Essay:

1. Adrenal cortex – Actions & regulations of Glucocorticoids – Aug 2004

2. SHORT NOTES:


b) Neuro muscular blocking agents: (Vol I Unit II 156)

- Blocking of neuro muscular junction produces muscle relaxation

Uses:

- helps in surgical operations
- psychotic patients

Blocking – 2 types

a. inhibiting release of Ach

b. drugs antagonise Ach

A. Inhibiting release of Ach:

- From presynaptic membrane, eg. botulinum toxin

B. Drugs that antagonise the action of Ach on post synaptic membrane (2 ways)

1. By competitive inhibition – eg. tubocurarine – compete for the same site of nicotinic ach receptors

   eg. neostigmine – antagonists to curare (anti-cholinesterases)

2. by persistent depolarisation – Succinyl choline persistent depolarisation to cause

   local energy exhaustion with no further generation of ATP.

   Suxa methonium – destroyed by pseudo cholinesterase by itself after 5 mins.
c) Hormones regulating pancreatic exocrine secretion:

2 hormones – Secretin & Cholesystokinin – pancreozymin (CCK-PZ)

1. Secretin:
   - discovered by Bayliss & starling (1907)
   - produced by argentaffin cells in the crypts of the mucosa of upper part of small intestines
   - produce flow of alkaline watery pancreatic juice by acting on the duct cells of pancreas
   - volume of fluid is directly proportional to secretin
   - also stimulates bile secretion & potentiates the effect of CCK-PZ on pancreas
   - along with CCK-PZ causes contraction of pyloric sphincter & delays gastric emptying

2. CCK-PZ:
   - Produced by granular mucosal cells – upper portion of SI (duodenum & Jejunum)
   - causes contraction of gall bladder to release bile & also causes secretion of pancreatic juice rich in enzymes
   - increases the secretion of enterokinase
   - produces tropic effect on pancreas.
   - action thru phospholipase C
   - found in neurons in the brain

d) Fertility tests in males & females (Vol II Unit X – 815)
Male:

testosterone level – adult men- 300 -1000 ng / dl
- adult women – 30-70 ng / dl

Semen analysis:
- Colour – white, opalescent
- Specific gravity – 1028
- pH – 7.35-7.45
- Average volume – 2.5-3.5 ml
- Sperm count – 80-120 million/ml
- Motility – more than 80 %
- Normal morphology

Female:

i) Basal body temperature:
- 0.3 °C rise in temp after ovulation due to thermogenic effect of progesterone

ii) cervical mucous – thick mucous / thin mucous – after & before ovulation respectively

iii) Spinbarkheit test

iv) Ultrasonography – appearance of changes in the endometrium for the proliferative & luteal changes

3. Plasma proteins & Plasmapheresis:

Aug 2004

Plasmapheresis:
- procedure to study the importance of plasma proteins.
- studied in the standard plasma depleted dog
- whole blood drawn from the animal & the cells suspended in the same volume of
  ringer locke solution are reinjected into the animal.

Findings:
- sudden decrease 4-5 mg/dl – back to normal in 2-7 days – by mobilisation of labile protein reserve
- decreased below 4mg/dl – exhaustion of protein reserves
- decreased than 2mg/dl – results in shock & death of the animal.

Conclusion:
a) fixed cell proteins/ indispensable cell proteins
b) Dispensible proteins
c) Labile reserve proteins

3. Types of sweat glands – role in temperature regulation: (Vol I Unit VII 597)

2 kinds of sweat glands
i) Eccrine glands – densest on palm & soles, next on head & much less on trunk & extremities.
- they are supplied by cholinergic fibres present in sympathetic nerves

Role in temperature regulation:
- causes thermal sweating because their secretions increases due to rise of external / internal body temperature
- emotional states
- exercise
- vomiting
  - after ingestion of spicy food

ii) Apocrine glands:
  - from hair follicles
  - mainly in axilla & around nipples & in females labia majora & mons pubis
  - causes non-thermal sweating
  - stimulated by epinephrine carried in the blood stream

4. Compound action potential:
  - an Extracellular recording action potential which is made ‘monophasic’
    recording by injuring the part of a nerve placing one of the external
    recording electrode on it.

causes of compound action potential:
  - mixed nerve is made up of families of fibres
  - fast conducting fibres – conduction is faster than slow conducting fibres

Factors affecting compound potential:

i) types of fibres

ii) strength of the stimulus

4.c – Thiocyanate space:
  - used to measure the ECF volume

    Measurement of Extracellular Fluid Volume. The volume of extracellular
fluid
    can be estimated using any of several substances that disperse in the
plasma and
    interstitial fluid but do not readily permeate the cell membrane. They
include
radioactive sodium, radioactive chloride, radioactive iothalamate, thiosulfate ion, and inulin.

When any one of these substances is injected into the blood, it usually disperses almost completely throughout the extracellular fluid within 30 to 60 minutes. Some of these substances, however, such as radioactive sodium, may diffuse into the cells in small amounts.

Therefore, one frequently speaks of the sodium space or the inulin space, instead of calling the measurement the true extracellular fluid volume.

Calculation of Intracellular Volume. The intracellular volume cannot be measured directly. However, it can be calculated as

\[
\text{Intracellular volume} = \text{Total body water} - \text{Extracellular volume}
\]

4.d – LH surge & its physiological significance:

Oestrogen – increases GnRH response

↓

induces within 24 hours Increase in LH called LH surge

This causes sudden ise in LH secretion, increase in LH serum concentration at the mid-cycle

Phy Significance:

Ovulation occurs about 9 hours after the Lh surge Therfore LH is also called ovulating hormone.
Essay:

1. Gastric juice secretion – Feb 2005

   note on mucosal barrier:

Mucosal barrier:

- surface epithelium of gastric mucosa – of columnar mucous cells – secrete mucous and HCO3

- mucous is made up of mucins – visible mucous --- gel like substance, alkaline in nature, lubricates the food, coats the mucosa.

- Definition – mucous membrane along with HCO3 plus tight junction serve a protective function preventing damage to the mucosa of the stomach and duodenum – MUCOSAL BARRIER.

Gastric ulcer:

Defn – is the term referred to break down of the mucosal epithelium of stomach and or duodenum.

Etiology:

a) Helicobacter pylori

b) Vinegar

c) Ethanol

d) Bile salts

e) Non – steroidal anti-inflammatory drugs – eg. aspirin, brufen, voveran etc

NSAID – inhibit prostaglandin synthesis which is needed to synthesise bicarbonate and mucous secretion & inhibits acid secretion by activating G1 receptors

Hypersecretion of gastric acid:
(i) Pepsinogen I – in acid secreting region – elevated levels of this have a fivefold greater incidence of peptic ulcer than normal individuals.

(ii) Gastrin – on feeding – increased gastrin due to hypersensitive parietal cells to gastrin.

(iii) Zollinger Ellison syndrome - in patients with gastrinomas – tumors that secrete gastrin (may occur in stomach, duodenum, pancreas)

Management:
1. Antacids – forms of gel – coats the mucosa (gastric / duodenal)
2. H2 receptor blocking drugs – mediates acid secretion
3. Omeprazole – acts by inhibiting gastric H K ATP ase
4. Vagotomy – in severe conditions
5. In Helicobacter pylori – antibiotics

SHORT NOTES:

a) Exocrine functions of pancreas:
   AUG 2005

b) Mismatched blood transfusion: (Vol I Unit II 110)
   - signs & symptoms occur because the recipient serum contains antibodies (α or β or anti D) which agglutinate the donor’s RBCs.

   - In apparent hemolysis:
     - Injected RBCs are rapidly destroyed.
     - the recipient’s blood returning within a week or less to its pre-transfusion state.

   - Post-transfusion jaundice:
- Hemolysed RBC – release of Hb – gets metabolised to bilirubin producing ‘hemolytic jaundice’.

➢ Hemoglobinuria & renal failure:

- violent pain in the back (elsewhere), tightness in the chest, because of agglutinated RBCs forms clumps & blocks the capillaries

- Oliguria:- due to fall in BP, local vascular disturbances in kidneys cause marked fall in GFR, precipitated acid hematin, anuria in later stages.

c) Acidification of urine (Vol I Unit VII 565)

Major sites of urine acidified are DCT & CT (distal convoluted tubule & collecting duct)

- though most secreted H+ in the PCT – there is no significant contribution of H+

- Limiting pH maximal H+ gradient against which the transport mechanism can secrete H+ corresponds to a urine pH of about 4.4.

Major buffer systems:

(i) Bicarbonate system

(ii) Dibasic phosphate system

(iii) Ammonia system
d) Infertility in a female:

I Abnormalities associated with female phenotype:-


Delayed puberty - decreased sexual development, of female type dwarfism & webbing of the neck.

Commonest presenting complaint is primary amenorrhoea.

II Testicular feminisation syndrome / complete androgen resistance syndrome –
- Sex chromosome – XY
- genetically males, sex chromatin test –ve
- normal breast development
- primary amenorrhea
- external genetalia are of female type.

III Super female:
- XXX
- no characteristic abnormalities
- commonly found in the general population

IV female Pseudohermaphroditism:
- female internal genetalia, masculine external genetalia
- congenital virilising adrenal hyperplasia

e) Sarcomere:

- The contractile unit of the muscle between two ‘Z’ lines called Sarcomere (2.5 µm in length)
- The cross striations which are characteristic of skeletal muscle are due to difference in the
  Refractive indices of various parts of muscle fiber.
- The dark band – highly refractile material anisotropic – ‘A’ band (1.5 µm in length)
- centre of each ‘A’ band – a slightly less refractile region called ‘H’ band (0.5 µm in length)
- ‘M’ line is seen in the middle of the H band due to central bulge in each of ‘A’ band
- This line plus narrow light area on either side of it is called – pseudo H zone

- the alternate light band is made of lower refractile material – Isotropic ‘I’ band (1 µm in length)

- In the center of each I band is found a narrow line of highly refractile material which therefore

  looks dark called ‘Z line

g) Pregnancy tests:

- based on the presence of human chorionic gonadotrophin in urine which appears as early as 14 days after conception

- Immunological tests & Biological tests

- Immunological tests:

  Principle – Antibodies to HCGs produced from rabbits by injecting HCGs. The antiserum produced can be used to detect the presence of HCG in urine.

  Procedure:- Urine 1 drop + HCG antiserum

  ↓

  Neutralisation / No Neutralisation

  ↓    ↓

  with latex particles with latex particles

  ↓    ↓

  No agglutination Agglutination

  ↓    ↓

  +ve pregnancy -ve pregnancy

i) Anticoagulants (Vol I Unit II)
A. Natural anticoagulants

**Heparin:**
- powerful anticoagulant
- facilitates action of antithrombin III
- inhibits – IX, X, XI, XII factors of coagulation
- origin of MAST cells
- contain IgG receptors – regain – mediate allergic & anti-inflammatory reactions
- heparin is responsible for fluidity of blood
- post operatively prevents spread of intravascular thrombosis
- Antithrombin, Protein C are other natural anticoagulants

B. Synthetic anticoagulants:

1. Vitamin K antagonists – effective orally
   - Coumarin derivatives – eg. Dicoumoral
   - Warfarin
   - Phenindione
   - action by competitive inhibition of vitamin K in liver

2. Clotting prevented invitro – Ca removed from blood
   - Sodium citrate / Oxalate
   - Ethylene diamine tetra acetic acid (EDTA)

3. Chelating agents:- Malayan pit viper – direct anticoagulant effect on fibrinogen by forming imperfect fibrin polymer (invitro)
   - in vivo- defibrination, conversion of plasminogen to plasmin
4. Arvin (Ancord) – type of snake venom
   - used therapeutically – defibrination – produces – FIBRINOGENOPENIA
5. Cold – 5-10º C postpones coagulation
   - arrests hemorrhage – prevents bleeding by inducing reflex vasoconstriction.
1. Describe synthesis, actions and regulation of thyroid hormones. Add note on clinical manifestations of hypo and hyper secretions of this hormone.

