SYLLABUS

Medical Technologist/ Medical Laboratory Scientists

Virology

CONTENTS

1. NOMENCLATURE/ACRONYMS

General

CEU	Continual Education Units
EQC	External Quality Control
HPCSA	Health Professions Council of South Africa
IATA	International Air Transport Association
ISO	International Organization for Standardization
IQC	Internal Quality Control
MSDS	Material Safety Data Sheet
OHSA	Occupational Health and Safety Act
PBMT	Professional Board for Medical Technology
SABS	South African Bureau of Standards
SOP	Standard Operating Procedure
POPI	Protection of Personal Information Act

Discipline – Virology

SOP: Standard operating Procedure

CPE: Cytopathic effect

BSC: Biosafety cabinet

UV: ultra violet

CO_2: Carbon dioxide

ELISA: Enzyme Linked Immunosorbent Assay

CSF: cerebrospinal fluid

CMV: Cytomegalovirus

HSV: Herpes Simplex Virus

RSV: Respiratory Syncytial Virus

HBV: Hepatitis B Virus

HCV: Hepatitis C Virus

EBV: Epstein Barr Virus

Hep A: Hepatitis A Virus

PCR: Polymerase chain reaction hMPV:

Human Metapneumovirus

SANAS: South African National Accreditation Systems

Conc.: concentration

OD: optical density

MW: molecular weight

HIV: Human Immunodeficiency Virus

AIDS: Acquired Immune Deficiency Syndrome

HAI: Haemagglutination inhibition

2. INTRODUCTION

The objective of this syllabus is to provide the intern Medical Technologists or Medical Laboratory Scientists and student Medical Technicians with a guideline on the essential aspects that must be covered in order to adequately prepare themselves for the HPCSA's PBMT examination.

The examination will be based on the contents of this syllabus and related theoretical and practical knowledge gained during study at the HPCSA accredited training facility. The examination consists of two, two-hour (three-hour for Clinical Pathology and its specials) papers. The papers are in a form of written theory and practical.

Please refer to:

- Reference material
- Nomenclature/acronyms

HPCSA regulations require that accredited training laboratories perform a minimum of 80% of the tests identified in this syllabus. Laboratories are required to ensure that interns/students receive appropriate training in the tests contained within the syllabus but which are not routinely performed on site. Where practical training at an alternate training facility is not feasible, minimum of theoretical and written assessments are compulsory.

Candidates must achieve a minimum mark of 50% overall and **a sub-minimum of 45% for each paper,** to pass the examination. Emphasis will be placed on problem solving and on practical application of theoretical knowledge, as expected from any competent laboratory professional.

Candidates will not be expected to memorise specific details and quantities of reagent preparations. They will however be expected to know the principles on which tests are based and how to interpret the test results.

NB: Interns/students are reminded that this document is merely a guideline intended to aid the study process. As specialists in a discipline, they are expected to keep their knowledge current and to have an in-depth understanding of their subject.

3. STATUTORY REGULATIONS AND ETHICS

Objective

Provide the intern/student with information on the regulations and ethical principles, which underpin the practice of medical laboratory technology.

Specified outcomes

On completion of this section, the intern/student should be able to:

- ✓ Demonstrate knowledge of the structure and function of the HPCSA.
- ✓ Demonstrate knowledge of the structure and function of the PBMT.
- ✓ Discuss the regulations relating to the scope of profession.
- ✓ Describe the legal and ethical standards related to the professional practice of medical technology.
- ✓ Demonstrate knowledge of the requirements for the acquisition of CEUs.
- ✓ Demonstrate knowledge on the practice/ethos of how confidentiality in the workplace is obtained and maintained.
- ✓ Demonstrate knowledge of the National Health Act No. 61 of 2003
- ✓ Demonstrate knowledge of the Health Professions Act No. 56 of 1974
- ✓ Demonstrate knowledge of the POPI Act No. 4 of 2013
- ✓ Demonstrate knowledge of the Human Tissue Act No. 65 of 1983
- ✓ Demonstrate knowledge of the Children's Act No. 38 of 2005, where applicable

Sources of Information – *Acts, regulations and HPCSA guidelines*

4. TOTAL QUALITY MANAGEMENT SYSTEM

The intern/student must obtain basic knowledge of the principles and practices involving laboratory safety, quality management systems, laboratory accreditation and basic laboratory administration.

