C M S A
The Colleges of Medicine of South Africa NPC
Nonprofit Company (Reg No.1955/000003/08)
Nonprofit Organisation (Reg. No. 009-874 NPO)
Vat No. 4210273191
27 Rhodes Avenue, PARKTOWN WEST, 2193
Tel: +27 11 726 7037; Fax: +27 11 726 4036
Website: www.cmsa.co.za
General: Academic.Registrar@cmsa.co.za

JOHANNESBURG OFFICE
EXAMINATIONS & CREDENTIALS

ACADEMIC OFFICE

January 2022

THE COLLEGE OF PATHOLOGISTS OF SOUTH AFRICA

R E G U L A T I O N S

FOR ADMISSION TO THE FELLOWSHIP OF THE COLLEGE OF PATHOLOGISTS OF SOUTH AFRICA IN HAEMATOLOGY

FC Path(SA) Haem

1.0 COMPONENTS

The examination comprises Part II which is the final exit examination

2.0 PURPOSE OF ASSESSMENT

The aim of this assessment is to evaluate if the candidate who has completed the minimum training period, has acquired the appropriate professional knowledge, skills and attitude stipulated by the HPCSA training requirements and standards in order to be licensed by the HPCSA as a practitioner of haematology at specialist level. This assessment is one of two parts of the HPCSA requirement for registration as a haematologist. The other part of the registration requirement is assessment of a research report by the host university.

3.0 ADMISSION TO THE EXAMINATION

A candidate may be admitted to Part II of the examination having

3.1 Obtained a post-community service/internship qualification to practice medicine which is registered with the Health Professions Council of South Africa (HPCSA)

3.2 Completed Part I of the FC Path(SA) Haem examination. Exemptions to Part I may be considered on the basis of having completed a Part I equivalent examination acceptable to the College of Pathologists.

3.3 Completed three and a half (3½) years fulltime post-community service/internship training as a Haematology Registrar in a teaching and training hospital/institution.

3.4 Completed at least three (3) months training in a transfusion medicine training facility. Time spent on supervised transfusion medicine calls or diploma/certificate in transfusion medicine may be accepted as part of the required three months training

3.5 From the second semester 2014 the submission of your Portfolio at the time of making your application is compulsory for all candidates who entered into their Registrar post from 1 January 2010

4.0…/

4.0 FORMAT OF THE EXAMINATION

The Part II examination, with an overall pass mark of 50%, comprises:

4.1 Two 3-hour online examination papers, with a sub-minimum of 50%

4.1.1 Paper 1 will stress laboratory practice and the basic principles of haematology, immunology and blood transfusion

4.1.2 Paper 2 will stress applied clinical haematology

4.2 A modified clinical/practical/oral exam will be conducted in the form of a microscope-based Assessment of Competence, a series of written online examinations and a Structured Oral Examination

4.2.1 Format of the microscope based Assessment of Competence

- Paper 1 (Morphology)
- Number of cases: 12
- Duration of examination: 3 hours (15 minutes per case). An additional 45 minutes to allow for typing, if needed
- Examination Material: glass slides
- Examination to be answered online using a Google form

4.2.2. Format of the written dry practical examinations

- Written paper 2: Coagulation, flow cytometry, blood transfusion (3 hours, and an additional 45 minutes for typing, if needed)
- Written paper 3: Molecular Haematology, Cytogenetics and FISH, special haematology (3 hours, and an additional 45 minutes for typing if needed)
- Both written papers will consist of short questions and will be answered online using Google forms. An examination booklet will be provided for calculations.

4.2.3 Format of the Structured Oral Examination:

- Number of virtual stations: 2 (2 cases per station= total of 4 cases)
- Duration of each station: 30 minutes
- Number of examiners: 2 per station
- Examination material may include: case histories and test results, still images, photos and diagrams.
- Examination presentation: examination material and questions will be presented as PowerPoint slides
- The examination will be conducted remotely using Zoom

4.3 Marking of the practical examination:

- A Score of 50% or more will be deemed a pass score for the combined written papers and is required to proceed to the practical/oral examination. A Score of 50% or more will be deemed a pass score for the combined practical/oral component of the examination. There are no sub-minima for the individual written papers or individual practical/oral examinations.
- A memorandum with mark allocation will be used for each component of the examination.
- The marks for the microscope-based Assessment of Competence will be combined to obtain an average score with an overall pass mark of 50% required.
- The marks for written paper 2 and paper 3 will be combined to obtain an average score.
- The marks for the Structured Oral Examination will be combined to obtain an average score.
- The final mark will consist of
  - Written Paper 1 and 2 30%
  - Microscope-based Assessment of Competence (Paper 1 Morphology) 25%
  - Paper 2 (Coag, Flow, Blood transfusion) 15%
  - Paper 3 (Molecular, cytogenetics, FISH and Special haematology 15%
  - Structure oral exam: clinical case vignettes 15%

5.0 ADMISSION AS A FELLOW

5.1 Only candidates who have completed training in a CMSA recognised registrar post may be awarded a fellowship if successful in the examination.

5.2 **Candidates who have written the examination as a prerequisite from the HPCSA for inclusion on the specialist register are not eligible to be awarded a Fellowship but will be sent a letter confirming their success in the examinations**

All other candidates will be asked to sign a declaration as below:

I, the undersigned, …… do solemnly and sincerely declare

that while a member of the CMSA I will at all times do all within my power to promote the objects of the CMSA and uphold the dignity of the CMSA and its members

that I will observe the provisions of the Memorandum and Articles of Association, By-laws, Regulations and Code of Ethics of the CMSA as in force from time to time

that I will obey every lawful summons issued by order of the Senate of the said CMSA, having no reasonable excuse to the contrary

and I make this solemn declaration faithfully promising to adhere to its terms

Signed at …… this ……..…… day of

…….. 20 ……..

Signature ……..……

Witness ……
(who must be a Founder, Associate Founder, Fellow, Member, Diplomate or Commissioner of Oaths)

5.2 A two-thirds majority of members of the CMSA Senate present at the relevant meeting shall be necessary for the award to any candidate of a Fellowship

5.3 A Fellow shall be entitled to the appropriate form of certificate under the seal of the CMSA

5.4 In the event of a candidate not being awarded the Fellowship (after having passed the examination) the examination fee shall be refunded in full

5.5 The first annual subscription is due one year after registration (statements are rendered annually)

A P P E N D I X A

1.0 RECOMMENDED READING

Additional sources of theoretical and practical haematology knowledge such as current haematology journals and the latest editions of the following textbooks are recommended:

- **Litchman *etal*:** *William's Hematology*
- **Dacie and Lewis:** *Practical Haematology*
- **Hoffbrand *et al*** : *Postgraduate haematology*
- **Bradley:** *Lecture Notes on Molecular Medicine*
- **Reeves *et al*** : *Lecture Notes on Immunology*

2.0 SYLABUS FOR PART II

- This haematology curriculum outline is for guidance only and may not cover all aspects of haematology which may be included in the examination of candidates.

