COLLEGE OF INTENSIVE CARE MEDICINE
OF AUSTRALIA AND NEW ZEALAND

Syllabus for the First Part Examination of the Basic Sciences for Intensive Care Medicine

Fifth Edition (2025)

Foreword

This document represents the fifth edition of the *Syllabus for the First Part Examination of the Basic Sciences for Intensive Care Medicine*. The current review has focused on refining and streamlining both the content and its presentation to better support candidates in their preparation. Several sections from previous editions have been consolidated to improve clarity and coherence—for example, liver physiology is now included under the *Gastrointestinal System*, and immunology has been incorporated within the *Haematological System*. Similarly, anatomy and measurement topics have been integrated into the organ system subsections to which they are most relevant.

Topics continue to be organised according to major organ systems and include the associated anatomy, physiology, measurement, and pharmacology. The *Respiratory* and *Cardiovascular* sections feature subheadings to reflect the more detailed knowledge and understanding expected in these areas.

The First Part Examination maintains its emphasis on an integrated approach to the study and assessment of the Basic Sciences as they relate to Intensive Care Medicine. It is intended that this syllabus be reviewed every five years, or sooner if significant updates are warranted.

Finally, the quality and utility of this document have been made possible through the contributions of numerous individuals, including those involved in the development of previous editions, candidates who have provided feedback after sitting the CICM First Part Examination, past and current CICM First Part Examiners, and all others acknowledged within this document.

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Chair
First Part Examination Committee
College of Intensive Care Medicine

Contributors and Acknowledgements

The strength, relevance, and enduring value of this fifth edition of the *Syllabus for the Basic Sciences in Intensive Care Medicine* are grounded in the significant contributions of the individuals listed below. It is essential that their names be included—not only to formally acknowledge their invaluable input, but also to instill confidence in current and future trainees who rely on this document to guide their study of the Basic Sciences as they apply to Intensive Care Medicine.

The following individuals served as an expert review panel for this edition.

Dr Naomi Pallas
Dr Melita Trout
Dr Patricia Hurune
Dr Sam Marment

In addition, acknowledgment is given to the First Part Examination Court of Examiners.

Special thanks are also extended to the College examinations staff—Paisiri Subaram and Emma Wells—for their assistance in collating and reviewing the revised syllabus.

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Learning Objectives for the First Part Examination

Introduction

The syllabus and its learning objectives are designed to provide a guide for:

- Trainees in preparation for the First Part Examination
- Supervisors of training and trainee educators
- First Part Examiners

The syllabus ensures that trainees, educators, and examiners work from a common foundation. All examinations are derived from and based on the syllabus. These learning objectives are designed to outline the minimum level of understanding required for each topic. The accompanying texts are recommended on the basis that the material contained within them provides sufficient information for trainees to meet the learning objectives. Trainees are strongly encouraged to explore the existing and evolving body of knowledge of the Basic Sciences as they apply to Intensive Care Medicine by reading widely around listed texts and web resources.

The syllabus provides a common foundation for trainees, educators, and examiners, ensuring alignment in teaching, learning, and assessment. All examinations are developed from and aligned with the content of the syllabus. The learning objectives specify the minimum required level of understanding for each topic.

Trainees are strongly encouraged to engage with the broader and continually evolving body of knowledge in the Basic Sciences as it relates to Intensive Care Medicine. The recommended texts have been chosen as they generally provide sufficient content to support the attainment of the specified learning objectives though some may require additional reading beyond the listed texts and websites.

For all sections of the syllabus, a thorough understanding of normal physiology and pharmacology is expected, along with their variation within the following contexts:

- *extremes of age (neonates, paediatrics and the elderly)*
- *extremes of body size (obesity)*
- *pregnancy including parturition and foetal*
- *critical illness including sepsis, cardiac, respiratory, liver and renal failure.*

Glossary of Terms used in the First Part Examination

Throughout this document, specific terms are used within the required abilities to indicate the expected level of knowledge. A glossary of these terms is provided below. These terms are also used in the examination and define both the breadth and depth of knowledge required, as well as the expected structure for its presentation.

Calculate	Work out or estimate using mathematical principles. Show the relevant stages of the process in the working.
Classify	Divide into categories. Organise and arrange ideas, items or objects into groups according to their similarities.
Compare and contrast	Examine the similarities and differences including the context(s) in which they arise or are observed.
Define	Give the precise meaning.
Describe	Give a detailed account of. Provide details on the characteristics and features.
Explain	Relate cause and effect. Make the relationships between things evident. Provide why and/or how.
Interpret	Demonstrate the meaning or significance in the context provided.
List	Provide an itemised, concise series of points.
Outline	Provide a summary of the important points. Requires an overview of the main characteristics and features without the finite or minor details.
Relate	Show a connection between. Explain how concepts or items are connected to each other and to what extent they are alike or affect each other.
Understand	Appreciate the details of; comprehend. Examine the impact of. Demonstrate the application of knowledge to new concepts or situations.

Notes on Pharmacology

This document is intended to provide a guide to the minimum breadth and depth of knowledge required for certain drugs or classes of drugs that are relevant to the CICM First Part Examination and the practice of General Intensive Care.

