

# Pre-Clinical Masterclass 2020/21

*The following 12 Core Subjects are covered:*

## Cells and Genetics

- **Cells:** organelles, cell junctions and key cell-signalling pathways.
- **Metabolism:** glycolysis, anaerobic respiration, fat metabolism, Krebs cycle, and ATP generation.
- **Cell cycle:** principles and key regulation points.
- **Genetics:** oncogenes, tumour suppressor genes, structure and replication of DNA, protein synthesis, mitosis, and meiosis.

*The following notes are found as additional material in the 'Cells & genetics' handout. And is covered as 'Cancer biology' lecture*

- **Tumour biology:** definitions, features of malignancy, and angiogenesis.
- **Metastasis:** sequence and common examples.
- **Oncogenes:** principles, major pathways and viral-induced malignancy.
- **Tumour suppressor genes:** principles and major pathways.
- **Treatment:** principles of chemotherapy, hormone therapy, and radiotherapy.

## Pharmacology

- **Receptors and signalling:** types of receptor-drug interactions and G-proteins.
- **Pharmacokinetics:** absorption, volume of distribution, elimination, and CYP450 system.
- **Dose-response relationships:** agonist/antagonist/response graphs.

## Neuromuscular System

- **Anatomy:** spinal cord, upper limb, lower limb, neck and abdominal wall.
- **Neurones:** microanatomy, membrane potentials, action potentials, synapses and local anaesthetics.
- **Reflexes:** monosynaptic and polysynaptic.
- **Autonomic nervous system:** anatomy and physiology of sympathetic and parasympathetic systems.
- **Muscle fibres:** ultrastructure, neuromuscular junction, excitation-contraction coupling, and sliding filament hypothesis.
- **Bones:** structure, physiology of bone turnover, and classification.

## Respiratory System

- **Anatomy:** chest wall, lungs and surface anatomy, microanatomy of the airways, upper airways and larynx.
- **Gases & ventilation:** principles of gas movement and ventilation, compliance, role of surfactant, resistance, flow limitation, and COPD.
- **Gas exchange and transport:** alveolar gases, haemoglobin, oxygen transport, and CO<sub>2</sub> transport.
- **Respiratory failure:** ventilation-perfusion mismatch and causes of respiratory failure.
- **Control of respiration:** chemoreceptors and central processing.

## Endocrine System

- **Pituitary:** anatomy, hormones produced, and hypothalamic control.
- **Thyroid:** anatomy, thyroid hormone synthesis, actions, hyper-/hypo-thyroidism, and goitre.
- **Parathyroid:** anatomy, feedback, and calcium regulation.
- **Adrenals:** anatomy, control, steroid hormone synthesis, and actions.
- **Endocrine pancreas & diabetes:** microanatomy, hormone control, insulin release, and overview of diabetes.

## Digestive System

- **Enteric nervous system:** overview, smooth muscle, and control of the ENS.
- **Salivary glands:** anatomy and secretion mechanism.
- **Abdominal anatomy:** boundaries, peritoneum, omenta, and sacs.
- **Stomach:** anatomy, acid secretion and control.
- **Small bowel:** anatomy, absorption of macronutrients, iron, and vitamin B<sub>12</sub>.
- **Pancreas:** anatomy, secretions and pancreatitis.
- **Large bowel:** anatomy, functions and defecation.
- **Liver:** anatomy, microanatomy, functions, bile acids, and bilirubin metabolism.
- **Emesis:** physiology and pharmacology.

## Central Nervous System

- **Anatomy:** skull and meninges, ventricles, arterial & venous systems, key neural structures, and cranial nerves.
- **Sensory pathways:** spinothalamic, dorsal columns, pain, sight, and hearing.
- **Motor pathways:** corticospinal, cerebellum, basal ganglia, and Parkinson disease.
- **Higher functions:** speech and consciousness.

## Cardiovascular

- **Anatomy:** surface anatomy, mediastinum, cardiac structure, and coronary anatomy.
- **Myocytes:** ultrastructure, membrane physiology, and control of heart rate.

- **Cardiac cycle:** Frank-Starling law and heart failure.
- **Blood pressure:** vessel haemodynamics, baroreflex, arterioles, and anti-hypertensives.
- **Coronary circulation:** flow dynamics and metabolic hyperaemia.
- **Capillaries:** structure, Starling's forces, and lymphatic system.

## Renal System

- **Anatomy:** kidney, ureters, bladder, and prostate.
- **Filtration:** glomeruli, ultrafiltration, and regulation.
- **Renin-angiotensin-aldosterone system:** principles and acute kidney injury (renal failure).
- **Volume regulation:** Loop of Henle, osmoregulation, and diuretics.
- **Re-absorption:** sodium, potassium, urea, bicarbonate, and acid-base.

## Immunology

- **Bacteria:** prokaryotes and acute phase response (complement, macrophages, neutrophils).
- **Lymphocytes:** selection, antigen presentation, HLA, spleen, antibodies, and interaction with macrophages.
- **Viruses:** structure and viral response.
- **Haemostasis:** clotting, fibrinolysis, platelets and anticoagulants.

## Reproductive system

- **Anatomy:** male reproductive system, female reproductive system, and inguinal canal.
- **Female:** oogenesis, menstrual cycle, and folliculogenesis.
- **Male:** HPG axis and spermatogenesis.
- **Fertilisation & early embryology:** fertilisation, blastocyst development, gastrulation, and the three germ layers.
- **Placenta:** structure and function.
- **Labour:** overview and regulation.
- **Foetal physiology:** foetal cardiovascular system and changes at birth.

## Cancer Biology

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- **Treatment:** principles of chemotherapy, hormone therapy, and radiotherapy.