**Synthesis:**

Steps involved in synthesis of thyroid hormones:
1. Iodide pump (iodide trapping)
2. Triiodothyronine formation
3. Oxidation of iodide ion
4. Iodination of tyrosine and formation of the thyroid hormones
5. Storage of thyroglobulin
6. Release of thyroxine and triiodothyronine from the thyroid gland
7. Transport of thyroxine and triiodothyronine to tissues

---

**Diagram:**

[Diagram showing the synthesis process of thyroid hormones with various labeled steps and molecules such as $T_3$, $T_4$, and $T_9$.]
**Regulation:**

![Figure 76-7](#)

**Actions:** Repeated in

**Hyposcretion of hormone – Hypothyroid**

Increased secretion of thyroid hormones, free T4 and T3 level increases

**Myxedema:** Its occurs in adults

**Features:**

1. Goiter
2. Puffiness of face with periorbital swelling
3. Ptosis
4. Dry, thickened, rough and yellow skin

**Hypersecretion of hormone – Hyperthyroid**

Increased secretion of thyroid hormones, free T4 and T3 level increases
Features:

1. BMR increases
2. Hypersensitive to heat
3. Graves disease i.e exophthalmic goiter
4. Tachycardia
5. Thyroid tumours

Short notes

1. Intestinal phase of pancreatic juice - repeated in
2. Menstrual cycle - repeated in
3. Ionic basis of RMP
   
   Definition:
   
   A potential difference is observed between the inside and outside of the cell at rest called
   as the resting membrane potential.
   
   Normal RMP : -90mv

**The equilibrium potential:**

**Forces acting on ions**

The forces acting on ions across the cell membrane produces the variation in membrane potential.

1. Forces on cl⁻
2. Forces on K⁺
3. Forces on Na⁺
4. Forces on ca²⁺

4. Water absorption in renal tubules:

Water movement across membrane is determined by hydrostatic and osmotic pressure gradient.

A) Reabsorption from PCT
   PCT is site of active reabsorption of many substances e.g. glucose, Na⁺.

B) Reabsorption from loop of Henle
   1) The descending limb of loop of henle – Is highly permeable to water, but the ascending limb is impermeable
   2) In the ascending limb

C) Reabsorption in DCT and CT
   1) The tubular fluid entering the DCT is always hypotonic plasma
      The early part of DCT- Impermeable to water and continued removal of the solutes in excess of solvent further dilutes the tubular fluid

D) In the terminal DCT and CT
   The osmality in the tubular fluid changes according to water permeability Of the tubule to ADH

Essay:

2) Intrinsic pathway of blood coagulation (Repeated in oct:2003)
   Add note on function of platelets (Repeated in

Short notes

A) ABO blood group system (Repeated in aug:2004)
B) Spermatogensis (Repeated August 2006)

C) Regulation of acid – base balance by kidney

The kidneys are responsible for clearing the body of metabolically produced non carbonic acids. The normal urine is acidic in nature

Sources of non carbonic acid:

1) Cellular metabolism
2) High protein diets
3) Waste products
4) Strenous exercise
5) Ingestion of acidifying salts
6) Renal tubular generation of H⁺

Role of kidneys

Major function of kidney:

1) The kidneys excrete a daily load of 50-100 m Eq of metabolically produced non carbonic acid, which represents as H⁺ excretion of 1 m Eq/kg of body weight/ day

Buffer systems in the kidney

1. Bicarbonate system
2. Dibasic phosphate system
3. Ammonia system

D) Micturition (Repeated in Feb 2006)
Essay:

1. Describe the functions of growth hormone (Repeated in October 2003)
   What are the clinical disorder associated with it? (Repeated in August 2008)

Short notes:

a) Peristalsis (Repeated in August 2004)

b) Glomerulo feedback (Repeated in August 2008)
c) Test of ovulation (Repeated in April 2001)

d) Heat stroke

✓ When core temperature is more than $41^\circ C$ ($106^\circ F$) for prolonged periods it may cause permanent brain damage.
✓ When it is more than $43^\circ C$ death occurs due to heat stroke.
✓ Increase in heat production in the muscle and causes marked rise in body temperature, is called malignant hyperthermia.

3. Describe Erythropoiesis. What are the factors regulating it? (Repeated in Feb 2006).

Short notes

a) Mechanism of HCL secretion (repeated in February 2005)

b) Molecular basis of muscle contraction (Repeated in August 2006)

c) Defecation reflex

Definition:

Defecation is the process in which unwanted food residue or faeces are evacuated in the rectum.
Defecation reflex:

defecation is initiated by *defecation reflexes*. One of these reflexes is an *intrinsic reflex* mediated by the local enteric nervous system in the rectal wall.

This can be described as follows:

When feces enter the rectum, distention of the rectal wall initiates afferent signals that spread through the *myenteric plexus* to initiate peristaltic waves in the descending colon, sigmoid, and rectum, forcing feces toward the anus.

As the peristaltic wave approaches the anus, the *internal* anal sphincter is relaxed by inhibitory signals from the myenteric plexus; if the *external* anal sphincter is also consciously, voluntarily relaxed at the same time, defecation occurs.

The intrinsic myenteric defecation reflex functioning by itself normally is relatively weak.
To be effective in causing defecation, it usually must be fortified by another type of defecation reflex, a *parasympathetic defecation reflex* that involves the sacral segments of the spinal cord, shown in Figure 63-6.

When the nerve endings in the rectum are stimulated, signals are transmitted first into the spinal cord and then reflexly back to the descending colon, sigmoid, rectum, and anus by way of parasympathetic nerve fibers in the *pelvic nerves*. These parasympathetic signals greatly intensify the peristaltic waves as well as relax the internal anal sphincter, thus converting the intrinsic myenteric defecation reflex from a weak effort into a powerful process of defecation that is sometimes effective in emptying the large bowel all the way from the splenic flexure of the colon to the anus.

d) Compartments of body fluids

Compartments:

- Total body water (TBW) - 42L
- Extracellular fluid (ECF) - 14 L
- Intracellular fluid (ICF) -28L

A) Extra cellular fluid compartment:

  This is fluid contained in the space outside the cell. ECF compartments includes: Plasma, interstitial fluid and transcellular fluid.

Plasma:

  This is fluid portion of the blood. It represents 25% of the ECF.
Plama volume (L) = Blood volume (L) × 100 - Hematocrit

100

Interstitial fluid:

It is the part of ECF that is outside the vascular system.

Transcellular fluid:

It represents fluid in the lumen of structures lined by epithelium it includes: Digestive secretions, sweat, cerebrospinal fluid, pleural, peritoneal, synovial, intraocular and pericardial fluids.

Paper III - August 2004

Short notes:

1. Plasma proteins:

Proteins which are present in the plasma are called as plasma proteins.

Major plasma proteins

Albumin
Globulin
Fibrinogen

Types:

Alpha Globulin
Beta globulin
Gamma globulin

Functions:
1) Maintains colloidal osmotic pressure
2) Protects against iron intoxication
3) Helps in iron transport
4) Prevents loss of iron through urinary excretion
5) Regulates the renal threshold for haemoglobin
6) Coagulation factors: alpha & beta globulin
7) Angiotensinogen: Alpha\(_2\) globulin

b) Pharyngeal stage of deglutition

Stage II:

Soft palate is elevated and thrown against posterior pharyngeal wall to close of the nasal cavity. This prevents the food from entering the nasal cavity.

\[ \text{Larynx rises with elevation of hyoid bone vocal cords are approximated} \]

And breathing is momentarily inhibited

\[ \text{Posterior pillars of fauces} \]

\[ \text{Cricopharngael muscle briefly relaxes} \]

Cricopharngael muscle contracts and vocal cords open to allow resumption of Rhythmic breathing.

C) Inter cellular connections
i) Tight junction

ii) Desmosomes (or) Adherens junction

iii) Gap junction

**Tight junction:**

It forms a barrier to the movement of ions and other solutes from one side of epithelium to the other

**Desmosomes**

This holds adjacent cells firmly together in areas that are subjected to stretching, such as the skin

**Gap junction**

It permits rapid propagation of electrical potential changes from one cell to another

Eg: Cardiac and smooth muscle cells

d) **Nerve action potential (Repeated in Feb 2005)**

e) **Physiological effects thyroid hormones**

   Calorigenic (heat production) action:

      i) Thyroid hormones stimulate heat production in the body

      ii) $T_3$ and $T_4$ increase the oxygen consumption of tissues

**on Protein metabolism:**

$T_4$ - increases protein synthesis resulting in positive nitrogen balance
$T_4$ - protein catabolism due to increase in BMR which leads to negative nitrogen balance

On CVS:

Increase in systolic and fall in diastolic BP

Causes:

i) Mild decrease in mean BP

ii) Increase in pulse pressure

On bones:

$T_4$ deficiency leads to anaemia due to:

i) Decreased bone marrow metabolism which decreases the erythropoiesis and produces normochromic anaemia.

On carbohydrate metabolism:

$T_4$ increases peripheral utilization of glucose

Thus can cause hypoglycemia

On lipid metabolism:

Increases synthesis of cholesterol in the liver

On CNS:

$T_4$ is necessary for normal development and activity of the CNS.

f) **Contraceptive method**

**Contraceptive measures in male:**
1. Conventional method
2. Coitus interruptus
3. Vasectomy

Conventional methods:

**Condoms**

Advantages:

i) Easy to use

ii) Provide protection against sexually transmitted diseases

**Coitus interrupts:**

Withdrawal of penis before ejaculation

**Vasectomy**

Withdrawal of penis before ejaculation

Advantage:

It is relatively safe and convenient method

Female contraceptive measures (Repeated in aug:2005)

g) Neuro endocrinal reflex

Sukling

Stimulation of the tactile receptors in the areolar region of the breast
Activates somatoesthetic neural pathways

Which transmit signal to the paraventricular nuclei in hypothalamus

Reflex secretion of oxytocin into blood stream

Oxytocin is carried to the mammary gland

Where it causes milk release in lactating women by contraction of the myoepithelial cells

Which covers the surface of the epithelium of the alveoli, ducts & mammary glands

Thus expelling their contained milk into the duct

**h) Small intestinal movements**

i) Rhythmic segmental contractions or pendular movements

ii) Peristalisis

iii) Tonic contractions

**Rhythmic segmental contractions or pendular movements**
Segmentation movements churn and mix the contents of the digestive tract but do not produce net movement in a particular direction.

**Peristalsis**

It propels materials along the length of the GIT.