Trainees are expected to understand a drug's pharmacology in the context of normal physiology, along with the variation within the following contexts:

- *extremes of age (neonates, pediatrics and the elderly)*
- *extremes of body size (obesity)*
- *pregnancy including parturition and foetal*
- *critical illness including sepsis, cardiac, respiratory, liver and renal failure.*

An understanding of potential toxicities and their corresponding antidotes is also expected. Agents may appear in multiple sections when used for different indications. Each drug or drug class has been assigned a specified level of understanding, as outlined below. This serves as a guide to the minimum knowledge required for that drug. For drug classes without specified examples, it is recommended that a prototypical agent from the class be studied, alongside relevant variations, with a focus on the key differences among the agents within that class.

Levels of Pharmacology Knowledge

Level 1
For these drugs, a detailed knowledge and comprehension of the following is required:

- Class, indications, and dose
- Pharmaceutics – including the relevant packaging considerations, formulation, isomerism and significance, compatibility and excipients
- Mechanism of action
- Pharmacodynamics and adverse effects
- Pharmacokinetics

Level 2
For these drugs, a detailed knowledge and comprehension of the following is required:

- Class, indications, and dose
- Mechanism of action
- Pharmacodynamics and adverse effects
- Important pharmacokinetic considerations or differences when using in the ICU.

Level 3
For these drugs, a detailed knowledge and comprehension of the following is required:

- Class and indications
- Mechanism of action
- Pharmacodynamics and adverse effects

Recommended Texts

Candidates are encouraged to use the most recent version of each of the following texts. Most are available online in ANZCA library which can be accessed via the CICM website.

General Physiology

Good introductory textbooks include:

"Principles of Physiology for the Anaesthetist" by Kam and Power
OR
"Textbook of Medical Physiology" by Guyton and Hall
OR
"Medical Physiology" by Walter Boron and Emile Boulpaep
OR
"Ganong's Review of Medical Physiology" by Barrett et al

Respiratory Physiology

"Nunn's Applied Respiratory Physiology" by Lumb
AND
"Respiratory Physiology – the essentials" by West

Cardiovascular Physiology

"Cardiovascular Physiology" by Pappano and Wier

Renal Physiology

"Vander's Renal Physiology" by Eaton and Poole

Pharmacology

"Pharmacokinetics made easy" by Birkett and Australian Prescriber
AND
"Drugs in Anaesthesia and Intensive Care" by Smith et al
AND
"Basic and Clinical Pharmacology" by Katzung et al.
OR
"Applied Pharmacology in Anaesthesiology and Critical Care" by Milner and Welch
OR
"Pharmacology for Anaesthesia and Intensive Care" by Peck and Hill

Measurement

"Physics and Measurement for Anesthesia" by McLintic et al
OR
"Basic Physics and Measurement in Anaesthesia" by Davis and Kenny
OR
"Physics in Anaesthesia" by Middleton et al.

Anatomy

"Applied Anatomy for Anaesthesia and Intensive Care" by Georgiou, Thompson & Nickells
AND
"Gray's Anatomy for Students" Drake et.al

Blood

"Australian Red Cross Blood Service" (http://www.transfusion.com.au) AND
"New Zealand Blood Service" (http://www.nzblood.co.nz)

Additional texts with useful sections

Antibiotic Chapter of "Therapeutic Guidelines" available online: https://tgldcdp.tg.org.au/index

MimsOnline for individual drug details available online: https:mimsonline.com.au

"Oh's Intensive Care Manual" Handy et.al. *(*particularly useful for monitoring devices and waveform interpretation).

Please note: Online non-peer reviewed sources may not be reliable and hence have not been included on the recommended reading list. Care should be taken to confirm the accuracy of any online material. The exam is prepared and marked using the recommended texts provided and online peer-reviewed sources, as such these should not be considered the definitive source material.

Section A: Cellular Physiology

i. Describe the structure and functions of the following cellular components:
   a. cell membrane
   b. nucleus
   c. mitochondria
ii. Outline the role of other intracellular organelles including:
   a. golgi apparatus
   b. ribosomes
   c. endoplasmic reticulum
   d. cytoskeleton
iii. Outline the classification and function of cellular receptors.
iv. Explain the mechanisms of transport of substances across cell membranes,
v. Describe the Gibbs-Donnan effect.
vi. Describe the mechanisms by which cells maintain homeostasis and integrity.

Section B: Concepts in Pharmacology

B1: Pharmacokinetics

i. Explain the single and multiple compartment pharmacokinetic models.
ii. Describe the absorption of drugs and factors that influence this.
iii. Describe the distribution of drugs and factors that influence this.
iv. Describe the mechanisms of drug metabolism and clearance.
v. Describe the concept of effect-site concentration
vi. Describe the concept of context sensitive half-time.
vii. Compare the kinetics of an intravenous bolus dose (and dosing regimen) and a continuous infusion.
viii. Explain clinical drug monitoring including the relevance of:
    a. peak and trough concentrations
    b. minimum therapeutic concentrations

B2: Pharmacodynamics

i. With respect to receptor theory, explain the concepts of drug action, including the following:
    a. law of mass action
    b. affinity
    c. association and dissociation constants
ii. Explain drug actions with respect to the following:
    a. enzyme interactions
    b. physico-chemical interactions
    c. receptor interactions, including:
        i. ion channels and fluxes
        ii. second messengers and G-proteins
        iii. nucleic acid synthesis
        iv. regulation of receptor number and activity
        v. structural relationships between receptors and ligands
iii. Define and explain dose-effect relationships of drugs, including dose-response curves, with reference to:
    a. graded and quantal response
    b. therapeutic index and therapeutic window
    c. intrinsic activity, potency and efficacy and their relevance to:
        i. agonists
        ii. competitive and non-competitive antagonists
        iii. partial agonists
        iv. mixed agonist-antagonists
        v. inverse agonists

