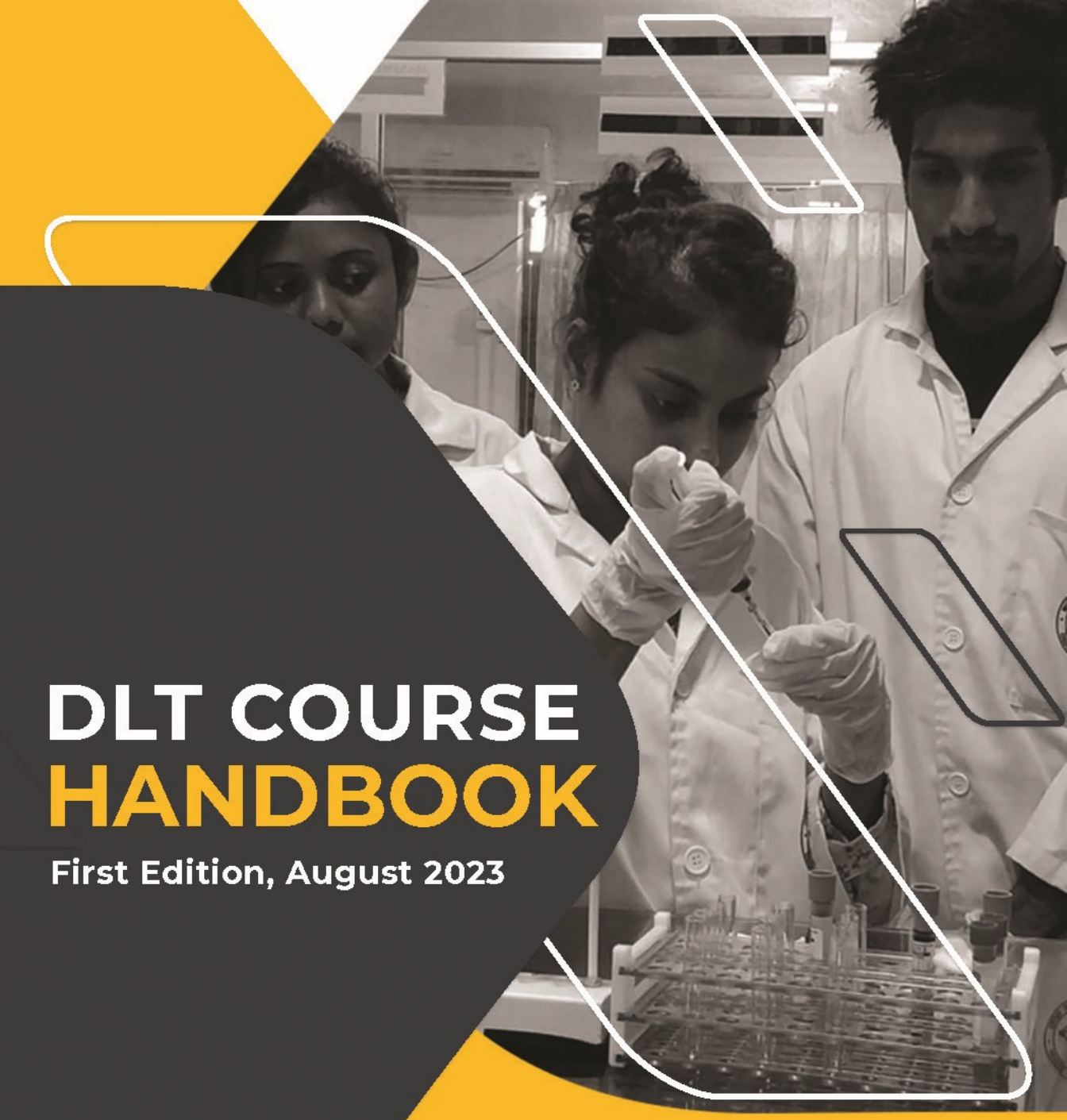

DLT COURSE HANDBOOK

First Edition, August 2023

Institute of Chemistry Ceylon

Institute of Chemistry Ceylon

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First Edition, August 2023

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First edition - August 2023

DISCLAIMER

This handbook has been compiled with information received up to August 2023. It is hereby notified that this handbook is only for general information and is not for official purposes. Any information contained herein should be confirmed by reference to the relevant authority or should be confirmed by the relevant authority.

Vision

Contribute towards a society with good values by offering intellectual growth through education in chemical sciences.

Mission

To be a centre of excellence by offering quality education in chemical sciences through teaching, learning, research, innovations and good ethical practices.

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Message from the President

It is with great pleasure that I provide this message for the new edition of the Handbook of the Diploma in Laboratory Technology (DLT) programme of the Institute of Chemistry Ceylon.

The Institute of Chemistry Ceylon, a professional body for the general advancement of Chemical Science and the practice of Chemistry in Sri Lanka, is the successor to the Chemical Society of Ceylon, founded in 1941. Both the Chemical Society and Institute of Chemistry Ceylon are among the oldest scientific bodies in Sri Lanka. The Institute has been significantly expanding during the past few decades, and it now offers many academic programmes, namely, the BSc (Hons) in Chemical Science, Graduateship in Chemistry (GIC) and Diploma in Laboratory Technology (DLT).

The "Laboratory Technicians' Certificate Course in Chemistry (LTCC)" was the first academic programme offered by the Institute of Chemistry Ceylon in 1973. The syllabus was later changed, modernized, and upgraded to suit the national demands and requirements, and it is now offered as "Diploma in Laboratory Technology" focusing on imparting middle level technical expertise in Chemical Analysis and Research to students. The Institute is equipped with modern instrumentation and laboratories for students to conduct experiments and to perform research. Moreover, the Institute, being in the metropolitan area of Colombo, has the benefit of attracting academic staff members from many other universities, private sector organizations and industries, providing quality, well-rounded education to its students.

Prof. H M D N Priyantha
B.Sc. (Peradeniya), Ph.D. (Hawaii), FNASSL, F.I.Chem.C.
President, Institute of Chemistry Ceylon

Message from the Dean

Welcome to the Diploma in Laboratory Technology (DLT) program. I am pleased to extend my best wishes to all the new enrollees. The Diploma in Laboratory Technology Course (DLT) has been very successful in providing the industry with technical personnel of high quality and in-depth knowledge. Many of the alumni of the DLT program are now in well-recognized managerial level posts in private sector/ industry/higher educational institutes and government organizations.

The DLT program is now enrolling its 50th batch.

The Ceylon Medical College Council recognized the DLT Course in 2018 as a qualification to obtain the Medical Laboratory Technology status for those following the clinical pathway.

We have pooled together highly competent internal academics, visiting lecturers from state universities, and qualified professionals from government agencies and research institutes to help you achieve your dreams.

The Institute of Chemistry Ceylon (Sri Lanka) with a Mission to be a center of excellence in Chemical Sciences for Socio-economic development through education, research, and innovation was founded in 1971 as a successor to the Chemical Society Ceylon (1941).

The Institute of Chemistry was recognized by Act of Parliament No15 in 1972

In addition to the DLT program, the Institute of Chemistry has played a pivotal role in being the largest provider of Graduate Chemists to a vast array of organizations in the country. This has been largely due to the 'Educational Arm of the Institute of Chemistry, the College of Chemical Sciences (CCS), which administers the DLT program, Graduateship in Chemistry (GIC) course (since 1979). A University Grants Commission-accredited B.Sc. program in Chemical Sciences got off the ground (commencing 2020) with the 4th batch of students being just enrolled.

I wish you the best of luck with your studies and encourage you to complete your diploma on a high note within the allocated two-year period.

Prof. Srianthie A Deraniyagala,
B.Sc. (Hons, Colombo), Ph.D. (Dalhousie), F.I.ChemC, C.Chem.
Dean/College of Chemical Sciences, Institute of Chemistry Ceylon
Former Senior Professor, University of Colombo

Message from the Director, DLT

It is with great pleasure that I write this message to all the new enrollees. You have made a revelation decision to become a part of the Institute of Chemistry Ceylon family.

I have been associated with the Institute as well as the CCS for over 40 years and my coordinatorship in the diploma program is more than 20 years. It is worthwhile to mention that the course was initially conducted at Aquinas University College from 1973 up to the year 2004 and at the time it was named as Laboratory Technician Certificate Course (LTCC). In 1998, LTCC course was upgraded by expanding the syllabus to a Diploma level and renamed it as Diploma in Laboratory Technology in Chemistry (DLTC). In 2005, with the establishment of the new building in Rajagiriya, we moved to our own premises. In 2018 we obtained the Ceylon Medical College Council (CMCC) accreditation for our Diploma program. Then the DLTC Course was upgraded to a "Diploma in Laboratory Technology" (DLT) in the year 2018 to cover 60 credits. This recognition was gained as a result of the collective efforts of many well-wishers. DLT course has three specializing fields; Medical Laboratory Technology (MLT), Clinical Laboratory Technology (CLT), and Food and Material Technology (FMT).

So far we have produced more than 1630 diplomates since 1973. After completion of the diploma, most of our students have started working in Clinical as well as Industrial laboratories in both government and private sectors. Some of them have started higher studies in different streams and today some are even graduating as Graduate Chemists.

Life ahead will not be easy. The foundation that you will receive from the IChemC will help you build your career to move forward with dedication and courage. You will come across situations where you have to take crucial decisions. Stick to your ethics, follow the right pathway, and make your family and IChemC proud.

Mr. E G Somapala
B.Sc. (Peradeniya), M.Sc. (Strathclyde), C.Chem., F.I.Chem.C.
Director, Diploma in Laboratory Technology

Institute of Chemistry Ceylon

The Institute of Chemistry Ceylon is the successor to the Chemical Society of Ceylon (founded in 1941) and was established in the year 1971 for the general advancement of the science and practice of chemistry. It is a not-for profit organization, learned society catering to the Chemical Sciences as well as a professional, qualifying and examination body looking after and responsible for the maintenance and enhancement of the profession of Chemistry in Sri Lanka. It is the oldest such body in any branch of the basic sciences in Sri Lanka. The Golden Jubilee of the Institute was held in 1991 & the Diamond Jubilee in 2001. The 75th Anniversary falls on 25th January 2016.

The Institute of Chemistry Ceylon was incorporated by Act of Parliament No. 15 of 1972 with the following aims and objectives: -

(a) to promote and advance the science of Chemistry and its applications in Sri Lanka;

(b) to advise the Government, and give counsel to public corporations, local bodies and other institutions on all matters connected with the application of Chemistry to the progress and development of the country;

(c) to promote the acquisition, dissemination and interchange of chemical knowledge by:-providing a forum for the presentation of original communications and discussions thereon; establishing and maintaining libraries; publishing matters of interest to the profession of chemistry & any other means;

(d) to promote education in chemistry at all levels;

(e) to promote, encourage and foster original research in Chemistry;

(f) to assess the eligibility of candidates for admission to the various grades of membership;

(g) to conduct or provide for the conduct of the qualifying examinations for all grades of membership of the Institute and to promote, provide or approve programmes of study for such examinations;

(h) to conduct or provide for the conduct of examinations for the award of diplomas, certificates and other distinctions, in such branches of Chemistry as the Institute may from time to time, deem necessary and to prescribe, approve or provide programmes of study for such examinations;

(i) to ensure the maintenance of high standards in the professional activities and the general conduct of its members;

(j) to establish liaison with other scientific and professional organizations;

(k) to establish and enhance the status of the profession of Chemistry in Ceylon;

(l) to take any other measures that may be necessary for the attainment of all or any of the objectives of the Institute.

The Institute was declared as an approved charity by an Order published by the Hon'ble Minister of Finance in the Government Gazette No. 121 of 26.12.80. Donations made by any institution or individual to the Institute of Chemistry Ceylon, are therefore deductible from the assessable income of such institution or individual for income tax purposes.

College of Chemical Sciences

The College of Chemical Sciences (CCS) was established in January 2001 during the Diamond Jubilee celebration of the Institute of Chemistry Ceylon on 25-01-2001. As per By-Law 15 of the Institute of Chemistry Ceylon, the College of Chemical Sciences was established to conduct all the educational and training activities of the Institute. Any recommendations made by the Academic Board of CCS is approved by the Academic Board of the Institute of Chemistry Ceylon, which is governed by the Council of the Institute.

Day to day administration is carried out by a full-time Dean also appointed by the Council. Full time Academic Staff Members constitute the internal academic staff (page 8) while the Teaching Assistants constitute the internal Academic Support Staff. The administrative staff is headed by the Registrar of the College. A Librarian & Assistant Librarians are in charge of the Library. A number of other full time non-academic staff comprise the balance staff. A number of Visiting Academics drawn from Universities, research institutes, and service organizations and well as the private sector also assist in carrying out the day to day teaching activities of the College.

As per By–Law 15.1 of the Institute, the functions of the College are:-

(a) to conduct post-secondary, Graduateship, Diploma and Certificate courses in the Chemical Sciences

(b) to promote education in and application of Chemistry at levels

(d) to initiate research activities in collaboration with Universities, Industry and foreign Institutions

(e) to establish library facilities including database access and technology information

(f) to conduct refresher/in-service/training courses for scientists and teachers

(g) to assist industry in product development, problem solving, quality improvement and product diversification

(h) to encourage staff exchange between the College and the Universities/ Research Institutes in Sri Lanka and overseas.

(i) to publish journals/monographs etc., to disseminate the latest know how in the Chemical Sciences

(j) to take any measures that may be necessary for the attainment of the educational goals of the Institute

Academic Board of the Institute of Chemistry Ceylon

A statutory committee known as the Academic Board of the Institute of Chemistry Ceylon is appointed by the Council annually to promote, conduct and co-ordinate all the education, training, and academic affairs of the College of Chemical Sciences. All the formal educational programmes are the immediate responsibility of this committee which is chaired by the President of the Institute, and includes the Dean as the Vice Chairman, Secretary for Educational Affairs as the Secretary of the Academic Board of IChemC, Senior Assistant Registrar or Assistant Registrar as the Assistant Secretary. Two representatives of the Academic Board of CCS also constitute this committee. The Heads of Departments of CCS and full-time visiting professors, one of the Honorary Secretaries of the Institute, the Chairman of the Admissions & Ethical Practices Committee of the Institute and the Institute's Honorary Treasurer are appointed as ex-officio members of the Academic Board. In addition, the Board consists of eleven elected members, and also comprises of the Registrar of the Institute and the Librarian as representatives of the administrative staff. Additional members can be co-opted as required.

The Academic Board of the Institute of Chemistry Ceylon has the following powers, duties and functions as per by – law 15.4

(a) to recommend to the Council names to fill vacancies that may arise from time to time in the Academic Board of the Institute of Chemistry Ceylon .

(b) to have the right to co-opt additional members (Corporate or non-Corporate) for the purpose of effectively carrying out its powers, functions and duties subject to Council approval being obtained. Such persons co-opted have no voting rights and could be excluded from any meeting or part of a meeting if such an exclusion is deemed fit in the opinion of the Academic Board of the Institute of Chemistry Ceylon.

(c) to conduct the functions of the College as set out in by –law 15.1

(d) to have powers to conduct or provide for the conduct of examinations for the award of diplomas, certificates and other distinctions in such branches of Chemistry as the Institute may from time to time deem necessary and to prescribe, approve or provide courses of study for such examinations.

(e) to inform the Council on all matters concerning courses of study and examinations conducted, sponsored or approved by the Institute, including the appointment, reprimandment, suspension or dismissal of students, examination candidates and other personnel associated with such courses of study and examinations except examiners and lecturers.

(f) to recommend to the Council any

reprimandment, suspension or dismissal of examiners and lecturers.

(g) to recommend to the Council for the award of educational qualifications, awards and other distinctions.

(h) to conduct examinations for outside institutions including government departments, when requested on a payment of fees.

(i) to submit an Annual Report to the Council by such date as determined by the Council.

(j) to form and revise regulations governing courses and examinations of the Institute, and shall inform the Council on all such instances.

(k) to meet within a month of its appointment and thereafter at intervals not exceeding two months. The quorum for such meetings shall be seven.

(l) to have the right to decide on the utilization of the funds in the name of the College in such a manner as to promote the duties and functions of the College of Chemical Sciences, subject to approval of the Council being obtained.

Academic Board of the College of Chemical Sciences

The Academic Board of College of Chemical Sciences is appointed for formulating recommendations with regard to the educational and allied activities of the College. The Board is chaired by the Dean, and includes the Senior Assistant Registrar or Assistant Registrar as the Secretary. The elected members consist of all internal academics of CCS and five members representing visiting lecturers. In addition, two representatives of the Students' Association of CCS also constitute this committee.

The Academic Board of College of Chemical Sciences is chaired by the Dean, and includes the Senior Assistant Registrar or Assistant Registrar as the Secretary. The elected members consist of all internal academics of CCS and five members representing visiting lecturers. In addition, two representatives of the Students' Association of CCS also constitute this committee.

PREAMBLE

Formal Educational Programmes of the Institute of Chemistry Ceylon commenced in 1973 with the Laboratory Technicians' Certificate Course in Chemistry (LTCC). This course was organized to meet a pressing need to provide middle-level technical expertise in support of programmes involving "Chemical Analysis and Research". This is still the only such course available in any field of basic science in Sri Lanka.

The Laboratory Technicians' Certificate Course was upgraded to a Diploma Programme in 1998 and the programme was renamed "Diploma in Laboratory Technology in Chemistry" (DLTC). The course content was suitably expanded and revised. The first DLTC programme which commenced in August 1998 was completed in February 2000. The DLTC Course was upgraded to a "Diploma in Laboratory Technology" (DLT) in the year 2018 to cover 60 credits. The DLT programme now commences in January each year. The programme runs for approximately 2 years with students acquiring knowledge and analytical skills in Basic Chemistry, Clinical Chemistry, Analytical Chemistry, Industrial Chemistry, Biological Chemistry, Food Chemistry, Food Technology. Electronics, Statistics, Management, Information Technology, and Laboratory Practice. During the 2nd year, students have the opportunity to specialized in Food and Material Technology (FMT) OR Clinical Laboratory Technology (CLT) / Medical Laboratory Technology (MLT).

The LTCC/DLTC programmes were conducted at the premises of Aquinas College, Colombo until November 2006 (1st to 32nd batch). The programme for the 33rd batch commenced, at Adamantane House in Rajagiriya in November 2005, with the administration also being conducted by the College of Chemical Sciences. The 34th batch was admitted in November 2006 to the same venue. Since moving to Adamantane House, the enrollment has increased considerably.

The Diploma programme is designed to provide school leavers a technical, job-oriented programme. It would also serve to improve the knowledge and skills of those already employed as technicians in laboratories. Those who complete this programme successfully are entitled to follow the Graduateship Programme in Chemistry conducted by the College of Chemical Sciences, Institute of Chemistry. This programme is carried out entirely in the English medium.

RECOGNITION OF THE COURSE

The Diploma in Laboratory Technology qualification carries much weight as a certificate issued by a professional body. Further, recognition is given to the Diploma in Laboratory Technology Certificate by some public sector and private sector organizations who pay the fees of their employees and also give increments and other credit for employees who successfully complete the course.

The following benefits are provided by the Institute of Chemistry Ceylon to holders of the Diploma in Laboratory Technology Certificate.

1. Admission to the Graduateship Programme in Chemistry to in lieu of the normal requirement of three GCE (A/L) passes.
2. Students with an Honours pass at the overall DLT Examination are entitled to a scholarship to follow the Graduateship Programme in Chemistry. The scholarship includes a waving of the tuition fees (theory) of the first two years (Levels 1 & 2) of the Graduateship Programme in Chemistry.
3. Those who complete the DLT programme are required to become TECHNICIAN members of the Institute for life. They are entitled to use the designation Tech.I.Chem.C. after their names.
4. Those having a pass at the Graduateship (Levels 1 & 2) Examination and an Honours/ Merit pass at the DLT Examination are also entitled to Licentiate Membership of the Institute after sufficient experience in the Chemical Sciences.
5. Those having a DLT pass and have been a technician member of the Institute of Chemistry Ceylon for not less than 8 years and have adequate experience in the Chemical Sciences are eligible to obtain Licentiate Membership (L.I.Chem.C.) of the Institute which is normally open to those having a B.Sc. (3 years) degree including Chemistry as a subject.

ENTRY QUALIFICATIONS

Diploma in Food and Material Technology (FMT) and Diploma in Clinical Laboratory Technology (CLT)

The following entry criteria have to be satisfied to enroll in the DLT programme and subsequently at the FMT/CLT programmes.

- Should have followed the GCE Advanced Level examination in the Science Stream with Chemistry as a subject.

  AND

- Should have passed six subjects in one sitting, with credit passes for Mathematics and Science at the G.C.E. (O/L) examination, and should have passed English Language in not more than two sittings.

Diploma in Medical Laboratory Technology (MLT) Stream

To follow the MLT programme, the following criteria have to be satisfied.

- Should have passed six subjects with credit passes in Mathematics and Science at the G.C.E. (O/L) examination in one sitting and should have passed English Language in not more than two sittings.

  AND

- Should have passed any two subjects from among Physics, Biology, Agriculture, and Combined Mathematics in one sitting, with a credit pass for Chemistry in one sitting at the G. C. E. (A/L) Examination.

  AND

- Should be not less than 18 years or more than 35 years of age as of first day in January each year.

Note: Only those who qualify in the MLT stream shall be eligible to apply for MLT registration.

Opportunities

After successful completion of the programme, diplomates could be,

- Recruited as a qualified middle-level technician (technical officer) by private and public sector organizations;
- Admitted to the Institute of Chemistry Ceylon as a Technician member;
- Enrolled into the GIC programme and can get qualified as a Graduate Chemist within four years, even without A/L qualifications.

REGISTRATION OF STUDENTS

Students are selected by the College of Chemical Sciences after an interview of applicants.

COURSE MODULES

THE COURSE CONSISTS OF MODULES AS GIVEN BELOW

1st Year -
14 General Modules

Subject Code	Subject	Credits
G 1	Basic General Inorganic Chemistry	2
G 2	Basic Physical Chemistry	2
G 3	Basic Organic Chemistry	2
G 4	Analytical Chemistry I	2
G 5	Analytical Chemistry II	2
G 6	Analytical Chemistry III	2
G 7	Laboratory Practice	1
G 8	Basic Biological Chemistry I	2
G 9	Basic Biological Chemistry II	2
G 10	Basic Electronics	2
G 11	Basic Mathematics	2
G 12	Basic Statistics	2
G 13	Introduction to Information Technology	2
G 14	Introduction to Management	2

2nd Year -

Special Modules for Medical Laboratory Technology (MLT)

14 Special Modules

Subject Code	Subject	Credits
MLT 1	Introduction to Medical Laboratory	2
MLT 2	Clinical Biochemistry I	2
MLT 3	Clinical Biochemistry II	2
MLT 4	Diagnostic Microbiology	2
MLT 5	Diagnostic Parasitology	2
MLT 6	Clinical Haematology I	2
MLT 7	Clinical Haematology II	3
MLT 8	Clinical Biochemistry III	2
MLT 9	Clinical Biochemistry IV	3
MLT 10	Toxicology and Molecular Diagnostics	2
MLT 11	Histopathology and Cytology	2
MLT 12	Quality Assurance and Accreditation	2
MLT 13	Laboratory Practice	1
MLT 14	Clinical Laboratory Training (6 months)	6

2nd Year -

Special Modules for Clinical Laboratory Technology (CLT)

14 Special Modules

Subject Code	Subject	Credits
CLT 1	Introduction to Medical Laboratory	2
CLT 2	Clinical Biochemistry I	2
CLT 3	Clinical Biochemistry II	2
CLT 4	Diagnostic Microbiology	2
CLT 5	Diagnostic Parasitology	2
CLT 6	Clinical Haematology I	2
CLT 7	Clinical Haematology II	3
CLT 8	Clinical Biochemistry III	2
CLT 9	Clinical Biochemistry IV	3
CLT 10	Toxicology and Molecular Diagnostics	2
CLT 11	Histopathology and Cytology	2
CLT 12	Quality Assurance and Accreditation	2
CLT 13	Laboratory Practice	1
CLT 14	Clinical Laboratory Training (6 months)	6

2nd Year -

Special Modules for Clinical Laboratory Technology (CLT)

14 Special Modules

Subject Code	Subject	Credits
FMT 1	Fundamentals of Chemical Engineering	2
FMT 2	Food Chemistry, Food Additives, Food Contaminants, Food Spoilages and Food Preservations	3
FMT 3	Food Processing (Plant Origin)	2
FMT 4	Food Processing (Animal Origin)	2
FMT 5	Food Microbiology	2
FMT 6	Food Analysis	2
FMT 7	Polymer Science and Petroleum	2
FMT 8	Industrial Chemistry I	3
FMT 9	Industrial Chemistry II	2
FMT 10	Occupational Health, Safety, Pollution & Waste Management and Environmental Chemistry	2
FMT 11	Pharmaceutical and Cosmetic Technology	2
FMT 12	Quality Assurance and Accreditation	1
FMT 13	Laboratory Practice	1
FMT 14	Food Industrial Training (6 months)	6

GENERAL MODULES (14)
(common to all students)

G 1 – BASIC GENERAL AND INORGANIC CHEMISTRY (30 hrs)

Competencies and Descriptions:

This module is designed to explain the fundamentals of General and Inorganic chemistry.

Learning Outcomes:

At the end of this module students will be able to:

- explain the physical quantities and SI units
- describe the matter, atomic structure, electronic configuration, and other relevant rules
- describe the Periodic Table of elements and their behavior
- describe the formation of various chemical formulae
- explain the chemical reactions and redox reactions
- explain the inter-molecular and intra-molecular forces and coordination complexes

Important pertinent content (knowledge):

- Physical quantities; their interrelationships and SI units
  - ❖ Basic quantities, derived quantities, unit prefixes, basic calculations
- Description of matter
  - ❖ States of matter, physical properties of matter
- Atomic structure and electronic configuration
  - ❖ Introduction of atomic structure, Bohr model and postulates, Quantum numbers, Hund's rule, Pauli's exclusion principle, Aufbau principle
- Periodic Table of elements
  - ❖ Effective nuclear charge, shielding effect, atomic radius, ionic radius, ionization energy, electron affinity
  - ❖ s - block: hydration enthalpies, melting points, reactions with oxygen, hydrogen, and chlorine, thermal stability, characteristic flame colors
- Chemical formulae
  - ❖ Empirical formulae, molecular formulae
- Chemical equations and Redox reactions
  - ❖ Balancing acid-base equations, balancing redox reactions
- Bonding chemistry, electronegativity, and dipole moments
  - ❖ Lewis structures, ionic bonds, covalent bonds, bond length, electronegativity, dipole moments
- Resonance
- VSPER theory and molecular shapes
- Intermolecular and intra-molecular forces

- ❖ Van der Waals interactions, dipole-dipole interactions, ion-dipole interactions, hydrogen bonding
- Coordination complexes
  - ❖ Introduction & definitions, ligands, coordination number, nomenclature

Important pertinent skills:

Knowledge in fundamental physical chemistry is required for a laboratory technician.