**Tonic contractions**

Promotes absorption

**i) Morphology of platelets**

a) Platelets are the smallest blood cells colourless, spherical, oval or granulated bodies.

b) 2.5 micrometer in diameter

c) Cytoplasm contains
   
   i) Golgi apparatus
   
   ii) Endoplasmic reticulum
   
   iii) Few mitochondria

d) Platelet membrane

   it has identical structure with the cell membrane are:

   i) Phospholipids
   
   ii) Cholesterol
   
   iii) Glycolipids

   e) Von willi brand factor
Plays role in platelet adhesion

Functions:

i) Haemostasis:
   Spontaneous arrest of bleeding by physiological process

ii) Platelet adhesion

iii) Platelet activation
   The activated platelets:
   a) Change the shape
   b) Discharge their granule contents
   c) Stick to each other called platelet aggregation

- Blood coagulation
- Clot retraction
- Phagocytic function
- Storage and transport function

Essay:

1. Hormones of Pituitary Gland:
   a) anterior pituitary
      i) Thyroid stimulating hormone (TSH, Thyrotrophin)
      ii) Adrenocorticotropic hormone (ACTH, Corticotrophin)
      iii) Growth Hormone (GH, Somatotrphin)
iv) Follicle stimulating hormone (FSH)
v) Luteinising Hormone (LH)
vi) Prolactin (Luteotrophic hormone, luteotrophin, lactogenic hormone)

b) Intermediate lobe
i) α β melanocyte stimulating hormone (melanotrophin, intermedin)

c) Posterior lobe:
i) Vasopressin (ADH, anti diuretic hormone)
ii) Oxytocin

Mechanism of action of growth hormone:

Generally proteins & polypeptide hormones, many aminoacid derivatives exert their actions thru 2nd messengers

Hormone
↓
Receptor in the outer / inner surfaces of the cell membrane
↓
increases formation of cAMP (2nd messenger)
↓
converts protein kinase into active form
↓
protein kinase a
↓
phosphorylation of proteins by altering their forms & activity
  - change in membrane permeability
- activation or inactivation of rate limiting enzymes
- increased / decreased protein synthesis by action on ribosomes
- regulation of release of hormones from endocrine gland

note on Acromegaly:
- Acromegaly – enlargement of peripheral regions
- usually due to acidophilic tumour of ant.pituitary
- 20-40% - associated with increased prolactin secretion

Characteristic features:
- prognathism – elongation, widening of the mandible
- prominent brow
- thickening of the skin & coarsening of facial features – acromegalic facies
- kyphosis – periosteal growth of vertebrae causing bowing of spine & metacarpals, metatarsals – leads to acral parts
- hypertrophy of soft tissues
- Cardiomegaly, hepatomegaly, Splenomegaly, Renomegaly, etc
2. Role of platelets in coagulation of blood:
**SHORT NOTES:**

a) *Saltatory conduction in nerve fibres:*

- Jumping of depolarisation from node to node (node of ranvier) is called *Saltatory conduction*.
- Conduction in a myelinated nerve fibre is from node to node - *saltatory conduction*.
- Myelin - effective insulator, action potentials are generated only at nodes.
- The regions are exposed to ECF.
- As node to node - rapid conduction hence less energy expenditure.
- Conduction at rate of 50-100 times than in unmyelinated fibres.
- Economical & saves energy.

b) *Phagocytosis:*

Def – Cell eating – process by which Extracellular substances are engulfed by the cells.

Eg – bacteria, foreign substances, dead tissues.

Mechanism:

- The substance makes contact with the cell membrane and then invaginates.
- the endocytic vesicle pinches off from the cell membrane & fuses with another intracellular beside – eg lysosome, from which the invaginated substance is released to ICF
- Neutrophils & monocytes – active phagocytosis
- They contain – fever producing substance – endogenous pyrogen – imp mediator of febrile response to bacterial pyrogens

d) Humoural Immunity:
- acquired immune defence system
- mediated by B-Lymphocytes
- activate complement system
- neutralise antigens
- due to circulating antibodies – gamma globulins
- is a major defence against bacterial infections

Humoural response B-lymphocyte encounters bacterium

\[ \downarrow \]

plasma cell formation

\[ \downarrow \]

Secretion of antibodies

\[ \downarrow \]

Antibodies attack bacteria

\[ \downarrow \]

Bacteria eliminate by phagocytosis
e) Functions of saliva:
1. *ptyalin*:
   - salivary amylaseα
   - aids in digestion (only cooked starch)
   - starch to maltose
   - bolus formation with saliva
   - amylase digestion continues appropriately half an hour bile stomach
   - amylase inactivated at pH < 4.0

2. *Mucin*
   - lubricates food, assists mastication, facilitates swallowing
   - protects oral mucosa
   - keeps mouth moist
   - aids speech
   - serves as a solvent for the molecules that stimulates the taste buds
   - minimises risk of buccal infection, dental caries
   - contains – lysosomes that kills bacterria
   - IgA – immunological function
   - Lactoferin – binds with iron & arrests bacterial multiplication
     (bacteriostatic)
   - Buffers & binds to toxic tannins
   - maintains pH at 7.0 – protects tooth enamel
   - contains somatostatin, glucagons & nerve growth factors

f) **Actions of Pancreatic juice**: (Vol I Unit IV – 229)
Enzymes & actions

i) Pancreatic amylase - digests starch of boiled & unboiled to maltose stable in pH between 4-11

ii) Pancreatic lipase – hydrolyses neutral fats to glycerol esters & fatty acids, action at the range of pH – 7-9

iii) Pancreatic esterase: - converts cholesterol esters to cholesterol

iv) pancreatic proteolytic enzymes: - Trypsinogen ------ by enterokinase ---- trypsin ------- proteins ------- polypeptides

Chymotrypsinogen--------- by trypsin ------- chymotrypsin --- digests -- --- proteins into ----- small polypeptides

v) Procarboxy peptidase – A & B

- by the action of enterokinase – converts peptides into amino acids

g) Hypothalamic thermostat:

Thermoregulation ----- Anterior & posterior hypothalamus

Anterior hypothalamus --- increase heat loss & decrease heat production

i) cutaneous vasodilatation

ii) Sweating

iii) increase in respiration

Decrease heat production

i) anorexia, decreases sympathetic discharge decrease in BMR

ii) apathy & inertia decreases body activity as a whole

iv) decrease TSH secretion from anterior pituitary

Posterior hypothalamus:

Increase heat production:
i) Shivering - an involuntary response

ii) hunger – increase food intake, increases sympathetic discharge

iii) increase voluntary activity – because of seminiferous increase

iv) increase TSH secretion – from ant pituitary

v) increase catecholamines from adrenals

**h) Cystometrogram: (Vol I Unit II – 588)**

- The relationship between intra vesicle pressure & volume recorded --- cystometry
  - plot of intravesicular pressure against volume of fluid in the urinary bladder is called CYSTOMETROGRAM
  - an initial slight increase in pressure – upto 10 cm H2O - when 100 ml
  - long nearly flat segment – upto 300 - 400 ml --- due to intrinsic tone of bladder itself
  - this manifests Law of Laplace \( P = \frac{2T}{R} \)
  - where \( P \) – pressure, \( T \) – tension, \( R \) – radius
  - beyond this point, collection of fluid causes – sudden sharp rise in pressure- -- Micturition is triggered

**i) Myxedema:**

- advanced hyperthyroidism in adults characterised by swelling of skin & subcutaneous tissues
- Features
  - Goiter – enlargement of thyroid gland
  - puffiness of face with periosteal swelling
  - coarsening & loss of scalp hair
- ptosis – drooping of upper eyelid
- dry thickened rough & yellow skin
- associated features – low BMR, hypersensitive to cold, low voltage ECG, hoarseness of voice, psychosis, (myxedemous madness), memory loss, increase in serum cholesterol

j) Negative feedback mechanism in hormonal regulation:

- negative feed back control is important for survival
- the target organ hormones act either on the anterior pituitary / on the hypothalamus at 3 levels
- Long loop feedback, short loop feedback, Ultra short loop feedback
- HYPOTHALAMUS
  \[ \downarrow \]
  ANTERIOR PITUITARY
  \[ \downarrow \]
  TARGET GLAND

Negative Feedback Nature of Most Control Systems
Most control systems of the body act by negative feedback, which can best be explained by reviewing some of the homeostatic control systems mentioned previously. In the regulation of carbon dioxide concentration, a high concentration of carbon dioxide in the extracellular fluid increases pulmonary ventilation. This, in turn, decreases the extracellular fluid carbon dioxide concentration because the lungs expire greater amounts of carbon dioxide from the body. In other words, the high concentration of carbon dioxide initiates events that decrease the concentration toward normal, which is negative to the initiating stimulus. Conversely, if the carbon dioxide concentration falls too low, this causes feedback to increase the concentration. This response also is negative to the initiating stimulus.

In the arterial pressure–regulating mechanisms, a high pressure causes a series of reactions that promote a lowered pressure, or a low pressure causes a series of reactions that promote an elevated pressure. In both instances, these effects are
negative with respect to the initiating stimulus. Therefore, in general, if some factor becomes excessive or deficient, a control system initiates negative feedback, which consists of a series of changes that return the factor toward a certain mean value, thus maintaining homeostasis.

“Gain” of a Control System. The degree of effectiveness with which a control system maintains constant conditions is determined by the gain of the negative feedback. For instance, let us assume that a large volume of blood is transfused into a person whose baroreceptor pressure control system is not functioning, and the arterial pressure rises from the normal level of 100 mm Hg up to 175 mm Hg. Then, let us assume that the same volume of blood is injected into the same person when the baroreceptor system is functioning, and this time the pressure increases only 25 mm Hg. Thus, the feedback control system has caused a “correction” of –50 mm Hg—that is, from 175 mm Hg to 125 mm Hg. There remains an increase in pressure of +25 mm Hg, called the “error,” which means that the control system is not 100 per cent effective in preventing change.

The gain of the system is then calculated by the following formula:
Thus, in the baroreceptor system example, the correction is –50 mm Hg and the error persisting is +25 mm Hg. Therefore, the gain of the person’s baroreceptor system for control of arterial pressure is –50 divided by +25, or –2. That is, a disturbance that increases or decreases the arterial pressure does so only one third as much as would occur if this control system were not present. The gains of some other physiologic control systems are much greater than that of the baroreceptor system. For instance, the gain of the system controlling internal body temperature when a person is exposed to moderately cold weather is about –33. Therefore, one can see that the temperature control system is much more effective than the baroreceptor pressure control system.

k) Female contraceptive measures: (Vol II Unit X – 841)

1. Conventional methods – temporary method
2. Intrauterine device - temporary method
3. Contraceptive pills - temporary method
4. Tubectomy – permanent method

Conventional methods
- use of cervical diaphragm
- use of spermicides
- Rhythm/calendar method

**IUCD**
- implantation of foreign body into uterine cavity
- mechanism of action – prevents deposition of sperm into the uterine cavity
- alters the release of ovum & prevents fertilisation & implantation

**Contraceptive pills**
- classical pills
- sequential pills
- administration of large dose of oestrogen
- mini/micropill

action is alters release of ovum, reduces pain during menstruation

**Tubectomy**
- bilateral ligation of fallopian tubes
- relatively safe & convenient permanent method to prevent pregnancy
Essay:

1. **Erythropoiesis**: (Vol. I, unit II, 65-67)
   - Production of red blood cells – Erythropoiesis

During intrauterine life:

   Mesoblastic stage
   - In early embryo upto 3 months of fetal life, RBCs are formed from mesoderm of yolk sac
   Hepatic stage:
   - After 3 months of fetal life – liver & spleen
   Myeloid stage
   - Middle life of fetal period from bone marrow- hepatic & myelod are extravascular Erythropoiesis

Stages:

- Hemocytoblast – 19-23 µm – very big, contains chromatin, nucleus is big, aim all around the nuclei, deep basophilic, active mitosis
- Proerythroblast – 15 -20 µm, nucleus , nucleoli are open, deep basophilic, active mitosis
- Early normoblast, 14- 16 µm, size decreases, no nuclei, chromatin condenses, polychromatophilic staining, active mitosis
- Intermediate normoblast – 10-14 µm, nucleus size further decreases, chromatin further condenses, marked cytoplasm, polychromatophilic staining, hemoglobin starts appearing, mitosis stops
- Late normoblast- 8-10 µm, nucleus very small with chromatin but cartwheel appearance, further increase in the amount of Hb.
- Later stage of Late normoblast – 7-8 µm ucleus degenerates, becomes uniformly deeply stained, pyknotic, further increase in Hb, acidic less basophilic.
- Reticulocyte – no nucleus, 7-8 µm remnants of RNA present, acidophilic
- Erythrocyte – 7.3-7.4 µm
Regulation of Erythropoiesis:

i) General factors – Hypoxia

ii) Special maturation factors – Dietary factors, Intrinsic factor – B12, folic acid