B3: Variability of Drug Response

i. Classify and describe adverse drug reactions.
ii. Classify and describe mechanisms of drug interactions.
iii. Describe variability in drug responses due to physiological changes with reference to the following:
    a. extremes of age (neonates, pediatrics and the elderly),
    b. extremes of body size (obesity),
    c. pregnancy including parturition and foetal,
    d. critical illness including sepsis, respiratory, cardiac, liver and renal failure
iv. Define tachyphylaxis, tolerance, addiction, dependence and idiosyncrasy.
v. Describe the mechanisms of tolerance.
vi. Outline the relevance of genetics to variability of drug response including the significance of the following pharmacogenetic disorders:
    a. malignant hyperthermia,
    b. atypical cholinesterase.
vii. Explain isomerism and its clinical importance with examples.

Section C: Respiratory System

C1: Anatomy of the Respiratory System

i. Describe the structure and function of the upper and lower airways including the alveolus.
ii. Describe the structure of the chest wall and diaphragm and relate this to respiratory mechanics.
iii. Outline the anatomy of the pulmonary and bronchial circulation.
iv. Compare and contrast the respiratory systems of the neonate and adult.
v. Describe the anatomy relevant to the following procedures:
    a. insertion of an intercostal catheter,
    b. endotracheal intubation,
    c. cricothyroidotomy,
    d. percutaneous tracheostomy,
    e. bronchoscopy.

C2: Control of Ventilation

i. Describe the control of breathing and the factors that affect it.
ii. Describe the oxygen and carbon dioxide response curves, including how these may be used to assess the control of ventilation.

C3: Mechanics of Breathing

i. Describe the process of inspiration and expiration including the changes in the chest wall, diaphragm, pleura, and lung parenchyma.
ii. Describe the pressure-volume relationships of the respiratory system.
iii. Define and describe compliance (static, dynamic, and specific) including the factors that affect it and its measurement.
iv. Relate compliance to the elastic properties of the respiratory system.
v. Describe the pressure-flow and flow-volume relationships of the lung.
vi. Define and describe airway resistance and the factors that affect it.
vii. Explain the concept of time constants in relation to lung mechanics and ventilation.
viii. Explain the vertical gradient of pleural pressure, its significance and the effect of positioning.
ix. Describe surfactant including its production, composition and role.
x. Define and describe the work of breathing and its components.

C4: Lung Volumes and Capacities

i. State the normal values of lung volumes and capacities.
ii. Define the functional residual capacity of the lung and:
    a. describe its clinical significance,
    b. describe the factors that affect it,
    c. explain how it is measured.
iii. Define the closing capacity of the lung and:
    a. describe the clinical significance,
    b. describe the factors that affect it,
    c. explain how it is measured.

C5: Pulmonary Circulation

i. Describe the regulation of the pulmonary circulation including the role of endogenous nitric oxide.
ii. Define and describe pulmonary vascular resistance and the factors that affect it.
iii. Compare and contrast the pulmonary and systemic circulations.

C6: Ventilation-Perfusion (V/Q) Relationships

i. Describe the concepts of global and regional ventilation and perfusion and:
    a. describe the factors that affect these concepts,
    b. describe the West's zones of the lung and explain the mechanisms responsible for them,
    c. explain V/Q matching and mismatching,
    d. explain the effect of V/Q mismatch on oxygen transfer and carbon dioxide elimination.
ii. Define dead space and:
    a. describe its components,
    b. explain how these may be measured,
    c. describe the physiological impact of increased dead space.
iii. Explain the concept of shunt and:
    a. the physiological effects of shunt,
    b. how shunt may be measured.
iv. Define venous admixture and describe its relationship to shunt and V/Q mismatch.

C7: Gas Transport and Diffusion

i. Describe the movement of oxygen from the atmosphere to the cell including detail on oxygen carriage in the blood.
ii. Explain the oxy-haemoglobin dissociation curve and factors that may alter it.
iii. Describe the movement of carbon dioxide from the cell to the atmosphere including detail on carbon dioxide carriage in the blood.
iv. Explain the carbon dioxide dissociation curve and factors that may alter it.
v. Define diffusing capacity and explain its measurement.
vi. Explain perfusion-limited and diffusion-limited transfer of gases and the consequences of each.

C8: Applied Respiratory Physiology

i. Describe the physiological consequences of intermittent positive pressure ventilation and positive end-expiratory pressure.
ii. Explain the physiological effects of the following:
    a. hyperoxaemia,
    b. hypoxaemia,
    c. hypercapnoea,
    d. hypocapnoea.
iii. Explain the effects on respiratory anatomy and physiology of the following:
    a. extremes of age,
    b. extremes of body size including obesity,
    c. pregnancy,
    d. critical illness including sepsis, cardiac, renal and liver failure,
    e. changes in posture including proning,
    f. exercise.
iv. Outline the non-ventilatory functions of the lungs.
v. Describe the humidification of inhaled air and its importance.
vi. Describe the cough reflex including the relevant pathways and its role.