Haematology curriculum modular outline

Module	**Description**
Module 1	Haemopoiesis
Module 2	Morphology
Module 3	Haematologic malignancies
Module 4	Haemostasis and thrombosis
Module 5	Blood transfusion
Module 6	Automation and quality assurance
Module 7	Specialised diagnostic haematology
Module 8	Laboratory Management
Module 9	Skills
Module 10	Immunology and basic molecular biology

2.1 Module 1. Haemopoiesis

2.1.1 Comprehensive knowledge of the developmental process of all three haemopoietic cell lines including but not limited to

- Stem cell biology and plasticity
- Erythropoiesis
- Lymphocyte biology
- Thrombopoiesis
- Leucocyte maturation and differentiation

2.1.2 Comprehensive knowledge of cell surface receptor and cell surface protein changes during haemopoietic development, differentiation and maturation. This should include but not limited to

- Understanding the role of growth factors in haemopoiesis
- Understanding the role of cytokines in haemopoietic proliferation, differentiation and maturation

2.1.3 Comprehensive knowledge of normal erythropoiesis including but not limited to

- Erythropoietic maturation stages
- Haemoglobin structure and function including embryology and genetics
- Porphyrin protein biochemistry
- Genetics and biochemistry of Iron metabolism
- Vitamin b12 and folate biochemistry

2.1.4 Comprehensive knowledge of normal platelet structure and function including but not limited to

- Role of thrombopoietin in thrombopoiesis
- Platelet endothelial cell interaction
- Platelet activation including adhesion, aggregation and degranulation

2.1.5…/

2.1.5 Comprehensive knowledge of normal granulocyte development, proliferation, differentiation and maturation including but not limited to
- Expression of cell surface receptors and HLA proteins
- Role of various cytokines
- Various developmental compartments and factors influencing these

2.1.6 Comprehensive knowledge of abnormal erythropoiesis including comprehensive understanding of aetiology, Pathophysiology, diagnosis, risk factors and treatment of
- Nutritional anaemias
- Hypoproliferative anaemias
- Haemolytic anaemias
- Haemochromatosis
- Porphyria
- Haemoglobinopathies
- Thalassemias
- Enzymopathies

2.1.7 Comprehensive knowledge of aetiology, pathophysiology, diagnosis and treatment of primary and secondary quantitative abnormalities of red cells including but not limited to
- Erythrocytosis

2.1.8 Comprehensive knowledge of aetiology, pathophysiology, differential diagnosis and treatment of quantitative and qualitative abnormalities of white cells including but not limited to
- Granulocytopaenia
- Lymphopaenia and lymphocyte dysfunction
- Leucytosis including eosinophilia, neutrophilia, monocytosis and basophilia

2.1.9 Comprehensive knowledge of aetiology, pathophysiology, diagnosis of abnormal platelet function including but not limited to abnormalities of
- Adhesion
- Aggregation
- Granular content release
- Signal transduction abnormalities

2.1.10 Apprehensive knowledge of aetiology, pathophysiology and diagnostic approach of quantitative platelet abnormalities including
- Thrombocytopaenia
- Thrombocytosis

2.1.11 Comprehensive knowledge of pathophysiology and diagnostic approach to acquired and congenital bone marrow failure syndromes including but not limited to
- Aplastic anaemia
- Pancytopaenia
- Congenital bone marrow failure syndromes

2.2 **Module 2: Morphology**

2.2.1 Comprehensive knowledge of principles of light microscopy including structure and function of
- Lenses
- Diaphragm
- Eyepieces and magnification
- Light source

2.2.2 Comprehensive knowledge of factors influencing the optimum microscopic examination of specimen including but not limited to
- Optimum setting of lenses, light and objective selection
- Optimum smear preparation
- Optimum smear staining
- Recognition of artifacts of specimen preparation, fixation and staining

2.2.3…/

2.2.3 Comprehensive knowledge of factors influencing accurate interpretation of microscopic examination results including but not limited to
- Correct assessment of clinical information
- Normal ranges appropriate for age , sex and geographical location
- Interpretation of peripheral blood counts and indices

2.2.4 Comprehensive knowledge of indications and interpretation of stains used in the peripheral blood examination including but not limited to
- Romanowsky stains
- Supravital stains
- Perl's Prussian blue stains

2.2.5 Comprehensive knowledge of normal cellular morphology and composition of peripheral blood including
- Relative and absolute counts of the various cell types
- Acceptable limits of variation in normal cellular morphology

2.2.6 Comprehensive knowledge of quantitative and qualitative abnormalities of erythropoiesis in the peripheral blood including but not limited to
- Abnormalities of cell size, shape, colour, distribution and inclusions
- Diagnostic approach to fragments and thrombocytopenia
- Significance of normoblastaemia and teardrops

2.2.7 Comprehensive knowledge of qualitative and quantitative abnormalities of white cells including but not limited to
- Recognition of circulating abnormal white cells such as blasts, hairy cells
- Left and right shift and their significance
- Dysplastic features
- Leucocytosis and leucopenia aetiology, Pathophysiology and differential diagnosis
- White cell inclusions such as Auer rods, pigments and granules

2.2.8 Comprehensive knowledge of qualitative and quantitative platelet abnormalities including but not limited to
- Thrombocytopenia and thrombocytosis aetiology, Pathophysiology and diagnostic approach
- Differential diagnosis of giant platelets
- Recognition of pseudothrombocytopaenia

2.2.9 Comprehensive knowledge of normal bone marrow cellular composition, structure and maturation stages including but not limited to
- Erythropoietic maturation and quantitative limits
- Granulopoietic composition, maturation and quantitative limits
- Structure, function and quantitative limits of megakaryocytes, plasma cells, and lymphocytes

2.2.10 Comprehensive knowledge of assessment of quality of bone marrow aspirate including
- Evaluation of optimum smear preparation and staining
- Intramedulary elements composition

2.2.11 Comprehensive knowledge of abnormal bone marrow qualitative and quantitative findings including but not limited to
- Diagnosis of myeloproliferative disorders including acute leukemias
- Diagnosis of plasma cell dyscrasias
- Diagnosis of lymphoproliferative disorders
- Diagnosis of Myelodysplastic syndromes

2.2.12 Comprehensive knowledge of various stains used in the analysis bone marrow aspirate including their
- Principles
- Indications
- Procedures
- Interpretations
- Limitations

2.2.13 Comprehensive knowledge of classification systems of the various clonal haemopathies including
- The FAB classification
- WHO classification of haematolymphoid malignancies