Teaching methods:

- Lecture /Presentations
- Group problem-solving activities

Assessment: End Semester Exam (SEQ)

References:

- Lee, J., 2009. *Concise Inorganic Chemistry*. Oxford: Blackwell Science
- Atkins, P., Overton, T., Rourke, J., Weller, M., & Armstrong, F. 2010. *Shriver & Atkins' Inorganic Chemistry*. Oxford: Oxford University Press.

G 2 – BASIC PHYSICAL CHEMISTRY (30 hrs)

Competencies and Descriptions:

This module is designed to explain the fundamentals of physical chemistry including units and dimensions, states of matter, basic electrochemistry, and heat transfer.

Learning Outcomes:

At the end of this module students will be able to:

- make use of dimensional analysis and unit conversions in scientific equations.
- solve problems using gas laws.
- explain the basics of the kinetic theory of gases.
- describe phase equilibria involved in two and three-component systems.
- identify the basic functions of electrochemical cells.
- restate fundamentals of heat transfer

Important pertinent content (knowledge):

- Units and dimensions:
  - ❖ Fundamental dimensions and derived dimensions, dimensional analysis, SI units, British gravitation units, prefixes, and unit conversions.
- Concentration units:
  - ❖ Molarity, molality, normality, weight and mass percentages, weight by weight, weight by volume, volume by volume units, parts per million, billion, and trillion units.
- Gaseous State:
  - ❖ Ideal and real gasses, gas laws, kinetic molecular theory of gasses, Maxwell-Boltzmann distribution.
- Liquid state:
  - ❖ Viscosity, surface tension
- Electrochemistry:
  - ❖ Electrochemical cells, thermodynamics of cells, electrolytic cells, conductance
- Phase equilibria:
  - ❖ Two-component systems, three-component systems, Henry's law, steam distillation, fractional distillation
- Heat transfer:
  - ❖ Heat capacity, specific heat capacity, latent heat, calculations related to heat transfer

Important pertinent skills:

Knowledge in fundamental physical chemistry is required for a laboratory technician.

Teaching methods:

- Lecture /Presentations
- Group problem-solving activities

Assessment: End Semester Exam (SEQ)

References:

- Mankad, T., 2017. *Master Book for Physics*. Chapter 03.
- Goldsby, K.; Chang, R., 2015. *Chemistry*.
- Atkins, P.; De Paula, J.; Keeler, J., 2018. *Atkins' Physical Chemistry*. Oxford University Press:

G 3 – BASIC ORGANIC CHEMISTRY (30 hrs)

Competencies and Descriptions:

This module is designed to explain the principles of organic chemistry and the properties, synthesis, and reactions of major organic compounds.

Learning Outcomes:

At the end of this module students will be able to:

- Identify organic compounds in terms of the functional groups present
- correlate hybridization/ bonding to the nature of the functional group
- compose the structure of an organic molecule based on the IUPAC nomenclature and *vice-versa*
- identify possible arrangements of atoms in molecules having the same molecular formula
- correlate reaction mechanisms with bonding aspects of the functional group
- strategize synthetic pathways for the conversion of functional groups of aliphatic and aromatic compounds

Important pertinent content (knowledge):

- Introduction to Organic Chemistry
  - ❖ Review of general chemistry, atoms, bonds, and molecular geometry, electronegativity, formal charge, resonance structures
- Trivial names of common organic compounds, common names, IUPAC nomenclature
- Isomerism
  - ❖ Constitutional (structural) isomers - chain isomers, position isomers, functional group isomers
  - ❖ stereoisomers – diastereomers, enantiomers
- Hydrocarbons- classifications
- Alkanes
  - ❖ Types, nomenclature, physical properties, reactivity - reactions with free radicals
- Alkenes
  - ❖ Types, nomenclature, physical properties, reactions of alkenes - electrophilic additions as characteristic reactions of alkenes, the addition of hydrogen halides to simple alkenes and its mechanism, carbo-cations as reactive intermediates, the relative stability of primary, secondary and tertiary carbo-cations, anomalous behavior of HBr in the presence of peroxides (the mechanism is not necessary.), the addition of bromine to simple alkenes, mechanism of addition of bromine

to ethane, addition of sulphuric acid and the hydrolysis of the addition product, reaction with cold alkaline $KMnO_4$ (Baeyer's test), catalytic addition of hydrogen

- Alkynes
  - ❖ Nomenclature, preparation of alkynes by elimination reactions of dihalides, reactions of alkynes- addition reactions of HX and X_2, hydrations, reductions, oxidative cleavage, reactions of terminal alkynes with, Na or $NaNH_2$, ammoniacal CuCl, ammoniacal $AgNO_3$
- Aromatic hydrocarbons
  - ❖ Benzene and aromaticity, structure and stability of benzene, electrophilic aromatic substitution, bromination, the Friedel-Crafts reaction, substituent effects, oxidation of aromatic compounds, reduction reactions
- Alkyl halides
  - ❖ Nomenclature, properties of alkyl halides, their preparation from alkanes and alkenes, resonance stabilization, Grignard reagents.
- Alcohols and Phenols
  - ❖ Nomenclature, properties, preparation, alcohols from carbonyl compounds, reduction, Grignard reaction
- Ethers
  - ❖ Nomenclature, properties, reactions of ethers, acidic cleavage, ring opening
- Aldehydes and ketones
  - ❖ General reactions, preparation, nucleophilic addition reactions of aldehydes and ketones, nucleophilic addition of amines
- Carboxylic acids and their derivatives
  - ❖ Nomenclature, structure and properties, acidity, preparation, reactions, nucleophilic acyl substitution reactions, chemistry of acid halides, esters, amides
- Amines and amides
  - ❖ Nomenclature, structure and properties, basicity, synthesis, reactions
- Nitro compounds
  - ❖ Nomenclature, structure and properties, synthesis, reactions

Important pertinent skills:

Problem-solving in basic organic chemistry

Teaching methods:

- Lecture /Presentations
- Guided learning sessions

Assessment: End Semester Exam (MCQ/SEQ)

References:

- McMurry, J. E. *Organic Chemistry*. 8th ed. 2010. Cornel University.
- Carey, F. A., Giuliano, R. M. *Organic Chemistry*. 9th ed. 2014. New York, McGraw-Hill.
- Bruice, P. Y., *Essential Organic Chemistry*, 3rd ed. 2016. University of California, Santa Barbara. Pearson.
- Solomons, T. W. G., Craig B. F., 2016. *Organic chemistry*.

G 4 – ANALYTICAL CHEMISTRY I (30 hrs)

Competencies and Descriptions:

This module is designed to explain the fundamentals of basic analytical chemistry.

Learning Outcomes:

At the end of this module students will be able to:

- select a sample for given sets of data
- calculate mean, median, mode, Standard Deviation, and Error, and Selection of the most accurate and precise data
- balance the simple acid-base reaction formulae, calculate the initial pH, endpoint pH, final pH of titrations and sketch a titration curve
- select correct indicators for titrations and solve the problems based on acid-base mixtures
- calculate the formation constant, feasibility of a complex formation titration and solve the problems based on complex formation titrations
- calculate the oxidation numbers and balance the redox reactions based on the oxidation numbers. Solve the problems related to redox titrations.

Important pertinent content (knowledge):

- The evaluation of analytical data
  - ❖ Sample and population of data
  - ❖ Mean, median, mode, standard deviation, variance, and errors
  - ❖ Accuracy and precision of data
  - ❖ Problem-solving based on data analysis
- An introduction to titrimetric methods of analysis
  - ❖ Principles of titration
  - ❖ Strong acids and strong base
  - ❖ Weak acid and weak base
  - ❖ Mono-functional acid-base and polyfunctional acid base
  - ❖ Neutralization reactions
  - ❖ pH scale
- Acid-base titrations in aqueous medium and non-aqueous media
  - ❖ Acid-base titrations
  - ❖ pH curves
  - ❖ equivalence point pH and endpoint
  - ❖ The vertical portion of the titration curve and feasibility of acid-base titration

- ❖ Gibbs free energy change in an acid-base titration
- ❖ Selection of suitable indicators for titration and pKIn
- ❖ pKa, pKb, and pKw
- ❖ Titration of acid-base mixtures
- ❖ Problem-solving based on acid-base titrations

- Complex formation titrations
  - ❖ Principles of formation of complexes
  - ❖ EDTA titrations
  - ❖ Effect of pH on complex formation titration
  - ❖ Indicators for complex formation titrations
  - ❖ Feasibility of complex formation titrations
  - ❖ Formation constants
  - ❖ Problem-solving based on complex formation titrations
- Oxidation-Reduction titrations
  - ❖ Oxidation numbers of a compound
  - ❖ Oxidation and reduction based on oxidation numbers
  - ❖ Redox reactions
  - ❖ Balancing the redox reaction using oxidation number and inspection method
  - ❖ Problem-solving based on redox titration

Important pertinent skills:

Interpretation of laboratory results and technical validation.

Teaching methods:

- Lectures/Presentations/Video Lessons
- Guided learning sessions

Assessment: End Semester Exam (Structure Type)

References:

- Skoog, D.A., West, D.M., Holler, F.J., Crouch, S.R., 2014. *Fundamentals of Analytical Chemistry*.
- Skoog, D.A., West, D.M., Holler, F.J., Crouch, S.R., 2014. *Principles of Instrumental Analysis*, 6th ed, Thomson Brooks/Cole.
- Mendham, J., 2009. *Vogel's Textbook of Quantitative Chemical Analysis*, New Delhi: Pearson.

G 5 - ANALYTICAL CHEMISTRY II (PART A) (15 hrs)

Competencies and Descriptions:

This module is designed to explain the fundamentals of physical chemistry including titrimetric methods, gravimetric methods, and equilibrium chemistry.

Learning Outcomes:

At the end of this module students will be able to:

- describe the basic concepts of titrimetry, classification of titrimetry, and apply concepts to solve simple problems relating to titrimetry
- classify gravimetric methods and apply various gravimetric methods to practice
- understand the physical meaning of equilibrium and apply the rate law

Important pertinent content (knowledge):

- Overview of Titrimetry
  - ❖ Acid-Base titrations
  - ❖ Complexation titrations
  - ❖ Redox titrations
  - ❖ Precipitation titrations
- Gravimetric methods
  - ❖ Overview of gravimetric methods
  - ❖ Precipitation gravimetry
  - ❖ Volatilization gravimetry
  - ❖ Particulate gravimetry
- Equilibrium Chemistry
  - ❖ Reversible reactions
  - ❖ Chemical equilibria
  - ❖ Thermodynamics
  - ❖ Equilibrium chemistry
  - ❖ Equilibrium constants for chemical reactions
  - ❖ Le Châtelier's principle
  - ❖ Ladder diagrams

Important pertinent skills:

Knowledge in fundamental analytical chemistry is required for a laboratory technician.

Teaching methods:

Lecture /Presentations
Group problem-solving activities

Assessment: End Semester Exam (SEQ)

References:

- Atkins, P.; De Paula, J.; Keeler, J., *Atkins' Physical Chemistry*. 2018. Oxford University Press
- Skoog, D., *Skoog and West's Fundamentals of Analytical Chemistry*. 2018. Andover: Cengage Learning EMEA

G 5 - ANALYTICAL CHEMISTRY II (PART B) (15 hrs)

Competencies and Descriptions:

This module is designed to explain the principles of electroanalytical methods used in clinical and pharmaceutical analysis.

Learning Outcomes:

At the end of this module students will be able to:

- identify various electrical measurements and describe the principles in different electroanalytical techniques.
- outline the advantageous and disadvantageous of different electroanalytical techniques compared to other techniques.
- apply the principle behind calibration and standard addition methods used in electroanalytical techniques

Important pertinent content (knowledge):

- Electrodes and potentiometry:
  - ❖ Reference electrodes: calomel electrodes, silver/silver chloride electrodes
  - ❖ Indicator electrodes: metallic indicator electrodes; metal electrodes of the first kind, second kind, and redox electrodes
  - ❖ Membrane electrodes
  - ❖ Ion-selective electrodes
  - ❖ Response and selectivity of ion-selective electrodes; glass electrodes, solid-state electrodes, liquid-liquid electrodes;
- Direct potentiometric measurements; Potentiometric titrations,
- Electro-gravimetry and coulometric methods of analysis:
  - ❖ Current-voltage relationship during electrolysis,
  - ❖ Coulometry: Controlled working electrode potential coulometry, coulometric titrations, mediators
- Conductometry
- Polarography and Voltammetric Methods of Analysis
  - ❖ Classical polarography: diffusion current, residual current and limiting current, half wave potential, voltammetry

Important pertinent skills:

Calibration and principles of electroanalytical devices and interpretation of laboratory results and technical validation.

Teaching methods: Lecture /Presentations

Assessment: End Semester Exam (SEQ)

References:

- Skoog, D. A., West, D. M., Holler, F. J. 1992. *Fundamentals of Analytical Chemistry*, Saunders College Publishing New York.
- Plambeck, J. A., Somerset, N. J. 1982. *Electroanalytical Chemistry: Basic Principles and Applications*, New York: Wiley.
- Crow, D. R., 1992. *Principles and Applications of Electrochemistry*. Blackie Academic Glasgow.

G 6 – ANALYTICAL CHEMISTRY III (30 hrs)

Competencies and Descriptions:

This module is designed to learn the principles of chromatography, absorptiometry, and their applications.

Learning Outcomes:

At the end of this module students will be able to:

- understand the separation techniques and chromatography
- describe the different types of chromatographic techniques and their applications
  e.g., paper, thin layer, GCMS, HPLC
- understand the absorption techniques in molecular spectroscopy
  e.g., visible and ultraviolet spectroscopy
- describe the applications of UV-Visible spectroscopy
- outline the basic principles involved in Atomic absorption and flame emission spectroscopy
- understand the applications of AA and AES, ICPMS

Important pertinent content (knowledge):

- Separation techniques
- Basic principles of chromatography;
- Gas Chromatography
- Mass Spectroscopy, High-Performance Liquid Chromatography
- Sample preparation for chromatography
- Applications of chromatographic techniques
- Basic principles of molecular spectroscopy;
- IR Spectroscopy, UV-Visible Spectroscopy
- Basic principles of Atomic Spectroscopy;
- Atomic Absorption Spectroscopy, Flame Photometry
- Application of knowledge in Atomic Absorption Spectroscopy and Flame Photometry

Important pertinent skills:

Application of knowledge in an analytical laboratory to carry out the determination of various chemical components including detection of colouring matters, identification of oils and fats, determination of heavy metals, pesticide residues

Teaching Methods:

- Lecture/Presentations
- Handouts/documents
- Demonstrations of the equipment involved

Assessment: End semester examination (MCQ/SEQ)

References:

- Atkins, P.; De Paula, J.; Keeler, J., *Atkins' Physical Chemistry*. 2018. Oxford University Press
- Skoog, D., 2014. *Skoog and West's Fundamentals of Analytical Chemistry*. Andover: Cengage Learning EMEA

G 7 – LABORATORY PRACTICES (45 hrs)

Competencies and Descriptions:

This module is designed to learn skilled laboratory technicians by giving the practical experience in general laboratory practices including laboratory safety and management.

Learning Outcomes:

At the end of this module students will be able to:

- identify all the glassware and be familiar with the handling techniques, operation of analytical balance, pH meter, melting point apparatus
- prepare bench reagents and standardize solutions
- perform acid-base, complexometric, redox, and iodometric titrations to determine the concentration of the respective unknown solution
- identify cations and anions using respective analytical methods
- carry out distillation and extraction techniques according to the requirement
- carry out applications of paper chromatography and colorimetry

Important pertinent content (knowledge):

- Glassware identification, handling, safety, and their applications
- Preparation of bench reagents – preparation of standard oxalic acid solution and preparation of a concentration series
- Standardization of unknowns by preparation of standard solutions – standardization of phthalic acid using standard NaOH solution
- Titrimetric methods
  - ❖ Strong acid – strong base titration (NaOH/HCl)
  - ❖ Weak acid – strong base titration (NaOH/H_2CO_3)
  - ❖ Complexometric titration (EDTA with Ca^{2+} /Mg^{2+})
  - ❖ Redox titrations ($KMnO_4$/Oxalic acid)
  - ❖ Iodometric titrations (I_2/$Na_2S_2O_3$)
- Colorimetry – determination of the concentration of an unknown by constructing a calibration plot
- Identification of cations and anions
  - ❖ Flame test – to identify cations
  - ❖ Semi-micro qualitative test – to identify anions
- Identification of organic compounds
- Identification of carbohydrates and amino acids
- Distillation techniques and its applications

- ❖ Simple distillation
- ❖ Fractional distillation
- ❖ Steam distillation

- Extraction techniques – isolation of caffeine from tea leaves and carry out qualitative tests
- Chromatographic techniques
  - ❖ Paper Chromatography – identifying the food colours present in ready to drink carbonated beverages
- Simple instrumentation techniques
  - ❖ Handling, measurement, maintenance, and safety of pH meter, melting point apparatus
- Laboratory safety and management
  - ❖ Equipment handling, safety, and storage of chemicals

Important pertinent skills:

Development of technical skills to work in a laboratory environment

Teaching Methods:

- Lecture/Presentations
- Demonstrations
- Small group discussions

Assessment: Practical Exam

References:

- Vogel, A., 1970. *Elementary Practical Organic Chemistry*. Londres: Longman.
- Vogel, A. and Svehla, G., 1997. *Vogel's Qualitative Inorganic Analysis*. Harlow: Addison, Wesley, Longman.

G 8 – BASIC BIOLOGICAL CHEMISTRY I (30 hrs)

Competencies and Descriptions:

This module is designed for students to understand the importance of cells and its components, nucleic acids, proteins, vitamins, and photosynthesis.

Learning Outcomes:

At the end of this module students will be able to:

- understand the basics of cell and cell components and their importance
- describe the importance of nucleic acids – their structure and function
- explain the replication, transcription, and translation of DNA
- describe the structure and function of amino acids and proteins
- understand enzymes – their function, kinetics, inhibition, and regulation

Important pertinent content (knowledge):

- Cell
  - ❖ Cell classification, components in each type, and their functions.
  - ❖ Differences and similarities of each cell type.
  - ❖ Structure of cell membrane and its functions.
  - ❖ Introduction to different types of transport through cell membrane – active, passive (simple diffusion and protein assisted passive diffusion), phagocytosis.
- Nucleic Acids
  - ❖ Common structure (nucleotide structure, phosphodiester bond, and directionality of the chain growth)
  - ❖ N-bases – purines and pyrimidines
  - ❖ The difference in the structure of DNA and RNA
  - ❖ Specifics of DNA structure
  - ❖ Complimentary base pairing of DNA including H-bonding
  - ❖ Reasons of DNA being double-stranded and having deoxy pentose sugar.
  - ❖ How DNA is packaged in the cell – bacteria vs human
  - ❖ Introduce the gene structure.
  - ❖ Types of RNA, their structure, and functions.
  - ❖ DNA replication
    - part in the cell cycle in which DNA replication occurs
    - overview of replication – introduce parental and daughter
    - DNA, semiconservative replication, leading strand, lagging strand, Okazaki fragments, the directionality of chain growth

- major components of the replication
- replication initiation of E. coli – binding initiator proteins to the replication origin (AT rich regions) followed by binding of helicase and its function, introduce single stranded proteins and its function,
- how RNA primer is synthesized in replication initiation – need of a primer for DNA polymerase, why DNA polymerase cannot initiate DNA replication, introduce primase and its function, the first two nucleotides are purines in this primer,
- length of the primer
- introduce topoisomerase and its function
- DNA replication elongation process- introduce DNA polymerase and its function, elongation in the leading strand, elongation in the lagging strand (how Okazaki fragments are formed with a primer in each and create gaps between the fragments), introduce ligase and its function, removal of RNA primer
- Details of DNA polymerase structure – three active sites and their functions, proofreading mechanism, introduce exonuclease and its function.
- k. DNA replication termination – how gaps are closed, introduce ligase and its function, removal of RNA primer using DNA polymerase, and addition of DNA nucleotides using ligase

❖ Transcription
- introduce more details of a gene (enhancer site, promoter site, and open reading frame, and how each of these areas is located in prokaryotes, fungi, and humans)
- discuss the location of transcription in bacteria and eukaryotes
- discuss the directionality of synthesis and DNA template for mRNA
- transcription initiation of E. coli – binding of RNA polymerase and synthesis of mRNA
- transcription initiation of eukaryotes – how enhancer region and promoter regions come closer by binding of initiation factors and formation of the DNA loop followed by binding of RNA polymerase to the TATA promoter site and forms preinitiation complex
- elongation and termination of mRNA synthesis
- structure of crude mRNA, why crude mRNA needs protection before coming into the cytosol in eukaryotes, three post-transcriptional modifications

❖ Translation
- Introduce ribosomes, three sites in ribosomes, details of tRNA, codon, and anticodon, and discuss the codon chart including one start codon and three

stop codons
    - Translation initiation – the difference in initiation in bacteria and eukaryotes
    - Details of translation initiation in eukaryotes – 5' cap-dependent initiation
    - Translation elongation – details of the formation of the polypeptide chain using the mRNA code, formation of peptide bond using peptidyl transferase
    - Translation termination and structure of crude polypeptide chain
    - Transport of crude polypeptide chain into rough ER for post-translational modifications
    - Discuss different post-translational modifications and the importance of those – phosphorylation, glycosylation, disulfide bond formation, acetylation, ubiquitination

- Amino Acids and Proteins
    - ❖ Introduction – need of protein to the cell, digestion in general, different food sources
    - ❖ Amino acids – structure, classification of natural amino acids, essential amino acids, ionization, isoelectric point, peptide bond
    - ❖ Proteins
        - Primary structure
        - Secondary structures – alpha helix and beta sheets, backbone H-bonding
        - Super secondary structure – beta-hairpin, Greek key beta-barrel, zinc finger motif, coiled-coil, helix-turn-helix, beta-alpha-beta TIM barrel – structure and function
        - Tertiary structure and its stabilizing force – H-bond, electrostatic interactions, Van der Waals forces, and disulfide bonds formed from side chains
        - Quaternary structure
        - Different parts of a protein – specifics of the binding site, surface, inner part, the interface of a multi-subunit protein
        - Classes of proteins – globular, fibrous, and membrane proteins. Their shape structure, solubility, stability, and functions are discussed
        - Protein denaturation – what is denaturation and factors that affect denaturation
    - ❖ Enzymes
        - Introduction, biological uses, industrial uses
        - Enzyme classification – only the six main classes
        - The general structure of an enzyme
        - Proposed mechanisms for enzyme activity – lock and key model and induced fit model
        - Cofactors – prosthetic groups and coenzymes
        - Factors affecting the enzyme activity – temperature, pH, substrate

concentration, enzyme concentration
    - Enzyme kinetics for a single substrate reaction – introduce Michaelis-Menten kinetics and equation, steady state assumption, discuss the importance of each parameter in the equation, importance of Km, Lineweaver-Burk plot
    - Inhibitors for Michaelis-Menten kinetics – Competitive and non-competitive inhibition and drugs used as inhibitors
    - Regulation of enzyme activity – zymogen activation, feedback inhibition, allosteric regulation, covalent modification (discuss very briefly and provide specific examples)
    - Gel electrophoresis for proteins – SDS-PAGE
- Vitamins
    - ❖ Water soluble vitamins –
        - Vit B – associated coenzymes, biochemical function, and deficiencies
        - Vit C – structure, biochemical function, and deficiencies
    - ❖ Fat-soluble vitamins
    - ❖ Vitamin A – structure, how it relates to vision, function, and deficiency
    - ❖ Vit. D, E, and K – general structures, food sources, biochemical functions, and deficiencies
- Photosynthesis
    - ❖ Introduction – a general overview of photosynthesis, a cross-section of a chloroplast, the difference between monocotyledon and dicotyledon plants and their leaf cross sections, the structure of chlorophyl
    - ❖ Light-dependent reaction – chlorophyll location, PS I, and II – briefly show their protein structure and binding sites (manganese site, chlorophyl site, and other cofactors), maximum wavelengths, absorption of sunlight by chlorophyll and electron excitation, water oxidation, formation of $NADPH_2$ and ATP through the electron transport chain
    - ❖ Light independent reaction – chlorophyl location, Calvin cycle, and glucose synthesis, a problem with ribulose phosphate carboxylase, adaptation to overcome the problem, the difference between C3 and C4 reactions, C3 and C4 plant morphologies
    - ❖ Photorespiration – reactions and disadvantages to the plant

Important pertinent skills:

Develop the skills on basic components of the cell, DNA replication, the importance of amino acids, proteins, and vitamins, explain the mechanism of photosynthesis

Potentially useful teaching methods

- Powerpoint Presentations
- Handouts
- Discussions
- Tutorials

Assessments: Exam at the end of the module.

Useful references

- Alberts, B., 2008. *Molecular Biology of the Cell*. New York, Garland Science Taylor & Francis
- Nelson, M. C. D. 2008. Lehninger, *Principles of Biochemistry*, New York, W.H. Freeman, and Company

G 9 – BASIC BIOLOGICAL CHEMISTRY II (30 hrs)

Competencies and Descriptions:

This module is designed for students to gain knowledge about primary metabolic pathways, the biological importance of macro-nutrients, and secondary metabolites.

