Handbook

Diploma in Laboratory Technology (D.L.T)

Faculty of Science

Eastern University, Sri Lanka

2019

DIPLOMA IN LABORATORY TECHNOLOGY (D.L.T)

GOALS AND OBJECTIVES

The Diploma Programme in Laboratory Technology is designed based on SLQF level 3 to produce technical grade personnel capable of carrying out various laboratory analysis and practical works under the supervision of a technologist.

Specifically,

1. Assist in chemical analysis and quality control in industry, hospitals, schools, colleges and research institutions.
2. Assist in laboratory instrumentation with physical analyses, the maintenance and repair of instruments.
3. Assist in biological and biochemical analysis and experiments in hospitals, schools, colleges and research institutes.
4. Use interpersonal and communication skills appropriate to the laboratory technology environment.
5. Facilitate the learners with various learning strategies that lead to lifelong learning.

Expected learning Outcomes

Upon successful completion of the diploma programme, students will be able to

- adhere to safety rules and good laboratory practices at all times governing in applied science laboratories
- explain basic principles of instrumentation and its applications
- use appropriate methods to identify and quantify unknown analytes in aqueous / organic media.
- apply appropriate biochemical tests for the diagnosis of human disease
- acquire work experience or work integrated learning.

DURATION OF TRAINING

18 months course including lectures, Small Group discussion, Demonstrations, laboratory work, field visits if any.

COURSE STRUCTURE OF THE PROGRAM

- The program shall be conducted on a CREDIT system assigned to COURSES. The duration of the programme would be a maximum of 18 months with **30 credits**.

- The coursework component consists of core courses which are compulsory. Each course is comprised of a theory and/or practical component. ONE CREDIT is equivalent to **15 hours of lectures** in the theory component (**T**) or **30 hours of activity** (laboratory work / field study) in the practical component (**P**).

- The Medium of instruction will be English/Tamil.

EXAMINATIONS AND EVALUATION PROCEDURES

Evaluation of Course work

All theory courses and the laboratory courses will be evaluated according to the criteria given below and a grade will be assigned for each course unit.

- End of course examination

- Continuous assessments (mid-semester examination, assignments, etc.)

Courses with laboratory and/or fieldwork shall be evaluated, where applicable, on a continuous assessment basis.

The minimum grade a student should achieve to pass a course is '**C'**.

For all courses a minimum of 80 % attendance is compulsory.

Grade Points and Grade Point Average (GPA)

Grade Point Average (GPA) is the credit-weighted arithmetic mean of the Grade Point Values, which is determined by dividing the total credit-weighted Grade Point Value by the total number of credits. GPA shall be computed to the second decimal place.
The Grade Point Average (GPA) will be computed using the grades earned for compulsory courses.

On completion of the end of course examination the instructor(s) is/are required to hand over the grades of a given course to the programme coordinator who will assign the Grade Points using the following table:

Grade	Grade Point
A+	4.00
A	4.00
A^-	3.70
B^+	3.30
B	3.00
B^-	2.70
C^+	2.30
C	2.00
C-	1.70
D+	1.30
D	1.00
F	0.00

Example: A student who has completed three course units each of two credits and two course unit with one credit, with grades A, C, B, D and C^+ respectively would have the GPA of 2.66 as calculated below.

$$\frac{(2\ X\ 4.0)+(2\ X\ 2.0)\ +\ (2\ X\ 3.0)+(1\ X\ 1.0)+\ (1\ X\ 2.3)}{2+2+2+1+1} = \frac{21.3}{8} = 2.6625$$

Grade Point Average = 2.66

Repeat Courses

If a student fails a course, he/she shall repeat the course examinations at the next available opportunity.
Candidates are allowed to repeat a course only twice on two subsequent occasions. However, if there's no possibility of a subsequent examination in a reasonable period of time, a special repeat examination may be conducted, on the recommendation of the senate, EUSL.

CRITERIA FOR THE AWARD OF THE CERTIFICATE/DIPLOMA

Criteria for the Award of the Diploma

Pass

A student registered for the diploma will be awarded the Diploma in Laboratory Technology (D.L.T) if he/she satisfies the following conditions

(i) Obtains an overall GPA of not less than 2.00 or

(ii) Obtains C grade or above in all compulsory course units

(ii) Complete the relevant requirements within a period of **three** years.