C9: Respiratory Measurement

i. Describe the measurement of the partial pressure of oxygen and/or carbon dioxide and oxy-haemoglobin and/or deoxy-haemoglobin saturation including:
    a. methods of measurement; pulse oximetry and co-oximetry,
    b. limitations and potential sources of error of each,
    c. methods used to minimise error and artefact including the need for calibration.
ii. Describe the measurement of exhaled carbon dioxide including:
    a. methods of measurement; qualitative and quantitative capnography,
    b. limitations and potential sources of error of each,
    c. methods used to minimise error and artefact including the need for calibration.
iii. Describe the measurement and interpretation of pulmonary function tests.

C10: Respiratory Pharmacology and Equipment

i. Understand the pharmacology of oxygen.
ii. Understand the methods of oxygen delivery including:
    a. high-flow nasal oxygen,
    b. non-rebreather mask,
    c. venturi mask,
    d. hudson mask,
    e. low flow nasal cannula.
iii. Understand the pharmacology of bronchodilator drugs and methods of delivery.
iv. Understand the pharmacology of inhaled pulmonary vasodilator drugs.
v. Understand methods of humidification including:
    a. passive – heat and moisture exchange devices,
    b. active – heated humidification devices.

Respiratory Pharmacopeia

Level 1	Oxygen
Level 2	Bronchodilators - anti-muscarinic agents - ipratropium, theophylline (aminophylline) - beta agonists - salbutamol
Level 3	Corticosteroids - inhaled - intravenous - oral Inhaled pulmonary vasodilators - nitric oxide - prostacyclin

Section D: Cardiovascular System

D1: Cardiovascular Anatomy

i. Describe the anatomy of the heart including the chambers, valves and pericardium.
ii. Describe the anatomy of the coronary circulation.
iii. Describe the structure of the excitatory elements of the heart including:
    a. Sino-atrial node,
    b. Atrio-ventricular node,
    c. Bundle of His,
    d. Purkinje Fibres.
    e. anatomical course of conduction.
iv. Describe the anatomy relevant to arterial cannulation of the following:
    a. Radial artery,
    b. Femoral artery,
    c. Brachial artery,
    d. Dorsalis Pedis artery.
v. Describe the anatomy relevant to central venous cannulation of the following:
    a. Femoral vein,
    b. Internal jugular vein,
    c. Subclavian vein,
    d. the antecubital fossa and upper arm veins – basilic, cephalic and brachial.

D2: Electrical Properties of the Heart

i. Explain the ionic basis and processes involved in the following:
    a. automaticity of cardiac pacemaker cells,
    b. excitation and relaxation of cardiac pacemaker cells,
    c. excitation and relaxation of cardiac muscle cells.
ii. Correlate the mechanical events of the cardiac cycle with the electrical and ionic events described above.

D3: Determinants and Control of Cardiac Output

i. Describe the normal pressure and flow patterns of the cardiac cycle.
ii. Define cardiac output, its components and describe the determinants of each.
iii. Describe the cardiac reflexes including;
    a. Baroreceptor reflex,
    b. Chemoreceptor reflex,
    c. Bainbridge reflex,
    d. Treppe (Bowditch) effect,
    e. Anrep effect.
iv. Explain the Frank-Starling mechanism and its relationship to excitation-contraction coupling.
v. Describe myocardial oxygen demand and supply and the factors that may alter each.
vi. Explain the cardiac output and vascular function curves and their correlation.
vii. Explain the pressure-volume relationships of the left and right ventricles and the clinical applications.
viii. Describe the factors that affect central venous and mixed venous oxygen saturation.

D4: The Peripheral Circulation

i. Explain the factors that determine systemic blood pressure and its regulation.
ii. Describe the physiological factors that may contribute to pulse variations in blood pressure.
iii. Describe total peripheral vascular resistance and the factors that affect it.
iv. Describe the regulation of the coronary circulation.
v. Describe the features of the capillary microcirculation, including mechanisms of fluid exchange and its regulatory controls.
vi. Contrast the capillary microcirculations of specialised vascular beds including, but not limited to, the pulmonary and renal capillary networks.

D5: Applied Cardiovascular Physiology

i. Explain the cardiovascular changes and compensatory responses in the following contexts:
    a. changes in posture – lying, sitting and standing,
    b. hypovolaemia,
    c. following a fluid bolus,
    d. anaemia,
    e. exercise,
    f. aging,
    g. pregnancy,
    h. obesity,
    i. critical Illness.
ii. Explain the physiological consequences of the following on the cardiovascular system:
    a. intermittent positive pressure ventilation,
    b. positive end-expiratory pressure,
    c. the Valsalva manoeuvre.