2. Synthesis, regulation & functions of cortisol
   Repeated – Aug 2004 (4053)

Short notes:

a) Ultra structure of skeletal muscle: (Vol I, unit III – 159)
   - Skeletal muscle is made up of many long thin cells called muscle cells / muscle fibres
   - Contained in connective tissue sheets & form bundles of fibres
   - Origin & insertion in tendons
   - Multinucleated, long 1-40 μm cylindrical in shape, surrounded by a cell membrane – Sarcolemma
   - Muscle fibres are made up of myofibrils
   - 1 – 2 μm in diameter, lies parallel to one another & are striated
   - Contractile proteins – Actin & myosin
   - Regulatory proteins - troponin & tropomyosin

b) Deglutition: (Vol I, unit IV – 206,7)
   There are three stages 1. Oral stage 2. Pharyngeal stage. 3. Oesophageal stage
   - I stage – is voluntary, food is moistened, lubricated by saliva, with the movements of the tongue, hard palate – food into the pharynx
   - II stage -Repeated (Aug
   - III stage – Oesophageal stage
   - Oesophagus is approx – 25 cm length, separated from the oral cavity by the upper oesophageal sphincter & from the stomach by the lower oesophageal sphincter.
   - Relaxed at rest
   - 2 types of peristalsis
- Primary & secondary
- Swallowing or local stimulation of oesophagus at any level causes development of peristalsis
- After reaching the oesophagus food is propelled into the stomach
- Secondary peristalsis is initiated by the presence of food within the oesophagus due to the stimulation of mechanical or irritant receptors
- Is coordinated by intrinsic nervous system of the oesophagus.

c) **Composition & functions of gastric juice**
   Repeated – Aug 2004 - 4053

d) **Erythroblastosis foetalis**
   Repeated –

e) **Nerve supply to bladder & Micturition:** (Vol I, unit VII pg – 586-9)
   Nerve supply
   - Sympathetic
   - Parasympathetic
   - Somatic
     Micturition – spinal reflex facilitated / inhibited by higher centers
   - Increase in pressure beyond 400 cm H2O nerve reflex – Micturition reflex
   - The urinary bladder fills with urine, impulses from the stretch receptors wall stretches
   - Causing sensory signals – to dorsal nerve root S2,3,4. Through pelvic nerve, & then back again to the urinary bladder through parasympathetic fibres in the same nerve – Micturition reflex
   - Control - Facilitatory area – Pontine region & posterior hypothalamus
   - Inhibitory area – Mid brain

f) **Thrombocyte:**
   Repeated

g) **Ovarian cycle:**
   Repeated
h) **Hormones acting on breast:**
   - Oestrogen, Progesterone, Prolactin.
   - **Oestrogen**
     - Duct development
     - Thickening of nipple & marked growth & branching of ducts
     - Hence called growth hormone of breast.
   - **Progesterone**
     - Along with oestrogen – glandular development.
     - Promotes growth of lobules and alveolar tissues in the breast
   - **Prolactin**
     - Acts on breast under the influence of oestrogen and progesterone

i) **Functions of skin:** (Vol II, Pg – 586)
   - Protection
   - Temperature regulation – Heat loss through
   - Sweating – Apocrine & Eccrine glands causing Thermal & Non-thermal sweating respectively
   - Increases heat production in colder conditions – Shivering
   - Heat loss through – vasoconstriction on exposure to cold
   - Horripilations – Goose pimples

j) **Thyrotoxicosis:** (Vol II, unit IX – 710)
   - Increased circulating levels of free T4 & T3
   - Commonest cause is Grace’s disease
   - Called as Exophthalmic goiter / Thyrotoxicosis
   - An auto immune disorder
   - Thyroid stimulating antibodies – also Long acting thyroid stimulator thyroid stimulating Immunoglobulins
   - Combine with receptors and replace TSH from its binding sites then acts via cyclic AMP causes prolonged action.
   - Increased growth of thyroid gland
   - Diffuse enlargement/ hyperplasia of thyroid gland
   - Characteristic features:
     - Serum TSH is increased
     - Exophthalmus
- Lip retraction
- Periorbital swelling etc

**PAPER III PHYSIOLOGY**

**Aug – 2006**  **Sub code – 4053**

**Essay:**

1. Hormones of Adrenal gland, Functions and regulation of Glucocorticoids.  
   Note on Cushing’s syndrome.
   Repeated – Aug 2004, (sub code – 4053)

2. Composition, function & regulation of Pancreatic secretion.
   Aug – 2005 – Functions (4053)
   April - 2001 – Regulation. (4053)

3. Immunity:
   Humoral Immunity - Aug – 2005 (4053)
   Cell mediated Immunity – Aug 2004 (4053)

**Short notes:**

a) Fate of Hb after Hemolysis:
   - Hemoglobin – heam & globin
   - Globin – enters amino-acid pool
   - Haem - into Fe^{2+} - reused for synthesis of Hb
   - Remaining part – into biliverdin then to bilirubin – excreted in bile

b) Movements of Small intestine
c) Steps involved in formation in Urine
Repeated - Aug 2004 (4053)

d) Spermatogenesis:
- Process by which sperms are formed
- Begins at puberty & continues throughout life – decline in old age.

Steps
- Primitive germ cells (46 chromosomes) – undergoes mitotic division
- Becomes primary spermatocytes (46 chromosomes)
- Undergoes 1st meiotic division
- Becomes secondary spermatocytes (23 chromosomes) - undergoes 2nd meiotic division
- Spermatids (23 chromosomes)
- On maturation become matured sperms or spermatozoa.

e) Neuroendocrine reflex:
Repeated – Feb 2005 (4053)

f) Adrenogenital syndrome:
- This syndrome is due to tumor of adrenal cortex
- Causes excessive secretion of sex steroids
- Congenital deficiency of 11\(\beta\) - hydroxylase leads to deficient secretion of aldosterone, cortisol & the syndrome of congenital adrenal hyperplasia.
- Hyperplasia – due to increased ACTH
- Pre-pubertal boys develop – Precocious pseudo puberty (without the testicular growth)
- Females – Pseudo hermaphroditism
- Prepubertal & adult females develop – Adrenal virilism
- Majority cases – salt losing form of adrenal hyperplasia.

**PAPER III PHYSIOLOGY**

**Feb – 2007**       **Sub code – 4053**

**Essay:**

1. **Glucose homeostasis:**
   - Maintenance of stable physiological environment within physiological limits – homeostasis
   - Maintenance of normal glucose level
   - Fasting 80-100 mg; Postprandial – 140mg
   - Importance of maintaining glucose level is that the brain will not be able to survive without glucose for more than 2 mins
   - Hormones that play in this are
     - Insulin (when increase in blood glucose level)
     - Glucagon, corticosteroids, Growth hormone, Thyroid hormone, Catecholamines … (when decrease in blood glucose level)
   - After meals – insulin – peripheral utilization by the tissues
   - After 2 hours – liver – glycogenolysis, Gluconeogenesis
   - Catecholamines – Gluconeogenesis
   - Other hormones like cortisol, GH, thyroid – increase blood glucose level (glycogenolysis, Gluconeogenesis)
- Glucagon - glycogenolysis, Gluconeogenesis – increase blood glucose level
- On prolonged fasting Kidney comes to play the role
- Thus glucose homeostasis is done

**Note on GTT: (glucose tolerance test)**

- Test done to assess the glucose metabolic state of a person
- Administration of glucose orally – 75 gms – oral GTT
- Normal GTT: When fasting venous blood - ≤ 115 mg/dl, after 2 hrs after administration of glucose - ≤ 140 mg/dl & no value is ≥ 200 mg/dl
- Diabetic GTT: When fasting venous blood - ≥ 115 mg/dl, after 2 hrs after administration of glucose - ≥ 200 mg/dl
- Impaired GTT: When fasting and pp are above the upper limits of normal but below the values diagnostic of diabetic GTT.

**Note on Diabetes mellitus:**

- Diabetes – ‘siphon’ mellitus – ‘sugar’
- Causes – Insulin deficiency, usually associated with hormones which normally have antagonistic actions to insulin. (GH, Catecholamines, Glucagon, Cortisol, thyroid hormones etc)
- Mainly due to hyperglycemia with decreased utilization
- There is extracellular glucose & intracellular deficiency – a situation called ‘Starvation in midst of Plenty’
- Features – Hyperglycemia, Glycosuria, Polyuria, Dehydration, Polydipsia, Polyphagia, Loss of weight, Ketonuria and poor resistance to infections.

2. **Menstrual cycle, hormonal control in various phases and note on pregnancy tests.**
   Repeated – menstrual cycle – Aug 2008 (4053)
   Pregnancy tests - April – 2001 (4002)
3. Concentration of urine in kidney.
   Repeated - Aug 2004 (4053)

Short notes:

a) Blood groups:
   Repeated - Aug 2002 (4053)

b) Anticoagulants :
   Repeated - Apr 2001 (4002)

c) Micturition reflex :
   Repeated – Feb 2006(4053)

d) Fat Absorption:

   - Pancreatic electrolytes, monoglycerides, fatty acids& bile salts interact spontaneously to form – micelles
   - Micelles – are water soluble complexes – 3-10mm in diameter, can dissolve hydrophobic compounds
   - Are passively absorbed along their concentration gradient into the luminal brush border, actively reabsorbed more distally in the ileum.
   - Monoglycerides & fatty acids - form chylomicrons, contain protein therefore called – esterified fatty acid.
   - Fat absorption is greater in upper part of the small intestine, some in the ileum also.
   - Cholesterol, like the short chain fatty acids, is absorbed directly into the lymphatics & reconverted into cholesterol esters. It is mainly absorbed from the distal part of the small intestine.
   - On a moderate fat intake 95% of the ingested fat is absorbed. Only 5-6% is excreted in stools
   - This process is not developed at birth, hence infants fecal fat content is 10-15% of the ingested fat.
f) **Gastro intestinal hormones:**

- Biologically active polypeptides synthesised by the mucosa of the GIT are GI hormones
- 2 families
- 1. Gastrin (Gastrin, CCK) 2. Secretin (Secretin, GIP, VIP, Glucagon, Glicentin)

**Gastrin**

- Secreted by ‘G’ cells in the deeper portions of pyloric glands in the gastric mucosa.
- Also found in the pituitary gland, medulla oblongata, vagus & sciatic nerves
- Occurs in three forms – G 34, G 17, G 14 of which G 17 is the most active form with respect to gastric acid secretion.
- Inactivated mainly in the kidney & small intestine
- Stimulates gastric acid secretion
- Growth of the gastric mucosa
- Stimulates gastric motility
- Stimulates insulin & glucagon secretion after a protein meal

**Cholecystokinin- pancreozymin:**

- Produced by granular mucosal cells of upper portion of small intestine – duodenum & jejunum
- Causes contraction of gall bladder to release bile
- Causes enzyme rich pancreatic secretion
- Trophic effect on pancreas.
- CCK & Gastrin stimulates glucagon

**Secretin:**

- Hormone to be discovered first (Bayliss & Starling)
- Produced by argentaffin cells of upper part of small intestine
- Causes alkaline watery pancreatic juice.
- Stimulates bile secretion also
- Along with CCK-PZ causes contraction of pyloric sphincter & delays gastric emptying.

