In fulfilling the role of medical expert, surgeons will need to integrate and apply all their knowledge, clinical skills and professional attitudes in the provision of their patient-centred care.

**At graduation the trainee will be able to:**
Establish and maintain clinical knowledge, skills and attitudes appropriate to their practice. Medical expertise is required in many fields including:

- **Basic Sciences**
  - anatomy
  - biology
  - pathology
  - immunology
  - microbiology
  - pharmacology
  - physiology
- **Pre-operative, intra-operative, and post-operative care and assessment in particular**
  - DVT prophylaxis
  - Fluid and electrolytes
  - Wound care
  - Haemastasis
- **Apply clinical knowledge in practice to recognise and solve real-life problems in particular, the treatment of pain**
  - pathophysiology
  - psychosocial
  - analgesics
  - pain relief
<table>
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<th>Suggested Reading</th>
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<td>Prescribed textbooks – examinable material is contained in the publications listed below:</td>
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<tr>
<td><strong>Anatomy</strong></td>
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<tr>
<td><strong>Physiology</strong></td>
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<tr>
<td>• <em>Review of Medical Physiology</em>, 20th Ed., 2001 - Ganong W.F., Lange</td>
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<tr>
<td>• <em>Text Book of Medical Physiology</em>, 10th Ed 2000 - Guyton, A.C., Igaku Shoin/Saunders</td>
</tr>
<tr>
<td><strong>Pathology</strong></td>
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<tr>
<td>• <em>Really Essential Medical Immunology</em>, – Ivan Roitt &amp; Arthur Rabson</td>
</tr>
<tr>
<td>• <em>Integrated Basic Surgical Sciences</em>, 2000 (Chapter 29.4, 37.1 and 37.2)</td>
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<tr>
<td><strong>Online resources</strong> – Case studies; Surgical Trainees Educational Modules (STEM) series; and practice MCQs, available via the College website: <a href="http://www.surgeons.org">http://www.surgeons.org</a></td>
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MODULE OBJECTIVES

Establish and maintain clinical knowledge, skills and attitudes appropriate to their practice

Level 1 – Basic Surgical Training

The required level of knowledge, understanding and application will be such as to provide a sound basis for Specialist Surgical Training in any Surgical Specialty without requiring the level of special knowledge, understanding and application appropriate to any given specialty.

Anatomy and biology

General objectives

- identify the location and relations of the component structures of the human body of general significance to the practice of surgery
- recognise the appearance under light microscopy of the tissues and organs of the human body, for the purpose of distinguishing normal from pathological structure
- describe the basic mechanisms of structure and function
- recognise how at the cellular and tissue level individual tissues and organs are designed to subserve their physiological functions
- appreciate how the structure of viscera is designed to subserve their physiological functions
- identify the function of the bones, muscles, joints, nerves and vessels of the human body
- appreciate how the anatomy of structures in the human body relates to the pathology of those structures and their relations with respect to the production of clinical signs and symptoms
- understand the embryological basis of developmental abnormalities of surgical importance, namely: the abnormal shape and location of organs, the ectopic location of functioning tissues, the aberrant course of vessels or other structure that may give rise to clinical signs and symptoms or that may: constitute a hazard in the conduct of surgery, surgically reparable congenital abnormalities

Specific objectives

- state, identify (in patients and in dissected specimens and in photographs, radiographs and other facsimiles thereof), and distinguish correct from incorrect descriptions of the surface anatomy, morphology, relations, cellular and intra-cellular structure of the following structure or systems and their components, such as the eye, inner ear, middle ear, external auditory meatus, respiratory tract and lungs, gastrointestinal tract including the mouth, salivary glands, liver, biliary system and pancreas, reticulo-endothelial system, urinary tract, male and female reproductive tracts and their associated glands, heart and pericardium, pituitary, thyroid, parathyroid, and adrenal glands (cartilages of the nose and pinna, and the structure of teeth are excluded)
  - for each of the structures and systems listed above, state, explain and recognise, and distinguish correct from incorrect descriptions of, how their morphological features are related to or subserve their functions, and how their morphological features are related to manifestations of disorders and diseases of those structures or system
- state, identify (in patients and in dissected specimens and in photographs, radiographs and other facsimiles thereof), and distinguish correct from incorrect descriptions of the course, surface anatomy, relations and distribution of: the primary, secondary, tertiary and quaternary branches of the aorta, the primary branches of the cervical, brachial, lumbar and lumbosacral plexuses, the intercostal nerves and vessels, the inferior and superior venae cavea and their primary, secondary, tertiary and quaternary tributaries, the thoracic duct, the ophthalmic artery, the cranial nerves, the sympathetic trunk (including its segmental distribution)
for each of the structures listed directly above, state, explain, recognise and distinguish correct from incorrect descriptions of, how their morphological features relate to the manifestations of diseases or disorders that may involve these structures, and how their features relate to the practice of surgery on and around these structures.

- state, recognise and distinguish correct from incorrect descriptions of what can be demonstrated by electron microscopy and light microscopy of tissues and cells of the human body.

- state, recognise in photomicrographs and facsimiles thereof, and distinguish correct from incorrect descriptions of, the electron microscopic appearance and morphology of the following components of an archetypical human cell: the membrane, the nucleus and nuclear envelope, and cytoplasmic organelles.

  - for each of the structures listed directly above, state and distinguish correct from incorrect descriptions of the functions of each of these structures.

- state, identify in patients and in dissected specimens and in photographs or other facsimiles thereof, and distinguish correct from incorrect descriptions of, plus state, recognise in photomicrographs and facsimiles thereof, and distinguish correct from incorrect descriptions of, the characteristic and distinguishing features, as seen by electron microscopy or light microscopy, of the following tissues: bone, fibrous connective tissue, fibrocartilage, elastic and hyaline cartilage, synovium, peritoneum, pleura and pericardium, blood cells and hemopoietic tissues, cardiac, smooth and skeletal muscle, peripheral nerves and their ganglia, adipose tissue, skin, blood vessels and lymphatics.

  - for all cells and tissues listed directly above, state and distinguish correct from incorrect descriptions of how their microscopic structure relates to or subserves their function.

- state, identify in patients and in dissected specimens and in photographs and other facsimiles thereof, and distinguish correct from incorrect descriptions of:

  - the components, location and clinical significance of arterial anastomoses of the orbit, shoulder, elbow, thigh, knee, hand, foot, chest wall and thoracic cavity, abdominal wall, thigh, pelvis, perineum and gastro-intestinal tract.