D6: Cardiovascular Measurement

i. Describe the principles and interpretation of the electrocardiogram (ECG) including:
    a. methods of measurement including the components of the ECG,
    b. limitations and potential sources of error and artefact including the need for calibration,
    c. methods used to minimise error and artefact,
    d. normal and abnormal values and waveforms where relevant.
ii. Describe the measurement and interpretation of blood pressure monitoring including:
    a. methods of measurement; invasive and non-invasive,
    b. limitations and potential sources of error of each,
    c. methods used to minimise error and artefact including the need for calibration,
    d. normal and abnormal values and waveforms where relevant.
iii. Describe the measurement and interpretation of central venous pressure monitoring including:
    a. method of measurement,
    b. limitations and potential sources of error,
    c. methods used to minimise error and artefact including the need for calibration,
    d. normal and abnormal values and waveforms where relevant.
iv. Describe the measurement and interpretation of cardiac output monitoring including:
    a. methods of measurement,
    b. limitations and potential sources of error,
    c. methods used to minimise error and artefact including the need for calibration,
    d. normal and abnormal values and waveforms where relevant.
v. Outline the principles of ultrasound including:
    a. The generation and detection of the ultrasound,
    b. The role of the following on the image produced:
        i. transducer properties including frequency,
        ii. image resolution,
        iii. reflection and scattering,
        iv. attenuation,
        v. refraction.
    c. Describe the Doppler Effect and its application for medical ultrasound in the intensive care unit.

D7: Cardiovascular Pharmacology

i. Understand the pharmacology of inotropes and vasopressors.
ii. Describe the structure-activity relationships of adrenergic drugs.
iii. Understand the pharmacology of anti-hypertensive drugs.
iv. Understand the pharmacology of anti-arrhythmic drugs.

Cardiovascular Pharmacopeia

Level 1	Adrenergic inotropes and vasopressors - adrenaline (epinephrine) - noradrenaline (norepinephrine) Non-adrenergic inotropes and vasopressors - phosphodiesterase III inhibitors – milrinone - vasopressin Antiarrhythmics - amiodarone - atropine - digoxin - magnesium - sodium channel antagonists - lignocaine
Level 2	Adrenergic inotropes and vasopressors - dobutamine - metaraminol Non-adrenergic inotropes and vasopressors - calcium sensitisers/PDE inhibitors – levosimendan Antihypertensives - beta antagonists – esmolol, propanolol - mixed antagonists – labetalol - glyceryl trinitrate - sodium nitroprusside Antiarrhythmics - adenosine
Level 3	Adrenergic inotropes and vasopressors - dopamine - ephedrine - isoprenaline (isoproterenol) - midodrine - phenylephrine Antihypertensives - ACE inhibitors as a class - alpha antagonists – prazosin - angiotensin receptor blockers as a class, - beta antagonists – metoprolol. - calcium channel antagonists - non-dihydropyridines and dihydropyridines - centrally acting alpha agonists – clonidine - hydralazine - mixed alpha and beta antagonists – carvedilol Antiarrhythmics - beta antagonists – sotalol - calcium channel antagonists - verapamil

Section E: Renal System

E1: Renal Anatomy and Physiology

i. Outline the anatomy of the kidneys with particular focus on the functional unit, the nephron.
ii. Outline the functions of the kidney.
iii. Describe renal blood flow and its regulation.
iv. Describe glomerular filtration and its regulation
v. Describe the functions of the renal tubules and collecting ducts including the counter-current mechanisms.
vi. Outline the physiological changes associated with renal dysfunction and their effects.

E2: Renal Equipment and Measurement

i. Outline the principles of dialysis and filtration.
ii. Outline the principles of measurement of glomerular filtration rate and renal blood flow.
iii. Outline the utility of biochemical estimates of renal function, including but not limited to the measurement of serum creatinine and estimates of creatinine clearance such as eGFR.

E3: Renal Pharmacology

i. Understand the pharmacology of diuretics.
ii. Understand the pharmacology of renal replacement fluid.

Renal Pharmacopeia

Level 1	Diuretics - drugs acting on the Loop of Henle - frusemide (furosemide)
Level 2	Nil
Level 3	Diuretics - drugs acting on the distal tubule or collecting duct – thiazides and aldosterone antagonists - drugs acting on the proximal tubule – carbonic anhydrase inhibitors - osmotic agents – mannitol Renal replacement fluid - including a brief outline of variants relating to mechanisms of anticoagulation

Section F: Body Fluids and Electrolytes

F1: Physiology of Body Fluids and Electrolytes

i. Define and describe osmosis, colloid osmotic pressure and reflection coefficients including the factors that determine them.
ii. Explain the composition and distribution of body fluid.
iii. Define and describe osmolality and explain the regulation of plasma osmolality.
iv. Outline the production, composition, circulation, and functions of lymph.
v. Describe the distribution, regulation and physiological importance of the following ions;
    a. calcium,
    b. chloride,
    c. magnesium,
    d. potassium,
    e. phosphate,
    f. sodium.

F2: Intravenous Fluid Pharmacology

i. Understand the pharmacology of crystalloids.
ii. Understand the pharmacology of albumin colloid solutions.
iii. Understand the pharmacology of supplemental electrolyte and buffer solutions.

Fluid and Electrolyte Pharmacopeia

Level 1	Crystalloids - 0.9% saline - glucose containing solutions. - balanced salt solutions - Hartmanns, Plasmalyte - hypertonic saline solutions Colloids - albumin – 4%, 5%, 20% Electrolytes and buffers - magnesium - potassium - sodium bicarbonate
Level 2	Electrolytes and buffers - calcium chloride - calcium gluconate - phosphate
Level 3	Nil

Section G: Acid - Base

G1: Acid Base Physiology

i. Explain the regulation of plasma and cellular pH and their importance.
ii. Explain the physiological basis of acid-base disturbances.
iii. Describe the buffer mechanisms in the body including their chemistry and role.
iv. Explain the traditional (Henderson-Hasselbach) and physico-chemical (Stewart) approaches to acid-base interpretation.

