

MBTCR 9261T:

Developmental Biology and Neuroscience

No. of Credits	6
Theory/Composite	Theory
No. of periods assigned	6 Theory

Course description/objective:

The course is designed to

1. provide a comprehensive understanding of the principles of developmental biology and the process of development of tissues and organs.
2. provide holistic concept of reproductive health and current issues in reproduction biology, including assisted reproduction techniques.
3. enable students to understand the processes of regeneration and senescence and the various molecular mechanisms underlying animal behaviour.
4. provide an overview of stem cell biology and applications of the same for research and therapeutic purposes.
5. familiarise students with diverse neuro-ethological perspectives, modern neurocognitive aspects, implication of circadian disorders, neurological and neurodegenerative disorders.
6. thus acclimatize the students with in-depth knowledge of the various aspects of developmental biology and neurobiology.

Syllabus:

Module A (40 marks)

(3 classes/week)

UNIT I: Reproductive Health and Modern trends in Reproduction

Reproductive System and health: (a) Basic patterns of animal reproduction, functional anatomy of human reproductive system, human reproductive cycle (b) Reproductive Endocrinology (c) Male and female Infertility, Semen analysis.

Gametogenesis: (a) Process of gametogenesis (b) Ultrastructure of gametes (c) Egg membranes.

Fertilization and Cleavage: (a) Role of capacitation (b) Mechanism of fertilization, prevention of polyspermy (c) Role of cleavage and blastulation, fate map in chick blastula.

Modern trends in Reproduction: (a) Assisted reproduction techniques in human (b) Prenatal and Postnatal diagnosis (c) Reproductive toxicology.

UNIT II: Neuro-Ethological Perspectives

Neuroethology: (a) Concept of neurocognition and metacognition, neural control of emotion (b) modern neurocognitive aspects.

Learning and memory: (a) Instinctive and learning behavior, fixed action pattern (b) memory, synaptic plasticity.

Chronobiology: (a) Types of biological rhythms, physiological basis of biological clock (b) human circadian rhythms and related disorders, chronotherapy.

Neurological disorders and stress: (a) Overview of neurological and neurodegenerative disorders, importance of neurotransmitters in neurological health (b) Neurohormonal regulation of stress, importance of mind-body therapeutics.

Module B (40 marks)

(3 classes/ week)

UNIT III: Morphogenesis and Organogenesis

Morphogenesis: Morphogenetic movements, gastrulation and formation of germ layers in amphibians, birds and mammals. The Organizer Concept: Spemann's experiments, embryonic induction and organization of the organizer, competence, potency and differentiation.

Organogenesis and Development: (a) Cell aggregation in Dictyostelium (b) Paracrine signalling and vulva formation in *C. elegans* (c) Gene regulation during development: Segmentation in *Drosophila*, homeotic gene complexes and the Hox genes (d) limb development in vertebrates (e) Development of the brain, formation and differentiation of the neural tube and tissue architecture of the CNS (f) Development of the vertebrate eye (retina, lens and cornea).

Environmental regulation of development: Environmental regulation and disruption of normal development, polyphenism, endocrine disruptors and teratogenic agents.

UNIT IV: Regeneration and Senescence

Stem Cell Biology: Embryonic and adult stem cells, induced pluripotent stem cells, general and cell lineage markers, self renewal factors in stem cells. Stem cell therapies: cell based therapies, therapeutic cloning, cord blood stem cells. Ethical issues related to stem cell research.

Regeneration: Epimorphosis, morphallaxis and compensatory regeneration with examples.

Ageing: ageing and biology of senescence, mitochondrial control of ageing, insulin pathway in ageing, environmental control of ageing.

UNIT V: Genetic and Molecular Basis of Behaviour: Neural pathways and molecular basis of learning, brain mapping.

Texts & Reading/Reference Lists:

- 1) A.C. Guyton, J.E. Hall. Textbook of Medical Physiology.
- 2) B.M. Koeppen, B.A. Stanton. Berne and Levy Physiology.
- 3) G.G. Matthews. Neurobiology.
- 4) M.M. Cox, D.L. Nelson. Lehninger Principles of Biochemistry.
- 5) B.I. Balinsky. An Introduction to Embryology.
- 6) B.M. Carlson. Foundations of Embryology.
- 7) S.F. Gilbert. Developmental Biology.
- 8) L.A. Dugatkin. Principles of Animal Behaviour.
- 9) J. Alcock. Animal Behaviour.
- 10) Relevant scientific literature.

Q.Paper Structure for End Sem Theory

Module A (40 marks):

Subjective Questions:

Answer any 1 out of 2 questions. 10 x 1 = 10 marks

Answer any 3 out of 5 questions. 10 x 3 = 30 marks

Module B (40 marks):

Objective Questions: Answer any 5 out of 6 questions. 2x5 = 10 marks

Subjective Questions: Answer any 3 out of 5 questions (with subparts). 10 x 3 = 30 marks

-----X-----