Merit Pass

A student registered for the diploma programme will be awarded the diploma with distinction if he/she satisfies all the following conditions:

(i) Obtains grades **B** or better in all course units

(ii) Obtains a minimum cumulative GPA of 3.30 from all compulsory course units

(iii) Complete the relevant requirements at the first sitting.

Criteria for the Award of the Certificate

A candidate, who wishes to leave the diploma programme after completing a minimum of 15 credits from Basic Laboratory Techniques (BLT) course unit, will be awarded a certificate, if he/she obtained a minimum overall GPA of 2.00 in 15 credits.

Effective Date of the D.L.T

The effective date of the diploma shall be the date of the last paper of written examinations for the academic programme.

Transcript

A duly certified transcript of a candidate's academic record will be issued on receipt of an application with prescribed fee.

OUTLINE SYLLABUS

COURSE UNIT	No. of Credits
BLT: BASIC LABORATORY TECHNIQUES	
BLT 1. Laboratory management	02
BLT 2. Safety in the laboratory	02
BLT 3. Museum techniques	02
BLT 4. General laboratory instrumentation	02
BLT 5. Calibration of laboratory instruments	02
BLT 6. Basic Mathematics and Statistics	02
BLT 7. Basic Electricity & Electronics	02
ESR. Ethics and Social Responsibility	01
Total credits	**15**
ALT: ADVANCED LABORATORY TECHNIQUES	
ALT 1. Microscopy	02
ALT 2. Water quality analysis	02
ALT 3. Laboratory on applied Chemistry	02
ALT 4. Food analysis	02
ALT 5. Medical laboratory procedures	02
ALT 6. Principle of aquatic Toxicology	02
PPG. Photography and Photomicrography	02
PSM. Procurement and Supply Management	01
Total credits	**15**
Total	**30**

DETAILED SYLLABUS

BLT: Basic Laboratory Techniques

BLT 1. Laboratory management (01 T+01 P)

Aim: To explain the general concept of laboratory management

Course content:

- The correct procedures for installing (or locating): (i) Balances (ii) Barometers and some Electronic instruments, understand the management of stores, The principles of store keeping, The acquisition, storage and use of technical information, The record keeping in the laboratory, The importance of discipline in the laboratory, The routine administrative functions in the laboratory. ordering consumables and equipment, maintaining stock books and inventories

Intended Learning outcomes: At the completion of this course students will have the ability to,

1. *identify* the basic principles of Laboratory Information Systems, Laboratory Operational Management.
2. *learn* the management of stores
3. *apply* the correct procedures for installing (or locating):

Assessment strategy:

Formative: 1. Continuous assessment tests/quizzes (20 %) (ILO. 1)

2. Student presentation/Assignment (10 %) (ILO's. 1, 2)

Summative: Written examination (70 %) (ILO's. 1,2 and 3)

Recommended References

1. Berry, T (1990). Managing the total quality transformation. McGraw-Hill, New York.
2. Robbins, J (1994). The quality program. American Association of Blood Banks.

BLT 2. Safety in the laboratory (01 T + 01 P)

Aim: To provide the safety in a laboratory

Course content:

- The common laboratory hazards, Hazardous Chemicals, Personal Protective Equipment. Health Hazards, Fire Safety, Chemical Spills, Physical Hazards, Chemical Storage, Shipping of Hazardous Materials, Guidance on the Use of Hazardous Chemicals

Intended Learning outcomes: At the completion of this course students will have the ability to,

1. *explain* the basic safety rules in the laboratory.
2. *survey* the common laboratory hazards.
3. *enumerate* safety measures adopted in different types of applications in a laboratory.

Assessment strategy:

Formative: 1. Continuous assessment tests/quizzes (20 %) (ILO's. 1,2)

2. Student presentation/Assignment (10 %) (ILO's. 1,2, 3)

Summative: Written examination (40 %) (ILO's. 1,2 and 3)
Practical examination (30 %) (ILO's. 2,3)

Recommended References

1. Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards: Updated Version, National Academies Press (US), 2011.

2. American Chemical Society, Safety in Academic Chemistry Laboratories. 5th edition.1990.

BLT 3. Museum techniques (01T +01 P)

Aim: To provide the plant anatomy and physiology, Curating of plant materials, Taxonomy of higher and lower levels of Plants, Zoological.

