |  | 147 | Tabulate differences in gross features and blood supply of jejunum and ileum |
|  | Mesenteries | 148 | Describe the mesentery of small intestine |
|  | Appendix | 149 | Describe the gross features, blood supply and mesentery of appendix |
|  |  | 150 | Describe the clinical correlates of appendix |
|  | Abdominal aorta | 151 | Enumerate the branches of abdominal aorta. |
|  |  | 152 | Describe the course and distribution of celiac trunk |
|  |  | 153 | Describe the course and distribution of superior mesenteric artery |
|  |  | 154 | Describe the course and distribution of inferior mesenteric artery |
|  | Inferior vena cava | 155 | Describe the origin, course, tributaries and relations of inferior vena cava |
|  | Lymphatic drainage | 156 | Describe the origin, course and relations of Cisterna chili |
|  |  | 157 | Describe the lymphatic drainage of abdominal organs |
| Embryology | Development of midgut | 158 | Describe the formation and rotation of midgut loop |
|  |  | 159 | Describe the physiological herniation of midgut loop |
|  |  | 160 | Enlist the derivatives of mid gut loop |
|  |  | 161 | Describe the development of mesenteries |
|  |  | 162 | Describe the various anomalies of midgut development |
| Histology | Jejunum and ileum | 163 | Discuss histological features of jejunum and describe plica circulares. |
|  |  | 164 | Discuss histological features of ileum and describe Payers patches. |
|  |  | 165 | Discuss the various structural specializations meant for increasing the surface area of small intestine (plica circulares, crypts of Lieberkühn, villi and microvilli) |
|  | Appendix | 166 | Discuss histological features of appendix. |
| Physiology | Movements of the small intestine | 167 | Describe different types of movements of small intestine. |
|  |  | 168 | Describe the control of peristalsis by nervous and hormonal signals |
|  | Secretion of small intestine | 169 | Describe secretion of mucus by Brunner’s glands in the duodenum |
|  | Pancreatic enzymes | 170 | Describe the chemistry, secretion, functions and regulation of pancreatic enzymes |
|  | Intestinal digestive enzymes | 171 | Describe the chemistry, secretion, functions and regulation of small intestinal digestive enzymes  |
|  |  | 172 | Describe secretion of intestinal digestive juices by the crypts of lieberkühn |
|  | Gastrointestinal hormones | 173 | Describe the secretion, structure, functions and regulation of Gastrin, Secretin, Cholecystokinin and other GI hormones |
|  | Disorders of small intestine | 174 | Describe abnormal digestion of food in the small intestine in pancreatic failure |
|  |  | 175 | Describe malabsorption by the small intestinal mucosa in Sprue |
| Biochemistry | Pancreatic secretions | 176 | Describe the composition of pancreatic secretions |
|  |  | 177 | Describe the mechanism of secretion and actions of pancreatic enzymes |
|  |  | 178 | Describe the mechanism of synthesis of Bicarbonates |
|  | Digestion and absorption | 179 | Describe the mechanism of digestion and absorption of fats in the intestines |
|  |  | 180 | Describe the mechanism of digestion and absorption of proteins in the intestines |
|  |  | 181 | Describe the mechanism of digestion and absorption of carbohydrates in the intestines |
|  |  | 182 | Describe the mechanism of absorption of Iron, Vitamin-B12 and Folate in the intestines |
|  | Energy requirement of human body | 183 | Discuss the daily energy requirement of a human body in health and disease |
|  |  | 184 | Define BMR |
|  |  | 185 | Enlist the causes of high and low BMR |
|  |  | 186 | Describe the daily requirements of common vitamins, Iron, Calcium, Iodine and other minerals  |
|  | Nutritional disorders | 187 | Define Protein energy malnutrition and its associated clinical conditions |
|  | Adipose tissues | 188 | Discuss adipose tissue homeostasis |
| Pharmacology | Anti-diarrheal drugs | 189 | Classify anti-diarrheal drugs and their mechanism of action |
|  | Drugs for constipation | 190 | Classify drugs used in constipation, and their mechanism of action |