G2: Acid Base Measurement

i. Describe the measurement and interpretation of the blood gas samples including:
    a. normal and abnormal arterial and venous blood gas samples
    b. relevant physiological and measurement factors or errors that can affect blood gas interpretation
    c. the role of base excess and standard base excess in blood gas interpretation

Section H: Nervous System including autonomic and pain

H1: Nervous System Anatomy

i. Describe the anatomy of the cranial nerves relevant to brainstem reflexes.
ii. Describe the anatomy of the cerebral and spinal cord circulations.
iii. Describe the anatomy relevant to the circulation of cerebrospinal fluid.
iv. Outline the major sensory and motor pathways and their course from the periphery to cortex.
v. Describe the anatomy relevant to performing a lumbar puncture.

H2: Nervous System Physiology

i. Explain the determinants of intracranial pressure.
ii. Describe the regulation of the cerebral and spinal cord circulations.
iii. Describe the production, composition, regulation and role of cerebrospinal fluid.
iv. Describe the blood brain barrier including the structure, function and relevant transport mechanisms.
v. Describe the classification of nerve fibre types and outline the differences in their features.
vi. Explain the basic electro-physiology of neural tissue, including conduction of nerve impulses, role of myelin and synaptic functions.
vii. Classify and outline the major endogenous neurotransmitters of the nervous system including their role, receptor(s) and distribution.

H3: Autonomic Nervous System Anatomy and Physiology

i. Outline the anatomy of the autonomic nervous system including:
    a. the cortical, brainstem and/or spinal cord origin(s),
    b. major plexus and ganglions,
    c. fibre types and neurotransmitters,
    d. end organ innervation.
ii. Describe the receptors of the autonomic nervous system including their subtypes and their pre- or post-ganglionic location and function.
iii. Describe the major neurotransmitters of the autonomic nervous system including their synthesis, release and fate.
iv. Explain the end-organ innervation and effects of the autonomic nervous system.

H4: Pain Physiology

i. Define and describe pain, including:
    a. peripheral nociception and sensitization,
    b. pain sensation conduction and pathways
    c. receptors and mediators involved in pain sensation and transmission,
    d. spinal cord modulation, including an outline of the gate-control theory,
    e. central processing of pain sensation
    f. role and features of descending pathways.
ii. Describe the classification (where relevant), distribution and role in pain sensation of:
    a. opioid receptors,
    b. NMDA receptors.

H5: Nervous System Measurement

i. Describe the measurement and interpretation of intracranial pressure including:
    a. methods of measurement,
    b. limitations and potential sources of error,
    c. methods used to minimise error and artefact including the need for calibration,
    d. normal and abnormal values and waveforms where relevant.

H6: Neuropharmacology

i. Understand the pharmacology of hypnotic and/or sedative drugs.
ii. Understand the pharmacology of local anaesthetic drugs.
iii. Understand the pharmacology of analgesic drugs.
iv. Understand the pharmacology of anti-depressant drugs.
v. Understand the pharmacology of anti-psychotic drugs.
vi. Understand the pharmacology of anti-convulsant drugs.
vii. Describe the pharmacokinetics of drugs used in the epidural and subarachnoid space.
viii. Understand the pharmacology of drugs and/or toxins acting upon the autonomic nervous system.

Neurological Pharmacopeia

Level 1	Sedatives - benzodiazepines – midazolam, diazepam - dexmedetomidine - ketamine - propofol Local anaesthetics (amides) - lignocaine - bupivacaine - ropivacaine Analgesics - ketamine - opioids – oxycodone, fentanyl, morphine - paracetamol Antimuscarinics - atropine
Level 2	Sedatives - barbiturates - thiopentone Analgesics - opioids - buprenorphine, hydromorphone, methadone, remifentanil, tapentadol, tramadol - gabapentinoids - gabapentin, pregabalin Anticonvulsants - phenytoin Antimuscarinics - glycopyrrolate Cholinesterase inhibitors - neostigmine Other - nimodipine
Level 3	Analgesics - non-steroidal anti-inflammatory drugs as a class Antidepressants - monoamine oxidase inhibitors - selective serotonin reuptake inhibitors - serotonin-noradrenaline reuptake inhibitors - tricyclic anti-depressants Antipsychotics - first generation antipsychotics – haloperidol, droperidol - second generation antipsychotics – olanzapine, quetiapine Anticonvulsants - lamotrigine - lacosamide - levetiracetam - phenobarbitone - sodium valproate Cholinesterase inhibitors - organophosphates

Section I: Musculoskeletal System

I1: Musculoskeletal System Anatomy and Physiology

i. Describe the anatomy of skeletal, smooth and cardiac muscle.
ii. Describe the physiology of skeletal, smooth and cardiac muscle including excitation-contraction coupling.
iii. Describe the structure and physiology of the neuromuscular junction including receptors present.
iv. Explain the concept of motor units.
v. Describe the relationship between muscle length and tension.
vi. Describe the mechanism of the following
    a. monosynaptic stretch reflex,
    b. single twitch,
    c. tetany.

I2: Neuromuscular Measurement

i. Outline the monitoring of neuromuscular blockade.

I3: Neuromuscular Pharmacology

i. Understand the pharmacology of neuromuscular blocking drugs and their reversal agents.