Course content:

- Identification of Plant and Animal Groups, Use of keys in identification, Collection techniques in the field, Methods of Culture and Preservation, Herbarium and Museum preparation, skeletal mounts.

Intended Learning outcomes: At the completion of this course students will have the ability to,

1. *demonstrate* the skills in tissue culture and museum techniques.
2. *identify and explain* the roles, training, skills, knowledge, opportunities, and requirements of
   museum educators.
3. *identify and apply* how the different skill and knowledge areas of museum education can be applied to appropriate projects.

Assessment strategy:

Formative: 1. Continuous assessment tests/quizzes (20%) (ILO's. 1,2)

2. Student presentation/Assignment (10 %) (ILO's. 1,2)

Summative: 1. Final examination (40 %) (ILO's. 1,2 and 3)
2. Practical examination (30 %) (ILO's. 1,3)

Recommended References

1. Edward Porter Alexander and Edward Porter (2009). Museums in motion: an introduction to the history and functions of museums.

2. George Ellis Burcaw (1997). Introduction to Museum Work, Trade paperback ISBN-13.

BLT 4. General laboratory instrumentation (01 T + 01 P)

Aim: To provide the knowledge of laboratory instrumentation

Course content:

- The operation, use and care of basic measuring instruments, the principles and instrumentation of spectrophotometer and colorimetry, the types of power supply units in the laboratory, componets of spectrophotmers (light sources, monochromators, detectors, photomultiplier tubes, recorders) the essentials of trouble-shooting techniques.

Intended Learning outcomes: At the completion of this course students will have the ability to,

1. *conduct* select testing procedures.
2. *explain* essential components of instruments.
3. *evaluate the* validity and reliability of instruments.

Assessment strategy:

Formative: 1. Continuous assessment tests/quizzes (20 %) (ILO's. 1,2)

2. Student presentation/Assignment (10 %)(ILO's. 2, 3)

Summative: 1. Final examination (40 %) (ILO's. 2, 3)
2. Practical examination (30 %) (ILO's. 1 and 3)

Recommended References

1. Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards: Updated Version, National Academies Press (US), 2011.
2. Mary C. Haven, Gregory A. Tetrault and Jerald R. Schenken (1994). Laboratory Instrumentation, John Wiley & Sons.

BLT 5. Calibration of laboratory instruments (01 T +01 P)

Aim: To provide the knowledge to handle the laboratory instruments

Course content:

- Operation and calibration of laboratory, glass wares, Operation and calibration of pH Meter, Conductivity meter and Turbidity meter, operation of balance and their calibration.

Intended Learning outcomes: At the completion of this course students will have the ability to,

1. *explain* the different types of laboratory glass wares and their functions.
2. *point out* different types of calibration techniques for laboratory meters.
3. *judge* the appropriate uses of instruments.

Assessment strategy:

Formative: 1. Continuous assessment tests/quizzes (20%) (ILO's. 1,2)

2. Student presentation/Assignment (10 %)(ILO's. 2)

Summative: 1. Final examination (30 %) (ILO's. 1,2)

2. Practical examination (40 %) (ILO's. 2,3)

Recommended References

1. Guidance for the Preparation of Standard Operating Procedures. U.S. EPA. Current Version. 2007.

2. Christian Elbert (2012). Calibration Technology Basics, reference instruments for pressure and temperature, professional calibration.

BLT 6. Basic Mathematics and Statistics (02 T)

Aim: To provide the fundamental of Mathematics and Statistics

Course content:

- *Basic Mathematics*: Number system, Trigonometric Functions, Linear Equations, Inequalities in one variable, Quadratic Equations, Cartesian coordinates, Straight lines, Graphs and Limits of Functions, Intersection of graphs, Curved graphs, Differentiation, Integration.
- *Statistics***:** Collection of data, Organization of data, Classification of data, Histogram-frequency polygon, Mean, median, mode, Mean deviation, Standard deviation, Coefficient of variation, Normal and the standard distribution, Probability, distributions, Sample and population, Normal Distribution, Confidence limits, Use of *Z*-table and *t*-table.

Intended Learning outcomes: At the completion of this course students will have the ability to,

1. *use* the fundamental knowledge for a Mathematical expressions.
2. *define* the graph, differentiation and integration functions.
3. *interpret* scatter plots and histograms and have the required knowledge to carry out simple problems involving differentiation and integration populations, sample sizes and statistics.