Learning Outcomes:

At the end of this module students will be able to:

- explain the importance of carbohydrates including structure and function
- describe the structure and function of lipids (fatty acids)
- explain primary metabolic pathways such as glycolysis, TCA cycle, electron transport chain, beta-oxidation of fatty acids, fatty acid synthesis, and HMP pathway
- describe the classes of secondary metabolites and their function

Important pertinent content (knowledge):

- Carbohydrates
  - ❖ Introduction – food sources, digestion, function
  - ❖ Classification – monosaccharides, disaccharides, and polysaccharides
  - ❖ Monosaccharides – structures of triose, pentose, and hexose, classification as aldose and ketose
  - ❖ Glucose and fructose – structure, carbon numbering, the difference in the main functional group, cyclization, stable forms, hemiacetal, anomeric carbon, alpha and beta structure, optical isomerism in general
  - ❖ Disaccharides – introduce glycosidic bonds (alpha and beta 1,4 and 1,6), the structure of maltose, lactose, and sucrose
  - ❖ Reducing and non-reducing sugars including the Benedict test
  - ❖ Polysaccharides – structure, function, and industrial uses of starch, glycogen, cellulose, inulin, chitin, and pectin, also discuss glycoproteins and peptidoglycans
- Lipids
  - ❖ Introduction – importance, function, food sources, digestion
  - ❖ Classification of lipids (fatty acids)
    - general structure and solubility
    - classification according to the chain length
    - classification according to the number of double bonds
    - compare the structure and melting points, trans fats
    - omega fatty acids
    - essential fatty acids

- ❖ Beta oxidation of fatty acids – very briefly since this is discussed in details under metabolism
- ❖ Naturally occurring fatty acids – triglycerides, phospholipids, and sphingolipids – general structure and biological importance. Saponification, hydrogenation, and hydrolysis of triglycerides.
- ❖ Glycolipids – structure and biological importance
- ❖ Lipid peroxidation and the dangers of resulting products
- ❖ Cholesterol – general structure and function
- ❖ Lipoproteins – HDL, LDL, VLDL, and chylomicrons (structure and function)

- Metabolism – Primary energy-yielding pathways
  - ❖ Introduction – need of energy to the cell, catabolism, anabolism, summary of central metabolic pathways, central metabolic molecule, energy molecule ATP (its structure and hydrolysis)
  - ❖ Glycolysis – cellular location, reactions in the pathway, irreversible and reversible reactions of the pathway, net ATP production
  - ❖ The fate of pyruvate under aerobic – TCA cycle
  - ❖ TCA cycle - cellular location, acetyl CoA synthesis, TCA cycle reactions, energy yield
  - ❖ Electron transport chain in brief – show the cycle
  - ❖ The fate of pyruvate under anaerobic conditions (yeast and bacterial fermentation)
  - ❖ Beta oxidation of fatty acids – cellular location, activation of fatty acids to cross the mitochondrial membrane, show the pathway reactions, calculate the number of acetyl CoA formed and number of ATP released, calculate how many oxidation cycles are needed to completely oxidize one fatty acid molecule
  - ❖ Fatty acid synthesis – cellular location, reaction pathway, regulation, and biological importance
  - ❖ HMP pathway – reaction pathway, regulation, and biological importance
- Secondary metabolites
  - ❖ Introduction
    - definition of secondary metabolites and uses in general
  - ❖ Terpenes, alkaloids, polyphenols, and flavonoids – general structure, chemical compounds for each group, uses for plants, uses for humans, plant sources

Important pertinent skills

Explaining the structure, function, and metabolic pathways of primary metabolites, classification of secondary metabolites, their structure, and function

Potentially useful teaching methods

- Powerpoint Presentations
- Handouts
- Discussions
- Tutorials

Assessments: Exam at the end of the module.

Useful references

- Alberts, B., 2008. *Molecular Biology of the Cell*. New York, Garland Science Taylor & Francis
- Nelson, M. C. D. 2008. Lehninger, *Principles of Biochemistry*, New York, W.H. Freeman, and Company

G 10 – BASIC ELECTRONICS (30 hrs)

Competencies and Descriptions:

This module is designed to explain the principles of electricity, the applications of passive and active electronic components, introduction to test and measuring instruments used in electronics.

Learning Outcomes:

At the end of this module students will be able to:

- describe the basic concepts of electricity and to read and identify the values of electronic components
- calculate biasing levels of electronic circuits by applying basic laws
- explain how to step down and step up transformers works
- design voltage regulator circuits
- describe methodologies used in circuit fault detection and troubleshooting
- state the capabilities of test and measuring instruments used in electronics

Important pertinent content (knowledge):

- AC theory and basic concepts in electricity
- Passive electronic components: resistors, capacitors, and inductors
- Diodes and their applications
- Bipolar junction transistor
- Test and measuring instruments
- Operational amplifiers
- Oscillators and different types of waveforms
- AC to DC conversion and power supplies
- Fault detection and maintenance of simple electronic equipment

Important pertinent skills:

Apply basic laws in electronics to design and analyze electronic circuits

Teaching methods: Lecture /Demonstrations

Assessment: End Semester Exam (MCQ)

References:

- Horowitz, P. and Hill, W. 2010. *The art of electronics*. Cambridge University Press.
- Sedra, A., Smith, K. 1987. *Microelectronic circuits*. New York: Holt, Rinehart, and Winston.

G 11 – BASIC MATHEMATICS (30 hrs)

Competencies and Descriptions:

This module is designed for students to gain knowledge in basic concepts of Mathematics and the applications of basic mathematics in solving problems in chemistry.

Learning Outcomes:

At the end of this module students will be able to:

- identify rational and irrational numbers
- solve the logarithms functions
- apply linear equations and graphs to solve problems in chemistry
- use calculus in solving problems in chemistry
- find maximum and minimum points in given functions

Important pertinent content (knowledge):

- Algebra
  - ❖ Multiplying, adding, subtracting algebraic expression
- Fractions
  - ❖ Simplifying, adding, and subtracting fractions, simple partial fractions
- Surds and Indices
  - ❖ Squares, cubes and other roots, rational numbers
- Quadric equations and simultaneous equations
  - ❖ Solving a quadric equation by factorizing
- Differentiation
  - ❖ The gradient of a curve, differentiation from the first principal, differentiation of a function product, and quotient
- Trigonometric Functions
  - ❖ Trigonometric ratios of 30^o, 45^o, 60^o, the sine, cosine, and tangent functions
- Straight lines
  - ❖ The standard form and the general form for the equation of a straight line
- Basic Integration
  - ❖ Integration as the reverse of differentiation, the sum of the difference of a function, integration of a product, and quotient
- Coordinate Geometry
  - ❖ Cartesian coordinates, the length, midpoint, and gradient of a line joining two points, parallel and perpendicular lines.

Important pertinent skills:

Gain knowledge in basic mathematics and their applications

Teaching Methods:

- Lecture/Presentations
- Handouts/documents
- Demonstrations of the equipment involved

Assessment: End semester examination

References:

- Bostock; L., Chandier, S., *Core Maths*
- Connelly, J. F., Fratangelo R. A., *Elementary Technical Mathematics with Calculus*

G 12 – BASIC STATISTICS (30 hrs)

Competencies and Descriptions:

This module is designed for students to gain knowledge in basic concepts in statistics and its applications.

Learning Outcomes:

At the end of this module students will be able to:

- apply statistical techniques to collect, organize and classify the data.
- draw Histogram, Frequency polygon curve
- measure central tendency and dispersion
- use Z- table and T- table
- evaluate errors in experimental measurements

Important pertinent content (knowledge):

- Data Collection and Histogram
- Collection of data, arranging the data, organizing, and classification of data, histograms
- Central Tendency and Dispersion
- Mean, median, mode, calculate mean and median of classified data, mean deviation, standard deviation, Relative standard deviation, and Coefficient of variation.
- Sample and Population
- Distribution Curve
- Normal distribution curve, Standard normal distribution curve, t- distribution curve, Use of Z and t- tables
- Errors
- Types of errors, how to minimize the measurements of errors in analytical chemistry
- Confidence limit, Confidence interval, and Confidence Level in different probability

Important pertinent skills:

Application of knowledge in an analytical laboratory to carry out the determination of various chemical components including detection of colouring matters, identification of oils and fats, determination of heavy metals, pesticide residues

Teaching Methods:

- Lecture/Presentations
- Handouts/documents

Assessment:

- Continuous Assignments
- End semester examination

References:

- Loyer, M. and Triola, M., 2007. Student's solutions manual to accompany elementary statistics, 10th ed. Boston: Pearson/Addison Wesley.
- Triola, M. and Iossi, L., 2014. Elementary Statistics. 13th ed. Pearson.

G 13 – INFORMATION TECHNOLOGY (30 hrs)

Competencies and Descriptions:

This module is designed to provide knowledge and skills in the latest developments in information technology.

Learning Outcomes:

At the end of this module students will be able to:

- identify computer hardware devices and software applications
- apply spreadsheets to perform calculations and draw graphs
- use MS Word to professionally typeset a document
- carry out a literature survey using Internet resources
- conduct group presentations using MS PowerPoint
- draw and visualize 2D and 3D chemical structures using computer software

Important pertinent content (knowledge):

- Introduction to computer hardware & software
  - ❖ Basic computer hardware components and their functions (e.g CPU, memory, hard disks, motherboard, input devices, output devices, etc)
  - ❖ Demonstrating the parts of a computer by opening a casing of a computer
  - ❖ Choosing specifications for a computer/laptop
  - ❖ Categorization of software (e.g. system software, application software, free software, open source software, proprietary software)
  - ❖ Introduction to computer networking and Internet
  - ❖ Internet Security
  - ❖ Introduction to latest developments in IT (e.g supercomputing, internet of things, artificial intelligence, augmented reality, etc)
- Word processing and report writing
  - ❖ Introduction of different features in MS word for word processing such as word styles, page layouts, page numbering, aligning, etc.
  - ❖ Designing a word template with an auto content page
  - ❖ Adding references and citations
- Making presentations using PowerPoint
  - ❖ How to make an effective presentation using MS Powerpoint
  - ❖ In-class PowerPoint presentation on the latest development of IT
  - ❖ Independently perform a literature search through the Internet
- Spreadsheet applications

- ❖ Introduction to spreadsheet applications using MS Excel and applications
- ❖ Basic MS Excel functions/formulas used in mathematics and statistics
- ❖ Performing basic descriptive statistics applications using MS Excel
- ❖ Drawing graphs, trend lines, and regression analysis using MS Excel

- Drawing molecules and molecular visualization
  - ❖ Drawing 2D chemical structures and reactions using Chemdraw software
  - ❖ Drawing 3D small molecular structures using Avergadro software
  - ❖ Visualizing biomolecular structures with VMD software and introduction to pdb files.

Important pertinent skills:

- Spreadsheet applications
- Presentation
- Teamwork
- Information literacy

Teaching methods:

- Lecture /Presentations
- Student group presentations
- Practical assignments

Assessment:

- End Semester Exam(MCQ/SEQ) – 75%
- PowerPoint presentation – 20%
- Assignments – 5%

References:

- Barrante, J. R. *Applied Mathematics for Physical Chemistry*. 03rd ed. 1974, Prentice-Hall, Inc
- Cramer, C. J. *Essentials of Computational Chemistry: Theories and Models*. 02nd ed. John Wiley & Sons, Ltd
- Jack, A. H., John, F. K., Gretchen, M. *Cases and Application in Microsoft Excel 5.0.* 1996

G 14 – INTRODUCTION TO MANAGEMENT (30 hrs)

Competencies and Descriptions:

This module is designed to explain the principles and essentials of Management and Business Environment, Business Communication, and the main areas in the management of Human Resources and Marketing.

Learning Outcomes:

At the end of this module students will be able to:

- define management and describe the functions of management
- learn the Relationship between the Management levels and skills/competencies
- describe an organization and the main functions of an organization
- describe the concepts applicable in organizing (unity of command, the span of control…)
- understand the organization chart and the bases of departmentalization
- explain a business and business environment
- carry out a SWOT and PEST analysis for any organization
- define Human Resource Management (HRM) and key result areas of HRM
- describe the essentials of basic labor law conditions in Sri Lanka under the main acts
- outline the difference between Recruitment and Selection
- explain the processes of Recruitment and Selection
- understand the importance of teamwork and team building
- define communication and modes of communication in an organization
- describe the various methods of communication practiced by organizations
- define marketing and the activities of marketing
- describe the 7 Ps in marketing
- understand the concepts of consumer buying behavior and the importance of Segmenting, Targeting, and Positioning (STP)
- outline the importance of International Marketing and the drivers of international marketing
- outline the entry strategies to international marketing
- understand the concepts of Entrepreneurship
- explain the functions, characteristics, and traits of a successful entrepreneur
- understand the importance of being an entrepreneur

Important pertinent content (knowledge):

- Functions of Management
- Basic functions of an organization

- Analyze the organization chart and the bases of departmentalization
- Determine micro/macro factors affecting an organization
- SWOT/PEST analysis
- Key result areas of HRM
- Teamwork/Team building
- Effective communication
  - ❖ Oral
  - ❖ Written
- Basic labor laws in Sri Lanka
  - ❖ Shop & Office Employees Act
  - ❖ Wages Board Ordinance
  - ❖ Maternity Benefit Ordinance
  - ❖ EPF/ETF Acts
  - ❖ Gratuity Act
- 7 Ps in Marketing
- Basics in International Marketing
- Entrepreneurship and the importance of entrepreneurship to Sri Lanka

Important pertinent skills:

Interpretation of basic concepts in Management, HR, Marketing, and Entrepreneurship

Teaching methods:

- Lecture /Presentations
- Guided learning sessions
- Group work
- Videos

Assessment: End Semester Exam (SEQ)

References:

- Drucker, P. *The Esssentials of Management*, 2008, Collins Business essentials
- Dessler, G. and Varkkey, Biju 2018. *Human Resource Management*, 15th edition
- Kottler, P. 2007. *Principles of Marketing* 11th Edition, Patience Hall of India
- Ratnayake, A. P. 2006. *Hand Book on Basic Labor Law* FCCISL, 1st edition
- Collins, J (2001). *Good to Great*. USA: Harper Collins Publishers.

SPECIAL MODULES (14)
Medical Laboratory Technology (MLT)

MLT 1 - INTRODUCTION TO MEDICAL LABORATORY (30 hrs)

Competencies and Descriptions:

This module is designed to help students to gain an understanding of the major processes taking place in a medical laboratory. It would also help in understanding the basic requirements when establishing a laboratory, working in a laboratory and the organizational structure of a medical laboratory. Students would also gain an understanding of the calculation in chemical pathology and basic clinical interpretation of common laboratory test results.

Learning Outcomes:

At the end of this module students will be able to:

- state the basic requirements of a clinical laboratory
- identify the common analytical techniques and instruments
- describe the standard operational procedures
- explain the pre-analytical, analytical, and post-analytical phases
- describe the laboratory automation, Laboratory Information Systems (LIS)
- describe the Internal Quality Control (IQC)
- describe the External Quality Assurance (EQA)
- describe the laboratory safety, Good Laboratory Practices, and Ethics
- explain the clinical utility of laboratory tests and interpret common laboratory test results
- describe the laboratory accreditation process

Important pertinent content (knowledge):

- Introduction to medical laboratory
- Meaning of common terminologies used in laboratory medicine
- Designing of a medical laboratory
- Major disciplines in laboratory medicine
- Organizational structure of a medical laboratory
- Role of a medical laboratory personnel
- Basic needs and requirements of a medical laboratory
    - ❖ Human resources
    - ❖ Physical requirements
    - ❖ Chemical requirements
    - ❖ Legal requirements
    - ❖ Different equipment and analyzers

- Testing process
  - ❖ Understand the testing process in a medical laboratory
  - ❖ Understand the three phases of laboratory testing
- Pre-analytical Phase
  - ❖ Define pre-analytical phase
  - ❖ List pre-analytical variables
  - ❖ Discuss the effects of pre-analytical variables on laboratory test results
- Analytical phase
  - ❖ Define the analytical phase
  - ❖ List the factors which affect the analytical phase and describe their effects on analytical procedures
  - ❖ Describe how to assure quality in the analytical phase
- Post-analytical phase
  - ❖ Define the post-analytical phase
  - ❖ Describe the technical and clinical validation of test reports
  - ❖ List and identify the significance of the information given in a test report
- Laboratory automation
  - ❖ Define automation
  - ❖ List the advantages of automation
  - ❖ Describe different analyzer types
  - ❖ Describe laboratory information systems
- Internal Quality Control (IQC)
  - ❖ Significance and essential components of an IQC programme
  - ❖ Set up an IQC programme
  - ❖ Ensuring the quality of test results by an IQC programme
- External Quality Assurance (EQA)
- Describe the value of EQA in a laboratory quality management system
- Laboratory safety, Good Laboratory Practices, and ethics
  - ❖ Code of conduct/ethics of medical laboratory professionals
    - Describe important ethical aspects related to laboratory personnel
  - ❖ Laboratory Safety
    - Describe general principles of ensuring safety in laboratories
    - List common hazards and describe precautions to avoid them
  - ❖ Clinical waste handling
    - List the categories of waste
    - Describe universal precautions
    - Describe how to handle sharps and sharp injuries
    - How to manage blood spills

Important pertinent skills:

- Identify the causes of erroneous test results
- Preventive actions
- Familiarization with different types of tests and clinical interpretation of common lab tests
- Implementation of safe and good laboratory practice
- Operation and maintenance of laboratory instruments and analyzers

Teaching methods: Lecture /Presentations

Assessment: End Semester Exam (Written)

References:

- Cheesebrough, M. 2005. *District Laboratory Practice in Tropical Countries*. 2nd ed. Cambridge University Press.
- Godkar, P. B., Godkar, D. P. 2014. *Text book of Medical Laboratory Technology.* 3rd ed. Bhalani Publishing House
- Burtis, C. A., Bruns, D. E. and Ashwood, E. R. 2007. *Tietz Fundamentals of Clinical Chemistry*. 6th ed. WB Saunders Co.

MLT 2 - CLINICAL BIOCHEMISTRY I (30 hrs)

Competencies and Descriptions:

This module is designed to help students to gain an understanding of the basic principles in acid-base imbalances, serum electrolytes, and diseases related to hemoglobin.

Learning Outcomes:

At the end of this module students will be able to:

- interpret the serum electrolyte analysis report
- differentiate clinical disorders associated serum electrolytes
- analyze the HPLC reports related to hemoglobinopathies
- compare the analytical techniques involved in electrolyte analysis and the possible errors
- explain the concept related to plasma osmolality and the relevancy of rehydration fluids
- interpret acid base data reports related to acid base imbalances

Important pertinent content (knowledge):

- Basic concepts of fluid and electrolyte balance
- Hypernatraemia and potassium disorders
- Determination of serum electrolytes
- Osmolarity measurements
- Basic concepts of acid-base balance
- Metabolic acid-base disorders, respiratory and mixed acid-base disorders
- Interpretation of acid-base data
- Oxygen transport and its disorders

Important pertinent skills:

Interpretation of laboratory results and technical validation.

Teaching methods:

- Lecture /Presentations
- Discussions
- Guided learning Sessions

Assessment: End Semester Exam(MCQ/SEQ)

References:

- Marshall, W. J. Bangert, S. K. and Lapsley, M. 2012. *Clinical Chemistry*. 7th ed. Elseveir.
- Burtis, C. A., Bruns, D. E. and Ashwood, E. R.2007. *Tietz Fundamentals of Clinical Chemistry*. 6th ed.WB Saunders Co.
- Fody, E. P., Schoeff, L. E.and Bishop, M. L.2009. *Clinical Chemistry*, Techniques, Principles, Correlations. 6th ed. Lippincott Williams & Wilkins.
- Khera, R., Singh, T., Khuana, N., Gupta, N. and Dubey, A. P. 2015. HPLC in Characterization of Hemoglobin Profile in Thalassemia Syndromes and Hemoglobinopathies: A Clinicohematological Correlation. *Indian Journal of Hematology Blood Transfusio*n, 31(1):110–5.
- B. D. Rose. and T. W. Post. 2001. *Clinical Physiology of Acid-Base and Electrolyte Disorders*. 5th ed. New York: McGraw-Hill Education.
- Cheesebrough, M. 2005. *District Laboratory Practice in Tropical Countries*. 2nd ed. Cambridge University Press.
- Godkar, P. B., Godkar, D. P. 2014. *Text book of medical laboratory technology*. 3rd ed. Bhalani Publishing House
- Chawla, R., 2014. *Practical clinical biochemistry: methods and interpretations*. 4th ed. New Delhi: Jaypee Brothers Medical Publishers.

MLT 3 - CLINICAL BIOCHEMISTRY II (30 hrs)

Competencies and Descriptions:

This module is designed to help students to understand the principles of urine and stool analysis, renal function tests, and interpretation of results.

Learning Outcomes:

At the end of this module students will be able to:

- differentiate normal urine from abnormal urine.
- explain the principles of biochemical investigations of urine and stool analysis.
- describe the biochemical investigations of renal function and understand the concepts of Glomerular filtration rate (GFR)
- interpret the results of urine and stool analysis and renal function tests.

Important pertinent content (knowledge):

- 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
  - ❖ Chemical analysis of urine
  - ❖ Microscopic examination of urine
  - ❖ Common pattern of abnormal urine composition in disease
  - ❖ Urinary tract infection and urine culture
- Examination of Stool
  - ❖ Collection of fecal specimens
  - ❖ Physical examination of stool
  - ❖ Microscopic examination of stool
  - ❖ Chemical examination of stool
- Investigations of Renal Function
  - ❖ Functions of the kidney
  - ❖ Tests of glomerular function, glomerular filtration rate, serum creatinine, blood urea, proteinuria
  - ❖ Investigations of tubular functions
  - ❖ Osmolality measurements in plasma and urine

- ❖ Water deprivation test
- ❖ Acid load test
- ❖ Proteinuria and Aminoaciduria

Teaching methods:

- Lecture /Presentations
- Demonstrations
- Handouts

Assessment: End Semester Exam (MCQ/SEQ)

References:

Gaw, A., Murphy, M.J., Srivastava, R., Cowan, R.A. and O'Reilly, D. St.J. 2015. *Clinical Biochemistry, An illustrated colour text*. 5th ed.ChurchilLiningstone/Elsevier.

MLT 4 - DIAGNOSTIC MICROBIOLOGY (30 hrs)

Competencies and Descriptions:

This module is designed to introduce infectious organisms and diagnose using different microbial techniques. It covers biology of bacteria, fungi, and viruses and the mechanisms of their pathogenicity. It will also provide opportunities for a student to develop both informatics and diagnostic skills in microbiology, including the practical application and interpretation of laboratory tests for the diagnosis of infectious diseases.

Learning Outcomes:

At the end of this module students will be able to:

- describe principles of microbial taxonomy, structure, physiology, immunology, and pathogenesis-related to human microbial pathogenesis
- develop a knowledge of microbial organisms and their relevance of infectious diseases
- explain the preparation of clinical specimens for laboratory identification
- describe the detection of sexually transmitted infections
- describe the theory behind immunological diagnostic testing and virological diagnostic testing
- apply knowledge gained in theory and technical skills to identify bacteria and fungi in the laboratory

Important pertinent content (knowledge):

- Introduction to medical microbiology and diagnostic microbiology
- Characteristics of bacteria, fungi, and viruses
- Basic cell structure of bacteria, fungi, and viruses
- Diverse groups of bacteria, fungi, and viruses
- Principles of immunology
- Infections, pathogenesis, and immune responses to microbial and viral infections
- Specimen collection, transport, and storage
- Bacterial diagnostic techniques
    - ❖ Laboratory identification and isolation of organisms for clinical specimens, urine culture, blood culture, puss culture, stool culture, CSF, respiratory tract
    - ❖ Biochemical identification of bacteria
    - ❖ Antibacterial susceptibility test (ABST)
- Molecular diagnostic techniques (PCR)
- Immunological diagnostic testing
- Virological diagnostic testing

- Detection of mycological infections
- Sexually transmitted infections detection
- Laboratory quality control

Important pertinent skills:

- Biology of microorganisms
- Pathogenicity & virulence factors
- Immune responses to microbial infections
- Laboratory identification of bacteria and fungi
- Immunological diagnostic techniques
- Safety procedures of handling samples
- Sterilization and aseptic procedures
- Waste disposal and management

Teaching methods:

- Lecture /Presentations
- Demonstrations
- Handouts

Assessment: End Semester Exam (MCQ/SEQ)

References:

- Greenwood, D., Slack, R., Barer, M. and Irving, W., 2012. *Medical Microbiology*. 18th ed. London: Churchill Livingstone.
- Pelczar, Jr. M. J., Chan, E. C. S and Kreig, N. R. 2006. *Microbiology*. 5th ed. New York: Mc Graw Hill Inc.
- Spicer, W. J., 2000. *Clinical Bacteriology, Mycology, and Parasitology: An Illustrated Colour Text*. London: Churchill Livingstone.
- Brooks, G., Carroll, K. C., Butel, J., Morse, S. and Mietzner, T. A., 2009. *Jawetz, Melnick, and Adelberg's Medical Microbiology*. 25th ed. New York: McGraw-Hill.
- Forbes, B., Sahm, D., and A., Weissfeld, 2007. *Bailey & Scott's Diagnostic Microbiology*. 12th ed. Elsevier.

MLT 5 - DIAGNOSTIC PARASITOLOGY (30 hrs)

Competencies and Descriptions:

This module is designed to introduce parasites and diagnose using different techniques. This provides opportunities for a student to develop both informatics and diagnostic skills in parasitology, including the practical application and interpretation of laboratory tests.