Neuromuscular Pharmacopeia

Level 1	Neuromuscular blockers - aminosteroids – rocuronium - isoquinolines - cisatracurium - suxamethonium
Level 2	Neuromuscular blockers - aminosteroids – vecuronium, pancuronium - isoquinolines – atracurium Reversal agents - neostigmine - sugammadex
Level 3	Nil

Section J: Gastrointestinal System

J1: Gastrointestinal Anatomy and Physiology

i. Outline the blood supply of the gastrointestinal system.
ii. Describe the composition, volumes, and regulation of gastrointestinal secretions.
iii. Describe the control of gastrointestinal motility, including lower oesophageal sphincter function.
iv. Describe the mechanisms of nausea and vomiting.
v. Describe the exocrine functions of the pancreas.
vi. Outline the digestion and absorption of fat, protein, and carbohydrates.
vii. Outline the absorption of water, electrolytes, and vitamins throughout the gastrointestinal system.

J2: Liver Anatomy and Physiology

i. Describe the anatomy of the liver with particular focus on the functional unit, the acinus.
ii. Describe the blood supply of the liver and its regulation.
iii. Describe the functions of the liver.
iv. Describe the physiology of bile including composition, circulation and regulation.
v. Outline the physiological changes associated with liver dysfunction and their effects.

J3: Gastrointestinal Measurement

i. Describe the laboratory assessment of liver function.
ii. Outline the measurement and interpretation of intra-abdominal pressure including:
    a. methods of measurement,
    b. limitations and potential sources of error of each.

J4: Gastrointestinal Pharmacology

i. Understand the pharmacology of drugs that increase gastric fluid pH.
ii. Understand the pharmacology of drugs with anti-emetic activity.
iii. Understand the pharmacology of drugs that affect gastrointestinal motility.
iv. Understand the pharmacology of drugs used in liver failure.

Gastrointestinal Pharmacopeia

Level 1	Nil
Level 2	Nil
Level 3	Acid suppression - proton pump inhibitors Antiemetics - cyclizine - droperidol - metoclopramide - ondansetron - prochlorperazine - promethazine Drugs that affect gastrointestinal motility - aperients and laxatives - prokinetics – erythromycin, metoclopramide - octreotide (somatostatin) Drugs used in liver failure - lactulose - rifaximin - terlipressin

Section K: Nutrition and Metabolism

K1: Nutrition and Metabolism Physiology

i. Describe normal nutritional requirements, including vitamins and trace elements.
ii. Define basal metabolic rate and outline the factors that influence it.
iii. Describe the cellular metabolism of fat, carbohydrate, and protein.
iv. Outline aerobic and anaerobic metabolism.
v. Outline the synthesis, role and metabolism of the following substances;
    a. lactate,
    b. ketones.

K2: Nutrition and Metabolism Measurement

i. Describe the measurement of metabolic rate and nutritional requirements including:
    a. methods of measurement and/or estimation,
    b. limitations and potential sources of error.

K3: Nutrition and Metabolism Pharmacology

i. Understand the pharmacology of enteral nutrition.
ii. Understand the pharmacology of parenteral nutrition.
iii. Understand the pharmacology of vitamins and trace elements.

Nutrition Pharmacopeia

Level 1	Nil
Level 2	Enteral feed solutions* TPN solutions* Vitamins and trace elements - vitamin K ** specific brand descriptions are not required however brief details on common variants should be covered ie. low sodium or high protein.*
Level 3	Nil

Section L: Endocrine System

L1: Endocrine Physiology

i. Describe the endocrine secretions of the pancreas including their regulation and function.
ii. Describe the control of blood glucose including effects of fasting and response to a glucose load.
iii. Outline the endocrine secretions of the pituitary and hypothalamus including their regulation and function.
iv. Outline the endocrine secretions of the thyroid including their regulation and function.
v. Outline the endocrine secretions of the kidney and adrenal gland including their regulation and function.
vi. Outline the control of plasma calcium.

L2: Endocrine Pharmacology

i. Understand the pharmacology of glucocorticoids.
ii. Understand the pharmacology of mineralocorticoids.
iii. Understand the pharmacology of hypoglycaemic drugs.
iv. Understand the pharmacology of glucagon.
v. Understand the pharmacology of vasopressin and its analogues.

Endocrine Pharmacopeia

Level 1	Hypoglycaemic drugs - insulin – rapid and short acting Vasopressin (argipressin)
Level 2	Hypoglycaemic drugs - insulin – long acting Vasopressin analogues - desmopressin - terlipressin
Level 3	Hypoglycaemic drugs - biguanides - SGLT2 Inhibitors - sulphonylureas - GLP-1 receptor agonists Glucagon Glucocorticoids and mineralocorticoids - dexamethasone - fludrocortisone - hydrocortisone - methylprednisone - prednisone

Section M: Thermoregulation

M1: Temperature Physiology

i. Define and describe the following:
    a. heat
    b. temperature
    c. normal body temperature
    d. inter-threshold range
    e. thermoneutral zone
ii. Outline the mechanisms for heat transfer between the body and the environment.
iii. Explain the mechanisms by which body temperature is detected and regulated.
iv. Explain the physiological effects and responses to hypothermia and hyperthermia.

M2: Temperature Measurement

i. Describe the measurement of body temperature including:
    a. methods of measurement – invasive and non-invasive, electrical and non-electrical,
    b. limitations and potential sources of error,
    c. usual values and variations.