  - the components, location and clinical significance of portal-systemic anastomoses and venous anastomoses that circumvent the internal jugular vein, the superior vena cava and the inferior vena cava.

  - the bones of the skull, their named parts, their articulations, the foramina, canals and other spaces they contain, and the structures that pass through those foramina, canals and spaces.

  - the location, attachment, relations, actions and functions of the skeletal muscles of the human body.

  - the bones of the human body and their named features, including epiphyses, the ossification of the hip, femur and elbow, the shape and components of the joints of the human body, the primary attachments, disposition and relations of the named ligaments of the axial and appendicular skeletons and jaw, (as named in the latest edition of the *Nomina Anatomica*), the component parts of the ligaments of the knee, elbow and ankle, the disposition and attachments of the deep fasciae of the arm, forearm, hand, leg, back and neck, the location and attachments of the retinacula of the limbs, the location and extent of the most common patterns of the synovial sheaths of the wrist, hand ankle and foot.

  - for each of the structures listed immediately above, state and explain, recognise and distinguish correct from incorrect descriptions of, how their structure subserves their functions and how it relates to the manifestations of diseases and disorders involving these structures.

(Note: Explicitly excluded from this objective are: the ossification of bones other than those specified, component parts of the ligaments of the shoulder, wrist, hand and foot, detailed structure of the intra-articular, capsular and related components of the interphalangeal, metacarpophalangeal, metatarsophalangeal, carpometacarpal, tarsometatarsal, intercarpal and intertarsal joints, structure and disposition of the pulleys of the fibrous flexor sheaths, fascial compartments of the foot).
• state and distinguish correct from incorrect descriptions of the three primary germinal layers of the embryonic disc and their ultimate derivatives
• state, explain, recognise in patients and in dissected specimens and in photographs, radiographs and in facsimiles thereof, and distinguish correct from incorrect descriptions of the following conditions and their embryological basis: the ectopic location of glandular organs and tissues, the malposition of viscera, the duplication of viscera, anomalies of the aorta and its primary branches, aberrant arteries of the kidney and liver, atresia of the gastrointestinal tract, imperforate anus, tracheo-oesophageal fistula, fistulae between the alimentary, urinary and genital tracts, Meckel's diverticulum, cysts of the mesonephric and paramesonephric ducts and their remnants, spina bifida and cystic defects of the spinal cord and dural sac, cleft lip and cleft palate, hypospadias, septal defects of the heart, transposition of the great vessels, exomphalos, normal and abnormal channels in the diaphragm, abnormal size or shape of the genitalia
(Note: Explicitly excluded from these objectives are: the histogenesis of the central nervous system and special sense organs - the ear, eye and nose, the development of the limbs and their bones, joints, muscles nerves and vessels, intra-uterine growth of the embryo and foetus, the structure of the placenta, the formation of the blastocyst and implantation, the development of the neurocranium and viscerocranium, the embryonic and post-natal development of teeth).
• describe, identify in dissected specimens and in photographs, radiographs and facsimiles thereof, and distinguish correct from incorrect descriptions of: the topographical features of the brainstem and spinal cord, the lobes of the cerebral hemispheres, the central sulcus, precentral and postcentral gyri, the parieto-occipital sulcus and calcarine sulcus, the cortical areas responsible for motor control, sensation, vision, hearing and eye movements, the light microscope appearance of typical neocortex, the macrostructure and relations of the basal ganglia, the topographical anatomy of the thalamus, metathalamus, hypothalamus and epithalamus, the topographical anatomy of the limbic system, the location and functions of the nuclei and central connections of the cranial nerves, the course and distribution of the anterior, middle and posterior cerebral, basilar and vertebral arteries and their primary branches, the structure, disposition and connections of the dural venous sinuses
(Note: Explicitly excluded from this objective is the internal venous drainage of the central nervous system).
• in terms of the nuclei, tracts and nerves involved, state and distinguish correct from incorrect descriptions of, and apply to the solution of clinical problems, the neural pathways and connections responsible for vision, hearing, balance, taste, salivation, nociception, touch, vibration, proprioception, the blink reflex, the gag reflex, head-turning, conjugate gaze, optokinetic pursuit
(Note: Explicitly excluded from this objective are the neural networks of the retina and of the inner ear and the central connections of the vestibular and cochlear nerves and of the olfactory tract)
• state, distinguish correct from incorrect descriptions of, and apply to the solution of clinical problems, the origin, disposition and connections of the pyramidal tract, the medial, lateral and dorsal reticulospinal tracts, the lateral and medial vestibulospinal tracts, the tectospinal tract
• state, distinguish correct from incorrect descriptions of, and apply to the solution of clinical problems, the connections, pathways and functions of the cortical, spinal and vestibular loops of the cerebellum
• state, distinguish correct from incorrect descriptions of, and identify in dissected specimens and in photographs and facsimiles of specimens, the microscopic and macroscopic structure, attachments, relations, blood supply and nerve supply of the meninges of the skull and spinal cord.

Pathology
General objectives
• extrapolate from normal structure and function, together with a knowledge of hereditary and environmental influences, how the body is affected by these with the production of any combination of consequences which are: passive and degenerative and/or, reactive and/or neoplastic;
• understand the molecular biological bases and the structural/functional manifestations of these processes in general and in particular in common disease processes
• recognise the principles of statistical analysis in biology
• understand the principles of pharmacology, pharmacokinetics, pharmacodynamics and the actions and interactions (both beneficial and harmful) of pharmacological agents which commonly and importantly impinge on surgical practice. Texts used are named in this document and in the Part 1 Examination Recommended Reading List. Robbins: Pathologic Basis of Disease 5th ed. (WB Saunders) is the pathology text. The majority of question material is sourced from the section on 'general pathological principles', comprising Chapters 1-10, pages 1-466 inclusive. Material sourced from the organ systems section is outlined in the Part 1 Examination Recommended Reading List. Roitt: Essential Immunology 8th ed. (Blackwell) is the source for immunology questions. Information in Roitt specifically excluded from use in question construction is also indicated in the Part 1 Examination Recommended Reading List. Immunopathology questions may be sourced from Robbins.