Learning Outcomes:

At the end of this module students will be able to:

- explain the basic principle of Parasitology and Entomology
- explain the basic principles of laboratory techniques in parasitology and entomology
- identify common parasites and understand their life cycles
- correlate clinical conditions in parasitology and entomology

Important pertinent content (knowledge):

- Classification of Parasites
  - ❖ Introduction and Classification
  - ❖ Identification of human parasites, their life cycles, and pathogenesis
- Specimen Collection and storage
- Detailed understanding of
  - ❖ Protozoa
  - ❖ Classification of Intestinal Protozoa,
  - ❖ Tissue Protozoa- Toxoplasma, Blood Protozoa, Blastocystatomysis
  - ❖ AIDS related Protozoa
  - ❖ Ciliates and flagellates
  - ❖ Helminths and Nematodes, Tissue Nematodes
  - ❖ Malarial parasites
  - ❖ Cestodes
  - ❖ Flukes (Blood and other)
- Diagnostic methods in parasitology
- Examination of stool
- Examination of blood
- Immunodiagnosis in parasitology
- Parasitic zoonosis
- Medical Entomology
  - ❖ Introduction to Entomology
  - ❖ Understanding of life cycles of

- Mosquitoes
- Flies
- Fleas
- Lice
- Bugs
- Ticks
- Mites

Important pertinent skills:

- Identification of the life cycle and different stages of the life cycle
- Correlate laboratory findings with clinical conditions
- Interpretation of laboratory findings
- Safety procedures of handling samples
- Sterilization and aseptic procedures
- Waste disposal and management

Teaching methods:

- Lecture /Presentations
- Demonstrations
- Hands-on sessions
- Handouts

Assessment: End Semester Exam (MCQ/SEQ)

References:

- Mehlhorn, H. 2001. *Encyclopedic Reference of Parasitology: Biology, Structure, Function*. 2nd ed. Berlin: Springer.
- Spicer, W. J., 2000. *Clinical Bacteriology, Mycology, and Parasitology: An Illustrated Colour Text*. London: Churchill Livingstone.
- Jayaram, C. K. and Paniker, M. D., 2013. *Paniker's Textbook of Medical Parasitology*. 7th ed. New Delhi: Jaypee Brothers Medical Publishers.

MLT 6 - CLINICAL HAEMATOLOGY I (30 hrs)

Competencies and Descriptions:

To have basic knowledge of the formation, structures, and functions of blood cells. To develop skills to perform basic hematological investigations.

Learning Outcomes:

At the end of this module students will be able to:

- describe the formation of blood cells & their functions.
- outline the specimen collection process for hematological investigations.
- describe the principles behind the anticoagulant action.
- describe sample storage, transport, and preparation for analysis in hematology.
- perform staining of blood film and identification of common staining problems and how to overcome these problems.
- perform basic hematological tests.
- Erythrocyte sedimentation rate (ESR), Packed cell volume (PCV), estimation of hemoglobin, manual FBC estimation, Automated FBC estimation, red cell indices & interpretation, WBC/DC manual DC & cell identification, Reticulocyte count & red cell inclusions, bleeding time, PT, APTT & TT.
- describe physiological changes in the blood.
- describe the possible pre-analytical, analytical & post-analytical errors in hematological investigations.

Important pertinent content (knowledge):

- Principles of hemopoiesis
  - ❖ Definition of hemopoiesis
  - ❖ Factors necessary for hemopoiesis
  - ❖ Sites of hemopoiesis
  - ❖ Functions of RBC, platelets & WBC
- Measures taken in specimen collection
  - ❖ Approach to phlebotomy
  - ❖ General rules & regulations
  - ❖ Assessing the situation & preparation
  - ❖ How to carry out the procedure
  - ❖ Sample storage, transport & preparation for analysis
  - ❖ Waste disposal
  - ❖ Rejection criteria

- ❖ Sample storage, transport & preparation for analysis
- Anticoagulants
  - ❖ Action
  - ❖ Specific indication for each type of anticoagulant
- Blood film preparation
  - ❖ Basic principles of staining
  - ❖ Reticulocyte preparation
  - ❖ Problem-solving in blood film preparation
- Basic haematology tests
  - ❖ Erythrocyte Sedimentation Rate
  - ❖ Pack Cell Volume
  - ❖ Manual estimation of Hb
  - ❖ Manual estimation of WBC/DC
  - ❖ Automated estimation of Hb
  - ❖ Red cell indices & cell identification
  - ❖ Reticulocyte count & red cell inclusions
  - ❖ Physiological changes in blood
  - ❖ Pre-analytical, analytical & post-analytical errors in hematology
- Physiological changes in blood
  - ❖ Changes of haematological parameters at birth, during adolescence & pregnancy
- Quality assurance in haematology
  - ❖ Basics of pre-analytical, analytical & post-analytical errors

Important pertinent skills:

- Staining blood films
- Perform basic laboratory investigations
- Interpreting basic laboratory investigations

Teaching methods:

- Lecture /Presentations
- Discussions
- Demonstrations
- Case-based learning
- Handouts

Assessment: End Semester Exam (Written)

References:

- Anderson, S. C. and Poulsen, K. B., 2003. *Anderson's Atlas of Hematology*. Lippincott Williams & Wilkins.
- Norfolk, D., 2013. *Handbook of Transfusion Medicine*. 5th ed. United Kingdom Blood Services.
- Bain, B., Bates, I., and Laffa, M., 2016. *Dacie and Lewis Practical Hematology*. 12th ed. Elsevier.
- Hoffbrand, V. and Moss, P. A. H., 2011. *Essential Hematology*. 6th ed. Wiley-Blackwell.
- Bain, B. J., 1990. *Leukemia diagnosis: a guide to the FAB classification*. Philadelphia: Gower Medical Publications.

MLT 7 - CLINICAL HAEMATOLOGY II (30 hrs)

Competencies and Descriptions:

To have basic knowledge of hematological disorders, and relevant investigations. Understanding blood banking. To develop skills to perform basic blood bank investigations.

Learning Outcomes:

At the end of this module students will be able to:

- describe the pathophysiology and clinical features of nutritional anemia (Iron deficiency & B12/folate deficiency)
- demonstrate the routine and special tests employed in the diagnosis of nutrient deficiency anemia.
- explain hemolysis/hemolytic anemia and outline the classification of hemolytic anemia.
- interpret the laboratory test results of different types of hemolytic anemia.
- describe the pathophysiology, clinical features, morphology, and laboratory investigations of acute leukemia, chronic leukemia, multiple myeloma & lymphoma.
- describe the pathophysiology, clinical features, morphology, and laboratory investigations of chronic myeloproliferative disorders (MPD).
- explain laboratory diagnosis of aplastic anemia.
- describe the methodology of Bone Marrow examination.
- describe the mechanism of hemostasis & outline the basic investigations in thrombosis.
- investigate a bleeder.
- explain the inheritance of ABO & Rh blood group systems, outline the specimen collection process for testing of ABO & Rh blood grouping, Direct & Indirect Coombs test, and understand the pathophysiology of hemolytic disease of the newborn (HDN).
- describe the preparation of blood components and their importance in blood transfusion.
- understand basic concepts of quality assurance in hematology and the application of internal & external quality control methods to the hematology laboratory.

Important pertinent content (knowledge):

- Nutritional anemias
  - ❖ Pathophysiology of nutritional anemias
  - ❖ Basic laboratory investigations
- Hemolytic anemia
  - ❖ Pathophysiology of hemolytic anemias
  - ❖ Basic laboratory investigations

- Hematological malignancies
  - ❖ Pathophysiology & clinical features of acute/chronic leukemia, multiple myeloma & lymphoma
  - ❖ Basic laboratory investigations
- Aplastic anemia & myeloproliferative disorders (MPD)
  - ❖ Pathophysiology
  - ❖ Basic laboratory investigations
- Bone marrow examination
  - ❖ Methodology
  - ❖ Side effects
  - ❖ Investigations related to bone marrow examination
- Investigations in bleeding & thrombosis
  - ❖ Basic investigations.
  - ❖ Common acquired & congenital disorders related to bleeding & thrombosis.
- Blood banking
  - ❖ ABO & Rh blood group systems
  - ❖ Testing of ABO & Rh grouping
  - ❖ Direct & indirect Coombs tests
  - ❖ Hemolytic disease of new born
- Quality assurance in hematology
  - ❖ Application of internal & external quality Control methods in the hematology laboratory

Important pertinent skills:

- Perform investigations related to blood banking.
- Interpreting basic laboratory investigations in hematological disorders.

Teaching methods:

- Lecture /Presentations
- Discussions
- Demonstrations
- Case-based learning
- Handouts

Assessment: End Semester Exam

References:

- Anderson, S. C. and Poulsen, K. B., 2003. *Anderson's Atlas of Hematology*. Lippincott Williams & Wilkins.
- Norfolk, D., 2013. *Handbook of Transfusion Medicine*. 5th ed. United Kingdom Blood Services.
- Bain, B., Bates, I., and Laffa, M., 2016. *Dacie and Lewis Practical Haematology*. 12th ed. Elsevier.
- Hoffbrand, V. and Moss, P. A. H., 2011. *Essential Haematology*. 6th ed. Wiley-Blackwell.
- Bain, B. J., 1990. Leukemia diagnosis: A Guide to the FAB Classification. Philadelphia: Gower Medical Publications

MLT 8 - CLINICAL BIOCHEMISTRY III (30 hrs)

Competencies and Descriptions:

This module is designed to help the students to gain knowledge on laboratory investigation of selected body fluids.

Learning Outcomes:

At the end of this module students will be able to:

- list the cardiac markers used in the diagnosis of acute myocardial infarction
- outline cardiac disorders and principles of analyzing different cardiac markers.
- describe laboratory analysis of cardiac markers.
- outline Purine catabolism.
- outline the biochemical basis of gout.
- outline the use of C-reactive protein in the assessment of inflammation.
- describe laboratory analysis of uric acid, cardiac markers, and C-reactive protein and Interpret the results
- list the different types of tissue fluid in the human body
- outline the collection method, transporting and storing of tissue fluids
- list the laboratory tests involved in the detection of tuberculosis bacteria
- list the steps in sputum analysis
- describe the identification of TB bacteria
- outline the hormones involved in pregnancy
- explain the molecular basis for the detection of hCG in urine by hCG strip test
- describe the tumor markers and their clinical applications
- explain the analytical errors in tumor marker analysis
- explain and interpretation of seminal fluid analysis

Important pertinent content (knowledge):

- Examination of cerebrospinal fluid, serous fluids (pleural, pericardial, and peritoneal fluids), synovial fluid, gastric juice, duodenal contents, and saliva
- Analysis of semen
- Examination of sputum
- Investigation of cardiac markers
- Investigation and interpretation of lipid profile
- Investigation of tumor markers
- Determination of serum uric acid
- Pregnancy test

- Rheumatoid factor
- C – Reactive protein

Important pertinent skills:

Interpretation of laboratory results and technical validation.

Teaching methods:

- Lecture /Presentations
- Tutorials / Handouts
- Guided learning sessions

Assessment: End Semester Exam (MCQ/SEQ)

References:

- Marshall, W. J., Bangert, S. K. and Lapsley, M. 2012. *Clinical Chemistr*y. 7th ed. Elsevier.
- Burtis, C. A., Bruns, D. E and Ashwood, E. R.2007. *Tietz Fundamentals of Clinical Chemistry*. 6th ed.WB Saunders Co.
- Fody, E. P., Schoeff, L. E and Bishop, M. L.2009. *Clinical Chemistry: Techniques, Principles, Correlations*.6th ed. Lippincott Williams & Wilkins.
- Diamandis, E. P., 2002. *Tumour Markers: Physiology, Pathobiology, Technology, and Clinical Applications*. Washington, DC: AACC Press
- Cheesebrough, M. 2005. *District Laboratory Practice in Tropical Countries*. 2nd ed. Cambridge University Press.
- Godkar, P. B., Godkar, D. P. 2014. *Textbook of Medical Laboratory Technology*. 3rd ed. Bhalani Publishing House
- Chawla, R., 2014. *Practical Clinical Biochemistry: Methods and Interpretations*. 4th ed. New Delhi: Jaypee Brothers Medical Publishers.

MLT 9 - CLINICAL BIOCHEMISTRY IV (30 hrs)

Competencies and Descriptions:

This module is designed to explain the principles of metabolic disorders, liver functions, gonadal function tests, and serum calcium homeostasis.

Learning Outcomes:

At the end of this module students will be able to:

- list the pancreatic function and liver function tests
- outline the importance of exocrine and endocrine pancreatic function test
- describe OGTT and blood sugar series in laboratory
- outline carbohydrate metabolism and abnormalities of carbohydrate metabolism.
- describe the liver function tests and applications
- outline lipid metabolism and abnormalities of lipid metabolism
- outline the mechanisms in transporting cholesterol in the human body
- outline the principles of measuring and interpretation of lipid profiles
- outline laboratory investigations included in the lipid profile
- outline the investigations used in the diagnosis and management of diabetes mellitus
- define subfertility
- list the investigations available for the detection of subfertility
- briefly explain the gonadal function test
- describe the calcium homeostasis in human
- list the disorders related to calcium metabolism
- list the investigations for monitoring the calcium status of the body

Important pertinent content (knowledge):

- Pancreatic function tests
- Liver function tests, biochemical assessment of liver function
  - ❖ Determination of serum bilirubin
  - ❖ Determination of plasma enzymes – AST, ALT, AP, gamma- GT
  - ❖ Determination of plasma proteins and protein electrophoresis
- Diagnosis and management of diabetes mellitus
  - ❖ Urine testing – glucose, ketone bodies
  - ❖ Blood glucose testing – Fasting blood glucose, random blood glucose, Post prandial blood glucose, oral glucose tolerance test
  - ❖ Determination of glycosylated hemoglobin, fructosamine, and urinary micro-albumin and their clinical use in the long-term management of diabetes mellitus.

- Thyroid function test – determination of T4, T3, and TSH
- Gonadal function and subfertility
- Laboratory testing in calcium disorders and bone diseases.
- Electrochemiluminescence and ELISA technique

Important pertinent skills: Interpretation of laboratory results and technical validation.

Teaching methods:

- Lecture /Presentations
- Guided learning Sessions

Assessment: End Semester Exam (MCQ/SEQ)

References:

- Marshall, W. J. Bangert, S. K. and Lapsley, M. 2012. *Clinical Chemistry*. 7th ed. Elsevier.
- Burtis, C. A., Bruns, D. E. and Ashwood, E. R.2007. *Tietz Fundamentals of Clinical Chemistry*. 6th ed.WB Saunders Co.
- Fody, E. P. Schoeff, L. E. and Bishop, M. L.2009. *Clinical Chemistry: Techniques, Principles, Correlations*.6th ed. Lippincott Williams & Wilkins.
- Cheesebrough, M. 2005. *District Laboratory Practice in Tropical Countries*. 2nd ed. Cambridge University Press.
- Godkar, P. B., Godkar, D. P. 2014. *Text Book of Medical Laboratory Technology*. 3rd ed. Bhalani Publishing House
- Chawla, R., 2014. *Practical Clinical Biochemistry: Bethods and Interpretations*. 4th ed. New Delhi: Jaypee Brothers Medical Publishers.

MLT 10 - PART A -THERAPEUTIC DRUG MONITORING AND TOXICOLOGY (15 hrs)

Competencies and Descriptions:

This module is designed to help students to gain knowledge on the principles of therapeutic drug monitoring and toxicology, the analytical techniques involved in these fields, and the application of this knowledge in laboratory investigations.

Learning Outcomes:

At the end of this module students will be able to:

- explain the principles of therapeutic drug monitoring
- outline classification of poisons
- explain important physical and chemical characteristics and symptoms in the identification of poisons and interpretation of analytical results
- explain metabolism & route of excretion
- explain systematic sample collection for toxicological analysis and preservation
- classify narcotics and psychotropic substances
- explain the applications of newer analytical techniques

Important pertinent content (knowledge):

- Therapeutic drugs, classification, and poisoning
- Classification of pesticides
- Vegetative poisons (poisonous plants and their active ingredients)
- Metallic poisons, cyanides, alcohols
- Important physical and chemical characteristics and symptoms
- Factors modifying the action of poisons
- Systematic sample collection for toxicological analysis and preservation
- Classification of narcotics and psychotropic substances
- Sample preparation techniques in toxicology
- Applications of newer analytical techniques and interpretation of results in forensic toxicology and narcotics and psychotropic substance analysis
- Interpretation of results

Important pertinent skills:

- Sample collection and preservation
- Sample preparation techniques
- Newer analytical techniques

- interpretation of results

Teaching methods:

- Lecture /Presentations
- Handouts

Assessment: End Semester Exam (MCQ/SEQ)

References:

- Moffat, A.C., Jackson, J. V., Moss, M. S. and Widdop, B. 1986. *Clarke's Isolation and Identification of Drugs in Pharmaceuticals, Body fluids, and Postmortem Material*. 2nd ed. London: The Pharmaceutical Press.
- Moffat, A. C., Osselton, D. and Widdop, B. 2002. *Clarke's Isolation and Identification of Drugs in Pharmaceuticals, Body fluids, and Postmortem Material.* 3rd ed. London: The Pharmaceutical Press.

MLT 10 - PART B - MOLECULAR DIAGNOSTICS (15 hrs)

Competencies and Descriptions:

This course provides a comprehensive overview of the fundamental principles of clinical molecular diagnostics and explores the use of molecular techniques in the diagnosis of disease.

Learning Outcomes:

At the end of this module students will be able to:

- describe the structure, function, and replication of DNA and RNA.
- list and describe the steps of the method for nucleic acid extraction, and determine quantity and quality.
- describe the methods utilized in the analysis and characterization of nucleic acids and proteins.
- describe the purpose of each reagent and the steps required for the polymerase chain reaction & DNA sequencing.
- describe the human chromosomal structure and identify normal versus mutations that may be present.
- describe the methods used to detect genetic mutations in humans.
- describe techniques used in the clinical lab to detect: DNA Polymorphisms, microorganisms, inherited diseases, neoplastic diseases, and DNA-based tissue typing.
- describe the procedures utilized for quality control and quality assurance in the molecular diagnostic laboratory.

Important pertinent content (knowledge):

- Nucleic acid structure and function
- DNA chemistry (reactions etc)
- Chromosome structure
- The basic principles of modern genetics as they apply to disease transmission
- Nucleic acid isolation, identification, and amplification
- DNA sequencing
- Techniques used in infectious disease diagnosis in the clinical laboratory
- Components of a molecular laboratory
- Evaluation of controls to validate results obtained

Teaching methods:

- Lecture /Presentations
- Handouts

Assessment: End Semester Exam (Written)

References:

- Watson, J. D., Meyers, R. M., Caudy, A. A., and Jan, A., 2006. *Recombinant DNA: Genes and Genomes — A Short Course*. 3rd ed. New York: W.H. Freeman and Company.

MLT 11 - HISTOPATHOLOGY AND CYTOLOGY (30 hrs)

Competencies and Descriptions:

This module is designed to help students to gain an understanding of histopathological and cytological techniques.

Learning Outcomes:

At the end of this module students will be able to:

- work in the pathology laboratory.
- describe the collection, handling, and storage of surgical pathology and cytology specimens
- know the procedures to be followed with each specimen up to the storage of slides and disposal of specimens.
- interpret the results of the various staining techniques.
- know the theory of operating principles and the importance of preventive maintenance of equipment used in histopathology laboratory.

Important pertinent content (knowledge):

- Specimen collection, transport, storage, and disposal
- Preparation of different types of fixatives and decalcifying solutions.
- Methods of fixation and decalcification
- Frozen sections
- Tissue processing
- Preparation of tissue block
- Section cutting and preparation of slides
- Use of histokinette, wax embedding machine, microtome, and cryostat.
- Principles of staining and staining techniques
- H and E staining technique and pap staining technique.
- Mounting, storage of slides
- Cyto-preparative techniques

Teaching methods:

- Lectures
- Tutorials and handouts

Assessment: End Semester Exam (MCQ/SEQ)

References:

- Suvarna, K., Layton, C.,Bancroft, J., 2018. *Bancroft's Theory and Practice of Histological Techniques*. 8th ed. Elsevier.
- Cook D.J. and Warren P.J. 2015. 3rd ed. *Cellular Pathology: An Introduction to Techniques and Applications*. Scion Publishers.
- Gartner, L. and Hiatt, J., 2010. *Concise Histology*. Elsevier.

MLT 12 - QUALITY ASSURANCE AND ACCREDITATION (30 hrs)

Competencies and Descriptions:

This module is designed to help students to gain an understanding the quality assurance and accreditation schemes of laboratories and standard applications.

Learning Outcomes:

- At the end of this module students will be able to:
- outline the concepts of quality assurance and quality control.
- perform the quality assurance procedures of a medical laboratory.
- outline the basic principles of instrument calibration.
- interpret the quality control data obtained from quality assurance procedures.
- identify the events in quality control failures.
- propose corrective actions systematically.
- outline the concepts of clinical laboratory accreditation.
- outline the principles in conducting laboratory audits.

Important pertinent content (knowledge):

- Quality assurance and quality control
- Introduction to quality assurance
- Quality assurance procedures and quality control concepts (internal quality control and external quality control)
- Systematic troubleshooting
- Verification of methods & performance specifications,
- Monitoring quality
- Shewart charts
- Westguard rules
- Quality indicators (customer complaints, turnaround time, customer satisfaction)
- Quality system essentials that support the quality
- Guidelines of clinical laboratory accreditation
- ISO15189
- Laboratory internal and external audits

Important pertinent skills:

- Apply quality assurance principles to the medical laboratory process
- Documentation and following of guidelines regarding ISO 15189

Teaching methods:

- Lecture /Presentations
- Discussions

Assessment: End Semester Exam (Written)

References:

- Cheesebrough, M. 2005. District Laboratory Practice in Tropical Countries. 2nd ed. Cambridge University Press.
- Godkar, P. B., Godkar, D. P. 2014. Textbook of Medical Laboratory Technology. 3rd ed. Bhalani Publishing House
- Burtis, C. A., Bruns, D. E. and Ashwood, E. R. 2007. Tietz Fundamentals of Clinical Chemistry. 6thed. WB Saunders Co.
- International Standard ISO15189 Medical laboratories – Requirements for quality and competence.

MLT 13 - CLINICAL LABORATORY PRACTICE (45 hrs)

Competencies and Descriptions:

This module is designed to help students to gain the necessary skills in practicing essential medical laboratory investigations by understanding their principles and apply accordingly.

Learning Outcomes:

At the end of this module students will be able to:

- demonstrate safe practices in a microbiology laboratory
- describe the basic principles of sterilization techniques and isolation of microorganisms
- inoculate microbes using an aseptic technique.
- apply the principles of staining and biochemical techniques for the diagnosis of infectious organisms.
- interpret basic laboratory tests for the diagnosis of infectious diseases.
- identify parasites using blood samples and immunological screening.
- perform routine urine analysis.
- perform investigations related to the diagnosis of diabetes mellitus.
- perform investigations of lipid profiles.
- perform liver function tests and renal function tests.
- perform routine hematological investigations.
- perform basic histological and cytological techniques.
- isolate and identify medically important microorganisms.

Important pertinent content (knowledge):

- Microbiology
  - ❖ Biosafety rules & regulations in microbiology lab and Microscopy
  - ❖ Media preparation and sterilization techniques
  - ❖ Aseptic transfer techniques & quantification of bacteria
  - ❖ Pure culture techniques introduction and streaking
  - ❖ Staining techniques (simple staining, negative staining, Gram staining, and endospore staining
  - ❖ Biochemical identification of microorganisms
  - ❖ Antibiotic Sensitivity Testing and MIC
  - ❖ Processing of real samples for microbiological analysis
  - ❖ Identification of fungal specimens
- Parasitology
  - ❖ Preparation of thin and thick blood smears and staining
  - ❖ Preparation and examination of fecal smears of saline and iodine

- ❖ Sample concentration techniques
- ❖ Immunological rapid diagnostic test

- Routine urine analysis
  - ❖ Normal urine constituents
  - ❖ Physical
  - ❖ Chemical
  - ❖ Microscopical
  - ❖ Abnormal constituents of urine/UFR
  - ❖ Other urine tests
- Laboratory diagnosis of diabetes mellitus
  - ❖ Specimen collection
  - ❖ Glucose oxidase method (GOD/POD)
  - ❖ FBS/PPBS/RBS
  - ❖ OGTT
- Assessment of liver function
  - ❖ Kinetic reactions
  - ❖ AST/ALT
  - ❖ Alkaline phosphatase
  - ❖ GGT
  - ❖ Serum bilirubin
- Assessment of renal function
  - ❖ Serum creatinine
  - ❖ Blood urea/BUN
  - ❖ eGFR
- Assessment of Lipid profile
  - ❖ Estimate of total cholesterol
  - ❖ Estimation of HDL and LDL
  - ❖ Estimation of triglycerides
- Routine hematological investigations
  - ❖ Preparation of blood films and staining
  - ❖ Hemoglobin
  - ❖ PCV
  - ❖ Platelet count
  - ❖ WBC/DC
  - ❖ ESR
  - ❖ PT/INR
- Basic histological techniques
  - ❖ Fixatives

- ❖ Specimen processing
- ❖ Wax impregnation
- ❖ Section cutting
- ❖ Staining

Important pertinent skills:

- Sterilization techniques, media preparation, and isolation of pure cultures
- Laboratory identification of bacteria and fungi
- Preparation of blood samples for detection
- Preparation of reagents, stains, and handling of glassware and equipment
- Basic analytical techniques
- Spectrophotometry
- Calculation and interpretation of results
- Maintenance of laboratory glassware and equipment
- Waste disposal and management

Teaching methods:

- Practical sessions
- Demonstrations
- Lectures / Presentations
- Handouts

Assessment:

- End of semester examination (70%) (Practical)
- Continuous assessment (30%)

References:

- Lammert, John M., *Techniques in Microbiology A Student Handbook*
- Leboffe, M., *A Photographic Atlas for the Microbiology Laboratory,* 4th Edition.
- Fischbach, F. *A Manual of Laboratory Diagnostic Tests*, Philadelphia, Lippincott, 1998.
- Cheesebrough, M. 2005. *District Laboratory Practice in Tropical Countries*. 2nd ed. Cambridge University Press.
- Godkar, P. B., Godkar, D. P. 2014. *Text book of Medical Laboratory Technology*. 3rd ed. Bhalani Publishing House

MLT 14 - CLINICAL LABORATORY TRAINING (6 months)

Learning Outcomes:

At the end of this module students will be able to:

- work in a clinical lab as a team player or a leader as needed
- obtain reliable measurements, perform statistical treatment, and interpret them
- demonstrate writing skills related to assigned projects
- demonstrate presentation skills related to assigned projects
- to give students an opportunity to get an insight into the operation of a laboratory and to relate their academic discipline to the workplace.
- to contribute to the development of the student by providing responsibility appropriately matching with their level of knowledge, experience and potential.
- to develop the student's personal skills as well as their scientific knowledge and technical competence to find entry level position in the industry

Important pertinent content (knowledge):

- Time duration of industrial placement is a minimum of 960 notional hours, 6 months. Students are expected to take an active part, in cooperation with the placement.
- The nature of the work undertaken will vary substantially and solely depends upon the industry, to secure an appropriate placement in the industry.
- The report produced should summarize the various projects in which the student was engaged, the benefits gained, and the application of theory into practice.
- Students have to work in a Clinical Lab where all the basic clinical tests are conducted (Microbiology, Hematology, Parasitology, Pathology, Histopathology, Bio-Chemical Analysis, Molecular Diagnostics, etc)
- You should at least complete 90% of the given training plan.
- Diary should be signed by a related Consultant or Sri Lanka Medical Council Registered (SLMC) MLT (with the registration Number)

Assessment:

- Exposure Report – 55%
- Presentation – 25%
- Viva - 10%
- Diary – 10%

SPECIAL MODULES (14)
Clinical Laboratory Technology (CLT)

CLT 1 - INTRODUCTION TO MEDICAL LABORATORY (30 hrs)

Competencies and Descriptions:

This module is designed to help students to gain an understanding of the major processes taking place in a medical laboratory. It would also help in understanding the basic requirements when establishing a laboratory, working in a laboratory and the organizational structure of a medical laboratory. Students would also gain an understanding of the calculation in chemical pathology and basic clinical interpretation of common laboratory test results.