Learning outcomes:

At the end of this section, the student should be able to:

- ❖ Describe/evaluate/formulate the components involved in a Quality Management System and Laboratory Accreditation (in keeping with the relevant ISO standards) under the headings as listed in 3.1 – 3.10

- ❖ Discuss the concept of laboratory accreditation as defined by the specific standards relevant to medical and public health laboratories.

4.1 LABORATORY SAFETY

Objective

Provide knowledge of all safety procedures that must be applied in the workplace and an understanding of the legislation relating to laboratory safety procedures.

Specified outcomes

On completion of this section, the intern/student should be able to:

- ✓ Describe the regulations relating to the *transport* of specimens.
- ✓ Describe the regulations relating to the *handling* of medico-legal specimens.
- ✓ Explain laboratory safety in relation to the OHSA (1993).
- ✓ List/state the responsibilities of safety representatives and first aiders as required by the OHSA (1993).
- ✓ Describe/summarize the procedures for the storage, handling and disposal of laboratory waste including chemicals, biohazardous waste, radioactive waste, human tissue, solid contaminated waste, liquid contaminated waste, sharps and gases.
- ✓ Describe/motivate and demonstrate the proper safety precautions while handling and disposing of infectious material including those potentially containing organisms like Human Immunodeficiency Virus, Hepatitis virus or Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2).
- ✓ Explain/describe the safety protocols involved in event of a needle-stick injury and exposure to blood-borne pathogens.
- ✓ Motivate/explain the various biosafety level requirements when working with infectious material.
- ✓ Explain and apply the fundamental concepts of the relevant legislation pertaining to laboratory safety.

RANGE: *Occupational Health and Safety Act; Hazardous Substances Act; Compensation for Occupational Injuries and Diseases Act*

- ✓ Demonstrate knowledge of the procedures to follow in the event of laboratory accident or emergency.

RANGE: *Chemical or bio-hazardous spill, fire, flood, bomb threat*

- ✓ Describe the correct procedures for the storage, handling and disposal of laboratory waste.
- ✓ Describe the application of laboratory safety procedures to the collection, transport, storage and analysis of biological specimens including IATA regulations.

RANGE: *Biological specimens, human tissue; solid and liquid bio-hazardous waste; radioactive waste and sharps*

- ✓ Describe the basic principles for the storage, handling and disposal of chemicals; poisons; flammable substances; gases and infectious material.
- ✓ Describe procedures to follow for the prevention, control and management of laboratory-acquired infections including general housekeeping and decontamination of equipment.
- ✓ Describe the purpose and basic content of the MSDS.
- ✓ Demonstrate knowledge of the protocols to follow in the event of injuries on duty including needle-stick injury.
- ✓ Define the role of the designated safety personnel.

RANGE: *Fire marshal; safety representative and first aid officer*

- ✓ Recognize the international safety symbols used in the laboratory environment.
- ✓ Demonstrate the knowledge of **all** safety and emergency equipment.

RANGE: *Fire hose, blanket and extinguishers, spill kits, eyewash station, first aid box, safety shower*

4.2 SPECIMENS/PRE-ANALYTICAL EQUIREMENTS

Objective

Provide an understanding of the optimal specimen requirements for the maintenance of the integrity and suitability for ***all types*** of laboratory analysis with particular reference to the tests specified throughout this syllabus.

Specified Outcomes

On completion of this section, the intern/student should be able to:

- ✓ Demonstrate knowledge of any required patient preparation for the collection of specimens for individual tests.
- ✓ Collect specimens as defined within current statutory requirements and limitations.
- ✓ Describe the optimal specimen requirements for the individual tests, i.e., container, quantity, time limits etc.
- ✓ Describe the conditions under which the specimens must be transported to the laboratory

- ✓ Display knowledge of the optimal storage conditions should testing be delayed and the stability of the specimen for the individual testing process.
- ✓ Where applicable, capture the data and patient demographics that are required for the registration of the specimens at the laboratory accurately.
- ✓ Explain the principle of continuous identification of the specimen, aliquots, traceability and documentation.
- ✓ Describe the process (identify criteria) for the rejection of unsuitable specimens.
- ✓ Conduct the pre-analytical processes (preparation) required for specimen type and test requested.