• understand the general pathological mechanisms (degenerative, reactive and neoplastic) underlying common disease, including a knowledge of aetiology, pathogenesis, epidemiology, investigation and natural history, how these may be modified by the appropriate use of therapeutic agents; and, molecular biological, genetic and statistical aspects together with basic clinical decision analysis

Genetics and molecular biology
General objectives
• identify the normal control of cell growth and division, the ways in which these mechanisms may malfunction and the principles of the methods by which genetic malfunctions may be detected

Specific objectives
• explain the structure of DNA and RNA, the cell cycle, the genesis of genetic abnormalities, including the principles of molecular biology techniques used in the detection of these abnormalities
• identify Mendelian genetics including specific conditions which are either common or important, or which exemplify important principles
• explain cytogenetics, including specific conditions which are either common and important disorders or which exemplify important principles as well as the basics of laboratory techniques used for the detection of cytogenetic abnormalities.

Neoplasia
General objectives
• identify the nature of neoplasia and the biology of neoplastic growth, the causes of neoplasms and the differences between benign and malignant neoplasms. Be able to apply these principles and demonstrate a knowledge of the anatomy, function and behaviour of common and important neoplasms, both benign and malignant

Specific objectives
• describe the characteristics of benign and malignant neoplasms including their general gross and microscopic appearances and their biological behaviour, growth and methods of spread including expansion, invasion and metastasis
• identify the basis of classification of neoplasms according to their differentiation, the relationship of morphological characteristics to likely behaviour and the implications of these characteristics in regard to the likely biology and response to therapy
• recognise the molecular basis of neoplasia, the genetic and environmental causes of neoplasms and the basis of the progressive aggression of malignant neoplasms which reflects their acquired genetic instability
• identify the progressive and multi-step nature of neoplastic induction and progression and how this is reflected in the nature of ‘pre-cancer’ and pre-cancerous conditions
• recognise the growth cycle, the molecular basis for this and the mediation and modulation of cell growth through ligand-receptor interactions, how these normal interactions are disorganised in neoplasia and how the factors coordinating normal cell growth (both DNA and protein/polypeptide
'growth factors') engage inappropriately in neoplastic growth mediation; this includes factors influencing the progressive and relentlessly increasing mass of neoplastic tissue and its invasive and destructive biology

• identify the clinical effects of neoplasms including those which are predictable as well as those which are related to tumour secretions producing systemic effects such as cachexia, and paraneoplastic syndromes

• describe the morphological and behavioural characteristics of common and clinically important neoplasms including prognosis, principles of treatment and the laboratory manifestations and investigations of neoplasms (particularly lung; breast; large bowel; prostate; solar skin cancers)

Statistics

General objectives

• identify the principles of statistical analysis which will permit the critical evaluation of published data in medical sciences, including the incidence of diseases and the effects of therapeutic intervention in the natural history of disease processes

Specific objectives

• outline the principles of statistical analysis, including commonly used parametric and non-parametric tests

• describe clinical decision analysis

• define the principles of population statistics

• explain the design and interpretation of clinical trials

Immunology

General objectives

• understand the function of the immune system in normal individuals and apply this to a range of stimuli including infective organisms and immunosuppressive drugs, including how the function of the immune system may be measured and how immunological mechanisms may be used in disease prevention

• understand ways in which the immune system itself may malfunction including hypersensitivity reactions, immunodeficiency disorders and autoimmunity

Specific objectives

• describe non-specific defence mechanisms, the complement system, the major histocompatibility complex

• identify the cells of the immune system, their functions, their interactions, cell subsets, cell surface markers and receptors

• recognise the structure, function and genetics of secretory products of cells involved in the immune response, including immunoglobulins, interleukins and various other factors

• recognise the control and activation of the normal immune response and how this is affected by various drugs or other therapeutic agents such as vaccines

• describe immunity to infection by bacteria, viruses, fungi and protozoa

• identify abnormal immunologic responses including hypersensitivity, autoimmunity and immunodeficiency disorders

• recognise the mechanisms of transplant rejection and how these may be avoided or modified by therapeutic intervention

• define the principles of diagnostic testing in immunology, including the basic principles (not detailed knowledge of actual methodology) of commonly used immunological tests, their applications and their limitations.
Tissue response to injury

General objectives

- identify the influences on cells and tissues, of injury and the degenerative (passive) changes that result from alterations in the internal and external environment of cells, including sub-lethal injury, necrosis and apoptosis
- explain the reactions of the body to the presence and damaging actions of noxious environmental agents (physical, chemical [including pharmacological and endogenous], biological) and how these are influenced by genetic factors; recognise and understand both the beneficial and harmful effects of body defence reactions (inflammation and healing, immunology, thrombocoagulation) to environmental damage and to the occurrence of localised tissue death within the individual.

Specific objectives

- describe the environmental influences that can cause cell injury and death and how these act
- identify ways in which the metabolic and structural/functional integrity of cells is vulnerable to injury, from whatever cause
- illustrate the ways in which cells are structurally and functionally injured by damage to the integrity of structure and/or functions of aerobic respiration, membrane, proteins and the genetic apparatus of cells
- identify the mechanisms and consequences (passive, reactive and functional) of sublethal cell injury, necrosis and apoptosis, including basic knowledge of the pathological anatomy and types of tissue changes, including in particular ischaemia and infarction and its most common underlying cause, atheroma (and its pathogenesis). the 'normal' reactive changes to injury (atrophy [e.g., osteoporosis], hypoplasia, hypertrophy, and hyperplasia); their pathological counterparts, metaplasia, dysplasia and the common and important causes of these
- describe the molecular basis of diseases of metabolism and their clinical and morphological manifestations, including the basis and manifestations of pituitary, thyroid and adrenal diseases, diabetes mellitus, amyloidosis, fibrinoid necrosis; and the principles of the underlying (enzymic deficiency) basis of well-known metabolic (and storage) diseases with significant surgical overtones; show an understanding of the pathogenesis and manifestations of pathological calcification and pigmentation
- identify the structural and functional changes involved in the reactions of the defence and healing processes of immune reactivity, acute and chronic (including granulomatous) inflammation, regeneration and fibrous repair. This should include an ability to demonstrate understanding of the molecular/pharmacological mechanisms which bring about these reactions, how they are endogenously modulated and how they interact and are modified by pharmacological manipulation. An appreciation of both the beneficial and harmful effects of these reactions should be able to be delineated, demonstrating an understanding of the pathogenesis and pathology of aberrant defence reactions of importance in surgical practice (such as inflammatory bowel disease, systemic vasculitis, rheumatoid disease)
- explain the interaction of the defence reactions with invading microbes, including the influence of variations in the effectiveness of the defence reactions in disease (e.g., immune deficiency)
- identify thrombocoagulation, both normal in trauma defence and pathological, causing local ischaemia and disseminated thrombocoagulation; the pharmacological mediation and pathological consequences of these processes, including arterial and venous thrombosis, embolism, ischaemia and thrombosis as well as the causes and effects of haemorrhage
- identify the pathophysiological basis of oedema due to pressure/volume overload and to increased vascular permeability, including the mechanistic and pharmacological bases (cardiac failure, hypoproteinaemia, anaphylaxis, progressive shock of various causes, lymphoedema).
- describe the causes and pathophysiology of organ failure; in particular, this should include detailed knowledge of respiratory, renal and hepatic failure as well as a basic understanding of the pathophysiological principles of cardiac failure and of organ failure which impinges significantly on surgical practice (e.g., adrenal cortical hypofunction).
Microbiology (including Infection and antibiotics)