Learning Outcomes:

At the end of this module students will be able to:

- state the basic requirements of a clinical laboratory
- identify the common analytical techniques and instruments
- describe the standard operational procedures
- explain the pre-analytical, analytical, and post-analytical phases
- describe the laboratory automation, Laboratory Information Systems (LIS)
- describe the Internal Quality Control (IQC)
- describe the External Quality Assurance (EQA)
- describe the laboratory safety, Good Laboratory Practices, and Ethics
- explain the clinical utility of laboratory tests and interpret common laboratory test results
- describe the laboratory accreditation process

Important pertinent content (knowledge):

- Introduction to medical laboratory
- Meaning of common terminologies used in laboratory medicine
- Designing of a medical laboratory
- Major disciplines in laboratory medicine
- Organizational structure of a medical laboratory
- Role of a medical laboratory personnel
- Basic needs and requirements of a medical laboratory
    - ❖ Human resources
    - ❖ Physical requirements
    - ❖ Chemical requirements
    - ❖ Legal requirements
    - ❖ Different equipment and analyzers

- Testing process
  - ❖ Understand the testing process in a medical laboratory
  - ❖ Understand the three phases of laboratory testing
- Pre-analytical Phase
  - ❖ Define pre-analytical phase
  - ❖ List pre-analytical variables
  - ❖ Discuss the effects of pre-analytical variables on laboratory test results
- Analytical phase
  - ❖ Define the analytical phase
  - ❖ List the factors which affect the analytical phase and describe their effects on analytical procedures
  - ❖ Describe how to assure quality in the analytical phase
- Post-analytical phase
  - ❖ Define the post-analytical phase
  - ❖ Describe the technical and clinical validation of test reports
  - ❖ List and identify the significance of the information given in a test report
- Laboratory automation
  - ❖ Define automation
  - ❖ List the advantages of automation
  - ❖ Describe different analyzer types
  - ❖ Describe laboratory information systems
- Internal Quality Control (IQC)
  - ❖ Significance and essential components of an IQC programme
  - ❖ Set up an IQC programme
  - ❖ Ensuring the quality of test results by an IQC programme
- External Quality Assurance (EQA)
- Describe the value of EQA in a laboratory quality management system
- Laboratory safety, Good Laboratory Practices, and ethics
  - ❖ Code of conduct/ethics of medical laboratory professionals
    - Describe important ethical aspects related to laboratory personnel
  - ❖ Laboratory Safety
    - Describe general principles of ensuring safety in laboratories
    - List common hazards and describe precautions to avoid them
  - ❖ Clinical waste handling
    - List the categories of waste
    - Describe universal precautions
    - Describe how to handle sharps and sharp injuries
    - How to manage blood spills

Important pertinent skills:

Identify the causes of erroneous test results

- Preventive actions
- Familiarization with different types of tests and clinical interpretation of common lab tests
- Implementation of safe and good laboratory practice
- Operation and maintenance of laboratory instruments and analyzers

Teaching methods: Lecture /Presentations

Assessment: End Semester Exam (Written)

References:

- Cheesebrough, M. 2005. District Laboratory Practice in Tropical Countries. 2nd ed. Cambridge University Press.
- Godkar, P. B., Godkar, D. P. 2014. Text book of Medical Laboratory Technology. 3rd ed. Bhalani Publishing House
- Burtis, C. A., Bruns, D. E. and Ashwood, E. R. 2007. Tietz Fundamentals of Clinical Chemistry. 6th ed. WB Saunders Co.

CLT 2 - CLINICAL BIOCHEMISTRY I (30 hrs)

Competencies and Descriptions:

This module is designed to help students to gain an understanding of the basic principles in acid-base imbalances, serum electrolytes, and diseases related to hemoglobin.

Learning Outcomes:

At the end of this module students will be able to:

- interpret the serum electrolyte analysis report
- differentiate clinical disorders associated serum electrolytes
- analyze the HPLC reports related to hemoglobinopathies
- compare the analytical techniques involved in electrolyte analysis and the possible errors
- explain the concept related to plasma osmolality and the relevancy of rehydration fluids
- interpret acid base data reports related to acid base imbalances

Important pertinent content (knowledge):

- Basic concepts of fluid and electrolyte balance
- Hypernatraemia and potassium disorders
- Determination of serum electrolytes
- Osmolarity measurements
- Basic concepts of acid-base balance
- Metabolic acid-base disorders, respiratory and mixed acid-base disorders
- Interpretation of acid-base data
- Oxygen transport and its disorders

Important pertinent skills: Interpretation of laboratory results and technical validation.

Teaching methods:

- Lecture /Presentations
- Discussions
- Guided learning Sessions

Assessment: End Semester Exam(MCQ/SEQ)

References:

- Marshall, W. J. Bangert, S. K. and Lapsley, M. 2012. Clinical Chemistry. 7th ed. Elseveir.

- Burtis, C. A., Bruns, D. E. and Ashwood, E. R.2007. Tietz Fundamentals of Clinical Chemistry. 6thed.WB Saunders Co.
- Fody, E. P., Schoeff, L. E.and Bishop, M. L.2009. Clinical Chemistry, Techniques, Principles, Correlations.6thed. Lippincott Williams & Wilkins.
- Khera, R., Singh, T., Khuana, N., Gupta, N. and Dubey, A. P. 2015. HPLC in Characterization of Hemoglobin Profile in Thalassemia Syndromes and Hemoglobinopathies: A Clinicohematological Correlation. Indian Journal of Hematology Blood Transfusion,31(1):110–5.
- B. D. Rose. and T. W. Post. 2001. Clinical Physiology of Acid-Base and Electrolyte Disorders. 5th ed. New York: McGraw-Hill Education.
- Cheesebrough, M. 2005. District Laboratory Practice in Tropical Countries. 2nd ed. Cambridge University Press.
- Godkar, P. B., Godkar, D. P. 2014. Text book of medical laboratory technology. 3rd ed. Bhalani Publishing House
- Chawla, R., 2014. Practical clinical biochemistry: methods and interpretations. 4th ed. New Delhi: Jaypee Brothers Medical Publishers.

CLT 3 - CLINICAL BIOCHEMISTRY II (30 hrs)

Competencies and Descriptions:

This module is designed to help students to understand the principles of urine and stool analysis, renal function tests, and interpretation of results.

Learning Outcomes:

At the end of this module students will be able to:

- differentiate normal urine from abnormal urine.
- explain the principles of biochemical investigations of urine and stool analysis.
- describe the biochemical investigations of renal function and understand the concepts of Glomerular filtration rate (GFR)
- interpret the results of urine and stool analysis and renal function tests.

Important pertinent content (knowledge):

- 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
    - ❖ Chemical analysis of urine
    - ❖ Microscopic examination of urine
    - ❖ Common pattern of abnormal urine composition in disease
    - ❖ Urinary tract infection and urine culture
- Examination of Stool
    - ❖ Collection of fecal specimens
    - ❖ Physical examination of stool
    - ❖ Microscopic examination of stool
    - ❖ Chemical examination of stool
- Investigations of Renal Function
    - ❖ Functions of the kidney
    - ❖ Tests of glomerular function, glomerular filtration rate, serum creatinine, blood urea, proteinuria
    - ❖ Investigations of tubular functions

- ❖ Osmolality measurements in plasma and urine
- ❖ Water deprivation test
- ❖ Acid load test
- ❖ Proteinuria and Aminoaciduria

Teaching methods:

- Lecture /Presentations
- Demonstrations
- Handouts

Assessment: End Semester Exam (MCQ/SEQ)

References:

- Gaw, A., Murphy, M.J., Srivastava, R., Cowan, R.A. and O'Reilly, D. St.J.2015. Clinical Biochemistry, An illustrated colour text.5th ed. Churchil Liningstone/Elsevier.

CLT 4 - DIAGNOSTIC MICROBIOLOGY (30 hrs)

Competencies and Descriptions:

This module is designed to introduce infectious organisms and diagnose using different microbial techniques. It covers biology of bacteria, fungi, and viruses and the mechanisms of their pathogenicity. It will also provide opportunities for a student to develop both informatics and diagnostic skills in microbiology, including the practical application and interpretation of laboratory tests for the diagnosis of infectious diseases.

Learning Outcomes:

At the end of this module students will be able to:

- describe principles of microbial taxonomy, structure, physiology, immunology, and pathogenesis-related to human microbial pathogenesis
- develop a knowledge of microbial organisms and their relevance of infectious diseases
- explain the preparation of clinical specimens for laboratory identification
- describe the detection of sexually transmitted infections
- describe the theory behind immunological diagnostic testing and virological diagnostic testing
- apply knowledge gained in theory and technical skills to identify bacteria and fungi in the laboratory

Important pertinent content (knowledge):

- Introduction to medical microbiology and diagnostic microbiology
- Characteristics of bacteria, fungi, and viruses
- Basic cell structure of bacteria, fungi, and viruses
- Diverse groups of bacteria, fungi, and viruses
- Principles of immunology
- Infections, pathogenesis, and immune responses to microbial and viral infections
- Specimen collection, transport, and storage
- Bacterial diagnostic techniques
    - ❖ Laboratory identification and isolation of organisms for clinical specimens, urine culture, blood culture, puss culture, stool culture, CSF, respiratory tract
    - ❖ Biochemical identification of bacteria
    - ❖ Antibacterial susceptibility test (ABST)
- Molecular diagnostic techniques (PCR)
- Immunological diagnostic testing
- Virological diagnostic testing

- Detection of mycological infections
- Sexually transmitted infections detection
- Laboratory quality control

Important pertinent skills:

- Biology of microorganisms
- Pathogenicity & virulence factors
- Immune responses to microbial infections
- Laboratory identification of bacteria and fungi
- Immunological diagnostic techniques
- Safety procedures of handling samples
- Sterilization and aseptic procedures
- Waste disposal and management

Teaching methods:

- Lecture /Presentations
- Demonstrations
- Handouts

Assessment: End Semester Exam (MCQ/SEQ)

References:

- Greenwood, D., Slack, R., Barer, M. and Irving, W., 2012. Medical Microbiology. 18th ed. London: Churchill Livingstone.
- Pelczar, Jr. M. J., Chan, E. C. S and Kreig, N. R. 2006. Microbiology. 5th ed. New York: Mc Graw Hill Inc.
- Spicer, W. J., 2000. Clinical Bacteriology, Mycology, and Parasitology: An Illustrated Colour Text. London: Churchill Livingstone.
- Brooks, G., Carroll, K. C., Butel, J., Morse, S. and Mietzner, T. A., 2009. Jawetz, Melnick, and Adelberg's Medical Microbiology. 25th ed. New York: McGraw-Hill.
- Forbes, B., Sahm, D., and A., Weissfeld, 2007. Bailey & Scott's Diagnostic Microbiology. 12th ed. Elsevier.

CLT 5 - DIAGNOSTIC PARASITOLOGY (30 hrs)

Competencies and Descriptions:

This module is designed to introduce parasites and diagnose using different techniques. This provides opportunities for a student to develop both informatics and diagnostic skills in parasitology, including the practical application and interpretation of laboratory tests.

Learning Outcomes:

At the end of this module students will be able to:

- explain the basic principle of Parasitology and Entomology
- explain the basic principles of laboratory techniques in parasitology and entomology
- identify common parasites and understand their life cycles
- correlate clinical conditions in parasitology and entomology

Important pertinent content (knowledge):

- Classification of Parasites
  - ❖ Introduction and Classification
  - ❖ Identification of human parasites, their life cycles, and pathogenesis
- Specimen Collection and storage
- Detailed understanding of
  - ❖ Protozoa
  - ❖ Classification of Intestinal Protozoa,
  - ❖ Tissue Protozoa- Toxoplasma, Blood Protozoa, Blastocystatomysis
  - ❖ AIDS related Protozoa
  - ❖ Ciliates and flagellates
  - ❖ Helminths and Nematodes, Tissue Nematodes
  - ❖ Malarial parasites
  - ❖ Cestodes
  - ❖ Flukes (Blood and other)
- Diagnostic methods in parasitology
- Examination of stool
- Examination of blood
- Immunodiagnosis in parasitology
- Parasitic zoonosis
- Medical Entomology
  - ❖ Introduction to Entomology
  - ❖ Understanding of life cycles of

- Mosquitoes
- Flies
- Fleas
- Lice
- Bugs
- Ticks
- Mites

Important pertinent skills:

- Identification of the life cycle and different stages of the life cycle
- Correlate laboratory findings with clinical conditions
- Interpretation of laboratory findings
- Safety procedures of handling samples
- Sterilization and aseptic procedures
- Waste disposal and management

Teaching methods:

- Lecture /Presentations
- Demonstrations
- Hands-on sessions
- Handouts

Assessment: End Semester Exam (MCQ/SEQ)

Reference:

- Mehlhorn, H. 2001. Encyclopedic Reference of Parasitology: Biology, Structure, Function. 2nd ed. Berlin: Springer.
- Spicer, W. J., 2000. Clinical Bacteriology, Mycology, and Parasitology: An Illustrated Colour Text. London: Churchill Livingstone.
- Jayaram, C. K. and Paniker, M. D., 2013. Paniker's Textbook of Medical Parasitology. 7th ed. New Delhi: Jaypee Brothers Medical Publishers.

CLT 6 - CLINICAL HAEMATOLOGY I (30 hrs)

Competencies and Descriptions:

To have basic knowledge of the formation, structures, and functions of blood cells. To develop skills to perform basic hematological investigations.

Learning Outcomes:

At the end of this module students will be able to:

- describe the formation of blood cells & their functions.
- outline the specimen collection process for hematological investigations.
- describe the principles behind the anticoagulant action.
- describe sample storage, transport, and preparation for analysis in hematology.
- perform staining of blood film and identification of common staining problems and how to overcome these problems.
- perform basic hematological tests.
- Erythrocyte sedimentation rate (ESR), Packed cell volume (PCV), estimation of hemoglobin, manual FBC estimation, Automated FBC estimation, red cell indices & interpretation, WBC/DC manual DC & cell identification, Reticulocyte count & red cell inclusions, bleeding time, PT, APTT & TT.
- describe physiological changes in the blood.
- describe the possible pre-analytical, analytical & post-analytical errors in hematological investigations.

Important pertinent content (knowledge):

- Principles of hemopoiesis
  - ❖ Definition of hemopoiesis
  - ❖ Factors necessary for hemopoiesis
  - ❖ Sites of hemopoiesis
  - ❖ Functions of RBC, platelets & WBC
- Measures taken in specimen collection
  - ❖ Approach to phlebotomy
  - ❖ General rules & regulations
  - ❖ Assessing the situation & preparation
  - ❖ How to carry out the procedure
  - ❖ Sample storage, transport & preparation for analysis
  - ❖ Waste disposal
  - ❖ Rejection criteria

- ❖ Sample storage, transport & preparation for analysis
- Anticoagulants
  - ❖ Action
  - ❖ Specific indication for each type of anticoagulant
- Blood film preparation
  - ❖ Basic principles of staining
  - ❖ Reticulocyte preparation
  - ❖ Problem-solving in blood film preparation
- Basic haematology tests
  - ❖ Erythrocyte Sedimentation Rate
  - ❖ Pack Cell Volume
  - ❖ Manual estimation of Hb
  - ❖ Manual estimation of WBC/DC
  - ❖ Automated estimation of Hb
  - ❖ Red cell indices & cell identification
  - ❖ Reticulocyte count & red cell inclusions
  - ❖ Physiological changes in blood
  - ❖ Pre-analytical, analytical & post-analytical errors in hematology
- Physiological changes in blood
  - ❖ Changes of haematological parameters at birth, during adolescence & pregnancy
- Quality assurance in haematology
  - ❖ Basics of pre-analytical, analytical & post-analytical errors

Important pertinent skills:

- Staining blood films
- Perform basic laboratory investigations
- Interpreting basic laboratory investigations

Teaching methods:

- Lecture /Presentations
- Discussions
- Demonstrations
- Case-based learning
- Handouts

Assessment: End Semester Exam (Written)

References:

- Anderson, S. C. and Poulsen, K. B., 2003. Anderson's Atlas of Hematology. Lippincott Williams & Wilkins.
- Norfolk, D., 2013. Handbook of Transfusion Medicine. 5th ed. United Kingdom Blood Services.
- Bain, B., Bates, I., and Laffa, M., 2016. Dacie and Lewis Practical Hematology. 12th ed. Elsevier.
- Hoffbrand, V. and Moss, P. A. H., 2011. Essential Hematology. 6th ed. Wiley-Blackwell.
- Bain, B. J., 1990. Leukemia diagnosis: a guide to the FAB classification. Philadelphia: Gower Medical Publications.

CLT 7 - CLINICAL HAEMATOLOGY II (30 hrs)

Competencies and Descriptions:

To have basic knowledge of hematological disorders, and relevant investigations. Understanding blood banking. To develop skills to perform basic blood bank investigations.

Learning Outcomes:

At the end of this module students will be able to:

- describe the pathophysiology and clinical features of nutritional anemia (Iron deficiency & B12/folate deficiency)
- demonstrate the routine and special tests employed in the diagnosis of nutrient deficiency anemia.
- explain hemolysis/hemolytic anemia and outline the classification of hemolytic anemia.
- interpret the laboratory test results of different types of hemolytic anemia.
- describe the pathophysiology, clinical features, morphology, and laboratory investigations of acute leukemia, chronic leukemia, multiple myeloma & lymphoma.
- describe the pathophysiology, clinical features, morphology, and laboratory investigations of chronic myeloproliferative disorders (MPD).
- explain laboratory diagnosis of aplastic anemia.
- describe the methodology of Bone Marrow examination.
- describe the mechanism of hemostasis & outline the basic investigations in thrombosis.
- investigate a bleeder.
- explain the inheritance of ABO & Rh blood group systems, outline the specimen collection process for testing of ABO & Rh blood grouping, Direct & Indirect Coombs test, and understand the pathophysiology of hemolytic disease of the newborn (HDN).
- describe the preparation of blood components and their importance in blood transfusion.
- understand basic concepts of quality assurance in hematology and the application of internal & external quality control methods to the hematology laboratory.

Important pertinent content (knowledge):

- Nutritional anemias
  - ❖ Pathophysiology of nutritional anemias
  - ❖ Basic laboratory investigations
- Hemolytic anemia
  - ❖ Pathophysiology of hemolytic anemias
  - ❖ Basic laboratory investigations

- Hematological malignancies
  - ❖ Pathophysiology & clinical features of acute/chronic leukemia, multiple myeloma & lymphoma
  - ❖ Basic laboratory investigations
- Aplastic anemia & myeloproliferative disorders (MPD)
  - ❖ Pathophysiology
  - ❖ Basic laboratory investigations
- Bone marrow examination
  - ❖ Methodology
  - ❖ Side effects
  - ❖ Investigations related to bone marrow examination
- Investigations in bleeding & thrombosis
  - ❖ Basic investigations.
  - ❖ Common acquired & congenital disorders related to bleeding & thrombosis.
- Blood banking
  - ❖ ABO & Rh blood group systems
  - ❖ Testing of ABO & Rh grouping
  - ❖ Direct & indirect Coombs tests
  - ❖ Hemolytic disease of new born
- Quality assurance in hematology
  - ❖ Application of internal & external quality Control methods in the hematology laboratory

Important pertinent skills:

- Perform investigations related to blood banking.
- Interpreting basic laboratory investigations in hematological disorders.

Teaching methods:

- Lecture /Presentations
- Discussions
- Demonstrations
- Case-based learning
- Handouts

Assessment: End Semester Exam

References:

- Anderson, S. C. and Poulsen, K. B., 2003. Anderson's Atlas of Hematology. Lippincott Williams & Wilkins.
- Norfolk, D., 2013. Handbook of Transfusion Medicine. 5th ed. United Kingdom Blood Services.
- Bain, B., Bates, I., and Laffa, M., 2016. Dacie and Lewis Practical Haematology. 12th ed. Elsevier.
- Hoffbrand, V. and Moss, P. A. H., 2011. Essential Haematology. 6th ed. Wiley-Blackwell.
- Bain, B. J., 1990. Leukemia diagnosis: A Guide to the FAB Classification. Philadelphia: Gower Medical Publications

CLT 8 - CLINICAL BIOCHEMISTRY III (30 hrs)

Competencies and Descriptions:

This module is designed to help the students to gain knowledge on laboratory investigation of selected body fluids.

Learning Outcomes:

At the end of this module students will be able to:

- list the cardiac markers used in the diagnosis of acute myocardial infarction
- outline cardiac disorders and principles of analyzing different cardiac markers.
- describe laboratory analysis of cardiac markers.
- outline Purine catabolism.
- outline the biochemical basis of gout.
- outline the use of C-reactive protein in the assessment of inflammation.
- describe laboratory analysis of uric acid, cardiac markers, and C-reactive protein and Interpret the results
- list the different types of tissue fluid in the human body
- outline the collection method, transporting and storing of tissue fluids
- list the laboratory tests involved in the detection of tuberculosis bacteria
- list the steps in sputum analysis
- describe the identification of TB bacteria
- outline the hormones involved in pregnancy
- explain the molecular basis for the detection of hCG in urine by hCG strip test
- describe the tumor markers and their clinical applications
- explain the analytical errors in tumor marker analysis
- explain and interpretation of seminal fluid analysis

Important pertinent content (knowledge):

- Examination of cerebrospinal fluid, serous fluids (pleural, pericardial, and peritoneal fluids), synovial fluid, gastric juice, duodenal contents, and saliva
- Analysis of semen
- Examination of sputum
- Investigation of cardiac markers
- Investigation and interpretation of lipid profile
- Investigation of tumor markers
- Determination of serum uric acid
- Pregnancy test

- Rheumatoid factor
- C – Reactive protein

Important pertinent skills: Interpretation of laboratory results and technical validation.

Teaching methods:

- Lecture /Presentations
- Tutorials / Handouts
- Guided learning sessions

Assessment: End Semester Exam (MCQ/SEQ)

References:

- Marshall, W. J., Bangert, S. K. and Lapsley, M. 2012. Clinical Chemistry. 7th ed. Elsevier.
- Burtis, C. A., Bruns, D. E and Ashwood, E. R.2007. Tietz Fundamentals of Clinical Chemistry. 6th ed.WB Saunders Co.
- Fody, E. P., Schoeff, L. E and Bishop, M. L.2009. Clinical Chemistry: Techniques, Principles, Correlations.6th ed. Lippincott Williams & Wilkins.
- Diamandis, E. P., 2002. Tumour Markers: Physiology, Pathobiology, Technology, and Clinical Applications. Washington, DC: AACC Press
- Cheesebrough, M. 2005. District Laboratory Practice in Tropical Countries. 2nd ed. Cambridge University Press.
- Godkar, P. B., Godkar, D. P. 2014. Textbook of Medical Laboratory Technology. 3rd ed. Bhalani Publishing House
- Chawla, R., 2014. Practical Clinical Biochemistry: Methods and Interpretations. 4th ed. New Delhi: Jaypee Brothers Medical Publishers.

CLT 9 - CLINICAL BIOCHEMISTRY IV (30 hrs)

Competencies and Descriptions:

This module is designed to explain the principles of metabolic disorders, liver functions, gonadal function tests, and serum calcium homeostasis.

Learning Outcomes:

At the end of this module students will be able to:

- list the pancreatic function and liver function tests
- outline the importance of exocrine and endocrine pancreatic function test
- describe OGTT and blood sugar series in laboratory
- outline carbohydrate metabolism and abnormalities of carbohydrate metabolism.
- describe the liver function tests and applications
- outline lipid metabolism and abnormalities of lipid metabolism
- outline the mechanisms in transporting cholesterol in the human body
- outline the principles of measuring and interpretation of lipid profiles
- outline laboratory investigations included in the lipid profile
- outline the investigations used in the diagnosis and management of diabetes mellitus
- define subfertility
- list the investigations available for the detection of subfertility
- briefly explain the gonadal function test
- describe the calcium homeostasis in human
- list the disorders related to calcium metabolism
- list the investigations for monitoring the calcium status of the body

Important pertinent content (knowledge):

- Pancreatic function tests
- Liver function tests, biochemical assessment of liver function
  - ❖ Determination of serum bilirubin
  - ❖ Determination of plasma enzymes – AST, ALT, AP, gamma- GT
  - ❖ Determination of plasma proteins and protein electrophoresis
- Diagnosis and management of diabetes mellitus
  - ❖ Urine testing – glucose, ketone bodies
  - ❖ Blood glucose testing – Fasting blood glucose, random blood glucose, Post prandial blood glucose, oral glucose tolerance test
  - ❖ Determination of glycosylated hemoglobin, fructosamine, and urinary micro-albumin and their clinical use in the long-term management of diabetes mellitus.

- Thyroid function test – determination of T4, T3, and TSH
- Gonadal function and subfertility
- Laboratory testing in calcium disorders and bone diseases.
- Electrochemiluminescence and ELISA technique

Important pertinent skills: Interpretation of laboratory results and technical validation.