4.3 LABORATORY EQUIPMENT

Objective

Explain the correct use, principle of operation, maintenance of laboratory equipment and the appropriate troubleshooting procedures to apply when indicated.

Specified outcomes – applicable to all equipment/instruments and analyzers

On completion of this section, the intern/student should be able to:

- ✓ Describe the principle of operation where applicable.
- ✓ Operate all equipment optimally in accordance with recommended operating procedures.
- ✓ Apply the correct safety precautions during the operation and maintenance of equipment.
- ✓ Demonstrate full knowledge of, and apply, the correct maintenance, service and calibration requirements within scope, of/for the specific instrumentation.
- ✓ Differentiate between calibration, validation and verification.
- ✓ Conduct applicable decontamination procedures.
- ✓ Apply the appropriate functional checks to ensure optimal operation.
- ✓ Describe and implement troubleshooting procedures when optimal operation is not demonstrated by the instrument on-board functional checks.

- ✓ Demonstrate an understanding of the approach to the validation and/or verification of new equipment, reagents and testing kits (Qualitative and Quantitative).
- ✓ Demonstrate full knowledge of the maintenance procedures, all equipment records and documentation required for good laboratory practice.

Knowledge of the makes and models in use in the current workplace in all disciplines is required of the following:

- ➢ Laboratory instrumentation
- ➢ Automated and semi-automated testing, detecting and identifying systems

a) Standard laboratory equipment:

- ○ Fridges ○ Freezers ○ Stopwatches/timers ○ Centrifuges, safety centrifuges
- ○ Bio-hazardous safety cabinets – Class I and II
- ○ Fume hood/cupboard ○ Incubators - aerobic and anaerobic ○ Balances – top pan and fine analytical chemical ○ Thermomixers
- ○ Pipettes – glass, disposable, adjustable & fixed volume pipettes, automated and air displacement
- ○ Pipette aids – rubber teats, pro-pipettes and dispensers ○ Water baths ○ pH meters ○ Rotators Shakers ○ Flat bed and vortex mixers
- ○ Microscopes - light, phase contrast, inverted and fluorescent ○ Thermometers - min/max, electronic and mercury

b) Automated and semi-automated equipment:

- ○ Automated serology analysers
- ○ Manual immunoassays
- ○ Molecular amplification and detection systems ○ Spectrophotometers

(The systems have been listed generically, to allow for inter-laboratory differences between specific types/makes of instruments used. The student is expected to have a basic understanding **of *one example of each*).**

RANGE: *See item 6*

4.4 LABORATORY REAGENTS

Objective

Provide details of the correct preparation, storage and disposal of laboratory reagents.

Specified outcomes

On completion of this section, the intern/student should be able to:

- ✓ Differentiate between controls and calibrators.
- ✓ **Demonstrate knowledge of the objective, use and retention of package inserts/ instructions for use (IFU's).**
- ✓ Prepare, store, and safely dispose of laboratory reagents.
- ✓ Define terms and solutions used in the laboratory:

RANGE: *Working reagents, controls, calibrators, reagent kits, buffers, physiologically normal saline, molar and molal solutions disinfectants, sterilizers.*

4.5 STOCK CONTROL

Objective

Outline the processes involved in good stock management**.**

Specified outcomes

On completion of this section, the intern/student should be able to:

- ✓ Describe/evaluate/motivate/design the components of a good Inventory/ Stock control system.
- ✓ Demonstrate knowledge of the basic principles to apply when managing stock.
- ✓ Demonstrate an understanding of the receipt of stock including the required records regarding condition of goods, expiry dates and lot numbers.
- ✓ Demonstrate an understanding of stock rotation with particular reference to expiry dates.