2.2.14 Comprehensive knowledge of diagnostic approach of the trephine biopsy specimen including
- Assessment of quality and adequacy of the specimen
- Strengths and weaknesses of trephine examination
- Acceptable limits of qualitative and quantitative cellular composition
- Assessment of erythropoiesis, megakaryopoiesis, granulopoiesis and stoma composition and architecture
- Utility of trephines in diagnosis of lymphomas and other clonal haemopathies

2.3 **Module 3: Haematologic malignancies**

2.3.1 Comprehensive knowledge of the various classification systems of haematolymphoid malignancies including the
- WHO classification
- REAL classification-historical perspective
- FAB classification-historical perspective

2.3.2 Comprehensive knowledge of basic cancer biology including
- Mechanics and kinetics of tumor growth
- Tumor genesis and immortalisation
- Angiogenesis
- Cell invasion and metastasis
- Role of telomeres and senescence in cancer biology

2.3.3 Comprehensive knowledge of epidemiology, clinical presentation, aetiology/risk factors, molecular pathophysiology, diagnosis, treatment and prognostic assessment and complications of chronic myeloproliferative disorders including
- Chronic myeloid leukemia
- Polycythaemia vera
- Idiopathic myelofibrosis
- Essential thrombocythaemia

2.3.4 Comprehensive knowledge of epidemiology, aetiology/risk factors, clinical features, molecular pathophysiology, diagnosis, treatment principles and complications of the Acute Myeloid Leukemias

2.3.5 Comprehensive knowledge and competency in understanding classification and prognosis of acute myeloid leukemia including the role of
- morphology
- cytochemistry
- cytogenetics
- molecular analysis and
- flow cytometry

2.3.6 Comprehensive knowledge of the epidemiology, clinical features, molecular pathophysiology, diagnosis and treatment principles of Myelodysplastic syndromes

2.3.7 Comprehensive knowledge of the classification (WHO) and international prognostic and staging system of Myelodysplastic syndromes.

2.3.8 Comprehensive knowledge of the epidemiology, natural history, aetiology, molecular Pathophysiology, diagnosis , treatment of B-cell lymphoproliferative disorders including
- Acute lymphoblast leukemias
- Chronic lymphocytic leukemias
- High grade lymphomas
- Low grade/Indolent lymphomas

2.3.9…/

2.3.9 Comprehensive knowledge of epidemiology, natural history, aetiology, clinical presentation, diagnosis, treatment and prognostic markers for T-cell lymphoproliferative disorders including
- Adult T-cell lymphoma leukemia
- T-cell LGL leukemia
- T-cell lymphomas
- NK cell lymphomas
- Cutaneous T-cell lymphoma, Sezary and Mycosis fungoides
- Adult T-cell leukemia/lymphoma

2.3.10 Comprehensive knowledge of the epidemiology, natural history, aetiology, molecular Pathophysiology, diagnosis, treatment and prognostic markers of plasma cell dyscrasias and immunoproliferative disorders including
- Myeloma
- Plasma cell leukemia
- Plasmacytomas
- Amyloidosis
- MGUS
- Waldenstrom's Macroglobulinaemia

2.3.11 Comprehensive knowledge of Hodgkin's lymphoma including its epidemiology, natural history, classification, clinical presentation, diagnosis, treatment and prognostic markers

2.3.12 Comprehensive knowledge of the aetiology, diagnosis, treatment of histiocytic and dendritic cell neoplasms

2.3.13 Comprehensive knowledge of the cell biology, clinical presentation, diagnosis and treatment principles of mastocytosis

2.4 **Module 4: Haemostasis and thrombosis**

2.4.1 Comprehensive knowledge of the current views on the basic mechanism of haemostasis and thrombosis including
- Primary and secondary haemostatic events
- Cascade model of haemostasis
- Revised coagulation pathway
- Cell based model of haemostasis

2.4.2 Comprehensive knowledge of function of the various components of haemostasis including
- Procoagulant and anticoagulant proteins
- Vascular endothelium
- Platelets
- Fibrinolysis

2.4.3 Comprehensive knowledge of the genetics, natural history, presentation, pathophysiology, diagnosis and treatment of the various congenital bleeding disorders including
- Haemophilia A and B
- Von Willebrandt disease
- Other coagulation factor deficiencies
- Hereditary (functional) platelet disorders

2.4.4 Comprehensive knowledge various replacement therapies and bypassing agents including but not limited to
- Nature of preparation
- Dose and formulation
- Indications for use
- Contraindications
- Adverse effects and complications of use

2.4.5 Comprehensive knowledge of complications of replacement therapy including but not limited to
- Infectious complications
- Immunologic complications
- Hypercoagulable complications

2.4.6…/

2.4.6 Comprehensive knowledge of aetiology, pathophysiology, diagnosis and treatment of acquired bleeding disorders including
- Liver and renal pathology
- Connective disorders
- Inhibitors
- Anticoagulant therapy
- Platelet disorders
- Drug induced disorders

2.4.7 Comprehensive knowledge of clinical presentation, diagnosis and management of congenital causes of thrombosis including but not limited to
- Factor V Leiden
- Prothrombin G20210A
- Protein S and C
- Antithrombin deficiency
- Sticky platelet syndrome
- Hyperhomocysteinaemia

2.4.8 Comprehensive knowledge of clinical presentation, pathophysiology, diagnosis and treatment of acquired causes of hypercoagulable state including but not limited to
- Antiphospholipid syndrome
- Heparin induced thrombocytopenia

2.4.9 Comprehensive knowledge of techniques for diagnostic evaluation of thrombophilic state including
- Indications for the techniques
- Principles of the methods
- Interpretation of results
- Limitations of the tests

2.4.10 Comprehensive knowledge of various classes of antithrombotics and anticoagulants including their indications, dose, side effects and complications of
- Heparins
- Warfarin
- Antithrombin
- Antiplatelet agents
- Antifibrinolytics

2.5 **Module 5: Blood transfusion**

2.5.1 Comprehensive knowledge of the scientific basis of transfusion medicine including but not limited to
- Genetics and biochemistry of major blood cells antigens(ABO, Rh, HLA)
- Clinical and pathological consequence of antibodies to major antigens
- Kinetics and functions of blood cells in health and disease
- Haemoglobin structure and function

2.5.2 Comprehensive knowledge of principles of pretransfusion testing including but not limited to
- Basic blood grouping
- Procedures for compatibility testing
- Principles of cross match strategies
- Principles of antibody identification

2.5.3 Comprehensive knowledge of blood donations and component preparation procedures including but not limited to
- Donor recruitment procedures
- Donor blood processing and testing
- Blood component preparation and production
- Blood derivatives preparation and production

2.5.4…/

2.5.4 Comprehensive knowledge of the various blood components and derivatives including
- indications
- dose
- contraindications
- adverse effects

2.5.5 Comprehensive knowledge of clinical uses of blood components including uses in
- Cardiopulmonary bypass
- Emergency medicine
- General surgery
- Haematology and oncology
- Transplantation
- Neonatology and paediatrics
- Nephrology

2.5.6 Comprehensive knowledge of the adverse effects of blood transfusion including diagnosis and management of
- Immunologic complications
- Infectious complications
- Metabolic complications
- Pulmonary complications
- Iron overload
- Post-transfusion GVHD

2.5.7 Comprehensive knowledge of autoimmune aspects of transfusion including but not limited to the diagnosis and treatment of
- Autoimmune haemolysis
- Immune thrombocytopenia

2.5.8 Comprehensive knowledge of medico legal aspects of transfusion including but not limited to
- Informed consent and confidentiality
- Paternity testing
- Religious objection to transfusion

2.5.9 Comprehensive knowledge of aphaeresis and phlebotomy procedures including
- Principles of apheresis technology
- Indications for apheresis and phlebotomy
- Complications of apheresis and their management

2.6 **Module 6. Automation**

2.6.1 Comprehensive knowledge of advantages and disadvantages of using automated analytical instruments including but not limited to
- Turn around times
- Cost of analysis
- Cost of apparatus and operative cost
- Safety issues
- Accuracy and precision of analysis

2.6.2 Comprehensive knowledge of the process of selection and evaluation an analytical instrument including but not limited to
- Reliability
- Robustness
- Linearity
- Limits of detection
- Accuracy and precision
- User friendliness
- Instrument maintenance

2.6.3…/

2.6.3 Comprehensive knowledge of the analytical principles of the various automated haematology instruments including but not limited to
- DC detection
- Flow impedance
- Electronic impedance
- Light scatter

2.6.4 Comprehensive knowledge of factors influencing analytical performance including but not limited to
- Operator skill
- Instrument variables
- Reagent variables
- Analyte variables

2.6.5 Comprehensive knowledge of instrument maintenance procedures including but not limited to
- Instrument start up procedure
- Calibration
- Internal quality control procedures
- Decontamination
- Service scheduling

2.6.6 Comprehensive knowledge of the principles for troubleshooting instrument errors including identification of
- Analyte errors
- Reagent errors
- Instrument errors

2.6.7 Comprehensive knowledge of procedures and indication for doing manual counts including
- Manual differential count
- Manual platelet count
- Manual Reticulocyte count

2.6.8 Comprehensive knowledge of the principles of internal control procedures including procedures for verifying
- Precision
- accuracy
- consistency

2.7 **Module 7: Specialised haematology diagnostic modalities**

2.7.1 Comprehensive knowledge of basic principles of flow cytometric analysis including
- Analytical principles
- Instrumentation structure and function
- Applications of flow cytometry
- Limitations of flow cytometry

2.7.2 Comprehensive overview of normal cell ontogeny and phenotypic expression including maturation and differentiation markers for
- B-cell ontogeny
- T-cell ontogeny
- Myeloid development and maturation
- Monocytic differentiation and maturation

2.7.3 Comprehensive understanding of the Cluster of Designation classification of monoclonal antibodies and their utility in health and disease

2.7.4 Comprehensive knowledge of factors influencing the selection of markers in the diagnostic workup including
- Target population assessment
- Specimen size
- Patient age
- Clinical features

2.7.5…/

2.7.5 Comprehensive knowledge of preparation of specimen for flow cytometric analysis including
- Sample storage
- Separation methods

2.7.6 Comprehensive knowledge of data analysis including the significance of
- Forward scatter analysis
- Side scatter analysis
- Gating techniques
- Multiple colour analysis

2.7.7 Comprehensive knowledge of the commonly used diagnostic panels including
- Evaluation of clonality
- Acute leukemic screen
- Chronic screen
- Plasma cell screen
- Ploidy analysis
- CD34 analysis
- Platelet marker analysis

2.7.8 Comprehensive knowledge of principles of cytogenetic analytical techniques including
- Karyotypic analysis
- FISH
- RT PCR

2.7.9 Comprehensive knowledge of specific cytogenetic aberrations and their, prognostic value and diagnostic value in haematologic malignancies including
- Lymphoid malignancies
- myeloid malignancies
- myelodysplastic syndromes
- myeloproliferative disorders
- plasma cell dyscrasias

2.7.10 Comprehensive knowledge principles of the various forms of PCR including
- Standard PCR
- RT-PCR and RQ-PCR
- Multiplex PCR

2.7.11 Comprehensive knowledge of application of PCR in its various forms in haematology including it use in
- Establishing clonality
- Minimal residual disease assessment
- Molecular diagnostic tool

2.7.12 Comprehensive knowledge of the principles, indications, procedures, limitations and interpretation of the various cytochemical stains used in haematology including
- Myeloperoxidase stain
- Combined esterase/ double esterase(SE and NSE)
- Kleihauer stain
- Malaria staining
- Perl's Prussian blue stain
- TRAP
- Eosin stain
- Giemsa stain

2.7.13 Principles of trephine biopsy processing including
- Processing
- Special trephine stains
- Immunohistochemistry

2.8…/

2.8 **Module 8: Laboratory management**

2.8.1 Comprehensive knowledge of design and set-up of a testing laboratory including but not limited to
- Physical structure compliance with safety regulations
- Selection and evaluation of instruments
- Selection and storage of reagents
- Storage and archive facilities
- Facilitating work flow
- Selection of appropriate staff
- Appropriate water and power supply

2.8.2 Selection and implementation of laboratory computer system including
- Hardware reliability
- Software testing and robustness
- Appropriate networking and backup system

2.8.3 Comprehensive knowledge of computer skills including but not limited to
- Word processing programmes
- Spreadsheet programmes
- Database programmes

2.8.4 Comprehensive knowledge of all aspects of laboratory safety including but not limited to
- Design of appropriate access and exit points
- Fire and emergency drills
- Management of chemical spills
- Management of injury on duty and needle stick injuries
- Temperature requirements
- Electrical safety
- Appropriate waste disposal

2.8.5 Comprehensive knowledge of financial and accounting aspects of the laboratory including but not limited to
- Budgeting for the laboratory
- Test costing
- Volume and revenue analysis
- Cost effective testing analysis
- Stock control

2.8.6 Comprehensive knowledge of factors influencing the choice of instruments and reagents for the laboratory including but not limited to
- Work volumes
- Technical staff skill
- Robustness of the hardware and software technology
- Technical validation results

2.8.7 Comprehensive knowledge of procedures for selection and implementation of new testing methods including
- Establishment of reference ranges
- Establishing accuracy and precision performance
- Establishing degree of uncertainty of measurement

2.8.8 Comprehensive knowledge and understanding of the importance of support services of the laboratory including but not limited to
- Phlebotomy service
- Specimen Transport
- IT support
- Reagent supplies
- Instrument support

2.8.9…/

2.8.9 Comprehensive knowledge of the good laboratory and clinical practice including but not limited to
- internal and external quality assurance
- document control
- laboratory accreditation
- staff education competency programmes
- vertical and horizontal laboratory audits
- turn around evaluation

2.8.10 Comprehensive knowledge of human resource aspects of laboratory of the laboratory including but not limited to
- Importance of hierarchy
- Organogram development
- Staff selection and recruitment
- Keeping staff records
- Knowledge of labour legislation
- Managing conflict
- Grievance and disciplinary procedures

2.9 **Module 9: Skills**

2.9.1 Comprehensive knowledge of the indications, contraindications, complications and competency in the following procedural skills
- Preparation of peripheral blood smear
- Bone marrow aspiration and biopsy
- Insertion and management of indwelling vascular access

2.9.2 Comprehensive knowledge of indications and interpretation of stains used in the peripheral blood examination including but not limited to
- Romanowsky stains
- Supravital stains
- Perl's Prussian blue stains

2.9.3 Comprehensive knowledge of counseling and communication skills including but not limited to
- Communicating life threatening diagnosis
- Counseling for specific testing
- Communication with other healthcare givers

2.9.4 Comprehensive knowledge of laboratory and clinical investigation skills including
- Ethical conduct of research (Good Clinical and laboratory practice)
- Purpose, content and design of informed consent document
- Design of clinical trials
- Application for funding
- Importance of biostatics in research

2.9.5 Comprehensive understanding of the role of the multidisciplinary care team in patient care including but not limited to
- Strengths and weaknesses of colleagues
- Developing multidisciplinary care plans
- How to access specialised services to maximize patient care

2.9.6 Comprehensive knowledge of safe handling of cytotoxic and biological agents including
- Appropriate preparation
- Safe administration
- Management of side effects
- Safe disposal

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2.10 **Module 10: Immunology and basic molecular biology**

2.10.1 Comprehensive knowledge and understanding of structure and function of cellular components of the immune system including but not limited to
- Phagocytes
- Natural killer cells
- Mast cells
- Dendritic cells
- Lymphoid cells

2.10.2 Comprehensive knowledge of structure and function of molecules of the immune system including but not limited to
- Complement
- Interferons
- Acute phase proteins
- Other cytokines

2.10.3 Comprehensive knowledge and understanding of antibodies including but not limited to
- Basic structure
- Antibody development and generation of diversity
- Antibody function
- Allotypes and idiotypes

2.10.4 Comprehensive knowledge of cytokines structure and function including but not limited to
- Cytokine families
- Cytokine applications and clinical practice

2.10.5 Comprehensive knowledge of antigen recognition pathophysiology including but not limited to
- Major histocompatibility antigens
- Antigen processing and presentation
- B cell recognition of antigen
- T cell recognition of antigen

2.10.6 Comprehensive knowledge of cell mediated immunity including
- T cytotoxic cell response
- T helper cell response
- T cell activation
- B cell activation

2.10.7 Comprehensive knowledge of basic molecular genetics including but not limited to
- Basic principles of molecular cloning
- Analysis of gene structure and function
- Gene expression and function

2.10.8 Comprehensive knowledge of basic molecular biology techniques including but not limited to
- Restriction enzyme digestion
- RFLP
- PCR
- Cloning
- Genetic mapping
- Sequencing techniques
- Microarray analysis

A P P E N D I X B

1.0 GUIDELINES ON PART I AND PART II THEORETICAL KNOWLEDGE

- This haematology curriculum outline is for guidance only and may not cover all aspects of haematology which may be included in the examination of candidates.
- Additional sources of theoretical and practical haematology knowledge such as current haematology journals and the latest editions of the following textbooks are recommended:
  - **Litchman *etal*:** *William's Hematology*
  - **Dacie and Lewis:** *Practical Haematology*
  - **Hoffbrand *et al*** : *Postgraduate haematology*
  - **Bradley:** *Lecture Notes on Molecular Medicine*
  - **Reeves *et al*** : *Lecture Notes on Immunology*

2.0 Haematology curriculum modular outline

Module	Description
Module 1	Haemopoiesis
Module 2	Morphology
Module 3	Haematologic malignancies
Module 4	Haemostasis and thrombosis
Module 5	Blood transfusion
Module 6	Automation and quality assurance
Module 7	Specialised diagnostic haematology
Module 8	Laboratory Management
Module 9	Skills
Module 10	Immunology and basic molecular biology

2.1 Module 1. Haemopoiesis

2.1.1 Comprehensive knowledge of the developmental process of all three haemopoietic cell lines including but not limited to

- Stem cell biology and plasticity
- Erythropoiesis
- Lymphocyte biology
- Thrombopoiesis
- Leucocyte maturation and differentiation

2.1.2 Comprehensive knowledge of cell surface receptor and cell surface protein changes during haemopoietic development, differentiation and maturation. This should include but not limited to

- Understanding the role of growth factors in haemopoiesis
- Understanding the role of cytokines in haemopoietic proliferation, differentiation and maturation

2.1.3 Comprehensive knowledge of normal erythropoiesis including but not limited to

- Erythropoietic maturation stages
- Haemoglobin structure and function including embryology and genetics
- Porphyrin protein biochemistry
- Genetics and biochemistry of Iron metabolism
- Vitamin b12 and folate biochemistry

2.1.4 Comprehensive knowledge of normal platelet structure and function including but not limited to

- Role of thrombopoietin in thrombopoiesis
- Platelet endothelial cell interaction
- Platelet activation including adhesion, aggregation and degranulation

2.1.5 Comprehensive knowledge of normal granulocyte development, proliferation, differentiation and maturation including but not limited to

- Expression of cell surface receptors and HLA proteins
- Role of various cytokines
- Various developmental compartments and factors influencing these

2.1.6…/

2.1.6 Comprehensive knowledge of abnormal erythropoiesis including comprehensive understanding of aetiology, Pathophysiology, diagnosis, risk factors and treatment of

- Nutritional anaemias
- Hypoproliferative anaemias
- Haemolytic anaemias
- Haemochromatosis
- Porphyria
- Haemoglobinopathies
- Thalassemias
- Enzymopathies

2.1.7 Comprehensive knowledge of aetiology, pathophysiology, diagnosis and treatment of primary and secondary quantitative abnormalities of red cells including but not limited to

- Erythrocytosis

2.1.8 Comprehensive knowledge of aetiology, pathophysiology, differential diagnosis and treatment of quantitative and qualitative abnormalities of white cells including but not limited to

- Granulocytopaenia
- Lymphopaenia and lymphocyte dysfunction
- Leucytosis including eosinophilia, neutrophilia, monocytosis and basophilia

2.1.9 Comprehensive knowledge of aetiology, pathophysiology, diagnosis of abnormal platelet function including but not limited to abnormalities of

- Adhesion
- Aggregation
- Granular content release
- Signal transduction abnormalities

2.1.10 Apprehensive knowledge of aetiology, pathophysiology and diagnostic approach of quantitative platelet abnormalities including

- Thrombocytopaenia
- Thrombocytosis

2.1.11 Comprehensive knowledge of pathophysiology and diagnostic approach to acquired and congenital bone marrow failure syndromes including but not limited to

- Aplastic anaemia
- Pancytopaenia
- Congenital bone marrow failure syndromes

2.2 **Module 2: Morphology**

2.2.1 Comprehensive knowledge of principles of light microscopy including structure and function of

- Lenses
- Diaphragm
- Eyepieces and magnification
- Light source

2.2.2 Comprehensive knowledge of factors influencing the optimum microscopic examination of specimen including but not limited to

- Optimum setting of lenses, light and objective selection
- Optimum smear preparation
- Optimum smear staining
- Recognition of artifacts of specimen preparation, fixation and staining

2.2.3 Comprehensive knowledge of factors influencing accurate interpretation of microscopic examination results including but not limited to

- Correct assessment of clinical information
- Normal ranges appropriate for age , sex and geographical location
- Interpretation of peripheral blood counts and indices

2.2.4…/

2.2.4 Comprehensive knowledge of indications and interpretation of stains used in the peripheral blood examination including but not limited to
- Romanowsky stains
- Supravital stains
- Perl's Prussian blue stains

2.2.5 Comprehensive knowledge of normal cellular morphology and composition of peripheral blood including
- Relative and absolute counts of the various cell types
- Acceptable limits of variation in normal cellular morphology

2.2.6 Comprehensive knowledge of quantitative and qualitative abnormalities of erythropoiesis in the peripheral blood including but not limited to
- Abnormalities of cell size, shape, colour, distribution and inclusions
- Diagnostic approach to fragments and thrombocytopenia
- Significance of normoblastaemia and teardrops

2.2.7 Comprehensive knowledge of qualitative and quantitative abnormalities of white cells including but not limited to
- Recognition of circulating abnormal white cells such as blasts, hairy cells
- Left and right shift and their significance
- Dysplastic features
- Leucocytosis and leucopenia aetiology, Pathophysiology and differential diagnosis
- White cell inclusions such as Auer rods, pigments and granules

2.2.8 Comprehensive knowledge of qualitative and quantitative platelet abnormalities including but not limited to
- Thrombocytopenia and thrombocytosis aetiology, Pathophysiology and diagnostic approach
- Differential diagnosis of giant platelets
- Recognition of pseudothrombocytopaenia

2.2.9 Comprehensive knowledge of normal bone marrow cellular composition, structure and maturation stages including but not limited to
- Erythropoietic maturation and quantitative limits
- Granulopoietic composition, maturation and quantitative limits
- Structure, function and quantitative limits of megakaryocytes, plasma cells, and lymphocytes

2.2.10 Comprehensive knowledge of assessment of quality of bone marrow aspirate including
- Evaluation of optimum smear preparation and staining
- Intramedulary elements composition

2.2.11 Comprehensive knowledge of abnormal bone marrow qualitative and quantitative findings including but not limited to
- Diagnosis of myeloproliferative disorders including acute leukemias
- Diagnosis of plasma cell dyscrasias
- Diagnosis of lymphoproliferative disorders
- Diagnosis of Myelodysplastic syndromes

2.3.12 Comprehensive knowledge of various stains used in the analysis bone marrow aspirate including their
- Principles
- Indications
- Procedures
- Interpretations
- Limitations

2.3.13 Comprehensive knowledge of classification systems of the various clonal haemopathies including
- The FAB classification
- WHO classification of haematolymphoid malignancies

2.2.14 Comprehensive knowledge of diagnostic approach of the trephine biopsy specimen including
- Assessment of quality and adequacy of the specimen
- Strengths and weaknesses of trephine examination
- Acceptable limits of qualitative and quantitative cellular composition
- Assessment of erythropoiesis, megakaryopoiesis, granulopoiesis and stoma composition and architecture
- Utility of trephines in diagnosis of lymphomas and other clonal haemopathies

2.3 **Module 3: Haematologic malignancies**

2.3.1 Comprehensive knowledge of the various classification systems of haematolymphoid malignancies including the
- WHO classification
- REAL classification-historical perspective
- FAB classification-historical perspective

2.3.2 Comprehensive knowledge of basic cancer biology including
- Mechanics and kinetics of tumor growth
- Tumor genesis and immortalisation
- Angiogenesis
- Cell invasion and metastasis
- Role of telomeres and senescence in cancer biology

2.3.3 Comprehensive knowledge of epidemiology, clinical presentation, aetiology/risk factors, molecular pathophysiology, diagnosis, treatment and prognostic assessment and complications of chronic myeloproliferative disorders including
- Chronic myeloid leukemia
- Polycythaemia vera
- Idiopathic myelofibrosis
- Essential thrombocythaemia

2.3.4 Comprehensive knowledge of epidemiology, aetiology/risk factors, clinical features, molecular pathophysiology, diagnosis, treatment principles and complications of the Acute Myeloid Leukemias

2.3.5 Comprehensive knowledge and competency in understanding classification and prognosis of acute myeloid leukemia including the role of
- morphology
- cytochemistry
- cytogenetics
- molecular analysis and
- flow cytometry

2.3.6 Comprehensive knowledge of the epidemiology, clinical features, molecular pathophysiology, diagnosis and treatment principles of Myelodysplastic syndromes

2.3.7 Comprehensive knowledge of the classification (WHO) and international prognostic and staging system of Myelodysplastic syndromes.

2.3.8 Comprehensive knowledge of the epidemiology, natural history, aetiology, molecular Pathophysiology, diagnosis , treatment of B-cell lymphoproliferative disorders including
- Acute lymphoblast leukemias
- Chronic lymphocytic leukemias
- High grade lymphomas
- Low grade/Indolent lymphomas

2.3.9 Comprehensive knowledge of epidemiology, natural history, aetiology, clinical presentation, diagnosis, treatment and prognostic markers for T-cell lymphoproliferative disorders including
- Adult T-cell lymphoma leukemia
- T-cell LGL leukemia
- T-cell lymphomas
- NK cell lymphomas
- Cutaneous T-cell lymphoma, Sezary and Mycosis fungoides
- Adult T-cell leukemia/lymphoma

2.3.10 Comprehensive knowledge of the epidemiology, natural history, aetiology, molecular Pathophysiology, diagnosis, treatment and prognostic markers of plasma cell dyscrasias and immunoproliferative disorders including
- Myeloma
- Plasma cell leukemia
- Plasmacytomas
- Amyloidosis
- MGUS
- Waldenstrom's Macroglobulinaemia

2.3.11 Comprehensive knowledge of Hodgkin's lymphoma including its epidemiology, natural history, classification, clinical presentation, diagnosis, treatment and prognostic markers