**GIP**: *(Gastric inhibitory polypeptide)*

- Produced by cells of duodenum & jejunum in response to glucose & fat
- In high doses inhibits gastric juice secretion & its motility hence called GIP
- Stimulates \( \beta \) cells of pancreas to increase insulin secretion hence also called – glucose dependent insulinotropic polypeptide.

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**Paper III – August 2007**

**Essay:**

1) Define haemostasis. Explain the steps involved in intrinsic mechanism of clotting. Add note on hemophilia (Repeated in aug:2008)
2) Describe in detail the phases of deglutition (Repeated in feb:2006)

**Short notes:**

a) Artificial kidney

1) Hemodialysis

✓ Heparanized blood is pumped from one of the patients arteries through cellophane tubing that is surrounded by a large volume of dialyzing fluid.
✓ Blood flows one direction and dialyzing fluid in other across the tubing.
The tubing then conduits the purified blood back into the patient by way of a vein. As blood flows through the tubing, the concentrations of non protein plasma solutes tend to reach diffusion equilibrium with those of the solutes in the dialyzing fluid.

Peritoneal dialysis:

- It uses the lining of the person's own abdominal cavity as a dialyzing membrane.
- Dialyzing fluid is injected via a needle inserted through the abdominal wall, into the cavity and allowed to remain there for hours, during which solutes diffuse into the fluid from the patient's blood.
- The dialyzing fluid is removed by reinserting the needle and replaced with new fluid.
- This procedure can be performed several times daily.

b) Feedback mechanism (Refer aug:2005)

g) Cytoskeleton

- All cells have a system of fibers called cytoskeleton that maintains the structure of the cell.
- It allows a cell to change shape and also permits movement. The cytoskeleton
- Comprises of microtubules and microfilaments, along with proteins that bind them together.

Types:
Microtubules

Microfilaments

**Functions:**

a) Movements of the chromosomes
b) Cell movement
c) Processes that move secretion granules in the cell
d) Movement of proteins within the cell membrane

c) Female contraceptive (repeated in Feb 2005)
d) Nerve action potential (refer Feb 2006)
e) Hypothyroidism (refer Nov 2001)
f) B-lymphocyte (refer Aug 2005)

h) Erythropoietin

It is a glycoprotein, 74% protein and 26% carbohydrate.

Sources and metabolism:

Erythropoietin secreted in the peritubular capillaries.

**Formation and release:**

Hypoxia of kidneys causes release of renal erythropoietic factor or erythrogenin which acts on a plasma substrate, erythropoietinogen to form erythropoietin.

Kidneys ↓ Liver ↓
Hypoxia

Renal erythropoietic factor → Erythropoietinogen

Erythropoietinogen → Erythropoietin

Erythropoietin → Sensitive stem cells → proerythroblast

i) calcitonin (repeated in Feb:2008)

j) Functions of blood

**Respiratory:**

Blood transports oxygen from lungs to the tissues and of carbon dioxide from tissues to the lungs

**Excretory:**

Blood transports the metabolic wastes eg. Urea, uric acid.

**Homeostatic for water, PH and electrolyte concentration:**

Blood forms internal environment of the cell i.e Millieu interieur

**Regulation of body temperature:**

Blood preserves the very narrow range in body temperature.
Essay:

1) Discuss the regulation of serum \( \text{ca}^{2+} \) concentration. What is tetany? How do you treat it?

**Regulation of serum \( \text{ca}^{2+} \)**

Calcium regulation involves:

Three hormones:

1) Parathyroid hormone
2) Vitamin D
3) Calcitonin

Three tissues:

1) Kidney
2) Bone
3) Intestine

Three cell type:

1) Osteoblast
2) osteoclast
3) osteocyte

**Actions Parathyroid hormone: (PTH)**

- Plasma ionic $\text{ca}^{2+}$ ↓
  - Calcitonin
  - PTH $\uparrow$
    - Kidney
    - Bone
    - Intestine
      - Absorption of $\text{ca}^{2+}$
      - Release of $\text{ca}^{2+}$
      - $1,25 \text{ DHCC}$ $\uparrow$
        - Absorption of $\text{ca}^{2+}$ from renal tubules
        - Release of $\text{ca}^{2+}$ from bone matrix
          - Absorption of $\text{ca}^{2+}$ from gut
            - Plasma ionic $\text{ca}^{2+}$ $\uparrow$
Actions of vitamin D (1,25 dihydroxy cholecalciferol)

Plasma $\text{Ca}^{2+}$

$\downarrow$

PTH

Secretion

$\downarrow$

1,25DHCC

$\downarrow$

Bone

Intestine

Kidney

$\uparrow$ Resorption

$\uparrow$ $\text{Ca}^{2+}$ reabsorption

$\uparrow$ $\text{Ca}^{2+}$ reabsorption

Release of $\text{Ca}^{2+}$

Actions of calcitonin

Plasma ionic $\text{Ca}^{2+}$

$\downarrow$
**Calcitonin**

- **Bone**
- **Kidney**
- **Intestine**

↓ Resorption  ↓ $\text{ca}^{2+}$ absorption  $\text{ca}^{2+}$ excretion

**Tetany:** Clinical entity due to low ionic calcium in blood

**Features:**

1. Tingling numbness
2. Stiffness of hand and feet
3. Muscular cramps
4. Carpopedal spasm (Obstetrician’s hand)
5. Larngeal stridor

**Treatment:**

Calcium supplements.
2) Enumerate the functions of liver and write about jaundice

**Functions:**

**Synthetic:** Liver synthesizes

- Most of the plasma proteins specially albumin; it does not synthesize Immunoglobulins, which are synthesized in R-E system.
- Some clotting factors, e.g fibrinogen(I), prothrombin (II) and factors V, VII, IX and X.
- **Enzymes:**
  - i) Alkaline phosphatase
  - ii) SGOT (serum glutamic oxaloacetic transaminase)
  - iii) SGPT (serum glutamic pyruvic transaminase)
  - iv) SICD (serum iso citrate dehydrogenase)

- **Urea:** Liver removes ammonia from the body to synthesize Urea
- **Cholesterol:** it is synthesized from active acetate

**ii) Metabolic:**
Liver is the central organ of metabolism and participates in all three metabolism of the body.

**On carbohydrate metabolism:**

- Liver helps in synthesis, storage and release of glucose by following processes:
  - Glycogenesis: glycogen is formed from glucose and stored in the liver.
  - Glycogenolysis: liver glycogen is broken down to glucose

  iii) **bile secretion**

- Synthesis of bile salts and bile acids from cholesterol, which helps in activation of lipase and emulsification of fats

  iv) **Detoxicating and protective function**

- By complete destruction of drugs e.g Nicotine and short acting barbiturates

  v) **Miscellaneous formation:**

- Storage organ:
  
  Liver stores glycogen, fat, protein, vitamins(A and $\text{B}_{12}$)

Jaundice is a yellow discoloration of the skin, eyes and other tissues caused by the presence of an excessive accumulation of bilirubin in the plasma and tissue fluids.

**Fate of bilirubin:**
RBCs destruction

FREE (unconjugated) bilirubin lipid and
Soluble; bound to albumin

Conjugated bilirubin with
UDPGA (uridine diphosphate glucuronic acid) → general circulation
Degradation by colon
Bacterial flora

Bilirubin

Stercobilinogen → 20% enters portal circulation
80% excreted in faeces (20-250mg/day)

urine bilirubin
Urine urobilinogen

Stercobilin brownish compound
gives brown color to faeces

Types of jaundice:
1) pre hepatic (hemolytic jaundice)
2) Hepatic (Heptocellular jaundice)
3) post hepatic (obstructive jaundice)

II) Short notes:

1) ovulation (repeated in April 2001)

2) Glomerular filtration rate (Repeated Feb:2005)

4) Micturition (Repeated in Oct 2006)

5) Movement of small intestine (repeated in Aug 2004)

6) T-lymphocyte (repeated in Aug 2004)

7) Enzymes of exocrine pancreas (repeated in Aug 2006)

8) Corpus luteum

    After ovulation capillaries from theca interna invade the rapidly dividing granulosa layer and clotted blood is replaced with yellowish, lipid rich luteal cells forming the corpus luteum. (Yellow body).

    This enlarges for 8 or 9 days during which the luteal cells secrete estrogen and progesterone. And

    (i) If fertilization has not occurred, the corpus luteum regresses and eventually corpus albicans
(ii) If pregnancy occurs the corpus luteum continues to grow for several months under the influence vascular endothelial growth factor and begins to degenerate approximately 6\textsuperscript{th} month.

3) Tubular maximum for glucose

✓ It refers to the maximal amount of a given solute that can be transported (reabsorbed or secreted) per minute by the renal tubules

✓ The highest attainable rate of reabsorption is called the maximum Tubular tubular reabsorptive capacity and is designated as Tr (or T\textsubscript{m})

✓ Substances that are reabsorbed by an active carrier mediated process and that have a T\textsubscript{m} include: (Hpo\textsubscript{4}), glucose, amino acids, uric acid albumin.
✓ The highest attainable rate of secretion is called the maximum tubular secretory capacity and is designated $T_s$.

✓ The overall transport maximum for the kidneys, which is normally about 375 mg/min, is reached when all nephrons have reached their maximal capacity to reabsorb glucose.

3) Physiologic principles of tissue transplantation

Types:

i) **Homograft (Allo graft)**: Graft from one person to another

ii) **Autograft**: graft from one site to another in the same person

iii) **Heterograft (xenograft)** – graft from one animal species to another

Biological significance:

Its ability to reject occasional mutant cell formed during the normal course of cell division in the body.

Paper III Aug 2008 Sub Code: 4053)

Essay:

1. Menstrual cycle: - & Ovarian changes (Vol II Unit X 828)

Defn – cyclic changes that occur periodically in females during reproductive age
Changes in ovary:

Premenstrual ovary

- increase in ovarian weight
- after 8 yrs increase in ovarian secretions inturn increase in weight

Post menstrual ovary

- hypothalamic maturation – menarchy – ovulation
- release of ovary at periodical interval
- increase in fluid in ovaries – increase in the size of one of the follicles
- zona pellucida, granulosa cells, cumulus oophorhicus
- ischemic necrosis of overlying cells
- increased fluid pressure with the grannian follicle
- ovulation – antral fluid escapes leading hemorrhage into thetheca interna
- forms corpus hemorrhagicum
- after ovulation granulosa cells – replaced to form corpus luteum
- if fertilization has not occurred corpus luteum into corpus albicas
- if pregnancy – corpus luteum grows & regresses approx at the 6th month.