Teaching methods:

- Lecture /Presentations
- Guided learning Sessions

Assessment: End Semester Exam (MCQ/SEQ)

References:

- Marshall, W. J. Bangert, S. K. and Lapsley, M. 2012. Clinical Chemistry. 7th ed. Elsevier.
- Burtis, C. A., Bruns, D. E. and Ashwood, E. R.2007. Tietz Fundamentals of Clinical Chemistry. 6th ed.WB Saunders Co.
- Fody, E. P. Schoeff, L. E. and Bishop, M. L.2009. Clinical Chemistry: Techniques, Principles, Correlations.6th ed. Lippincott Williams & Wilkins.
- Cheesebrough, M. 2005. District Laboratory Practice in Tropical Countries. 2nd ed. Cambridge University Press.
- Godkar, P. B., Godkar, D. P. 2014. Text Book of Medical Laboratory Technology. 3rd ed. Bhalani Publishing House
- Chawla, R., 2014. Practical Clinical Biochemistry: Bethods and Interpretations. 4th ed. New Delhi: Jaypee Brothers Medical Publishers.

CLT 10 - PART A – THERAPEUTIC DRUG MONITORING AND TOXICOLOGY (15 hrs)

Competencies and Descriptions:

This module is designed to help students to gain knowledge on the principles of therapeutic drug monitoring and toxicology, the analytical techniques involved in these fields, and the application of this knowledge in laboratory investigations.

Learning Outcomes:

At the end of this module students will be able to:

- explain the principles of therapeutic drug monitoring
- outline classification of poisons
- explain important physical and chemical characteristics and symptoms in the identification of poisons and interpretation of analytical results
- explain metabolism & route of excretion
- explain systematic sample collection for toxicological analysis and preservation
- classify narcotics and psychotropic substances
- explain the applications of newer analytical techniques

Important pertinent content (knowledge):

- Therapeutic drugs, classification, and poisoning
- Classification of pesticides
- Vegetative poisons (poisonous plants and their active ingredients)
- Metallic poisons, cyanides, alcohols
- Important physical and chemical characteristics and symptoms
- Factors modifying the action of poisons
- Systematic sample collection for toxicological analysis and preservation
- Classification of narcotics and psychotropic substances
- Sample preparation techniques in toxicology
- Applications of newer analytical techniques and interpretation of results in forensic toxicology and narcotics and psychotropic substance analysis
- Interpretation of results

Important pertinent skills:

- Sample collection and preservation
- Sample preparation techniques

- Newer analytical techniques
- interpretation of results

Teaching methods:

- Lecture /Presentations
- Handouts

Assessment: End Semester Exam (MCQ/SEQ)

References:

- Moffat, A.C., Jackson, J. V., Moss, M. S. and Widdop, B. 1986. Clarke's Isolation and Identification of Drugs in Pharmaceuticals, Body fluids, and Postmortem Material. 2nd ed. London: The Pharmaceutical Press.
- Moffat, A. C., Osselton, D. and Widdop, B. 2002. Clarke's Isolation and Identification of Drugs in Pharmaceuticals, Body fluids, and Postmortem Material. 3rd ed. London: The Pharmaceutical Press.

CLT 10 - PART B – MOLECULAR DIAGNOSTICS (15 hrs)

Competencies and Descriptions:

This course provides a comprehensive overview of the fundamental principles of clinical molecular diagnostics and explores the use of molecular techniques in the diagnosis of disease.

Learning Outcomes:

At the end of this module students will be able to:

- describe the structure, function, and replication of DNA and RNA.
- list and describe the steps of the method for nucleic acid extraction, and determine quantity and quality.
- describe the methods utilized in the analysis and characterization of nucleic acids and proteins.
- describe the purpose of each reagent and the steps required for the polymerase chain reaction & DNA sequencing.
- describe the human chromosomal structure and identify normal versus mutations that may be present.
- describe the methods used to detect genetic mutations in humans.
- describe techniques used in the clinical lab to detect: DNA Polymorphisms, microorganisms, inherited diseases, neoplastic diseases, and DNA-based tissue typing.
- describe the procedures utilized for quality control and quality assurance in the molecular diagnostic laboratory.

Important pertinent content (knowledge):

- Nucleic acid structure and function
- DNA chemistry (reactions etc)
- Chromosome structure
- The basic principles of modern genetics as they apply to disease transmission
- Nucleic acid isolation, identification, and amplification
- DNA sequencing
- Techniques used in infectious disease diagnosis in the clinical laboratory
- Components of a molecular laboratory
- Evaluation of controls to validate results obtained

Teaching methods:

- Lecture /Presentations
- Handouts

Assessment: End Semester Exam (Written)

References:

- Watson, J. D., Meyers, R. M., Caudy, A. A., and Jan, A., 2006. Recombinant DNA: Genes and Genomes — A Short Course. 3rd ed. New York: W.H. Freeman and Company.

CLT 11 - HISTOPATHOLOGY AND CYTOLOGY (30 hrs)

Competencies and Descriptions:

This module is designed to help students to gain an understanding of histopathological and cytological techniques.

Learning Outcomes:

At the end of this module students will be able to:

- work in the pathology laboratory.
- describe the collection, handling, and storage of surgical pathology and cytology specimens
- know the procedures to be followed with each specimen up to the storage of slides and disposal of specimens.
- interpret the results of the various staining techniques.
- know the theory of operating principles and the importance of preventive maintenance of equipment used in histopathology laboratory.

Important pertinent content (knowledge):

- Specimen collection, transport, storage, and disposal
- Preparation of different types of fixatives and decalcifying solutions.
- Methods of fixation and decalcification
- Frozen sections
- Tissue processing
- Preparation of tissue block
- Section cutting and preparation of slides
- Use of histokinette, wax embedding machine, microtome, and cryostat.
- Principles of staining and staining techniques
- H and E staining technique and pap staining technique.
- Mounting, storage of slides
- Cyto-preparative techniques

Teaching methods:

- Lectures
- Tutorials and handouts

Assessment: End Semester Exam (MCQ/SEQ)

References:

- Suvarna, K., Layton, C.,Bancroft, J., 2018. Bancroft's Theory and Practice of Histological Techniques. 8th ed. Elsevier.
- Cook D.J. and Warren P.J. 2015. 3rd ed. Cellular Pathology: An Introduction to Techniques and Applications. Scion Publishers.
- Gartner, L. and Hiatt, J., 2010. Concise Histology. Elsevier.

CLT 12 - QUALITY ASSURANCE AND ACCREDITATION (30 hrs)

Competencies and Descriptions:

This module is designed to help students to gain an understanding the quality assurance and accreditation schemes of laboratories and standard applications.

Learning Outcomes:

At the end of this module students will be able to:

- outline the concepts of quality assurance and quality control.
- perform the quality assurance procedures of a medical laboratory.
- outline the basic principles of instrument calibration.
- interpret the quality control data obtained from quality assurance procedures.
- identify the events in quality control failures.
- propose corrective actions systematically.
- outline the concepts of clinical laboratory accreditation.
- outline the principles in conducting laboratory audits.

Important pertinent content (knowledge):

- Quality assurance and quality control
- Introduction to quality assurance
- Quality assurance procedures and quality control concepts (internal quality control and external quality control)
- Systematic troubleshooting
- Verification of methods & performance specifications,
- Monitoring quality
- Shewart charts
- Westguard rules
- Quality indicators (customer complaints, turnaround time, customer satisfaction)
- Quality system essentials that support the quality
- Guidelines of clinical laboratory accreditation
- ISO15189
- Laboratory internal and external audits

Important pertinent skills:

- Apply quality assurance principles to the medical laboratory process
- Documentation and following of guidelines regarding ISO 15189

Teaching methods:

- Lecture /Presentations
- Discussions

Assessment: End Semester Exam (Written)

References:

- Cheesebrough, M. 2005. District Laboratory Practice in Tropical Countries. 2nd ed. Cambridge University Press.
- Godkar, P. B., Godkar, D. P. 2014. Textbook of Medical Laboratory Technology. 3rd ed. Bhalani Publishing House
- Burtis, C. A., Bruns, D. E. and Ashwood, E. R. 2007. Tietz Fundamentals of Clinical Chemistry. 6th ed. WB Saunders Co.
- International Standard ISO15189 Medical laboratories – Requirements for quality and competence.

CLT 13 - CLINICAL LABORATORY PRACTICE (45 hrs)

Competencies and Descriptions:

This module is designed to help students to gain the necessary skills in practicing essential medical laboratory investigations by understanding their principles and apply accordingly.

Learning Outcomes:

At the end of this module students will be able to:

- demonstrate safe practices in a microbiology laboratory
- describe the basic principles of sterilization techniques and isolation of microorganisms
- inoculate microbes using an aseptic technique.
- apply the principles of staining and biochemical techniques for the diagnosis of infectious organisms.
- interpret basic laboratory tests for the diagnosis of infectious diseases.
- identify parasites using blood samples and immunological screening.
- perform routine urine analysis.
- perform investigations related to the diagnosis of diabetes mellitus.
- perform investigations of lipid profiles.
- perform liver function tests and renal function tests.
- perform routine hematological investigations.
- perform basic histological and cytological techniques.
- isolate and identify medically important microorganisms.

Important pertinent content (knowledge):

- Microbiology
  - ❖ Biosafety rules & regulations in microbiology lab and Microscopy
  - ❖ Media preparation and sterilization techniques
  - ❖ Aseptic transfer techniques & quantification of bacteria
  - ❖ Pure culture techniques introduction and streaking
  - ❖ Staining techniques (simple staining, negative staining, Gram staining, and endospore staining
  - ❖ Biochemical identification of microorganisms
  - ❖ Antibiotic Sensitivity Testing and MIC
  - ❖ Processing of real samples for microbiological analysis
  - ❖ Identification of fungal specimens
- Parasitology
  - ❖ Preparation of thin and thick blood smears and staining

- ❖ Preparation and examination of fecal smears of saline and iodine
- ❖ Sample concentration techniques
- ❖ Immunological rapid diagnostic test

- Routine urine analysis
  - ❖ Normal urine constituents
  - ❖ Physical
  - ❖ Chemical
  - ❖ Microscopical
  - ❖ Abnormal constituents of urine/UFR
  - ❖ Other urine tests
- Laboratory diagnosis of diabetes mellitus
  - ❖ Specimen collection
  - ❖ Glucose oxidase method (GOD/POD)
  - ❖ FBS/PPBS/RBS
  - ❖ OGTT
- Assessment of liver function
  - ❖ Kinetic reactions
  - ❖ AST/ALT
  - ❖ Alkaline phosphatase
  - ❖ GGT
  - ❖ Serum bilirubin
- Assessment of renal function
  - ❖ Serum creatinine
  - ❖ Blood urea/BUN
  - ❖ eGFR
- Assessment of Lipid profile
  - ❖ Estimate of total cholesterol
  - ❖ Estimation of HDL and LDL
  - ❖ Estimation of triglycerides
- Routine hematological investigations
  - ❖ Preparation of blood films and staining
  - ❖ Hemoglobin
  - ❖ PCV
  - ❖ Platelet count
  - ❖ WBC/DC
  - ❖ ESR
  - ❖ PT/INR
- Basic histological techniques

- ❖ Fixatives
- ❖ Specimen processing
- ❖ Wax impregnation
- ❖ Section cutting
- ❖ Staining

Important pertinent skills:

- Sterilization techniques, media preparation, and isolation of pure cultures
- Laboratory identification of bacteria and fungi
- Preparation of blood samples for detection
- Preparation of reagents, stains, and handling of glassware and equipment
- Basic analytical techniques
- Spectrophotometry
- Calculation and interpretation of results
- Maintenance of laboratory glassware and equipment
- Waste disposal and management

Teaching methods:

- Practical sessions
- Demonstrations
- Lectures / Presentations
- Handouts

Assessment:

- End of semester examination (70%) (Practical)
- Continuous assessment (30%)

References:

- Lammert, John M., Techniques in Microbiology A Student Handbook
- Leboffe, M., A Photographic Atlas for the Microbiology Laboratory, 4th Edition.
- Fischbach, F. A Manual of Laboratory Diagnostic Tests, Philadelphia, Lippincott, 1998.
- Cheesebrough, M. 2005. District Laboratory Practice in Tropical Countries. 2nd ed. Cambridge University Press.
- Godkar, P. B., Godkar, D. P. 2014. Text book of Medical Laboratory Technology. 3rd ed. Bhalani Publishing House

CLT 14 - CLINICAL LABORATORY TRAINING (6 months)

Learning Outcomes:

At the end of this module students will be able to:

- work in a clinical lab as a team player or a leader as needed
- obtain reliable measurements, perform statistical treatment, and interpret them
- demonstrate writing skills related to assigned projects
- demonstrate presentation skills related to assigned projects
- to give students an opportunity to get an insight into the operation of a laboratory and to relate their academic discipline to the workplace.
- to contribute to the development of the student by providing responsibility appropriately matching with their level of knowledge, experience and potential.
- to develop the student's personal skills as well as their scientific knowledge and technical competence to find entry level position in the industry

Important pertinent content (knowledge):

- Time duration of industrial placement is a minimum of 960 notional hours, 6 months. Students are expected to take an active part, in cooperation with the placement.
- The nature of the work undertaken will vary substantially and solely depends upon the industry, to secure an appropriate placement in the industry.
- The report produced should summarize the various projects in which the student was engaged, the benefits gained, and the application of theory into practice.
- Students have to work in a Clinical Lab where all the basic clinical tests are conducted (Microbiology, Hematology, Parasitology, Pathology, Histopathology, Bio-Chemical Analysis, Molecular Diagnostics, etc)
- You should at least complete 90% of the given training plan.
- Diary should be signed by a related Consultant or Sri Lanka Medical Council Registered (SLMC) MLT (with the registration Number)

Assessment:

- Exposure Report – 55%
- Presentation – 25%
- Viva - 10%
- Diary – 10%

SPECIAL MODULES (14)
Food and Material Technology (FMT)

FMT 1 - FUNDAMENTALS OF CHEMICAL ENGINEERING (30 hrs)

Competencies and Descriptions:

This module is designed to explain the principles of thermodynamics, transport phenomena, particle technology, and separation processes.

Learning Outcomes:

At the end of this module students will be able to:

- gain basic knowledge of thermodynamic properties and principles
- understand the fundamentals of transport phenomena and apply the following equations
- Mass and energy balance equations
- Fourier's law, Newton's law of cooling, and Stefan-Boltzmann's law
- Continuity equation and Bernoulli equation
- understand the theory of particle technology and gain knowledge on particle size analysis
- understand the theory of unit operations used as separation processes
- understand the integrated use of unit operations and unit processes in the industry
- obtain practical exposure to a real process industry context with special reference to the use of unit operations in laboratory analysis/testing/measurement

Important Pertinent Content (Knowledge):

- Introduction to Chemical Engineering
  - ❖ Chemical process industries
  - ❖ Scaling-up of process
  - ❖ Product lifecycle
- Thermodynamics
  - ❖ Definitions and fundamental concepts
  - ❖ First Law of Thermodynamics
  - ❖ Second Law of Thermodynamics
- Transport Phenomena
  - ❖ Mass balance and Energy balance
  - ❖ Heat transfer
  - ❖ Refrigeration
  - ❖ Fluid mechanics
    - Continuity equation
    - Laminar and turbulent flow
    - Boundary layer theory

- Bernoulli equation

- Particle technology and separation processes
  - ❖ Particle characterization (single particles)
    - Measurement of particle size
    - Particle size distribution
    - Mean particle size
  - ❖ Classification of solid particles
  - ❖ Size reduction of solids
  - ❖ The flow of fluids through granular beds and packed columns
  - ❖ Sedimentation
  - ❖ Filtration
  - ❖ Membrane Separation Process
    - Microfiltration
    - Ultrafiltration
    - Nano-filtration
    - Reverse osmosis
- Centrifugal Separations
- Extraction
  - ❖ Solvent extraction
  - ❖ Leaching
  - ❖ Supercritical extraction
- Distillation
  - ❖ Distillation theory
  - ❖ Binary distillation
  - ❖ The fractionating column
  - ❖ Introduction to multi-component distillation
- Drying
  - ❖ Equilibrium moisture content
  - ❖ Rate of drying
  - ❖ Drying equipment
- Adsorption
- Ion Exchange
- Evaporation
  - ❖ Evaporation rate
  - ❖ Equipment for evaporation
- Crystallization
  - ❖ Super-saturation
  - ❖ Crystal nucleation

- ❖ Crystal growth
- Case Study (production process of the sugar industry)

Important Pertinent Skills: Application of fundamental theories

Teaching Methods:

- Lecture/ Presentations
- Handouts, Video Clips
- Tutorials
- Industry/ Laboratory Visit

Assessment:

- Assignment (based on industrial visit/ case study) – 30%
- End Semester Exam (MCQ/SEQ 3 hrs) – 70%
  - ❖ Part A: 10 MCQs (compulsory)
  - ❖ Part B: 04 SEQs (selective)

References:

- Textbook of Chemical Engineering Thermodynamics. K. V. Narayanan (2013-06-19). (2020). Phi Learning.
- Coulson and Richardson's Chemical Engineering. R. K. Sinnott (1993) Vol. 2

FMT 2 - FOOD CHEMISTRY, FOOD ADDITIVES, FOOD CONTAMINANTS, FOOD SPOILAGES & FOOD PRESERVATION

(30 hrs)

Competencies and Descriptions:

This module is designed to explain the chemistry of the basic components of food including foreign substances, food additives, food contaminants, and food spoilage & preservation.

Learning Outcomes:

At the end of this module students will be able to:

- explain the chemistry of food constituents and their derivatives
- outline the importance of food additives
- indicate the details of food contaminants including the sources
- identify the food adulterants and quantify them in food
- describe the methods of food spoilage and prevention
- process the food preservation indicating the basic principles involved

Important pertinent content (knowledge):

- Food components
  - ❖ Water, minerals, carbohydrates, proteins, lipids
- Foreign substances in food
  - ❖ Food additives, food contaminants, and food adulterants
- Food additives definitions and classifications according to the function
  - ❖ Food preservatives
  - ❖ Shelf life extenders
  - ❖ Sensory improvers
  - ❖ Process aids
- Food contaminants and their sources of food
  - ❖ Definition of contaminants
  - ❖ Chemical contaminants
    - Metal
    - Pesticide residues
    - Veterinary drug residues
    - Manmade chemicals
    - Microbial toxins
- Food Adulteration in Sri Lanka

- Methods of food spoilage
  - ❖ Physical damage
  - ❖ microbiological spoilage
  - ❖ chemical and biochemical spoilage
- Food preservation
  - ❖ High-temperature and low-temperature preservation
  - ❖ Chemical preservation
  - ❖ Irradiation

Important pertinent skills:

Describe the chemistry and functions of each food component and the detection of foreign substances in food

Teaching Methods:

- Lecture/Presentations
- Handouts
- Guided learning sessions

Assessment: End semester examination (MCQ/SEQ)

References:

- Coultate, T. (2015). Food: The Chemistry of its Components 6th ed. Royal Society of Chemistry.
- Doyle, M. P., Diez-Gonzalez, F., & Hill, C. (2019). Food Microbiology: Fundamentals and Frontiers (ASM Books) 5th ed. ASM Press.

FMT 3 - FOOD PROCESSING - PLANT ORIGIN (PART A) (12 hrs)

Competencies and Descriptions:

This module is designed to explain the principles of processing of fruits, vegetables, spices, sugarcane, plant-based alcoholic and non-alcoholic beverages, and the health benefits of the products

Learning Outcomes:

At the end of this module students will be able to:

- explain the processing of fruits and vegetables, non-alcoholic beverages, and their nutritional importance
- outline the manufacturing of alcoholic plant-based beverages and the production of spice essential oils and their uses
- Important pertinent content (knowledge):
- processing of fruits and vegetables, their nutritional importance, and health benefits
- processing and health benefits of non-alcoholic beverages such as tea, coffee, and cocoa
- manufacturing of alcoholic plant-based beverages such as beer, wine, distilled alcoholic beverages
- knowledge in the manufacture of value-added products from local fruits, vegetables, spices, and sugarcane for local human consumption and export
- describe processing, active ingredients, and uses of spices such as pepper, cinnamon, nutmeg, cloves, cardamoms, turmeric, and ginger and their health benefits

Important pertinent skills:

Ability to process local fruits and vegetables and correlate local fruits and vegetables with health benefits

Teaching methods: Lecture /Presentations /Handouts

Assessment: End Semester Exam

References:

- Stevens, R. O. G. E. R. (1997). Book review: A manual on the essential oil industry, Silva T. D., United Nations Industrial Development Organization (UNIDO), Vienna, Austria, 1995. Flavour and Fragrance Journal, 12(3), 222.
- Potter, N. N., & Hotchkiss, J. H. (2012). Food Science: Fifth Edition (Food Science Text

Series) (Softcover reprint of the original 5th ed. 1995 ed.). Springer.

Competencies and Descriptions:

This module is designed to explain the basic principles involved in the processing technology of cereals, pulses, and ground nuts and their products.

Learning Outcomes:

At the end of this module students will be able to:

- understand the technology involved in the processing of various cereal products and pulses
- understand the methods involved in the preparation of secondary products of cereals and pulses
- understand the methods and the chemistry involved in the preparation of bread
- understand the process involved in the manufacture of ground nuts and describe the processing of soya products

Important pertinent content (knowledge):

- Processing of cereals
  - ❖ Corn flour, corn starch, corn oil
  - ❖ Wheat flour
  - ❖ Rice and rice flour
- Preparation of cereal-based products
  - ❖ Bread
  - ❖ Spaghetti and noodles
  - ❖ Papadam
- Processing of ground nut
- Soya products
  - ❖ Textured vegetable proteins
  - ❖ Soya oil

Important pertinent skills: Knowledge of processing of cereals, pulses, and ground nut

Teaching Methods:

- Lecture/Presentations
- Handouts
- Guided learning sessions

Assessment: End semester examination (MCQ/SEQ)

References:

- Adelakun, O. E., Duodu K. G., Buys E., and Olanipekun B. F. (2013) Potential Use of Soybean Flour (Glycine max) in Food Fortification, Soybean - Bio-Active Compounds
- Serna-Saldivar, S. O. (2010). Cereal Grains: Properties, Processing, and Nutritional Attributes (Food Preservation Technology) (1st ed.). CRC Press.

FMT 4 - FOOD PROCESSING - ANIMAL ORIGIN (30 hrs)

Competencies and Descriptions:

This module is designed to explain the principles of the processing technology of animal-based food products.

Learning Outcomes:

At the end of this module students will be able to:

- explain the basic principles involved in the animal-based food industries
- explain the meat quality, meat curing, and smoking
- explain the preparation of meat products
- explain the fish technology, fish preservation, and fish products
- explain the chicken processing and poultry industry
- explain the processing of milk-based products such as liquid milk and its products

Important pertinent content (knowledge):

- Animal-based food industries
  - ❖ basic principles involved in the technology of meat, fish, poultry, and dairy products
- Meat and meat curing
  - ❖ meat quality, meat colour, and its changes due to various treatments
  - ❖ meat curing and preparation of meat products, fish and sausages, meatballs, ham, bacon, etc.
- Fish and fish product processing
  - ❖ Fresh fish and spoilage, fish preservation, and fish products
- The poultry industry, quality control of eggs, and manufacture of open egg products
- Milk and milk-based industries
  - ❖ processing of milk-based products such as liquid milk and its products
  - ❖ manufacture of fermented milk products
  - ❖ butter and cream manufacture
  - ❖ cheese manufacture
- Importance of all these processing industries for the expansion of the Sri Lankan dairy industry

Important pertinent skills:

To understand the technology involved in the animal-based food industry

Teaching Methods:

- Lecture/Presentations
- Handouts
- Guided learning sessions

Assessment: End Semester Examination (MCQ/SEQ)

References:

- Fitzgerald, A. J. (2015). Animals as Food: (Re)connecting Production, Processing, Consumption, and Impacts (The Animal Turn). Michigan State University press.
- Pandey, R. K. (2013). Production Processing and Marketing of Milk and Milk Products. Biotech.
- Owens, C. M., Alvarado, C., & Sams, A. R. (2010). Poultry Meat Processing. Boca Raton, FL: CRC Press

FMT 5 - FOOD MICROBIOLOGY (30 hrs)

Competencies and Descriptions:

This module is designed to explain the principles of microbiology procedures, the morphology of micro-organisms, various staining procedures, identification of micro-organisms specially associated with food, biochemical tests involved in the identification of micro-organisms, and the method of handling of food involved in an outbreak.

Learning Outcomes:

At the end of this module students will be able to:

- explain the microbiology procedures in cleaning, disinfection, and sterilization
- explain the microbiological procedures in isolation of microorganisms by culturing in different media
- practice the various staining procedures and examination under a microscope to identify the various types of micro-organisms
- carry out various biochemical tests and interpret them to confirm the identity of the micro-organisms
- explain microbiological infections and intoxications
- identify the pathogenic micro-organisms involved in an outbreak

Important pertinent content (knowledge):

- Microbiological procedure on cleaning disinfection sterilization
  - ❖ Use of autoclave
  - ❖ UV
  - ❖ Dry heat method
  - ❖ Sterile filtration
  - ❖ Chemical sterilization
- Maintenance of culture media
  - ❖ Inoculation procedures
    - Four-way streaking
    - Quadrant method
- Identification of micro-organisms
  - ❖ Use of morphological characters
    - Staining techniques
  - ❖ Use of biochemical characters
- Identification of pathogenic micro-organisms in a food poisoning incident

- ❖ The outbreak of a food poisoning

Important pertinent skills:

Able to identify the micro-organisms in a sample of food

Teaching Methods:

- Lecture/Presentations
- Handouts/documents
- Guided learning sessions

Assessment: End Semester Examination (MCQ/SEQ)

References:

- Doyle, M. P., Diez-Gonzalez, F., & Hill, C. (2019). Food Microbiology: Fundamentals and Frontiers (ASM Books) (Fifth ed.). ASM Press.
- Erkmen, O., & Bozoglu, F. T. (2016). Food Microbiology: Principles into Practice (1st ed.). Wiley.