| Community Medicine | Food borne infection | 191 | Describe the epidemiology of food borne infections and their control measures |
| Paediatrics | Acute gastroenteritis | 192 | Describe the aetiology, clinical features, complications and treatment of acute gastroenteritis |

# Theme 5: Bleeding Per Rectum

|  |  |  |  |
| --- | --- | --- | --- |
| Gross Anatomy | Large intestine | 193 | Describe the gross features of cecum, ascending, transverse and descending and sigmoid colon |
|  |  | 194 | Describe the mesentery of large intestine |
|  |  | 195 | Describe the gross anatomy of rectum |
|  |  | 196 | Describe the gross anatomy of anal canal |
|  |  | 197 | Describe the blood supply of anal canal and its clinical correlates. |
|  |  | 198 | Describe the boundaries and contents of Ischiorectal (anal) fossa |
| Embryology | Development of hind gut | 199 | Describe the partitioning of cloaca |
|  |  | 200 | Enlist the derivatives of hind gut |
|  |  | 201 | Enlist the developmental anomalies of hindgut |
| Histology | Colon | 202 | Discuss the histological features of colon  |
|  |  | 203 | Describe the characteristic features of intestinal glands |
|  | Rectum | 204 | Describe the histological features of Rectum  |
| Physiology | Movements of the Colon | 205 | Describe different types of movements of colon |
|  |  | 206 | Describe gastro-colic reflex and duodeno-colic reflexes |
|  |  | 207 | Describe the mechanism of defecation reflex |
|  | Secretion of Large Intestine | 208 | Describe secretion of mucus by the large intestine |
|  | Disorders of Large intestine | 209 | Describe constipation, megacolon |
|  |  | 210 | Explain mechanism of diarrhea and its causes. |
|  |  | 211 | Explain paralysis of defection in spinal cord injuries |
|  | General Disorders of the gastrointestinal tract | 212 | Describe the mechanisms of Vomiting and Nausea |
|  |  | 213 | Describe Vomiting Act |
|  |  | 214 | Describe Gastrointestinal Obstruction |
|  |  | 215 | Describe gases in the gastrointestinal tract (flatus) |
| Biochemistry | Intestinal juices | 216 | Describe the composition of intestinal juices |
| Pathology | Carcinoma of colon and Rectum | 217 | Describe the etiology, histological findings, clinical presentation and staging of carcinoma of colorectal carcinoma |
| Surgery | Colorectal malignancies | 218 | Describe the etiology, clinical features, investigations and management of colorectal cancers |

# Metabolism

|  |
| --- |
| Theme-6: Glucose control (Carbohydrate metabolism) |
| Biochemistry | Oxidative Phosphorylation | 219 | Describe the generation of proton gradient & the resultant motive force across the inner mitochondrial membrane by transport of electrons through ETC which in turn produces ATP by oxidative phosphorylation |
|  |  | 220 | Describe the structure of ATP synthase enzyme(complex-V) & explain how it works as a rotary motor to synthesize ATP from ADP & Pi |
|  | Respiratory Chain Inhibitors & Uncouples | 221 | Describe the control of the rate of respiration, oxidation of reducing equivalents via ETC & its tightly coupling with oxidative phosphorylation in mitochondria |
|  |  | 222 | Discuss certain common poisons which block respiration or oxidative phosphorylation & identify their site of action |
|  |  | 223 | Explain how uncouplers act as poisons by dissociating oxidation from oxidative phosphorylation via ETC but at the same time they may have a physiological role in generating body heat |
|  | Glycolysis | 224 | Define Glycolysis |
|  |  | 225 | Describe the entry of glucose into different kinds of cells through various GLUT transporters |
|  |  | 226 | Describe the reactions of glycolysis |
|  |  | 227 | Describe the transportation of NADH to Mitochondria via various Shuttles |
|  |  | 228 | Describe the energetics of glycolysis |
|  |  | 229 | Describe the fates of pyruvate |
|  |  | 230 | Describe the types of glycolysis especially the anaerobic glycolysis |
|  |  | 231 | Describe the key enzymes and regulation of glycolysis |