Assessment strategy:

Formative: Continuous assessment tests/quizzes (40 %) (ILO's. 1,2, 3)

Summative: Written examination (60 %) (ILO's. 1,2 and 3)

Recommended References

1. Hastie, Tibshirani and Friedman(2009). An Introduction to Statistical Learning, 2nd edition,

2. Debra Anne Ross (2010). Master Math: Basic Math and Pre-Algebra, 2nd Edition, Stanford University.

BLT 7. Basics of Electricity & Electronics (01 T + 01 P)

Aim: To provide the Electricity Principles and their operations

Course content:

- Electrical Quantities and Units, Fundamental of electronic circuits, Laws and Measurements,
  Circuit Components, Multiple-Load Circuits, Complex-Circuit Analysis, Power in AC Circuits, Capacitance, Transformers, Learn computer design aids.

Intended Learning outcomes: At the completion of this course students will have the ability to,

1. *use* meters and test equipment to measure electrical quantities.
2. *identify and apply* the current resistance and power in DC circuits.
3. *test* the fundamentals of inductance, capacitance and impedance in AC circuits.

Assessment strategy:

Formative: Continuous assessment tests/quizzes (30 %) (ILO's. 1,2, 3)

Summative: 1. Final examination (40 %) (ILO's. 1,2)
2. Practical examination (30 %) (ILO's.2, 3)

Recommended References

1. S. K. Bhattacharya (2011). Basic Electrical and Electronics Engineering, *Pearson*, ISBN: 9788131754566, India.

2. Max (2002). Fogiel Handbook of Basic Electricity, Research & Education Association, USA.

ESR. Ethics & Social Responsibility (01 T)

AIM: To introduces the relevance and importance of ethics & social responsibility in a different environment.

Course content:

- Ethics versus the Law , Moral Responsibility, Moral Theory, Ethical Decision-Making, Corporate Social Responsibility Theory, Administrative Law, Human rights,

Intended Learning outcomes: At the completion of this course students will have the ability to,

1. *enhance* awareness and increase understanding of the nature of ethics in an environment.
2. *increase* awareness of the challenges of business social responsibility.
3. *manage*/*handle* legal aspects in administration.
4. *describe* fundamental rights and human rights in Sri Lankan context.

Assessment strategy:

Continuous assessment tests/quizzes (30 %) (ILO's. 1,,4)
Written examination (70 %) (ILO's. 1,2,3,4)

Recommended References

1. Gary Chan & George Shenoy (2011). Ethics and Social Responsibility, 2nd edition Singapore, McGraw-Hill Education (Asia).

2. Charles M. Scanlan (1909). The Clergyman's Hand-book of Law, Benziger Brothers, Chicago.

ALT: Advanced Laboratory Techniques

ALT 1. Microscopy (01 T + 01 P)

Aim: To provide the knowledge on the microscope examination of micro-organisms.

Course content:

- the principle of microscopy, all types of microscope e.g. light microscope, compound microscope, phase contrast microscope, electro-microscope, the application of each type of microscope in the study of microbiology. Preparation of samples for microscopy

Intended Learning outcomes: At the completion of this course students will have the ability to,

1. *explain* the principle of microscopy.
2. *identify* and *describe* all types of microscope.
3. *compare* the application of each type of microscope.

Assessment strategy:

Formative: Continuous assessment tests/quizzes (30 %) (ILO's. 1,2,3)

Summative: 1. Final examination (30 %) (ILO's. 1, 3)
2. Practical examination (40 %) (ILO's. 2,3)

Recommended References

1. Michael J. Dykstra (1993). A Manual of Applied Techniques for Biological Electron Microscopy
Pp 272, ISBN 03064-44496.
2. Suzanne Bell, Keith Morris (2009). An Introduction to Microscopy CRC Press, ISBN 9781420084504 .

ALT 2. Water quality analysis (01 T + 01 P)

Aim: To provide the knowledge on standard water quality methods and applies them to analysis of water.

Course content:

- Determination of Concentrations of Common Ions, Total dissolved solids (TDS), Hardness,

Turbidity, Acidity, Dissolved oxygen (DO), Biochemical oxygen demand (BOD), titrimetry: acid base, redox and precipitation titrations.

