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**VETERINARY/ANIMAL PHYSIOLOGY**

**CHAPTER 10: REPRODUCTION**

**DR. BRIJESH KUMAR YADAV1, DR. KAVISHA GANGWAR2**

**1ICAR-IVRI ANIMAL REPRODUCTION DIVISION IZATNAGAR BAREILLY UP,243122**

**2ASSISTANT PROFESSOR, VETERINARY PATHOLOGY, DUVASU MATHURA UP,281001**

Gonadal hormones and their functions in male and female. Neuroendocrine-gonadal axis and feedback regulation. Male spermatogenesis. Accessory sex glands. Sexual behaviour, erection, ejaculation etc. Semen evaluation. Factors affecting reproduction. Artificial insemination – collection, preservation and transport and semen diluents. Freezing of semen. Oogenesis. Follicular development. Ovulation. Corpus luteum. Reproductive cycles in animals. Factors affecting reproductive cycles. Female reproductive hormones. Oestrous synchronization, superovulation. Sperm capacitation and acrosomal reaction. Sperm and ovum transport in female genital tract. Fertilization. Implantation. Maternal recognition of pregnancy, Maintenance of pregnancy and its hormonal control. Physiology of placenta. Physiology of parturition and its hormonal control. Embryo transfer – collection, preservation, transport, and transfer of embryos. Oocyte culture. In vitro fertilization.

**Terminologies-**

**Acrosomal reaction**- The acrosomal reaction is the process of the egg and sperm cells fusing together during fertilization.

**Allantois** -Diverticulum of the hindgut fuses with chorion to form the chorioallantois placenta.

**Amnion-** Innermost of the fetal membranes forming the waterbag that surrounds and protects the embryo/fetus.

**Andrology**- Study of male reproductive system.

**Areolae-** Specialized parts of chorion opposite endometrial glands that are involved in uptake of nutrients and other molecules from maternal system (singular areolus).

**Artificial insemination (AI)** -It is a technique in which sperm are collected from the male, processed, stored, and artificially introduced into the female reproductive tract at proper time for the purpose of conception.

**Azoospermia-** Absence of sperm in the semen.

**Chorion** -Outermost of the fetal membranes. The fetal part of the placenta develops from it.

**Chorionic girdle**- A ring of tissue that forms on the horse placenta around day 25 to 36 of pregnancy. Subsequently, cells from the chorionic girdle invade the endometrium to form endometrial cups.

**CL dependent species-** A species in which progesterone needed for the maintenance of pregnancy is dependent upon a functional corpus luteum.

**Conceptus** - The products of conception, ex., the embryo or fetus and its associated placental membranes.

**Corpus luteum** -The "yellow body" that develops from a follicle of the ovary after a ripened egg has been discharged. It produces progesterone, a hormone that prepares the lining of the uterus to receive a fertilized egg.

**Capacitation-** The change undergone by sperm in the female reproductive tract that enables them to penetrate and fertilize an egg.

**Coolidge effect** -It is defined as the restoration of mating behaviour in males (that have reached sexual satiation) when the original female is replaced by a novel female.

**Cryopreservation-** It is a process where cells or whole tissues are preserved by cooling to low sub-zero temperatures, such as (typically) −196 °C (the boiling point of liquid nitrogen).

**Courtship (Sexual display)-** It is the specialized behaviour in animals that leads to or initiates mating.

**Dry ice** -The solid carbon dioxide with a temperature of -770 C.

**Dewar flask-** An insulated flask used for holding cryogenic fluids. The flask contains an inner and outer layer usually separated by an evacuated space. The inner surface of the flask is usually coated with silver or aluminium to minimize heat loss.

**Dominant follicle** -A single large follicle that continues to grow while suppressing the growth of follicles larger than 4 mm in diameter.

**Embryo-** In this period, rapid growth and differentiation occur, during which the major tissues, organs, and systems are established and the major features of external body form are recognizable.

**Embryo Transfer Technology (ETT)-** is a technique used to increase the reproduction rate of cows and buffaloes. Embryo transfer simply means collection of an embryo from a superior donor female and its transfer to the uterus of a recipient female of the same species

**Endometrial cup** Knob or cup like structures on the endometrium of the pregnant mare that are formed from invading placental cells from the chorionic girdle. Cells of the endometrial cups, which produce equine chorionic gonadotropin, first form about day 36 to 38 of pregnancy and are destroyed by day 100 to 140 of pregnancy.

**Epididymal transit time-** The interval between release and ejaculation of sperm. In bulls, the duration of this interval averages 8.3 days (range, 7 to 13 days), with shorter periods occurring in response to frequent ejaculation.

**Erection** -An erection is the stiffening of the penis which occurs during sexual arousal.

**Ejaculation-** It is defined as the reflex expulsion of semen from the penis.

**Estrus** Period at which a female animal shows sexual desire towards the male.

**Estrus synchronization-**Manipulation of estrous cycle or induction of estrus to bring a group of females into estrus at predetermined time is termed as synchronization of estrus.

**Flehmen Reaction-** After sniffing the male stands rigidly and holds his head in horizontal position with extended neck and raised upper lips. This reaction is called Flehmen reaction.

**Fetal membranes**-Closely related to extraembryonic or fetal membranes that are differentiated into the yolk sac, amnion, allantois, and chorion.

**Fetus -**Growth and changes in the form of the fetus characterize this period.

**Fertilization-** The process of combining the male gamete, or sperm, with the female gamete, or ovum.

**Follicle** -A somewhat spherical mass of cells usually containing a cavity. A smalll crypt, such as the depression in the skin from which the hair emerges.

**Follicular dynamics-** The process of continual growth of ovarian follicle leading to preovulatory size and its regression or ovulation, is known as follicular dynamics.

**Follicular phase-** First phase of the estrous cycle, at a time when a new cohort of follicles is recruited, from which the Graafian follicle will be selected.

**Freezing** -The conversion of an unfrozen solution into the solid form.

**Gynaecology**- Study of female reproductive system.

**Gestation**-The period from implantation of the blastocyst in the endometrium until the termination of pregnancy.The period in which animals complete their embryonic and fetal development within the uterus. Length of gestation is calculated as the interval from fertile mating to parturition.

**Gonad** Primary sex glands, ovaries, or testes.

**Gonadotropin releasing hormone (GnRH)** -Decapeptide hypothalamic releasing hormone controls pituitary gonadotropin synthesis/secretion and ultimately, reproductive competence. The peptide, secreted by hypothalamic neurons into the hypophyseal portal circulation, that induces pituitary (LH)/(FSH) secretion.

**Graafian follicle-** Dominant follicle, completing its growth process.

**Intromission** -Intromission is the successful entrance of the penis into the vagina.

**Implantation-** The blastocyst adheres to, penetrates, and establishes nutritional support from maternal tissues, normally the endometrium.

**Inhibin** -Glycoprotein hormone made up of two disulfides linked and dissimilar subunits and involved in suppression of pituitary FSH.

**Interferons-** (IFNs) Interferons (IFNs) are a group of proteins, which were initially identified by their ability to protect cells against viral infections.

**Liquid nitrogen-** It is nitrogen in a liquid state at a very low temperature. It is produced industrially by fractional distillation of liquid air. Liquid nitrogen is inert, colourless, odourless, non-corrosive, non-flammable and extremely cold.

**Luteal phase-** Second phase of the estrous cycle, characterized by the presence of the corpus luteum when implantation occurs.

**Luteolysin -**An agent that causes regression of the corpus luteum.

**Luteolysis-** Process of regression of the corpus luteum.

**Libido-** Libido is defined as the "willingness and eagerness" of a male to attempt to mount and service.

**Mating ability-** It refers to the ability and competence of the bull in fulfilling this aspiration.

**Maternal recognition of pregnancy-** Before attaching to the endometrium, the blastocyst secretes substances which prolong the life span of the cyclic corpus luteum beyond the period of the estrous cycle. The time at which it occurs is known as maternal recognition of pregnancy (MRP).