- ✓ Describe the correct storage conditions for all stock.
- ✓ Differentiate between open vail stability and expiry date.
- ✓ Demonstrate knowledge of company policy with regard to the use of expired reagents, controls and calibrators.
- ✓ Knowledge of the maintenance of reference Quality Control stock.

4.6 QUALITY ASSURANCE and ACCREDITATION

Objective

Expose the intern/student to all aspects of quality assurance.

Specified outcomes

On completion of this section, the intern/student should be able to:

- ✓ Discuss quality assurance and quality control in the correct context.
- ✓ Define and apply the appropriate processes of quality assurance in the pre-analytical, analytical and post analytical areas of specimen handling.
- ✓ Demonstrate general knowledge on the terms accreditation, ISO and SANAS.
- ✓ Demonstrate general knowledge on the use, performance and evaluation of risk assessments.
- ✓ Define and explain all quality assurance terminology.

RANGE: *Non-conformance, corrective action, preventive action, root cause analysis, continual improvement, audits – internal & external*

4.7 QUALITY CONTROL

Objective

Expose the intern/student to all aspects of quality control.

Specified outcomes

On completion of this section the intern/student should be able to:

- ✓ Describe and apply the appropriate quality control processes, which must be performed and applied in the analysis of all analytes, parameters, reagents, equipment and analyzers operation as contained within this syllabus.
- ✓ Explain the principles of IQC and EQC procedures in the context of the tests performed.
- ✓ Apply a sound knowledge of all the principles, procedures, calculations and interpretation of all related internal and external, ***quantitative*** quality control data.
- ✓ Student must demonstrate understanding of Levey Jennings charts in order to do trend analysis.
- ✓ Apply a sound knowledge of all the principles, procedures and interpretation of all related internal and external, ***qualitative*** quality control data.
- ✓ Describe the potential causes and apply appropriate troubleshooting procedures in the event of failed internal and external, quantitative and qualitative quality control.
- ✓ Define and explain all terminology used in the assessment of quality control results.

RANGE: *Specificity, sensitivity, precision, accuracy, reference range, biological variance*

4.8 METHOD VALIDATION

Objective

Expose the student to all aspects of method validation.

Specified outcomes

On completion of this section, the student should be able to:

- ✓ Differentiate between validation and verifications in terms of relevant ISO standards.
- ✓ Demonstrate an understanding of the approach to the validation and/or verification of new equipment, reagents and testing kits (Qualitative and Quantitative).
- ✓ Student must demonstrate understanding of concepts such as normal distribution including mean, median, CV, standard deviation.
- ✓ Student must demonstrate understanding of concepts such as sensitivity, specificity, and predictive value, accuracy, precision, correlation, linearity and bias.

RANGE: *Uncertainty of measurement, various errors, delta difference, bias, linearity*

4.9 PERSONNEL

Objective

Provide knowledge of basic requirements for personnel in terms of relevant ISO standards.

Specified outcomes

On completion of this section, the intern/student should be able to:

- ✓ Describe the personal documents and records, which are required for all laboratory personnel.
- ✓ Demonstrate an understanding of the terms ‘competency’ and ongoing competency’ in terms of the training of all laboratory personnel.

4.10 DOCUMENTATION

Objective

Provide knowledge of basic requirements of documentation in terms of relevant ISO standards.

Specified outcomes

On completion of this section, the intern/student should be able to:

- ✓ Describe/identify/appraise the components of good data management system.
- ✓ Demonstrate knowledge of document control requirements in terms of relevant ISO standards.
- ✓ Demonstrate knowledge of the required content of SOP’s including the minimum content of the cover page.
- ✓ Know the process on how to make documents obsolete.
- ✓ Demonstrate knowledge on the retention and disposal of this documentation.
- ✓ Demonstrate knowledge on document control and review.
- ✓ Differentiate between a record and document.

RANGE: *Policies, procedures (SOPs), working instructions, raw data, equipment records, quality control records, personnel records, package inserts/IFUs*

5. LABORATORY RELATED MATHEMATICS

Objective

Provide the intern/student with instruction on the application of the correct mathematical formulae to relevant calculations.