General objectives
• understand the pathogenesis and laboratory aspects of microbial infections, as related to the practice of surgery in general

Specific objectives
• describe the body's normal microbial flora including situations which may influence its composition and number, and its potential role in disease
• recognise the role and importance of the body's normal defence mechanisms (mucocutaneous surfaces, humoral and cellular) in the prevention, containment and resolution of microbial diseases ageing
• recognise pathogenesis of infection - host defence mechanisms and microbial virulence
• identify surgically relevant bacterial, viral, fungal and parasitic infections, including infection following surgery, e.g., wound infection, septicaemia, and infections with surgical implications, e.g., peritonitis, anaerobic soft tissue infections, AIDS
• identify anti-microbial agents and their scientific use in the therapy and prevention (prophylaxis) of infection
• develop knowledge of sterilisation and disinfection procedures
• recognise laboratory medicine aspects of infectious diseases, e.g., principles behind blood culture techniques, interpretation of gram stains, antimicrobial susceptibility techniques
• recognise the principles behind blood culture, direct microscopy and antibiotic sensitivity testing techniques.
• demonstrate sound knowledge of the principles and methods of sterilisation, and the practical use of disinfectants.
• identify microbe(s) commonly associated with infections of relevance to surgery
• identify microbial virulence as this relates to the pathogenesis of infections caused by bacteria, fungi, viruses and parasites important in the practice of surgery. The significant microbes are:
  a) Bacteria:
   ° Staphylococcus aureus, S. epidermidis;
   ° Streptococcus pyogenes, St. pneumoniae, 'St. milleri' (St. anginosus);
   ° Enterococcus faecalis, Ent. faecium;
   ° Escherichia coli and related coliforms;
   ° Pseudomonas aeruginosa;
   ° Clostridium perfringens, Cl. difficile, Cl. tetani.
   ° Peptostreptococci
  b) Fungi:
   ° Candida albicans and related species;
   ° Aspergillus fumigatus;
   ° Pneumocystis carinii.
  c) Viruses:
   ° human immunodeficiency virus (HIV);
   ° hepatitis B and C viruses;
the herpes group;
- papilloma viruses.

d) Parasites:
- Echinococcus granulosus (hydatid).

**Antibiotics**

**General objectives**
- identify the principles behind the scientific use of selected antimicrobial agents as relates to the prevention (prophylaxis) and treatment of surgically related microbial diseases

**Specific objectives**
- describe the mode of action and mechanisms (including genetic basis) of resistance to antibacterial agents
- identify the properties and uses in surgery of the following antibiotics or groups of antibacterial agents - beta-lactams; aminoglycosides; quinolones; metronidazole, clindamycin and other anti-anaerobe agents; vancomycin; fusidic acid; and rifampicin
- explain the rationale behind, and uses of antimicrobials in surgical prophylaxis
- identify and describe antifungal agents (amphotericin B and its various formulations, fluconazole, flucytosine) and their use in the treatment and prophylaxis of Candida infections
- identify the prophylactic regimens directed towards the prevention of viral diseases (e.g., AIDS, hepatitis) following accidental exposure to blood and/or blood products

**Pharmacology**

**General objectives**
- identify the general principles of pharmacokinetics relating to therapeutic agents used in the treatment of common diseases.
- recognise the major principles of pharmacodynamics of therapeutic agents in frequent use in the treatment of common diseases

**Specific objectives**
- extrapolate from a knowledge of anatomy, physiology and pathology the major changes to pharmacodynamic and pharmacokinetic processes which may occur and be significantly altered by and within surgical practice
- explain pharmacokinetic terms such as half-life, clearance and volume of distribution, using examples such as anticoagulants, anticonvulsants and antiarrhythmics
- identify the route of administration upon bio-availability of drugs such as opiates and antiarrhythmics
- discuss the difference between drugs which undergo extensive metabolism within the body, such as phenytoin, and those that are excreted unchanged, such as gentamicin
- describe the changes in organ function which will be associated with significant changes in the pharmacokinetic parameters (e.g., renal failure and digoxin, cardiac failure and lignocaine, liver failure and midazolam).
- identify the pharmacodynamics of major drug groups, relating to the theories of receptor action, thus considering concepts of drugs with agonist, antagonist and partial agonist properties (e.g., b-agonists such as salbutamol, b-blockers such as propanolol, partial agonists (predominantly blocking) such as tamoxifen
- describe and explain the reflex responses (autonomic) which occur following the administration of many drugs (e.g., decreased heart rate which accompanies therapeutic response to theophylline)
identify the major types of side effects/toxicity which may occur secondary to drug use, including common ones such as extension of known action, e.g., loss of consciousness with alcohol), itch with morphine (histamine release from mast cells), immune responses to sulphonamides/penicillins
recognise common drug interactions and the mechanisms by which they arise, e.g., pharmacokinetic or pharmacodynamic.
use basic pharmacological principles of pharmacodynamics and pharmacokinetics, and present the information as a mini pharmacopoeia
distinguish between pharmacodynamics, including the mechanism of action of a drug, particularly where it maybe important in understanding its use and/or its side-effects, and pharmacokinetics, which include factors such as bioavailability (particularly to emphasise difference in routes of administration), plasma protein finding, clearance (metabolism if relevant)
identify the reason or dosage and dosing schedules, the effect of disease states on drugs, the effect of the drug on the patient, and potential clinically relevant drug interactions.