Intended Learning outcomes: At the completion of this course students will have the ability to,

1. *explain* the major types of water pollution and its effects on aquatic ecosystems.
2. *perform* standard water quality analysis.
3. *discuss* and *list* ways to reduce water pollution.

Formative: 1. Continuous assessment tests/quizzes (20 %) (ILO's. 1,2)
2. Student presentation/Assignment (10 %)(ILO's. 2,3)

Summative: 1. Final examination (30 %) (ILO's. 1, 3)
2. Practical examination (40 %) (ILO's. 2,3)

Recommended References

1. Vogel's Textbook of quantitative chemical analysis, 5th edition, Thames Polytechnic, London(1989).
2. David Harvey (2010). Modern Analytical Chemistry, McGraw-Hill Companies, Inc, USA.

ALT 3. Laboratory on applied Chemistry (01 T + 01 P)

Aim: To provide the knowledge on applied chemistry laboratory and use the laboratory techniques for chemical analysis.

Course content:

- Special equipment and techniques, Distillation (simple, fractional, steam, reduced pressure), Solvent extraction, Separating funnel, Soxhlet extraction, Melting point determination, Recrystallization (purification), Paper chromatography-food colour identification, Application of Flame Photometer, Quantitative Analysis of Aqueous Solution.

Intended Learning outcomes: At the completion of this course students will have the ability to,

1. *adhere* to safety rules governing an applied chemistry laboratory and use basic laboratory techniques for chemical analysis.
2. *perform* titrimetric and gravimetric methods in quantitative analysis of unknown analytes.
3. *solve* stoichiometric and other analytical calculations.

Assessment strategy:

Formative: 1. Continuous assessment tests/quizzes (20 %) (ILO's. 1,2,3)
2. Student presentation/Assignment (10 %)(ILO's. 1, 3)

Summative: 1. Final examination (30 %) (ILO's.1, 2, 3)
2. Practical examination (40 %) (ILO's. 2,3)

Recommended References

1.Freeman (1963). Chemistry An Experimental Science Laboratory Manual (0-7167-0002-6), Chemical Education Material Study.

2. Chemical Laboratory Safety and Security Publisher: National Academies Press 2016, ISBN/ASIN: 0309392209.

ALT 4. Food analysis **(01 T + 01 P)**

Aim: To provide the principles of chemical and instrumental methods for the qualitative and quantitative analysis of food.

Course content:

- Introduction to food analysis, Proximate analysis, Food sampling and Sample preparation for chemical analysis

Intended Learning outcomes: At the completion of this course students will have the ability to,

1. *discuss* a sound theoretical knowledge of the basic principles of food chemistry.
2. *use* the modern analytical methods applicable to the chemical analysis of food.
3. *demonstrate* practical knowledge of selected food analysis techniques.

Assessment strategy:

Formative: 1. Continuous assessment tests/quizzes (20 %) (ILO's. 1,2)
2. Student presentation/Assignment (10 %)(ILO's. 2,3)

Summative: 1. Final examination (30 %) (ILO's. 1, 2)
2. Practical examination (40 %) (ILO 3)

Recommended References

1. Rui M. S. Cruz, Igor Khmelinskii and Margarida Vieira (2014). Methods in Food Analysis, CRC Press, NewYork.
2. S. Suzanne Nielsen (2010). Food Analysis, Fourth Edition, Springer, USA,

ALT 5.Medical laboratory procedures **(01 T + 01 P)**

Aim: To provide the opportunities to practice medical laboratory procedures

Course content:

- Organizational structure of Clinical laboratories, Basic needs of clinical laboratory, Role of Doctors and Medical Laboratory Professionals, Code of conduct/ethics of Medical laboratory Professionals, Basic causes of accidents, Common types of laboratory accidents, First aid in laboratory accidents, Clinical laboratory records, Clinical utility of laboratory tests.
- Urine Analysis: Physiology of urine formation, Composition of normal urine, Collection of urine specimens, Types of urine specimens, Preservation of urine specimens, Routine examination of urine/Gross examination, Microscopic examination of urine, Chemical analysis of urine, Common pattern of abnormal urine composition in disease, Urinary tract infection and Urine culture.
- Blood Analysis: Blood glucose testing, Blood cell counting etc.

Intended Learning outcomes: At the completion of this course students will have the ability to,

1. *expand* knowledge of basic phlebotomy procedures.
2. *perform* and *process* routine laboratory specimens.
3. *apply* the use of the principles of laboratory safety.