2.3.12 Comprehensive knowledge of the aetiology, diagnosis, treatment of histiocytic and dendritic cell neoplasms

2.3.13 Comprehensive knowledge of the cell biology, clinical presentation, diagnosis and treatment principles of mastocytosis

2.4 **Module 4: Haemostasis and thrombosis**

2.4.1 Comprehensive knowledge of the current views on the basic mechanism of haemostasis and thrombosis including
- Primary and secondary haemostatic events
- Cascade model of haemostasis
- Revised coagulation pathway
- Cell based model of haemostasis

2.4.2 Comprehensive knowledge of function of the various components of haemostasis including
- Procoagulant and anticoagulant proteins
- Vascular endothelium
- Platelets
- Fibrinolysis

2.4.3 Comprehensive knowledge of the genetics, natural history, presentation, pathophysiology, diagnosis and treatment of the various congenital bleeding disorders including
- Haemophilia A and B
- Von Willebrandt disease
- Other coagulation factor deficiencies
- Hereditary (functional) platelet disorders

2.4.4 Comprehensive knowledge various replacement therapies and bypassing agents including but not limited to
- Nature of preparation
- Dose and formulation
- Indications for use
- Contraindications
- Adverse effects and complications of use

2.4.5 Comprehensive knowledge of complications of replacement therapy including but not limited to
- Infectious complications
- Immunologic complications
- Hypercoagulable complications

2.4.6 Comprehensive knowledge of aetiology, pathophysiology, diagnosis and treatment of acquired bleeding disorders including
- Liver and renal pathology
- Connective disorders
- Inhibitors
- Anticoagulant therapy
- Platelet disorders
- Drug induced disorders

2.4.7…/

2.4.7 Comprehensive knowledge of clinical presentation, diagnosis and management of congenital causes of thrombosis including but not limited to
- Factor V Leiden
- Prothrombin G20210A
- Protein S and C
- Antithrombin deficiency
- Sticky platelet syndrome
- Hyperhomocysteinaemia

2.4.8 Comprehensive knowledge of clinical presentation, pathophysiology, diagnosis and treatment of acquired causes of hypercoagulable state including but not limited to
- Antiphospholipid syndrome
- Heparin induced thrombocytopenia

2.4.9 Comprehensive knowledge of techniques for diagnostic evaluation of thrombophilic state including
- Indications for the techniques
- Principles of the methods
- Interpretation of results
- Limitations of the tests

2.4.10 Comprehensive knowledge of various classes of antithrombotics and anticoagulants including their indications, dose, side effects and complications of
- Heparins
- Warfarin
- Antithrombin
- Antiplatelet agents
- Antifibrinolytics

2.5 **Module 5: Blood transfusion**

2.5.1 Comprehensive knowledge of the scientific basis of transfusion medicine including but not limited to
- Genetics and biochemistry of major blood cells antigens(ABO, Rh, HLA)
- Clinical and pathological consequence of antibodies to major antigens
- Kinetics and functions of blood cells in health and disease
- Haemoglobin structure and function

2.5.2 Comprehensive knowledge of principles of pretransfusion testing including but not limited to
- Basic blood grouping
- Procedures for compatibility testing
- Principles of cross match strategies
- Principles of antibody identification

2.5.3 Comprehensive knowledge of blood donations and component preparation procedures including but not limited to
- Donor recruitment procedures
- Donor blood processing and testing
- Blood component preparation and production
- Blood derivatives preparation and production

2.5.4 Comprehensive knowledge of the various blood components and derivatives including
- indications
- dose
- contraindications

2.5.5…/

2.5.5 Comprehensive knowledge of clinical uses of blood components including uses in
- Cardiopulmonary bypass
- Emergency medicine
- General surgery
- Haematology and oncology
- Transplantation
- Neonatology and paediatrics
- Nephrology

2.5.6 Comprehensive knowledge of the adverse effects of blood transfusion including diagnosis and management of
- Immunologic complications
- Infectious complications
- Metabolic complications
- Pulmonary complications
- Iron overload
- Post-transfusion GVHD

2.5.7 Comprehensive knowledge of autoimmune aspects of transfusion including but not limited to the diagnosis and treatment of
- Autoimmune haemolysis
- Immune thrombocytopenia

2.5.8 Comprehensive knowledge of medico legal aspects of transfusion including but not limited to
- Informed consent and confidentiality
- Paternity testing
- Religious objection to transfusion

2.5.9 Comprehensive knowledge of aphaeresis and phlebotomy procedures including
- Principles of apheresis technology
- Indications for apheresis and phlebotomy
- Complications of apheresis and their management

2.6 **Module 6. Automation**

2.6.1 Comprehensive knowledge of advantages and disadvantages of using automated analytical instruments including but not limited to
- Turn around times
- Cost of analysis
- Cost of apparatus and operative cost
- Safety issues
- Accuracy and precision of analysis

2.6.2 Comprehensive knowledge of the process of selection and evaluation an analytical instrument including but not limited to
- Reliability
- Robustness
- Linearity
- Limits of detection
- Accuracy and precision
- User friendliness
- Instrument maintenance

2.6.3 Comprehensive knowledge of the analytical principles of the various automated haematology instruments including but not limited to
- DC detection
- Flow impedance
- Electronic impedance
- Light scatter

2.6.4…/

2.6.4 Comprehensive knowledge of factors influencing analytical performance including but not limited to
- Operator skill
- Instrument variables
- Reagent variables
- Analyte variables

2.6.5 Comprehensive knowledge of instrument maintenance procedures including but not limited to
- Instrument start up procedure
- Calibration
- Internal quality control procedures
- Decontamination
- Service scheduling

2.6.6 Comprehensive knowledge of the principles for troubleshooting instrument errors including identification of
- Analyte errors
- Reagent errors
- Instrument errors

2.6.7 Comprehensive knowledge of procedures and indication for doing manual counts including
- Manual differential count
- Manual platelet count
- Manual Reticulocyte count

2.6.8 Comprehensive knowledge of the principles of internal control procedures including procedures for verifying
- Precision
- accuracy
- consistency

2.7 **Module 7: Specialised haematology diagnostic modalities**

2.7.1 Comprehensive knowledge of basic principles of flow cytometric analysis including
- Analytical principles
- Instrumentation structure and function
- Applications of flow cytometry
- Limitations of flow cytometry

2.7.2 Comprehensive overview of normal cell ontogeny and phenotypic expression including maturation and differentiation markers for
- B-cell ontogeny
- T-cell ontogeny
- Myeloid development and maturation
- Monocytic differentiation and maturation

2.7.3 Comprehensive understanding of the Cluster of Designation classification of monoclonal antibodies and their utility in health and disease

2.7.4 Comprehensive knowledge of factors influencing the selection of markers in the diagnostic workup including
- Target population assessment
- Specimen size
- Patient age
- Clinical features

2.7.5 Comprehensive knowledge of preparation of specimen for flow cytometric analysis including
- Sample storage
- Separation methods

2.7.6 Comprehensive knowledge of data analysis including the significance of
- Forward scatter analysis
- Side scatter analysis
- Gating techniques
- Multiple colour analysis

2.7.7 Comprehensive knowledge of the commonly used diagnostic panels including
- Evaluation of clonality
- Acute leukemic screen
- Chronic screen
- Plasma cell screen
- Ploidy analysis
- CD34 analysis
- Platelet marker analysis

2.7.8 Comprehensive knowledge of principles of cytogenetic analytical techniques including
- Karyotypic analysis
- FISH
- RT PCR

2.7.9 Comprehensive knowledge of specific cytogenetic aberrations and their , prognostic value and diagnostic value in haematologic malignancies including
- Lymphoid malignancies
- myeloid malignancies
- myelodysplastic syndromes
- myeloproliferative disorders
- plasma cell dyscrasias

2.7.10 Comprehensive knowledge principles of the various forms of PCR including
- Standard PCR
- RT-PCR and RQ-PCR
- Multiplex PCR

2.7.11 Comprehensive knowledge of application of PCR in its various forms in haematology including it use in
- Establishing clonality
- Minimal residual disease assessment
- Molecular diagnostic tool

2.7.12 Comprehensive knowledge of the principles, indications, procedures, limitations and interpretation of the various cytochemical stains used in haematology including
- Myeloperoxidase stain
- Combined esterase/ double esterase(SE and NSE)
- Kleihauer stain
- Malaria staining
- Perl's Prussian blue stain
- TRAP
- Eosin stain
- Giemsa stain

2.7.13 Principles of trephine biopsy processing including
- Processing
- Special trephine stains
- Immunohistochemistry

2.8 **Module 8: Laboratory management**

2.8.1 Comprehensive knowledge of design and set-up of a testing laboratory including but not limited to
- Physical structure compliance with safety regulations
- Selection and evaluation of instruments
- Selection and storage of reagents
- Storage and archive facilities
- Facilitating work flow
- Selection of appropriate staff
- Appropriate water and power supply

2.8.2…/

2.8.2 Selection and implementation of laboratory computer system including
- Hardware reliability
- Software testing and robustness
- Appropriate networking and backup system

2.8.3 Comprehensive knowledge of computer skills including but not limited to
- Word processing programs
- Spreadsheet programs
- Database programs

2.8.4 Comprehensive knowledge of all aspects of laboratory safety including but not limited to
- Design of appropriate access and exit points
- Fire and emergency drills
- Management of chemical spills
- Management of injury on duty and needle stick injuries
- Temperature requirements
- Electrical safety
- Appropriate waste disposal

2.8.5 Comprehensive knowledge of financial and accounting aspects of the laboratory including but not limited to
- Budgeting for the laboratory
- Test costing
- Volume and revenue analysis
- Cost effective testing analysis
- Stock control

2.8.6 Comprehensive knowledge of factors influencing the choice of instruments and reagents for the laboratory including but not limited to
- Work volumes
- Technical staff skill
- Robustness of the hardware and software technology
- Technical validation results

2.8.7 Comprehensive knowledge of procedures for selection and implementation of new testing methods including
- Establishment of reference ranges
- Establishing accuracy and precision performance
- Establishing degree of uncertainty of measurement

2.8.8 Comprehensive knowledge and understanding of the importance of support services of the laboratory including but not limited to
- Phlebotomy service
- Specimen Transport
- It support
- Reagent supplies
- Instrument support

2.8.9 Comprehensive knowledge of the good laboratory and clinical practice including but not limited to
- internal and external quality assurance
- document control
- laboratory accreditation
- staff education competency programs
- vertical and horizontal laboratory audits
- turn around evaluation

2.8.10…/

2.8.10 Comprehensive knowledge of human resource aspects of laboratory of the laboratory including but not limited to

- Importance of hierarchy
- Organogram development
- Staff selection and recruitment
- Keeping staff records
- Knowledge of labour legislation
- Managing conflict
- Grievance and disciplinary procedures

2.9 **Module 9: Skills**

2.9.1 Comprehensive knowledge of the indications, contraindications, complications and competency in the following procedural skills

- Preparation of peripheral blood smear
- Bone marrow aspiration and biopsy
- Insertion and management of indwelling vascular access

2.9.2 Comprehensive knowledge of indications and interpretation of stains used in the peripheral blood examination including but not limited to

- Romanowsky stains
- Supravital stains
- Perl's Prussian blue stains

2.9.3 Comprehensive knowledge of counseling and communication skills including but not limited to

- Communicating life threatening diagnosis
- Counseling for specific testing
- Communication with other healthcare givers

2.9.4 Comprehensive knowledge of laboratory and clinical investigation skills including

- Ethical conduct of research(Good Clinical and laboratory practice)
- Purpose, content and design of informed consent document
- Design of clinical trials
- Application for funding
- Importance of biostatics in research

2.9.5 Comprehensive understanding of the role of the multidisciplinary care team in patient care including but not limited to

- Strengths and weaknesses of colleagues
- Developing multidisciplinary care plans
- How to access specialised services to maximize patient care

2.9.6 Comprehensive knowledge of safe handling of cytotoxic and biological agents including

- Appropriate preparation
- Safe administration
- Management of side effects
- Safe disposal

2.10 **Module 10: Immunology and basic molecular biology**

2.10.1 Comprehensive knowledge and understanding of structure and function of cellular components of the immune system including but not limited to

- Phagocytes
- Natural killer cells
- Mast cells
- Dendritic cells
- Lymphoid cells

2.10.2…/

2.10.2 Comprehensive knowledge of structure and function of molecules of the immune system including but not limited to
- Complement
- Interferons
- Acute phase proteins
- Other cytokines

2.10.3 Comprehensive knowledge and understanding of antibodies including but not limited to
- Basic structure
- Antibody development and generation of diversity
- Antibody function
- Allotypes and idiotypes

2.10.4 Comprehensive knowledge of cytokines structure and function including but not limited to
- Cytokine families
- Cytokine applications and clinical practice

2.10.5 Comprehensive knowledge of antigen recognition pathophysiology including but not limited to
- Major histocompatibility antigens
- Antigen processing and presentation
- B cell recognition of antigen
- T cell recognition of antigen

2.10.6 Comprehensive knowledge of cell mediated immunity including
- T cytotoxic cell response
- T helper cell response
- T cell activation
- B cell activation

2.10.7 Comprehensive knowledge of basic molecular genetics including but not limited to
- Basic principles of molecular cloning
- Analysis of gene structure and function
- Gene expression and function

2.10.8 Comprehensive knowledge of basic molecular biology techniques including but not limited to
- Restriction enzyme digestion
- RFLP
- PCR
- Cloning
- Genetic mapping
- Sequencing techniques
- Microarray analysis