Physiology
General objectives
- demonstrate a clear understanding of normal human physiology and recognise how this may be altered by pathological processes, surgery or anaesthesia
- draw a distinct correlation between physiological changes and physical signs or symptoms elicited in patients
- demonstrate understanding of the philosophy of homeostasis by explaining the history and application of physiological control theory with particular reference to negative and positive feedback, and the laws of thermodynamics
- demonstrate understanding of cellular function by explaining the functional role of the structural components of the cell, with particular reference to the processes and regulation of gene expression
- recognise physiological changes that ensue in a patient following prolonged vomiting or diarrhoea, occur in renal function after surgery, or prevail in a patient with a duodenal ulcer

Alimentary
Specific objectives
- identify gastrointestinal motility by explaining its regulation
- identify the different alimentary secretions by explaining their functions and regulation of production
- recognise carbohydrate, fat and protein digestion by explaining the processes by which digestive end products as well as water, electrolytes and other substances are absorbed
- recognise common and preventable surgical alimentary tract disorders by describing their special physiological bases and consequences

Blood
Specific objectives
- describe the process and sites of erythropoiesis in the human, differentiating between different stages of development
- list the common human haemoglobin variants, indicating the developmental stage at which each appears
- describe the structure of haemoglobin and the relationship between this structure and the oxygen carrying function
- describe the mechanism by which senescent RBCs are removed from the blood and how the constituent components are "recycled"
- outline the mechanism by which iron is absorbed
- differentiate forms of iron deficiency from investigational information (e.g., blood film, iron studies)
• describe the inheritance of ABO and Rh blood groups, and how a given pair of individuals could be related, given their blood groups
• with respect to blood clotting:
  ° explain the mechanisms of clotting (intrinsic plus extrinsic pathways)
  ° describe the specific deficiency present in each of the major blood clotting disorders e.g., haemophilia
  ° describe the mechanism(s) by which anticoagulation using warfarin/heparin plus antiplatelet agents (e.g., aspirin) affect clotting
  ° interpret a given "clotting profile" with respect to i) diagnosis, ii) the likely outcome of the defect, iii) in the case of anticoagulation whether therapy is appropriate or not, iv) the anticoagulation therapy appropriate
• cardiovascular
  ° demonstrate an understanding of the origin and spread of cardiac excitation by explaining the mechanisms of the normal electrocardiogram, and the electrocardiographic findings in both cardiac and systemic disease, e.g., cardiac arrhythmias, coronary disease, and hypertension.
  ° describe the mechanical events in the cardiac cycle by explaining how changes are produced in both arterial and venous pulses, the heart sounds (murmurs and bruits commonly encountered) and in myocardial contraction.
  ° identify the processes which control myocardial contractility and cardiac output by explaining how factors may modify these processes in health, e.g., exercise, and disease e.g., heart failure.
  ° explain the control of blood flow by explaining the biophysical principles affecting flow in vessels and how blood flow is measured during physiological disturbances in man and experimental preparations
  ° indicate the capillary circulation by explaining how water, gases and larger molecules exchange across the capillary wall and equilibrate with the interstitial fluid
  ° identify the content and volume of the interstitial fluid and the functional role of the lymphatic circulation, by explaining the role of the extracellular space in health and disease
  ° review rapidly acting regulation of the systemic circulation by outlining the functional role of substances secreted by the endothelium, of circulating hormones, and of neural mechanisms
  ° identify factors which control systemic blood pressure, by explaining the role of 'baroreceptors', and 'volume receptors', and their efferent mechanisms
  ° demonstrate sound working knowledge of methods used for measuring blood pressure and their application (invasive and non-invasive)
  ° demonstrate sound working knowledge of methods used for measuring cardiac output and relationship between cardiac output (cardiac index) and systemic vascular resistance. Explain how measurements are made in the clinical situation
  ° demonstrate a sound working knowledge of methods used for the measurement of venous pressure and explain their application in the clinical situation
  ° distinguish factors regulating venous return in the context of both health (e.g., postural changes) and in surgical conditions (e.g., congestive heart failure, acute blood loss, burns and dehydration)
  ° recognise cerebral circulation, explain the formation and function of cerebrospinal fluid, the structure and function of the blood brain barrier, and how to measure cerebral blood flow. Explain how the cerebral circulation and brain metabolism is regulated
  ° describe coronary circulation, explaining how coronary blood flow is regulated, and how this changes in coronary artery disease
  ° review cutaneous circulation, explaining its control in temperature regulation, sweating and the local reaction to injury
  ° identify splanchnic circulation, including the intestinal and hepatic circulations, by explaining how it is controlled, and its functional role in the splanchnic bed as a blood reservoir
  ° describe placental and foetal circulations, explaining their structure, function and control
  ° review skeletal muscle circulation, explaining in particular the control of muscle blood flow in the context of exercise and sporting activities
describe compensatory adjustments of the cardiovascular systems, by explaining the effects and control during changes in gravity, particularly in the context of posture, altitude (including zero gravity), barometric pressure and rapid acceleration

identify cardiovascular response to exercise by describing the immediate haemodynamic effects and their mechanisms, and the longer-term adaptation that occurs with training

describe circulatory consequences of blood loss, outlining the reflex and local controls in hypovolaemia, and its management in clinical situations

identify various factors that produce and sustain shock, by explaining the cardiovascular compensatory reactions activated by shock, together with the treatment of shock

explain heart failure and describe its manifestations, pathogenesis and treatment

identify various types of hypertension by outlining the different causes, the long term effects on the cardiovascular system, and the management of hypertension

recognise and review physiological effects of drugs used in cardiovascular medicine, by explaining the mechanism of action of inotropic agents, vasodilators, vasoconstrictors, anti-arrhythmics and beta-blockers

Haemotology and transfusion

General objectives

- describe the normal development of cells of the bone marrow and lymphoid tissues, how they react normally to noxious stimuli, their abnormalities in terms of reactive and neoplastic processes and the effects of these in the normal individual and in association with other diseases
- identify the causes and effects of defective haemostasis and abnormal thrombocoagulation
- explain blood groups and transfusion practice, particularly as it impacts on surgical practice; identify the hazards of transfusion and the use of blood products in medical practice.