Section N: Haematological and Immunological System

N1: Physiology of Haematological System

i. Outline the components of blood and plasma including their synthesis and function.
ii. Outline the degradation, metabolism and clearance of:
    a. red blood cells,
    b. haemoglobin,
    c. platelets.
iii. Explain the classification of blood groups including ABO and rhesus factor.
iv. Describe the process and regulation of haemostasis, coagulation and fibrinolysis.
v. Describe the mechanisms of preventing thrombosis including endothelial factors and natural anticoagulants.
vi. Explain the physiological consequences of acute and chronic anaemia.

N2: Physiology of Immunological System

i. Outline the non-immune host defenses used to defend against infection.
ii. Outline innate and acquired immunity including how these systems interact in the immune response.
iii. Describe the factors involved in the initiation and resolution of inflammation and the immune response.
iv. Explain the immunological basis of hypersensitivity reactions including anaphylaxis in detail

N3: Haematological Measurement

i. Describe the methods for assessing coagulation, including viscoelastic assays.
ii. Outline the methods for assessing platelet function.

N4: Haematological Pharmacology

i. Understand the pharmacology of drugs that affect coagulation including:
    a. anti-coagulants and their reversal agents where relevant,
    b. anti-platelet drugs,
    c. fibrinolytic drugs,
    d. anti-fibrinolytic drugs,
ii. Understand the pharmacology of blood and plasma products including:
    a. preparation,
    b. typing and cross matching,
    c. storage and effects of storage.
iii. Describe the adverse consequences of blood transfusion, including massive transfusion.

Haemotology Pharmacopeia

Level 1	Anticoagulants - low molecular weight heparin - unfractionated Heparin - warfarin Blood products - albumin - cryoprecipitate - fractionated plasma products - fresh frozen plasma - platelets - red cells
Level 2	Antiplatelets - aspirin - ADP receptor blockers – clopidogrel, ticagrelor, prasugrel Fibrinolytics - alteplase Anticoagulants - apixaban - bivalirudin - dabigatran - rivaroxaban Anticoagulant reversal agents - protamine - vitamin K
Level 3	Anticoagulant reversal agents - idarucizumab - andexanet alpha Antiplatelets - GPIIb/IIIa inhibitors – abciximab and tirofiban Antifibrinolytics - tranexamic acid Fractionated or recombinant plasma products - antithrombin III - factor IX - factor VIIa - factor VIII - immunoglobulin - fibrinogen concentrate - factor concentrates – Prothrombinex, Beriplex

Section O: Microbiology

O1: General Microbiology

i. Describe the classification of bacteria.
ii. Outline the classification of viruses.
iii. Outline the classification of fungi.

O2: Antimicrobial Pharmacology

i. Outline the classification and understand the pharmacology of antibacterial agents.
ii. Explain the principles of antimicrobial resistance.
iii. Outline the classification and understand the pharmacology of antiviral agents.
iv. Outline the classification and understand the pharmacology of antifungal agents.
v. Outline the pharmacology of antiseptics and disinfectants.

Antibmicrobial Pharmacopeia

Level 1	Antibacterial agents - aminoglycosides - carbapenems - cephalosporins - glycopeptides - vancomycin - penicillins
Level 2	Nil
Level 3	Antibacterial agents - beta-lactamase inhibitors - lincosamides - macrolides - metronidazole - quinolones - tetracyclines - trimethoprim/sulphamethoxazole Antiviral agents - acyclovir - ganciclovir - oseltamivir Antifungal agents - amphotericin - caspofungin - fluconazole Antiseptics and disinfectants - alcohol - chlorhexidine - iodine

Section P: Obstetrics and Neonatal

P1: Obstetric Anatomy and Physiology

i. Describe the physiological changes during pregnancy.
ii. Outline the physiological changes during parturition.
iii. Describe utero-placental blood flow and its regulation.
iv. Describe the physiological consequences of changes in posture during pregnancy including the consequences of aorto-caval compression.

P2: Neonatal Anatomy and Physiology

i. Outline the functions of the placenta.
ii. Describe the foetal circulation.
iii. Describe foetal-placental blood flow and its regulation.
iv. Describe the structure, characteristics and function of foetal haemoglobin.
v. Describe the transfer of substances across the placenta including the double Bohr and Haldane effects.
vi. Describe the circulatory and respiratory changes that occur at or soon after birth including:
    a. the transition from foetal to neonatal circulation,
    b. the establishment of ventilation.

P3: Obstetric and Neonatal Pharmacology

i. Understand the pharmacology of oxytocic and tocolytic drugs.

Obstetrics and Neonatal Pharmacopeia

Level 1	Nil
Level 2	Nil
Level 3	Oxytocics, including but not limited to: - Syntocinon - ergot alkaloids - ergotamine - prostaglandin analogues – PGF2-alpha, misoprostol Tocolytics, including but not limited to: - glyceryl trinitrate - salbutamol - calcium channel blockers

Section Q: Antidotes and decontaminating agents

i. Understand the pharmacology of antidotes and decontaminating agents not listed elsewhere.

Antidotes and decontaminating agents Pharmacopeia

Level 1	Nil
Level 2	Nil
Level 3	- activated charcoal - dantrolene - digoxin antibodies - flumazenil - lipid emulsion therapy - Intralipid - methylene blue - N-acetylcysteine - naloxone - pralidoxime

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