Assessment strategy:

Formative: 1. Continuous assessment tests/quizzes (20 %) (ILO's. 1,2,3)

2. Student presentation/Assignment (10 %)(ILO's. 2,3)

Summative: 1. Final examination (40 %) (ILO's. 1, 2)

2. Practical examination (30 %) (ILO's. 2,3)

Recommended References

1. General requirements for the competence of testing and calibration laboratories. Geneva, Switzerland: ISO; 2005.
2. Phyllis Cox and Danielle Wilken (2010). Palko's Medical Laboratory Procedures, 3rd edition.

ALT 6. Principle of aquatic Toxicology (01 T + 01 P)

Aim: To provide the knowledge of the interactions between anthropogenic chemicals and aquatic ecosystems.

Course content:

- Introduction to Aquatic Toxicology, Major Classes of Pollutants, Routes by Which Pollutants Enter the Aquatic Ecosystems, Direct Chemical methods for the identification, quantification and speciation of inorganic pollutants, *In situ* biomonitoring systems for water quality assessment, Determination of Toxicity.

Intended Learning outcomes: At the completion of this course students will have the ability to,

1. *identify* and *quantify* pollutants and ascertaining their points of input into the ecosystem.
2. *discriminate* between acute responses and chronic effects such as teratogenesis, mutagenesis and carcinogenesis.
3. *predict* and *assess* risk to human health.

Assessment strategy:

Formative: 1. Continuous assessment tests/quizzes (20 %) (ILO's. 1,2,3)

2. Student presentation/Assignment (10 %)(ILO's. 2,3)

Summative: 1. Final examination (40 %) (ILO's. 1, 2 and 3)
2. Practical examination (30 %) (ILO's. 1,2 and 3)

Recommended References

1. Rand, Gary M.; Petrocelli, Sam R. (1985). Fundamentals of aquatic toxicology: Methods and applications. Washington: Hemisphere Publishing. ISBN 0-89116-382-4.
2. Mikko Nikinmaa (2014). Introduction to Aquatic Toxicology, Elsevier, Finland.

PPG. Photography and Photomicrography (01 T + 01 P)

Aim: To provide the techniques involved in taking photographs and audio-visuals

Course contents:

- Photography: Basic principles and types of cameras,Types of lens and their uses, Types of films and use of light, Close-up photography and taking photographs, Developing, printing and drying, Photomicrography: Microscope and camera, Selection of material, Taking of photographs.

Intended Learning outcomes: At the completion of this course students will have the ability to,

1. *define* photography and distinguish between amateur and technical photography (i.e. photomicrography, photomicrography).
2. *explain* and *test* the functions of the mechanical and optical parts of the camera and enlarger.

Assessment strategy:

Formative: 1. Continuous assessment tests/quizzes (20 %) (ILO's. 1,2)
2. Student presentation/Assignment (10 %) (ILO's. 1,2)

Summative: Written examination (70 %) (ILO's. 1,2)

Recommended References

1. Schmidt, L., Haulenbeek, J.B. (1932). A Method of Photographing Gross Specimens. J. Biol. Photographic A.;1:76.
2. Brian Matsumoto (2010). Practical Digital Photomicrography.

PSM. Procurement and Supply Management (01 T)

Aim: To provide the importance of procurement and supplier management

Course content:

- Introduction to Procurement, The Procurement Process, Tactical purchasing and strategic purchasing, The supplier evaluation and selection process, Key supplier evaluation criteria, Overcoming barriers to supplier development, University Procurement Procedure, National Procurement Procedure. Calling for quotations and tender boards

Intended Learning outcomes: At the completion of this course students will have the ability to,

1. *familiarize* with the basic concepts, techniques, methods and applications of procurement and supplier management.
2. *explain* the analytical skills and opportunities for improvement in supply chain.
3. *recognize* and *promote* ethical practices in project finance, acquisition and procurement.

Assessment strategy:

Formative: Continuous assessment tests/quizzes (30 %) (ILO's. 1,2)

Summative: Written examination (70 %) (ILO's. 1,2 and 3)

Recommended References

1. Procumbent guidelines (2016). Goods and works, Democratic Socialist Republic of Sri Lanka, National procurement agency.
2. Fred Sollish (2009). The Procurement and Supply Manager's Desk Reference 2nd Edition.