|  |  | 232 | Discuss the glycolysis in RBC |
|  |  | 233 | Describe the biomedical Significance and clinical disorders of glycolysis |
|  |  | 234 | Discuss glycolysis in cancer cells |
|  |

|  |
| --- |
| Oxidation of Pyruvate |

 | 235 | Describe the conversion of pyruvate into acetyl CoA |
|  |  | 236 | Enumerate the enzymes & coenzymes of PDH complex |
|  |  | 237 | Describe the sequence of reactions catalyzed by PDH complex. |
|  |  | 238 | Describe the regulation of PDH complex |
|  |  | 239 | Discuss the clinical aspects of PDH complex especially the congenital lactic acidosis |
|  |  | 240 |  |
|  | Tricarboxylic Acid Cycle | 241 | Define citric acid cycle |
|  |  | 242 | Describe the sources of acetyl CoA in mitochondria |
|  |  | 243 | Describe the reactions of TCA |
|  |  | 244 | Discuss the energetics of TCA |
|  |  | 245 | Discuss the energy yield of one molecule of glucose when it is converted into carbon dioxide and water |
|  |  | 246 | Name the vitamins that play key role in TCA |
|  |  | 247 | Describe the amphibolic nature of TCA |
|  |  | 248 | Discuss the regulation of TCA |
|  |  | 249 | Enumerate the inhibitors of TCA and their sites of inhibition |
|  | Gluconeogenesis | 250 | Define Gluconeogenesis  |
|  |  | 251 | Name the organs and sub cellular location where Gluconeogenesis occurs |
|  |  | 252 | Describe the substrates or precursors of Gluconeogenesis |
|  |  | 253 | Describe the three bypass reactions |
|  |  | 254 | Describe the Gluconeogenesis from Fatty Acids |
|  |  | 255 | Discuss the Cori's cycle |
|  |  | 256 | Discuss the regulation of Gluconeogenesis |
|  |  | 257 | Name the key enzymes of Gluconeogenesis |
|  | Hexose Mono Phosphate shunt | 258 | Discuss the Role of Pentose Phosphate Pathway |
|  |  | 259 | Name the tissues where Hexose Mono Phosphate shunt occurs |
|  |  | 260 | Describe the reactions of the two parts of Hexose Mono Phosphate shunt |
|  |  | 261 | Describe the Role of thiamine in Hexose Mono Phosphate shunt |
|  |  | 262 | Enumerate the Similarities & differences b/w glycolysis and HMP shunt pathway |
|  |  | 263 | Discuss the functions of NADPH (produced in Hexose Mono Phosphate shunt) in various tissues and cells |
|  |  | 264 | Discuss G6PD deficiency and its effects in various tissues and cells |
|  |  | 265 | Describe the regulation of HMP shunt pathway |
|  | Uronic Acid Pathway | 266 | Enumerate the products of Uronic acid pathway and their importance |
|  |  | 267 | Discuss why ascorbic acid is vitamin for humans  |
|  | Galactose Metabolism | 268 | Describe the uses & requirements of galactose in the body |
|  |  | 269 | Discuss the various reactions with enzymes involved |
|  |  | 270 | Describe the Genetic Deficiencies of Enzymes in Galactose Metabolism and their effects |
|  | Fructose Metabolism | 271 | Describe the Main source of Fructose |
|  |  | 272 | Discuss the various reactions with enzymes involved |
|  |  | 273 | Discuss the Fructose formation in Seminal fluid |
|  |  | 274 | Describe the mechanism of formation of diabetic cataract |
|  |  | 275 | Discuss the Defects in Fructose Metabolism and their effects |
|  | Glycogen Metabolism | 276 | Describe the structure and functions of the glycogen especially the significance of its polymer nature |
|  |  | 277 | Describe the Difference between Liver & muscle glycogen |
|  |  | 278 | Describe the synthesis of glycogen by two mechanisms with its enzymes |
|  |  | 279 | Discuss the breakdown of glycogen with its enzymes  |
|  |  | 280 | Describe the Regulation of Glycogen metabolisms |
|  |  | 281 | Discuss the glycogen storage diseases with deficient enzymes and cardinal clinical features |
| Theme 7: Obesity (Fat metabolism) |
| Biochemistry  | Fatty acid (FA) synthesis (*De Novo*) | 282 | Enumerate the organs where fatty acid synthesis occurs with sub cellular sites |
|  |  | 283 | Discuss the source of Acetyl CoA that will be used for FA synthesis with reason |
|  |  | 284 | Discuss how acetyl CoA comes out of mitochondria for the synthesis of FA |