Time of ovulation

- release of ovum is ovulation
- basal body temperature
- cervical mucous test
- spin barkheit test
- endometrial biopsy
- the timing of ovulation is of value – desired to promote / avoid conception – safe period / fertile period

2. **Types of salivary glands – composition, functions, regulation of salivary secretion**

*(Vol I Unit IV – 202)*

1. Parotid
2. sub mandibular
3. sublingual

Composition – 1500 ml / day

**Digestive enzymes**

i) Ptyalin- salivary amylase

ii) lysosomes – bactericidal

iii) kallikrein – proteolytic enzyme

iv) lipase – lipolytic emzyme

v) mucin – glycoprotein

vi) IgA – first immunological defence against bacteria & viruses

Cations – Na – 15- 20 mEq/L

K – 20-25 m Eq/L

Ca – traces

Anions – Cl- 15- 20 mEq/L

HCO3 – 10-15 mEq/L

phosphates – traces

bromide – traces
pH – 7.0

organic contents – urea, uric acid, creatinine

*Functions of saliva – Aug 2005*

*Regulation*

i) Stimulation of parasympathetic nerves:
   - liberates proteolytic enzyme kallikrein
   - thru Ach – acts on plasma alpha 2 globulin
   - release of VIP (vasoactive intestinal polypeptide)
   - vaso dilatation of blood vessels of salivary glands
   - stimulates secretion from acini
   - Atropine reduces the salivary secretion

ii) Stimulation of Sympathetic nerve
   - small amounts of saliva rich in organic components & mucus from submandibular & sub lingual salivary glands
   - increase in salivary secretion – taste of food, smell, sight & thought
   - dry food finely ground – stimulates salivary secretion

**SHORT NOTES**

1. Features of Acromegaly: - Aug 2005

2. Tubulo glomerular feed back (Vol I Unit VII)
3. HCl – secretion mechanism – repeated Feb 2005

4. Extrinsic mechanism of coagulation of blood – Feb 2005

5. Functions of platelets – Aug 2004

6. Actions of parathormone – Feb 2005

7. Cystonetrogram – Aug 2005

8. Neuro endocrine reflex – Aug 2004

9. Erythroblastocic foetalis –
   - presence of many nucleated RBCs in the circulation which is compensated by an intense normo blastic response of the marrow, associated with high reticulocyte count.
   - Rn negative mother + Rh positive fetus
     ↓
     Anti D (from fetus to mother)
     ↓

- Rn negative mother + Rh positive fetus
  ↓
  Anti D (from fetus to mother)
mother responds and produces antibodies against that (usually 1st child is not affected)

↓

Changes in fetus – hemolytic jaundice
- hydrops fetalis
- icterus gravis neonatrum
- kernicterus

treatment – exchange blood transfusion

10. Hemophilia:
- caused by – abnormality / deficiency of factor VIII
- X chromosome
- transmitted by females - males are carriers

diagnosis
- coagulation time – CT increased
- bleeding time – normal

treatment:
- fresh blood transfusion – because factor VIII is lost rapidly on storage
- injecting factor VIII & IX – (cryoprecipitation / frozen plasma)
- injecting thrombin/ thromboplastin

SHORT ANSWERS:

1. Functions of eosinophils
- anti- allergic, inhibits mast cell degradation
- parasiticidal
- degrades the effects of inflammatory mediators

2. **Anticoagulants in Lab**

   i) sodium citrate
   
   ii) sodium oxalate
   
   iii) EDTA – ethylene diamine tetra acetic acid

3. **Diff bet Adult & fetal Hb**

<table>
<thead>
<tr>
<th>Hb A</th>
<th>Hb F</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 α  and 2 β chains</td>
<td>2 α and 2δ – much resistant to the action of alkalies than HbA</td>
</tr>
<tr>
<td>Lesser affinity for oxygen – than HbF</td>
<td>greater affinity</td>
</tr>
<tr>
<td>Life span – 120 days</td>
<td>80 days</td>
</tr>
</tbody>
</table>

4. **Functions of sertoli cells : Aug 2005**

5. **Functions of large intestine : - Feb 2010**

6. **Migrating myoelectric complex**

   - modified pattern of electrical & motor activity in the smooth muscles of GIT
   
   - phase I- no electrical spikes
   
   - phase II –irregualr electrical & mechanical activity
   
   - Phase III - regualr electrical & mechanical activity
   
   - occurs 90- 120 mins after a meal
- helps to clear the GIT

7. **Achalasia cardia: (Vol I Unit IV -209)**

- failure of lower oesophageal sphincter – relax completely on swallowing due to destruction of local nerve plexus
- constriction of sphincter causes food accumulation in the oesophagus & proximal esophageus – thus dilates

8. **Hormones of Hypothalamus (Vol II Unit IX)**

   Anterior

   1. releasing & inhibiting hormones
   a) Growth homone releasing hormone
   b) Growth hormone inhibiting hormone
   c) Thyrotropin
   d) corticotrophin
   e) Prolactin inhibiting hormone

   Posterior hormones

   Vasopresin & Oxytocin

9. **Actions of Prolactin**

   - During pregnancy – lobules of alveoli – differentiates, requires prolactin, oestrogen & progesterone
   - milk production
   - following delivery – synthesis of lactose, anovulation / ammnorrhoea

10. **Name 2\textsuperscript{nd} messengers**

    - these are the basic regulators of cell metabolism
    - eg Cyclic AMP, Cyclic GMP,. Calcium
1. **Nuclei of hypothalamus, connections & hypothalamic obesity**

   Nuclei of hypothalamus:
   a) Preoptic area:
      - Preoptic nucleus
   b) Anterior (Supraoptic area)
      - Supraoptic nucleus
      - Suprachiasmatic nucleus
      - Paraventricular nucleus
      - Anterior nucleus
   c) Middle- tuberal area
      - Ventromedial nucleus
      - Dorsomedial nucleus
      - Arcuate nucleus
   d) Posterior – mammillary area:
      - Mamilary body
      - Posterior nucleus
   e) Lateral nucleus

   **Hypothalamic obesity:**

   - There are two nuclei concerned with hunger & feeding
   - Venteromedial nucleus acts as – Satiety center
   - Lateral nucleus – feeding center
   - Hypothalamic obesity – bilateral lesions in the ventromedial nuclei
   - Destruction of lateral hypothalamic nuclei – anorexia & the animal dies of starvation even though the food is plentiful
   - Stimulation of lateral nuclei – excessive eating
   - Mechanism:
     - Satiety center is the primary center that controls food intake
- Feeding center is chronically active and is inhibited by the activity in the satiety center after the ingestion of food.
- Satiety center – cells are glucostats – sense glucose in the blood.
- Glucostatic theory – if inadequately supplied with glucose – their activity is decreased, they get activated & the individual is hungry.
- If adequately supplied with glucose, the satiety center actively inhibits the feeding center.
- This explain Polyphagia in DM
- Lipostatic theory:
  - Hypothalamic nuclei also respond to change in the level of fatty acids
  - Leptin, protein hormone produced mainly in the adipose cells.
  - It acts on hypothalamus to decrease the neuropeptide Y release & produces decreased food intake & energy expenditure.
- Therefore any defect in the leptin receptor genes results in obesity.

2. Counter current mechanism in the concentration of urine & note on diuresis:

   Counter current – repeated –

Diuresis: (Vol I, unit VII, p- 552, 545, 565)

- Increase in flow of urine
- Water & Osmotic diuresis
  Water diuresis:
  - Produced by drinking of large quantity of water/ hypotonic fluid
  - Begins about after 15 mins of water ingestion reaches maximum in 40 mins
  - Characterised by diuresis of dilute urine 50 mOsm/L upto 20 L per day
  - Produced due to inhibition of ADH secretion secondary to decrease in plasma osmolality after water is absorbed.
  - Amount of water reabsorbed in PCT is normal
  Osmotic diuresis:
  - Produced by presence of large quantities of unabsorbed solutes such as Na, glucose, urea etc
  - Characterised by diuresis in which urine concentration is approximately that of plasma, inspite of maximal ADH secretion & very large urine flow rates.
- Produced due to decreased water reabsorption in the PCT & LOH secondary to administration of large amount of Na, urea, mannitol etc or substances presents in amounts exceeding the capacity of tubules to reabsorb them. Eg. glucose in DM

**Short notes:**

a) **Micturition reflex:**
   Repeated – Feb 2006 (4053)

b) **Gastric emptying:** (Vol I, unit IV 220)
   - Normally food stays in the stomach for 2 ½ - 3 hours
   - When food enters – fundus relaxes to accommodate 1-2 liters of food called receptive relaxation
   - Stretch receptors in the stomach initiate – vasovagal reflex producing receptive relaxation
   - Food becomes chime
   - Gastric emptying begins as soon as a larger part of the gastric contents become fluid enough to pass through the pylorus
   - The force of gastric peristalsis determines the emptying & not the tone of the pyloric sphincter.
   - Results from progressive wave of contraction which sequentially involves antrum
   - Followed by sequential contraction of pylorus
   - Only chime enters into the duodenum & the rate is determined by gastric & duodenal factors
   - Enterogastric reflex
   - Depends on the type of food
   - Gastric factors promote gastric emptying
   - Duodenal factors usually inhibit
   - Applied – Early & Late gastric emptying – Dumping syndrome

c) **Indicators of ovulation:**
   Repeated -
d) **Myxedema:** (Vol II, unit IX – 708)
- Hypothyroidism – reduced levels of free T4 & T3 in adults
- Advanced hypothyroidism – swelling of skin & subcutaneous tissues
  Characteristic features:
  - Enlargement of thyroid gland – goiter
  - Puffiness of face
  - Coarsening & loss of scalp hair
  - Ptosis – drooping of upper eye lid
  - Dry thickened rough & yellow skin
  - Low BMR, hypersensitive to cold, low voltage ECG, hoarseness of voice, memory loss, increase in S.cholesterol level.

e) **Entero hepatic circulation:** (Vol I, unit II, IV – 78, 239, 241)
- A part of bile excreted from liver is reabsorbed in the small intestine – entero hepatic circulation
- Bile is continuously secreted by the hepatic cells into the bile capillaries collected into the hepatic ducts stored in gallbladder
- Bile salts are – sodium & potassium salts of bile acids
- Primary & secondary bile acids
- Taurocholic acids & Glycocholic acids
- Of the total bile salts about 90-95 % are reabsorbed from the terminal ileum in the portal vein – to liver – Entero hepatic circulation
  Importance:
  - It is necessary because of the limited pool of bile salts available to aid digestion & absorption

f) **Conn’s syndrome:**
- Primary hyperaldosteronism
- Prolonged excessive secretion of aldosterone from the adrenal cortex
  Characteristic features:
  - Elevated plasma & urinary aldosterone levels
  - Rise in plasma sodium & marked fall in potassium, decrease in sodium content of sweat, saliva & GIT secretions
  - Prolonged hyperkalemia
  - Marked muscle weakness
- Kidney damage resulting in loss of its concentrating power & Polyuria
  Hypokalemic nephropathy
- Metabolic alkalosis – may lead to tetany
- Hypertension due to sodium & water retention.

g) **Functions of glucocorticoids:**
   Repeated

h) **Significance of Rh group:** (Vol I Unit II)
- The Rh antibody is called as D & the antibody is anti –D. They are IgG type.
- Called as warm antibodies, as reacts best at warm temperature
- Can cross the placenta
- Rh blood group system has not been detected in tissues other than RBC
- C, D, E are the common type of Rh antigens
- D is widely prevalent
- Rh negative individuals – anti D antibodies are not naturally present in the plasma but the production of anti D antibodies – by transfusion with Rh positive blood.
- As it can cross the placenta – it is dangerous if Rh negative mother having the Rh positive foetus
- It causes production of anti D antibodies from the mother – the second fetus – hemolysis
- Hemolytic jaundice, kernicterus, hydrops foetalis, erthroblastocis foetalis
- Prevention of Rh incompatibility.

i) **A transport mechanism across cell membrane:**
   Repeated

j) **Albumin : Globulin ratio:**
- The ratio of albumin & globulin – 1.7 : 1
- Albumin controls colloid osmotic pressure, binding & carrier protein
- Helps in transport of anions, cations, dyes, drugs, hormones, fattyacids, aminoacids, enzymes.
Globulins are - α, β, γ LDL, Chylomicrons Immunoglobulins, Haptoglobins etc
- The ratio has to be maintained between albumin & globulin

**Short answers:**

1. **Actions of Insulin.** (Vol II, Unit IX – 770)
   - Carbohydrate, protein & fat metabolism – decrease in blood glucose level

2. **Estrogen functions:**
   - Development of secondary sexual characters in females
   - Fat distribution in the body
   - Development of breasts etc

3. **Aldosterone escape:**
   - In patients with hyperaldosteronism or when aldosterone is administered for several days to normal individuals the kidney escapes from sodium retaining effect - called Aldosterone escape
   - Over secretion produces - hypernatremia with increased ECFV.
   - ECFV reaches certain limit – sodium excretion is increased inspite of continued action of aldosterone on the DCT.