FMT 6 - FOOD ANALYSIS (30 hrs)

Competencies and Descriptions:

This module is designed to explain the basic principles involved in the analysis of food.

Learning Outcomes:

At the end of this module students will be able to:

- understand the basic principles involved in the proximate analysis of food
- explain the methodology in the determination of the food components including the food additives
- interpret the analytical parameters obtained during the analysis of various food commodities for the composition
- understand the newer technologies used in the food analysis

Important pertinent content (knowledge):

- Proximate analysis of food and calculation of energy
- Use of proximate analytical results to interpret the quality of food
- Identification of food additives qualitatively and quantitatively
- Detection of food adulterants
- Microscopic examination of food
- Identification of contaminants

Important pertinent skills:

Interpretation of analytical results obtained during proximate analysis

Teaching Methods:

- Lecture/Presentations
- Handouts
- Guided learning sessions

Assessment: End semester examination (MCQ/SEQ)

References:

- Pearson, D., Egan, H., Kirk, R. S., & Sawyer, R. (1981). Chemical Analysis of Foods. Edinburgh: Churchill Livingstone.
- Cruz, R. M., Khmelinskii, I., & Vieira, M. (2016). Methods in Food Analysis. CRC

Press.

Competencies and Descriptions:

This module is designed to explain the chemical and physical properties of leather, rubber, and plastics materials and their industrial applications.

Learning Outcomes:

At the end of this module students will be able to:

- explain the production process of leather, rubber, and plastics
- list the chemical and physical properties of these materials
- describe the value-addition methods practiced in the leather, rubber, and plastic industries
- describe the industrial applications of leather, rubber, and plastics and the importance of these industries for the economy of the country

Important pertinent content (knowledge):

- Leather
  - ❖ Vegetable tanning
  - ❖ Chrome tanning
  - ❖ Applications of leather as an industrial material
    - e.g. shoes, bags, belts
- Rubber
  - ❖ Natural and synthetic rubber
  - ❖ Molecular structure
  - ❖ Chemical properties
  - ❖ Physical properties
  - ❖ Vulcanization of rubber
  - ❖ Applications of rubber as an industrial material
    - e.g. tyre industry, gloves production
- Plastics
  - ❖ Raw materials of plastic manufacturing
  - ❖ Types of plastics
    - Thermoplastics
    - Thermosetting
  - ❖ Applications of plastics as an industrial material

- e.g. bottles, cups, ropes, brushes

❖ Recycling of plastics

Important pertinent skills:

Understanding the properties of leather, rubber, and plastics and how these properties are important at industries.

Teaching methods:

- Lectures
- Handouts
- Assignments
- Industrial visits

Assessment: End Semester Exam (SEQ)

References:

- Blackley, D.C. "Polymer Lattices: Science & Technology: Fundamental Principles" Vol 1, 2nd edition, 1997
- Billmeyer Fred W. "Textbook of Polymer Science" 03rd edition, 2005
- Stevens Malcolm P. 'Polymer Chemistry" 03rd edition, 2011

FMT 7 - POLYMER SCIENCE AND PETROLEUM (PART B – PETROLEUM) (12 hrs)

Competencies and Description:

This module is designed to explain the principle of mining and distillation of crude oil and improve the quality and quantity of gasoline in various techniques.

Learning Outcomes:

At the end of this module students will be able to:

- the overview of the petroleum industry, types of fuels, crude oil composition, and classification
- briefly explain the fractional distillation of crude oil and how to improve the quality and quantity of gasoline from crude oil.

Important pertinent content (Knowledge)

- Illustrate the sketch of the following
  - ❖ Mining of crude oil
  - ❖ Mechanical pumping of oil
  - ❖ Fractional distillation of crude oil
  - ❖ Bubble tower
  - ❖ How crude oil was formed
  - ❖ Merits and demerits of liquid fuels
  - ❖ Refining of petroleum
  - ❖ Distillation and rectification of crude oil
    Cracking process of petroleum
    - Thermal cracking
    - Catalytic cracking
  - ❖ Knocking and octane number
  - ❖ The octane rating of fuels

Important pertinent skills

Preparation of various grades of octane no gasoline by blending of n-heptane and 2.2.4 tri methyl pentane.

Teaching methods

- Lecture / Presentation
- Handouts

Assessments: End semester Exam

References

- Agarwal, S. (2019). Engineering Chemistry: Fundamentals and applications. Cambridge, United Kingdom: Cambridge University Press.
- Mallick, A. (2009). Engineering Chemistry. New Delhi: Viva Books.
- Erich, V. N., Rasina, M. G., & Rudin, M. G. (1988). The Chemistry and Technology of Petroleum and Gas. Moscow: Mir Publ.

FMT 8 - INDUSTRIAL CHEMISTRY I

(Part A - Cement, Ceramic, Brick, Clay, Lime, Refractories iron and steel) (25 hrs)

Competencies and Description:

This model is designed to explain the production properties and applications of cement, ceramic, brick, clay, refractories, and steel industries.

Learning Outcomes:

At the end of this module students will be able to:

- describe the type of cement, its properties, and it's applications in various construction work
- explain the chemical reactions taking place inside the rotary kiln furnace.
- describe the classifications of ceramics, such as clay products, refractories, and glasses, explain the types of plain carbon steels and how to manufacture special steels such as corrosion-resistant and heat-resistant steels
- describe the various types of heat treatment processes

Important pertinent content (Knowledge) •

- Production of cement using raw material
- Functions of the ingredients of cement such as lime, silica, alumina, gypsum, iron ore
- Chemical composition of cement (C2S, C3S, C2A, C4AF)
- Settings and hardness of Portland cement
- Properties and harsh temperature applications of refractories for furnace lining
- Clay products and their applications
- Refining of iron from iron Ore
- How the microstructure changes with the carbon content of plain carbon steels
- Basic heat treatment such as
  - ❖ Annealing
  - ❖ Normalizing
  - ❖ Hardening
  - ❖ Temporizing

Important pertinent skills

Maintain the quality parameters to obtain the required finished product

Teaching methods

- Lecture / Presentation
- Handouts

Assessment: End Semester Exam

References

- Agarwal, S. (2019). Engineering Chemistry: Fundamentals and Applications. Cambridge, United Kingdom: Cambridge University Press.
- Mallick, A. (2009). Engineering Chemistry. New Delhi: Viva Books.
- Erich, V. N., Rasina, M. G., & Rudin, M. G. (1988). The Chemistry and Technology of Petroleum and Gas. Moscow: Mir Publ.

FMT 8 - INDUSTRIAL CHEMISTRY I

(Part B & C - Paint technology and Nanotechnology) (20 hrs)

Competencies and Descriptions:

This module is designed to explain:

- the chemical and physical properties of paints, pigments, binders, and their applications
- the definition of Nanotechnology, different types of nanostructure, and physical and chemical properties of nanomaterials

Learning Outcomes:

At the end of this module students will be able to:

- explain paint technology
- explain the production technology, chemical, physical and mechanical properties of paints, chemical modifications of paint, and industrial applications
- nanotechnology
  - ❖ explain the definition of Nanotechnology, different types and applications of nanomaterials

Important pertinent content (knowledge):

- Paint
  - ❖ Introduction and definition of a paint
  - ❖ Raw materials used in the paint industry
  - ❖ Production technology
  - ❖ Types of paints
    - emulsion, varnish, enamel, lacquer, etc
  - ❖ Chemical and physical properties of paints
  - ❖ Color chemistry of paints
  - ❖ Value addition by chemical and physical modifications
  - ❖ Health and environmental impacts of paints
- Nanotechnology
  - ❖ Definition of Nanotechnology
  - ❖ Atomic structure and atomic size of nanomaterials
  - ❖ Challenges of nanoscience and nanotechnology
  - ❖ carbon age - a new form of carbon (carbon nano tube (CNT) to graphene)
  - ❖ Influence of nano over micro/macro, size effects, and crystals, large surface-to-volume ratio, surface effects on the properties

- ❖ One-dimensional, two dimensional, and three-dimensional nanostructured materials
- ❖ Applications of nanomaterial
  - Ferroelectric materials
  - Coating
  - molecular electronics and nano-electronics
  - biological and environmental applications
  - membrane based application
  - polymer-based application.
  - metal oxides, semiconductors, composites

Important pertinent skills:

- Paint
  - ❖ Understand the properties of paints and how these properties are important at industries.
- Nanotechnology
  - ❖ Understand the definition of nanotechnology, the chemical and physical properties of nanomaterials, and industrial applications of nanomaterials

Teaching methods:

- Lectures
- Handouts
- Assignments

Assessment: End Semester Exam

References:

- Blackley, D.C. "Polymer Lattices: Science & Technology: Fundamental Principles" Vol 1, 2nd edition, 1997
- Bentley, J and Turner, G P A "Introduction to Paint Chemistry" Fourth edition, 1998
- Hornyak, G. L., Moore, J. J., Tibbals, H. F., & Dutta, J. (2008). Fundamentals of Nanotechnology (1st ed.). CRC Press.
- Sanders, W. C. (2018). Basic Principles of Nanotechnology (1st ed.). CRC Press.

FMT 9 - INDUSTRIAL CHEMISTRY II

(Part A - Industrial Minerals, and Precious Minerals) (18 hrs)

Competencies and Descriptions:

This module is designed to explain:

- the production of glasses using raw materials, their properties, and their industrial and domestic applications.
- the definition, distribution, properties, and applications of minerals.
- the chemical and physical properties of precious minerals and industrial minerals and their applications

Learning Outcomes:

At the end of this module students will be able to:

- describe the production of various types of glasses, their properties, the flow diagram of glass manufacture, and applications
- describe the definition and classification of minerals, distribution, excavation processes of minerals from underground earth or earth crust, the properties and applications
- explain the formation of precious minerals and their distribution, the chemical, physical and crystallographic properties
- explain the value-addition methods and the importance of precious mineral-based industries in Sri Lanka

Important pertinent content (knowledge):

- Glasses
  - ❖ Production of types of glasses such as
    - Soft glass
    - Hard glass
    - Flint glass
    - Heat and shockproof glass
    - Insulating glass
    - Wired glass
    - Laminating glass
    - Bullet-resistant laminated glass
  - ❖ Properties and applications of the above glasses
  - ❖ Glass fabrication
    - Blowing

- Flat drawing and rolling
- Pressed glass
- Laminated glass
- Structural glass

- Industrial minerals
  - ❖ Exploration, extraction, refining, physical, mechanical, and chemical properties and commercial types of applications of the following minerals
    - Graphite
    - Feldspar
    - Dolomite
    - Mica
    - Kaolin
    - Magnesite
    - Apatite
  - ❖ Mineral sands
  - ❖ Study the mineral chemistry, magnetic properties, and higher temperature applications of the following mineral sands
    - Ilmenite
    - Quartzite
    - Zircon
- Precious minerals
  - ❖ The formation of precious minerals
  - ❖ Major mineral groups
    - Native elements
    - Sulfides
    - Halides
    - Oxides and hydroxides
    - Nitrates, carbonates, borates
    - Sulfates
    - Phosphates, arsenates, vanadates
    - Silicates
- The physical, chemical, and crystallographic properties of minerals
- Chemistry of gems and industrial minerals
- Chemistry of colour enhancement and value addition of gems & minerals

Important pertinent skills:

- How to maintain the heat treatment cycle to obtain good quality products
- The importance of industrial minerals and precious minerals, their classification, and

applications

Teaching Methods:

- Lecture/Presentations
- Handouts
- Guided learning sessions

Assessment: End semester examination (MCQ/SEQ)

References:

- Agarwal, S. (2019). Engineering chemistry: Fundamentals and applications. Cambridge, United Kingdom: Cambridge University Press.

FMT 9 - INDUSTRIAL CHEMISTRY II

(Part B - Textile) (12 hrs)

Competencies and Descriptions:

This module is designed to explain the conversion of fibers into finished textile fabrics which are ready to be introduced to the consumer market.

Learning Outcomes:

At the end of this module students will be able to:

- explain the chemical nature and identity of textile fibers.
- describe textile dyes, textile chemical finishes, and their applications and effects on the environment
- describe control usage of water and disposition of wastewater.

Important pertinent content (knowledge): •

- Common textile fibres and their chemical structures (Classification)
  - ❖ Cotton, silk, and wool
  - ❖ Cellulose fibers, protein chains
  - ❖ Synthetic polymers – nylon, polyester, Pp, PU
- Textile manufacturing process
  - ❖ Spinning, weaving, knitting, preparation, scouring, bleaching, mercerisation
- Sizing and size application
  - ❖ Natural sizes and synthetic starches
- Textile pre-treatment and preparation
  - ❖ De-sizing, enzyme washing,
- Textile scouring and bleaching
- Mercerisation process
- Textile dyes and their common chemical properties
- Dyeing of textiles
- Textile printing and auxiliaries
- Textile finishes
- Process water quality
- Effluent control

Important pertinent skills:

Explanation of the chemical nature of textile fibers, textile chemical processes, and related chemistry

Teaching Methods:

- Lecture/Presentations
- Handouts
- Guided learning sessions

Assessment: End semester examination (MCQ/SEQ)

References:

- Agarwal, S. (2019). Engineering chemistry: Fundamentals and applications. Cambridge, United Kingdom: Cambridge University Press.
- Bechtold, T. (2019). Textile Chemistry. Berlin: Walter de Gruyter GmbH.

FMT 10 - OCCUPATIONAL HEALTH, SAFETY, POLLUTION & WASTE MANAGEMENT AND ENVIRONMENTAL CHEMISTRY

(Part A - Occupational health and safety, Environmental Chemistry) (8 hrs)

Competencies and Descriptions:

This module is designed to explain the fundamental principles and effects of environmental pollution, hazardous chemicals, safety, and waste management in chemical laboratories.

Learning Outcomes:

At the end of this module, students will be able to:

- explain different types of pollution and their causes and effects, identify categories of pollutants
- define hazardous chemicals, and their effects to humans, describe the greenhouse effect, global warming, ozone depletion
- identify safety equipment, safety symbols, personal safety, explain good laboratory practices, handling chemicals, handling glassware, etc

Important pertinent content (knowledge):

- Pollution of the environment
  - ❖ Definition of pollution,
- Types of Pollution - Air pollution, water pollution
- Causes of pollution
- Definition of pollutants
- Types of pollutants
- Effects of pollution
  - ❖ Acid rain
  - ❖ Smog
  - ❖ Greenhouse effect
  - ❖ Global warming
  - ❖ Ozone depletion
- Hazardous chemicals
  - ❖ Routes of entry
  - ❖ Toxic effects
  - ❖ Sources of information –MSDS
- Safety in the laboratory
  - ❖ Safety equipment

- ❖ Safety symbols
- ❖ Personal safety
- ❖ Good Laboratory practices
- ❖ Handling chemicals
- ❖ Handling glassware and equipment
- ❖ Heating substances
- ❖ Electrical safety
- ❖ Accidents and injuries

- Chemical Waste
  - ❖ Types of waste material
  - ❖ Characteristics of waste
  - ❖ Disposal of waste
  - ❖ Disposal of common lab chemicals

Important pertinent skills: Application of safety in laboratory sessions

Teaching Methods:

- Lecture/Presentations
- Handouts

Assessment: End semester examination (MCQ/SEQ)

References:

- Wikipedia contributors. (2020, October 4). Chemical safety.
- Rieuwerts John, 2015. The Elements of Environmental Pollution. 1st ed. Routledge.

FMT 10 - OCCUPATIONAL HEALTH, SAFETY, POLLUTION & WASTE MANAGEMENT AND ENVIRONMENTAL CHEMISTRY

(Part B & C - Waste management & Environmental Chemistry) (22 hrs)

Competencies and Descriptions:

This module is designed to give an overview of types of waste, waste management, and functional elements in the solid waste management system.

Learning Outcomes:

At the end of this module, students will be able to:

- explain different types of waste, waste management, waste disposal techniques, advantages and disadvantages of various disposal methods, and functional elements in the solid waste management system

Important pertinent content (knowledge):

- Types of waste
  - ❖ Solid
  - ❖ Liquid
  - ❖ Gas
- Types of solid waste
  - ❖ Agricultural
  - ❖ Food processing
  - ❖ Mining
  - ❖ Industrial
  - ❖ Municipal
  - ❖ Hospital and radioactive waste
  - ❖ Hazardous waste
- Waste disposal methods
  - ❖ Open dumping
  - ❖ Ocean dumping
  - ❖ Landfills
  - ❖ Sanitary landfills
  - ❖ Composting
  - ❖ Recycling
  - ❖ Incineration
  - ❖ Resource recovery

- Waste reduction by the 3R system
  - ❖ Reduce
  - ❖ Recycle

Important pertinent skills: Methods of waste management and disposable methods

Teaching Methods:

- Lecture/Presentations
- Handouts

Assessment: End semester examination (MCQ/SEQ)

References:

- Blackman, W. C. (2001). Basic Hazardous Waste Management. Boca Raton: Lewis.
- Agarwal, S. (2019). Engineering Chemistry: Fundamentals and Applications. Cambridge, United Kingdom: Cambridge University Press.

FMT 11 - PHARMACEUTICAL AND COSMETIC TECHNOLOGY

(Part A - Pharmaceuticals) (18 hrs)

Competencies and Descriptions:

This module is designed to explain different types of dosage forms, their classifications & their regulations, the production of different dosage forms, quality control and quality assurance of pharmaceuticals, GMP, method validation, and pharmaceutical packaging.

Learning Outcomes:

At the end of this module, students will be able to:

- explain different types of dosage forms with their applications, new drug delivery systems, and different types of classifications of drugs
- explain the manufacturing of pharmaceuticals, list and outline the pharmacopoeias accepted in Sri Lanka, quality of pharmaceuticals, quality parameters, and quality control tests.
- outline method validation, define and explain GMP
- explain antibiotics, vitamins, antiseptics and disinfectants, and pharmaceutical packaging

Important pertinent content (knowledge):

- Dosage form classification with examples and their relative applications
- Novel drug delivery systems
- The steps/ processes involved in the manufacture of different dosage forms
  - ❖ Oral solids
  - ❖ Oral liquids
  - ❖ Sterile products
- General Introduction of
  - ❖ British Pharmacopoeia
  - ❖ United States Pharmacopoeia
  - ❖ Indian Pharmacopoeia
- Definitions of Quality control and Quality assurance
- Quality Control tests of different dosage forms
- Sources of pharmaceutical impurities and their limited tests
- Method validation, verification, installation and operational qualification, competency evaluation
- Definition and parameters of GMP

- Types of packaging used for pharmaceuticals and their suitability

Important pertinent skills: Knowledge of Pharmaceutical Sciences

Teaching Methods:

- Lecture/Presentations
- Handouts

Assessment: End semester examination (MCQ/SEQ)

References:

- British Pharmacopoeia. (2018). London: The Stationery Office.
- United States pharmacopeia. (2004). Montvale, NJ: Medical Economics.
- Remington, J. P., & Gennaro, A. R. (1990). Remington's pharmaceutical sciences. Easton, PA: Mack Pub.
- Beckett, A. H., & Stenlake, J. B. (1988). Practical pharmaceutical chemistry. London: Athlone Press.

FMT 11 - PHARMACEUTICAL AND COSMETIC TECHNOLOGY

(Part B - Cosmetics and Fragrance) (12 hrs)

Competencies and Descriptions:

This module is designed to explain the general definition of cosmetic products, ingredients used in cosmetics, analysis, safety, quality, and efficacy of cosmetic products.

Learning Outcomes:

At the end of this module, students will be able to:

- identify cosmetics according to the general definition, understand the international nomenclature of cosmetic ingredients
- describe official methods of analysis for cosmetics in different countries, determine quality, safety, and efficacy of cosmetic products, analyze of fragrance ingredients and investigate potentially allergenic fragrance-related substances

Important pertinent content(knowledge):

- General concepts and Cosmetic Legislation:
  - ❖ General aspects, safety, and efficacy of cosmetics:
- The European Union Cosmetic Directives, The US Regulatory approach, Japanese regulations
- A brief survey of other worldwide markets including Sri Lanka
- Specific legislation on ingredients
- The international nomenclature of cosmetic ingredients
- General review of official methods of analysis for cosmetics in different countries
- Substances subjected to control by the authorities
- General review of analytical method for cosmetics
- Rheological additive in cosmetics
- Analytical methods for monitoring and quality control of cosmetic products
- Sunscreen photo-stability, tanning and whitening agents in cosmetics, decorative: coloring agents and hair dyes
- Preservatives use in cosmetics:
  - ❖ antimicrobials and antioxidants, analytical methods for preservatives.
- Perfumes in cosmetics:
  - ❖ Types of perfumes
  - ❖ Analysis of fragrance ingredients

- ❖ Potentially allergenic fragrance-related substances
- Surfactants used in cosmetics

Important pertinent skills:

Identification and analysis of cosmetics products and ingredients

Teaching Methods:

- Lecture/Presentations
- Handouts

Assessment: End semester examination (MCQ/SEQ)

References:

- Salvador A. and Chisvert A 2012. Analysis of Cosmetic Products, 1st edition Elsevier.
- Sharma G. K., Gadiya J. and Dhanawat M. Textbook of Cosmetic Formulations

FMT 12 - QUALITY ASSURANCE AND ACCREDITATION (30 hrs)

Competencies and Descriptions:

This module is designed to explain the quality assurance and accreditation schemes of laboratories and standard applications.

Learning Outcomes:

At the end of this module students will be able to:

- outline the concepts of quality assurance and quality control.
- perform the quality assurance procedures of a medical laboratory.
- outline the basic principles of instrument calibration.
- interpret the quality control data obtained from quality assurance procedures.
- identify the events in quality control failures.
- propose corrective actions systematically.
- outline the concepts of clinical laboratory accreditation.
- outline the principles in conducting laboratory audits

Important pertinent content (knowledge):

- Quality assurance and quality control
- Introduction to quality assurance
- Quality assurance procedures and quality control concepts (internal quality control and external quality control)
- Systematic troubleshooting
- Verification of methods & performance specifications,
- Monitoring quality
- Shewart charts
- Westguard rules
- Quality indicators (customer complaints, turnaround time, customer satisfaction)
- Quality system essentials that support the quality
- Guidelines of clinical laboratory accreditation
- ISO15189
- Laboratory internal and external audits

Important pertinent skills:

- Apply quality assurance principles to the medical laboratory process
- Documentation and following of guidelines regarding ISO 15189

Teaching Methods:

- Lecture /Presentations
- Discussions

Assessment: End Semester Exam (Written)

References:

- Cheesebrough, M. 2005. District Laboratory Practice in Tropical Countries. 2nd ed. Cambridge University Press.
- Godkar, P. B., Godkar, D. P. 2014. Textbook of Medical Laboratory Technology. 3rd ed. Bhalani Publishing House
- Burtis, C. A., Bruns, D. E. and Ashwood, E. R. 2007. Tietz Fundamentals of Clinical Chemistry. 6thed. WB Saunders Co.
- International Standard ISO15189 Medical laboratories – Requirements for quality and competence

FMT 13 - LABORATORY PRACTICE

(Part A - Basic Microbiology) (15 hrs)

Competencies and Descriptions:

This module is designed to help students to gain the necessary skills in practicing essential medical laboratory investigations by understanding their principles and apply accordingly.

Learning Outcomes:

At the end of this module, students will be able to:

- describe the basic principles of sterilization techniques, isolation of microorganisms, and inoculation of microbes using aseptic techniques
- apply the principles of staining and biochemical techniques for the diagnosis of infectious organisms.

Important pertinent content (knowledge):

- Biosafety rules & regulations in microbiology lab and microscopy
- Media preparation and sterilization techniques
  - ❖ Dry heat
  - ❖ Moist heat
- Aseptic transfer techniques
- Quantification of bacteria
- Pure culture techniques introduction and streaking
  - ❖ Four-way streaking
  - ❖ Quadrant method
- Staining techniques
  - ❖ simple staining
  - ❖ negative staining
  - ❖ Gram staining
  - ❖ endospore staining
- Biochemical identification of microorganisms
  - ❖ Fermentation of bacteria
  - ❖ Citrate test
  - ❖ Indole test
  - ❖ MRVP tests
  - ❖ Catalase test
  - ❖ Oxidase test

- ❖ H_2S production test
- ❖ Urease test
- ❖ Testing for starch, lipid, gelatin, and casein hydrolysis of bacteria
- Antibiotic Sensitivity Testing and MIC
- Identification of fungal specimens

Important pertinent skills:

- Sterilization techniques, media preparation, and isolation of pure cultures
- Laboratory identification of bacteria and fungi

Teaching methods:

- Practical sessions
- Demonstrations
- Lectures / Presentations
- Handouts

Assessment:

- End of semester examination (70%) (Practical)
- Continuous assessment (30%)

References:

- Lammert, John M., Techniques in Microbiology A Student Handbook
- Leboffe, M., A Photographic Atlas for the Microbiology Laboratory, 4th Edition.
- Fischbach, F., A Manual of Laboratory Diagnostic Tests, Philadelphia, Lippincott, 1998.
- Cheesebrough, M. 2005. District Laboratory Practice in Tropical Countries. 2nd ed. Cambridge University Press.
- Godkar, P. B., Godkar, D. P. 2014. Textbook of medical laboratory technology. 3rd ed. Bhalani Publishing House

FMT 13 - LABORATORY PRACTICE

(Part B - Food Analysis) (15 hrs)

Competencies and Descriptions:

This module is designed to gain knowledge in laboratory experiments on food analysis.

Learning Outcomes:

At the end of this module students will be able to:

- understand the basic principles involved in the determination of proximate analytical parameters of the food components such as moisture, ash, acid insoluble ash, fiber, oil and fats, and protein content.
- determine the food additives qualitatively and quantitatively, such as preservatives, food colouring matters, and adulterants
- calculate the Energy Value using the proximate analytical parameters of food and learn food microscopy to identify various starches and food ingredients such as spices

Important pertinent content (knowledge):

- Sample preparation of food for analysis
- Determination of moisture
- Determination of total ash, water-soluble ash, and acid-insoluble ash
- Determination of crude fiber content
- Determination of oil and fats
- Determination of protein
- Determination of carbohydrates
- Calculation of Food Energy value
- Determination of added colouring matter
- Determination of benzoic acid and sulfur dioxide
- Microscopic examination of various foods and flours

Important pertinent skills:

- Interpretation of laboratory results
- Comment on food adulterations
- Identify the food components under microscopy

Teaching Methods:

- Lecture/Presentations
- Handouts
- Guided learning sessions

Assessment: Continuous assessment of the practical component

References:

- Pico, Y. (2020). Chemical Analysis of Food: Techniques and Applications (2nd ed.). Academic Press.