|  |  | 285 | Describe the steps of FA synthesis with enzymes  |
|  |  | 286 | Describe the FA synthase enzyme with its structure and components |
|  |  | 287 | Describe the product of FA synthase and the subsequent fate of this product |
|  |  | 288 | Discuss the regulation of FA synthesis |
|  |  | 289 | Discuss why animals cannot convert fatty acids into glucose |
|  |  | 290 | Describe the further elongation and desaturation of FA and its regulation |
|  | Mobilization of stored fats (oxidation of FA) | 291 | Describe how fats are mobilized from adipose tissues to the organs where they will be used for oxidation |
|  |  | 292 | Enumerate the various methods of oxidation of FA |
|  |  | 293 | Discuss the stages of beta oxidation with its reactions |
|  |  | 294 | Calculate the no. of ATP obtained when one molecule of palmitic acid is oxidized completely |
|  |  | 295 | Describe the genetic deficiencies of FA oxidation i.e. MCAD & CAT deficiencies with their hallmarks |
|  |  | 296 | Discuss the oxidation of odd-chain FA |
|  |  | 297 | Compare the processes of FA synthesis with FA oxidation |
|  | Metabolism of Ketone bodies | 298 | Enumerate the ketone bodies |
|  |  | 299 | Define ketogenesis |
|  |  | 300 | Describe the steps of ketogenesis |
|  |  | 301 | Discuss the energy yield during ketogenesis in liver |
|  |  | 302 | Enumerate the conditions in which there is increased ketogenesis |
|  |  | 303 | Discuss utilization of ketone bodies |
|  |  | 304 | Discuss the energy yield in ketone bodies utilization in extra hepatic tissues |
|  |  | 305 | Describe the regulation of ketogenesis in well-fed healthy conditions, during early stages of starvation & in prolonged starvation |
|  |  | 306 | Discuss the ketoacidosis in diabetes |
|  | Complex Lipid metabolism | 307 | Describe the synthesis of triacylglycerol by two mechanisms |
|  |  | 308 | Describe the synthesis of phosphatidic acid |
|  |  | 309 | Enumerate the substances formed from phosphatidic acid |
|  |  | 310 | Describe the synthesis of glycerophospholipids |
|  |  | 311 | Discuss the degredation of glycerophospholipids |
|  |  | 312 | Describe the synthesis of ceramide and sphingophospholipids (shingomyelin) |
|  |  | 313 | Discuss the degradation of shingomyelin |
|  |  | 314 | Discuss Niemann-Pick disease with its cardinal clinical features |
|  |  | 315 | Discuss Farber disease with its cardinal clinical features |
|  |  | 316 | Describe the synthesis of glycosphingolipids |
|  |  | 317 | Describe the degradation of glycosphingolipids |
|  |  | 318 | Describe the abnormalities of phospholipid metabolism i.e. true demyelinating diseases and sphingolipidosis  |
|  | Eicosanoid metabolism | 319 | Define eicosanoids and describe their two classes |
|  |  | 320 | Describe the synthesis of prostanoids by cyco-oxygenase pathway |
|  |  | 321 | Enumerate the two isomers of cyclo-oxygenase with their inhibition |
|  |  | 322 | Discuss why low dose aspirin therapy is used in strokes and heart attacks |
|  |  | 323 | Describe biochemical reason for the adverse effects of NSAIDs & steroids |
|  |  | 324 | Describe the catabolism of the prostanoids |
|  |  | 325 | Describe the lipoxygenase pathway for synthesis of Leukotrienes and lipoxins |
|  |  | 326 | Describe the synthesis of leuktriene biosynthesis inhibition |
|  |  | 327 | Enumerate the leukotriene receptor antagonists |
|  | Metabolism of cholesterol | 328 | Describe the major sites of cholesterol synthesis as well as sub cellular sites |
|  |  | 329 | Describe the source of cholesterol synthesis |
|  |  | 330 | Describe the various steps of cholesterol synthesis |
|  |  | 331 | Discuss the regulation of cholesterol synthesis |
|  |  | 332 | Enumerate the inhibitors of HMG CoA reductase inhibitors |
|  |  | 333 | Describes the degradation and excretion of cholesterol with synthesis of bile acids, their conjugation, bile salt formation and micelle formation in lumen of the intestine |
|  |  | 334 | Discuss the enterohepatic circulation of bile salts |