**Metestrous bleeding-** The presence of blood in the vulval discharge 48 to 72 hours after end of estrus. It is due to petechial hemorrhages in the endometrium. It is only an indication that a cow has been in estrus and not related to conception.

**Negative feedback-** loop Process whereby a hormone secreted by a target organ (e.g., the ovary) signals to the hypothalamic pituitary axis to secrete stimulatory hormones (e.g., LH and FSH) to be readjusted to steady state.

**Oocyte** -A cell in the ovary derived from an oogonium that, upon undergoing meiosis, produces an ovum; a primitive egg in the ovary.

**Oogenesis-** It is development and maturation of the ovum.

**Parturition** -Physiologic process by which the pregnant uterus delivers the fetus and placenta from the maternal organism (labor).

**Placenta** -Apposition or fusion of the fetal membranes to the endometrium to permit physiologic exchange between fetus and mother. It originates because of various degrees of fetal maternal interactions and is connected to the embryo by a cord of blood vessels.

**Placentome-** In ruminants, the fetal cotyledons fuse with caruncles or specialized projections of the uterine mucosa to form placentomes or functional units.

**Puberty** -The onset of puberty can be defined as a gradual progression of several biologic events, such as the onset of spermatogenesis, appearance of sperm in the ejaculate, and capability of intromission.

**Polyspermy-** Immediately following fertilization, the egg surface (zona pellucida) changes to prevent fusion of additional sperm. When this fails, one or more sperm enter the egg to form polyploid embryos.

**Recrystallization** -It refers to the growth of larger crystals at the expense of smaller ones.

**Refractory period-** It is a period during which a second copulation does not take place.

**Reproduction**- a complex process that involves many psychological and physio-chemical events in genesis of a new individual. Reproduction has 3 purposes: species existence, food, and genetic improvement.

**Straws**- These are thin-walled plastic tubes of different dimensions. Straws are now the most popular container in the world for semen packaging. They have replaced glass ampoules and pellets.

**Serving capacity-** It is a measure of the number of services achieved by a male under stipulated conditions and thus it includes both libido and mating ability.

**Sexual satiation-** It refers to a condition in which after a certain copulation further stimulus will not make ready to a male for copulation.

**Spermatogenesis-** It is a highly synchronized and hormonally controlled sequence of events wherein the germ cells undergo a series of divisions and differentiation (spermatogonia, primary spermatocytes, secondary spermatocytes, early spermatids, and late spermatids) resulting in the formation of haploid sperm.

**Spermatocytogenesis-** It is the proliferative phase in which spermatogonial cells multiply by a series of mitotic divisions followed by the meiotic divisions which produce haploid spermatid.

**Spermiogenesis-** The round spermatids are transformed into elongated spermatozoa by a series of progressive morphologic changes is called spermiogenesis. This is also called differentiation phase.

**Spermiation** -The release of spermatozoa from the Sertoli cells into the lumen of seminiferous tubule is called spermiation. It is analogous to ovulation in the female except that spermiation occurs continuously throughout the testis.

 **Spermatogenic cycle-** It is defined as the reappearance of the same stage or complete sequence of stages at any given site within a given section of the seminiferous tubule.

 **Spermatogenic wave-** It is defined as a complete series of the stages along the length of a seminiferous tubule which is approximately 10 mm long in bulls.

**Seasonally polyestrous-** Commencing estrous cycle during specific breeding season.

**Seminiferous tubules-** Convoluted tubes found in the testes, which contain cells that produce sperms.

**Superovulation**-This is the process of induction of multiple ovulations, above the normal level that occur naturally, using exogenous hormones and it can be determined by the status of follicular development at the time of gonadotrophins treatment.

**Sexual behaviour-** It can be described as a pattern of well-defined steps, including actively seeking estrus females, courtship, mounting, intromission, and ejaculation.

**Sexual maturity** -It occurs when the development of both spermatogenesis and reproductive behaviour allows effective coordinated service and subsequent fertilization.

**Testis** -One of the two egg shaped glands which produce spermatozoa, normally situated in the scrotum. Also called Testicle.

**Testosterone-** A steroid hormone produced by cells of the testis independent from cells that produce spermatozoa. A primary circulating androgen. Theca A sheath, such as the one covering a tendon or a vesicular ovarian follicle.

**Refresher points-**

1.LH hormone is also called Interstitial Cell Stimulating Hormone (ICSH).

2.Preoptic Nuclei (PON) - Majority of GnRH producing neurons.

3.Arcuate nucleus (ARC)- Surge centre absent.

4.GnRH is a decapeptide (10 amino acids).

5.Prolactin is not a glycoprotein.

6.Oxytocin has two sites of origin, the ovary (CL) and hypothalamus (PVN, SON).

7.Prolactin is luteotropic hormone in Rat, Bitch, Sheep.

8.Myoepithelial cells or Basket cells (smooth muscle) is present in alveoli of teat.

9.Carbon no. in steroid hormones- Cholesterol 27, Pregnenolone 20C, Progesterone-21 Testosterone 19 C, Oestradiol 18 C, PGF2alfa 20C.

10.Spermatogenesis have two phases: Spermatocytogenesis (spermiocytognesis) and spermiogenesis.

11.Spermatocytogenesis is the proliferative phase and spermiogenesis is the differentiative phase.

12.Spermiogenesis is divided into 4 phases – Golgi, Cap, Acrosomal and Maturation phase.

13.Spermatogenic wave is appox.10mm long in bulls.

14.No receptors for FSH or Testosterone on germ cells.

15.Sertoli cells contains receptors for both FSH and Testosterone.

16.Accessory sex glands include Vesicular glands, prostate gland, and bulbourethral glands.

17.Vesicular glands or seminal vesicles are absent in dog and cat.

18.Prostate is well developed in dog and have alkaline secretions.

19.Bulbourethral or Cowper’s glands – dribbling in bull and make gel portion in Boar.

20.Sexual Behaviours in male animals can be divided into three stages.

 1. Precopulatory stage- Sexual arousal, courtship, erection, penile protrusion

 2. Copulatory stage-Mounting, intromission, ejaculation

 3. Postcopulatory stage-Dismounting, Refractory period, and memory.

21.Flehmen reaction- means to curl the upper lip and absent in Boar.

22.Erection is under influence of Parasympathetic nervous system.

23.Ejaculation is controlled by Sympathetic nervous system.

24.Testosterone in male is aromatized to oestradiol in the brain.

25.Measurement of metabolic activity by MBRT and Fructolysis index.

26.Functional assessment-Cervical Mucus Penetration Test (CMPT), Penetration of zona free hamster test, Hypoosmotic swelling test (HOST).

27.MBRT time for good quality semen is 3-6 min.

28.HOST solution have 150 milliosmole/kg.

29.Antonie van Leeuwenhoek (1677)- give term Animalcules.

30.Father of modern Artificial insemination is Lazzaro Spallanzani (1780).

31.G. Amantia (1914)-Developed first AV

32.Polge, Smith and Park -discovered cryoprotective effects of glycerol.

33.Sampat Kumaran (1939)- First time AI in India at Palace Dairy Farm Mysore.

34.Most common method of semen collection in Ruminants, Stallion is AV method.

35.Most common method of semen collection in dog is Digital manipulation of penis.

36.In Boar most common method is Gloved hand technique.

37.Temperature of AV is most important in Bull and Pressure in Boar and stallion.

38.Osmolarity of semen is 280-300 mos/kg.

39.Most common extender or diluter used in Bull is Egg Yolk Tris Glycerol (EYTG).