FMT 13 - LABORATORY PRACTICE

(Part C - Examination of Paint – Interior and Exterior Applications) (15 hrs)

Competencies and Descriptions:

This module is designed to gain knowledge in laboratory experiments on paints.

Learning Outcomes:

At the end of this module students will be able to:

- understand the basic principles of emulsion paint analysis according to the SLSI guidelines.
- obtain hands-on experience such as viscosity measurements, hard and soft drying, spreading capacity calculation and pH measurements

Important pertinent content (knowledge):

- Sample preparation of emulsion paint for analysis
- Preparation of panels for paint testing
- Determination of quantity of material in a container
- Determination of spreading capacity
- Determination soft drying and hard drying
- Determination of pH measurements
- Determination of viscosity
- Determination of Pb content in a paint sample
- Determination of flow time
- Determination of non-volatile matters
- Determination of gloss
- Determination of resistance to water

Important pertinent skills: Analysis of paint

Teaching Methods:

- Lecture/Presentations/videos
- Handouts
- Guided learning sessions

Assessment: Continuous assessment of the laboratory session

References: SLS: 533, SLS 557, SLS: 539

FMT 14 - INDUSTRIAL TRAINING (6 months)

Learning Outcomes:

At the end of this module students will be able to:

- work in the industry as a team player or a leader as needed
- identify problems in industrial processes
- obtain reliable measurements, perform statistical treatment, and interpret them
- demonstrate writing skills related to assigned projects
- demonstrate presentation skills related to assigned projects
- display an appreciation of good practices in an industrial setting.
- to give students an opportunity to get an insight into the operation of a laboratory and to relate their academic discipline to the workplace.
- to contribute to the development of the student by providing responsibility appropriately matching with their level of knowledge, experience and potential.
- to develop the student's personal skills as well as their scientific knowledge and technical competence to find entry level position in the industry

Important pertinent content (knowledge):

- Time duration of industrial placement is a minimum of 600 notional hours 6 months.
- Students are expected to take an active part, in cooperation with the placement.
- The nature of the work undertaken will vary substantially and solely depends upon the industry, to secure an appropriate placement in the industry.
- The report produced should summarize the various projects in which the student was engaged, the benefits gained, and the application of theory into practice.
- Students can work in any food related, polymer, petroleum, paint, cosmetics (Material related) industry.

Assessment:

- Exposure Report – 55%
- Presentation – 25%
- Viva - 10%
- Diary – 10%

EXAMINATION CRITERIA AND AWARD OF CERTIFICATES

EXAMINATION CRITERIA AND AWARD OF CERTIFICATES

The course is composed of 28 Modules each of 30 hours in duration.

1. EXAMINATIONS

   i. A candidate should sit for the examination in the 28 modules comprising 14 general modules (including laboratory practice) and 14 special modules, over the two years of the DLT programme. Examinations are conducted on completion of each modules.

   ii. Grades will be assigned for each module on the following basis:

Marks	Grade	GPA
85-100	A+	4.00
75-84	A	4.00
70-74	A-	3.70
60-69	B+	3.30
55-59	B	3.00
50-54	B-	2.70

Marks	Grade	GPA
45-49	C+	2.30
40-44	C	2.00
35-39	C-	1.70
30-34	D+	1.30
25-29	D	1.00
0-24	E	0.00

   iii. Based on the results of the examinations for the 28 Course modules, three categories of passes are awarded:

   - Honours Pass
   - Merit Pass
   - Pass

Category	Weighted Average	Minimum Total A^- or better grades	Minimum Total B^- or better grades	Minimum A^- or better grades in Special Modules	Minimum B^- or better grades in Special Modules	Maximum C^-, D, and D^+ grades in General Modules	Maximum C^-, D, and D^+ grades in Special Modules	Maximum Total E grades	GPA
Honours	70%	15	-	7	-	3	0	0	3.70
Merit	50%	-	15	-	7	3	0	0	2.70
Pass	40%	-	-	-	-	3	0	0	2.00

2. AWARDS

The Institute of Chemistry gives awards to students performing excellently in the programme with an Honours Pass as follows.

i. First in Batch - Dr. G C N Jayasuriya Award for the Best Performance

G C N Jayasuriya Award for the Best Performances

Dr. G C N Jayasuriya donated Rs. 10,000 in 1987 as an endowment for the award for Best Performances. The fund now stands at Rs. 92000. Further, the Institute of Chemistry Ceylon gives cash awards to the students placed second and third in the batch.

ii. First in Industrial and Food Chemistry- Mr. Rohan K Fernando Prize for the best performance.

iii. First in Clinical Laboratory Technology - P D Luckman De Zoysa Memorial Prize for the best performance.

However, these awards will not be made if the candidates do not secure at least a Merit pass.

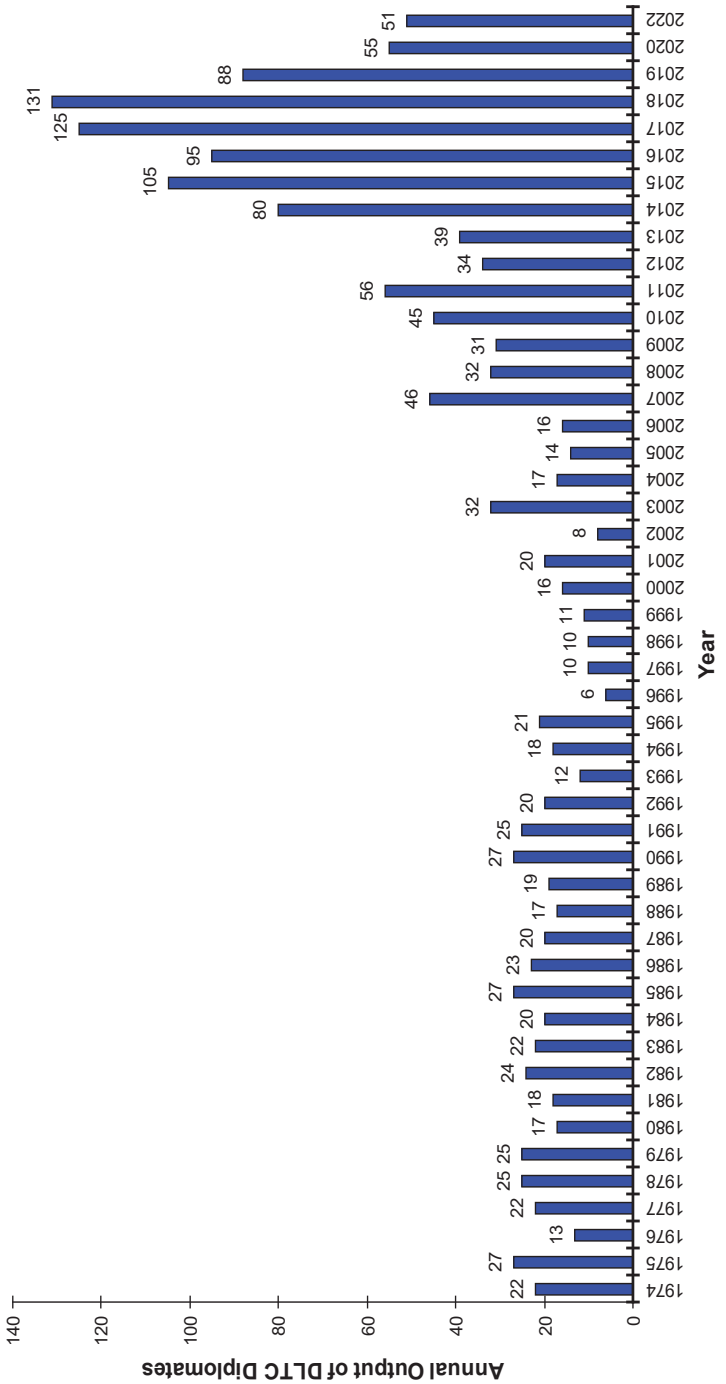
The Tuition fee (theory) of the Graduateship in Chemistry (Levels 1& 2) for all students with an honours pass will also be paid by the College of Chemical Sciences, if following Graduateship Programme.

RECORDS OF LTCC/DLTC/DLT PROGRAMME

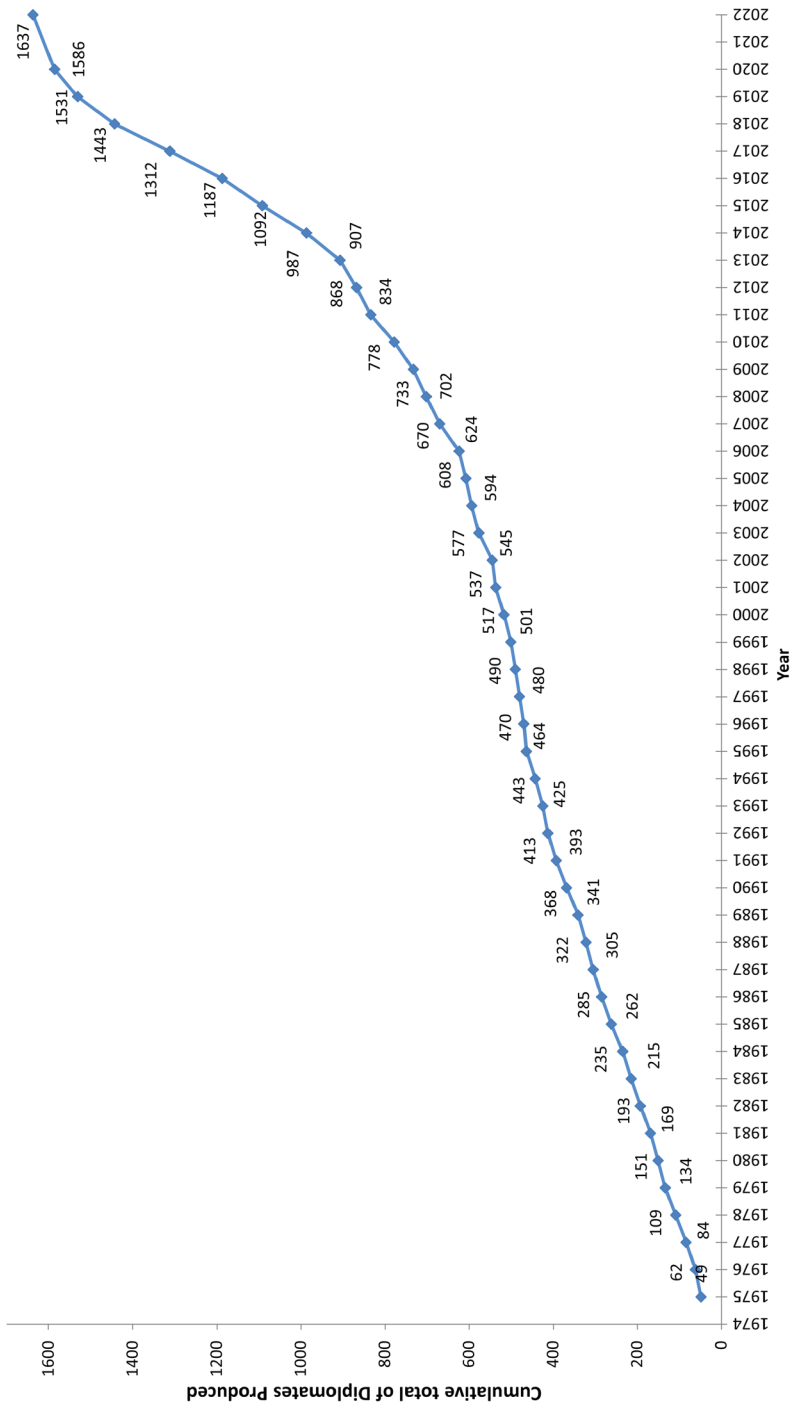
Number of Successful Students 1974 – 2022

Year	Honours Pass	Merit Pass	Ordinary Pass	Total Pass
1974	3	8	11	22
1975	8	3	16	27
1976	2	4	7	13
1977	2	4	16	22
1978	3	4	18	25
1979	3	3	19	25
1980	3	1	13	17
1981	4	9	5	18
1982	11	8	5	24
1983	4	9	9	22
1984	2	4	14	20
1985	3	10	14	27
1986	1	6	16	23
1987	3	6	11	20
1988	4	2	11	17
1989	2	4	13	19
1990	8	11	8	27
1991	8	9	8	25
1992	5	4	11	20
1993	-	8	4	12
1994	4	6	8	18
1995	3	7	11	21
1996	3	3	-	6
1997	1	5	4	10
1998	1	5	4	10
1999	-	3	8	11
2000	1	8	7	16
2001	-	6	14	20
2002	-	5	3	8
2003	2	11	19	32
2004	1	6	10	17
2005	1	6	7	14
2006	1	7	8	16
2007	4	23	19	46
2008	2	16	14	32
2009	4	11	16	31
2010	5	23	17	45
2011	6	18	32	56
2012	4	13	17	34
2013	8	4	27	39
2014	9	41	30	80
2015	9	51	45	105
2016	14	42	39	95
2017	12	60	53	125
2018	23	41	67	131
2019	14	45	29	88
2021	7	29	15	55
2022	5	28	18	51
Total	**223**	**640**	**770**	**1637**

ANNUAL OUTPUT OF DLT DIPLOMATES (1974 – 2022)



CUMULATIVE TOTAL OF DLT DIPLOMATES (1974 – 2022)



DR. G C N JAYASURIYA AWARD

Year	Name of the Recipient	Year	Name of the Recipient
1974	Ms L K Fernando	1998	Mr T B L Peiris
1975	Mr M C P Wijeratne	1999	Not Awarded
1976	Mr K Somasunderam	2000	Mr T M P B Tennakoon
1977	Mr P M G Senaratne	2001	Not Awarded
1978	Ms H S P Jayatunga	2002	Not Awarded
1979	Ms A Abayasekera	2003	Ms K S Supramaniam
1980	Ms C Samarawickrama	2004	Ms S A Wijesinghe
1981	Ms T L Y A Siritunga	2005	Ms P A T S Perera
1982	Mr S Weeraratne	2006	Mr M K S Sandaruwan
1983	Ms I Y Perera	2007	Ms S K Dharshani
1984	Ms L S C Perera	2008	Ms V Karunathilake
1985	Mr. M R K Abeysinghe	2009	Mr M R L Fernando
1986	Ms I Y Abdulla	2010	Ms G A D Kaumadi
1987	Ms G B Premawathie	2011	Ms D M Perera
1988	Mr A Gunasena	2012	Ms M Y D Perera
1989	Ms M R G Jansz	2013	Mr. A H F Rikasa
1990	Mr T L J C Siritunga	2014	Mr M.S.Latheef
1991	Mr T L S S Sirithunga	2015	Ms A R Sappidin
1992	Mr B D Gamage	2016	Ms H G J Chandima
1993	Not Awarded	2017	Mr K I S Peiris
1994	Mr T V Cruze	2018	Ms M C Vidushani
1995	Ms A M Warnakulasuriya	2019	Ms. A M S S S Aasiya
1996	Ms T LRY Siritunga	2021	Ms. H I F Sara
1997	Ms Deepika Samanthi	2022	Ms. M N A Hanee

DIPLOMA IN LABORATORY TECHNOLOGY (DLT)

Coordinator Committee

President : Prof. H M D N Priyantha
B.Sc. (Peradeniya), Ph.D. (Hawaii), C.Chem., F.I.Chem.C.
President, Institute of Chemistry Ceylon

Dean : Prof. S A Deraniyagala
B.Sc. (Colombo), Ph.D. (Dalhousie, Canada), C.Chem., F.I.Chem.C.
Dean, College of Chemical Sciences

Director : Mr. E G Somapala
B.Sc. Hons (Peradeniya), M.Sc. (Strathclyde), C.Chem., F.I.Chem.C.,
Retired Government Analyst

Registrar : Mr. W M G Karunaratne
B.Sc., MBA, LLB, Attorney-at-Law

Head of the Department (Chemistry)
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Grad.Chem., Ph.D. (Heriot-Watt), C.Chem., F.I.Chem.C.
Senior Lecturer (Grade I) & Head/Department of Chemistry

Head of the Department (Allied Science)
: Dr. U S K Weliwegamage
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Senior Lecturer (Grade I) & Head/Department of Applied Sciences

Senior Administrative Executive/Registrar (Examination)
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B.Sc. (Ceylon), M.Tech. (Brunel)

Assistant Programme Coordinator
: Ms. U P Welikala
Grad.Chem., M.IChem.C., B.Sc. (USJ)

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Assistant Director (Accreditations), Sri Lanka Accreditation Board

Non – Academic Staff

Management Trainee: Ms. W G Chamini

Laboratory Assistant: Mr. D F H de Silva

CODE OF CONDUCT FOR STUDENTS & EXAMINATION OFFENSES

CODE OF CONDUCT FOR STUDENTS COLLEGE OF CHEMICAL SCIENCES, INSTITUTE OF CHEMISTRY CEYLON

1. Introduction

This Code of Conduct shall apply to all students at the IChemC. In addition to all academic and social activities at the IChemC premises, the Code of Conduct also applies to IChemC-sponsored or supervised events outside, which may affect the reputation of the IChemC. Rules and regulations of the IChemC that are not listed below, are also applicable. When a student is considered to be a threat to another person, to himself or herself, to the property, or to the orderly functioning of the IChemC, section 3 of this document shall be followed. The IChemC expects its student community to be well-disciplined. Severe disciplinary action will be taken for unethical and illegal behaviors of the students.

2. Prohibited Conduct

Examples of prohibited conduct include, without limitation:

- Plagiarism, copyright infringement, and cheating of academic work
- Examination offenses (as listed in pages 177 - 178)
- Aggressive behavior, violence towards human and physical resources
- Being disrespectful and disobedient
- Damaging, unauthorized use of property, services, and information
- Possession of alcohol or narcotics, and being intoxicated in the IChemC premises
- Discrimination against race, colour, gender, religion, and ethnic background
- Mental and physical harassment for others
- Theft
- Ragging and bullying

2.1. Ragging and bullying

Ragging and bullying are completely prohibited for students of the IChemC. Suitable disciplinary action will be taken for any student/student who is/are charged with these activities.

IChemC defines ragging as any act which causes, or is likely to cause physical or psychological injury, fear, or mental pain to a student of IChemC. Any student who behaves in such a manner will be accused of ragging.

IChemC defines bullying as the electronic, written, verbal, or physical act or a series of acts consisting of physical, social, or emotional domination of a student or a

group of students. Any student who behaves in such a manner will be accused of bullying.

2.2. Use of alcohol, tobacco, and drugs

Usage or distribution of cigarettes, alcohol, and narcotic substances at IChemC events and activities are strictly prohibited. The IChemC defines the above events as academic, intellectual, cultural, or social gatherings, which are open to all students, alumni, academic staff, and/or non-academic staff of the IChemC.

3. Disciplinary Action

If any student is accused of not adhering to the Code of Conduct, he/she shall be requested to face a hearing before a disciplinary committee, and the following sanctions or disciplinary action may be imposed separately or in combination. This list of sanctions or disciplinary action is not exhaustive. The IChemC reserves the right to impose additional sanctions or disciplinary action not listed herewith.

Procedure to be followed for disciplinary action

- When a complaint is received by the Dean, a three-member committee shall be appointed by the AB-IChemC.
- This committee shall gather evidence regarding the incident and determine whether it is a violation of conduct.
- The committee shall inform their observations to the President who in turn shall report to the Council.
- If the violation is not deemed to be serious, it shall be resolved through a discussion between the involved parties.
- If it is a violation of conduct, the Council shall authorize a preliminary inquiry and appoint a board of inquiry. Based on the report of the preliminary inquiry, the Council shall authorize a formal inquiry and appoint the board.
- Based on the report of the formal inquiry, the Council shall implement the recommendations.
- These recommendations may include, though are not limited to the following:
    - Termination of Privileges
    - Health and Wellness Assessment: for certain code violations
    - Suspension from IChemC premises and all its activities
    - Dismiss from the IChemC

EXAMINATION OFFENSES AND PUNISHMENTS

1. Any candidate who violates any of the conditions stipulated in the Code of Conduct shall be considered as having committed an examination offense.

2. Examination offenses shall include the following:
   a. Possession of unauthorized material
   b. Possession of any written material relevant or irrelevant to the respective exam, concealed or noted down on body parts or clothing, or any other authorized material such as admission card, calculator, stationery, etc.
   c. Removal of examination stationery
   d. Disorderly conduct
   e. Copying
   f. Disturbing other candidates
   g. Obtaining or attempting to obtain improper assistance
   h. Cheating or attempting to cheat
   i. Impersonation
   j. Aiding and abetting the commission of any of these offenses
   k. Violation of any of the requirements or conditions stipulated above.

3. In the event that a student has been in possession of any unauthorized material at an examination hall, he/she shall be presumed to have made use of such material.

4. In case of disorderly conduct, the Supervisor may exclude the candidate from the examination hall and issue him/her a letter canceling his/her candidature from the examination, and submit a formal report to the Registrar of Examinations.

5. In all other cases of examination offenses detected, the Supervisor of the examination shall obtain a statement from the candidate and write his/her report on the matter in the form provided for this purpose.

6. In all cases of examination offenses detected, the Supervisor of the examination shall submit a formal report to the Registrar of Examinations within 24 hours of the finishing time of the examination.

7. The DLT Director shall place all reports of examination offenses submitted by the Supervisors for the consideration of the Dean, who shall refer them to the Examination Disciplinary Committee for further action. The Examination Disciplinary Committee chaired by the Dean of the College of Chemical Sciences (CCS), shall investigate and make suggestions, including possible punishments regarding examination offenses. The punishments recommended by the Examination Disciplinary Committee shall be submitted to the Educational Committee of the Institute of Chemistry Ceylon (IChemC) for the final decision.

8. Any allegations regarding committing of examination offenses, submitted by the Registrar of Examinations to the Dean, shall decide whether these shall be referred to the Examination Disciplinary Committee for necessary action.

9. A candidate who is found guilty of an examination offense is liable to any one or more of the following punishments.

    a) Removal of his/her name from the pass list.

    b) Cancellation of his/her candidature from the whole or part of the examination, or

    c) Suspension from any examination conducted by CCS for such period as the IChemC may decide, or indefinitely, or

    d) Suspension from the CCS for such period as the IChemC may decide, or indefinitely.

10. Any candidate found aiding and abetting any examination offense, shall be liable to the same punishment as that applicable to the offense.

11. Any appeal against the decision of the Educational Committee shall be made to the Council.

For your Special Attention:

- All the students should be present for lectures on time. Students who are late (more than 15 minutes) will not be allowed to enter the lecture hall and practical sessions.
- Your attendance for lectures and practical sessions will be recorded. Those who do not have at least 80% attendance will not be allowed to sit for exams.
- Students are not allowed to use their mobile phones during lectures, practical sessions, and examinations.
- Students are not allowed to eat during lectures and practical sessions.
- Students are not allowed to take food and drink inside laboratories.
- Students should wear goggles, lab coats (will be provided on payment), and covered shoes during practical sessions.
- Those who do not adhere to the above rule will not be allowed to enter the laboratory.
- Students are not allowed to use the lift.
- Students with payment arrears will not be allowed to enter practical sessions and examinations.
- Students violating exam rules will be charged a fine and the studentship will be canceled.
- Strict actions will be taken against students misbehaving in the ICHEM premises.

All students are requested to read the examination criteria before the commencement of the course.

RULES AND REGULATIONS

RULES AND REGULATIONS

1. Criteria for Honours/Merit/Ordinary

Honours Pass

- Minimum fifteen (15) "A" grades in both years and Minimum seven (7) "A" for second-year subjects and Average above 75.
- Maximum three (3) "D" grades in the 1st year subjects and no "D" grades in 2nd year and no "E" grades in both years.
- Minimum "C" grade for Laboratory Practice (G7).

Merit Pass

- Minimum fifteen (15) "A and B" grades in both years and Minimum seven (7) "A and B" for second-year subjects and Average above 55
- Maximum three (3) "D" grades in the 1st year subjects and no "D" grades in 2nd year and no "E" grades in both years.
- Minimum "C" grade for Laboratory Practice (G7).

Ordinary Pass

- Average above 40
- Maximum three (3) "D" grades in the 1st year subjects and no "D" grades in 2nd year and no "E" grades in both years.
- Minimum "C" grade for Laboratory Practice (G7).

- The students who failed in the first attempt could be given "Honours" or "Merit" if they fulfilled all the other necessary criteria.
- Students who are absent on their first attempt will also be eligible for "Honours" or "Merit" if they fulfil all the other required criteria.

2. Repeating Practical Modules

- For the 1st year practicals (G 7), a student should have at least 80% attendance to be eligible to sit for the practical exam.

- For the 2nd year practicals (CLT/FMT 13), a student should have at least 50% attendance for each subsection to complete the module. CLT/FMT 13 consists of 3 subsections.
- If a student who is having 80% (with complete lab report submission) attendance and is absent for the G 7 final exam, the student can just sit for the final exam without attending the practicals on his/her next attempt.
- If a student fails or repeats the laboratory practice module (G 7 and CLT/FMT 13), he/she should repeat the whole module including all the quizzes and examinations in the next attempt.
- If a student sits on one section of CLT/FMT 13 on his/her 1st attempt, those marks can be transferred to consecutive years.

3. Repeating Training Modules

If a student fails the training module due to being unable to submit the training diary can submit the diary next year and complete the module. The marks obtained for the exposure report. Presentation and viva can be considered in the next attempt. (No need to redo those components unless the total mark is less than 40 even after completing all sections diary, exposure report, presentation and viva)

4. Repeating Modules with Assignments/Presentations

If a student repeats a subject (CLT 5, CLT 7, CLT 9, CLT 10, FMT 2) that contains assignments or presentations, that student must do assignments with the repeated batch. However, if the student is absent for the exam he/she does not need to redo the assignment/presentation. It is compulsory to submit the assignments in the above subjects.

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