Specific objectives

- explain the causes and effects on the body of anaemia and the overproduction (reactive and neoplastic) of the erythroid cell series
- identify the causes and effects on the body of underproduction and overproduction (reactive and neoplastic) of cells of the myeloid and monocytic series and interference with the normal functions of those cells. This includes an understanding of the morphological and functional effects of the leukaemias and other myeloproliferative disorders and their effects on an individual in health and in the face of surgical intervention
- describe the normal actions of the lymphoid system during defence reactions of the body; understand the malignant lymphomas including a functional classification system and the progression, effects and complications of Hodgkin's and non-Hodgkin's lymphomas
- explain the normal and impaired production of platelets, the role of platelets in normal haemostasis and pathological thrombosis, the effects of insufficiency of platelet numbers or action and the complications of thrombocytopathy (reactive and neoplastic)
- describe normal blood coagulation and the hereditary and acquired defects in (or overactivity of) blood coagulation, including the interaction of coagulation and platelet aggregation
- identify blood groups and transfusion principles, in particular as they apply to surgical practice, including the technical and biological hazards of transfusion and the use of blood products in surgical practice.

Endocrine

General objectives

- identify all endocrine systems by outlining the mechanisms regulating secretion of hormones and their actions on target cells and organs
Specific objectives
- describe the control of anterior and posterior pituitary function, explaining the influence of normal hypothalamic regulation
- recognise normal function of the anterior pituitary, explaining the mechanisms of symptoms and signs of hyperpituitarism and hypopituitarism
- identify normal function of the posterior pituitary, explaining the mechanisms of symptoms and signs of hypofunction (diabetes insipidus) and hyperfunction (hypersecretion of vasopressin)
- describe normal function of the thyroid, explaining mechanisms of symptoms and signs of hyperthyroidism and hypothyroidism
- identify normal function of parathyroid, explaining mechanisms of symptoms and signs of hyperparathyroidism and hypoparathyroidism.
- describe normal function of adrenal medulla and cortex, by explaining mechanisms of symptoms and signs of hyperfunction (Addison's disease) and hyperfunction (Cushing's disease) of the adrenal cortex; and hyperfunction (phaeochromocytoma) of the adrenal medulla
- review normal endocrine function of the kidney, explaining mechanisms of symptoms and signs of renal hypofunction (renal failure)
- identify normal function of the endocrine pancreas, by explaining mechanisms of symptoms and signs of hypofunction (diabetes mellitus) and hyperfunction (insulinoma)
- recognise normal function of sex hormones in reproduction, by explaining the mechanisms of the symptoms and signs of reproductive dysfunction in the male and female
- describe the regulation of body function in response to trauma, starvation, sepsis, and the stress of surgery, explaining the specific changes due to endocrine mechanisms
- identify endocrine functions of other body organs e.g., the heart, and lung, circumventricular organs in the brain and intermediate lobe of pituitary, by outlining their role in synthesising specific substances for controlling functions at both local, and remote sites (e.g., in the case of the heart, atrial natriuretic peptides and angiotensin)

Muscle
Specific objectives
- identify muscle contraction, by explaining the common and different processes involved in excitation-contraction-coupling in skeletal, cardiac and vascular smooth muscle
- explore the physiological role of nitric oxide, by explaining the sites and processes at and by which nitric oxide-like molecules are synthesised, and the role such molecules play in function of smooth, cardiac and skeletal muscle

Neurophysiology
Specific objectives
- describe cell membrane excitability, by outlining the processes for which a membrane potential is created, an action potential is initiated and propagated, and of factors which may modify these processes in health, e.g., local anaesthetics, and disease e.g., electrolyte disturbances
- identify intercellular signalling, explaining the processes of synaptic transmission at neuroeffector junctions in the somatic and autonomic nervous systems; and the factors which can modify these processes
- identify the autonomic nervous system, explaining the function of the autonomic nervous system and the transmitter specificity of its component parts, including the role of peptide transmitters
- identify reflex controls, including somatic and autonomic spinal reflexes, and axon reflexes, by explaining the role in symptoms and signs of e.g., stroke, hypertension, hypoxia and inflammation
- describe spinal neurophysiology, outlining the functional role of the sensory, motor and autonomic spinal tracts, particularly within the context of the symptoms and signs demonstrating their derangement e.g., referred pain, paraplegia
• distinguish the functions of cranial nerves, describing their role in "the special senses"
• recognise the functional roles of the basal ganglia, limbic system, hypothalamus and brainstem (including the reticular activating system) by explaining their role in memory, human behaviour, and in specific, relevant clinical derangements, e.g., brain tumour, and stroke
• identify the functional role of the cerebral cortex, outlining its function in sensory perception, motor control, and speech
• describe the functional role of the cerebellum, by explaining the mechanisms of fine motor coordination in health, and its destruction in disease
• examine the role of the cerebrospinal fluid and blood-brain barrier, by explaining how these entities protect the brain
• review EEG, explaining the patterns which demonstrate normal and deranged human behaviour (e.g., sleep, epilepsy)

Nutrition and Metabolism
General objective
• identify basic nutritional requirements for normal daily life

Specific objectives
• determine the inter-relationships of carbohydrate, protein and fat metabolism in the production of energy, and how these factors are changed with under-nutrition and over-nutrition
• identify the nutritional impact of surgery, outlining the metabolic complications and their mechanisms that may arise from surgery on patients with normal and abnormal nutrition

Urinary Tract
Specific objectives
• demonstrate an understanding of the renal circulation, explaining its control systems, particularly with respect to the afferent and efferent arterioles, and the vasa recta
• describe glomerular filtration by explaining the factors which mediate control
• identify renal tubular function by explaining its control from the proximal to distal segments
• describe renal function tests by explaining how they apply to diagnosis particularly in renal failure
• recognise the functional changes in the nephron in renal failure, explaining how these changes affect homeostasis, particularly in surgical conditions such as burns and crush injuries, and during the different forms of shock
• describe how diuretics affect nephron function by explaining the nature of diuresis
• review the control of bladder function, outlining the role of mechanisms used normally, and how these change in paraplegia, stroke, and destructive processes locally
• describe the effects of obstruction of the nephron, ureters, bladder and prostate, by describing the mechanisms of the relevant symptoms and signs