Specified outcomes

On completion of this section, the intern/student should be able to:

- ✓ Demonstrate proficiency in the calculations required for the preparation of solutions.

RANGE: *Physiological saline; percentage solutions*

6. THEME: Viral antigen detection

OUTCOMES:

At the end of the unit, the student will be able to:

- List and discuss the advantages and disadvantages of viral disease diagnosis through viral antigen detection.
- Describe proper specimen collection and antigen smear preparation for immunofluorescence testing.

Give an overview of the steps required in direct and indirect immunofluorescence methods.

- Compare virus isolation in culture with detection of viral antigen by immunofluorescence for Herpes simplex virus, RSV and other respiratory viruses.
- Describe enzyme immunoassay for antigen detection and profile the advantages and disadvantages of antigen detection enzyme immunoassay in detecting rotavirus, hepatitis B, RSV, influenza A and HSV antigens.
- Describe latex agglutination methods for viral antigen detection and discuss clinical application of this technique.
- Describe the Cytomegalovirus antigenemia assay, and explain how it is used in viral antigen detection.

7. THEME: Viral Immunology

OUTCOMES:

At the end of the unit, the student will be able to: List the different parts of the immune system. List the immune responses to viral infections.

- Give the definition of a vaccine.
- Compare attenuated vaccines and inactivated vaccines.
- List general factors that affect *in vitro* immunoserological assays.
- For the following serological principles give an overview of the procedural steps (including a diagram for those principle that are widely used in clinical virology) and describe the appearance of positive and negative results:
- ○ direct haemagglutination
- ○ passive haemagglutination
- ○ viral haemagglutination
- ○ haemagglutination inhibition
  - ○ direct immunofluorescence and indirect immunofluorescence
  - ○ enzyme immunoassay (competitive and non-competitive)
  - ○ immunoblotting and virus neutralisation.
- Define and provide formulas for calculation of sensitivity, specificity and predictive values and when provided with data, calculate these values.

8. THEME: Serological diagnosis of viral infections

OUTCOMES:

At the end of the unit the student will be able to:

- List and discuss the advantages and disadvantages of viral disease diagnosis through viral antigen and antibody detection.

  Give an overview of the steps required in µ Capture, Sandwich and Competitive ELISA's.

  - Discuss the mechanical factors affecting ELISA assays.
  - Discuss the reasons for having controls and calibrators.
- Give an overview of an Immunochromatographic test.
- Describe enzyme immunoassay for antigen detection and profile the advantages and disadvantages of antigen detection enzyme immunoassay in detecting viral infection e.g.; rotavirus, hepatitis B, RSV, influenza A and HSV antigens, ect.
- Interpretation of serological results for chronic and acute viral infections e.g, HBV, HCV, EBV, HSV, CMV, Measles, Rubella, etc.
- Explain the basis of viral diagnosis through serology and determine the circumstances in which serology rather than virus isolation or viral antigen detection is the test of choice.
- Detail how non-specific inhibitors and agglutinins are removed from the patient's serum prior to testing in the rubella haemagglutination inhibition (HAI) assay;
- Using Rubella virus infection as an example and assuming that assays detect primarily IgG, provide answers to the following for serological diagnosis of acquired and congenital infections and for determination of immune status:
  - How many sera samples should be tested? ○ When should these samples be tested? ○ Should the test be in a quantitative or qualitative format?
  - How are the results of testing interpreted?
- Tabulate the haemagglutination viruses, the type of red blood cells they agglutinate and the conditions required for haemagglutination such as pH and temperature; Outline the precautions taken in your laboratory to minimise HIV infection.
- Describe and perform the screening and confirmatory tests done in your laboratory for HIV and explain their significance in the diagnosis of HIV/AIDS
- Describe test modifications and pre-treatments used to make assay specific for IgM, and explain how IgG and Rheumatoid factor may interfere in IgM specific assays.
- Give examples of clinical situations in which IgM specific assays may be of use and discuss the problems, both technical and biological, that must be considered in interpreting the results of IgM specific assays.