40.Cryopreservation cause damage to sperm cells mainly Cold shock, Solution effects (slow freezing) and intracellular ice formation (rapid freezing).

41.Egg yolk in the extender prevents the sperm from cold shock during cooling.

42.Equilibration of semen at 40C for at least 4 hrs.

43.French mini straw have higher surface to volume ratio.

44.Dry ice: -790C

45.Liquid N2 temperature: – 1960C

46.Liquid Helium: -2650C

47.Permeating cryoprotectants- used in slow freezing ex. Glycerol, Ethylene,glycol,DMSO etc

48.Non-permeating cryoprotectants- used in rapid freezing ex. Sucrose, trehalose, galactose, Raffinose, Glycine and macromolecules like Ficoll, Polyvinylpyrolidone etc

49.Equine ovary have outer medulla and inner cortex and ovulation fossa.

50.Each cow ovary contains 150,000 primordial follicles at birth.

51.Follicular dynamics was first identified by Rajakoski.

52.Large luteal cells secrete most of progesterone (80%).

53.Largest corpus haemorrhagicum is present in mare.

54.CL is larger than graafian follicle in all species except mare.

55.CL is pear or cauliflower shaped in mare.

56.The most widely accepted model of luteolysis is the McCracken Model.

57.Homosexual behaviour is a common symptom of oestrus in Cow.

58.Most prominent and reliable sign of oestrus in buffalo is stand to be mounted.

59.Silent estrus is a common phenomenon in Buffalo.

60.Split heat and winter anestrus is common in mare.

61.Doka is temporary teat engorgement as a sign of heat in buffalo.

62. The pharmacological control of estrus cycle is based on two approaches: Either shortening the life span of CL by inducing early luteolysis by using PGF2α or Extending the life of CL by administering the Progesterone.

63.Ovsynch protocol is also called 0,7 and 9 days protocol.

64. Mainly FSH and PMSG are used to perform superovulation. As FSH has a biological half-life of only 2-4 hours, repeated injections are required at 12 hourly intervals to maintain the required blood levels, however, PMSG has about 7 days biological half-life.

65. Molecular and physiological changes, collectively known as capacitation

66.The acrosome reaction is the exocytosis of the acrosome, or the fusion of the outer acrosomal membrane with the sperm's plasma membrane in multiple locations along the head of sperm, leading to formation of numerous vesicles.

67.Zona pellucida is composed of entirely of three glycoproteins: ZP1, ZP2 and ZP3

68.ZP3 is ligand for sperm zona binding protein.

69.ZP3 binding with the receptors in sperm leads to increase in intracellular calcium, which acts as a second messenger to trigger the vascularization of the acrosome.

70.Fertile life of sperm is 30-48 hrs. And fertile life of ovum is 20-24 hrs.

71.Penetration of the zona by sperm occurs within 5 to 15 minutes after sperm attachment.

72.Physiologic polyspermy is common in birds and reptiles.

73.The pig appears most susceptible to polyspermy.

74.Block to polyspermy is at zona pellucida in most mammals (e.g. Sheep, swine) with a secondary physiologic block at vitelline membrane in rabbits.

75.In the mare, unfertilized eggs remain within the isthmus and slowly degenerate over several months, while developing embryos pass by them and enter the uterus.

76.Parthenogenesis, the development of an egg without intervention of the sperm, occurs in many invertebrate species and in some vertebrate species.

77.Twinning in monotocous domestic species is most frequently of the dizygotic type in which more than one egg is ovulated and the eggs are fertilized by different sperm, resulting in offspring no more identical than other full siblings.

78.Mares, transuterine migrations occurred approximately 13 times per day between days 10 to 16 of gestation.

79.Under the influence of progesterone, the uterine endometrium releases very little PGF2a and appears insensitive to estrogen or oxytocin stimulation, the "progesterone block."

80.Endocrine-exocrine model of maternal recognition of pregnancy in the pig.

81.The caruncles are convex in the cow and concave in the ewe and goat.

82.In sheep, between 90 and 100 placentomes are evenly distributed between the pregnant and nonpregnant horns. In cattle, 70 to 120 placentomes develop around the fetus and progress toward the distal limit of the chorioallantois in the nongravid horn.

83.Fetus determines the day of parturition, whereas the mother decides the hour of parturition.

83.Cortisol is transferred from mother to fetus in many species but not in goat and sheep.

84.The placenta relies on fetal cortisol to induce activity of the placental enzyme 17a hydroxylase and thus synthesize estrogen from progesterone.

85.In polytoccous species (sow) and twin bearing species (sheep and goat), 2nd stage cannot be separated from the 3rd stage.

86.Lochia, the uterine discharge that normally occurs during the puerperium, is composed of mucus, blood, shreds of fetal membranes, and maternal tissue and fetal fluids. Lochia ceases by the first week after parturition.

87. Most mares exhibit a foal heat within 6 to 13 days postpartum.

**Table 10.1 Length of oestrous cycle in animals**

|  |  |
| --- | --- |
| **Species** | **Length of oestrous cycle** |
| Cattle | 21 days (18 -24 days) |
| Buffalo | 21 days |
| Ewe | 16 – 17 days |
| Doe | 18 – 20 days |
| Mare | 19 – 23 days |
| Sow | 18 – 24 days |
| Bitch | 6 – 7 months |
| Cat | 15 – 21 days |

**Table 10.2 Time of ovulation in different animals**

|  |  |
| --- | --- |
| **Species** | **Time of ovulation** |
| Cattle and buffalo | 12 – 14 hours after the end of estrus |
| Ewe | 12 – 24 hours before the end of estrus |
| Doe | Towards the end of estrus |
| Mare | 1-2 days before the end of estrus |
| Sow | 1-2 days after onset of estrus |
| Bitch | 1-2 days after onset of estrus |
| cat | About 27 hours after coitus |

**Table 10.3 Age of puberty in different animals**

|  |  |
| --- | --- |
| **Species** | **Age of puberty** |
| Exotic cow | 8 – 18 months |
| Indigenous cow | 24 – 30 months |
| Buffalo | 24 – 48 months |
| Ewe | 8 – 12 months |
| Doe | 6 – 12 months |
| Mare | 18 – 24 months |
| Sow | 6 – 12 months |
| Bitch | 6 – 12 months |
| Cat | 5 – 12 months |

**Table 10.4 Homologies of female and male Reproductive organs**

|  |  |  |
| --- | --- | --- |
| **Embryological structure** | **Adult female** | **Adult male** |
| Gonads | Ovary | Testis |
| Mesenterium | Mesovarium | Mesorchium |
| Gabernaculum | Round ligaments of the uterusProper ligament of the ovary | Ligamentum testis |
| Paramesonephric duct (Mullerian Duct) | OviductsUterusCervixVagina (cranial portion) | Rudimentary |
| Mesonephric tubules | EpoophoronParoophoron | Efferent ducts |
| Mesonephric duct | Gartners duct | EpididymisVas deferensSeminal vesicle |
| Urogenital sinus | Vestibule | Penile urethra |
| Urogenital sinus | Vestibular glands (Bartholins glands) | Bulbourethral glands (Cowpers glands) |
| Urethral folds | Labia minora | Prepuce |
| Genital tubercle | Clitoris | Glans penis |
| Genital swellings | Vulvar lips (labia majora) | Scrotum |

**Table 10.5 Number of ova produced by different species**

|  |  |
| --- | --- |
| **Species** | **Number of ova** |
| Cow & Buffalo | 1 |
| Mare | 1 |
| Ewe | 1-2 |
| Doe | 1-3 |
| Sow | 6 -20 |
| Bitch | 1 -10 or even more |
| Queen | 1-12 |

**Table 10.6 Optimum time for service**

|  |  |
| --- | --- |
| **Species** | **Optimum time for service** |
| Cow | Just before the middle of oestrum to the end of the oestrum |
| She- Buffalo | 5 to 8 hrs before the cessation of heat or 16 to 20 hrs after the onset of heat |
| Mare | 2nd -3 rd day of oestrum |
| Ewe | 18-24 hrs after the onset of oestrum |
| Doe | 24-36 hrs after the onset of oestrum |
| Sow | 12-30 hrs after the onset of oestrum |
| Bitch | 2 -3 days after the onset of true oestrum or 10-14 days after the onset of proestrus bleeding |
| Queen | During oestrum |

**Table 10.7 Characteristics of different gonadotropins hormones**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Hormone** | **Mol.wt.(Daltons)** | **Carbohydrate (%)** | **Sialic acid (%)** | **Half life** |
| LH | 28,000-34,000 | 12-24% | 1-2 | 30 min. |
| FSH | 32,000-37,000 | 25 | 5 | 2 hrs |
| hCG | 38,000 | 32 | 8.5 | 11 hrs |
| PMSG | 68,000 | 48 | 10.5 | 26 hrs |

**Table 10.8 Transport Time of Ova and Zona Hatching**

|  |  |  |
| --- | --- | --- |
| **Species** | **Time in Oviduct** | **Zona Hatching (After ovulation)** |
| Sow | 50 hrs (about 2 days) | 6 days |
| Ewe | 72 hrs (3 days) | 7-8 days |
| Cow | 90 hrs (about 3.5 days) | 9-11days |
| Doe | 3-4 days | -- |
| Mare | 98 hrs (about 4 days) | 8 days |
| Bitch | 148 hrs (about 7 days) | 11-12 days |
| Queen | 4-8 days | 11-12 days |

**Table 10.9 Time of Maternal Recognition of Pregnancy**

|  |  |  |  |
| --- | --- | --- | --- |
| **Species** | **Days of MRP (days)** | **Pregnancy Recognition Factors** | **Days of Definite attachment(days)** |
| Sow | 12 | Estradiol | 18 |
| Ewe | 12-13 | Ovine interferon tau | 16 |
| Cow | 16-17 | Bovine interferon tau | 18-22 |
| Mare | 12-16 | Transuterine migration | 36-38 |
| Doe | 17 | Caprine interferon tau | -- |
| Camel | Before 8 days | Oestrogen | -- |
| Women | 7-12 days | hCG | 9-12 |

**Table 10.10 Duration of Spermatogenesis in different species**

|  |  |  |  |
| --- | --- | --- | --- |
| **Species** | **Duration of one cycle (days)** | **Number of cycles required to complete spermatogenesis** | **Duration of complete spermatogenesis (days)** |
| Boar | 9 | 4.3 | 37 |
| Ram | 10 | 4.7 | 47 |
| Horse | 12 | 4.5 | 54 |
| Bull &Dog | 14 | 4.3 | 60 |
| Buffalo | 8.6 | 4.4 | 38 |

**Table 10.11 Relative size of accessory sex glands in different animals**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Species** | **Ampulla** | **Prostate** | **Vesicular gland** | **Bulbourethral gland** |
| Cattle /Buffalo | (+) | ++ | +++ | + |
| Sheep | (+) | ++ | +++ | + |
| Horse | ++ | ++ | ++ | + |
| Pig | absent | + | ++ | +++ |
| Dog | absent | +++ | absent | absent |
| Cat | absent | ++ | absent | ++ |

Ampulla are present in species marked (+) but are not anatomically prominent.

**Table 10.12 Different types of Corpus Luteum**

|  |  |
| --- | --- |
| **Types of CL** |  |
| CL of pregnancy | Corpus luteum verum (true CL) |
| CL of oestrous cycle | Corpus luteum spurium (false yellow body) |
| Regressed CL | Corpus albicans |
| Bleeding corpus luteum (formed immediately after ovulation) | Corpus hemorrhagicum |

**Table 10.13 History of Artificial Insemination**

|  |  |  |
| --- | --- | --- |
| **Year** | **Researcher** | **Discovery** |
| 1678 | Leeuwenhoek | First time saw sperms. As animalcules |
| 1780 | Lazzaro Spallanzani | First Scientific AI. Inseminated Beagle bitch that later gave birth to 3 pups |
| 1939 | Sampath Kumaran | First AI in India at Military dairy farm Mysore |
| 1941 | Salisbury | Egg Yolk Citrate dilutor |
| 1951 | Stewart et al | First calf from frozen semen |

**Table 10.14 Types of Placenta and its classification**

|  |  |
| --- | --- |
|  | **Based on**  |
| **Species** | **Shape/villous pattern** | **Histological structure or maternal foetal barrier** | **Loss of maternal tissue at birth** |
| Ruminant | Cotyledonary | Syndesmochorial | Nondeciduate |
| Mare and sow | Diffuse  | Epitheliochorial | Nondeciduate |
| Dog & Cat | Zonary | Endotheliochorial | Deciduate |
| Human and Monkey | Discoidal | Haemochorial | Deciduate |

**Table 10.15 Types of Straws**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Types of straw** | **Volume (ml)** | **Length(mm)** | **Diameter(mm)** | **Area (mm2)** | **Material** |
| French Large /Maxi | 1.2 | 133 | 4.2 | -- | Polyvinylchloride |
| French medium /Midi | 0.5 | 133 | 2.8 | 1152 | Polyvinylchloride |
| French mini | 0.25 | 133 | 2 | 823 | Polyvinylchloride |
| German straw /Minitube | 0.4 | 90 | 2.9 | 555 | Plastic |

**Table 10.16 Milestones in Mammalian Embryo Transfer and IVF**

|  |  |  |
| --- | --- | --- |
| **Year** | **Researcher** | **Event** |
| 1890 | Walter Heape | Transferred 2 angora rabbit embryo into gestating Belgian doe |
| 1951 | Willett et al. | First embryo transfer in cattle |
| 1973 | Wilmut and Rowson | First successful cryopreservation of cattle embryo (Frosty II) |
| 1982 | Brackett et al. | First In vitro fertilization of in vivo matured oocyte |
| 1983 | Drost et al. | First embryo transfer in Buffalo |
| 1997 | Wilmut et al. | Dolly cloned from sheep mammary cell (born July 1996) |

**Table 10.17 Average Duration of the Three stages of Labor in Animals (hours)**

|  |  |
| --- | --- |
|  | **Stage of Labor** |
| **Species** | **Dilation of cervix** | **Expulsion of Fetus** | **Expulsion of Fetal Membranes** |
| Mare | 1-4 | 0.2-0.5 | 1 |
| Cow, Buffalo | 2-6 | 0.5-1.0 | 6-12 |
| Ewe | 2-6 | 0.5-2.0 | 0.5-8 |
| Sow | 2-12 | 2.5-3.0 | 1-4 |
| Dog | 6-12 | 3-12 | Within 15 min. |
| Camel | 4-40 | 0.25-1 | < 1 hr |

**Table 10.18 Reproductive Hormones**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **S.N.** | **Hormones** | **Trade name** | **Active ingredients** | **Dose & Route** | **Indications** |
| 1. | GnRH | Inj. Gynarich (Synthetic analogue of GnRH),2.5,5 mlInj.Receptal,2.5ml,10ml | Buserelin acetate4ug/ml | 10ug,IM20ug,IM | Anovulation, Delayed ovulation, Improvement of conception rateTrue anoestrus, Follicular cyst |
| 2. | ProstaglandinsPGF2α | Inj. Vetmate (Synthetic analogue of PGF2α) 2mlInj. Estrumate 20mlInj. Alfa two, Repragna, Pregma, Clostenol, 2 mlInj. Lutalyse (Natural analogue of PGs) 5ml,10 ml,30 ml | Cloprostenol sodium,250ug/mlDinoprost tromethamine,5mg/ml | 500ug,IM25-35mg,IM | Induction of parturition(ICD)PyometraFetal mummificationEstrus synchronizationLuteolysis of CLLuteal cystChronic endometritis |
| 3. | Oxytocin(Nano peptide hormone) | Inj.Meritocin 1 mlInj.Pitocin 1 mlInj.Oxcin 1 mlInj.Syntocinon,1 ml | Oxytocin5 IU/ml;IM,IV | 75-100 IUBovine5-25 IUBitch | Contraction of myometriumMilk let downTransport of sperm in oviduct |
| 4. | Progesterone | Inj.Duraprogen 2ml,3 mlInj.Proluton depot 1ml,2 ml | HydroxyP4 caproate,250mg/ml or 0.25 gm/mlHydroxyP4 caproate,250mg/ml | 500 mg500 mg | Maintenance of pregnancyHabitual abortionThreatened abortionEEDDelayed ovulationCOD |
| 5. | Oestrogen(E2) | Inj.Heat reg depot 3 mlInj.Preg-Heat 2 mlInj.Progynon depot 1 ml ampoules | Diethylstilbestrol ,10mg/mlOestradiol benzoate,1mg/mlEstradiol Valerate,10mg/ml | 30mg,IM0.01 mg/kgbwt,3rd ,5 th and 7th days after mating IM | Ripening of cervixMismating, misalliance |
| 6. | FSH | Inj.FolligonInj.Follitropin-VInj.TrophovetInj.Superov | eCG/PMSG,1000IU with solvent | 1500-3000IU,IM | Anestrussuperovulation |
| 7. | LH | Inj.ChorulonInj.Pubergen | hCG,1500IU as crystalline powder with solventhCG,5000IU | 1500-3000IU, IMIM | Induction of OvulationImprovement of conception rateFollicular cystMale hypogonadism |
| 8. | Prolactin | Tab.Cabgolin,0.25 mg,0.50 mg/tab. | Cabergoline(Prolactin inhibitor,Dopamine agonist) | 5ug/kgbwt,orally for 5-10 days OD | Pyometra in bitchPseudopregnancy in bitchMismating or misallinace |
| 9. | Testosterone | Inj.Testoviron depot,1 ml ampoules | Testosterone Enanthate,250mg/ml | 1 ml | Male hypogonadism |

**References Books**

1.Duke’s Physiology of Domestic animals by William O. Reece,13th edition

2.Arthur’s Veterinary Reproduction and Obstetrics ,10th edition

3.Reproduction in Farm Animals by Hafez ,7th edition

**FILL IN THE BLANKS**

1. Cotyledonary type of placenta is present in……………………….
2. Mature functional corpus luteum of a cyclic non-pregnant animal is known as……………………….
3. Safest drug to terminate pregnancy in bitches is……………………………
4. Equilibration period for buffalo bull semen is………………………………
5. Duration of fertile life of spermatozoa in bull is……………………………….
6. Prescrotal sigmoid flexure is found in…………………………..
7. Invitro maturation time for bovine oocyte is……………………..
8. Type of placenta in dog and cats…………………………
9. Bloated bull frog appearance is seen in which condition…………………………………………
10. In pig placenta large, abundant whitish uterine glands are called as………………………………
11. Discoidal type of placenta is present in……………………………….
12. Placental enzyme that converts progesterone to estrogen at the time of parturition………………
13. Time of maternal recognition of pregnancy in cow……………………………………..days
14. Pear shaped abdomen is seen in which dropsical condition……………………………………
15. Cuboni test is done in urine for detection of …………………………………hormone
16. Ovaro-bursal adhesion is identified by………………………………..method
17. In case of wry neck there is fixation of ……………………………………………………..joint
18. 3R for treatment of uterine prolapse are…………………… , ………………………. and……………………
19. Male genital system is ……………………………..in origin
20. Germ cells are………………………………..in origin
21. 1st histological evidence that indicate development of male genital system is………………………..
22. Ampulla opens into urethra through………………………………..
23. Nuclear invagination at anterior border of post acrosomal cap is…………………………….
24. In stallion seminal vesicles release…………………………………..
25. In boar seminal vesicles release ………………………….and …………………………………..
26. Period of exposure of male to estrous female upto first false mounting is………………………………
27. Intromission or copulation through rectum is…………………….
28. Ejaculation of semen outside vagina is……………………………
29. Strong coiling of tail over mid piece is………………………………………….
30. Non-permeating type of cryoprotectant is…………………………………………..
31. Receptors in endometrium that are required for PGF2α synthesis……………………………………….
32. Most common cause of dystocia in heifers is………………………..
33. During early pregnancy uterus secrete an iron containing protein known as……………………….
34. For super ovulation in cow dose of PMSG used is…………………………………
35. Cryptorchidism in stallion is called as………………………….
36. One dose of frozen semen contains…………………………number of motile spermatozoa for ideal conception in mare
37. Primary sperm receptor is…………………………….
38. Factor responsible for maternal recognition in pregnancy in cattle is………………………………
39. Treatment of foetal mummification is done by hormone…………………………
40. Hormone used for induction of oestrus in anoestrus bitches is…………………………….

**MATCH THE FOLLOWING**

1. Match the list

|  |  |
| --- | --- |
| Column 1 | Column 2 |
| 1. Cuboni test
 | 1. Induction of parturition in mare
 |
| 1. Endometrial cups
 | 1. Prevention of uterine contraction
 |
| 1. Oxytocin
 | 1. eCG
 |
| 1. Tocolysis
 | 1. oestrogen
 |

Choose correct answer

1. A-iii, B-iv, C-ii, D-i
2. A-iv, B-i, C-ii, D-iii
3. A-ii, B-iii, C-iv, D-i
4. A-iv, B-iii, C-i, D-ii
5. Match the list

|  |  |
| --- | --- |
| Column 1 | Column 2 |
| 1. Increased prolactin
 | 1. Termination of pregnancy in bitches without side effects
 |
| 1. Cabergoline
 | 1. Treatment of pyometra in bitches
 |
| 1. Mifepristone
 | 1. Induction of estrus in bitches
 |
| 1. PGF2α
 | 1. Pseudopregnancy
 |

Choose correct answer

1. A-ii, B-iv, C-iii, D-i
2. A-iii, B-ii, C-iv, D-i
3. A-iv, B-iii, C-i, D-ii
4. A-iv, B-i, C-ii, D-iii
5. Match the list

|  |  |
| --- | --- |
| Column 1 | Column 2 |
| 1. Wry neck
 | 1. Sebaceous like secretion
 |
| 1. Rotation
 | 1. Commonest cause of dystocia in buffaloes
 |
| 1. Waxing
 | 1. Lateral deviation of neck
 |
| 1. Uterine torsion
 | 1. position
 |

Choose correct answer

1. A-ii, B-iii, C-iv, D-i
2. A-iii, B-i, C-iv, D-ii
3. A-iii, B-iv, C-i, D-ii
4. A-ii, B-iv, C-i, D-iii
5. Match the list

|  |  |
| --- | --- |
| Column 1 | Column 2 |
| 1. Dog sitting posture
 | 1. Second stage of labor
 |
| 1. Breech presentation
 | 1. Common dystocia in ewes
 |
| 1. Ring womb
 | 1. Hip flexion posture
 |
| 1. Ferguson’s reflex
 | 1. Ventro-verticle presentation
 |

Choose correct answer

1. A-iii, B-iv, C-ii, D-i
2. A-i, B-iii, C-ii, D-iv
3. A-ii, B-i, C-iv, D-iii
4. A-iv, B-iii, C-ii, D-i
5. Match the list

|  |  |
| --- | --- |
| Column 1 | Column 2 |
| 1. Pseudo cervix
 | 1. Cow
 |
| 1. Uterine cotyledons
 | 1. Bitch
 |
| 1. Longest uterine horns
 | 1. Mare
 |
| 1. Largest body of uterus
 | 1. Sow
 |