Respiratory
General objective
• describe the respiratory system by outlining its structure in terms of function

Specific objectives
• identify the medullary and pontine respiratory control centres by explaining the influence of changes in oxygen and carbon dioxide tensions, and in H+ concentration in blood and CSF, on the control of breathing
describe the control of breathing by explaining the influence of pulmonary and somatic reflexes on ventilation
explain the ventilatory response to exercise in terms of central and peripheral mechanisms involved
review pulmonary ventilation, describing the concepts of alveolar ventilation and dead space ventilation including anatomical and alveolar components
explain hypoventilation by describing its effects on blood chemistry and cardiovascular changes
explain Fick's law of diffusion by outlining its significance for oxygen and carbon dioxide exchange in pulmonary and systemic tissues
distinguish the differences between pulmonary and systemic circulations by comparing vascular haemodynamics and capillary exchange factors
review the pressures within and around the pulmonary vessels and hypoxic pulmonary vasoconstriction
describe pulmonary blood flow, explaining how it can be measured and its quantitative value
identify the regional distribution of pulmonary blood flow, outlining the control factors responsible for it
identify water balance within the lung by describing how the responsible factors determine water distribution
review the metabolic functions of the lung by defining its catabolic and anabolic actions
indicate regional ventilation-perfusion ratio by explaining how differences occur in regional:
- ventilation
- perfusion
- V/Q ratio
- and the effects on overall gas exchange
- PH92
- how the effects of increasing and decreasing the V/Q ratio alter alveolar and end-capillary gas tensions
describe how high V/Q ratio regions generate alveolar dead space, and of the factors contributing to alveolar dead space ventilation
distinguish mechanisms by which veno-arterial shunting results from low V/Q ratio regions and from absolute shunting
identify how measurements of venous admixture using the shunt equation can be made and how the A-a PO2 difference can be used as an index of shunting
describe how oxygen is carried in blood, by explaining the significance of oxygen dissolved and bound to haemoglobin
review the properties and significance of the Hb-oxygen dissociation curve, explaining how oxygen is taken up in the lungs, and delivered to tissues
explain the mechanism of cyanosis, in terms of haemoglobin desaturation
describe how carbon dioxide is carried in blood, explaining the role of plasma and red cells
identify properties and significance of the carbon dioxide dissociation curve with respect to:
- carbon dioxide elimination by the lungs
- the Haldane effect
describe how the muscles of respiration overcome the elastic and flow-resistive impedance to breathing
explain how regional differences in ventilation occur due to changes in elastic properties of the lung (pressure-volume relationships, compliance and surfactant)
discuss the elastic properties of the chest wall
identify total compliance of the respiratory system by outlining its controlling factors
recognise pressure/volume/flow relationships for spontaneous ventilation
explain airway resistance by defining the physical determinants including the role of lung volume and dynamic airway compression
describe the effects of increased airway resistance.
• explain the effects of regional differences in airway resistance on the distribution of ventilation and gas exchange.
• describe how the upper airway humidifies, filters and warms inspired gas.
• indicate the subdivision of lung volume into primary lung volumes and capacities, especially vital capacity, functional residual capacity and closing volume.
• explain how common tests of lung function are carried out and how abnormal results may be interpreted.
• describe the mechanisms of arterial hypoxaemia, by explaining the effects of:
  ° hypoventilation
  ° shunt
  ° low V/Q ratios
  ° diffusion impairment, and
  ° the role of increasing the inspired oxygen concentration in each type.
• identify the basic mechanisms of hypoxic and ventilatory acute respiratory failure.
• discuss IPPV and PEEP, explaining the physiological effects of these applications.
• explain the effects of age and surgery on respiratory function, by explaining how this differs from normal.

Temperature Regulation
Specific objectives
• review the normal regulation of body temperature, explaining how metabolism interacts with autonomic controls.
• describe the regulation of body temperature during fever, by explaining the mechanism of central thermostat resetting.
• explain how variations in body temperature relate to homeostasis in normal, and in the post-operative state and in surgical conditions e.g., sepsis.

Fluid and electrolytes
Specific objectives
• demonstrate sound understanding of normal distribution of body fluids and their composition, explaining how the component-compartment volumes may be measured.
• identify factors responsible for the maintenance of fluid balance and electrolyte concentrations in the different body fluids eg. in the extracellular compartments, and intracellular departments, by explaining the role of ion pumps, buffer systems, hormones.
• recognise effects of changes in body fluid composition on membrane excitability in the different cells of the body by describing the effects on neurones, cardiac myocytes.
• review the control of acid-base balance, particularly as it applies to surgical conditions of fluid and electrolyte retention, and loss, by explaining the mechanisms and resultant state, in renal failure, gastrointestinal fistulae and obstruction, diarrhoea and dehydration.

Pre-operative, intra-operative, and post-operative care and assessment
The knowledge and skills to manage patients before, during and after a surgical procedure are essential. Most surgical operations should be, and are, uncomplicated. Many complications of surgery can be anticipated, and thus prevented. The scope of surgery has increased dramatically in the past 50 years and the potential for post-operative complications is almost infinite.
Pre-operative care generally starts with determining whether the patient has any comorbidities which may affect outcome (particularly cardiorespiratory or endocrine problems) which must be corrected or stabilised.
In emergency surgical procedures the priorities change, and the time available for correcting preoperative disorders is compressed or unavailable.
After surgery the requirements comprise regular review of the operative site, always checking that pain relief is adequate and appropriate, plus a continuing general systems review.

**Pre-operative**

*General objective*

- apply basic science knowledge and skills to optimise patient safety and care before surgery.

*Specific objectives*

**Clinical Skills**

- elicit the symptoms and signs of patients with "surgical" disorders

**Investigations**

- differentiate between available methods of investigation, including the principles underlying methods of investigation, such as, X-rays, computerised tomography, magnetic resonance imaging, ultrasound, radionuclides, endoscopy and biopsy
- assess patients with surgical disorders and identify associated risk factors.
- assess the severity and extent of a patient's surgical disorder, any concomitant medical disorders which may affect management, the significance of age and the medication associated with the treatment of these disorders

**Effects of Disease**

- identify how the physiological, anatomical, pathological and psychological effects of disease affect clinical presentation, investigation, treatment and prognosis

**Trauma**

- carry out the diagnosis, assessment, first aid, transportation, resuscitation and treatment of the injured, including patients with burns

**Resuscitation**

- perform resuscitation of the critically ill or injured

**Pre-operative Care**

- identify and be able to carry out:
  - pre-operative preparation
  - control of the effects of the disease to be treated
  - control of the effects of concomitant disease
  - prophylactic measures against intra and post-operative complications
  - informed consent
  - communication with patients, relatives and others
  - pre-medication.

**Deep Venous Thrombosis (DVT) prophylaxis**

- recognise the risk factors for DVT
- determine the natural history and clinical features of DVT
- determine an appropriate clinical approach to the diagnosis of DVT
- identify effective treatment

**Intra-operative care and assessment**

*General objective*
• identify and apply basic science knowledge and skills to optimise patient safety and care during surgery.

Specific objectives

Principles of Asepsis and Antisepsis

Safety in the Operating Theatre
• Describe and be able to ensure all appropriate steps are implemented for safety of the patient and all members of the surgical team in the operating theatre. This includes: Air change and air sterility. Operating tables. Operating microscopes. Diathermy, principles and hazards. Clothing. Special precautions (hepatitis, AIDS, radiation, anaesthetic gases). Protection of the unconscious patient.

Principles of general, regional and local anaesthesia
• Apply basic principles of general and regional anaesthesia
• Explain the principles of pre-anaesthetic assessment including impact of concomitant diseases on anaesthesia and surgery
• Review pharmacology of local anaesthetic agents such as Lignocaine, Bupivacaine
• Manage pain, acute and chronic
• Explain incidence prevention and management of common peri-operative complications
• Identify surgical issues in relation to anaesthesia and same day surgery.

Surgical Access
• For the most common surgical procedures be able to identify the most appropriate site and choice of incisions in relation to access, skin creases, blood and nerve supply, and retraction
• Identify and review adjuncts to surgery, for example, the properties, value, effects, choice of and use of instruments, ligatures, sutures, drains and catheters
• Identify issues relating to lighting.

Pathophysiology and Management of Wounds of all Tissues
• Review the effect of incisions produced by knives, diathermy, lasers.
• Describe the methods and effects of closure and fixation of wounds and tissue defects
• Discuss factors effecting wound healing and those relevant to failed wound healing
• Explain general principles governing the response of tissues to all forms of implanted materials
• Describe the patho-physiological effects and correction of intraoperative blood loss and fluid loss.

Emergency care
• Perform life-saving procedures, such as cardiac massage, relief of cardiac tamponade, trachcostomy, chest drains, ventilation, control of haemorrhage and amputation; crico thyroidotomy.
• Carry out emergency access to the body cavities, such as burrholes, thoracotomy and laparotomy for peritonitis, and deal with intestinal obstruction and abdominal haemorrhage.

Trauma
• Explain the principles of the surgical treatment (local and general) of all forms of trauma, including burns
• Identify what is required in evacuation of trauma victims, stabilisation, in flight care.
Post-operative care and assessment

**General objective**
- Identify and apply basic science knowledge and skills to optimise patient safety and care during surgery.

**Specific objectives**

**Management of pain**
- Differentiate between methods of post-operative analgesia and the pharmacology of common analgesics

**Principles and practices of intensive care**
- Identify the principles of, and be able to monitor:
  - respiratory, circulatory, renal and alimentary support, (for example, ventilators, blood gases, defibrillation, inotropic drugs, haemodialysis, peritoneal dialysis, monitoring of arterial and central venous pressure and cardiac output)
- Identify the contribution of rehabilitation and physiotherapy to the healing process
- Explain the aetiology and prevention of infection, and carry out the management of infection
- Identify the principles of fluid and electrolyte balance
- Review the issues relevant to nutrition and feeding of the post-operative patient

**Pathophysiology, investigation and management of post-operative complications**
- Identify and manage respiratory infection and atelectasis
- Identify the symptoms and describe the treatment of:
  - deep vein thrombosis and pulmonary embolism.
  - haemorrhage, fluid imbalance, shock, myocardial infarction and cardiac arrest.
  - retention of urine, renal failure.
  - paralytic ileus
  - jaundice
  - infection of all varieties and septicaemia
  - wound dehiscence

**Management of concomitant disease**
- Identify the symptoms and describe the complicating issues for surgery of:

**Management of severe injury**
- Identify the symptoms and describe the complicating issues of:
  - disseminated intravascular coagulation, fat embolism and the respiratory distress syndrome

**Non-surgical Treatment of Malignant Disease**
- Principle, practise, value and complications of radiotherapy
- Principles, pharmacology value and complications of chemotherapy and other therapeutic agents

**Management of the Chronic and Terminally Ill**
- Pain relief. Nutrition
- Psychological support
• Counselling
• Bereavement

Wound care
• demonstrate sound understanding of wound management
• define the differential characteristics between acute and chronic wounds
• distinguish between the three types of wound healing
• recognise the five major components of response of tissue to injury
• identify the principles of wound healing
• recognise the importance of growth factors in tissue repair
• determine the cellular sources and functions of the growth factors in acute wound healing
• identify both the intrinsic and extrinsic factors affecting wound healing
• recognise the five categories of wound dressings/ select appropriate wound dressing
• distinguish between the four wound infection classifications

Fluid and electrolytes

Haemostasis

Apply clinical knowledge in practice to recognise and solve real-life problems in particular, the treatment of pain

Level 2 – Specialist Surgical Training

Cardiothoracic Surgery

General Surgery

Neurosurgery

Orthopaedic Surgery

See requirements for the Orthopaedic Principles and Basic Science Examination (OPBS)
http://www.surgeons.org/AM/Template.cfm?Section=Interim_examinations&Template=/MembersOnly.cfm&NavMenuID=1021&ContentID=4796&DirectListCo mboInd=D
Otolaryngology Head and Neck Surgery
Modules

Paediatric Surgery
Modules
See requirements for the Paediatric Anatomy and Pathology examinations

Plastic and Reconstructive Surgery
Modules
See requirements for the Plastic & Reconstructive Surgical Science and Principles examination
http://www.surgeons.org/AM/Template.cfm?Section=Interim_examinations&Template=/CM/ContentDisplay.cfm&ContentID=1711

Urology
Modules

Vascular Surgery
Modules