- Be able to discuss or illustrate diagrammatically at least 3 methodologies used routinely in viral antibody detection.
- List at least 5 viruses whose diagnosis at present relies on the serological approach.
- Describe the proper storage of blood samples that will be tested for viral antibodies. When presented with sample results of quantitative serological test, be able to differentiate significant from non-significant differences in titer.

9. THEME: Molecular diagnostic techniques

OUTCOMES:

At the end of the unit the student will be able to:

- Describe the principle of a PCR.
- Explain controls necessary for a PCR.
- Discuss the three steps of a PCR.
- Design a PCR program.
- List the key reagent within a PCR and discuss the role/function of each reagent.
- Calculate primer dilution volumes (see Calculations UNIT 5).
- Explain factors that can affect a PCR.
- Describe the workflow dynamics in a PCR laboratory.
- Discuss and differentiate between Traditional PCR, NASBA, Reverse-transcriptase PCR, Multiplex and Real Time PCR.
- Assess the different applications of PCR
- Discuss the prevention of contamination in a PCR laboratory.
- Describe the safety aspects of working with specimens, reagents and equipment in the PCR laboratory.
- The student must be able to perform the electrophoresis of PCR products and analyse & interpret the gel results.
- Explain the procedures necessary to discard PCR products.
- Describe the principle of agarose gel electrophoresis.
- Explain factors that affect the rate of migration of nucleic acids within an agarose gel.
- Explain the function of Ethidium Bromide within an agarose gel and the hazards of using Ethidium Bromide.
- Trouble shooting of false negative and positive results with reference to amplification, extraction, detection, reagents, equipment and human errors.

10. THEME: Virus isolation in cell cultures

OUTCOMES:

At the end of the unit the student will be able to:

- Identify the preferred clinical specimens for viral isolation in various disease syndromes and for isolation of common human viral pathogens.

  Provide instructions for the collection of the various types of clinical samples for virus isolation including urine, peripheral blood, throat swab, rectal swab, stool, CSF, sputum and lesion or vesicle samples.
- Describe proper containers for specimen collection and transport, and indicate whether viral transport medium should be used.
- Give directions for short- and long-term storage and for transport of clinical samples for virus isolation studies to both in-house laboratories and off-site reference facilities.
- Describe viral transport media, listing components and their purpose.
- List the basic steps in the processing of clinical samples of inoculation into cell cultures and explain the purpose of each step.
- Define cytopathic effects (CPE) with examples of how CPE might appear.
- Explain how traditional cell cultures are examined for evidence of viral CPE.
- Explain the procedure and underline biological features that are important in haemadsorption, interference challenge and haemagglutination.
- Provide examples of viruses that can be definitely identified by immunofluorescence and neutralisation techniques.
- Describe viral neutralisation testing including test principle, viral titration and back titration.
- Describe the shell vial system, including proper inoculation, incubation and staining.
- Give specific information comparing isolation of CMV in shell vials and traditional cell cultures.
- Give examples of other viruses, other than CMV, that can be identified in shell vials.
- Describe virus isolation in cell cultures grown in micro well plates and indicate how the system is used for virus isolation.
- Describe human lymphocyte suspension cultures and list viruses that require this kind of system for their isolation.

11. REFERENCE MATERIAL

- Fenner and White' Medical Virology. Eds Christopher J. Burrell, Colin R. Howard, Frederick A. Murphy. 5th edition. Elsevier. 2016.
- Lennettes Laboratory Diagnosis of Viral Infections. Ed Keith R.Jerome. Routledge Taylor and Francis group. 4th Edition. 2010.
- Virology: An Illustrated Colour Text. Eds. Stephen N J Korsman, Gert Van Zyl, Wolfgang, Louise Nutt, Andersson Monique. Churchill Livingstone Elsevier. 2012

12. ASSESSMENTS EXPLANATORY WORDS LIST

In order to assist the trainer and examiner to capture a specific level of knowledge and the intern/student with the interpretation of questions, a list is provided which gives a description of what is needed for a specific verb during questioning in assessment.