|  |  | 335 | Discuss the role of bile acid sequestrants i.e. cholestyramine and dietary fibre |
|  |  | 336 | Discuss the regulation of bile acid synthesis |
|  | Metabolism of lipoproteins | 337 | Describe the structure of a typical lipoprotein particle |
|  |  | 338 | Enumerate the various classes of LP |
|  |  | 339 | Enumerate the functions of apolipoproteins |
|  |  | 340 | Describe the steps of chylomicrons’ metabolism |
|  |  | 341 | Describe the metabolism of VLDL |
|  |  | 342 | Describe the metabolism of LDL |
|  |  | 343 | Describe the metabolism of HDL |
|  | Disturbances of Lipid metabolism | 344 | Differentiate between hyperlipidemias and dyslipidaemia |
|  |  | 345 | Describe the Classification of hyperlipidemias with enzyme deficiency |
| Medicine  | hyperlipidemias | 346 | Describe the epidemiology, preventive strategies and diseases associated with hyperlipidemias |
| Theme 8: Wasting (Protein metabolism) |
| Biochemistry  | Amino acid pool& chemical processes for dissimilation of proteins | 347 | Discuss how amino acid pool is formed  |
|  |  | 348 | Discuss the chemical processes responsible for dissimilation of proteins: transamination, deamination and transdeamination |
|  |  | 349 | Discuss the clinical importance of transaminases |
|  | Ammonia transport and effects of ammonia toxicity on brain | 350 | Discuss how ammonia is formed in various tissues and transported to liver Discuss the effects of ammonia toxicity in brain |
|  | Urea cycle & its associated inherited disorders | 351 | Describe the Krebs-Henselet Cycle of Urea Formation in Liver |
|  |  | 352 | Describe the clinical significance of various enzymes involved in urea formation |
|  | Metabolism of aromatic amino acids | 353 | Discuss biosynthesis, fate, metabolic functions and related inherited disorders of aromatic amino acids |
|  | Metabolism of sulphur containing amino acids | 354 | Discuss biosynthesis, fate, metabolic functions and related inherited disorders of sulphur containing amino acids |
|  | Metabolism of individual amino acids | 355 | Discuss biosynthesis, fate, metabolic functions and related inherited disorders of Glycine, serine, and alanine |
|  |  | 356 | Discuss biosynthesis, fate, metabolic functions and related inherited disorders of acidic amino acids |
|  |  | 357 | Discuss biosynthesis, fate, metabolic functions and related inherited disorders of branched chain amino acids |

# List of practical works

|  |  |  |  |
| --- | --- | --- | --- |
| **Subject**  | **Topic**  | **S. No** | **Learning objectives** |
| Histology  | Lips and tongue | 358 | Identify the histological features of lips and tongue under the microscope |
|  | Esophagus  | 359 | Identify the histological features of Esophagus under the microscope |
|  | Stomach  | 360 | Identify the histological features of stomach under the microscope |
|  | Duodenum  | 361 | Identify the histological features of duodenum under the microscope |
|  | Liver | 362 | Identify the histological features of liver under the microscope |
|  | Gall bladder | 363 | Identify the histological features of gall bladder under the microscope |
|  | Jejunum and Ilium  | 364 | Identify the histological features of Jejunum and Ilium under the microscope |
|  | Appendix  | 365 | Identify the histological features of Appendix under the microscope |
|  | Colon and Rectum | 366 | Identify the histological features of Colon and Rectum under the microscope |
| Physiology  | Examination of abdomen | 367 | Examine a standardized patient`s abdomen |
| Biochemistry  | Determination of plasma proteins | 368 | Estimate the plasma proteins in a given blood sample |
|  | Determination of free, total and combined acidity of the Gastric juice | 369 | Estimate free, total and combined acidity of gastric juice |
|  | Determination of serum Bilirubin  | 370 | Estimate serum Bilirubin in a given blood sample |
|  | Determination of Titrable acidity of urine | 371 | Estimate the Titrable acidity of urine |
|  | Determination of serum cholesterol | 372 | Estimate serum Cholesterol in a given blood sample |