Choose correct answer

1. A-iii, B-ii, C-iv, D-i
2. A-ii, B-i, C-iv, D-iii
3. A-iii, B-ii, C-i, D-iv
4. A-iv, B-ii, C-iii, D-i
5. Match the list

|  |  |
| --- | --- |
| Column 1 | Column 2 |
| 1. Detection of free estrogen
 | 1. PSP dye test
 |
| 1. Tubal patency
 | 1. Cuboni test
 |
| 1. Trichomoniasis
 | 1. Bartlett test
 |
| 1. Endometritis
 | 1. White side test
 |

Choose correct answer

1. A-ii, B-i, C-iii, D-iv
2. A-i, B-iii, C-ii, D-iv
3. A-i, B-ii, C-iii, D-iv
4. A-ii, B-i, C-iv, D-iii
5. Match the list

|  |  |
| --- | --- |
| Column 1 | Column 2 |
| 1. Granulosa cells
 | 1. Activates LH surge
 |
| 1. Inhibin
 | 1. Lutein cells
 |
| 1. Estradiol
 | 1. Regulation of estrus in seasonal breeders
 |
| 1. Pineal gland
 | 1. Antral follicles
 |

Choose correct answer

1. A-ii, B-iv, C-i, D-iii
2. A-ii, B-iv, C-iii, D-i
3. A-iv, B-i, C-iii, D-ii
4. A-iii, B-iv, C-i, D-ii
5. Match the list

|  |  |
| --- | --- |
| Column 1 | Column 2 |
| 1. Mullerian duct
 | 1. ale
 |
| 1. Follicular fluid
 | 1. Differentiation and steroidogenic capacity
 |
| 1. Wolffian duct
 | 1. Ovulation
 |
| 1. LH surge
 | 1. Female
 |

Choose correct answer

1. A-ii, B-iv, C-i, D-iii
2. A-ii, B-iv, C-iii, D-i
3. A-iv, B-ii, C-i, D-iii
4. A-iii, B-iv, C-i, D-ii
5. Match the list

|  |  |
| --- | --- |
| Column 1 | Column 2 |
| 1. Infrared thermography
 | 1. Motile spermatozoa
 |
| 1. follicle dissection method
 | 1. Cooling capacity of testes
 |
| 1. Swim-up technique
 | 1. Oocyte collection
 |
| 1. Modified Friedman test
 | 1. Detection of eCG
 |

Choose correct answer

1. A-ii, B-iv, C-i, D-iii
2. A-ii, B-iii, C-i, D-iv
3. A-iv, B-ii, C-i, D-iii
4. A-iii, B-iv, C-i, D-ii
5. Match the list

|  |  |
| --- | --- |
| Column 1 | Column 2 |
| 1. Cloud burst
 | 1. Collection of oocytes from live animals
 |
| 1. TVOR
 | 1. Nuclear membrane disintegration
 |
| 1. TUNEL assay
 | 1. Pseudo pregnancy
 |
| 1. Germinal vesicle breakdown
 | 1. DNA status of spermatozoa
 |

Choose correct answer

1. A-ii, B-iv, C-i, D-iii
2. A-ii, B-iii, C-i, D-iv
3. A-iv, B-ii, C-i, D-iii
4. A-iii, B-i, C-iv, D-ii

**MULTIPLE CHOICE QUESTIONS**

1. Which of the following causes abortion in first trimester
2. Brucella
3. Listeria
4. Leptospira
5. Trichomonas
6. Foetus is defective in case of
7. Hydroallantois
8. Hydroamnios
9. Both
10. None of the above
11. Drugs that delay parturition
12. Isoxuprine
13. Carazolol
14. Oxytocin
15. Clenbuterol
16. a and b
17. b, c and d
18. a and d
19. a, b and c
20. which statements is correct

Statement 1- Sertoli cells secrete ABP, Inhibin,estrogen and Activin

Statement 2-Release of Spermatozoa into the lumen of seminiferous tubules is K/a

Spermiogenesis

1. Both statement1 and statement 2 are correct
2. Both statement1 and statement 2 are incorrect
3. Statement1 is correct but statement 2 is incorrect
4. Statement1 is incorrect but statement 2 is correct
5. Position of foetus is corrected by
6. Repulsion
7. Rotation
8. Force traction
9. Version
10. Line of treatment in endometritis
11. Oxytocin
12. PGF2α
13. oestrogen
14. Progesterone
15. Presentation of foetus is corrected by
16. Repulsion
17. Rotation
18. Force traction
19. Version
20. Which of the following are induced ovulatory
21. Dog
22. Cat
23. Rabbit
24. Camel
25. a and d
26. b and c
27. a, b and c
28. b, c and d
29. Large luteal cells of ovary secrete
30. estrogen
31. oxytocin
32. prolactin
33. progesterone
34. Seasonal polycyclic animals are
35. bitch
36. cow
37. mare
38. ewe
39. a, c and d
40. c and d
41. b and c
42. a, b, c and d
43. Progesterone is released from
44. corpus luteum
45. placenta
46. ovary
47. all
48. Main regulatory hormone that controls estrous cycle in sheep
49. estrogen
50. oxytocin
51. progesterone
52. prolactin
53. Foetal membrane slip is found during pregnancy at
54. 7-8 days
55. 14-15 days
56. 20-21 days
57. 45-46 days
58. In ov-synch estrous synchronisation protocol AI is done at
59. Same day of 2nd dose of GnRH
60. 10 – 18 hours after 2nd dose of GnRH
61. Same day of 2nd dose of PGF2α
62. 10 – 18 hours after 2nd dose of PGF2α
63. Vertebral column after thorax region is undeveloped in the condition
64. Schistosoma reflexus
65. Perosomus elumbis
66. Perosomus horridus
67. Achondroplasia
68. The born co-twin are asymmetrical in
69. Holocardium acardium
70. Free martin
71. Achondroplasia
72. Schistosoma reflexus
73. Multiple bended vertebral columns from occipital to sacrum and vertebrae are ankylosed and shortened in
74. Perosomus elumbis
75. Schistosoma reflexus
76. Perosomus horridus
77. Holocardium acardium
78. 3rd stage of parturition in mare last for
79. 2-8 hours
80. 3-10 hours
81. 0.5-3 hours
82. 2-3 hours
83. Hereditary causes of dystocia include
84. Hypoplasia of vulva or uterus
85. Uterus unicornis
86. Vitamin A deficiency
87. Endometritis
88. a, b and c
89. a and b
90. c and d
91. a, c and d
92. Seminal vesicle is developed from
93. Foetal glands
94. Genital tubercle
95. Mesonephric duct
96. Mesonephric tubules
97. What is the correct order of occurrence of 4 phases of oestrus cycle
98. Proestrus-Oestrus-Dioestrus-Metestrus
99. Oestrus- Metestrus- Proestrus- Dioestrus
100. Proestrus-Oestrus- Metestrus- Dioestrus
101. Dioestrus-Metestrus -Proestrus-Oestrus
102. Prostate and bulbourethral gland develops from
103. Genital tubercle
104. Genital swelling
105. Genital sinus
106. Genital fold
107. pH of secretions from seminal vesicles is
108. Acidic
109. Alkaline
110. Neutral
111. None
112. Gel portion of semen in boar that help to make cervical seal is secreted by
113. Seminal vesicle
114. Epididymis
115. Prostate gland
116. Cowper’s gland
117. Glans penis is absent in
118. Tom
119. Dog
120. Stallion
121. Bull
122. In case of post-pubertal castration which is correct
123. Libido is absent but ejaculation occurs
124. Libido is present and ejaculation occurs
125. Libido is present but ejaculation does not occur
126. Libido is absent and ejaculation does not occur
127. Arrange the following in sequence
128. Intromission
129. Ejaculation
130. Erection and protrusion
131. Mounting
132. Dismounting
133. a, c, b, d, e
134. c, d, a, b, e
135. d, b, c, a, e
136. c, a, d, b, e
137. Musculo-vascular penis is present in
138. Stallion
139. Bull
140. Ram
141. Dog
142. a and b
143. a, b and c
144. c and d
145. a and d
146. Impotentia coeundi involves
147. Unwillingness to mount
148. Inability in intromission
149. Inability to fertilize after normal service
150. Inability to ejaculate
151. a, b and c
152. a, b, c and d
153. a, b, and d
154. b, c and d
155. Dag defect occurs due to
156. Decreased concentration of Zn2+
157. Increased concentration of Zn2+
158. Decreased concentration of Mg2+
159. Increased concentration of Mg2+
160. Total average length of bull spermatozoan is
161. 4-5 µm
162. 10-12 µm
163. 20-40 µm
164. 60-70 µm
165. Stigma is the structure formed during the process of
166. Fertilization
167. Ovulation
168. Sperm penetration
169. Zona hatching
170. CO2 concentration that favours the metabolic rate of sperm is
171. 1-2 %
172. 5-10 %
173. 15-20 %
174. 20-25 %
175. Site of semen deposition in bovine in case of liquid semen and frozen semen is
176. Mid cervix and body of uterus
177. Body of uterus and mid cervix
178. External os and mid cervix
179. Uterine horns and body of uterus
180. Which of the following is permeating type of cryoprotectant
181. Glycerol
182. Sucrose
183. Trehalose
184. DMSO
185. Ethylene oxide
186. a, b and d
187. a, d and e
188. b, c and e
189. b, c and d
190. Cotyledonary placenta is found in
191. Ruminants
192. Equines
193. Carnivores
194. Humans
195. Physiological anestrum is observed during
196. Pregnancy
197. Pyometra
198. Mummification
199. pseudopregnancy
200. In which of the following animal’s testes are abdominal
201. sheep
202. rabbit
203. kangaroo
204. elephant
205. Gestation period of buffalo and mare are
206. 285 and 362 days respectively
207. 310 and 340 days respectively
208. 340 and 430 days respectively
209. 270 and 400 days respectively
210. Corpus luteum of pregnant animal is
211. CL hemorrhagicum
212. CL verum
213. CL gravitidis
214. CL spurium
215. Gestation period of elephant is
216. 250 ± 30 days
217. 350 ± 30 days
218. 450 ± 30 days
219. 650 ± 30 days
220. Which of the following combination is not correct
221. Bromocriptine – antiprolactin drug
222. Dinoprost – lutalyse
223. Diethylstilbesterol – estrumate
224. Buserelin acetate – GnRH analogue
225. Which of the following is progesterone antagonist
226. Gossypol
227. Mifepristone
228. Atosiban
229. Clomifen
230. Number of endometrial cups during pregnancy in mare is
231. 15 – 20
232. 5 – 10
233. 25 – 30
234. 1 – 2
235. Long half-life of eCG is due to presence of
236. Malic acid
237. Fumaric acid
238. Sialic acid
239. Acetic acid
240. Statement 1- An increase in the concentration of oestrogen in circulation causes an increase in the release of gonadotropins

Statement2- Progesterone decreases the sensitivity of the anterior pituitary to GnRH and decreases LH and FSH concentrations

1. Both statement 1 and statement 2 are correct
2. Both statement 1 and statement 2 are incorrect
3. Statement 1 is correct but statement 2 is incorrect
4. Statement 1 is incorrect but statement 2 is correct
5. Length of oestrus cycle in ewes
6. 17 – 25 days
7. 16 – 17 days
8. 12 – 14 days
9. 30 – 35 days
10. Luteolytic hormone in cattle is
11. Progesterone
12. estrogen
13. LH
14. FSH
15. Hippomanes is found in
16. Amniotic sac
17. Allantoic sac
18. Chorion
19. Both a and b
20. Nature of release of oxytocin during second stage of labour is
21. In spurts
22. In spurts and continuous
23. Continuous
24. Discontinuous
25. The maturation process which involves series of nuclear and cytoplasmic changes and the development of a tail in spermatid is known as
26. Spermiation
27. Spermiogenesis
28. Spermatidosis
29. Spermatogenesis
30. In bitches vaginal prolapse occur during
31. Proestus and estrus
32. Estrus and metestrus
33. Anestrus
34. Diestrus
35. Primary uterine inertia is common in
36. Mare
37. Doe
38. Cow
39. Canines
40. Which of the following is congenital condition affecting penis
41. Broken penis
42. Paraphimosis
43. Hypospadias
44. Priapism
45. Quality of semen collected in dairy bulls is better in
46. Massage technique
47. Artificial vagina method
48. Electo ejaculator method
49. Condom method
50. Minimum volume and concentration required to process bovine semen sample is
51. 7.5 ml, 1200 millions/ml
52. 2.5 ml, 500 millions/ml
53. 6 ml, 500 millions/ml
54. 3 ml, 750 millions/ml
55. In breeding bull semen, the head abnormality should not exceed
56. 7.5%
57. 10%
58. 12.5%
59. 15%
60. Gender selection of sperm can be done by
61. Time of insemination
62. Flow cytometry
63. PCR of individual sperm
64. Capacitation medium
65. Benzyl penicillin is added in the semen extender at the rate of
66. 1000 mg/ml
67. 1000 IU/ml
68. 1000 ng/ml
69. 1000 µg/ml
70. After parturition the best time to super ovulate the donor is
71. 20-30 days
72. 45-60 days
73. 90-100 days
74. 10-15 days
75. Weakest point of cryogenic container is
76. Canister
77. Goblet
78. Neck
79. Body
80. Male sex hormone, testosterone is secreted from
81. Sertoli cells
82. Leydig cells
83. Acinar cells
84. Myoid cells
85. Early embryo in uterus is nourished by
86. Yolk sac
87. Blastocoel
88. Histotrophic nutrition
89. Endometrium
90. Increase in progesterone level is required for ovulation in which species
91. Mare
92. Bitch
93. Cattle
94. Camel
95. Goat
96. A only
97. B only
98. C and D only
99. A, D and E only
100. Ovulation during primary oocyte stage occurs in which of the following species
101. Cow
102. Buffalo
103. Bitch
104. Mare
105. Goat
106. A and B only
107. C only
108. D only
109. A and E only
110. Spinnbarkeit test of cervical mucus is used to measure
111. pH
112. Viscosity
113. Elasticity
114. Fern pattern
115. Enzootic abortion in ewes is caused by
116. Campylobacter foetus foetus
117. Chlamydophila abortus
118. Ehrlichia ovina
119. Corynebacterium pseudotuberculosis
120. Primary uterine inertia can be treated with
121. Estrogen
122. Progesterone
123. PGF2α
124. Combination of oxytocin and calcium
125. Statement 1- oxytocin is secreted from hypothalamus in cattle

Statement 2- oxytocin is secreted from ovary in cattle

1. Statement 1 and 2 are correct
2. Statement 1 and 2 are incorrect
3. Statement 1 is correct and 2 is incorrect
4. Statement 1 is incorrect and 2 is correct
5. Split estrus is seen in
6. Mare
7. Sow
8. Buffalo
9. Goat
10. Prolonged estrus condition in cattle is seen in
11. Cystic follicle
12. Para ovarian cyst
13. Delayed ovulation
14. Luteal cyst
15. Free martin is associated with
16. Cystic ovary
17. Uterus unicornis
18. Ovarian hypoplasia
19. Paraovarian cyst
20. Shape of ovaries in swine
21. Almond shaped
22. Bean shaped
23. oval shaped
24. As bunch of grapes
25. Placenta of bitch is
26. Endotheliochorial
27. Zonary
28. Deciduate
29. Discoidal
30. Villous
31. A, B and C only
32. A, C and E only
33. B, C and D only
34. A, D and E only
35. Statement 1- Cryptorchid males can be used for breeding purposes