Bloom's taxonomy: explanatory list of words

Classify	Arrange information in categories.
Comment	Give your opinion regarding subject matter and illustrate it through examples. Interpret and evaluate
Correct	Identify and remedy mistakes, identify false statements and correct them.
Define	Give a clear, systematic and authoritative explanation (description of concepts to reflect the precise meaning thereof.
Describe	Write the basic facts/results down in a logical, systematic and wellstructured manner.
Distinguish	Show the difference, give the distinguishing characteristics.
Give a summary / review	Give a synopsis (summary, brief account) of the main facts of a subject and make comments.
Give an explanation	Make a summary of the main facts of a subject in clear, logical sequence so that differences, similarities and points of reference are clearly indicated.
Give an outline	Give a framework consisting of main facts and relevant information in support of these facts. It is not necessary to write down a detailed discussion.
Identify	Reproduce the essential characteristics (main facts).
Modify	Change, re-arrange and modify the given information.
Name	Make short notes of the required information, but do not discuss it in detail.
Paraphrase	The same as “define”. The student’s own words may be used.
Propose	Give a relevant answer / recommendation, indicate, portray.
Re-arrange	Re-divide into new / different classes, groups, types, characteristics. The information is generally provided in the paper.
Summarize / Give a summary	Give a resume of the most important facts without detail, illustrations, critical analysis or discussion.
Use	Make use of information or subjects supplied to illustrate/explain a specifi viewpoint.
Write a composition	Supply the information in logical and well-structured manner.
Write notes on	Comment in short explanation (clarification) on a given subject.
Contrast	Emphasize the differences, contrasts and anomalies of facts or events by using analysis, discussion, and examples.
Derive	Form an opinion from above-mentioned or given information.
Determine	Calculate, compare and make comments.
Determine	Prove, make a diagnosis by using facts and commentary.

Explain	Give a clear explanation (exposition). Elucidate by means of examples and/or illustrations and give reasons for pronouncements or results.
Illustrate	Use a sketch, diagram, graph or concrete item to explain a concept or solve a problem. It can also mean to give examples in well chosen, descriptive words.
Investigate	Analyze the facts (divide into sections) and write a critical discussion.
Map	Make a graphical representation (graph, flow diagram, map, etc.)
Motivate	Prove, give reasons, activate, and comment.
Process	Rewrite to reach the desired answer, summarize, elaborate, and revise.
Sketch	Give a brief resume of main features, (of the development, progress of events) logically divided into main facts and sub-sections.
Abstract	Find the core of information and formulate it in your own words. Concrete examples are not provided.
Analyze	Separate (divide) into two parts or elements, describe comprehensively and make comment. Find the core of information and formulate it in your own words. Concrete examples are not provided.
Apply	Show the application of acquired knowledge or given information in practice; or in relation to what is asked. Use the knowledge to reach an answer to the question.
Calculate	Use the information given to reach a sensible and acceptable answer/result.
Criticize	Judge the credibility of given fact or viewpoints and discuss the positive and negative elements of a statement, by giving and motivating your own opinion.
Demonstrate	Explain by using a sketch, model, picture, graph or a concrete subject. It may also imply a well-though out and well-formulated description.
Discuss	Analyze the matter carefully by discussing different aspects in logical arguments. Compare, contrast and debate.
Execute	The same as “apply”.
Handle	Scrutinize (study, consider) the subject from different viewpoints and provide a critical explanation thereof.
Interpret	Comment on available facts, with reference to applicable examples. Give a clear indication of own interpretation.
Judge	Give a critical evaluation of the subject.
Prove	Prove the facts in a logical resume of acceptable and relevant reasons.

Solve	Explain, prepare well thought-out answers/recommendations.
To show relations	Show by using analysis, discussion and examples how different facts are interrelated, or correspond to one another.
Design	Create and plan. Portray by means of illustrations or concrete artefacts. Create a model with a specific object in mind and also indicate the planning phase.
Evaluate	Make an assessment of value based on specific points of reference or criteria and give your own opinion. Do not describe. Personal viewpoints may be given.
Plan	Explain, compare, determine and make comments.

Approved		Date:	Comments:
Not Approved		Date:	Comments: