B.SC - Semester 2

(Core course – Theory)

Course Code – 1ZOOTC0201

Course Title - Comparative anatomy and developmental biology of vertebrates

UNIT: 5

Topic : OOGENESIS

Definition: It involves the formation of haploid female gametes, (ova) from the diploid mother cells, oogonia of the ovary of female organism. A spermatozon is specialized to deliver a haploid nucleus to the zygote where as an egg contributes not only a haploid nucleus but also a large dowry comprising.

(i) Food materials for building up in embryo.
(ii) Certain MRNAS & proteins necessary for initially development after fertilization.

Site of Oogenesis: Oognenesis takes place in the ovaries. The ovary is composed of connective tissue called stroma wrapped by a layer of cuboidal cells, called germinal epithelium , which is covered by a large flattened cells, called viceral peritonium, The stroma consists of an outer cortex and an inner medulla . the medulla contains rounded bodies called ovarian or graafin follicles at various stages of development. It also contained blood vessels, lymphatic vessel nerve, nerve fiber and some smooth muscle. Each follicle contains a large ovum surrounded by several layers of follicle cells.

In the male gamete differentiation occurs after meiosis, but in the female the oocyte is fully formed before meiosis is completed. Therefore differentiation of ovum is closely associated with meiosis and is generally takes places during prophase of meiosis-I.

Stages of oogenesis:- It consist of three phases Proliferative, growth and differentiation and maturation.

1. Proliferative Phase: In this phase certain primary germ cells which are large in size and having large nuclei of germinal epithelium of ovary undergo rapids mitotic divisions to form group of diploid egg mother

cells or oogonia. Thus oogonia divide mitotically to multiply their number. This form groups of oogonia called follicles or eggnest. Addition of oogonia results in the growth of the ovaries.

2. Phase of growth and differentiation. After sexual maturity of the animal, one oogonium of follicle or eggnest prepares for the formation of an ovum . This oogonium grows in size and is called primary oocyte. It is the future ovum while other oogonia of the follicle or eggnest lose the potential to became the primary oocyte and form a layer called follicular epithelium round the primary oocyte which provide in protectional nourishment to primary oocyte. An oocyte along which its follicular epithelium is termed an ovarian follicle

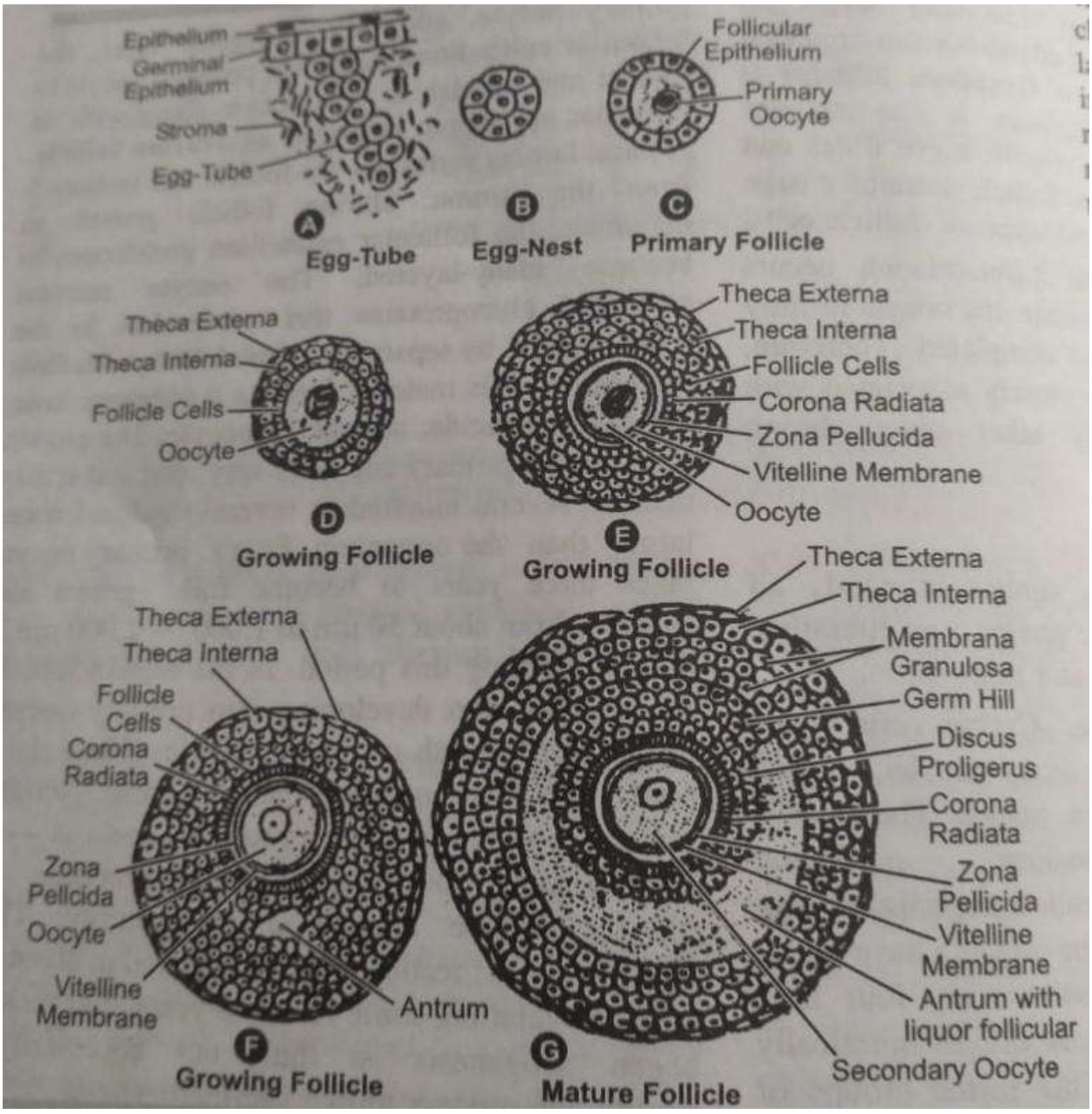

FIG1. Development of Graaffian Follicle (A-G)

Changes occur during Growth Phases:-

(i) Increase in Size of Oogonium: The size increase due to the accumulation of reserve food like proteins and fats in the form of yolk. Due to heavy weight, it is usually concentrated towards the lower portion of the egg forming the vegetative pole. The portion of the cytoplasm with egg pro-nucleus remain often separated from the yolk and occurs towards the upper portion of the egg forming in animal pole.

(ii) Number of mitochondria increase.

(iii) Increase in amount of Endoplasmic Reticulum and activity of the Golgi complex.

(iv) Formation of the vitelline membrane around the oocyte.

(v) Due to increase in the amount of DNA, the nuclear sap and number of nucleoli , size of nucleus increase.

(vi) In the growth phase nucleus genes which code for ribosomal RNA and are located in the nucleolus organizer region multiply to facilitate the rapid synthetic of ribosomal RNA. (This multiplication Of genes without mitosis is known as gene amplification or redundacy).

Vilellogensis: it is the process of production and accumulation of yolk in a developing oocyte.

The yolk is formed in the ovary but the balance of process occurs in the oviduct.

What is Yolk: Yolk is a heterogeneous substance and is mainly formed of proteins, phospholipids, natural fats, glycogen and some other carbohydrates. If yolk contains more lipids called fatty yolk .Fatty yolk is more abundant in egg of reptiles and birds where as proteins yolk present in eggs of many invertebrates and lower chordates.

Two types of yolk

(a) Granular Yolk: The protein yolk present in the form of fine granules in the cytoplasm of oocyte of investor and lower chordates.

(b) Yolk platelets: In insects and most of vertebrates like cyclostomes,

fishes, amphibious, reptiles and birds. The yolk is present in the form of large granules called yolk platelets. Yolk platelets contains two types of proteinaceous substances.

i) Phosvitin

ii) Lipovitellin

Phosvitin is highly phosphorylated protein with 8.4 ./. phosphorus where as lipovitellin is a combination of proteins and lipids with 17.5 ./. lipid content . In yolk platlets two molecules of phosvitin are associated with one molecule of phosvitin are arranged in a crystalline lattice .

Formation of Yolk: In an oocyte, yolk is synthesized in yolk nucleus which is lying adjacent to in nucleus of oocyte. It consist of clouds of mitochondria and converts soluble phosvitin yolk into insoluble yolk platelets. The Golgi complex endoplasmic reticulum and then mitochondria of oocyte are involved in protein synthesis.

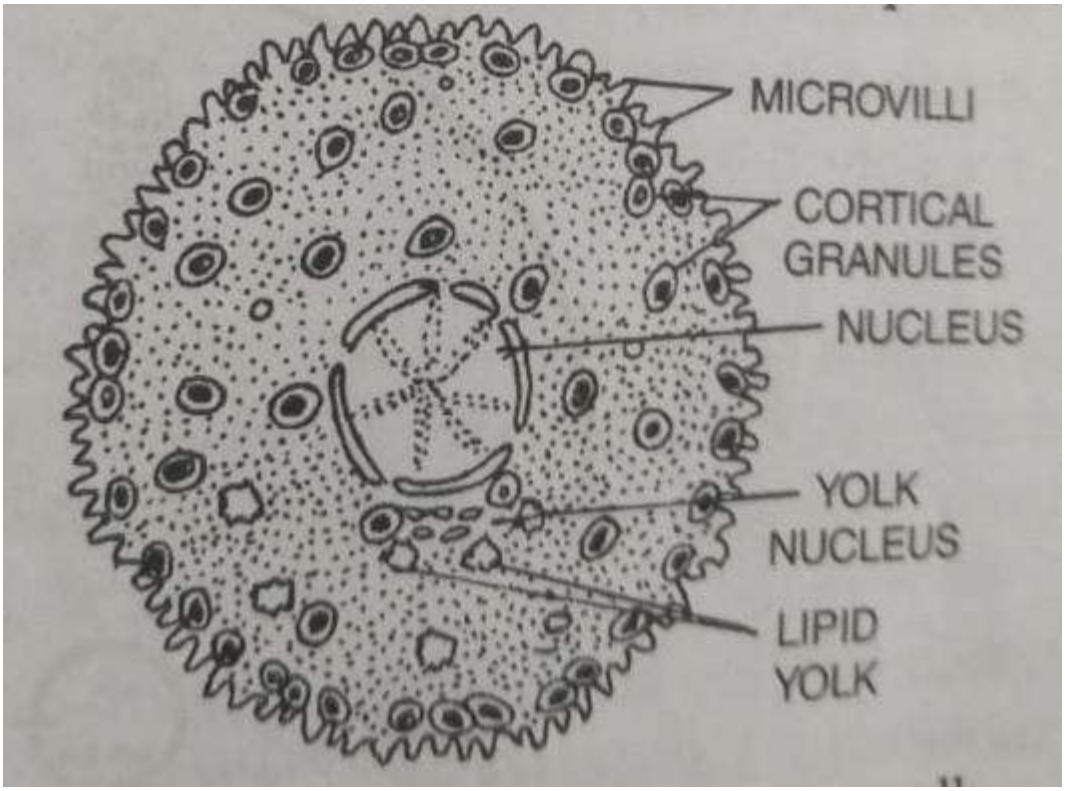

FIG 2.Oocyte Of Spirobis Showing Yolk Nucleus And Microvilli.

Vitellogenesis are of Two Types:

(i) Autosynthesis

(ii) Heterosynthesis

1) Autosynthesis: In this type yolk formation occur within the oocyte by this process the growing oocyte has many elongated mitochondria ree ribosome and dense annuli for the transfer of material from nucleus to cytoplasm. In later phase, outer membrane process many microvilli for pinocytosis . The pinocytic vessiles distance from the outer surface and move towards rough endoplasmic reticulum for yolk formation.

2) Heterosynthesis In this raw materials of yolk are formed outside the oocyte e.g. in vertebrates and insects. Yolk in synthesized in the other parts of the body of female. In insects yolk is synthesized in the fab bodies liver, ovary and midgets. In vertebrates yolk is synthesized in the liver. Then transported from these organs to ovarian follicles by blood. The oocyte called yolk from these yolk cells by micropinocytosis with the help of receptor- coated endocytotic vesicles.

3) Maturation Phase

In maturation phase the nucleus of the oocyte undergoes two maturation division. The first division is meiotic; as a result two haploid (n) cells are produced. In this division, cytokinesis is unequal; the large daughter cell with almost entire cytoplasm and yolk forms the secondary oocyte. while the smaller one with the haploid nucleus (n) and almost without cytoplasm forms the first polar body which is given off from the surface of oocyte at the animal pole.

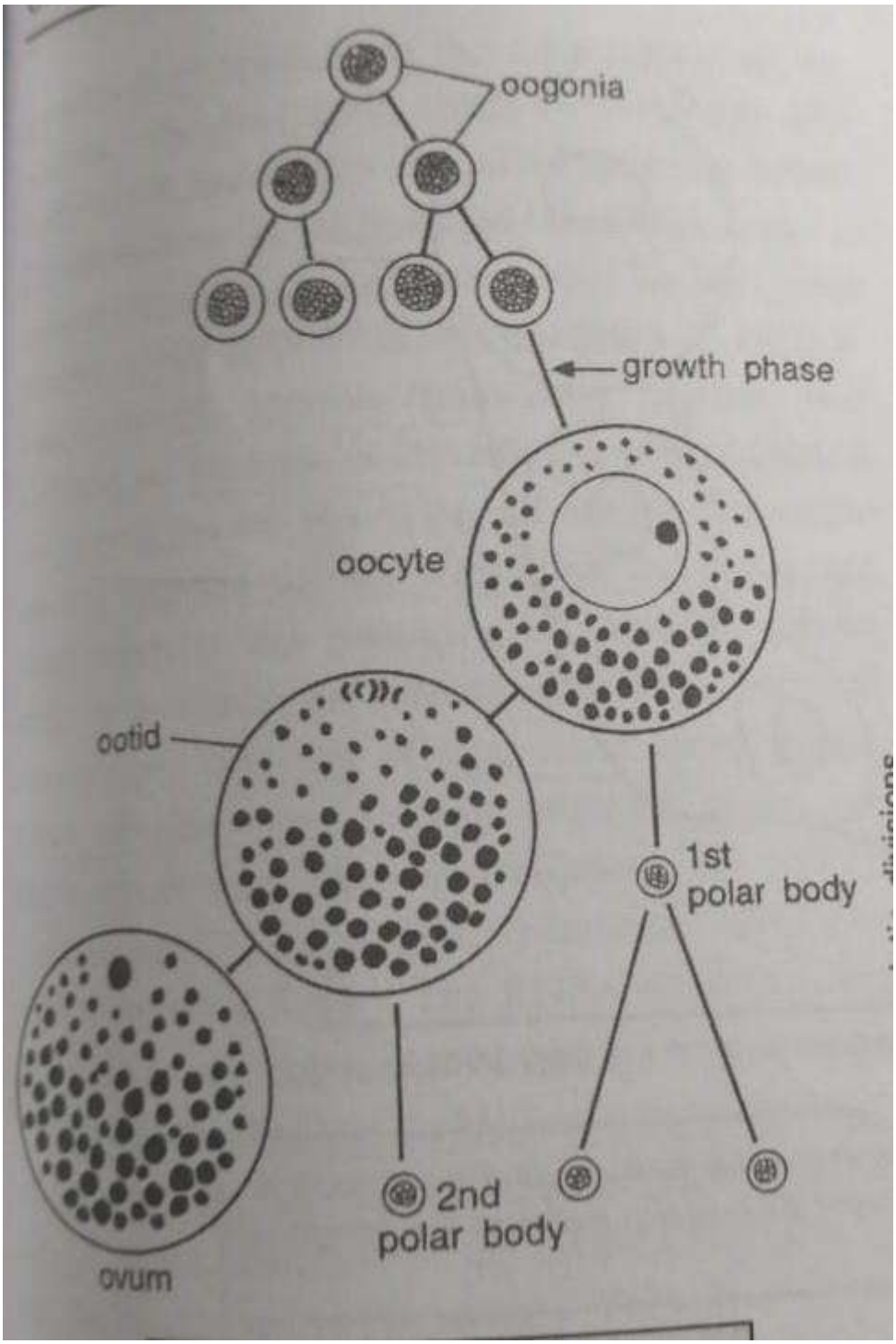

Fig : Oogenesis in Female Gonad.

The secondary oocyte with the haploid number of chromosome undergoes second maturation division or second meiotic division. This

division is also unequal the large one containing yolk is called ovum and small cell is the second polar body. He first polar may also divide thus, producing the total of three polar bodies which degenerate soon. So, as a result of oogenesis, only one functional ovum is formed from a primary oocyte. In most of the vertebrates, the first meiotic division occurs with the commencement of the growth phase, and second maturation division occurs when the egg is activated by the entry of sperm.