Study Guide Reproductive System:

1. Reproductive system works physiologically, for the continuity of generations. All other organs work for the individual body.

2. Gonads are primary sex organs; Testes in males produce sperms and Ovaries in females produce eggs. Sperms and ovaries are gametes, also called sex cells.

3. **Male Reproductive System:**

4. It consists of a pair of testes, a pair of duct = vas deferens, ejaculatory duct, urethra, penis and associated glands seminal vesicles, prostate gland and bulbourethral glands.

5. **Testes** are oval bodies lying in Scrotum, a skin pouch. This arrangement keeps the testes about 3⁰ Celsius cooler than body temperature and is needed to produce viable sperms. Testes produce sperms and male hormone Testosterone. If the embryo secretes testosterone embryo grow into a male otherwise by default the sex of embryo is female. Testosterone is responsible for male characters including appearance.

6. **Epididymis** is elongated structure lying posterolateral to testis and caps it. It collects sperms from testes and stores them for maturation (at least 20 days).

7. **Ductus = Vas deferens** moves superior and coils around ureter of its side. It receives sperms from Epididymis and joins seminal vesicle duct to form ejaculatory duct.

8. **Ejaculatory duct** then carries the sperms to urethra. Prostate Gland adds its secretion to urethra. Sperms and secretion of glands form semen which is ejaculated through penis during intercourse.

9. **Urethra** has 3 distinct parts. **Prostatic urethra** is the part passing through prostate gland. Middle part of urethra is not covered and is **Membranous urethra**. Urethra enters penis and is termed **Penile urethra**. Penile urethra opens at external urethral orifice, which passes out both urine and semen.

10. **Seminal Vesicles**: produce 60% of semen. It has vitamin C, Fructose and prostaglandins.

11. **Prostate Gland**: is a single gland lying below bladder. It produces an alkaline solution which neutralizes acids of vagina.

12. **Sperms** have acrosome, head, middle piece and tail. Acrosome has hydrolytic enzymes to dissolve egg membranes. Head has the sperm nucleus. Middle piece has mitochondria and centrioles. Tail is a flagellum for swimming. Sperms enter vagina and swim through uterus to upper parts of uterine = fallopian tubes where fertilization may take place.
13. **Impotence**: is the failure of penis to get erect or to remain erect during intercourse. Smoking and drug use increase the chance of impotence. Drugs like Viagra and Cialis restore temporarily this function.

14. **Sterility**: if a male cannot produce sperms or enough sperms to ensure fertilization he is called a sterile male.

15. **Female Reproductive System**:

16. It consists of a pair of ovaries, a pair of uterine = fallopian tubes, a uterus, a vagina and eternal genitalia.

17. **Ovaries** produce eggs in follicles. Follicles start developing before birth and stay in stage called primary follicles. Follicle Stimulating hormone secreted by anterior pituitary initiates growth and maturation of follicles. Many follicles start maturing but only 1, the largest, releases the secondary oocyte with 1\textsuperscript{st} polar body.

18. Oogonial cell (germinal cell) $\rightarrow$ primary oocyte (the cell ready to divide by meiosis) $\rightarrow$ secondary oocyte (has undergone Meiosis-1 and produced 1\textsuperscript{st} polar body).

19. Follicles release female hormones called estrogens.

20. **Uterine = Fallopian tubes** draw egg through ostium of fallopian = uterine tubes by beating cilia. Fertilization takes place in upper uterine = fallopian tubes.

21. **Uterus**: is the womb for development of baby. Both fallopian tubes lead to it. Uterus has smooth muscle fibers = myometrium and inner glandular and vascular tissue = Endometrium. The neck part of uterus protrudes into vagina and is called Cervix. In many women it becomes cancerous and called **Cervical Cancer** – the number 1 cancer in women.

22. **Vagina** is genital duct used for intercourse and birth. The opening of vagina is partially closed by a mucous membrane, **Hymen**. Greater Vestibular glands secrete mucous to lubricate distal vagina.

23. **Ovarian Cycle**: Ovaries have large number of follicles. Under the influence of FSH and LH some follicles start developing. Ultimately only one follicle reaches maturity. In most women ovarian cycle is of about 28 days. **Ovulation** is the release of secondary oocyte around 14th day of cycle. Ruptured follicle develops into a yellow body = Corpus Luteum. **Corpus luteum** secretes hormone **progesterone**.