Statement 2- Bilateral cryptorchid males show more or less normal sexual behaviour but are sterile

1. Statement 1 and 2 are correct
2. Statement 1 and 2 are incorrect
3. Statement 1 is correct and 2 is incorrect
4. Statement 1 is incorrect and 2 is correct
5. Correct sequence of follicular dynamics in cattle is
6. Recruitment
7. Dominance
8. Selection
9. Ovulation
10. a, c, b, d
11. b, a, c, d
12. c, d, a, b
13. b, c, d, a
14. Which hormone can be used for superovulation in cattle
15. Estrogen
16. Progesterone
17. FSH
18. PMSG
19. GnRH
20. A, B and C only
21. B and D only
22. C and D only
23. A, D and E only
24. Arrange events of spermatogenesis in sequence
25. Acrosomal phase
26. Golgi phase
27. Cap phase
28. Maturation phase
29. C, B, A, D
30. B, C, A, D
31. A, B, C, D
32. C, A, B, D
33. Assertion (A)- Hydroamnios is the gradual accumulation of fluid in amniotic sac

Reason (R)- Hypertrophy of endometrial glands leads to increased secretion of viscous and transparent fluid in uterine lumen

1. Both (A) and (R) are true and (R) is correct explanation of (A)
2. Both (A) and (R) are true and (R) is not the correct explanation of (A)
3. (A) is true but (R) is false
4. (A) is false but (R) is true
5. Hormone that is primarily responsible for the onset of ovarian activity and puberty in animals is
6. LH
7. FSH
8. GnRH
9. Estrogen
10. Degree of proximity between maternal and foetal blood circulation in placenta of animals in decreasing order
11. epitheliochorial
12. hemochorial
13. endotheliochorial
14. syndesmochorial
15. b, c, d, a
16. a, c, d, b
17. b, d, a, c
18. c, a, b, d
19. Which of the following hormones are released in maximum amount during Ferguson’s reflex at parturition
20. Estrogen
21. Progesterone
22. Oxytocin
23. Thyroxin
24. Dairy cattle reach puberty at % body weight of adult
25. 50-60 %
26. 20-30%
27. 60-70 %
28. 30-40 %
29. Time of ovulation in mare is
30. 1-2 days before end of estrus
31. 10-15 hours after end of estrus
32. 30-36 hours after onset of estrus
33. 12-24 hours before end of estrus
34. Metestrus period is characterised by
35. Increase in level of both estrogen and LH
36. Increase in level of estrogen and fall in level of LH
37. Fall in level of both estrogen and LH
38. Fall in level of estrogen and increase in level of LH
39. Statement 1 – For effective functioning the mammalian testes must be maintained at a temperature higher than that of the body

Statement 2 – Anatomical features of the testes and scrotum permit the regulation of testicular temperature

1. Statement 1 and 2 are correct
2. Statement 1 and 2 are incorrect
3. Statement 1 is correct and 2 is incorrect
4. Statement 1 is incorrect and 2 is correct
5. Which hormone stimulates the expression of MUC-1 protein in endometrium
6. Progesterone
7. Estradiol
8. PGE2
9. All of the above
10. Coolidge effect in males is because of
11. Novel females
12. Increase receptivity in existing females in herd
13. Addition of new male animals in the herd
14. Both a and c
15. Cryptorchidism is commonly seen in
16. Boar
17. Dog
18. Stallion
19. All of the above
20. Number of motile spermatozoa for ideal conception in cattle in single dose of frozen semen contain
21. 5 million
22. 10 million
23. 15 million
24. 20 million
25. White side test involves
26. 5% NaOH
27. 5% Nacl
28. 2% Nacl
29. 2% NaOH
30. Steps involved in embryo collection are
31. Embryo collection
32. Estrus synchronisation of recipient and donor
33. Artificial insemination of donor
34. Superovulation
35. b, d, c, a
36. b, c, a, d
37. c, b, d, a
38. a, d, b, c
39. Hormone that promotes sperm transport is
40. Inhibin
41. FSH
42. Relaxin
43. Oxytocin
44. Swiss cheese appearance of endometrium indicates
45. Anestrus
46. Cystic ovarian disease
47. Paraovarian cyst
48. Cystic corpus luteum
49. Virgin heifer test is done for
50. Endometritis
51. Trichomoniasis
52. Leptospirosis
53. Pyometra
54. Statement 1- Bandles ring dystocia is a type of secondary uterine inertia in mare

Statement 2- Primary uterine inertia is more common in mare

1. Statement 1 and 2 are correct
2. Statement 1 and 2 are incorrect
3. Statement 1 is correct and 2 is incorrect
4. Satement 1 is incorrect and 2 is correct
5. At the time of cryopreservation primary site of cryoinjury in sperm is
6. Mitochondria
7. Acrosome
8. Middle piece
9. Sperm plasma membrane
10. Trans uterine migration of embryo occurs in
11. Mare
12. Sow
13. Cattle
14. Ewe
15. Bitch
16. a, b and e
17. a, c and d
18. a, b, d and e
19. b, c, d and e
20. Polyspermy is commonly seen in
21. Dog
22. Cattle
23. Horse
24. Swine

 100.First invitro fertilization buffalo calf produced was

1. Apoorva
2. Pratham
3. Samrupa
4. Noori

**ANSWER KEY**

 **FILL IN THE BLANKS**

1. Ruminants
2. Corpus luteum spurium
3. Mifepristone
4. 4 hours
5. 30 – 48 hours
6. Boar
7. 24 hours
8. Zonary
9. Hydro allantois
10. Areolae
11. Rodents, rats, primates
12. 17-α-hydroxylase
13. 16-17 days
14. Hydramnios
15. Oestrogen
16. Neilson’s method
17. Atlanto-occipetal joint
18. Reduction, Reposition, Retention
19. Mesodermal
20. Endodermal
21. Tunica albuginea
22. Colliculus seminalis
23. Diadem effect
24. Ergothionine
25. Inositol and ergothionine
26. Reaction time
27. Pederasty
28. Onanism
29. Dag defect
30. Sucrose, trehalose
31. Oxytocin
32. Foeto-pelvic disproportion
33. Uteroferrin
34. 2500 – 3000 IU
35. Rig
36. 1500 million
37. ZP3
38. Interferon - τ
39. oestrogen and PGF2α
40. Prolactin inhibitors

**MATCH THE FOLLOWING**

1. d
2. c
3. c
4. d
5. b
6. a
7. a
8. c
9. b
10. d

**MULTIPLE CHOICE QUESTIONS**

1. d
2. b
3. c
4. c
5. b
6. b
7. d
8. d
9. d
10. b
11. d
12. c
13. d
14. b
15. b
16. a
17. c
18. c
19. b
20. c
21. c
22. c
23. b
24. d
25. a
26. c
27. b
28. d
29. c
30. b
31. d
32. b
33. b
34. a
35. b
36. a
37. a
38. d
39. b
40. b
41. d
42. c
43. b
44. b
45. c
46. a
47. b
48. b
49. b
50. c
51. b
52. a
53. d
54. c
55. b
56. b
57. a
58. b
59. b
60. c
61. c
62. b
63. c
64. b
65. b
66. c
67. b
68. d
69. a
70. a
71. c
72. c
73. d
74. a
75. d
76. a
77. c
78. b
79. a
80. a
81. a
82. c
83. c
84. a
85. c
86. d
87. a
88. a
89. d
90. d
91. a
92. a
93. d
94. b
95. b
96. b
97. d
98. c
99. d

100.b