NS/301: IMMUNOLOGY

Note: This paper has been designed to provide an exposure to fundamental concepts of immunology from anatomy to clinical aspects. The student is expected to have an understanding of the subject to an extend to be able to comprehend the bases of immunological disorders in general and the brain in particular.

UNIT I
Immunology - fundamental concepts
Innate and acquired immunity, components of innate and acquired immunity, antibody structure, antigen-antibody interactions; Cells and organs of the immune system and regulation of immune response.

UNIT II
Cellular basis of immunity
Cellular basis of adaptive immunity, B-cell and antibodies; Generation of antibody diversity; T cells and MHC proteins; Helper T cells and lymphocytic activation

UNIT III
Immunity to infection
Bacterial, viral, fungal and parasitic infections (with examples from each group). Overview of multiple sclerosis and autoimmune disease. Mechanisms of neuroinflammation; Role of astrocytes, Schwann cells and microglia.

UNIT IV
Clinical Immunology
Hypersensitivity. Autoimmunity, Transplantation, Tumor immunology and Immunodeficiency; Neuro-AIDS.

UNIT V
Immunotechnology
Hybridoma technology, Monoclonal antibodies, Immunochemical techniques antigen-antibody interactions and various cellular techniques; Vaccines, DNA vaccines

Suggested Books:

NS/302: SENSORY AND MOTOR SYSTEMS

Note: The basic senses-somatic sensations, olfaction, vision, audition, etc. all vary from one another. However, a few fundamental rules are followed by the brain in handling each of these diverse modalities. The central circuitry for sensory processing has well-organized maps which further determine interactions within and among the major categories of sensation. In this paper the students are expected to gain basic knowledge on neurobiology of sensation with the importance of structure-function relationships.

Every conscious or unconscious behaviour is regulated by the brain and the spinal cord based on a set of muscular contractions. Thus understanding of the spinal circuitry that makes elementary reflex movements possible and the way the brain governs successful performance of complex motor acts is essential.

The students shall be provided basic overviews on sensory and motor systems.

Unit-I
Transduction and processing of sensory signals - Basic Principles: Sensation and perception, Receptors, Parallel processing, Central processing, Common anatomical plan, Structure, function & connections of sensory cortex.
Sensory Transduction: Phototransduction, olfactory transduction, taste, mechanoreception.
Somatic sensation: Peripheral mechanisms of somatic sensation, Spinal and Brainstem components of somatosensory system, Thalamic ventrobasal complex, somatosensory areas of cerebral cortex.

Unit-II
Touch: Role of dorsal root ganglia cells in somatic sensory system, mechanoreceptors and other receptors, Primary somato-sensory cortex and information processing on touch, representation of body surfaces in the brain, cortical responses to stimuli.
Pain: Nociceptors, hyperalgesia, control of pain, opioid peptides and pain
Taste: Taste receptors and taste buds, turnover & replacement, Innervation by cranial nerves, flow of gustatory afferent information, Extraction of sensory information, Tuning of peripheral taste fibers; Gustatory neuron types, Modulation of taste activity in the Medulla

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Unit IV
Fundamentals of Motor Systems: Spinal cord as central pattern generator; Reflexes and locomotion. Brain projections to spinal cord: Posture and voluntary movements, Basal nuclei and cerebellum; Focusing and coordinating movement.

Muscle. Motor neurons and Motor neuron pools; Skeletal muscle, Motor Units, Motor neuron pools, Muscle afferents.


Supraspinal Descending Control: The medial “Postural” System: Ablation and transection studies; Sensory information about head posture. Postural reflexes of the head and the body, the role of Brainstem in controlling coordinated postural reactions, vestibular damage & disorders of the postural control.

Unit V
Voluntary Descending Control: Cortical pathways to Motor Neurons; Organization of the Motor cortex, Control of voluntary movements by the motor cortex.


Suggested Text Books

Unit-V

Why and how male and female brains differ?

Motivation & Reward:
- Neural Mechanisms of Motivation, Dopamine and Lateral Hypothalamic Syndrome.
- Reinforcement System
- Brain Aversion Systems
- Plasticity of nervous system
- Addiction

Suggested Text Books

NS/304: BEHAVIOUR AND COGNITIVE NEUROSCIENCE

Note: It is expected that in this paper the students will be exposed to the basic understanding of evolution of human brain and behaviour, cellular and genetics aspects of behaviour, cognitive development, neural control of attention, language acquisition and language processing, learning and memory, and cognitive functions like thought and consciousness. While this is the front line of neuroscience research today the students will be given the basic elementary exposure to the subject to stimulate them to undertake further research in this challenging area, it is essential to repeat that only introductory aspects of the subject shall be dealt.

Unit-I

- Human Brain Evolution
- Evolutionary and comparative principles, mammalian evolution
- Cognitive development and aging
- Brain and cognitive development
- Aging and cognition
- Pathological processes in cognitive development and aging

Unit-II

- Visual perception of objects
- Neuronal basis of object recognition
- Perception and recognition of specific classes of objects
- Spatial cognition
- Neural system of spatial cognition: Parietal cortex, Frontal cortex, Hippocampus and adjacent cortex

Unit-III

- Attention
- Verities of attention and Neglect syndrome
- Visual system and attention
- Language and communication
- Animal communication
- Human language

Unit-IV

- Learning and Memory: Basic Systems
- Basic mechanisms of learning, key insights from invertebrate studies
- Long-term potentiation
- Classical conditioning in vertebrates
- Mechanism of memory storage

Unit-V

- Learning and memory: Brain systems
- Major memory systems in mammalian brain
- Multiple memory systems and behaviour
- Executive brain functions
- Consciousness

Suggested Text Books

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LABORATORY COURSE - V: NS/305: NEUROPATHOLOGY
1. Neurotoxicological studies using animal models
2. Study of developing rat nervous system: Normative and under exposure to toxic agents
3. Study of pathological tissue from different pathological conditions
4. Study of permanent slides
5. Visits to neurology and neurosurgery clinics
6. Histopathological methods for analysis of pathological tissues
7. Study of neurodegenerative models, e.g., nerve injury models

LABORATORY COURSE - VI: NS/306: BEHAVIOUR BIOLOGY
1. Automated exploratory behaviour recording using activity monitor
2. Assessment of neuromuscular function/performance using Grip Strength Meter
3. Studies on locomotory behaviour in rats
4. Studies on learning behaviour using T-maze
5. Studies on learning behaviour using Y-maze
6. Studies on locomotory development like: pivoting, traversing, homing, etc.
7. Exploratory behaviour of young and old rats
8. Maternal behaviour in rats and mice
9. Nesting behaviour in birds
10. Study of museum specimens for adaptations

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