24. Each ovarian cycle, under the influence of Estrogen and Progesterone hormones, uterus prepares for development of baby by growing glandular/vascular tissue called Endometrium. If there is no pregnancy corpus luteum degenerates. Therefore, no progesterone is secreted and endometrium is shed off as menstruation, a flow of blood and tissue.
25. Released secondary oocyte is covered by a non-cellular Zona Pellucida and follicular cells called Corona radiata. Fallopian tubes draws coelomic fluid in them by beating cilia and sperms can come in contact in proximal fallopian tubes.

26. Fertilization is the entry sperm into an egg. Enzymes released by several sperms remove cells of corona radiata. The contact of 1st sperm results in Oocyte Activation. The sperm is engulfed and changes in egg membrane prevent entry of any further sperms. Secondary oocyte undergoes Meiosis-2 and produces the female pronucleus and 2nd polar body. Sperm produces male pronucleus. Spindle formation is initiated and degeneration of nuclear membranes results in intermixing of chromosomes of male and female pronuclei = Amphimixis. Fertilization is complete. The first diploid cell is called zygote. Fig 20.1

27. Cleavage is the series of mitotic divisions that divide the zygote into 2 → 4 → 8 → 16 → 32 and so on cells. At first a solid ball of cells, Morula is formed. The embryo continues to roll towards uterus. Fig 20-2

28. The cells of morula continue to divide and rearrange to form a hollow ball of ball of cells called Blastocyst. Blastocyst is formed of about 150 cells. It has an inner mass of embryonic cells surrounded by extra-embryonic Trophoblast. Inner Mass develops into embryo. Trophoblast absorbs nutrient rich uterine fluid and participates in formation of extra-embryonic membranes. It takes 6-7 days to form Blastocyst after fertilization / conception. Implantation: Blastocyst reaches uterus and gets attached to inner wall of uterus called Endometrium. Fig 20.3

29. Gastrulation: The 1st embryonic structure to possess 3 distinct germ layers is Gastrula. 3 germ layers are Ectoderm, Mesoderm and Endoderm. Each germ layer produces particular tissues/organs in embryo called fate of germ layers. Table 20.1 depicts most parts formed by each germ layer.

30. Ectoderm forms epidermis and associated glands, nails and hair, nervous tissue including brain and spinal cord and mucous linings of mouth, anus and nasal cavities; pituitary and adrenal medulla.

31. Mesoderm forms muscles, bones and cartilages, heart and vessels, kidneys, gonads and secondary sex organs.

32. Endoderm produces Respiratory lining, thymus, thyroid, pancreas, liver, stem cells that produce gametes; distal portions of ducts of urinary and reproductive systems.

33. During pregnancy ovaries stop ovarian cycles and therefore no menstruation. It is 1st sign of pregnancy and can be confirmed with pregnancy kits testing urine.

34. Gestation Period = length of human development from day of fertilization is 270 days.

35. Early embryo is covered with embryonic membranes, amnion, chorion, yolk sac and allantois. Amnion surrounds amniotic fluid to cushion the embryo against shocks and protect against
dehydration. **Yolk Sac** produces blood cells in early embryo, later this function is taken over by liver. Early embryo develops placenta, to get food and oxygen from mother’s blood and pass out wastes, from another embryonic membrane – **Chorion**. Chorionic villi enter into Endometrium. The composite of chorionic villi and Endometrium surrounding them form Placenta. The embryonic blood capillaries in chorionic villi and maternal capillaries in Endometrium lie very close to each other and exchange of materials (O₂, CO₂, glucose, amino acids, vitamins, urea and lot of others takes place. Fig 20.5. Allantois is reduced in humans and form part of urinary bladder.

36. **Labor and Delivery**: Oxytocin hormone and many other factors initiate spasmodic contractions of uterine smooth muscle fibers termed Labor. The goal of labor is forcible expulsion of fetus from uterus =Parturition. Birth takes place after about 40 weeks from last menstruation. Fig 20.11

37. **Dizygotic Twins**: result from fertilization of 2 separate eggs. They are like any other siblings, may be of same or different sexes. They have different combination of genes.

38. **Monzygotic or Identical Twins**: form from separated blastomeres of same zygote. They have similar genes and are of same sex and look alike.