4. **Functions of saliva:**
   - Repeated - in short notes –

5. **Significance of Erythrocyte sedimentation rate:**
   -

6. **Corpus luteum:**
   - Secretes progesterone – essential for maintaining pregnancy
   - Till 4 months – hence called corpus luteum of pregnancy

7. **Blood – Testis barrier:**
- Sertoli cells and the cells that line the seminiferous tubules
- helps maintaining the composition of the fluid in the lumen of the seminiferous tubules
- Protects the germ cells from blood borne noxious agents

8. GAP junctions:
- 2 – 20 nm space between the opposing membranes
- Space – filled with densely packed particles through which a channel Connects the two cells
- regulated by intracellular calcium

9. GFR:
- Glomerular filtration rate
- passive process, bulk transport of a fluid with its dissolved small solutes across a membrane.
- is the initial step in the urine formation

10. Dietary fiber:
- Dietary fibers are cellulose, hemicellulose & lignin
- Due to the absence of certain micro-organism dietary fibres are not digest in human beings.
  - Ingested cellulose passes out unchanged – helps in defecation
  - Decrease the incidence of cancer
  - Dilution of carcinogen by the water held by the dietary fibres.
Essay:

1. **Enteric and colonic movements:**

Enteric movements – Aug 2004

Colonic movements: (Vol I Unit IV – 255)

1. Segmental contraction – type I, type II movements)

2. Peristalsis

3. Mass peristalsis

Type I

- Small amplitude waves which cause pressure rise upto 5cm. saline
- Frequency 10-12 / min – 5 sec duration

Type II

- Large pressure contractions
- 1-2/ min – lasts for about 30 secs

Functions:

- mixing of the contents
- Facilitate absorption by exposing more of the contents to the mucosa.

Peristalsis:

- very small pressure waves of prolonged duration
- propel the contents towards the rectum.

Mass peristalsis:

- occurs more in the descending & the sigmoid colon.
- Propel the contents from the coecal region towards the rectum.
- Predominant contraction force during defecation.

Note on defecation - Sep 2002.


Short notes:

1. Cells in fibrous tissue – their functions:
   - made of mainly closely packed bundles of collagen fibres
   - Found lying in rows between bundles of fibres.

Functions:
   - forming ligaments which binds bones together
   - as an outer protective covering for bone, called periosteum
   - as an outer protective covering for some organs – eg. Kidney, lymph nodes, brain

2. Functional categorisation of plasma proteins: - Aug 2004

3. Starling forces & Oedema: (Vol I Unit II – 53)
   - hydrostatic pressure across the capillary wall – favours filtration
   - COP across the capillary wall – favours absorption.
   - Hydrostatic pressure – interstitial fluid – 2- 3 mm Hg
   - Interstitial fluid – osmotic pressure – 3-4 mm Hg

Oedema:
   - Abnormal collection of fluid in the interstitial spaces called Oedema.
Hypoproteinemia:
- decrease in plasma protein causes decrease in COP
- Increase in filtration occurs at arterial end & decrease in absorption of fluid at venous end.

4. Digestive proteases: (Vol I Unit IV – 267):
- enzymes concerned with digestion of protein
  (i) Pepsins - hydrolyses the bonds between aromatic amino acids – converts – proteases into peptones.
  (ii) Caseinogen: - milk protein – soluble caesin
  (iii) Endopeptidases : - Proteases & peptones – small polypeptides
  (iv) Exopeptidases – polypeptides – lower peptides & aminoacids
  (v) In small intestine – peptidases – peptides – free amino acids
  (vi) Digestion of nucleoproteins – nucleotides & nucleosides.

5. Transporters of aminoacids in gut & kidney: (Vol I Unit IV – 268)
Gut: - three separate transport systems
  (i) A neutral amino acid carrier system in the brush border transports neutral amino acids – it is Na dependent.
  (ii) A basic carrier amino acid system – in the brush border – transports basic amino acids – Na dependent
  (iii) Baso lateral membrane – transports – hydroxyl praline & other compounds.

Kidney (Pg 534)
- amino acids are transported in the PCT – proximal convoluted tubule.
6. Counter current in Juxta medullary nephrons - repeated

7. Abnormalities of Micturition: (Vol I Unit II – 590)

a) Automatic bladder
   - Injury to afferent nerves – tabes dorsalis
   - Lesion of lumbosacral dorsal nerve roots
   - patient unaware of the state of distension of bladder
   - voluntary Micturition
   - bladder becomes distended thin walled & hypotonic

b) Isolated / decentralized bladder:
   - Complete loss of voluntary Micturition
   - difficulty in initiation
   - bladder becomes flaccid & distended
   - residual urine – present
   - bladder – in later state shows periodic automatic emptying through the intervention of
     local peripheral neuro-muscular mechanisms.

8. Actions of parathormone: - repeated

9. Neuro hormonal reflexes: - Repeated

10. Immunological tests for pregnancy - repeated - Aug 2004

Short Answers:

1. Measurement of total body water

Total body water is 60%
Extracellular fluid, Interstitial fluid, Transcellular fluid

Measured by using D2O – formula - amount of dye (D2O) injected – amount of dye excreted

Concentration of dye

2. **Lipids in cell membrane:**
   - double layer of lipid molecules in which protein are embedded
   - considerable 20-40% of the dry weight of the membrane
   - Phospholipids, cholesterol & glycolipids
   - has head end – polar/ hydrophilic & tail end – non-polar/ hydrophobic

3. **Remodelling of bone tissue:**
   - osteoblasts – in bone form microfibrils few cm in length
   - they separate bone fluid from ECF
   - process of mineralization is controlled mainly by parathyroid hormone

4. **Fibrinolysis:**
   - Dissolution of the blood clot – called fibrinolysis
   - due to the action of proteolytic enzyme – plasmin
   - present as inactive plasminogen – converted into plasmin by the action of thrombin & tissue plasminogen activator

6. **Lingual lipase:**
   - lipolytic enzyme – secreted by the glands on the tongue hence called lingual lipase
   - digests milk protein

7. **Limiting pH of urine:**
   - lowest pH attainable in urine is 4.4 called as limiting pH
- maximal H + gradient against which the transport mechanism can secrete H+ corresponds to a urine pH of about 4.4

8. **Leptin:**

- leptin means – thin

- is a circulating protein hormone produced mainly in the adipose cells

- acts an hypothalamus to decrease the release of neuropeptide Y & produced decreased food intake & increased energy expenditure.

9. **Mullerian regression factor:**

- suppresses the growth of the mullerian ducts by a local action – ie it causes involution of the mullerian ducts

- a polypeptide / nucleic acid & is derived from fetal seminiferous tubules.

10. **Composition of Semen:**

- colour – white opalescent

- Specific gravity – 1028

pH – 7.35 – 7.5

Average volume – 2.5 – 3.5 – mg /ml

Fructose – 1.5 – 6.5 mg/ml

Phosphoryl choline -, Ergothionine
Paper3 – February 2011 (Sub code :4053)

Essay:

1. Write in detail the electron microscope structure of skeletal muscle and the molecular mechanism of muscular contraction (Repeated in August-2006)
2. Discuss the composition, mechanism and regulation of gastric secretion (Repeated in Feb-2006)

Short notes:

1. Neuro muscular junction (Repeated in august 2006)
2. Regulation of salivary secretion (Repeated in august 2008)
3. Functions of pancreatic juice (Repeated in august 2005)
4. Erythropoiesis (Repeated in Feb 2006)
5. Micturition reflex (Repeated in Feb 2006)
6. Spermatogenesis (Repeated in August 2006)
7. Glucagon
   
   Actions:
   1) Stimulates glycogenolysis:
      
      A) By inhibiting glycogen synthetase
      B) By activating cAMP formation

   2) Promotes gluconeogenesis
      a) Glucagon promotes formation of glucose from lactate, pyruvate, glucose, amino acids.

   3) Glucagon is a powerful lipolytic agent

   4) Calorigenic action:
      This is not due to hyperglycemia but this action requires the presence of glucocorticoids and T4,
5) Glucagon increases force of contraction of the heart by increasing cAMP.

6) It stimulates the secretion of GH, insulin and pancreatic somatostatin.

7) Fetoplacental unit (repeated August 2010)

8) Secondary active transport (Repeated in Feb:2005)

9) Fibrinolytic system

Factors that initiate clotting mechanism also stimulate the dissolution of the blood clot, called fibrinolysis.

Plasminogen

Or

Pro- Fibrinogen

Tissue damage $\rightarrow$ TPA $\rightarrow$ thrombin

Plasmin (inhibits)

Fibrin and Fibrinogen $\rightarrow$ Fibrin degradation products

Short answers

1. Milieu interior
It is a French word coined Claude Bernard. It is the internal sea (extracellular fluid) where all the cells and tissues live.

2. **Functions of large intestine**
   - This propel the food content into the rectum
   - Aid mixing of the contents of the colon
   - Vitamin K synthesis

3. **Steatohorrea**
   - Foul smelling, fatty stool due to pancreatic lipase deficiency

4. **Dietary fibre**
   - eg: Cellulose, hemicellulose and lignin enhances reabsorption of nutrients.
   - Increases bulk of stools

5. **Multi unit smooth muscle**
   - Number of muscle fibre innervated by a single fibre is less.
   - It have fine control over action eg: Muscles of eye

6. **Sarcomere**
   - Functional unit of muscle fibre. Space between two muscle fibre.

7. **Cytokines**
   - These are local hormones involved in bodily functions
     - IL-1, IL-2, IL-3.
8. **Auto immune disease**
   
   Antibodies formed against own body cells eg: Mysthenia gravis

9. **Na\(^+\) K\(^+\) pump**

   **Primary active transport:**
   
   Na\(^+\) K\(^+\) pump catalyzes the hydrolysis of ATP to ADP and uses the energy to force out 3Na\(^+\) ions from the cell and take 2K\(^+\) ions into the cell for each mole of ATP.

10. **EMG**

   Recordings from skeletal muscles are used to aid in the diagnosis of neuropathies and myopathies.
Paper III – August 2007

Essay:

3) Define haemostasis. Explain the steps involved in intrinsic mechanism of clotting. Add note on hemophilia (Repeated in aug:2008)

4) Describe in detail the phases of deglutition (Repeated in feb:2006)

Short notes:

a) Artificial kidney

1) Hemodialysis

✓ Heparanized blood is pumped from one of the patients arteries through cellophane tubing that is surrounded by a large volume of dialyzing fluid.
✓ Blood flows one direction and dialyzing fluid in other across the tubing.
✓ The tubing then conducts the purified blood back into the patient by way of a vein. As blood flows through the tubing, the concentrations of non protein plasma solutes tend to reach diffusion equilibrium with those of the solutes in the dialyzing fluid.

Peritoneal dialysis:

✓ It uses the lining of the persons own abdominal cavity as a dialyzing membrane.
✓ Dialyzing fluid is injected via a needle inserted through the abdominal wall, into the cavity and allowed to remain there for hours, during which solutes diffuse into the fluid from the patients blood.
✓ The dialyzing fluid is removed by reinserting the needle and replaced with new fluid.
✓ This procedure can be performed several times daily.

b) **Feedback mechanism** *(Refer aug:2005)*

g) **Cytoskeleton**

✓ All cells have a system of fibers called cytoskeleton that maintains the structure of the cell.
✓ It allows a cell to change shape and also permits movement. the cytoskeleton
✓ Comprises of microtubules and microfilaments, along with proteins that bind them together.

**Types:**

- Microtubules
- Microfilaments

**Functions:**

- e) Movements of the chromosomes
- f) Cell movement
- g) Processes that move secretion granules in the cell
- h) Movement of proteins within the cell membrane

c) **Female contraceptive** *(repeated in feb 2005)*

d) **nerve action potential** *(refer feb 2006)*

e) **Hypothyroidism** *(refer nov:2001)*
f) B-lymphocyte (refer aug: 2005)

h) Erythropoietin

It is a glycoprotein, 74% protein and 26% carbohydrate.

Sources and metabolism:

Erythropoietin secreted in the peritubular capillaries.

**Formation and release:**

Hypoxia of kidneys causes release of renal erythropoietic factor or erythrogenin which acts on a plasma substrate, erythropoietinogen to form erythropoietin.

![Diagram of erythropoietin formation and release](attachment:image.png)

i) calcitonin (repeated in feb: 2008)
j) Functions of blood

**Respiratory:**

Blood transports oxygen from lungs to the tissues and of carbon dioxide from tissues to the lungs

**Excretory:**

Blood transports the metabolic wastes eg. Urea, uric acid.

**Homeostatic for water, PH and electrolyte concentration:**

Blood forms internal environment of the cell i.e Millieu interieur

**Regulation of body temperature:**

Blood preserves the very narrow range in body temperature.
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**Physiology paper III – February 2008**

Essay:

3) Discuss the regulation of serum $\text{Ca}^{2+}$ concentration. what is tetany ?How do you treat it?

**Regulation of serum $\text{Ca}^{2+}$**
Calcium regulation involves:

Three hormones:
   1) Parathyroid hormone
   2) Vitamin D
   3) Calcitonin

Three tissues:
   1) Kidney
   2) Bone
   3) Intestine

Three cell type:
   1) Osteoblast
   2) Osteoclast
   3) Osteocyte

**Actions Parathyroid hormone: (PTH)**

Plasma ionic $\text{Ca}^{2+}$ ↓
Actions of vitamin D (1,25 dihydroxy cholecalciferol)

Plasma $\text{Ca}^{2+}$

$\downarrow$

PTH
Secretion
\[ \rightarrow \]
1,25DHCC
\[ \rightarrow \]

Bone \hspace{1cm} Intestine \hspace{1cm} Kidney
\[ \hspace{1cm} \rightarrow \hspace{1cm} \]

\[ \heartsuit \text{Resorption} \]
\[ \rightarrow \]
Re absorption \hspace{1cm} \[ \rightarrow \] \hspace{1cm} a^{2+} \hspace{1cm} \rightarrow \hspace{1cm} \text{re absorption} \hspace{1cm} \rightarrow \hspace{1cm} \text{c}^{2+} \hspace{1cm} \rightarrow \hspace{1cm} \text{re absorption} \]

Release of \( \text{ca}^{2+} \)

**Actions of calcitonin**

Plasma ionic \( \text{ca}^{2+} \)
\[ \rightarrow \]
Calcitonin
\[ \rightarrow \]

Bone \hspace{1cm} Kidney \hspace{1cm} Intestine
\[ \hspace{1cm} \rightarrow \hspace{1cm} \]

Resorption \[ \text{ca}^{2+} \text{ absorption} \] \[ \text{excretion} \]

**Tetany:** Clinical entity due to low ionic calcium in blood

**Features:**

1. Tingling numbness
2. Stiffness of hand and feet
3. Muscular cramps
4. Carpopedal spasm (Obstetrician’s hand)
5. Larngeal stridor

**Treatment:**

Calcium supplements.

---

4) **Enumerate the functions of liver and write about jaundice**

**Functions:**

**Synthetic:** Liver synthesizes
✓ Most of the plasma proteins specially albumin; it does not synthesize Immunoglobulins, which are synthesized in R-E system.
✓ Some clotting factors, e.g fibrinogen(I), prothrombin (II) and factors V, VII, IX and X.
✓ **Enzymes:**
  i) Alkaline phosphatase
  ii) SGOT (serum glutamic oxaloacetic transminase)
  iii) SGPT (serum glutamic pyruvic transminase)
  iv) SICD (serum iso citrate dehydrogenase)

✓ Urea: Liver removes ammonia from the body to synthesize Urea
✓ **Cholesterol:** it is synthesized from active acetate

**ii) Metabolic:**

Liver is the central organ of metabolism and participates in all three metabolism of the body.

**On carbohydrate metabolism:**

✓ Liver helps in synthesis, storage and release of glucose by following processes:
Glycogenesis: glycogen is formed from glucose and stored in the liver.
Glycogenolysis: liver glycogen is broken down to glucose

iii) bile secretion

✓ Synthesis of bile salts and bile acids from cholesterol, which helps in activation of lipase and emulsification of fats

iv) Detoxicating and protective function

✓ By complete destruction of drugs e.g Nicotine and short acting barbiturates

v) Miscellaneous formation:

✓ Storage organ:

Liver stores glycogen, fat, protein, vitamins (A and B₁₂)

Jaundice is a yellow discoloration of the skin, eyes and other tissues caused by the presence of an excessive accumulation of bilirubin in the plasma and tissue fluids.

Fate of bilirubin:

RBCs destruction

FREE (unconjugated) billrubin lipid and

Soluble; bound to albumin
Conjugated bilirubin with UDPGA (uridine diphosphate glucuronic acid) general circulation

Degradation by colon
Bacterial flora

Bilirubin kidney

Stercobilinogen —— 20% enters portal circulation
80% excreted in faeces (20-250mg/day)

urine bilirubin
Urine urobilinogen

Stercobilin brownish compound
gives brown color to faeces

**Types of jaundice:**

1) pre hepatic (hemolytic jaundice)
2) Hepatic (Heptocellular jaundice)
3) post hepatic (obstructive jaundice)

**II) Short notes:**
1) **ovulation** (repeated in april 2001)

2) **Glomerular filtration rate** (Repeated feb:2005)

4) **Micturition** (Repeated in oct 2006)

5) **Movement of small intestine** (repeated in aug 2004)

6) **T-lymphocyte** (repeated in aug 2004)

7) **Enzymes of exocrine pancreas** (repeated in aug 2006)

8) **Corpus luteum**

After ovulation capillaries from theca interna invade the rapidly dividing granulosa layer and clotted blood is replace with yellowish, lipid rich luteal cells forming the corpus luteum. (Yellow body).

This enlarges for 8 or 9 days during which the luteal cells secrete estrogen and progesterone. And

(iii) If fertilization has not occurred, the corpus luteum regresses and eventually corpus albicans

(iv) If pregnancy occurs the corpus luteum continues to grow for several months under the influence vascular endothelial growth factor and begins to degenerate approximately 6th month.

3) **Tubular maximum for glucose**

   ✓ It refers to the maximal amount of a given solute that can be transported
(reabsorbed or secreted) per minute by the renal tubules

✓ The highest attainable rate of reabsorption is called the maximum
Tubular tubular reabsorptive capacity and is designated as Tr (or T_m)

Substances that are reabsorbed by an active carrier mediated process
and that have a T_m include: (Hpo_4), glucose, amino acids, uric acid albumin.

✓ The highest attainable rate of secretion is called the maximum tubular
secretory capacity and is designated T_s

✓ The overall transport maximum for the kidneys, which is normally
about 375 mg/min, is reached when all nephrons have reached their
maximal capacity to reabsorb glucose.
3) Physiologic principles of tissue transplantation

Types:

j) Homograft (Allo graft): Graft from one person to another

ii) Autograft- graft from one site to another in the same person

iii) Heterograft (xenograft) – graft from one animal species to another

Biological significance:

Its ability to reject occasional mutant cell formed during the normal course of cell division in the body.

Essay:

1. Sliding filament hypothesis (Vol I Unit III 163)

A.F. Huxley & H.E. Huxley

- the process by which the shortening of the contractile elements in the muscle is brought about is the sliding of actin filaments over thick myosin filaments

- the sliding of filaments is brought about by formation of the cross-bridges between the head of myosin & actin filaments

Events during formation of the cross bridges

- in resting muscle – no cross bridges
- Troponin I is lightly bound to actin & tropomyosin covers the active site
- Ca2+ released from terminal cisternae by the action potentials
- binding of trponin I to actin is weakened, this permits tropomyosin laterally uncovering the binding sites
- hydrolysis of ATP by ATP ase activity in the myosin heads on actin filaments

Mechanism of Sliding of thin over thick filaments
- breaking & reforming of cross bridges between actin & myosin, repeating process in serial fashion for 5-6mins
- width of ‘A’ band is constant where as the ‘Z’ lines more closer together where muscle contracts & farther apart when it is stretched

2. Components of gastric secretion; regulation of gastric secretion

SHORT NOTES
1. Anticoagulants: Apr 2001 (4002)
2. G protein:
   - G Protein–. Many hormones activate receptors that indirectly regulate the activity of target proteins (e.g., enzymes or ion channels) by coupling with groups of cell membrane proteins called heterotrimeric GTP-binding proteins (G proteins)
   - There are more than 1000 known G protein–coupled receptors, all of which have seven
transmembrane segments that loop in and out of the cell membrane. Some parts of the receptor that protrude into the cell cytoplasm (especially the cytoplasmic tail of the receptor) are coupled to G proteins that include three (i.e., trimeric) parts—the a, b, and g subunits.

- When the ligand (hormone) binds to the extracellular part of the receptor, a conformational change occurs in the receptor that activates the G proteins and induces intracellular signals that either
  (1) open or close cell membrane ion channels or
  (2) change the activity of an enzyme in the cytoplasm of the cell.

- The trimeric G proteins are named for their ability to bind guanosine nucleotides. In their inactive state, the a, b, and g subunits of G proteins form a complex that binds guanosine diphosphate (GDP) on the a subunit. When the receptor is activated, it undergoes a conformational change that causes the GDP-bound trimeric G protein to associate with the cytoplasmic part of the receptor and to exchange GDP for guanosine triphosphate (GTP).

- Displacement of GDP by GTP causes the a subunit to dissociate from the trimeric complex and to associate with other intracellular signaling proteins; these proteins, in turn, alter the activity of ion channels or intracellular enzymes such as adenylyl cyclase or phospholipase C, which alters cell function.

- The signaling event is rapidly terminated when the hormone is removed and the a subunit inactivates itself by converting its bound GTP to GDP; then the a subunit once again combines with the b and g subunits to form an inactive, membrane-bound trimeric G protein.

- Some hormones are coupled to inhibitory G proteins (denoted Gi proteins), whereas others are coupled to stimulatory G proteins (denoted Gs proteins).
Thus, depending on the coupling of a hormone receptor to an inhibitory or stimulatory G protein, a hormone can either increase or decrease the activity of intracellular enzymes. This complex system of cell membrane G proteins provides a vast array of potential cell responses to different hormones in the various target tissues of the body.

Essay:

1. What are normal blood sugar levels? Which hormones regulate the blood sugar level & how? Add a note on diabetes mellitus

Repeated

2. Discuss the stages of erythropoiesis & the factors affecting it. Add a note on sickle cell anemia

Short notes:
1. Functions of Platelets - repeated
2. Composition & functions of gastric juice – rep Aug 2004
3. Molecular basis of skeletal muscle contractions- repeated
4. Sertoli cells – repeated
5. Rh blood group – repeated
6. Movements of small intestine – repeated
7. Functions of placenta – repeated
8. Functions of mitochondria
9. Puberty
10. Functions of glucocorticoids – repeated

Short answers:
1. Inulin clearance - repeated
2. Oxytocin - repeated
3. Fever- repeated
4. Second messengers- repeated
5. Functions of bile salts- repeated
6. ESR - repeated
7. Hypocalcemic tetany - repeated
8. Placental hormones
9. Myasthenia gravis - repeated

10. Immunoglobulins - repeated